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Dietary Diversity among Children Aged 6-23 Months in Bangladesh: Determinants and Inequalities

MORIAM KHANAM [*]
ABDUR RAZZAQUE SARKER[**]

Inadequate dietary intake is one of the causes of childhood undernutrition and associated morbidity and mortality in many low and middle-income countries, including Bangladesh. The study aims to identify the prevalence, associated factors, and socio-economic inequalities in minimum dietary diversity, minimum meal frequency, and minimum acceptable diet among 6-23 month-children in Bangladesh. This study uses data from the latest round of the Bangladesh Demographic and Health Survey (BDHS) 2017-18. Descriptive analyses have been conducted to report frequencies and percentages of the socio-demographic and economic characteristics of 6-23 months aged children. Bivariate and multiple logistic models are used to identify the predictors of each dietary indicator. In addition, we estimate concentration indices and use Wagstaff-based decomposition analysis to identify socio-economic inequalities in dietary diversity and their contributing factors. The study finds the prevalence of minimum dietary diversity, minimum meal frequency, and minimum acceptable diet as 38%, 81%, and 36%, respectively. Education of mothers is a significant predictor of all three dietary indicators. In addition, household wealth status and administrative division are significant predictors of minimum dietary diversity and minimum acceptable diet. Children of working mothers are found to have higher odds of having minimum meal frequency and minimum acceptable diet compared to their counterparts. We find concentration indices for minimum dietary diversity as 0.21 ($p<0.001$), for minimum meal frequency as 0.08 ($p<0.05$), and for minimum acceptable diet as 0.19 ($p<0.001$). Wealth status of household, mother's and father's education levels, and exposure to mass media are the major contributing factors to these inequalities. Therefore, policymakers and other stakeholders need to give prior attention to enhancing household wealth status, empowering women, and awareness-raising initiatives to improve the feeding practices of children in Bangladesh.

Keywords: Children, Dietary Diversity, Meal Frequency, Nutrition, Bangladesh
JEL Classification: C55, E61, I10, I14, I15

[*]Institute of Health Economics, University of Dhaka. [**]Population Studies Division, Bangladesh Institute of Development Studies (BIDS).

I. INTRODUCTION

Undernutrition of children is one of the leading causes of under-five mortality and morbidity globally (Ali, Arif, & Shah, 2021). About 45 per cent of the deaths of under-five children are related to nutrition-related factors (World Health Organization, 2022). While the undernutrition of children has multiple causes, inadequate dietary intake by children remains the most immediate one (Torlesse & Raju, 2018). From the age of six months, children require diets high in nutrient density and variety, as breast milk alone is no longer sufficient to meet children's micronutrient and energy needs (Remonja et al., 2018). Optimal infant and young child feeding practices are crucial for improving childhood nutrition, health, and development (UNICEF, 2021; World Health Organization, 2017). Children are more vulnerable to being malnourished during the period of transition from exclusive breastfeeding to complementary solid, semi-solid, or soft foods (NIPORT & ICF, 2020). Children should receive adequate food for their growth and development during this time. Food intake with low nutrient density during this time can lead to micronutrient deficiency and an increased incidence of diarrhoea and other infections (Ali et al., 2021).

Minimum dietary diversity is one of the eight indicators of infant and young child feeding (IYCF) practices launched by the World Health Organization (WHO) (World Health Organization (WHO), 2008). In South Asia, the majority of children do not receive complementary food as per the globally recommended standards (Torlesse & Aguayo, 2018). There is evidence from South Asia that children who could not have minimum dietary diversity and were not fed enough meals had a higher likelihood of suffering from undernutrition than their counterparts (Torlesse & Aguayo, 2018; UNICEF, 2019). Hence, the poor quality of child feeding practices is holding back efforts to enhance children's growth, development, and well-being in South Asia (Torlesse & Raju, 2018). Hence, without improved feeding practices for children, it is difficult to achieve the Sustainable Development Goal (SDG) target 3.2 to end preventable deaths of newborns and children under five by 2030. Despite the mounting evidence of the importance of diversified foods for children aged 6–23 months, the majority of them do not receive age-appropriate diversified foods and recommended meal frequency, especially in South Asia, including Bangladesh (Temesgen, Yenebabat, & Teshome, 2018; Torlesse & Aguayo, 2018). Torlesse and Aguayo (2018) found that despite good progress in improving breastfeeding practices compared to other regions, the lack of diversity in complementary foods and low frequency of feeding

remain problems in South Asia, including Bangladesh. Despite remarkable progress over the years in reducing childhood mortality and morbidity in Bangladesh, childhood undernutrition remains a challenge (USAID, 2021). Inadequate infant and young child feeding practices is one of the reasons behind childhood undernutrition. Therefore, it is crucial to identify the factors that are associated with adequate dietary intake in children.

Various studies in low and middle-income settings identified that different socio-economic and demographic characteristics of children and mothers/caregivers as associated with dietary diversity for children (Akter et al., 2021; Ali et al., 2021; Kabir et al., 2012; Keno, Bikila, & Etafa, 2021; Temesgen et al., 2018). A study in Bangladesh identified that age of children, mother's age and level of education, household size, wealth status, and administrative regions were the significant predictors of dietary diversity among children (Sheikh et al., 2020). Another recent study was conducted in six South Asian countries, including Bangladesh, to estimate the association between mother's education and infant and young child feeding practices (Tariqujjaman, Hasan, Mahfuz, Ahmed, & Hossain, 2022). The study found education as an important predictor of minimum dietary diversity and minimum acceptable diet among children in Bangladesh. Although various studies were conducted in many low and middle-income countries, including Bangladesh, to identify the associated factors of dietary diversity of children, very few studies were conducted with the latest available datasets. In addition, there is a paucity of studies that identified the socio-economic inequalities in childhood dietary diversity. A recent study in Bangladesh identified the pro-rich distribution of minimum dietary diversity for children in Bangladesh and identified household wealth status and education level of mothers as the major contributing factors to such inequalities (Kundu et al., 2022). However, this study used only one indicator of dietary diversity. Therefore, this study aims to identify the prevalence, associated factors, and inequalities in dietary diversity (for all three indicators) among children in Bangladesh.

II. METHODOLOGY

2.1 Study Population and Data Sources

This study used data from the latest round of the Bangladesh Demographic and Health Survey (BDHS) 2017-18. It is a nationally representative cross-sectional survey that collects information on demographic and socio-economic characteristics, maternal and child health indicators, child feeding practices, and

biomarkers. The survey was carried out under the authority of the National Institute of Population Research and Training (NIPORT), the Medical Education and Family Welfare Division, and the Ministry of Health and Family Welfare. The survey interviewed 20,127 reproductive-aged (15-49 years), ever-married women, with a response rate of 99%. The current study included data for children in the age group 6-23 months, as complementary feeding is recommended after six months of age. Children who had complete data in terms of the outcome and explanatory variables were included in this study.

2.2 Sampling Method and Sample Size

The BDHS used a two-stage stratified sampling frame to select households and used a nationally representative sample covering the entire population. The survey occupied the sampling frame prepared by the Bangladesh Bureau of Statistics (BBS) using population and household information from the population census, which is nationally representative. The complete list of enumeration areas (EAs) used for the population census by BBS was the sampling frame. The detailed sampling procedure, data collection methods, and data collection instruments have been described elsewhere (NIPORT & ICF, 2020).

2.3 Outcome Variables

There are three outcome variables in this study: minimum dietary diversity, minimum meal frequency, and minimum acceptable diet. According to WHO, minimum dietary diversity is a proxy for adequate micronutrient density of foods. It has been defined in BDHS 2017-18 as the proportion of children who received at least five out of eight food groups. The eight food groups which were covered in BDHS involve: (i) breast milk (ii) grains, roots, and tubers (iii) legumes and nuts (iv) dairy products (milk, yogurt, and cheese) (v) flesh foods (meat, fish, poultry, and liver/organ meat) (vi) eggs (vii) vitamin A-rich fruits and vegetables (iii) and other fruits and vegetables. Minimum meal frequency is a proxy for meeting minimum energy requirements. It has been defined as the proportion of children aged 6-23 months who received solid, semi-solid, or soft food (including milk for non-breastfed children) at least the minimum number of times (as recommended by WHO) or more in the last 24 hours. A minimum acceptable diet is a composite of both dietary diversity and meal frequency. A breastfed child of age 6-23 months has been considered to have a minimum acceptable diet if he/she had at least the minimum dietary diversity and minimum meal frequency on the previous day. Likewise, a non-breastfed child of 6-23 months has been considered as having a

minimum acceptable diet if he/she received at least two milk feedings with minimum dietary diversity and minimum meal frequency in the last 24 hours (Ali et al., 2021). Each outcome variable is binary: whether a child received minimum dietary diversity, whether a child received minimum meal frequency, and whether a child received minimum acceptable diet on the previous day of data collection.

2.4 Major Explanatory Variables

The explanatory variables used in this study include demographic and socio-economic characteristics, as used in other similar studies (Ali et al., 2021; Nguyen et al., 2018; Sheikh et al., 2020). This study involves sex of children (male or female), birth order of children (grouped as first, second to fourth, fifth or higher), household size (categorised as one to four, five to nine, ten or higher), sex of household head, mother's age, mother's education (grouped as no education, primary, secondary, and higher), father's education (categorised as no education, primary, secondary, and higher), mother's exposure to any mass media at least once a week (define as "1" if read newspaper and/or listen to music and/or watch TV and "0" otherwise), mother's working status (defined as yes or no), household's wealth status (grouped into five quintiles: poorest, poor, middle, richer, richest based on household's assets holdings), administrative division (defined as eight administrative divisions of Bangladesh), and region of residence (urban or rural).

2.5 Data Analysis

Data analysis for this study was done using STATA 16.0 software. Descriptive analyses were conducted to report frequencies and percentages of the socio-demographic and economic characteristics of 6-23 months aged children. Moreover, binary logistic regression analyses (as the dependent variables were binary) were done to find the association of each explanatory variable with the outcome variables separately. The explanatory variables that were found significant at $p<0.2$ level in the bivariate logistic regressions were included in the multivariable logistic regression models (Akter et al., 2021). Statistical significance in the multivariable model was determined with p values <0.05. Results were presented in terms of adjusted odds ratios (AORs) and 95% confidence intervals. This study also estimated the concentration index (CI) to show the distribution of each dietary indicator across children with varying socio-economic statuses. Wagstaff-based decomposition of CI was done to determine each variable's percentage contribution to the inequalities. In this regard, the

inequality analyses were performed in different stages using the concentration curve, concentration index, and concentration index decomposition. The concentration index summarised the graphical information (i.e., the area between the equality line and concentration curve) generated in the concentration curve. The index was calculated using the formula developed by O'Donnell et al. (2008). Finally, the estimated CIs were decomposed to realise the contribution of individual socio-economic characteristics as per the DHS dataset (Wagstaff, Van Doorslaer, & Watanabe, 2003). The results were presented in terms of the estimated elasticity, concentration index, absolute contributions (in the same unit as the concentration index), and adjusted percentage contributions (i.e., relative contributions).

2.6 Ethical Approval

BDHS is a publicly available dataset and can be downloaded from the DHS Program website. The survey followed standardised data collection procedures and received ethics approval from the National Research Ethics Committee (NREC) of the Bangladesh Ministry of Health and Family Welfare. The study analysed this publicly available DHS data set by taking consent from the MEASURE DHS program office. According to the DHS, they obtained written informed consent from women enrolled in the survey.

III. RESULTS

3.1 Background Characteristics

The weighted sample size of this study was 2,418 children of the age group 6-23 months. The background characteristics of study participants in terms of their socio-demographic and economic characteristics are presented in Table I. About 52 per cent of the children were male, and the majority (58 per cent) of the children had birth orders of two to four. A major portion (58.48 per cent) of the children were from households of sizes four to nine, and most children (86.25 per cent) were from male-headed households. About 74 per cent of mothers were in the age group 20-34 years, and about 56 per cent of mothers had access to mass media at least once a week. A slightly lower than 50 per cent of mothers (49.05 per cent) had secondary education, while only 32.48 per cent of fathers had a secondary level of education. About one-fourth percentage of the study participants were from the Dhaka division, while the lowest percentage was from the Barishal division. Most of the study participants (74.1 per cent) were from urban areas.

TABLE I

DISTRIBUTION OF SOCIO-DEMOGRAPHIC AND ECONOMIC CHARACTERISTICS OF 0-23 MONTHS CHILDREN IN BANGLADESH
(N=2,418)

Characteristics	Frequency	Percentage
Sex		
Female	1,165	48.20
Male	1,253	51.80
Age group of children		
6-11	813	33.63
12-17	833	34.43
18-23	772	31.94
Birth Order		
First	893	36.92
Second to Fourth	1,412	58.40
Fifth or higher	113	4.67
HH Size		
1-4	747	30.88
5-9	1,414	58.48
Above 10	257	10.63
Sex of HH head		
Male	332	13.75
Female	2,086	86.25
Mother's age		
15-19	464	19.21
20-34	1,801	74.47
35 and above	153	6.32
Mother's education		
No education	148	6.12
Primary	651	26.94
Secondary	1,187	49.07
Higher	432	17.87
Father's Education		
No education	333	13.79
Primary	848	35.05
Secondary	785	32.48
Higher	451	18.67

(Contd. Table I)

Characteristics	Frequency	Percentage
Mother's exposure to media (TV or newspaper, or radio)		
No	1,066	44.08
Yes	1,352	55.92
Mother working		
No	1,527	63.17
Yes	891	36.83
Wealth Index		
Poorest	497	20.56
Poorer	522	21.58
Middle	444	18.36
Richer	491	20.31
Richest	464	19.19
Division		
Barishal	140	5.81
Chattogram	498	20.60
Dhaka	615	25.42
Khulna	214	8.86
Mymensingh	206	8.50
Rajshahi	278	11.50
Rangpur	274	11.33
Sylhet	193	7.98
Region of Residence		
Urban	1,792	74.10
Rural	626	25.90
Total	2,418	100

3.2 Prevalence of Childhood Minimum Dietary Diversity, Minimum Meal Frequency, and Minimum Acceptable Diet

The prevalence of minimum dietary diversity, minimum meal frequency, and minimum acceptable diet and their distribution across different characteristics are presented in Table II. About 38 per cent of the children received minimum dietary diversity, 81 per cent received minimum meal frequency, and 35.85 per cent were fed a minimum acceptable diet in the preceding 24 hours of data collection. In summary, the prevalence of all three dietary indicators was about equally distributed between male and female children. Children who were the first child of their parents had a greater likelihood of receiving minimum dietary diversity, minimum meal frequency, and minimum acceptable diet. As household size

increased, the proportion of children with each dietary indicator also increased. The percentage of children with minimum dietary indicators was higher among children from male-headed households. The proportion of children with each dietary indicator was higher among children whose mothers had higher educational attainment, exposure to media, and working opportunities. Similarly, the proportion of children with minimum dietary diversity, minimum meal frequency, and minimum acceptable diet was higher among children from the richer wealth quintile who lived in the Rangpur division and urban areas.

TABLE II

DISTRIBUTION OF MDD, MMF, AND MAD AMONG 6-23 MONTHS AGED CHILDREN ACCORDING TO SOCIO-DEMOGRAPHIC AND ECONOMIC CHARACTERISTICS

Variables	MDD	MMF	MAD	Total
Total	928 (38.40)	1,960 (81.06)	867 (35.85)	2,418
Sex				
Female	452 (38.84)	944 (81.03)	424 (36.35)	1,165
Male	476 (37.99)	1,016 (81.10)	443 (35.38)	1,253
Age of children (months)				
6-11	187 (23.02)	595 (73.16)	179 (22.00)	813
12-17	378 (45.49)	701 (84.23)	358 (43.01)	833
18-23	363 (46.97)	664 (85.98)	330 (42.71)	772
Birth Order				
First	386 (43.18)	746 (83.54)	357 (39.90)	893
Second to Fourth	513 (36.36)	1,126 (79.76)	480 (34.01)	1,412
Fifth or higher	29 (26.12)	88 (77.83)	30 (26.63)	113
HH Size				
1-4	299 (40.13)	599 (80.22)	277 (37.14)	747
5-9	514 (36.40)	1,146 (81.03)	483 (34.16)	1,414
Above 10	114 (44.37)	215 (83.72)	1,067 (41.40)	257
Sex of HH head				
Male	799 (38.30)	248 (74.73)	115 (34.57)	332
Female	129 (39.03)	1,712 (82.07)	752 (36.05)	2,086
Mother's age (in years)				
15-19	168 (36.10)	369 (79.52)	155 (33.37)	464
20-34	701 (38.96)	1,460 (81.09)	654 (36.30)	1,801
35 and above	59 (38.81)	131 (85.5)	58 (38.02)	153

(Contd. Table II)

Variables	MDD	MMF	MAD	Total
Mother's education				
No education	28 (19.25)	109 (73.73)	25 (16.92)	148
Primary	196 (30.10)	515 (79.00)	186 (28.45)	651
Secondary	462 (38.93)	950 (80.06)	428 (36.08)	1,187
Higher	242 (56.02)	386 (89.44)	228 (52.84)	432
Father's Education				
No education	93 (27.94)	250 (74.96)	84 (25.20)	333
Primary	280 (33.09)	683 (80.54)	270 (31.88)	848
Secondary	306 (38.89)	627 (79.90)	277 (35.22)	785
Higher	249 (55.25)	400 (88.60)	236 (52.30)	451
Mother's exposure to media (TV or newspaper or radio)				
No	335 (31.50)	836 (78.46)	312 (29.25)	1,066
Yes	593 (43.87)	1,124 (83.12)	555 (41.05)	1,352
Mother working				
No	576 (37.70)	1,206 (78.97)	528 (34.60)	1,527
Yes	352 (39.60)	754 (84.66)	339 (38.00)	891
Wealth Index				
Poorest	132 (26.65)	386 (77.60)	126 (25.40)	497
Poorer	181 (34.73)	424 (81.28)	172 (32.97)	522
Middle	163 (36.63)	353 (79.54)	150 (33.70)	444
Richer	197 (40.14)	398 (81.13)	186 (37.91)	491
Richest	255 (54.96)	399 (85.91)	233 (50.20)	464
Division				
Barishal	48 (34.29)	108 (76.80)	45 (32.15)	140
Chattogram	190 (38.20)	381 (76.62)	171 (34.40)	498
Dhaka	247 (40.12)	502 (81.64)	231 (37.50)	615
Khulna	78 (36.62)	186 (87.05)	73 (34.23)	214
Mymensingh	76 (36.97)	180 (87.60)	73 (35.54)	206
Rajshahi	98 (35.30)	216 (77.70)	94 (33.89)	278
Rangpur	130 (47.48)	236 (86.05)	124 (45.14)	274
Sylhet	61 (31.67)	151 (78.10)	56 (28.82)	193
Region of Residence				
Urban	281 (44.83)	523 (83.50)	257 (41.06)	1,792
Rural	647 (36.15)	1,437 (80.21)	610 (34.03)	626

Note: MDD= minimum dietary diversity, MMF= minimum meal frequency, MSD=minimum acceptable diet.

3.3 Factors associated with MDD, MAF, and MAD

Estimates from the multivariable logistic regression analyses are presented in Table III. The variables found significant at a 20 per cent level in the bivariate logistic regressions were included in the multivariable logistic regression models. The result shows that children of mothers with higher education had 2.99 times higher odds of taking minimum dietary diversity (AOR=2.89, 95% CI=1.55, 5.38) than children of mothers with no education. Similarly, children of mothers with primary education had 1.73 times higher odds ($p<0.05$), and children of mothers with secondary level education had 2.04 times higher odds ($p<0.01$) of having minimum dietary diversity compared to children whose mothers had no education. Children from the richest households had significantly higher odds of having minimum dietary diversity intake (AOR=2.21, 95% CI=1.45, 3.37) than children from the poorest households. Compared to children from the poorest households, children from poorer (AOR=1.45, 95% CI=1.03, 2.02) and richer (AOR=1.41, 95% CI=1.04, 1.91) households had significantly higher odds of having minimum dietary diversity. Children from the Rangpur division had 1.76 times higher odds of having minimum dietary diversity compared to children from the Barishal division, and the result was significant at $p<0.01$ level. However, this study did not find any association of minimum dietary diversity with the region of residence (urban versus rural), birth order of children, household size, father's education, and mother's exposure to mass media.

For minimum meal frequency, this study found mother's age, mother's education, mother's working status, and administrative division as the significantly associated factors. Mothers who had higher levels of education, their children had 2.15 times higher odds of having minimum meal frequency compared to children of mothers with no formal education (95% CI=1.09, 4.23). Children whose mothers were working for livelihoods had 1.57 times higher odds ($p<0.01$) of receiving minimum meal frequency than children whose mothers were not working. Children from the Mymensingh division had greater odds of having minimum meal frequency (AOR=2.28, 95% CI=1.43, 3.62) than children from the Barisal division. Similarly, children from the Khulna division had 83 per cent greater odds of having minimum meal frequency than children from the Barishal division, and the result was significant at $p<0.05$.

TABLE III

RESULTS FROM MULTIVARIABLE LOGISTIC REGRESSION ON THE SOCIO-DEMOGRAPHIC AND ECONOMIC FACTORS INFLUENCING MDD, MMF, AND MAD

Variables	MDD		MMF		MAD	
	AOR (95% CI)	p-value	AOR (95% CI)	p-value	AOR (95% CI)	p-value
Birth Order						
First	1.08 (0.63,1.83)	0.788	1.44 (0.71,2.93)	0.314	0.96 (0.57,1.62)	0.888
Second to Fourth	0.97 (0.6,1.58)	0.903	1.06 (0.56,2.01)	0.862	0.87 (0.54,1.4)	0.558
Fifth or higher (ref)	1		1			
Sex of HH head						
Female (ref)			1			
Male			1.4 (0.99,1.96)	0.052		
HH Size						
1-4	0.99 (0.70,1.39)	0.935			0.94 (0.67,1.32)	0.731
5-9	0.84 (0.62,1.14)	0.268			0.83 (0.60,1.13)	0.232
Above 10 (ref)	1					
Mother's age						
15-19 (ref)			1			
20-34			1.26 (0.87,1.83)	0.223		
35 and above			2.15 (1.1,4.2)	0.025		
Mother's education						
No education (ref)	1		1		1	
Primary	1.73 (1.05,2.85)	0.033	1.32 (0.82,2.12)	0.249	1.87 (1.14,3.05)	0.013
Secondary	2.04 (1.21,3.43)	0.007	1.34 (0.8,2.22)	0.264	2.21 (1.31,3.73)	0.003
Higher	2.89 (1.55,5.38)	0.001	2.15 (1.09,4.23)	0.027	3.16 (1.71,5.82)	<0.001
Father's Education						
No education (ref)	1		1		1	
Primary	1.02 (0.73,1.43)	0.9	1.3 (0.92,1.85)	0.142	1.13 (0.79,1.6)	0.507
Secondary	1.03 (0.72,1.48)	0.869	1.2 (0.79,1.81)	0.389	1.06 (0.73,1.55)	0.741
Higher	1.36 (0.87,2.15)	0.18	1.71 (0.96,3.04)	0.068	1.49 (0.95,2.36)	0.084
Mother's exposure to media (TV or newspaper or radio)						
No (ref)	1		1		1	
Yes	1.18 (0.95,1.49)	0.138	1.15 (0.87,1.52)	0.324	1.23 (0.98,1.54)	0.075
Mother's working status						
No (ref)			1		1	
Yes			1.57 (1.2,2.06)	0.001	1.4 (1.12,1.75)	0.003
Wealth Index						
Poorest (ref)	1		1		1	
Poorer	1.41 (1.04,1.91)	0.026	1.2 (0.85,1.69)	0.304	1.4 (1.03,1.9)	0.034
Middle	1.37 (0.95,1.96)	0.092	1.02 (0.69,1.5)	0.921	1.3 (0.9,1.87)	0.163
Richer	1.45 (1.03,2.02)	0.029	1.05 (0.7,1.57)	0.823	1.46 (1.04,2.05)	0.030
Richest	2.21 (1.45,3.37)	<0.001	1.29 (0.76,2.18)	0.339	2.07 (1.36,3.17)	0.001
Division						
Barishal (ref)	1		1		1	
Chattogram	1.02 (0.72,1.45)	0.909	1.02 (0.68,1.53)	0.935	0.99 (0.69,1.4)	0.933
Dhaka	0.95 (0.65,1.37)	0.774	1.24 (0.80,1.92)	0.338	0.99 (0.67,1.46)	0.964
Khulna	0.94 (0.64,1.38)	0.759	1.83 (1.08,3.08)	0.024	0.9 (0.6,1.34)	0.609
Mymensingh	1.18 (0.76,1.82)	0.465	2.21 (1.4,3.48)	0.001	1.19 (0.76,1.85)	0.446
Rajshahi	0.94 (0.64,1.39)	0.766	0.96 (0.59,1.57)	0.877	0.94 (0.63,1.41)	0.774
Rangpur	1.76 (1.2,2.57)	0.004	1.63 (0.96,2.79)	0.072	1.61 (1.09,2.39)	0.017
Sylhet	0.94 (0.65,1.37)	0.752	1.26 (0.77,2.08)	0.361	0.94 (0.63,1.41)	0.775
Region of Residence						
Urban	1.10 (0.87,1.4)	0.436	1.15 (0.83,1.62)	0.4	1.07 (0.83,1.37)	0.602
Rural (ref)	1		1		1	

This study found that the mother's education, mother's working status, household wealth index, and administrative division were significant predictors of receiving a minimum acceptable diet. Children of mothers with primary education had about two times higher ($p<0.05$), children of mothers with secondary education had more than two times ($p<0.01$), and children of mothers with higher education had more than three times ($p<0.001$) higher odds of meeting minimum acceptable diet compared to children of mothers with no formal education. This study also found that children whose mothers were working had 40 per cent greater odds of receiving a minimum acceptable diet compared to their counterparts, and the result was significant at $p<0.01$. Children from the richest, richer, and poorer households had significantly greater odds of having a minimum acceptable diet compared to children from the poorest households. We found that children from the Rangpur division had 1.61 times higher odds (with $p<0.05$) of having a minimum acceptable diet compared to children from the Barishal division.

3.4 Inequalities in Minimum Dietary Diversity, Minimum Meal Frequency, and Minimum Acceptable Diet

Inequalities of minimum dietary diversity, minimum meal frequency, and minimum acceptable diet are shown in Table IV. From the inequality analysis, this study found that the concentration index for minimum dietary diversity was 0.21 ($p<0.001$). Similarly, the concentration indices for minimum meal frequency and minimum acceptable diet were 0.08 ($p<0.05$) and 0.19 ($p<0.001$), respectively (Table IV).

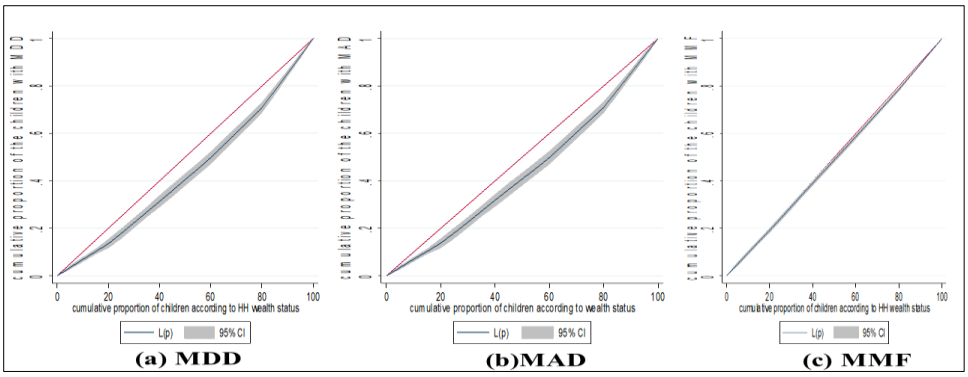
TABLE IV

INEQUALITIES IN MDD, MMF, AND MAD

Status	Concentration Index (CI)	Robust Standard error	p-value
MDD	0.21	0.027	<0.001
MMF	0.084	0.033	0.012
MAD	0.188	0.027	<0.001

This positive value of the concentration index for each indicator implies that the distribution of each minimum dietary indicator was more concentrated among the children from more affluent households. The level of inequalities for minimum dietary diversity and minimum acceptable diet were much larger than the inequalities in minimum meal frequency (Figure 1).

FIGURE 1: **Inequalities in MDD, MAD, and MMF among Bangladeshi Child**



3.5 Decomposition Analysis of MDD, MAD, and MMF

Table V shows results from the decomposition analysis and represents the contribution of different demographic and socio-economic factors to inequalities in minimum dietary diversity, minimum meal frequency, and minimum acceptable diet among 6-23 months children in Bangladesh. The 'Elasticity' columns show changes in the dependent variables associated with a one-unit change in the independent variables. The 'CI' column shows the distribution of the determinants with reference to wealth quintiles. A positive or negative sign of the CI implies that the factors were more concentrated among the rich or poor households. The 'Percentage Contribution' columns represent the relative contribution of each factor included in the model to the overall socioeconomic inequalities in minimum dietary diversity or minimum meal frequency, or minimum acceptable diet. The results indicate that for the socioeconomic inequalities in minimum dietary diversity, the major contributing factors were wealth index (44.26 per cent), mother's education (17.48 per cent), mother's exposure to mass media (15.32 per cent), father's education (9.75 per cent), region of residence (4.18 per cent). Similarly, wealth index (10.29 per cent), mother's education (10.63 per cent), father's education (11.56 per cent), mother's working status (9.86 per cent), father's education (10.69 per cent), and region of residence (4.50 per cent) were the major contributing factors for the socioeconomic inequalities in minimum meal frequency among children. Lastly, the main contributing factors for the inequalities in minimum acceptable diet were wealth index (43.98 per cent), mother's education (21.37 per cent), mother's working status (20.92 per cent), father's education (10.14 per cent), and administrative division (-6.61 per cent).

TABLE V

DECOMPOSITION OF SOCIOECONOMIC INEQUALITIES OF MDD, MAD AND MMF

Characteristics	MDD				MMF				MAD			
	Elasticity	CI	Absolute Contribution	Percentage Contribution	Elasticity	CI	Absolute Contribution	Percentage Contribution	Elasticity	CI	Absolute Contribution	Percentage Contribution
Sex												
Female (ref)												
Male	-0.014	0.008	-0.0001	-0.057	0.0001	0.008	0.000001	0.006	-0.016	0.008	-0.0001	-0.07
Birth Order												
First	0.071	0.131	0.009	4.483	0.025	0.131	0.003	3.904	0.041	0.131	0.005	2.818
Second to Fourth	0.029	-0.068	-0.002	-0.956	0.007	-0.068	-0.0001	-0.581	-0.01	-0.07	0.0007	0.36
Fifth or higher (ref)												
Total			0.007	3.527			0.003	3.323			0.004	3.178
HH Size												
01 to 4	-0.005	-0.045	0.0002	0.112	-0.012	-0.045	0.0006	0.654	-0.01	-0.045	0.0004	0.236
5 to 9	-0.063	-0.038	0.002	1.162	-0.018	-0.038	0.0007	0.821	-0.068	-0.038	0.003	1.382
Above 10 (ref)												
Total			0.0024	1.254			0.0013	1.475			0.003	1.618
Sex of HH head												
Male	-0.022	-0.088	0.002	0.947	0.05	-0.088	-0.004	-5.184	0.018	-0.088	-0.002	-0.861
Female (ref)												
Mother's age												
15-19 (ref)												
20-34	0.086	0.087	0.007	3.596	0.032	0.087	0.003	3.262	0.082	0.087	0.007	3.777
35 and above	0.019	-0.033	-0.001	-0.299	0.009	-0.033	-0.0003	-0.345	0.021	-0.033	-0.0007	-0.374
Total			0.006	3.297			0.0027	2.917			0.0063	3.403
Mother's education												
No education (ref)												
Primary	0.089	-0.38	-0.034	-16.319	0.013	-0.38	-0.005	-5.969	0.109	-0.38	-0.041	-21.898
Secondary	0.214	0.071	0.015	7.316	0.025	0.071	0.002	2.085	0.25	0.071	0.018	9.46
Higher	0.108	0.51	0.055	26.482	0.024	0.51	0.012	14.51	0.125	0.51	0.064	33.812
Total			0.036	17.479			0.009	10.626			0.041	21.374

(Contd. Table V)

Characteristics	MDD				MMF				MAD			
	Elasticity	CI	Absolute Contribution	Percentage Contribution	Elasticity	CI	Absolute Contribution	Percentage Contribution	Elasticity	CI	Absolute Contribution	Percentage Contribution
Father's Education												
No education (ref)												
Primary	0.011	-0.324	-0.003	-1.666	0.017	-0.324	-0.005	-6.452	0.031	-0.324	-0.01	-5.396
Secondary	0.014	0.196	0.003	1.36	0.012	0.196	0.002	2.474	0.019	0.196	0.004	2.015
Higher	0.038	0.529	0.02	9.752	0.018	0.529	0.01	11.564	0.048	0.529	0.025	13.521
Total			0.02	9.446			0.007	7.586			0.019	10.14
Mother's exposure to media (TV or newspaper or radio)												
No (ref)												
Yes	0.056	0.569	0.032	15.323	0.03	-0.274	-0.008	-9.906	0.071	-0.274	-0.02	-10.37
Mother working												
No (ref)												
Yes	0.053	-0.27	-0.015	-7.004	0.015	0.567	0.008	9.86	0.069	0.569	0.039	20.916
Wealth Index												
Poorest (ref)												
Poorer	0.042	-0.476	-0.02	-9.564	0.007	-0.476	-0.003	-3.894	0.041	-0.476	-0.02	-10.421
Middle	0.032	0.032	0.001	0.493	0.0003	0.032	0.00001	0.012	0.026	0.032	0.0008	0.441
Richer	0.043	0.518	0.022	10.641	0.001	0.518	0.0006	0.71	0.042	0.518	0.022	11.605
Richest	0.089	1	0.089	42.691	0.008	1	0.008	9.564	0.08	1	0.08	42.351
Total			0.092	44.261			0.006	10.286			0.083	43.976
Division												
Barishal (ref)												
Chattogram	0.006	0.088	0.0005	0.275	0.0002	0.088	0.00002	0.019	0.00001	0.088	0.000001	0.0003
Dhaka	-0.004	0.37	-0.002	-0.779	0.01	0.37	0.004	4.474	-0.002	0.37	-0.0006	-0.303
Khulna	-0.005	-0.003	0.00001	0.007	0.01	-0.003	-0.00003	-0.036	-0.006	-0.003	0.00002	0.009
Mymensingh	0.008	-0.257	-0.002	-0.10	0.012	-0.257	-0.003	-3.741	0.01	-0.257	-0.002	-1.305
Rajshahi	-0.005	-0.12	0.0006	0.30	-0.0006	-0.12	0.00007	0.078	-0.004	-0.12	0.0005	0.249
Rangpur	0.033	-0.315	-0.01	-5.03	0.0102	-0.315	-0.003	-3.807	0.032	-0.315	-0.01	-5.436
Sylhet	-0.001	-0.11	0.0001	0.055	0.003	-0.11	-0.0003	-0.39	-0.003	-0.11	0.0003	0.178
Total			-0.01069	-5.491			-0.002	-3.403			-0.012	-6.608
Region of Residence												
Urban	0.016	0.533	0.009	4.176	0.007	0.533	0.004	4.503	0.01	0.533	0.005	2.845
Rural (ref)												

IV. DISCUSSION

Although undernutrition prevalence has declined considerably over the last two decades, inequality in childhood undernutrition still remains a big concern in Bangladesh. This study identified the prevalence and associated factors of dietary diversity among 6-23 months children in Bangladesh using the latest country-representative demographic and health survey data. The study also estimated the socioeconomic inequalities in adequate dietary diversity among children. The study findings show that about 38 per cent of the children received minimum dietary diversity, about 81 per cent of the children had minimum meal frequency and nearly 36 per cent of the children were fed a minimum acceptable diet in the preceding 24 hours of data collection. Bangladesh has made some progress over the years in improving children's dietary intake as these percentages were 24 per cent, 64 per cent, and 21 per cent, respectively, in 2011. However, the progress is not at a satisfactory level, especially in achieving minimum dietary diversity and minimum acceptable diet. Hence, the country needs to strengthen its efforts so that children can get the required diverse diets to grow, develop and achieve their full potential (UNICEF, 2022). The study also identified mother's education level, household wealth status, and administrative division as the significant predictors of uptake of minimum dietary diversity among children in Bangladesh. For minimum meal frequency, this study found mother's age, mother's education, mother's working status, and administrative division as the significantly associated factors. Similarly, mother's education, mother's working status, household wealth index, and administrative division were the significant predictors of receiving a minimum acceptable diet.

The current study found that children of mothers with higher educational status had higher odds of having minimum dietary diversity, minimum meal frequency, and minimum acceptable diet. This study finding aligns with previous studies in Bangladesh and other developing countries (Kabir et al., 2012; Keno et al., 2021; Sheikh et al., 2020; Tariqujjaman et al., 2022). The possible explanation is that educated mothers are likely to have more information and awareness about their children's health, nutrition, and complementary feeding practices (Keno et al., 2021; Tariqujjaman et al., 2022). In addition, educated mothers might be better informed about the adverse consequences of a malnourished child (Sheikh et al., 2020). Mother's working status was found as a significant predictor of children achieving minimum meal frequency and having minimum acceptable diet. Another study in Pakistan also reported that working mothers' children have greater odds

of having a minimum acceptable diet (Ali et al., 2021). However, an earlier study in Bangladesh did not find mother's working status as a significant predictor of a child receiving a minimum acceptable diet (Sheikh et al., 2020). The possible explanation behind our finding may be that mothers with earning capacity have greater financial autonomy and decision-making power in the household.

Our study findings show that children from richer and the richest households have greater odds of meeting minimum dietary diversity and having minimum acceptable diet compared to children from the poorest households. This positive association between the wealth status of a household and the dietary diversity of children is consistent with findings from other studies (Ali et al., 2021; Keno et al., 2021; Sheikh et al., 2020). The result implies that a household's ability to purchase necessary foods is important for achieving adequate dietary diversity and an acceptable diet (Ali et al., 2021). The current study also found that children from the Rangpur division had higher odds of having minimum dietary diversity and minimum acceptable diet than Barishal. Other earlier studies in Bangladesh also found geographical variations in children's minimum dietary diversity and minimum acceptable diet (Kabir et al., 2012; Sheikh et al., 2020). Kabir et al. (2012) reported that minimum dietary diversity and minimum acceptable diet were lower in the Barishal division.

This study observed the concentration indices for minimum dietary diversity as 0.21 ($p<0.001$), for minimum meal frequency as 0.08 ($p<0.05$), and for minimum acceptable diet as 0.19 ($p<0.001$). This finding implies that the distribution of each dietary indicator was more concentrated among children from more affluent households. Another study in the Bangladeshi context also found a similar pro-rich distribution of minimum dietary diversity (Kundu et al., 2022). Wealth status of household, mother's and father's education levels, and exposure to mass media were the major contributing factors to these inequalities. Therefore, the in-depth attention of policymakers is needed to increase the accessibility regarding such factors and to design and roll out nutritional community-based education programs to increase nutritional knowledge and awareness among poorer segments of the community.

The current study has several limitations. Firstly, information on the dietary indicators was collected from mothers on a 24-hour recall basis. Therefore, there might be some recall bias or misreporting of information while reporting the last days' feeding practices. Secondly, there was no information in the dataset regarding the quantity and quality of the foods consumed by children. Hence, the

nutritional adequacy of the foods consumed could not be measured. Thirdly, due to the cross-sectional nature of the data, causal relationships may not be inferred. Fourthly, the measurement of wealth status was based on household assets due to the absence of data on household income and expenditures. Therefore, using such a wealth index rather than income quintiles is a limitation of this study. Despite the limitations, this study used a large, nationally representative dataset of Bangladesh. Therefore, the study findings can be generalised for children aged 6-23 months in Bangladesh.

V. CONCLUSIONS

This study has sketched the inequalities in minimum dietary diversity, minimum meal frequency, and minimum acceptable diet status among children. We identified the mother's education and administrative division as significant predictors of all three dietary indicators: minimum dietary diversity, minimum meal frequency, and minimum acceptable diet. Mother's working status was significantly associated with minimum meal frequency and minimum acceptable diet. The study also observed household wealth status as a significant influencing factor behind minimum dietary diversity and minimum acceptable diet among children. Policies should be designed to increase awareness among mothers about proper child-feeding practices, especially targeting children from relatively poor households and uneducated mothers. To tackle the inequalities in all three indicators, policies should be designed to improve children's dietary intake and reduce the socio-economic inequalities in child health status. This study's findings should be considered in the context of current and proposed policy decision-making.

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