ORIGINAL RESEARCH

CURRENT DEVELOPMENTS IN NUTRITION

Maternal and Pediatric Nutrition

Exploring the Factors Associated with Dietary Diversity of Children Aged 6–59 Months in Some Rural and Slum Areas of Bangladesh amid the COVID-19 Pandemic: A Mixed-Effect Regression Analysis

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ABSTRACT

Background: Dietary diversity (DD) is a key component of diet quality, and malnutrition due to poor diet quality leads to child morbidity and mortality. However, in Bangladesh, there is a lack of information on childhood DD (for children aged 6–59 mo) amid the coronavirus disease 2019 (COVID-19) pandemic.

Objectives: The purpose of this study was to assess the minimum DD and its associated factors among children aged 6–59 mo during the COVID-19 pandemic in Bangladesh.

Methods: A cross-sectional study was carried out in 6 districts of Bangladesh. A total of 1190 respondents were included using cluster random sampling. The Individual Dietary Diversity Score (IDDS) for children was used to assess the children's DD. Factors associated with DD of children were identified using a multilevel binary logistics regression model.

Results: About 70% of the children aged 6–59 mo had minimum DD during the COVID-19 pandemic in Bangladesh. Children who belonged to slum areas [adjusted odds ratio (AOR): 0.45; 95% CI: 0.24, 0.83], family income 12,000–15,000 Bangladeshi taka (BDT) (AOR: 1.79; 95% CI: 1.06, 3.05) and >15,000 BDT (AOR: 2.59; 95% CI: 1.47, 4.57), mothers aged 26–30 y (AOR: 0.35; 95% CI: 0.20, 0.62) and >30 y (AOR: 0.43; 95% CI: 0.22, 0.85), respondents who had 2 children <5 y old (AOR: 0.43; 95% CI: 0.28, 0.66), and children aged 12–23 mo (AOR: 1.89; 95% CI: 1.14, 3.20) were significantly associated with DD among children aged 6–59 mo.

Conclusions: The findings of this study highlight the need for food and nutrition-related intervention, particularly targeting mothers of younger age and with >2 children <5 y old, mothers from slum regions, and fathers who were unemployed, to improve children's DD practices. *Curr Dev Nutr* 2022;6:nzac109.

Keywords: dietary diversity, feeding practices, children, slum area, rural area, Bangladesh

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Abbreviations used: AOR, adjusted odds ratio; BDT, Bangladeshi taka; COVID-19, coronavirus disease 2019; DD, dietary diversity; DDS, dietary diversity score; HFS, household food security; IDDS, Individual Dietary Diversity Score.

Introduction

Globally, 45% of all child deaths are related to malnutrition (1) and South Asia bears the highest rates of stunting and wasting (2–4). Although, in Bangladesh, the prevalence of childhood stunting and wasting has substantially reduced in the past 2 decades, undernutrition is still a significant public health concern in the country (5–7). Infants' and young children's feeding covers a critical period in which malnutrition starts to develop in many infants, contributing significantly to the high burden of malnutrition in preschool children (8). Inadequate complementary feeding (completion of the first 6 mo of life) can result in stunting, and ∼6% of mortality in children <5 y old can be averted by appropriate complementary feeding practices (9, 10). Consumption of a wide variety of foods is essential for ensuring satisfactory nutrition, and sustainable growth and development from infancy to adulthood.

Dietary diversity (DD) is the consumption of a variety of food which is nutritionally adequate over a reference period (11, 12). In the context of infant and young child feeding, the proportion of minimum DD among children 6–59 mo of age (i.e., receiving foods from ≥4 out of 7 standard groups, or ≥5 out of 8 standard food groups, on the

preceding day) is as an imperative indicator (13, 14). Intake of diversified foods fulfills the children's requirements of essential nutrients like minerals and vitamins for growth and development, health, and well-being. Minimum DD is a useful indicator of diet quality, nutrient adequacy, and nutritional status of children (15–17). Studies have shown that child age, the sex of a child, mother's having nutritional knowledge, educational status, number of family members, and household wealth index are associated with DD (18, 19). Father's literacy has also been significantly associated with DD (20). Consequently, children who do not get diversified foods are at high risk of failing a class and discontinuing from schools, which has imposed a burden on communities, families, and national education systems (21).

However, the proportions of minimum DD feeding among children <5 y old were decreased due to the coronavirus disease 2019 (COVID-19) pandemic. Especially in developing countries, the burden of poor diet quality doubled and DD drastically decreased (22). Like other countries, in Bangladesh, the COVID-19 pandemic has imposed several challenges in areas such as minimum nutrition, food security, food systems, and health care delivery on efforts to ensure the optimum health and general well-being of the population (23). Research has shown that household food security and DD decreased during the COVID-19 pandemic in Bangladesh (24). There is a lack of evidence assessing DD and its associated factors among children <5 y old during the COVID-19 pandemic. The first 1000 d of life, from conception to age 2 y, are the period when foundations for good health are built. Because the first 1000 d of life are considered as a "window of opportunity," ensuring optimal nutrition in the first 5 y is important for cognitive development and physical growth (25). Particularly, children <5 y old are vulnerable to undernutrition and the burden of undernutrition is higher in rural areas and slum areas than in urban areas owing to inequity in availability and accessibility of food items. A previous study reported that low DD is a strong predictor of child stunting in rural Bangladesh (26). In addition, the adverse effects of COVID-19 might increase children's vulnerability to not getting diversified food and proper nutrition. As far as we know, this study was the first research in Bangladesh to assess the proportion of minimum DD among children aged 6–59 mo during the COVID-19 pandemic and its associated factors using a multilevel binary logistics regression model. Thus, an assessment can serve to understand the critical needs of this underexplored group and inform policy makers' priorities and development of intervention programs targeting associated factors to meet minimum DD. Hence, this study aimed to assess the DD and its associated factors among a large sample of children aged 6–59 mo during the COVID-19 pandemic in Bangladesh.

Methods

Study settings and sampling

The present study was carried out in 6 districts (Khulna, Magura, Patuakhali, Dhaka, Chittagong, and Barisal) of Bangladesh. These districts were selected randomly to collect data from slum areas in 3 districts (Dhaka, Chittagong, Barisal) and urban areas in 3 districts (Khulna, Magura, Patuakhali) (see **Figure 1**). A slum in Bangladesh is a highly populated urban residential area with poorly constructed housing units of poor quality and is often associated with poverty (27). Considering these 6 districts as a cluster, the cluster sampling technique was used

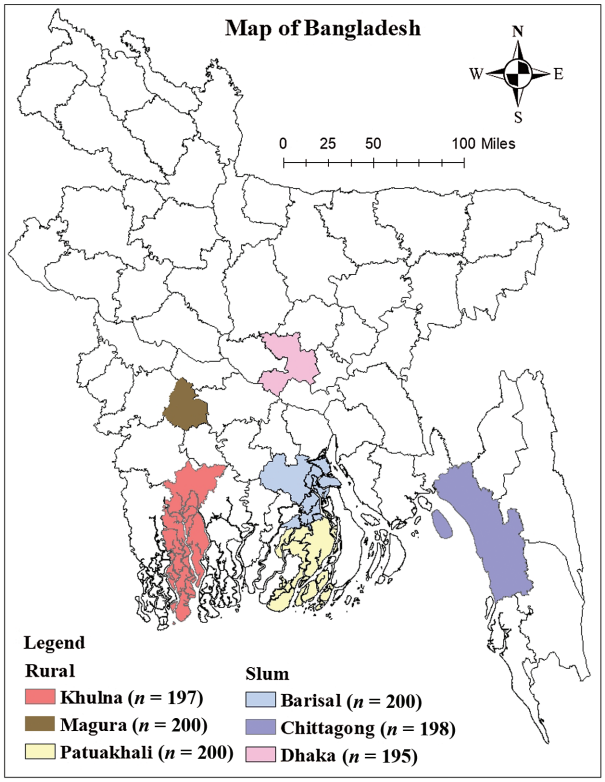

FIGURE 1 Study settings (Khulna, Magura, Patuakhali, Dhaka, Chittagong, and Barisal districts of Bangladesh).

because of the geographical variation that exists in those settings. The sample size was calculated using a single population proportion formula considering the prevalence of minimum DD (60%) of a previous study (28). OpenEpi version 3 (https://www.openepi.com/SampleSize/SSPropor.htm) was used with the assumptions of a 95% confidence level, 4% absolute precision, a design effect of 2, and taking a 60% prevalence of minimum DD among Bangladeshi children <5 y old, yielding a required sample size of 1152. Then, data were collected from 200 participants from each district (cluster) to attain the desired sample size.

Participants and procedure

A cross-sectional study was conducted among mothers/caregivers who had children <5 y old from the selected settings between January 2021 and April 2021. The following inclusion criteria were applied to select the participants: *1*) mother who had ≥1 child aged 6–59 mo and *2*) Bangladeshi citizen by birth. However, children and mothers who had any disability and illness were excluded from the study. A prestructured questionnaire was used to collect data and was pretested among 50 randomly selected participants to check its consistency. The mothers/caregivers were interviewed (face-to-face) by trained research staff. Seven interviewers (4 were hired as voluntary data collectors and 3 were from the author list), who were trained by the principal investigator of the study, were responsible for data collection. The lead investigator of the study arranged an online training session to train the data collectors about different sections of the questionnaire, interview techniques, and inclusion/exclusion criteria of the study. A total of 1276 mothers/caregivers were invited to participate; 58 mothers/caregivers

TABLE 1 Background characteristics of study participants and bivariate distribution of DD status across different subgroups[1]

Variables	Total, *n* (%)	Having minimum DD, *n* (%)		*P* value
		No	Yes	
Overall DD				
Having minimum DD, % (95% CI)	70.25 (67.59, 72.79)			
Not having minimum DD, % (95% CI)	29.75 (27.21, 32.41)			
Residence				
Rural	592 (49.75)	164 (27.70)	428 (72.30)	0.125
Slum	598 (50.25)	190 (31.77)	408 (68.23)	
Religion				
Muslim	956 (80.34)	301 (31.49)	655 (68.51)	0.008
Hindu	234 (19.66)	53 (22.65)	181 (77.35)	
Family monthly income, BDT				
<8000	330 (27.73)	124 (37.58)	206 (62.42)	0.000
8000–12,000	397 (33.36)	123 (30.98)	274 (69.02)	
12,001–15,000	206 (17.31)	50 (24.27)	156 (75.73)	
>15,000	257 (21.60)	57 (22.18)	200 (77.82)	
Mother's age, y				
≤20	229 (19.24)	61 (26.64)	168 (73.36)	0.009
21–25	531 (44.62)	140 (26.37)	391 (73.63)	
26–30	294 (24.71)	108 (36.73)	186 (63.27)	
>30	136 (11.43)	45 (33.09)	91 (66.91)	
Mother's education				
No schooling	132 (11.09)	40 (30.30)	92 (69.70)	0.447
Primary	457 (38.40)	136 (29.76)	321 (70.24)	
High school	431 (36.22)	136 (31.55)	295 (68.45)	
College	120 (10.08)	27 (22.50)	93 (77.50)	
Honours or above	50 (4.20)	15 (30.0)	35 (70.0)	
Mother's occupation				
Government job	10 (0.84)	1 (10.0)	9 (90.0)	0.193
Private job	53 (4.45)	12 (22.64)	41 (77.36)	
Housewife	1127 (94.71)	341 (30.26)	786 (69.74)	
Father's age, y				
≤25	151 (12.69)	56 (37.09)	95 (62.91)	0.257
26–30	461 (38.74)	115 (24.95)	346 (75.05)	
>30	578 (48.57)	183 (31.66)	395 (68.34)	
Father's education				
No schooling	125 (10.50)	40 (32.0)	85 (68.0)	0.257
Primary	419 (35.21)	135 (32.22)	284 (67.78)	
High school	440 (36.97)	130 (29.55)	310 (70.45)	
College	87 (7.31)	19 (21.84)	68 (78.16)	
Honours or above	119 (10.0)	30 (25.21)	89 (74.79)	
Father's occupation				
Government job	74 (6.22)	11 (14.86)	63 (85.14)	0.000
Private job	206 (17.31)	46 (22.33)	160 (77.67)	
Business	301 (25.29)	77 (25.58)	224 (74.42)	
Day laborer	505 (42.44)	186 (36.83)	319 (63.17)	
Others[2]	104 (8.74)	34 (32.69)	70 (67.31)	
Family size, members				
≤5	755 (63.45)	217 (28.74)	538 (71.26)	0.317
>5	435 (36.55)	137 (31.49)	298 (68.51)	
Children <5 y old, *n*				
1	1014 (85.21)	289 (28.50)	725 (71.50)	0.036
2	156 (13.11)	60 (38.46)	96 (61.54)	
≥3	20 (1.68)	5 (25.0)	15 (75.0)	
Order of children				
1	641 (53.87)	198 (30.89)	443 (69.11)	0.070
2	398 (33.45)	103 (25.88)	295 (74.12)	
≥3	151 (12.69)	53 (25.88)	98 (64.90)	
Children's age, mo				
6–11	135 (11.34)	51 (37.78)	84 (62.22)	0.070
12–23	222 (18.66)	48 (21.62)	174 (78.38)	

(*Continued*)

TABLE 1 (*Continued*)

Variables	Total, *n* (%)	Having minimum DD, *n* (%)		*P* value
		No	Yes	
24–35	250 (21.01)	64 (25.60)	186 (74.40)	
36–47	264 (22.18)	79 (29.92)	185 (70.08)	
48–59	319 (26.81)	112 (35.11)	207 (64.89)	
Sex of children				
Male	606 (50.92)	183 (30.20)	423 (69.80)	0.729
Female	584 (49.08)	171 (29.28)	413 (70.72)	
Household food security				
Extremely insecure	324 (27.23)	115 (35.49)	209 (64.51)	0.001
Moderately insecure	352 (29.58)	80 (22.73)	272 (77.27)	
Occasionally insecure	322 (27.06)	107 (33.23)	215 (66.77)	
Food secure	192 (16.13)	52 (27.08)	140 (72.92)	
Received microcredit loan previously				
Yes	779 (65.46)	253 (32.48)	526 (67.52)	0.005
No	411 (34.54)	101 (24.57)	310 (75.43)	
Current microcredit loan				
Yes	596 (50.08)	183 (30.70)	413 (69.30)	0.470
No	594 (49.92)	171 (28.79)	423 (71.21)	

[1] $n = 1190$. BDT, Bangladeshi taka; DD, dietary diversity.
[2] Others included jobless/retired, farmer, unemployed, etc.

refused, so the response rate was 95.45%. Then, after cleaning the data set during analysis, the final sample size of participants was 1190.

Outcome variable

The DD of children aged 6–59 mo in Bangladesh was the outcome measure of this study. The dietary diversity score (DDS) of children was measured using the Individual Dietary Diversity Score (IDDS) for children, which is composed of 8 different food groups and is often used as a proxy measure of the nutritional value of a person's diet (29). Children's DDS was calculated by summing the number of food groups eaten by children in the preceding 24 h. Numeric values were set for 8 different food groups as "0" for a negative answer (not consumed) or "1" for a positive answer (consumed), so that the total score ranged between 0 and 8 (29). Consumption of ≥5 out of 8 food groups was considered as having minimum DD. In the present study, the reliability of the IDDS scale was acceptable (Cronbach's $\alpha = 0.76$).

Independent variables

The independent variables for this study included place of residence, religion, family monthly income, mother's age (y), mother's education, mother's occupation, father's age (y), father's education, father's occupation, family size, number of children <5 y old in family, order of children, children's age (mo), sex of child, household food security (HFS) status, and previous and current microcredit-receiving status of households.

HFS status was assessed using the Household Food Security (HFS) scale, which is composed of 11 questions with a score assigned based on responses to each item reflecting a household's food security status for the previous month (24, 30). Higher scores were assigned for more favorable responses, and lower scores were assigned for less favorable responses. A higher score indicated a more favorable HFS. The internal consistency of the HFS scales was high (Cronbach's $\alpha = 0.80$). The HFS scores were categorized based on the percentiles of the scores into extremely insecure (score: <25th percentile), moderately insecure (score: 25–50th percentile), occasionally insecure (score: 50–75th percentile), and food secure (score: ≥75th percentile) (31). The information on the microcredit-receiving status of households was also included as independent variables. Microcredit was created to provide financial capital to landless and resource-poor rural households who would otherwise be ineligible for credit access or stuck in the informal credit system (32). Previous studies found a positive impact of microcredit on children's nutrition (32–34), and on the total household income as well as food and nonfood expenditures (35). Thus, receiving microcredit might have an effect on children's DD and a large number of households in Bangladesh receive microcredit.

Data analysis

We used descriptive statistics to show the characteristics of respondents and the differences in DD between categories were tested using Pearson chi-square analysis. Considering the cluster sampling technique of the study, a 2-level logistic regression analysis was used where 6 different districts of Bangladesh were considered as level-2 factors (clusters) to identify the factors associated with minimum DD of children aged 6–59 mo, accounting for the clustering effects on the outcome measure (36). Multicollinearity among covariates was checked using the variance inflation factor and tolerance. After using the multilevel approach, the intraclass correlation coefficient was also estimated. Adjusted odds ratios (AORs) along with 95% CIs were used to interpret the findings and a 5% significance level was considered. All analyses were performed using the statistical package Stata, version 17.0 (StataCorp., College Station, TX, USA).

Ethical considerations

All study protocols and procedures were reviewed and approved by the Research Ethical Committee (REC) of the Department of Food Microbiology, Patuakhali Science and Technology University, Bangladesh

TABLE 2 Regression analysis (unadjusted) showing the factors associated with minimum DD of children aged 6–59 mo in Bangladesh[1]

	Minimum DD			
Variables	**UOR**	**SE**	***P* value**	**95% CI**
Residence				
Rural	0.82	0.16	0.289	0.56, 1.19
Slum	Ref.			
Religion				
Muslim	Ref.			
Hindu	1.13	0.21	0.519	0.78, 1.62
Family monthly income, BDT				
<8000	Ref.			
8000–12,000	1.03	0.17	0.875	0.74, 1.43
12,000–15,000	1.31	0.28	0.207	0.86, 1.99
>15,000	1.87	0.37	0.001	1.28, 2.75
Mother's age, y				
≤20	0.94	0.17	0.728	0.65, 1.34
21–25	Ref.			
26–30	0.62	0.09	0.003	0.45, 0.85
>30	0.71	0.15	0.113	0.47, 1.08
Mother's education				
No schooling	Ref.			
Primary	1.17	0.28	0.495	0.74, 1.87
High school	1.01	0.24	0.970	0.64, 1.60
College	2.22	0.70	0.011	1.20, 4.10
Honours or above	1.32	0.51	0.475	0.62, 2.79
Mother's occupation				
Government job	Ref.			
Private job	0.32	0.36	0.307	0.04, 2.85
Housewife	0.25	0.27	0.196	0.03, 2.04
Father's age, y				
≤25	Ref.			
26–30	1.65	0.34	0.014	1.11, 2.47
>30	1.21	0.24	0.335	0.82, 1.78
Father's education				
No schooling	Ref.			
Primary	1.05	0.24	0.840	0.67, 1.64
High school	1.19	0.27	0.458	0.75, 1.87
College	2.11	0.71	0.027	1.09, 4.07
Honours or above	1.89	0.57	0.036	1.04, 3.43
Father's occupation				
Government job	Ref.			
Private job	0.54	0.20	0.095	0.26, 1.12
Business	0.51	0.18	0.059	0.25, 1.03
Day laborer	0.36	0.12	0.003	0.18, 0.71
Others[2]	0.31	0.12	0.003	0.14, 0.68
Family size, members				
≤5	Ref.			
>5	0.96	0.13	0.743	0.73, 1.25
Children <5 y old, *n*				
1	Ref.			
2	0.49	0.09	<0.001	0.33, 0.71
≥3	0.99	0.53	0.981	0.34, 2.84
Order of children				
1	Ref.			
2	1.18	0.17	0.274	0.88, 1.57
≥3	0.81	0.16	0.273	0.55, 1.19
Children's age, mo				
6–11	Ref.			
12–23	2.11	0.52	0.002	1.30, 3.42
24–35	1.71	0.40	0.023	1.08, 2.72
36–47	1.27	0.30	0.301	0.81, 2.00
48–59	0.99	0.22	0.972	0.65, 1.53

(*Continued*)

TABLE 2 (*Continued*)

Variables	Minimum DD			
	UOR	SE	*P* value	95% CI
Sex of children				
Male	Ref.			
Female	1.07	0.14	0.621	0.83, 1.37
Household food security				
Food insecure	Ref.			
Moderately insecure	1.35	0.25	0.115	0.93, 1.95
Occasionally insecure	0.86	0.16	0.405	0.60, 1.23
Food secure	1.09	0.24	0.681	0.71, 1.68
Received microcredit loan previously				
Yes	Ref.			
No	0.90	0.16	0.541	0.64, 1.27
Current microcredit loan				
Yes	Ref.			
No	0.87	0.12	0.310	0.67, 1.14

[1] $n = 1190$. In these univariate models, a 2-level logistic regression analysis was used where 6 different districts of Bangladesh were considered as level-2 factors. BDT, Bangladeshi taka; DD, dietary diversity; UOR, unadjusted odds ratio.
[2] Others included jobless/retired, farmer, unemployed, etc.

(approval number: FMB:15/12/2020:07). Written consent was obtained from the participants after discussing the purpose of the study, confidentiality of their data, and after assuring the participant that this research would not be harmful to them or their child. Respondents participated voluntarily and were informed about the future publication of this research.

Results

The present study found that ~70% (95% CI: 67.59%, 72.79%) of children had minimum DD. Respondents' residence was almost equally distributed between rural and slum areas (rural: 49.75%; slum: 50.25%). Only 20% of respondents' family monthly incomes were >15,000 Bangladeshi taka (BDT). One in 10 of the mothers (11.09%) had no schooling, and a majority of the mothers (94.71%) were housewives. About two-thirds of respondents' (63.45%) families had ≥5 members. Half of the children were male (50.92%) and the rest were female (49.08%). About two-thirds of respondents (65.46%) had received microcredit loans previously and half of them (50.08%) had current microcredit loans. More than half of the respondents (57.06%) reported that they felt the burden of the microcredit loan. Twenty-seven percent of the households showed extreme levels of food insecurity and only 16.13% of households were food secure (**Table 1**).

Table 1 shows the chi-square analysis (bivariate distribution) demonstrating the factors associated with DD of children <5 y old. This study found that place of residence, religion, family monthly income, maternal age, occupation of father, number of children <5 y old in the household, household food security status, and receiving a microcredit loan previously were significantly associated with DD of children <5 y old (all $P < 0.05$).

Table 2 shows the univariate models of the regression analysis. The univariate regression analysis showed that children from families having a monthly income >15,000 BDT, who had mothers having a college education, fathers aged 26–30 y and having a college education or above, and those aged 12–35 mo were more likely to get minimum DD. On the other hand, children of mothers aged 26–30 y, belonging to families with 2 children aged <5 y, and children of fathers whose occupation was day laboring or others (jobless/retired, farmer, unemployed, etc.) were less likely to get minimum DD (Table 2).

The estimate of the random-effect parameter (0.484) of the adjusted regression model showed that clustering variations were present in the outcome measure among 6 different districts of Bangladesh. All variables were included in the adjusted model to control for the confounding effect of the covariates on the outcome measure. From the adjusted regression model, this study found that children who belonged to slum areas were less likely to have minimum DD (AOR: 0.45; 95% CI: 0.24, 0.83) than those from rural areas. Children <5 y old of respondents whose family income was 12,000–15,000 BDT (AOR: 1.79; 95% CI: 1.06, 3.05) and >15,000 BDT (AOR: 2.59; 95% CI: 1.47, 4.57) were more likely to have minimum DD than their counterparts. Children whose mothers were aged 26–30 y (AOR: 0.35; 95% CI: 0.20, 0.62) and >30 y (AOR: 0.43; 95% CI: 0.22, 0.85) were less likely to have minimum DD than those whose mothers were aged 21–25 y. Contrarily, children whose fathers were aged 26–30 y (AOR: 2.14; 95% CI: 1.33, 3.46) and >30 y (AOR: 2.06; 95% CI: 1.19, 3.57) were more likely to have minimum DD than those whose fathers were aged ≤25 y. Children of respondents who had 2 children <5 y old were less likely to have minimum DD (AOR: 0.43; 95% CI: 0.28, 0.66) than their counterparts. In addition, children aged 12–23 mo had higher odds of having minimum DD (AOR: 1.89; 95% CI: 1.14, 3.20) than children aged 6–11 mo (**Table 3**).

Discussion

Consuming a variety of foods is essential for human beings (24, 37); especially for children aged <5 y, dietarily diverse food is very important for physical growth and mental development (38). However, the proportion of minimum DD decreased owing to the COVID-19 pandemic (22, 24, 39). This study found that the proportion who had min-

TABLE 3 Regression analysis (adjusted) showing the factors associated with minimum DD of children aged 6–59 mo in Bangladesh[1]

	Minimum DD			
Variables	**AOR**	**SE**	***P* value**	**95% CI**
Fixed-effect parameters				
Residence				
Rural	Ref.			
Slum	0.45	0.14	0.011	0.24, 0.83
Religion				
Muslim	Ref.			
Hindu	1.17	0.24	0.451	0.78, 1.74
Family monthly income, BDT				
<8000	Ref.			
8000–12,000	1.32	0.28	0.189	0.87, 1.99
12,000–15,000	1.79	0.49	0.031	1.06, 3.05
>15,000	2.59	0.75	0.001	1.47, 4.57
Mother's age, y				
≤20	0.68	0.15	0.083	0.44, 1.05
21–25	Ref.			
26–30	0.35	0.10	0.000	0.20, 0.62
>30	0.43	0.15	0.015	0.22, 0.85
Mother's education				
No schooling	Ref.			
Primary	1.24	0.32	0.398	0.75, 2.07
High school	0.94	0.25	0.814	0.55, 1.60
College	1.54	0.64	0.303	0.68, 3.48
Honours or above	0.79	0.42	0.655	0.27, 2.27
Mother's occupation				
Government job	Ref.			
Private job	0.40	0.46	0.424	0.04, 3.82
Housewife	0.37	0.42	0.378	0.04, 3.37
Father's age, y				
≤25	Ref.			
26–30	2.14	0.52	0.002	1.33, 3.46
>30	2.06	0.58	0.010	1.19, 3.57
Father's education				
No schooling	Ref.			
Primary	0.86	0.22	0.569	0.52, 1.43
High school	0.86	0.24	0.593	0.51, 1.48
College	1.43	0.58	0.374	0.65, 3.16
Honours or above	1.01	0.50	0.982	0.38, 2.67
Father's occupation				
Government job	Ref.			
Private job	0.62	0.25	0.242	0.27, 1.39
Business	0.50	0.21	0.102	0.22, 1.15
Day laborer	0.46	0.20	0.077	0.20, 1.09
Others[2]	0.33	0.15	0.016	0.13, 0.81
Family size, members				
≤5	Ref.			
>5	1.01	0.16	0.939	0.74, 1.38
Children <5 y old, *n*				
1	Ref.			
2	0.43	0.09	0.000	0.28, 0.66
≥3	0.93	0.54	0.897	0.30, 2.90
Order of children				
1	Ref.			
2	1.31	0.28	0.181	0.82, 1.61
≥3	1.24	0.33	0.418	0.74, 2.08
Children's age, mo				
6–11	Ref.			
12–23	1.91	0.50	0.014	1.14, 3.20
24–35	1.38	0.35	0.205	0.84, 2.29
36–47	1.09	0.28	0.740	0.66, 1.79
48–59	0.87	0.21	0.574	0.54, 1.40

(*Continued*)

TABLE 3 (*Continued*)

Variables	Minimum DD			
	AOR	SE	*P* value	95% CI
Sex of children				
Male	Ref.			
Female	1.06	0.15	0.682	0.81, 1.39
Household food security				
Food insecure	Ref.			
Moderately insecure	1.49	0.38	0.121	0.90, 2.45
Occasionally insecure	0.80	0.22	0.427	0.46, 1.39
Food secure	0.87	0.27	0.655	0.47, 1.60
Received microcredit loan previously				
Yes	Ref.			
No	0.80	0.17	0.298	0.53, 1.22
Current microcredit loan				
Yes	Ref.			
No	0.98	0.19	0.916	0.68, 1.42
Random-effects parameters				
Estimate (95% CI)	0.484	0.184		0.23, 1.02
Intraclass correlation coefficient	0.066	0.047		0.02, 0.24

[1] $n = 1190$. AOR, adjusted odds ratio; BDT, Bangladeshi taka; DD, dietary diversity. The adjusted model was a 2-level logistic regression where 6 different districts of Bangladesh were considered as a level-2 factor.
[2] Others included jobless/retired, farmer, unemployed, etc.

imum DD among children <5 y old was 70% in Bangladesh during the COVID-19 pandemic. This finding is higher than a study conducted in Bangladesh that stated 60% of children consumed dietarily diversified food (28). This result was also higher than a study conducted in Ethiopia, which found 24.4% of children had minimum DD (40). A possible reason is that, during the COVID-19 pandemic, mothers and fathers stayed at home, prepared food, and fed diversified food to their children. This might also have been possible owing to the preventive measures and actions such as maintaining the food supply and providing financial aid taken by the Government of Bangladesh along with the Bangladesh National Nutrition Council to respond to this crisis in a swift and effective manner, particularly for food and nutrition outcomes.

The results of this study also indicated that some sociodemographic factors such as family monthly income, mother's age, father's age, father's occupation, number of children <5 y old, and children's age were significantly associated with minimum DD for children <5 y old. Families which had monthly incomes >12,000 BDT were more likely to feed diversified food than families having monthly incomes <8000 BDT. A study conducted in Bangladesh revealed that children from a household where monthly expenditure on food was >5000 USD consumed dietarily diversified food, in line with the findings of this study. Moreover, studies have reported that children from a household in the richest category of a wealth index more likely practiced minimum DD food than the poorest, which supports the results of this study (28, 41).

As the age of the mother increased, the proportion of children who got minimum DD food decreased. This finding agrees with a study conducted in Ethiopia by Dangura and Gebremedhin (19). However, these findings disagree with studies conducted in Ethiopia and Bangladesh (28, 41). Furthermore, older fathers were more likely to have practices of feeding children <5 y old minimum DD food than were younger fathers. A father who was jobless/retired, a farmer, or unemployed was 67% less likely to feed minimum DD food to his children <5 y old than a government-employed father, which is in line with a study conducted in Bangladesh. Further study is recommended to identify why the DD of children was associated with higher paternal age yet with lower maternal age.

This study shows a family which had 2 children <5 y old was more likely to practice feeding their children dietarily diversified food than families with a single child. This is in line with a study conducted in Ethiopia (41). This could be related to children's computations while eating food. The same study conducted in Ethiopia (41) showed that children aged 12–23 mo were more likely to consume minimum DD food than children aged 6–11 mo, which is similar to the findings of this study of a significant association between children aged 12–23 mo and minimum DD food. A possible explanation is that children during the ages of 12–23 mo are more eager to take diversified food than when they are younger or older.

The strengths of this study lie in its rigorous methodological approach and analytical statistics. This study used a multilevel model to assess the district (cluster) effect on the factors of minimum DD among children <5 y old during the COVID-19 pandemic in Bangladesh. Consequently, cluster (districts) effects were found. Moreover, a larger sample size and being the first such study in Bangladesh are further strengths of this study. However, one of the limitations of this study was its cross-sectional design, which could not estimate any causal relation. Based on the findings of this study, the government should pay attention to a means of getting income to those fathers who were jobless/retired, farmers, and unemployed. Besides, there is the possibility of social desirability and reporting biases from the respondents due to the self-report nature of the measurements used in this study.

In conclusion, this study found that both district and individual factors were associated with minimum DD. Intervention should be given for those younger-age mothers, mothers from slum areas, and fathers who had no occupation. This study also implies that health professionals should give an emphasis on family planning to those who have >2 children <5 y old in the household in order to meet their minimum DD. Findings from this study will be conducive to policy makers to set up priority-based interventions and use context-specific solutions to ensure optimal DD in children aged 6–59 mo in Bangladesh during this COVID-19 pandemic.

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