



Research article

Impact of lockdown due to COVID-19 on nutrition and food security of the selected low-income households in Bangladesh

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ABSTRACT

This study aims to explore the impact of COVID-19 pandemic lockdown on household food security and the nutritional status of the children and identify the risk factors associated with it. A cross-sectional study was conducted in 220 households having at least one under 5 children of Narayanganj district in Bangladesh. Household food insecurity, coping strategies and nutritional status of children were the main outcome variables. Multivariate logistic regression analysis was performed to investigate the significant determinants. A total of 93.2 % of households were food insecure, with 32.3% experiencing mild, 18.6% facing moderate, and 42.3% undergoing severe food insecurity. Forty seven percent households used high coping strategies and 93.2% of households consumed less expensive/preferable food as the common coping technique. Logistic regression analysis showed the variables significantly associated with moderate to severe food insecurity were low household income before COVID-19 (AOR = 46.07, CI: 13.68–155.10), more reduction of family income (AOR = 32.47, 95% CI: 9.29–113.41), maternal occupation as housewife (AOR = 7.73, CI: 2.59–23.07), losses of job (AOR = 4.28, CI: 1.31–13.98) and higher family members (AOR = 3.39, CI: 1.07–10.71). The prevalence of stunting, underweight and wasting in children under 5 years of age were 29.0%, 23.4% and 15.6%, respectively. Significantly the independent predictors of stunting were maternal occupation, education, age, household head occupation, child age, and the coping strategy score. Household dietary diversity score was an important independent predictor of underweight and wasting. In conclusion, social safety net initiatives for vulnerable households along with maternal education and employment should be strengthened to reduce hunger and malnutrition.

1. Introduction

The widespread COVID-19 could be a health and human emergency, undermining the food security and nutritional status of households for millions of people around the world (UN, 2020). COVID-19 is an amazingly infectious disease, spreading quickly through human-to-human contact (Li et al., 2020a), and WHO declared COVID-19 as a global pandemic on March 11, 2020 (WHO, 2020). Various preventive measures have been taken throughout the world to reduce the severity of COVID-19 (UN, 2020). To prevent the transmission of COVID-19, the government of Bangladesh imposed a government holiday and a lockdown at various stages from March 26th to May 30th, 2020 (Mottaleb et al., 2020), while some highly infectious areas (such as Narayanganj) continued until the second week of June. During the initial periods of lockdown, everyone was encouraged to stay at home, unless there was an emergency, and all offices, both government and private, educational

institutions, business centers, and local and international transportation were partially or fully closed to prevent the COVID-19 transmission. As a result, many people lost their jobs and income, particularly day laborers, small business owners, and those from low-income households (UN, 2020; FAO, 2020; Kundu et al., 2020; Hamadani et al., 2020). The food supply chain in Bangladesh has been disrupted as a result of the lockdown, and prices for certain essential goods have begun to climb (FAO, 2020). Because of an immediate loss in availability or access to food, the entire scenario leaves individuals more vulnerable to a state of acute food insecurity. The latest evidence shows that 135 million individuals worldwide are suffering from severe food insecurity (FSIN 2020). According to the United Nations report on the State of Food Security and Nutrition in the World, around 118 million more people were expected to be suffering from chronic hunger in 2020 than in 2019 (FAO 2021). The effects of COVID-19 resulting in substantial and widespread increases in global food insecurity, affecting vulnerable households in nearly every

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nation is likely to last through 2022 and potentially beyond (World Bank, 2021). Subsequently, acute and chronic malnutrition, poverty, and other nutrition-related complications are likely to increase due to COVID-19 (FAO, 2020). The World Food Summit in 1996 defined food security as "Food security exists when all people, at all times, have physical and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (de Haen et al., 2011). The COVID-19 outbreak has the potential to impact household food security by not only altering food systems but also endangering family incomes owing to underemployment and physical access to food due to stay home orders (Devereux et al., 2020; Hamadani et al., 2020; Kundu et al., 2020). Nationally, 36 % of households were food insecure, according to Bangladesh Demographic and Health Survey data from 2011 (Chowdhury et al., 2018). A recent study in Bangladesh reported that household food insecurity in rural areas increased by 51.7% during the COVID-19 lockdown periods (Hamadani et al., 2020).

Child under nutrition is indeed a crucial public health concern and an emerging global policy issue, especially in resource-poor countries (WHO, 2016). Household food insecurity is one determinant of the nutritional status of children, especially in developing countries (Saaka and Osman, 2013; Ali et al., 2013), as it directly affects the quantity and quality of dietary intake (Arimond et al., 2011; Ali et al., 2013). COVID-19 not only affects household food security but also impacts the nutritional status and survival of under-5-year-old children in low-income and middle-income countries (LMICs) (Akseer et al., 2020). Reduced family income, changes in the consumption pattern of nutritious food, and disruptions to health, nutrition, and social welfare facilities all increase the risk of acute malnutrition (Akseer et al., 2020). The Lancet recently published a paper on low-and middle-income countries in which it was reported that the prevalence of moderate or severe wasting would increase by 14.3% among younger children due to the socioeconomic effects of COVID-19 (Headey et al., 2020). According to Bangladesh's most recent Multiple Indicator Cluster Survey (MICS), 28% of children under the age of five were stunted, 22.6% were underweight, and 9.8% were wasted (BBS & UNICEF, 2019). As per the Lancet projection, the number of wasted children in Bangladesh will increase from 1.7 million in 2019 to 1.9 million in 2020 (UNICEF, 2020). Child nutrition depends on several factors such as age, diseases of the child, number of under-5 children in the household, location (urban or rural) father and mother's education, mother's occupation, household income, household food security, and mother's BMI (Das and Gulshan, 2017; Khanam et al., 2019; Ali et al., 2019).

Even though Bangladesh has attained substantial macroeconomic growth over the last decade, approximately 15 million of its 160 million people are still living in extreme poverty, earning less than US \$1.90 per day (World Bank, 2018). The economic restrictions imposed by the COVID-19 lockdown would force at least 13 million more Bangladeshis below the poverty line (Chowdhury et al., 2020). The immediate effect of lockdown on household food security and an individual's nutritional status in LMICs is not well understood. The purpose of this study is to investigate family food security and child nutritional status during COVID-19 lockdown, as well as their correlations with other risk factors. The study also attempts to determine the influence of the COVID-19 pandemic lockdown on household food security and children's nutritional status.

2. Material and methods

2.1. Study designs and participants

This was a cross-sectional survey conducted in Kayet Para Union, Rupganj, Narayanganj, Bangladesh, at Chanpara Punarbasnkendra. The study area is about 10 km northeast of Dhaka Zero Point and comprises about 5000 households and is highly populated like an urban slum. Though the study area is on a rural site, the facilities and other characteristics are like those in urban settlements. For sample size calculation,

we immediately assumed that 50% of the families might be food insecure due to COVID-19. With a precision of 6.5% and a confidence interval of 95%, the minimum sample size required was 227. Households were selected in a study with at least one child under five years of age. We surveyed 220 households, representing 231 children under 5 years of age. We performed an impact study of lockdown across one month, from mid-May to mid-June 2020, inclusive. Information on socioeconomic and demographic characteristics (age, gender, educational status of father and mother), occupation of household heads and maternal occupation, monthly family income before COVID-19, family members, and living room were collected using a structured questionnaire.

2.2. Assessment of household food insecurity (HFI)

Household food insecurity was assessed using the Household Food Insecurity Access Scale (HFIAS) guideline version 3 (Coates et al., 2007). HFIAS is a continuous measure of the extent of food insecurity mainly associated with household access in the past 4 weeks. The HFIAS questionnaire consists of nine questions divided into three domains of food insecurity: (1) concern and uncertainty about the family's food supply; (2) a change in diet quality; and (3) an insufficient amount of food consumed (Ozaltin et al., 2010). The nine "frequency-of-occurrence" questions were asked as a follow-up to each phenomenon question to examine how often the situation takes place. Each reply was then scored on a range of 0–3; where 0 stands for 'no occurrence' 1 for 'rarely' 2 for 'sometimes' and 3 for 'often'. The total frequency of occurrence over the previous 30 days was calculated, and the household scores ranged from 0 to 27. A high-HFIAS value means lower family access to food and considerably more household food insecurity. Based on the score, households were categorized into food secure (HFIAS = 0–1), mildly food insecure (HFIAS = 2–7), moderately food insecure (HFIAS = 8–11), and severely food insecure (HFIAS >11) (Coates et al., 2007; Chakona and Shackleton, 2018). For the logistic regression and further analysis, food secure and mildly food insecure households merged into one group (secure to mildly food insecure); moderate and severely food insecure households merged into another group (moderately to severely food insecure).

The household hunger scale (HHS) consists of three subset questions from the HFIAS concerning inadequate food quantity and calculated according to the household hunger scale measurement guide (Ballard et al., 2011). Based on the HHS measurement guide, households were classified as having little to no hunger (Score: 0–1), moderate hunger (Score: 2–3), and severe hunger (Score: 4–6) (Ballard et al., 2011).

2.3. Coping strategies index (CSI)

The reduced CSI is regarded as a proxy indicator for household food insecurity and is computed based on a particular set of characteristics with a specific severity weighting (Maxwell and Caldwell, 2008). The CSI was calculated using five food-related coping strategies: unable to eat preferred food, trying to borrow food or any kind of help, consuming a smaller meal, restricting adult consumption so that young children can eat, and skipping meals over the previous 7 days. A detailed calculation of CSI can be found in a previous study (Saaka et al., 2017). A higher score indicates more coping strategies adopted by a household. There are no general thresholds for CSI. In this study, the total reduced CSI score is classified into three categories: no or low coping (CSI = 0–3), medium (CSI = 4–9), and high coping (CSI ≥10).

2.4. Food consumption score (FCS) and household dietary diversity scores (HDDS)

The "Food Consumption Score" (FCS) is a value generated by using the frequency of consumption of various groups of foods eaten by the residence within seven days of the research study. FCS was calculated according to the guidelines prepared by WFP (World Food Programme,

2007). The total FCS was classified for Bangladeshi population into three categories: poor consumption (FCS = 1.0 to 28); borderline (FCS = 28.1 to 42); and acceptable consumption (FCS = > 42.0) (Wiesmann et al., 2009).

The Household Dietary Diversity Score (HDDS) was accomplished by summing the number of foods or food groups consumed by the family members in the previous 24 h. The 24-hour-food recall method was used to recode the food and beverages consumed by the family members. HDDS [0–12] consists of 12 food groups, and is measured according to the guidelines for measuring household and individual dietary diversity (FAO, 2011). The HDDS was used as both a continuous and a categorical variable for analysis. Depending on the score, we have classified the households into two categories: good/accepted dietary diversity (6–12) and low/poor dietary diversity (0–5) (FAO, 2008).

2.5. Anthropometric measurements of children and adult

In accordance with standard procedure, standard anthropometric measurements such as height, length, and weight were taken. The WHO Anthro Plus Software (version 1.0.4, 2009) has been used to compute the nutrition indices such as the Z-scores for weight-for-age, height-for-age, and BMI-for-age (WHO, 2009). Stunting and underweight among children were defined as HAZ and WAZ, less than 2 SD below the median of the WHO reference population, respectively. Body Mass Index (BMI)-for-age Z-score cut-points of 2.0, >2.0 and >3.0 have been proposed by the WHO for children under five years of age as waste, overweight, and obese, respectively (de Onis and Lobstein, 2010).

2.6. Statistical analysis

All the statistical analyses were performed using the software SPSS 21 (Statistical Package for Social Sciences) for Windows (SPSS Inc., Chicago, IL, USA). Descriptive analyses were presented using means and standard deviations (SD). Some predictor variables (such as occupation, education level, and BMI) for household food insecurity and child undernutrition were categorized into two or more groups depending on the purpose of the analysis. We have categorized households into 2 groups: low-income households if the monthly household income before COVID-19 was 12500 TK and high-income households if it was >12500 TK. Like income, the proportion of income reduced per household by COVID-19 was divided into two groups: low reduction if monthly household income was reduced by 41.5% and high reduction if > 41.5%. Those cutoff points were chosen because they were the median value of the respective variable in our sample. Bivariate analysis was conducted using cross-table and chi-square tests to identify the relationship among risk variables with household food insecurity and children's nutritional status. Binary logistic regression analysis was performed to investigate the significant predictor variables for household food insecurity during lockdown. Besides this, three different logistic regression models (taking into account the dependent variables to be (i) stunting, (ii) wasting, and (iii) underweight) have been carried out to estimate the impact of lockdown and other risk factors on child nutritional status. All the final model choices were calculated by using the Hosmer and Lemeshow goodness-of-fit test, as well as the significance of the parameters was reviewed using the Wald test. The estimates of the strengths of associations were exhibited by the adjusted odds ratio (AOR) with a 95% confidence interval (CI). A p value of 0.05 was considered to be statistically significant.

2.7. Ethical consideration

This study was performed according to the guidelines suggested by the Declaration of Helsinki, and the study protocol was reviewed and approved by Daffodil International University Ethics Committee (Ref. No.: FAHSREC/DIU/2021/1008 (1)). After explaining the purpose of the survey to the participants, informed consent was taken from the study subject who was willing to participate in the study.

3. Results

3.1. Socio-demographic characteristics of the study household

A total of 220 households participated in the study. The households represent 710 populations in different age groups, such as under-five children, 231 (54.55% male and 45.45% female); between 5 and 17 years of age, 39; and 440 adults (Table 1). On average, the household consists of 3.2 family members. About 47% of the household heads have a secondary level of education, and garment jobs (26.8%) and rickshaw driving (26.8%) are the main occupations of the study household heads (Table 1). Before COVID-19, approximately 64% of the families had a monthly income of 10,000–20,000 Tk. (Table 1). All of the households (100%) were Muslim, and the vast majority (97.7%) had only one living room (Table 1). Due to lockdown, 98.2% of households reduced their income, and 11.4% of the household's head lost their jobs.

Table 1. Socio Demographic characteristic of the Study households.

Variables	Frequency	Percentage
Total Household	220	100
Household Size (Mean ± SD)	3.20 ± 0.517	
Distribution by Aged		
Aged 6–59 months		
Male	126	54.55
Female	105	45.45
Total	231	32.54
Aged 5–17 years		
Male	16	41.03
Female	23	58.97
Total	39	5.49
Adult 18 and above		
Male	223	50.68
Female	217	49.32
Total	440	61.97
Sex of Household head		
Male	208	94.55
Female	12	5.45
Occupation of Household head		
Day laborer	28	12.73
Rickshaw/Van driver	59	26.82
Bus/taxi driver	19	8.63
Garments workers	59	26.82
Private job worker	42	19.10
Businessman and others	13	5.90
Education of Household head		
Illiterate/informal education	31	14.10
Primary school	58	26.36
Secondary school	104	47.27
HSC	27	12.27
Family Income before lockdown		
6000–10000	62	28.44
>10000 - 15000	67	30.73
>15000 - 20000	73	33.48
>20000	16	7.34
Household income reduced due to lockdown	216	98.2
Household head loss Job due to lockdown	25	11.4
Living Room		
1 (One)	215	97.7
2 (Two)	5	2.3
Religion: Muslims	220	100

3.2. Household food insecurity and coping strategy index

Table 2 presents the overview findings of the perceptions of household level food security. According to HFIAS, only 6.8% of households were food secure, 32.3% were mildly food insecure, 18.6% were moderately food insecure, and 42.3% were severely food insecure during the initial periods of COVID-19 (Table 2). Whereas, according to the household hunger scale, 5.0% of households were suffering from severe hunger, 30.0% were suffering from moderate hunger, and 65% of families were suffering from little to no hunger (Table 2).

There were multiple forms of food insecurity in different families. Approximately 87% of the households surveyed were concerned to a different degree that they would not have enough food to feed their household members (Table 2). During the lock-down period, 93.18% of households consumed less quality or less preferable food, 91.82% consumed less diversified or monotonous food, 65.91% consumed a smaller amount of meat, 51.36% were required to reduce their daily meals, and 42.73% of households or household members went to sleep hungry at night at different frequency levels (Table 2).

Households have used a couple of coping strategies to minimize the impact of food shortages (Table 3). The main coping strategies used by households at different frequencies were to eat less-preferred/expensive food (93.2%), to reduce the size of meals (66.4%), to skip meals (53.7%), to borrow food or to rely on help from friends and relatives (47.7%) and to restrict adult consumption to ensure the intake of small children (18.2%) (Table3). Based on the CSI score, 29.5% of households used no or low coping strategies, 23.2% used medium, and 47.3% used high coping strategies (Table 3).

3.3. Factor associate with household food insecurity

Table 4 describes the detailed classification of food insecurity status among different socioeconomic and demographical variables. The low-income group (12500 Tk) had a significantly higher proportion of food insecure households than the higher income group (>12500 Tk). For example, 67.9% of the households in the low-income group were severely food insecure, whereas only 15.6% were in the high-income group (Table 4). In the lock down periods, as the family income

Table 2. Proportion of household that experienced food -insecurity related condition during the lockdown periods in the last 30 days.

Food insecurity Experienced	Frequency (N)	Proportion (%)
Worried the HH wouldn't have had sufficient food	192	87.37
Any HH member didn't get the food they wanted.	205	93.18
HH member has to eat less diversified foods.	202	91.82
HH member has to eat the food they didn't like	79	35.91
HH members have to consume a smaller meal than the requirement	145	65.91
Any member of the HH required to lower the frequency of daily meals	113	51.36
No food to consume at HH	37	16.82
HH member is going to sleep hungry at night.	94	42.73
Any member of the HH spends 24 h without eating food.	7	3.18
Household Food insecurity Access Prevalence		
Food Secure (Score 0–1)	15	6.8
Mild-food -insecure (Score 2–7)	71	32.3
Moderate Food insecure (Score 8–11)	41	18.6
Severe food insecure (Score >11)	93	42.3
Level of household hunger		
Little or no hunger	143	65.0
Moderate hunger	66	30.0
Severe hunger	11	5.0

Table 3. Description of coping strategies adopted to minimize the food insecurity.

Occurrences in last Week, N (%)	Coping Strategies ^a				
	Eating less preferred food	Borrow food or any kind of help	Consume a smaller meal	Restrict adult intake for children	Skipping meal
Daily	71 (32.3)	0 (0)	2 (0.9)	1 (0.5)	0 (0)
3–6 days/ week	92 (41.8)	17 (7.7)	63 (28.7)	12 (5.5)	23 (10.5)
1–2 days/ week	42 (19.1)	88 (40.0)	81 (36.8)	27 (12.2)	95 (43.2)
Never	15 (6.8)	115 (52.3)	74 (33.6)	180 (81.8)	102 (46.3)
Total	208 (93.2)	105 (47.7)	146 (66.4)	40 (18.2)	118 (53.7)
CSI score		No of Household (%)			
No/low coping (0–3)		65 (29.5)			
Medium coping (4–9)		51 (23.2)			
High coping (>9)		104 (47.3)			

^a All data is shown as number (%).

decreased, significantly more food insecure households were observed in groups with higher percentages of monthly income reduced. The result indicates the lockdown has a negative impact on household food security. There were significant associations with the occupation of the household head, such as the most severely food insecure households were found in day laborers', rickshaw-, and van driver's households, compared to garments and other occupations. Maternal occupation was also significantly associated with household food security ($p = 0.001$); maternal employment (garments and others) means more household income and, ultimately, less food insecurity as compared to housewife families (Table 4).

For logistic regression analyses, the four classes of HFIAS were regrouped into two (food secure/mild food insecure and moderate/severe food insecurity) to determine the severity of food insecurity. The estimated parameters of multiple logistic regression models to determine the influence of background factors on the moderate/severe food insecurity status of the household study are shown in Table 5. The variables significantly associated (p -value 0.05) with moderate/severe food insecurity are household income before COVID-19, percentage of reduced family income during lock-down, maternal occupation, family size, and family job losses (Table 5). Other independent variables such as occupation, age, and BMI of the household head were entered into the model but were found insignificant. Logistic regression analysis showed that households with lower monthly income before COVID-19 were 46 times more likely (AOR = 46.07, CI: 13.68, 155.103) to have moderate or severe food insecurity (Table 5). Households with a higher proportion of decreased income (41.5% of previous income) during lockdown were 32 times more likely to experience moderate or severe food insecurity than those with a lower proportion (AOR = 32.47, 95% CI: 9.29–114.41). Housewives were seven times more likely than working mothers to experience moderate or severe food insecurity (AOR = 7.73, 95% CI: 2.59–23.07) (Table 5).

3.4. Factor associate with households dietary diversity

Like food insecurity, Table 6 describes the comprehensive classification of food consumption scores and household dietary diversity scores among different socioeconomic variables. According to FCS, 46.4% of households consumed an acceptable diet, while 35% consumed a borderline diet (Table 6). In comparison, 47.3% of households can afford an acceptable diet (HDDS 6–12; Table 6). All the variables in Table 6 (previous family income, percent of reduced income, occupation of HH head, CSI) were significantly associated with FCS and HDDS. While

Table 4. Risk Factors to household Food insecurity status.

Variables	Food Secure (n = 15) ^a	Mild food Insecure (n = 71) ^a	Moderate food insecure (n = 41) ^a	Severe food insecure (n = 93) ^a	λ ² test, p value
Family Income					
<12500	1 (0.9)	13 (11.9)	21 (19.3)	74 (67.9)	75.51, (DF-3), p = 0.000
>12500	14 (12.8)	58 (53.2)	20 (18.3)	17 (15.6)	
Family Income Decreased					
<41.5 %	14 (13)	50 (46.3)	16 (14.8)	28 (25.9)	38.53, (DF-3), p = 0.000
>41.5%	1 (0.9)	21 (19.1)	25 (22.7)	63 (57.3)	
Occupation of the household's head					
Day labor/ Rickshaw/van driver	0 (0)	18 (20.7)	15 (17.2)	54 (62.1)	51.08, (Df-6), p = 0.000
Garment and service	6 (5.9)	45 (44.6)	22 (21.8)	28 (27.7)	
Others (Business and other)	9 (28.1)	8 (25)	4 (12.5)	11 (34.4)	
Food consumption Score					
Low Consumption (0–28)	0 (0)	0 (0)	0 (0)	41 (100)	165.83, (DF-6), p = 0.000
Borderline (28.1–42.0)	0 (0)	6 (7.8)	22 (28.8)	49 (63.8)	
Acceptable (>42.0)	15 (14.7)	65 (63.7)	19 (18.6)	3 (2.9)	
Household Dietary Diversity Score					
Low (0–5)	4 (3.4)	22 (19)	22 (19)	68 (58.6)	33.08, (DF-3), p = 0.000
Accepted (6–12)	11 (10.6)	49 (47.1)	19 (18.3)	25 (24)	
Coping Strategy Index					
No/low coping (0–3)	15 (23.1)	46 (70.8)	4 (6.2)	0 (0)	228.8, (DF-6), p = 0.000
Medium coping (4–9)	0 (0)	25 (49)	24 (47.1)	2 (3.9)	
High coping (>9)	0 (0)	0 (0)	13 (12.5)	91 (87.5)	
Child Mother Occupation					
Housewife	13 (7.6)	44 (25.9)	28 (16.5)	85 (50)	22.67, (DF-3), p = 0.000
Garments/ other service worker	2 (4)	27 (54)	13 (26)	8 (16)	

^a All data is shown as number (%).

mothers' occupation was significantly associated with FCS but not with HDDS.

3.5. Nutritional status of the under 5 children and its determinants

Table 7 describes the prevalence of child nutritional status at different levels or categories of the chosen factors. The prevalence of stunting in children under 5 years of age was 29.0% in this study. Although females (31.4%) were more at risk of stunting than males (27.0%), there was no significant difference. The prevalence of stunting among children aged 12–23 months (69.6%) was high, followed by those aged 6–11 months (44.4%), and it varied in different age groups (Table 7). In the descriptive analysis higher prevalence of stunting was found in different groups, such as low-income families (36.8%), severely food insecure households (34.4%), households headed by job/garment workers (32.4%), households with a low level of mother's education (41.4%), and households that consume less diversified food (34.1%).

Table 5. Model of Binary logistic regression for the predation of moderate/severe food insecurity.

	β	AOR	95% CI of AORs		Sig
			Lower	Upper	
Family Size: Family member >3	1.221	3.392	1.074	10.712	0.037
Family member <3 (r)					
Previous HH Monthly Income:<12500	3.830	46.072	13.685	155.103	0.000
Income >12500 (r)					
Reduced HH Income for COVID-19: >41.5% of previous income	3.480	32.472	9.297	113.413	0.000
<41.5% of previous income (r)					
Job loss due to Covid-19: yes	1.455	4.284	1.313	13.981	0.016
No (r)					
HH Occupation: Day Labors, Rickshaw driver/other	0.025	1.026	.442	2.380	0.953
Garments/service worker (r)					
HH Maternal Occupation: Housewife	2.045	7.732	2.591	23.070	0.000
Garments/service worker (r)					
Age of HH head	-.021	.979	.900	1.066	0.632
BMI of the HH head	.000	1.000	.871	1.148	0.998
Constant	-3.952	.019			0.048

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; HH, household; BMI, body mass index.

The set of variables accounted for 64.0% of the variance in household moderate/severe food insecurity (Nagelkerke R² = 0.64).

The study showed that about 23.4% of children under 5 years of age were underweight, and the highest (35.59%) were at the ages of 36–47 months (Table 7). A higher proportion of underweight children was observed in different categories of groups as found in stunting, except sex and age groups (Table 7).

The BMI -Z score for age was used to assess the wasting and overweight of the children under 5 years of age in this study. According to BMI -Z score for age, 15.6% of children were wasted and 9.1% were overweight/obese in the study (Table 7). Male children (18.3%) are more prone to wasting than female children (12.4%). However, female children (11.4%) were more likely to be overweight/obese than male children (7.1%) (Table 7). The highest prevalence of wasting among the children was seen at ages 48–59 months (28.4%).

Logistic regression models have been developed to determine the influence of the predictor variables on each of the different nutritional status measures of under-five children in the study. Table 8 depicts the predictions of the logistic regression model to identify the influence of factors on stunting, wasting, and underweight of children under 5 years of age, along with their significance level and adjusted odds ratios. When compared to children aged 48–59 months, the odds of being stunted were approximately 34 times higher among children aged 12–23 months (AOR = 33.88, 95% CI: 9.9–116.1, p-value 0.001) and nearly 7 times higher among children aged 6–11 months (AOR = 6.91, 95% CI: 1.77–26.99, p-value 0.001). Childhood stunting was more common in low-or uneducated mothers (AOR = 5.05, 95% CI: 1.82–1.91). Maternal education was a critical factor in combating childhood stunting. Other important predictor variables for stunting included mother occupation as housewife or unemployed (AOR = 4.99, 95% CI: 1.19–20.90, p-value = 0.028), household head occupation as garments or service workers (AOR = 3.38, 95% CI: 1.25–9.17, p-value = 0.017), low FCS (AOR = 7.91, 95% CI: 1.29–48.27, p-value = 0.025), and mother age. Other independent variables such as father's education, household income before COVID-19, percentage of reduced family income during lock-down, maternal BMI, household food insecurity status (HFIAS), and HDDS were entered into the model but were found insignificant for stunting (Table 8).

Table 6. Cross-classification of the study households' dietary diversity and food consumption scores based on socioeconomic factors.

	FCS, N (%) ^a				HDDS, N (%) ^a		
	Low	Borderline	Acceptable	P	Low	Accepted	P
Family Income							
<12500	32 (29.4)	57 (52.3)	20 (18.3)	0.000	74 (67.9)	35 (32.1)	0.000
>12500	9 (8.3)	18 (16.5)	82 (75.2)		40 (36.7)	69 (63.3)	
Family Income Decreased							
<41.5 %	13 (12)	26 (24.1)	69 (63.9)	0.000	49 (45.4)	59 (54.6)	0.043
>41.5%	28 (25.5)	49 (44.5)	33 (30)		65 (59.1)	45 (40.9)	
Occupation of the household's head							
Day labor/Rickshaw/van driver	27 (31)	43 (49.4)	17 (19.5)	0.000	56 (64.4)	31 (35.6)	0.012
Garment and service	9 (8.9)	26 (25.7)	66 (65.3)		48 (47.5)	53 (52.5)	
Other (Business and other)	5 (15.6)	8 (25)	19 (59.4)		12 (37.5)	20 (62.5)	
Total	41 (18.6)	77 (35)	102 (46.4)		116 (52.7)	104 (47.3)	
Child Mother Occupation							
Housewife	38 (22.4)	64 (37.6)	68 (40)	0.001	90 (52.9)	80 (47.1)	0.907
Garments/other service worker	3 (6)	13 (26)	34 (68)		26 (52)	24 (48)	
CSI							
No/low coping (0–3)	0 (0)	3 (4.6)	62 (95.4)	0.000	17 (26.2)	48 (73.8)	0.000
Medium coping (4–9)	0 (0)	15 (29.4)	36 (70.6)		25 (49)	26 (51)	
High coping (>9)	41 (39.4)	59 (56.7)	4 (3.8)		74 (71.2)	30 (28.8)	

Abbreviations: FCS, Food consumption score; CSI, coping strategy index; HDDS, Household dietary diversity score; ^aAll data is shown as number (%).

Significantly, the independent predictors of stunting were maternal occupation, maternal education, maternal age, household head occupation, age of child, food consumption score, and the coping strategy score (Table 8).

All the same factors/parameters as in the stunting model have been counted to construct the logistic regression model for both underweight and wasting (Table 8). But the only significant independent predictors of underweight were HDDS and family income before COVID-19 whereas the significant covariates for wasting were HDDS and childhood age. When compared to high HDDS families, children in low HDDS households were about 2.5 times (AOR = 2.53, 95% CI: 1.11–5.75, *p*-value 0.05) and 3.6 times (AOR = 3.62, 95% CI: 1.18–11.11, *p*-value 0.05) more underweight and wasted, respectively (Table 8). Children in low-income households (<12500 Tk/month) had a higher likelihood of being underweight compared to higher-income families (AOR = 4.76, 95% CI: 1.71–13.27, *p*-value < 0.05). Children aged 24–35 months had a 23% lower risk of being wasted (AOR = 0.234, 95% CI: 0.66–0.84, *p*-value 0.05) than children aged 48–59 months (Table 8).

4. Discussion

This is one of the few studies to evaluate the short-term effect of lockdown due to COVID-19 on income, food security, coping mechanisms, dietary diversity and nutritional status of children in low-income households in the selected study area. The study identified that almost half of the chosen households' food insecurity status was severe at the outset of the lockdown, which resulted from loss in income and had an impact on dietary diversity. A number of factors have been found that were either directly or indirectly related to the food security crisis created by the pandemic's start.

This research indicated that 93.2 percent of families in the survey were food-insecure that is corroborated by two other cross-sectional studies carried out in different times throughout Bangladesh during the period of lockdown, reporting 90 percent and 70 percent of household food insecurity, respectively (Das et al., 2020; Hamadani et al., 2020). The incidence of severe food insecurity and related dimensions, such as worry over food, poor quality, and inadequate quantities, found in the present investigation are similar to the findings of Das et al. study, which was conducted in both rural and urban contexts during lockdown (Das

et al., 2020). According to a 2018 study based on data from a national survey, 56.5 percent of households experienced mild, moderate, or severe food insecurity (Raihan et al., 2018). The percentage is much lower than the findings of this research, as well as other post COVID studies done in Bangladesh (Das et al., 2020; Hamadani et al., 2020; Kundu et al., 2020).

The current study's results are in line with the global literature such as Iran (Pakravan-Charvadeh et al., 2021), Jordan (Elsahoryi et al., 2020), Kenya and Uganda (Kansiime et al., 2021), all narrating similar increases in prevalence rate of food insecurity following the onset of the COVID pandemic, almost doubled compared to rates found in studies of pre-COVID era. Food insecurity was found to be 79–87% during the lockdown period in resource-poor settings such as Sub-Saharan Africa, despite disruptions and shocks in income generation and food supplies (Gourlay et al., 2021).

A reduction in income during lockdown has emerged as a prominent influencing factor behind increased household food insecurity among surveyed households. Several studies on rural families during the lockdown also revealed a strong link between income loss and food insecurity (Hamadani et al., 2020; Ahmed et al., 2021). According to this present study's analysis, 98.2% of household heads reported a drop in average income, while Kundu and his coworkers found that 71.8% of respondents reported a similar decline (Kundu et al., 2020). Similar studies on the effect of the COVID-19 pandemic on food security reported the same scenario, where low income households faced the most food insecurity (Shahzad et al., 2021; Hirvonen et al., 2021). Food insecurity was concentrated in households involved in labor-intensive and informal services such as day laborers and rickshaw/van drivers, who, according to a few studies, had a drop in income as low as 50% or did not collect a paycheck at all (LightCastle Partners, 2020; Sultana et al., 2021). The relationships between low-income status, food insecurity, and dietary diversification are well established (Gundersen et al., 2011). These factors could have intensified the inability to pay for food intake, thus influencing dietary diversity. The current study, as well as others (Kundu et al., 2020; Devereux et al., 2020), highlights the impact of low income and household head occupation as day laborer on dietary diversity and, in addition, the food consumption score. It is due to the fact that labor generates revenue, which increases purchasing power and allows access to food, health care, and other necessities. Households with a limited

Table 7. Cross classification of Child (6–59 months) Nutrition status of the study Subject by socioeconomic and demographic factor.

	Height/ age	Weight/age	BMI -Z score for age	
	Stunted (n = 67) ¹	Underweight (n = 54) ¹	Wasted (n = 36) ¹	Overweight/ obese (n = 21) ¹
Sex				
Male	34 (27)	32 (25.4)	23 (18.3)	9 (7.1)
Female	33 (31.4)	22 (21.0)	13 (12.4)	12 (11.4)
total	67 (29.0)	54 (23.4)	36 (15.6)	21 (9.1)
	$\lambda^2 = 0.55,$ p = 0.459	$\lambda^2 = 0.63,$ p = 0.427	$\lambda^2 = 1.5,$ p = 0.220	$\lambda^2 = 1.27,$ p = 0.259
Age				
6–11 month (n = 18)	8 (44.4)	4 (22.2)	0 (0)	5 (27.7)
12–23 month (n = 46)	32 (69.6)	8 (17.4)	0 (0)	10 (21.7)
24–35 month (n = 48)	8 (16.7)	9 (18.8)	4 (8.3)	1 (2.1)
36–47 month (n = 31)	11 (35.5)	11 (35.59)	7 (22.6)	2 (6.5)
48–59 month (n = 88)	8 (9.1)	22 (25.0)	25 (28.4)	3 (3.4)
	$\lambda^2 =$ 59.96, p = 0.000	$\lambda^2 = 4.17,$ p = 0.383	$\lambda^2 =$ 25.89, p = 0.000	$\lambda^2 = 23.06,$ p = 0.000
Family Income				
Low (<12,500 TK)	43 (36.8)	40 (34.2)	21 (17.9)	13 (11.1)
High (>12,500 TK)	23 (20.5)	14 (12.5)	15 (13.4)	8 (7.1)
	$\lambda^2 = 7.33,$ p = 0.007	$\lambda^2 = 14.93,$ p = 0.000	$\lambda^2 = 0.89,$ p = 0.344	$\lambda^2 = 1.08,$ p = 0.298
Food security by HFIAS				
Food Secure	2 (13.3)	1 (6.7)	1 (6.7)	0 (0)
Mild Food insecure	17 (23.6)	14 (19.4)	12 (16.7)	5 (6.9)
Moderate Food insecure	13 (31)	8 (19)	7 (16.7)	7 (16.7)
Severe Food insecure	35 (34.3)	31 (30.4)	16 (15.7)	9 (8.8)
	$\lambda^2 = 4.28,$ p = 0.233	$\lambda^2 = 6.20,$ p = 0.102	$\lambda^2 = 1.0,$ p = 0.799	$\lambda^2 = 4.83,$ p = 0.185
Household head occupation				
Service/Garments worker	35 (32.4)	25 (23.1)	16 (14.8)	11 (10.2)
Others	32 (26.0)	29 (23.6)	20 (16.3)	10 (8.1)
	$\lambda^2 = 1.14,$ p = 0.285	$\lambda^2 = 0.006,$ p = 0.936	$\lambda^2 =$ 0.091, p = 0.763	$\lambda^2 = 0.294,$ p = 0.588
Mothers Occupation				
Job Service (Garments)	5 (10.5)	7 (14.6)	11 (22.9)	5 (10.4)
Housewife	62 (33.9)	47 (25.7)	25 (13.7)	16 (8.7)
	$\lambda^2 =$ 10.16, p = 0.001	$\lambda^2 = 2.62,$ p = 0.106	$\lambda^2 = 2.47,$ p = 0.116	$\lambda^2 = 0.129,$ p = 0.720
Mother Education				
Primary/informal	24 (41.4)	19 (32.8)	8 (13.8)	6 (10.3)
Secondary to higher	43 (24.9)	35 (20.2)	28 (16.2)	15 (8.7)
	$\lambda^2 = 5.76,$ p = 0.016	$\lambda^2 = 3.81,$ p = 0.051	$\lambda^2 = 0.19,$ p = 0.664	$\lambda^2 = 0.15,$ p = 0.701
HDDS				
Low HDDS (0–5)	43 (34.1)	39 (31.0)	25 (19.8)	14 (11.1)
High HDDS (6–12)	24 (22.9)	15 (14.3)	11 (10.5)	7 (6.7)
	$\lambda^2 = 3.53,$ p = 0.060	$\lambda^2 = 8.88,$ p = 0.003	$\lambda^2 = 3.82,$ p = 0.050	$\lambda^2 = 1.37,$ p = 0.242

HDDS, Household dietary diversity score; HFIAS, Household food insecurity access scale; ¹All data is shown as number (%).

budget or a loss in income may be unable to afford adequate meals and may not consume foods from multiple food groups on a regular basis. Some have also shown that the rise in food prices, along with the loss in purchasing power, may have led to food shortages (LightCastle Partners, 2020; FAO, 2020). A seemingly high number of participants in several

studies reported decreased dietary diversity (Harris et al., 2020; Kundu et al., 2020). Thus, the additional economic strain imposed by the COVID-19 pandemic on already resource-constrained households should be considered in order to avoid dietary disruption and its subsequent consequences.

Family size has been identified among a number of other factors to be a major predictor of food insecurity in this study. In keeping with the present study's findings, a number of studies have revealed that during the pandemic, the food security of nuclear households was significantly higher (Kundu et al., 2020; Das et al., 2020; Shahzad et al., 2021). Previous research has shown that increasing the size of a family puts additional pressure on household spending (Raihan et al., 2018; Endale et al., 2014). When many generations of a family live together in a joint or extended home, competing desires to feed various family members may function as a restriction to food availability and nutrition (Madjdian and Bras, 2016). Similar research undertaken during disease outbreaks, such as MERS and the Ebola virus, has suggested that movement restriction policies have a significant impact on the food industry's distribution and retailing of numerous essential foods, resulting in food insecurity. When economic circumstances downgrade the price and availability of alternative protein sources, local epidemics of various illnesses can exacerbate both the health and food security condition of large sectors of the population (Kodish et al., 2019; Wernery & woo, 2019).

In this study, respondents from food-insecure families were much more likely to employ food-related coping methods than respondents from food-secure households. The majority of these people came from low-income families, which is a frequent outcome in previous research (Das et al., 2020; Shahzad et al., 2021). Eating less expensive foods as the most used strategy in this study, is also the finding of previous studies, conducted in food insecure households (Pakravan-Charvadeh et al., 2021; Ngidi and Hendriks, 2014). Food restriction methods such as missing meals or lowering meal size were also seen at the beginning of the lockdown period in Bangladesh (Rahman and Matin, 2020). Such rationing or shortfall management through reduction in meal size or number is also frequent in more than half of the study's participants of several prior research on low-income or vulnerable populations (Shisanya and Hendriks, 2011; Cordero-Ahiman et al., 2018). In the present investigation, the severely food insecure households utilized the highest number of coping techniques, which is consistent with previous comparable studies, because families in more extreme situations tend to turn to desperate and excessive methods (Das et al., 2020; Farzana et al., 2017). The study discovered that maintaining coping techniques had an influence on HDDS. Because of the financial challenges that high coping strategy users face, increasing the number of coping strategies decreases food quality and quantity, which has a significant impact on the level of inequality an individual can select to acquire necessary nutritional resources (Grobler, 2018).

This increased food insecurity during the current COVID -19 crisis has the potential to have a range of severe health repercussions. In this study, severely food insecure families had significantly lower dietary diversity, which may have an influence on nutritional adequacy by affecting the intake of a diversified diet. Previous research shows that urban inhabitants are unable to reduce rental costs, which leaves them vulnerable to dietary deficiencies (Rahman and Matin, 2020). As a result, additional study into the nutritional condition of targeted groups is needed. The present research looked at the children's nutritional status of the selected families afflicted by COVID 19 related restrictions. The prevalence of stunting and underweight of the study population (under 5 children) is almost similar to the national findings before COVID-19 (BBS & UNICEF, 2019). Whereas the prevalence of wasting among the under 5 children is 1.6 times higher than the national prevalence (9.8%) (BBS & UNICEF, 2019), which is also substantially bigger than the increase in level predicted in a Lancet publication by Headey et al. (2020). This conclusion suggests that lockdown did not influence chronic malnutrition (stunting), but acute malnutrition (wasting) was more evident during movement restriction.

Table 8. Logistic regression Model for the determinant of under 5 child stunting, underweight and wasting.

	Model I Stunted			Model II Underweight	Model III Wasted
	β	AORs (95% CI)	Sig	AORs (95% CI)	AORs (95% CI)
HH Maternal Occupation: Housewife	1.608	4.99 (1.19–20.90)	0.028	1.97 (.64–6.09)	.922 (0.29–2.94)
Garments/service worker (r)					
Mother Education: Primary and lower	1.615	5.03 (1.82–13.91)	0.002	1.56 (.66–3.67)	.49 (0.16–1.49)
Secondary and higher (r)					
Father Education: Primary and lower	.233	1.26 (.48–3.29)	0.634	.595 (.26–1.37)	1.28 (0.48–3.44)
Secondary and higher (r)					
FCS: Low (0–28)	2.068	7.91 (1.29–48.27)	0.025	.98 (0.19–5.01)	1.03 (0.11–9.72)
Borderline (28.1–42.0)	.536	1.71 (.39–7.43)	0.475	.97 (.24–3.85)	1.51 (0.25–9.28)
Acceptable (>42) (r)					
CIS: no/low (0–3)	2.354	10.52 (1.28–86.45)	0.028	1.81 (.28–11.71)	6.86 (0.62–75.2)
Medium (4–9)	1.966	7.14 (1.49–34.19)	0.014	1.19 (.28–5.02)	2.98 (.51–17.45)
High (>9) (r)					
HDDS: Low (0–5)	.061	1.062 (.50–2.52)	0.89	2.53*(1.11–5.75)	3.62*(1.18–11.11)
High (6–12) (r)					
Child Age in Months: 6–11 months	1.932	6.91 (1.77–26.99)	0.005	.503 (.12–2.03)	.000
12–23 months	3.523	33.88 (9.9–116.1)	0.000	.43 (.15–1.28)	.000
24–35 months	.967	2.63 (.74–9.34)	0.135	.69 (.25–1.93)	.234*(.66–0.84)
36–47 months	1.131	3.1 (.89–10.77)	0.075	1.07 (.38–3.0)	.77 (0.25–2.34)
48–59 months (r)					
Mother BMI					
Underweight (BMI: <18.5)	.288	1.33 (.26–6.95)	0.732	2.39 (.55–10.50)	.000
Normal (BMI: 18.5–25.0)	.175	1.19 (.5–2.84)	0.693	1.07 (.49–2.35)	1.21 (0.46–3.17)
Overweight/obese (BMI: >25.0) (r)					
Mother age	-.108	.90 (.81–.998)	0.046	.97 (.88–1.07)	1.10 (0.98–1.24)
Previous Monthly Income: <12500 Tk	.599	1.82 (.59–5.62)	0.298	4.76* (1.71–13.27)	2.61 (.79–8.61)
Income >12500 Tk (r)					
Reduced Income for COVID-19: >41.5% from previous income	-.854	.43 (.16–1.13)	0.088	.51 (.22–1.17)	.88 (.31–2.48)
<41.5% from previous income (r)					
HFIAS: Secure/mild food insecure	-.483	.62 (.13–2.97)	0.547	2.08 (.48–8.97)	.68 (.13–3.58)
Moderate/Severe food insecure (r)					
HH Occupation: Garments/service worker	1.218	3.38 (1.25–9.17)	0.017	1.23 (.55–2.77)	1.02 (.4–2.62)
Day Labors/Rickshaw driver/other (r)					

*Indicate the significant at p value < 0.05; 'r' represents reference category.

Abbreviations: AOR, adjusted odds ratio; CI, confidence interval; HH, household; FCS, Food consumption score; CSI, Coping strategy index; HDDS, Household dietary diversity score; BMI, body mass index; HFIAS, Household food insecurity access scale.

Stunting prevalence was shown to be related to a number of variables, including the food consumption score, the household head's employment status as an informal worker, the mother's poor education level, and their age. However, for the criteria of underweight and wasting, low family dietary diversity was revealed to be the sole contributing factor, along with low household income for the former indicator. The same socio-economic factors are responsible for child stunting and underweight, according to a recent pooled study of data from 35 low and middle-income nations (Li et al., 2020b). In this study, the highest prevalence of stunting and underweight was found in low-income and highly food-insecure homes. This discovery is consistent with other research indicating that children from severely food insecure households are less likely to attain a minimal diet diversity and, as a result, are more likely to be stunted, underweight, or wasted (Chandrasekhar et al., 2017). Poor feeding habits, especially a lack of nutritional diversity, are one of the direct causes of Bangladesh's high prevalence of childhood undernutrition (Ali et al., 2013). Therefore, under forceful conditions such as lockdowns and restrained economic activities, children from disadvantaged families being gravely affected seems conceivable. Previous studies do indicate that at times of compromised intake of food, it could result in acute malnutrition followed by micronutrient deficiencies (McDonald et al., 2015; Ghose et al., 2016). Since reduction in income after the

pandemic onset has not been a significant factor for any of these parameters, the existing malnutrition rate estimated within the present study sample may not be directly related to restrictive measures, occurring within the time frame of the study. Therefore, in order to achieve more conclusive evidence, longitudinal studies are needed. It is an important area for study as the probable significant impact of the pandemic on early childhood nutrition may have intergenerational implications for infant growth and development, with long-term effects on schooling, chronic disease risk, and overall human capital formation (Headey et al., 2020).

Maternal occupation and education have consistently been identified as strong influencers of household food security and child nutrition. Food insecurity and childhood malnutrition rates were lower among mothers who worked in the garment industry and who had at least a secondary education. Maternal education has a substantial impact on the nutritional condition of children, according to previous global research (Lepine and Strobl, 2013). Females who are educated are more likely to be better equipped, financially independent, and have more control or influence over the allocation of household resources, resulting in lower financial food insecurity and, ultimately, better child nutrition. Multiple additional studies confirm the present study's findings that maternal work is adversely related to food poverty and has a favorable influence on

children's development (Almani et al., 2012; Hoffman and Youngblade, 1999). According to some research, women who lead homes with fewer resources and a history of vulnerability are more likely to become food insecure during a pandemic (Morales et al., 2021; Shahzad et al., 2021).

5. Conclusion

According to this study, COVID-19 lockdown had a significant impact on household food insecurity, dietary diversity as well as acute malnutrition in children. People's lack of income, employment of household head as day laborer, mother's occupation as housewife and education have been recognized as the primary determinants of food insecurity. There was a large use of coping mechanisms by the households, leading into insufficient dietary diversity and food consumption, resulting in a high risk of acute malnutrition among children under the age of five. Therefore informal workers, who are the most vulnerable to income loss, should be included in social safety net initiatives. Those who have lost their jobs or money are at risk of food insecurity, the government should initiate a jobs program that guards against long-term unemployment and the related hunger and malnutrition risk. Thus, robust measures are required to ensure that vulnerable groups are supplied with food in case of emergency economic catastrophe through food programs, which build resilience, dignity, and self-sufficiency, and improve the availability of fresh produce. Maternal education and employment should be strengthened as it helps avoid child malnutrition in times of crisis such as pandemic lockdown.

Declarations

Author contribution statement

Kazi Muhammad Rezaul Karim: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Wrote the paper.

Tasnia Tasnim: Analyzed and interpreted the data; Wrote the paper.

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Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

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