

# COVID-19 effect on food security, livelihood, and mental health in affected households of Jashore, Bangladesh

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## ABSTRACT

**Background:** The COVID-19 pandemic has amplified concerns about global food insecurity, with dietary diversity emerging as a critical indicator of nutritional adequacy. These challenges have far-reaching implications for mental health, particularly in vulnerable populations.

**Objective:** This study delves into the intersection of post-COVID-19 household food insecurity, dietary diversity, and mental depression among affected households.

**Methodology:** A cross-sectional study conducted with a sample size of COVID 19 affected 500 households. Bivariate linear regression performed to establish associations with food insecurity, dietary diversity, and depression.

**Result:** The study found that only 33.4 % of households were food secure, while 40.8 % experienced moderate food insecurity. Most households (82.2 %) had a medium level of dietary diversity, and 45.6 % of respondents reported experiencing different level of depression. Urban residency, higher education, stable employment, and higher income were associated with lower food insecurity and better dietary diversity ( $p < 0.05$ ), whereas female-headed households, joint families, and older family heads had higher levels of depression. Job losses (63 %) and income reductions (69.8 %) during COVID-19 contributed significantly ( $p < 0.05$ ) to increased food insecurity and depression. Households with stable jobs, higher incomes, and access to nutritional information enjoyed better food security, greater dietary diversity, and lower depression. In contrast, rising food prices and job changes worsened both food insecurity and mental health outcomes.

**Conclusion:** The COVID-19 pandemic has impacted food security, dietary diversity and mental health in Jashore, Bangladesh, exacerbating food insecurity and mental depression, especially among vulnerable groups. However, households with stable jobs, better education, and access to information fared better.

## 1. Introduction

The World Health Organization (WHO) officially designated COVID-19 as a Public Health Emergency of International Concern (PHEIC) on January 30, 2020 [1]. The worldwide pandemic, which commenced on March 11, resulted in an immediate cessation of global activities [2,3]. The Food Agriculture Organization (FAO) of the United Nations defines food insecurity as an abrupt disruption in food supply, access, use, and stability. The prolonged lockdown due to the epidemic hindered all aspects of food security, resulting in heightened global food insecurity and several detrimental public health outcomes. Due to COVID-19 pandemic many people have lost their employment, transferred to

lower-paying jobs, or had no income [4,5]. Economic volatility lowers access to nutritional meals, leading to hunger, malnutrition, limited dietary diversity, and malnutrition related illnesses risen globally. Unemployment, low income, and poverty have all contributed to rising food insecurity rates [6].

According to the report of World Health Organization (WHO) [7], the world is not on track to reach global nutrition targets and achieve zero hunger by 2030. The World Health Organization's 2030 SDGs and the United Nations Decade of Action on Nutrition uphold nutrition and food security as human rights and public health priorities, emphasizing regional and global progress in eradicating hunger and malnutrition [8]. Bangladesh has a population of over 164 million, making it a highly

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populated nation. Compared to other mega-countries, the population density is five times higher in Bangladesh [9]. By 2050, the nation's population is predicted to have increased and stabilized at 260 million. This enormous population will bring with it challenges related to water and sanitation, food instability, and the detrimental consequences of climate change on public health and nutrition, including vector-borne illnesses that are projected to rise [10].

The COVID-19 pandemic has left an effect on people's health and well-being worldwide and is a serious threat to millions of people's access to food and nutrition [11]. The food security and nutritional condition of high-risk subpopulations those who live at or below respective poverty lines are expected to deteriorate as a result of the health and socioeconomic effects of COVID-19 [7]. Globally, around 690 million people did not consume the recommended amounts of calories prior to the COVID-19 pandemic. This is clearly a serious public health concern regarding food consumption, dietary diversity, and related food insecurity [5]. Poor people and communities of different minority groups are disproportionately affected by food insecurity, which is characterized by restricted or unpredictable access to enough nutritious food for an active, healthy life. Long-term and short-term adverse health outcomes are linked to food insecurity [12].

Household food insecurity affects all age groups, leading to malnutrition, undernutrition, obesity, and hidden hunger. Children from low-income households may experience long-term developmental, psychological, physical, and emotional consequences, even if the insecurity lasts short [13]. The key components of food security, food availability, and accessibility are impacted by the COVID-19 pandemic because it disrupts food systems, affects household earnings and job security, and restricts physical access to food [14].

Individual dietary diversity scores are deemed as an indicator of food security, indicating a household's financial capacity to obtain a variety of food types within a defined timeframe. They also measure the nutritional quality of foods, ensuring the right amount of essential nutrients are consumed [15]. The COVID-19 pandemic has significantly impacted Bangladesh's marginal population's living standards and food consumption, leading to job instability among informal labor market workers, including job loss, income decrease, and job switching [8].

During the COVID-19 outbreak, mental health issues such as anxiety, insomnia, elevated stress levels, and depressive symptoms are often prevalent in adults [16]. Developing country like Bangladesh, mental health is frequently disregarded [17], but it was reported that around 52.87 % of the adult population in Bangladesh was experiencing depression during COVID-19 [16]. Population density, household level, economic position, employment, life experience, disease load, and other characteristics are among those that have an impact on mental health [9]. The COVID-19 pandemic has significantly impacted mental health, causing additional costs for the public, healthcare providers, isolated populations, and close relationships, and understanding its impact can help prevent future mental health issues [9,18].

Several studies concerning household food insecurity and dietary diversity during COVID-19 have been conducted in Bangladesh [8,10,11,13,19,20]. On the other hand, different studies have focused on the mental health and depression status during COVID-19 among different study groups [9,17,21–24]. However, the literature review clearly indicated that there were no studies available concerning on post-COVID household dietary diversity, food insecurity and depression status among COVID-19 affected households in Jashore district. Jashore is one the most COVID-19 affected area in Bangladesh due to its geographical location. Jashore is one of the major financially significant districts of Bangladesh. Jashore is bounded by India to the west and the country largest import export land port named 'Benapol Land Port' is situated in this district. As these households were mostly affected during COVID-19, a better understanding of the scenario of the prevalence of these target populations will assist the government authorities and policymakers in developing effective strategies to improve the food security, dietary diversity, and depression status of these COVID-19

affected people. With this viewpoint, this study aims to determine the household food insecurity, dietary diversity, and depression status among COVID-19 affected households of Jashore district in Bangladesh and also determine its associated factors.

## 2. Methods

### 2.1. Study setting, sampling method and participants

A cross-sectional study was carried out from August 1, 2022, to February 1, 2023, in the Jashore district to investigate the household food insecurity, dietary diversity, and depression status among the COVID-19-affected households. Jashore, previously known as Jessore, is a southwest district in Bangladesh with a population of 2764,547. Its area is 2606.98 km<sup>2</sup>, and it gets 1537 mm of rain on average per year. While the rainy season is warm, humid, and cloudy, the summers are sunny and bright. The average winter and summer temperatures of Jashore are approximately 15.3 °C and 38.3 °C, respectively [25]. The geographical location of the study area is shown in Fig. 1.

In-person interviews were used to collect the data. The list of COVID-19-affected individuals in the Jashore district was obtained from the Civil Surgeon Office in Jashore in order to gather data about them and identify their houses. The list contained the name and address of the COVID-19-affected person from 2020 to 2021. The female heads of the COVID-19-affected households provided the data (both rural and urban), as they were the ones who were involved in food preparation, food distribution, family management, and other household chores. In this investigation, purposive sampling was employed. The majority of the COVID-19-afflicted families were located in the eight Jashore district upazillas: Abhaynagar, Bagherpara, Chaugachha, Jhikargacha, Keshabpur, Jashore Sadar, Manirampur, and Sharsha. So, data were collected from these areas according to the COVID-19 affected person's list.

The inclusion criteria of this study were: (a) being a resident of Jashore district; (b) residing in Jashore during COVID-19; (c) being the female head of the COVID-19-affected household; (d) being an adult (>18 years old); (e) being able to understand Bangla; and (f) being able to complete the survey. The exclusion criteria were: (a) households with no COVID-19-affected member; (b) female head of the family under the age of 18 years; (c) not being a resident of Jashore; (d) residing outside Jashore during COVID-19; and (e) not being able to complete the survey. The flow chart of the study design is shown in Fig. 2.

### 2.2. Sample size

Based on the unknown prevalence of household food insecurity, dietary diversity, and depression, the sample size was estimated with a 5 % tolerance for error at a 95 % confidence interval. The formula for calculating sample size was as follows [25].

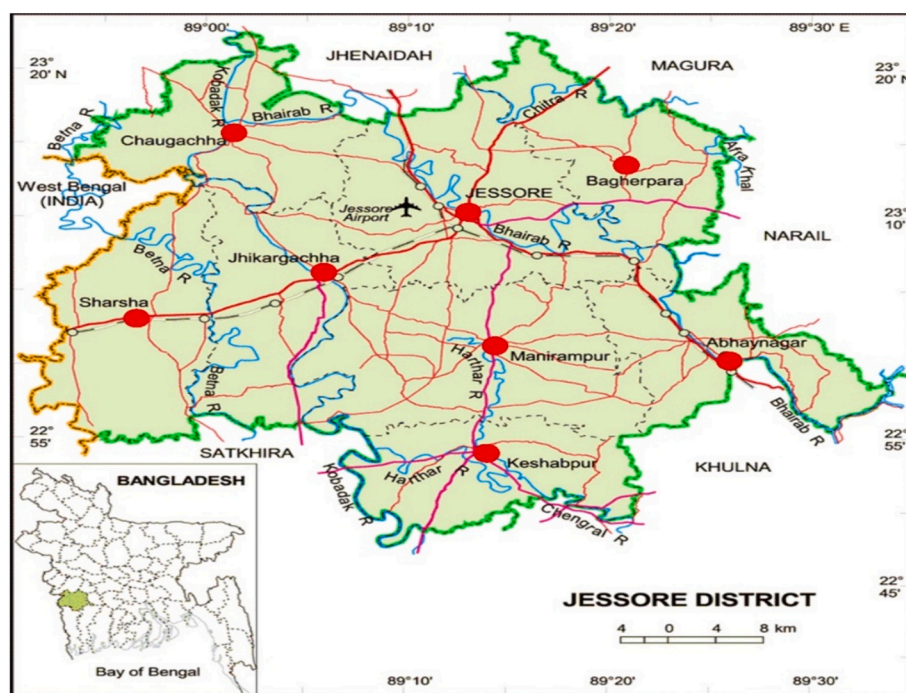
$$n = \frac{z^2 pq}{d^2} \quad (1)$$

Here, n = number of samples, z = 1.96 (95 % confidence interval), p = prevalence rate (50 % or 0.05), q = (1-p), d = proportion of margin of error (0.05).

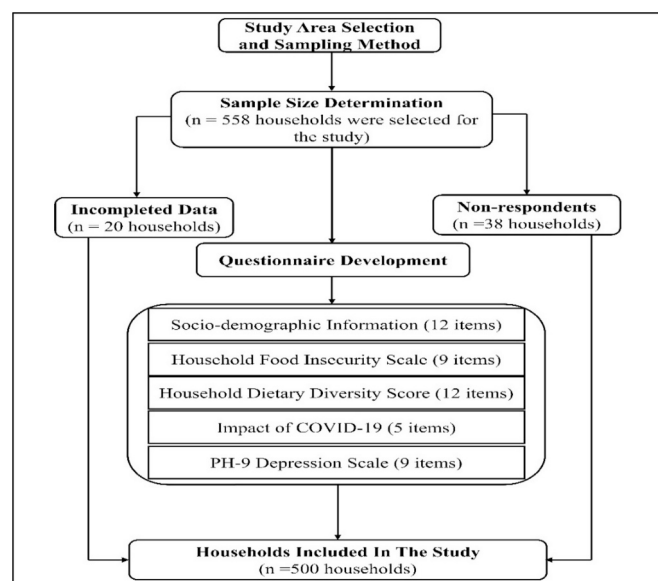
On this basis, a total of 384 households were calculated. Then, a total of 447 households were estimated using a 50 % prevalence rate and a 95 % response rate. To account for any potential errors in answering the questionnaire, an additional 25 % (n = 111) of households were included in the study, which yielded a sample size of 558 households. However, only a total of 500 households were included in the study, fulfilling all the requirements.

### 2.3. Data collection method

A pre-study questionnaire was translated into Bengali by two bilingual researchers and a multilingual expert to ensure consistency and



**Fig. 1.** Geographical location of study area. Red circles represent the sampling location. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)



**Fig. 2.** Flowchart of study design.

avoid bias. The questionnaire was pilot-tested with 50 respondents to ensure clarity and eliminate repetitive questions. The female head of the family provided data through a face-to-face interview. The team and supervisor discussed modifications to the questionnaire. Five skilled individuals conducted in-person interviews with five qualified interviewers with prior experience in health surveys and nutrition and food technology backgrounds. Interviewers received training on participant recruitment, study instruments, ethical considerations, and data collection methods. Before data collection, the enumerator assured respondents that their information would be kept private. The questionnaire provided a brief summary of the study's background, goals, methods, confidentiality agreement, and informed permission.

## 2.4. Questionnaire preparation

The survey questionnaire consisted of 47 closed-ended items, which took respondents approximately 25–30 min to complete. The questionnaire was split into five sections: 1. socio-demographic information (12 items); 2. household food insecurity access scale (9 items); 3. household dietary diversity score (12 items); 4. impact of COVID-19 (5 items); 5. PH-9 depression scale (9 items).

### 2.4.1. Socio-demographic information

Socio-demographic information consisted of 12 items and data were collected on: respondent's living area (rural, urban), respondent's age, respondent's education (illiterate, primary, Junior School Certificate (JSC), Secondary School Certificate (SSC), Higher Secondary Certificate (HSC), Bachelor of Science (BS), Master of Science (MS), respondent's occupation (government job, private job, business, housewife, others), gender of the family head (male, female), age of the family head ( $\leq 40$  years,  $> 40$  years), occupation of the family head (unemployed, farmer, government job, private job, business, housewife, others), education of the family head (illiterate, primary, JSC, SSC, HSC, BS, MS), monthly family income ( $\leq 20,000$  BDT,  $> 20,000$  BDT), number of family members ( $\leq 5$  person,  $> 5$  person), family type (nuclear, joint), having refrigerator (yes, no), sources of dietary and nutrition information (don't know, health professionals, traditional media, online sources and others).

### 2.4.2. Household food insecurity access scale (HFIAS)

Household food insecurity access was measured using the Household Food Insecurity Access Scale (HFIAS), which is part of the Food and Agriculture Organization - Food and Nutrition Technical Assistance III Project (FAO-FANTA) guidelines [26]. The HFIAS methodology aims to determine the frequency of food insecurity in households and identify changes in access. It uses two categories of linked questions: occurrence questions, which ask about the occurrence of a food insecurity-related circumstance within the past 30 days, and frequency-of-occurrence questions, which measure the frequency of a reported condition within the past four weeks [26,27]. Household food insecurity scores

range from 0 to 27. Based on the HFIAS scores, household food insecurity was categorized into four types: food secure (0–1), mildly (2–7), moderately (8–14), and severely food insecure (15–27) [28]. Food-secure households have enough food but rarely face food-insecurity-related issues. Mild food insecurity may involve occasional or frequent food shortages, monotonous diets, or occasional undesirable items. Moderate food insecurity often compromises on quality by sticking to a boring diet or reducing meal sizes or frequency. Severe food insecurity involves reducing meal sizes or skipping multiple meals and encountering severe situations like malnutrition, bed hunger, or fasting. A household is considered extremely food insecure if any of these situations occur once in the past 30 days or four weeks [27].

#### 2.4.3. Household dietary diversity score

The household dietary diversity Score (HDDS) is a tool used to measure the diversity of foods consumed by a household member over the past 24 h. The 12 food groups include cereals, vegetables, fruits, meat, eggs, fish, pulses, legumes, nuts, milk, oils, fats, butter, sugar, honey, and miscellaneous foods. The score ranges from 0 to 12. Higher dietary diversity indicates a higher score, ranging from 0 to 12. The HDDS scale was used for both continuous and categorical analyses, with scores divided into three categories: high dietary diversity (7–12), medium dietary diversity (4–6), and low dietary diversity (0–3) [8,11].

#### 2.4.4. Impact of COVID-19

This section of the questionnaire was used to evaluate the impact of COVID-19 on households. The questions were adapted from [8,11] with modifications. This section had five items, including the effect of COVID-19 on the occupation (same as before, lost job/business closed, occupation switched), effect of COVID-19 on income of the household head (same as before, less than before), increase of price due to COVID-19 (no, yes, don't know), increased buying capacity after COVID-19 (yes, no), increased food variety after COVID-19 (no, yes).

#### 2.4.5. Patient health Questionnaire-9 (PHQ-9) depression scale

The Patient Health Questionnaire-9 (PHQ-9) depression scale (PHQ-9) is a self-administered tool used to assess depressive disorders using nine items scored on their frequency in the last 14 days. It aligns with Diagnostic and Statistical Manual of Mental Disorders (DSM-V) criteria for identifying depressive disorders and is straightforward and often used clinically. The questionnaire has a reported sensitivity of 88 % and a specificity of 88 % for major depression. The score range is 0–27. The scores are used to categorize depression symptoms into five categories: 0–4 indicates no depression, 5–9 indicates mild depression, 10–14 indicates moderate depression, 15–19 indicates moderately severe depression, and 19–27 indicates severe depression [29]. The questions included were as follows: feeling little interest in doing things, feeling depression, trouble falling or staying asleep, feeling tired, poor appetite or overeating, feeling bad about self, trouble concentrating on things, feeling restlessness, thought of dying. The frequency of occurrence of the questions were also measured; not at all, several days, more than half the days, nearly every day.

### 2.5. Statistical analyses

The study employed bivariate linear regression to assess the association among socio-demographic information, the impact of COVID-19 on occupation, income, food purchasing ability, household food insecurity, household dietary diversity, and depression. Descriptive statistics were measured to summarize and determine the frequency, percentage of socio-demographic information, and impact of COVID-19 on households' day-to-day lives. The estimates of the strengths of associations were demonstrated by the  $\beta$  (co-efficient) with a 95 % CI. All tests were two-tailed, and a  $P$ -value of  $<0.05$  was set to determine statistical significance. Statistical analyses were performed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA).

### 2.6. Ethical approval and consent to participate

The protocol for this study was in accordance with the Declaration of Helsinki, and the Ethical Review Committee of the Faculty of Biological Science and Technology, Jashore University of Science and Technology, Jashore, approved all procedures involving human subjects or patients. For every respondent, written informed consent was acquired.

## 3. Results

### 3.1. Socio-demographic information

The socio-demographic information of the COVID-19 households is shown in Table 1. The majority of the respondents were from rural areas (59.2 %) and had primary education (23.6 %). Most of the respondents were housewives (90.4 %). The majority of the household heads were male (98 %) and above 40 years old (57.8 %). Nearly half of the household heads were businessmen (49.6 %) and were educated at a higher secondary level (23.2 %). However, most of the households were nuclear families (89.6 %), with a family size of  $\leq 5$  (81.4 %) and a monthly income of  $\leq 20,000$  taka (70.4 %). Overall, most of the households had refrigerators (77.6 %), and the respondents reported getting their dietary and nutritional information mostly from traditional media (43.8 %).

### 3.2. Household food insecurity, household dietary diversity and depression score

Fig. 3 (a–c) represents the percentage of household food insecurity, dietary diversity, and depression status. In the present study, the mean household food insecurity score was 7.27 (SD = 6.71). When household food insecurity scores were split into four categories (food secure, mildly food insecure, moderately food insecure, and severely food insecure), it was found that most of the households (40.8 %) were moderately food insecure and only 33.4 % households were food secure (Fig. 3 a). The mean of the household dietary diversity score was 5.25 (SD = 1.30). Most of the households (82.2 %) consumed a medium-diversified diet, and about 15.2 % of households took a diet with high dietary diversity, followed by 2.6 % of households with low dietary intake (Fig. 3 b). Table 2 represents the food groups consumed by COVID-19 households during the last 24 h. It was found that cereals and oils, fat, and butter had the highest consumption rate (100 %), followed by vegetables (89.4 %), fish (63.6 %), tubers and roots (59 %), and pulse (39 %). The lowest consumption rate was found in the fruit group (6.6 %). On the other hand, the mean of depression scores was 4.45 (SD = 3.18). However, it was revealed that most of the respondents had no depression (54.4 %) and about 38.4 % had mild depression, whereas only 1.6 % were found to have a moderately severe depression level (Fig. 3 c). (See Table 3.)

Table 2 presents the impact of dietary diversity and demographic characteristics among COVID-19 affected household in Jashore district. The average score of the dietary diversity was reported 5.89, indicating that respondents possess a medium dietary diversity. The study found that no significant association between dietary diversity and demographic characteristics among COVID-19 affected household based on gender of the family head ( $p = 0.512$ ), Age of the family head ( $p = 0.632$ ), occupation of the family head ( $p = 0.051$ ), education of the family head ( $p = 0.073$ ), family type ( $p = 0.651$ ). However, there was a significant association between dietary diversity and COVID-19 affected household on area of residence ( $p = 0.012$ ), educational level ( $p = 0.001$ ), occupation (respondents) ( $p = 0.004$ ), family income ( $P = 0.001$ ), family members ( $P = 0.002$ ). The study result demonstrated that dietary diversity improved with higher education, lower family members, stable occupation, higher family income.

**Table 1**

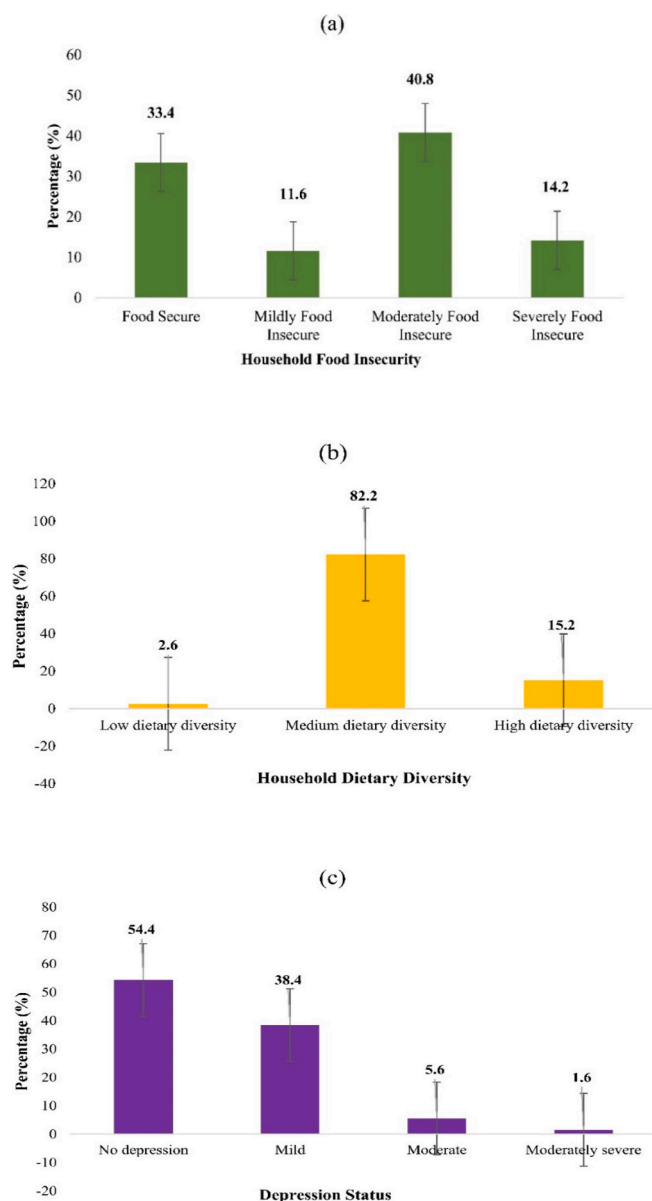
Socio-demographic information of the COVID-19 affected households in jashore district ( $n = 500$ ).

Variables	n (%)
Residence	
Rural	296 (59.2)
Urban	204 (40.8)
Education of respondent	
Illiterate	52 (10.4)
Primary	118 (23.6)
JSC	91 (18.2)
SSC	95 (19)
HSC	90 (18)
BS	38 (7.6)
MS	16 (3.2)
Occupation of respondent	
Govt. job	35 (7)
Private job	4 (0.8)
Business	4 (0.8)
Housewife	452 (90.4)
Others	5 (1)
Gender of the family head	
Male	490 (98)
Female	10 (2)
Age of the family head	
≤40 years	211 (42.2)
>40 years	289 (57.8)
Occupation of the family head	
Unemployed	4 (0.8)
Farmer	66 (13.2)
Govt. job	93 (18.6)
Private job	15 (3)
Business	248 (49.6)
Housewife	2 (0.4)
Others <sup>1</sup>	72 (14.4)
Education of the family head	
Illiterate	55 (11)
Primary	72 (14.4)
JSC	65 (13)
SSC	109 (21.8)
HSC	116 (23.2)
BS	63 (12.6)
MS	20 (4)
Monthly family income	
≤ 20,000 BDT	352 (70.4)
>20,000 BDT	148 (29.6)
Number of family member	
≤ 5 person	407 (81.4)
>5 person	93 (18.6)
Family type	
Nuclear	448 (89.6)
Joint	52 (10.4)
Having refrigerator?	
No	112 (22.4)
Yes	388 (77.6)
Sources of dietary/nutrition information	
Don't know	190 (38)
Health professional <sup>2</sup>	68 (13.6)
Traditional media <sup>3</sup>	219 (43.8)
Online source	11 (2.2)
Others <sup>4</sup>	12 (2.4)

Note: <sup>1</sup>Others included day laborer, rickshaw puller, housekeeper etc., <sup>2</sup>Health professional included physician, dietitian, nutritionist, etc., <sup>3</sup>Traditional media included TV, radio, newspaper, etc., <sup>4</sup>Others included friends, family members, books, etc.

### 3.3. Association of socio-demographic factors with household food insecurity, dietary diversity and depression

Table 4 represents the socio-demographic factors associated with household food insecurity, dietary diversity, and depression. The respondent's living area was significantly ( $p < 0.05$ ) associated with household food insecurity and dietary diversity. Respondents' living in urban areas had lower food insecurity ( $\beta = -0.08$ , 95 % CI:  $-2.27, 0.13$ ) and higher dietary diversity ( $\beta = 0.26$ , 95 % CI:  $0.46, 0.91$ ).



**Fig. 3.** (a-c): Percentage of household food insecurity, household dietary diversity, and depression status. Error bars represent standard error.

**Table 2**

Food consumption by households last 24 h in Jashore district ( $n = 500$ ).

Food groups	Consumed n (%)	Not-consumed n (%)
Cereals	500 (100)	0 (0)
Tubers and roots	295 (59)	205 (41)
Vegetables	447 (89.4)	53 (10.6)
Fruits	33 (6.6)	467 (93.4)
Meat, poultry, organ	65 (13)	435 (87)
Eggs	100 (20)	400 (80)
Fish and other sea foods	318 (63.6)	182 (36.4)
Pulses, legumes, nuts	195 (39)	305 (61)
Milk and other dairy products	35 (7)	465 (93)
Oils, fats and butter	500 (100)	0 (0)
Sugar and honey	70 (13.8)	430 (86.2)
Miscellaneous (condiments and other processed foods like snacks, beverages, tea, coffee etc.)	70 (14)	430 (86)

**Table 3**

The impact of socio-demographic characteristics on dietary diversity in the Jashore district.

Variables	Number of respondent's (n)			P-value
	Low (0–3)	Medium (4–6)	High (7–12)	
Area of residence				
Rural	65	144	87	<b>0.012</b>
Urban 204	69	95	40	
Education level (respondents)				
Illiterate	21	28	3	<b>0.001</b>
Primary	43	66	9	
JSC	24	41	26	
SSC	19	53	23	
HSC	17	49	24	
BS	5	14	19	
MS	2	8	6	
Occupation (respondents)				
Govt. job	4	19	12	<b>0.004</b>
Private job	1	2	1	
Business	0	2	2	
Housewife	52	300	100	
Others	1	3	1	
Gender of the family head				
Male	90	300	100	0.512
Female	2	6	2	
Age of the family head				
≤40 years	40	145	26	0.632
>40 years	38	176	75	
Occupation of the family head				
Unemployed	1	2	1	0.051
Farmer	11	41	14	
Govt. job	17	65	11	
Private job	5	8	2	
Business	48	175	25	
Housewife	1	1	0	
Others <sup>1</sup>	13	41	18	
Education of the family head				
Illiterate	15	35	5	0.073
Primary	8	52	12	
JSC	7	44	14	
SSC	9	65	35	
HSC	16	45	55	
BS	5	41	17	
MS	2	12	6	
Monthly family income				
≤ 20,000 BDT	33	212	107	<b>0.001</b>
>20,000 BDT	28	75	45	
Number of family member				
≤ 5 person	41	295	71	<b>0.002</b>
>5 person	18	45	30	
Family type				
Nuclear	45	308	95	0.651
Joint	11	29	12	
Having refrigerator?				
yes	24	78	10	0.911
no	97	238	53	
Sources of dietary/ nutrition information				
Don't know	18	143	29	0.742
Health professional <sup>2</sup>	12	45	11	
Traditional media <sup>3</sup>	29	177	13	
Online source	1	8	2	
Others <sup>4</sup>	3	8	1	
<b>Average dietary diversity score</b>	<b>Mean</b>	<b>SD</b>	<b>Minimum</b>	<b>Maximum</b>
	5.89	3.77	3	12

Respondents' educational status (JSC, SSC, HSC, BS, and MS) was associated with decreased food insecurity, while illiterate respondents were found to have higher food insecurity ( $\beta = 0.09$ , 95 % CI: 0.02, 4.13). Among the respondents, only JSC and illiterate respondents were associated with lower dietary diversity. Government job holders and

private job holders had lower food insecurity scores, and private job holders had significantly higher dietary diversity. Household heads who had no education or primary education and who completed JSC had significantly higher food insecurity. On the other hand, households with family heads with BS or MS education experienced low food insecurity. Dietary diversity was lower among households with family heads with no or below higher secondary education. Households having family income  $\geq 20,000$  BDT had low food insecurity ( $\beta = -0.36$ , 95 % CI: -6.49, -4.07) and high dietary diversity ( $\beta = 0.33$ , 95 % CI: 0.69, 1.16). Families with refrigerators had less food insecurity ( $\beta = -0.26$ , 95 % CI: -5.60, -2.87) and high dietary diversity ( $\beta = 0.212$ , 95 % CI: 0.39, 0.93) compared to those who did not have refrigerators. It was also found that households having dietary/nutrition information from online sources had less food insecurity ( $\beta = -0.03$ , 95 % CI: -5.02, 2.72) and significantly high dietary diversity ( $\beta = 0.09$ , 95 % CI: 0.05, 1.59), while households with no nutrition information had a high food insecurity score ( $\beta = 0.33$ , 95 % CI: 3.32, 5.80) and low dietary diversity scores ( $\beta = -0.11$ , 95 % CI: -0.54, -0.04). It was found that respondents' living in urban areas experienced depression higher ( $\beta = 0.05$ , 95 % CI: -0.24, 0.90) than those of living in rural areas. Respondents educational level was negatively associated with depression. Respondents with a government job ( $\beta = -0.05$ , 95 % CI: -1.77, 0.43) and a private job ( $\beta = -0.05$ , 95 % CI: -4.89, 1.39) had lower depression scores. Households with a female member as the main earning person ( $\beta = 0.09$ , 95 % CI: 0.001, 3.98) and households with a family head of >40 years ( $\beta = 0.12$ , 95 % CI: 0.22, 1.34) had higher depression scores. Household heads in farming, government jobs, and private jobs had higher depression scores, while family heads in other low-income job sectors and housewives were found to have higher depression scores. It was found that households with family income >20,000 BDT ( $\beta = -0.12$ , 95 % CI: -1.41, -0.19) and having a refrigerator ( $\beta = -0.12$ , 95 % CI: -1.60, -0.27) had lower depression scores. Joint families with >5 family members were found to have higher depression scores ( $\beta = 0.24$ , 95 % CI: 1.23, 2.64). Households that gathered nutrition information ( $\beta = -0.02$ , 95 % CI: -2.41, 1.36) were also found to have lower depression scores than other respondents.

### 3.4. Association of COVID-19 with household food insecurity, dietary diversity, and depression

Table 5 describes the frequency and percentage of the impact of COVID-19 on households. It was found that most of the households' main-earning members worked during COVID-19, while the majority of them (69.8 %) experienced less income during COVID-19. Among the respondents', 54.6 % think that food prices are not increasing due to COVID-19. Most of the respondents replied negatively to increased

**Table 5**

Frequency and percentage of COVID-19 impact on households in Jashore district.

Variables	n (%)
Effect of COVID-19 on occupation of HH/earning person of family	
Same as before	176 (35.2)
lost job/ business closed	315 (63)
Occupation switched	9 (1.8)
Effect of COVID-19 on income of HH/earning person of family	
Same as before	151 (30.2)
less than before	349 (69.8)
Increase of food prices due to COVID-19	
No	273 (54.6)
Yes	219 (43.8)
Don't know	8 (1.6)
Increased buying capacity after COVID-19	
No	298 (59.6)
Yes	202 (40.4)
Increased food variety after COVID-19	
No	392 (78.4)
Yes	108 (21.6)

buying capacity (59.6 %) and increased food consumption (78.4 %) after COVID-19. Table 6 represents the association of COVID-19 with household food insecurity, dietary diversity, and depression. The Households with no change in occupation had lower food insecurity scores ( $\beta = -0.35$ , 95 % CI:  $-6.01, -3.72$ ), higher dietary diversity ( $\beta = 0.02$ , 95 % CI:  $-0.61, 1.06$ ), and lower depression scores ( $\beta = -0.22$ , 95 % CI:  $-2.02, -0.91$ ). and those who switched jobs experienced higher food insecurity, irrespective of their higher dietary diversity. It was found that households with the same occupation had a lower depression score, but those who switched occupations had a higher depression score. Households who had less income during COVID-19 had significantly higher food insecurity ( $\beta = 0.40$ , 95 % CI:  $4.71, 7.07$ ), lower dietary diversity ( $\beta = -0.23$ , 95 % CI:  $-0.89, -0.41$ ), and a higher depression score ( $\beta = 0.30$ , 95 % CI:  $1.51, 2.67$ ). Households that reported that food prices were increased due to COVID-19 and who did not know the reason had a significantly higher food insecurity level but a lower dietary diversity score. Households that answered positively and negatively to the increase in food prices due to COVID-19 had higher depression scores. On the other hand, households that had increased buying ability and food variety after COVID-19 had low food insecurity, depression, and high dietary diversity.

#### 4. Discussion

The emergence and progression of the COVID-19 pandemic have generated a novel array of challenges, unprecedentedly influencing the globe in every facet of human existence, encompassing public health and overall well-being [30]. The crisis has progressively evolved from a simple health concern into an economic catastrophe, particularly impacting low and middle income nations, thereby presenting significant risks to food security and nutrition for populations worldwide through economic downturns, and disruptions within food systems, including marketing, logistics, and trade [8]. As a result, limitations on mobility have caused a drastic decrease in employment opportunities and increased poverty levels, resulting in increased considerable poor dietary diversity and food insecurity [31]. In the context of global concerns about the impact of COVID-19 on dietary diversity and food security, our study revealed the prevalence of household food insecurity, dietary diversity, and depression with associated factors among households in the Jashore district of Bangladesh. Despite the geographical variation, socioeconomic conditions, illiteracy, and natural disasters were responsible for the post-existing vulnerability to food insecurity, poor dietary diversity and alarming depression status in Jashore district.

This is one of the few study to evaluate post-COVID dietary diversity, household food insecurity, and depression among COVID-19-affected households. The study identified that most of the households' food insecurity status was moderately food insecure with moderate dietary diversity. The changes in income, switching to other professions, purchasing power, and changes in food consumption have impacted food insecurity, dietary diversity, and depression status among the COVID-19 households [30,32], which resulted from a loss in income and had an impact on dietary diversity. Along with number of factors such as education, family income, number of family members, employment opportunity etc. have been found that were either directly or indirectly related to poor dietary diversity, food insecurity and depression among households in the post-COVID period [5,33].

The COVID-19 pandemic has not only affected the health of billions of people around the world; it has also introduced food insecurity to their households [34]. This research observed that urban households had lower food insecurity and higher dietary diversity compared to rural households; this result is consistent with the similar studies in Bangladesh during Covid-19 [8,11]. The present study found that 66.6 % of COVID-19 affected households were food insecure; this result is corroborated by the Kundu et al. (2021) [11], where 70 % of households were found to be food insecure during COVID-19. On the other hand, two other cross-sectional studies carried out at different times

throughout Bangladesh during the period of lockdown reported 90 % [13] and 93.2 % [20] of household were food insecure respectively, which was higher than the present study. The higher food insecurity during COVID-19 may be due to the restriction in movement and decreased food accessibility [32,35].

Study result revealed that households that rely on agricultural farming, government jobs, and private jobs had a lower incidence of food insecurity than other occupations. This result corroborates findings from other similar study [36]. The higher educational status of the respondents and family head were negatively associated with household food insecurity. This may be due to the fact that better educated people can diversify their work environments, higher earning potential and have the adequate ability to maintain their families' food availability [37]. This research revealed that higher family income are significant factors in lower food insecurity scores and higher dietary diversity. These findings are consistent with those similar study from Bangladesh [8], Iran [38], Ghana [39]. This study found that family heads with higher level education had lower household food insecurity compared to illiterate or other primary-level educations. This finding is consistent with the findings from other study in Bangladesh [11], Peru [40], Ethiopia [41]. The possible explanation could be that household heads with higher education might be more aware of their food consumption from a variety of food groups as well as their food security. According to the study, food insecurity was found to be significantly influenced by lower income. Food security is seriously threatened in low-income homes, especially those of day laborers whose families rely only on their daily income [14]. Households with family heads losing their jobs due to COVID-19 had a higher food insecurity and lower dietary diversity. This is in line with the findings from another study in Bangladesh [8,11], Nepal [5]. Households with increased buying ability and food consumption after COVID-19 had lower food insecurity and higher dietary diversity. This finding is in line with the findings from another study in Bangladesh [20].

The mean of the household dietary diversity score was 5.25 (SD = 1.30), which is lower than others study [11,14]. Study demonstrate dietary diversity was higher in households living in urban areas. This result is in agreement with the other studies [42,43] and inconsistent with the findings from Banna et al. (2022) [8] and Zaman et al. (2024) [3], where dietary diversity was higher among rural residents. It was found that most of the households (82 %) were exposed to medium dietary diversity, which is higher than the findings from Bangladesh [25] where the majority of the respondents had medium dietary diversity. Several factors may help explain these relatively moderate outcomes. First, regional variations in the severity of the pandemic and the availability of resources could have played a role. Some regions may have had more access to food and food assistance, which could have buffered the negative effects of COVID-19 on dietary diversity. Additionally, local interventions, such as food assistance programs or community-based awareness, might have helped mitigate the impacts on respondents' well-being and improved dietary diversity. Family heads in different low-income occupations had a lower dietary diversity score; this finding is consistent with the findings by Getahun et al., (2023) [44]. It's probable that rural residents have a less diverse diet than those living in urban areas due to the lack of nutritional understanding and awareness. Additionally, the prevalence of junk food intake and online ordering and delivery services in urban areas might lead to an increase in dietary diversity among urban residents. Previous similar studies demonstrated that eating more junk food enhances dietary diversity among urban residents [45,46]. Dietary diversity and household food security were sensitive to seasonal variations, a finding which has been observed in other studies [47,48]. Seasonality was significantly associated with dietary diversity and food security status. Contrary findings reported elsewhere, and did not identify any significant differences in dietary diversity based on season [49]. A common limitation in the use of the HFIAS and dietary diversity tools is that they capture a 'snapshot' of the situation and do not reflect seasonal variances [47,48].

**Table 4**

Associations between socio-demographic variables, food insecurity, and depression of COVID-19 affected individual in Jashore.

Variables	Food Insecurity				Dietary diversity				Depression			
	R <sup>2</sup>	AR <sup>2</sup>	β	95 % CI	R <sup>2</sup>	AR <sup>2</sup>	β	95 % CI	R <sup>2</sup>	AR <sup>2</sup>	β	95 % CI
Residence												
Rural			Ref.	Ref.	0.066	0.064	Ref.	Ref.			Ref.	Ref.
Urban	0.006	0.004	−0.08*	(−2.27, 0.13)			0.26***	(0.46, 0.91)	0.003	0.001	0.05	(−0.24, 0.90)
Education of respondent												
Illiterate	0.135	0.124	0.09**	(0.02, 4.13)	0.065	0.053	−0.01	(−0.47, 0.36)	0.059	0.047	−0.02	(−1.23, 0.80)
Primary			Ref.	Ref.			Ref.	Ref.			Ref.	Ref.
JSC			−0.13**	(−3.94, −0.50)			0.05	(−0.17, 0.53)			−0.12**	(−1.84, −0.14)
SSC			−0.15***	(−4.31, −0.91)			0.13	(0.09, 0.77)			−0.21***	(−2.57, −0.89)
HSC			−0.21***	(−5.4, −1.10)			0.20	(0.32, 1.02)			−0.15***	(−2.09, −0.39)
BS			−0.27***	(−9.22, −4.62)			0.10	(0.04, 0.97)			−0.20***	(−3.59, −1.31)
MS			−0.20***	(−10.38, −4.17)			0.19	(0.77, 2.10)			−0.10**	(−3.45, −0.20)
Occupation of respondent												
Govt. job	0.038	0.030	−0.16***	(−6.48, −1.92)	0.023	0.016	0.08	(−0.02, 0.87)	0.006	−0.002	−0.05	(−1.77, 0.43)
Private job			−0.07*	(−12.07, 0.98)			0.11**	(0.28, 2.83)			−0.05	(−4.89, 1.39)
Business			0.02	(−5.07, 7.98)			0.07	(−0.22, 2.33)			0.03	(−2.14, 4.14)
Housewife			Ref.	Ref.			Ref.	Ref.			Ref.	Ref.
Others			0.08	(−0.58, 11.10)			0.03	(−0.74, 1.54)			0.02	(−2.31, 3.31)
Gender of the family head												
Male	0.021	0.019	Ref.	Ref.	0.001	−0.001	Ref.	Ref.	0.008	0.006	Ref.	Ref.
Female			0.15***	(2.80, 11.14)			0.04	(−0.46, 1.17)			0.09*	(0.001, 3.98)
Age of the family head												
≤40 years	0.004	0.002	Ref.	Ref.	0.004	0.002	Ref.	Ref.	0.015	0.013	Ref.	Ref.
>40 years			0.06	(−0.37, 2.01)			−0.06	(−0.39, 0.07)			0.12***	(0.22, 1.34)
Occupation of the family head												
Unemployed	0.215	0.206	0.15***	(5.54, 17.39)	0.033	0.021	−0.09**	(−2.60, −0.05)	0.093	0.082	−0.03	(−4.09, 1.95)
Farmer			−0.02	(−1.95, 1.31)			−0.056	(−0.57, 0.13)			−0.09**	(−1.69, −0.03)
Govt. job			−0.22***	(−5.17, −2.31)			0.055	(−0.13, 0.49)			−0.16***	(−2.05, −0.60)
Private job			−0.04	(−4.62, 1.63)			0.019	(−0.53, 0.82)			−0.03	(−1.83, 1.36)
Business			Ref.	Ref.			Ref.	Ref.			Ref.	Ref.
Housewife			0.12**	(4.13, 20.81)			0.009	(−1.62, 1.97)			0.12***	(1.68, 10.18)
Others <sup>1</sup>			0.32***	(4.53, 7.68)			−0.13***	(−0.81, −0.14)			0.18***	(0.81, 2.41)
Education of the family head												
Illiterate	0.225	0.215	0.29***	(4.19, 8.01)	0.066	0.055	−0.185***	(−1.17, −0.36)	0.069	0.058	0.09*	(−0.10, 1.89)
Primary			0.27***	(3.41, 6.92)			−0.074	(−0.65, 0.10)			0.22***	(1.06, 2.88)
JSC			0.16***	(1.28, 4.90)			−0.138***	(−0.92, −0.15)			0.10**	(0.03, 1.91)
SSC			0.07	(−0.41, 2.71)			−0.076	(−0.57, 0.09)			0.02	(−0.63, 0.99)
HSC			Ref.	Ref.			Ref.	Ref.			Ref.	Ref.
BS			−0.20***	(−5.79, −2.13)			0.078	(−0.08, 0.70)			−0.082	(−1.73, 0.17)
MS			−0.12**	(−6.84, −1.18)			0.077	(−0.09, 1.11)			−0.048	(−2.25, 0.68)
Monthly family income												
≤ 20,000 BDT	0.129	0.127	Ref.	Ref.	0.106	0.104	Ref.	Ref.	0.013	0.011	Ref.	Ref.
>20,000 BDT			−0.36***	(−6.49, −4.07)			0.33***	(0.069, 1.16)			−0.12**	(−1.41, −0.19)

(continued on next page)

Table 4 (continued)

Variables	Food Insecurity				Dietary diversity				Depression			
	R <sup>2</sup>	AR <sup>2</sup>	β	95 % CI	R <sup>2</sup>	AR <sup>2</sup>	β	95 % CI	R <sup>2</sup>	AR <sup>2</sup>	β	95 % CI
Number of family member												
≤ 5 person	0.027	0.025	Ref.	Ref.	0.013	0.011	Ref.	Ref.	0.056	0.054	Ref.	Ref.
> 5 person			0.17***	(1.36, 4.35)			0.11**	(0.08, 0.67)			0.24***	(1.23, 2.64)
Family type												
Nuclear	0.001	−0.001	Ref.	Ref.	0.002	0.000	Ref.	Ref.	0.003	0.001	Ref.	Ref.
Joint			0.031	(−1.25, 2.62)			0.05	(−0.21, 0.54)			0.06	(−0.30, 1.53)
Having refrigerator?												
No	0.069	0.067	Ref.	Ref.	0.045	0.043	Ref.	Ref.	0.015	0.013	Ref.	Ref.
Yes			−0.26***	(−5.60, −2.87)			0.21***	(0.39, 0.93)			−0.12***	(−1.60, −0.27)
Sources of dietary/ nutrition information												
Don't know	0.104	0.097	0.33***	(3.32, 5.80)	0.059	0.051	−0.11**	(−0.54, −0.04)	0.056	0.049	0.19***	(0.63, 1.83)
Health professional <sup>2</sup>			0.08	(−0.25, 3.23)			0.09**	(0.003, 0.69)			0.18***	(0.79, 2.48)
Traditional media <sup>3</sup>			Ref.	Ref.			Ref.	Ref.			Ref.	Ref.
Online source			−0.03	(−5.02, 2.72)			0.09**	(0.05, 1.59)			−0.02	(−2.41, 1.36)
Others <sup>4</sup>			0.11*	(1.21, 8.64)			0.15***	(0.49, 1.97)			0.13***	(0.90, 4.52)

Note: R<sup>2</sup> = R-squared, AR<sup>2</sup> = adjusted R-squared., Ref. = reference, <sup>1</sup>Others included day laborer, rickshaw puller, housekeeper etc., <sup>2</sup>Health professional included physician, dietitian, nutritionist, etc., <sup>3</sup>Traditional media included TV, radio, newspaper, etc., <sup>4</sup>Others included friends, family members, books, etc.; β represents regression co-efficient and CI represents 95 % confidence interval of the regression coefficients with lower bound and upper bound in the parenthesis; \*\*\*, \*\*, and \* indicate 1 %, 5 %, and 10 % significance levels respectively.

Table 6

Association of impact of COVID-19 with household food insecurity, dietary diversity, and depression in Jashore district.

Variables	Household Food Insecurity				Dietary Diversity				Depression			
	R <sup>2</sup>	AR <sup>2</sup>	β	95 % CI	R <sup>2</sup>	AR <sup>2</sup>	β	95 % CI	R <sup>2</sup>	AR <sup>2</sup>	β	95 % CI
Effect of COVID-19 on occupation of HH/earning person of family												
Same as before				(−6.01, −3.72)	0.067	0.064		(0.48, 0.94)	0.118	0.115	−0.22***	(−2.02, −0.91)
lost job/ business closed	0.157	0.154	−0.35***	Ref.			0.26***	Ref.			Ref.	Ref.
Occupation switched			0.16***	(4.07, 12.27)			0.023***	(−0.61, 1.06)			0.24***	(3.82, 7.79)
Effect of COVID-19 on income of HH/earning person of family												
Same as before	0.163	0.161	Ref.	Ref.	0.053	0.051	Ref.	Ref.	0.091	0.089	Ref.	Ref.
less than before			0.40***	(4.71, 7.07)			−0.23***	(−0.89, −0.41)			0.30***	(1.51, 2.67)
Increase of food prices due to COVID-19												
No	0.084	0.081	Ref.	Ref.	0.012	0.009	Ref.	Ref.	0.086	0.083	−0.45***	(−5.04, −0.75)
Yes			0.26***	(2.30, 4.59)			−0.09**	(−0.48, −0.02)			−0.17	(−3.23, 1.17)
Don't know			0.17***	(4.60, 13.67)			−0.07***	(−1.66, 0.16)			Ref.	Ref.
Increased buying capacity after COVID-19												
No	0.124	0.122	Ref.	Ref.	0.026	0.024	Ref.	Ref.	0.046	0.045	Ref.	Ref.
Yes			−0.35***	(−5.94, −3.69)			0.16***	(0.20, 0.66)			−0.22***	(−1.10, −0.84)
Increased food variety after COVID-19												
No	0.167	0.165	Ref.	Ref.	0.165	0.163	Ref.	Ref.	0.039	0.037	Ref.	Ref.
Yes			−0.408***	(−7.96, −5.34)			0.41***	(1.03, 1.54)			−0.20***	(−2.20, −0.87)

In terms of depression, this study revealed that a total of 45.6 % of respondents had depression. It is noteworthy to mention that the prevalence of depression found in the present study is lower than that found

among Bangladeshi medical students (49.9 %) [50], among Bangladeshi adult wage earners (79.35 %) [51], among low-income households (53.9 %) [52]; The differences in scale utilization and variations in

socio-demographic backgrounds could be the reason for the increased risk of depression in those studies as described by Islam et al. (2021) [16]. Another possible explanation is the resilience and coping mechanisms within the studied population. Individuals may have found ways to adapt to the changes brought on by the pandemic, such as social support, age, lifestyle and environmental factor, utilizing alternative food sources or engaging in self-care practices to manage stress. These factors, combined with the relatively stable economic conditions in the study region, could have contributed to the more moderate effects observed in this study compared to others conducted in different settings or regions with more severe disruptions. However, our finding was quite close to the findings found among young adults in the United States (43.3 %) [53], among Bangladeshi adult population (36.57 %) [16], low income adults in United States (33 %) [54]. The study found that respondents living in urban area experienced higher depression, on the other hand respondents with less family members and higher family income had lower depression scores, this findings are consistent with the findings from Sultana et al. (2021) [51]. Surprisingly, this study found that respondents' depression scores were lower irrespective of their educational level which was inconsistent with the study by Islam et al. (2021) [16] where higher depression scores were observed in respondents' with higher educational level. The impact of COVID-19 related data revealed that households with occupational change and less income due to COVID-19 led to higher depression scores. This findings are consistent with the study by [51], where it was observed that adult wage earners who had less salary, and laborers with unsatisfaction with their job had higher depression scores. Another study in Turkey [55] observed that COVID-19 impact on income was significantly ( $p < 0.01$ ) associated with depression.

## 5. Conclusion

This study highlights that socio-demographic factors, such as family income, employment status, residential area, job stability, and the education levels of both the household head and respondents, are strong predictors of food insecurity, poor dietary diversity, and mental depression in the post-COVID era. The findings show that higher household income and stable employment are closely associated with better food security. These results underscore the need for greater attention to food insecurity and dietary diversity among post-COVID households to improve overall health. Authorities must prioritize safeguarding food supply chains and integrating food and nutrition assistance into social protection programs to ensure that the most vulnerable populations have access to a diverse range of foods, either by supporting their purchasing power or directly providing food where necessary. Additionally, increasing access to information, mental health support and fostering community awareness can empower individuals, promoting self-resilience and helping households recover more effectively from the pandemic's impacts.

## 6. Strengths and limitations

This research boasts several strengths that make it unique and valuable. Firstly, it stands out as one of the few studies to explore the intersection of mental health, dietary diversity, and food insecurity in the wake of COVID-19. The use of well-established scales to develop the questionnaire ensures robust data collection, while in-person interviews of post COVID-19 affected household enhanced the reliability of responses. A pilot study further refined the methodology, improving the accuracy of data gathering. Maintained of diversity or adequacy within the sample by considering various subgroups within the COVID-19 affected population. To mitigate selection bias in purposive sampling, we ensure several approaches such as clear and objective criteria, diverse sources, strive for heterogeneity and reflexivity. Given the scarcity of information on this subject, the findings provide essential insights that can guide policymakers, researchers, and the government

in crafting policies to support food security and mental health in affected communities.

However, the study is not without its limitations. As a cross-sectional study, it cannot establish causal relationships, leaving questions about the direction of associations unanswered. The focus on households specifically affected by COVID-19 may limit the generalizability of the findings to broader populations. Additionally, while household dietary diversity offers insights into food accessibility, it doesn't fully capture the actual consumption levels of households, which could affect the accuracy of food security assessments.

## CRedit authorship contribution statement

**Sabrina Zaman:** Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Tamsel Ahammed:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Md Abul Hasan:** Writing – review & editing, Visualization, Validation, Formal analysis, Data curation. **Md. Enamul Huque:** Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Formal analysis, Data curation.

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## Declaration of competing interest

No conflict of interest exists between the authors.

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## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.dialog.2025.100217>.

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