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Food insecurity and its contributing determinants among rural households in the south-western region of Bangladesh, 2021: A cross-sectional study

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ABSTRACT

Introduction: The onset of the COVID-19 pandemic has disrupted food access, resulting in substantial consequences for food insecurity and contributing to adverse individual and public health outcomes. To comprehensively evaluate these challenges and grasp their implications for food security, this study aimed to evaluate the contributing determinants of food insecurity among rural households in the southwestern region of Bangladesh.

Study design: A cross-sectional study was conducted using a validated questionnaire in selected 310 rural household respondents from the southwestern region of Bangladesh.

Methods: Household food insecurity status was the outcome variable for the analysis. Multinomial logistic regression analysis was used to explore and predict risk factors correlated with food insecurity among southwestern Bangladeshi households.

Results: We found that 59 % and 27.5 % of households were suffering from moderate food insecurity and severe food insecurity, respectively. The multinomial regression model revealed that respondents residing in Kusthia (RRR = 5.56 CI:2.67–8.4 and RRR = 6.65, CI:3.37–9.22) aged between 30 and 40 years (RRR = 2.32, 95 % CI:1.84–3.77 and RRR = 1.87, 95 % CI:1.48–3.97) and 40–50 years (RRR = 1.86 95 % CI:1.46–3.82 and RRR = 1.95, 95 % CI:1.75–3.26) were significantly associated with mild-to-moderate and severe food insecurity. Respondents with a monthly family income of <58.96 USD (3.38 times and 2.18 times), had ≥5 family members (2.68 times and 1.89 times), and had poor income during the pandemic (4.25 times and 2.75 times) more likely to be moderate and severe food insecure.

Conclusion: The results emphasized that during the COVID-19 lockdown in Bangladesh, rural households faced diverse levels of food insecurity, ranging from moderate to severe. It suggests that efforts to raise awareness and implement support strategies for those at higher risk should not only focus on income but also consider additional factors such as family size, adults aged 30–40 years, and occupation.

1. What this study adds

- This study provides a comprehensive understanding of food insecurity among rural households in the southwestern region of Bangladesh, shedding light on a previously understudied area.
- Our findings suggest that a significant proportion of households were found to experience varying degrees of food insecurity, indicating a pressing need for interventions to address this issue.
- This research also identified several determinants, including residence, monthly income, household size, educational status, and income condition during COVID-19 than pre-pandemic contributing to food insecurity in the study area.
- Comprehending these factors is essential for crafting specific interventions to mitigate food insecurity and enhance the holistic welfare of rural households.

2. Implications for policy and practice

- Implement targeted interventions addressing the identified determinants of food insecurity in rural households of the southwestern

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region of Bangladesh, such as improving access to education, income generation opportunities, and agricultural support.
- Develop community-based programs focused on enhancing food security through initiatives like agricultural diversification, promoting of sustainable farming practices, and providing of nutritional education and resources.
- Strengthen collaboration between government agencies, non-governmental organizations, and local communities to formulate and implement comprehensive policies addressing the multifaceted nature of food insecurity in rural areas, focusing on building resilience and sustainability.

3. Background

Food insecurity refers to insufficient safe, nutritious food for a healthy, active life and normal growth. In contrast, this phenomenon occurs when households face challenges accessing and securing adequate [1]. This multidimensional issue is influenced by various factors, including poverty in low-income populations and household-related variables such as household type, household income, education level, ethnicity, and income [2]. These factors directly and indirectly contribute to an increased risk of food insecurity due to lower socioeconomic status and higher degrees of poverty [3]. Food insecurity mostly affects underprivileged communities, making them more vulnerable to extreme hunger, chronic illnesses, poor psychological health, societal disputes, and socio-economic inequalities, which may impede development [4]. It is also evident that a household's economic status is the most crucial factor impacting food insecurity in rural households [5].

However, the COVID-19 pandemic has escalated into a global public health emergency, particularly impacting the developing world [6]. According to the World Food Programme (WFP) methodology prediction, 309 million people will be acutely food insecure in 2024, more than double the number from 2020 [7] Additionally, the World Health Organization (WHO) voiced apprehension about the potential consequences of COVID-19 on food scarcity, hunger, and malnutrition, thereby exacerbating susceptibility to further diseases [8]. During the COVID-19 pandemic, people were unable to work due to a lack of jobs, and losses of business, and people had limited access to the market, which jeopardized their livelihoods because restrictions and lockdowns were implemented in numerous countries [9]. Food security has faced unparalleled challenges in the developing world due to the COVID-19 emergence [10]. Moreover, in developing nations, a significant portion of the population relies on informal labor as their primary source of income, and these communities generally have limited savings [11]. Consequently, implementing COVID-19 lockdown measures reduced income for many people in developing countries, leading to a rise in food insecurity [12]. Bangladesh also initiated nationwide lockdown measures on March 26, 2020, due to the pandemic [13]. Recent reports indicate that a subsequent increase in rural-urban migration created problems of financial instability and unemployment, especially for those working as day laborers, running small businesses, and low-income households [14]. Additionally, due to the lockdown, the food supply chain in Bangladesh has experienced significant disruptions, leading to a surge in prices for essential goods [15]. This sudden decrease in food availability and accessibility renders individuals more susceptible to acute food insecurity.

Various Bangladeshi studies reported that household food insecurity in rural areas increased by 51.7–67 % during the COVID-19 lockdown periods [16,17]. As a direct consequence of the lockdown in Bangladesh, a staggering 13 million individuals were unemployed without safety nets, an estimated 16.4 million fell into extreme poverty, and an additional 25.5 million fell below the severe poverty threshold simultaneously [18]. According to studies, the pandemic will predictably affect the safety of various disadvantaged groups, such as women, older people, children, people with disabilities, minorities, and asylum seekers, especially in terms of food, nutrition, and health, and it will exacerbate social and health inequalities [19,20]. According to the Global Food Security Index of 2022, Bangladesh was ranked 80th out of 113 countries worldwide, with scores of 52.1, 61.5, 58.4, and 43.9 in affordability, availability, quality and safety, and sustainability, respectively [21], which placed it below several neighboring ring countries, including Nepal, India, Indonesia, Sri Lanka, and Myanmar.

Several studies have been conducted to determine how the COVID-19 lockdown has affected food insecurity in multiple nations [22,23]. During the COVID-19 pandemic, the food security systems of most countries were worsened due to less food production, inadequate access to food, improper supply chain management, and reduced purchasing ability of sufficient food [23,24]. However, many studies conducted in our countries showed different impacts of COVID-19, which indicated worsened nutritional status in diverse age populations, food insecurity due to impeded access to available foods due to high prices, and reduced food production. These studies also revealed factors that were associated with food insecurity in urban and rural areas, and some studies also demonstrated the food insecurity status and its anticipated characteristics in a lower-economic-status population [13,17,23]. Furthermore, a few pieces of empirical evidence indicate the food insecurity status and its contributing factors among households in rural regions in the southwestern part of Bangladesh. This study aims to investigate the prevalence of household food insecurity and its associated factors among rural people in the southwestern region of Bangladesh. This study will provide specific information regarding the factors associated with household food insecurity. Moreover, our study will add a new dimension that helps the government authorities and policymakers identify the factors related to household food insecurity and make effective plans and policies to fight against future pandemic-related food insecurity issues in rural communities.

4. Methods

4.1. Study setting and respondents

This community-based cross-sectional study was conducted in rural areas of the southwestern region of Bangladesh during the COVID-19 pandemic, from November to December 2021. According to BBS (2011), southwestern rural regions contain 10 districts, 571 unions, 9289 villages, and 3,072,496 rural households [25]. The southwestern region has a history of food insecurity due to several natural, geographical, and socio-economic conditions, as it was selected for the study design [26,27]. Among all of the districts in the southwestern region, four sections (Kushtia, Jashore, Khulna, and Satkhira) were selected randomly. Secondly, four Upazilas in southwestern areas were selected. Thirdly, from the four upazillas, eight unions were chosen, respectively (Fig. 1). Finally, 310 rural household respondents were randomly selected after removing missing values and cleaning the data from a wider population for the study. The needed sample size (306) was calculated with a 95 % of confidence level, 5.6 % of margin error, 5 % of desired precision, and 20 % of non-response rate [28]. The inclusion criteria included the head of the household or who maintains the home, present on the survey day. Those lived in southwestern rural areas for the last six months and in terms of age (i.e., $\geq$18 years).

4.2. Study instruments and data collection procedure

A well-structured questionnaire was prepared to collect data regarding socio-economic characteristics and household food security during COVID-19 [17,29]. Risk assessment was undertaken to ascertain the feasibility and safety of face-to-face data collection activities during the pandemic. In addition, we established procedures and guidelines for data collectors to follow. Moreover, four trained interviewers were recruited with comprehensive training for data collection on COVID-19 prevention measures, including proper use of masks, gloves, PPE, hand

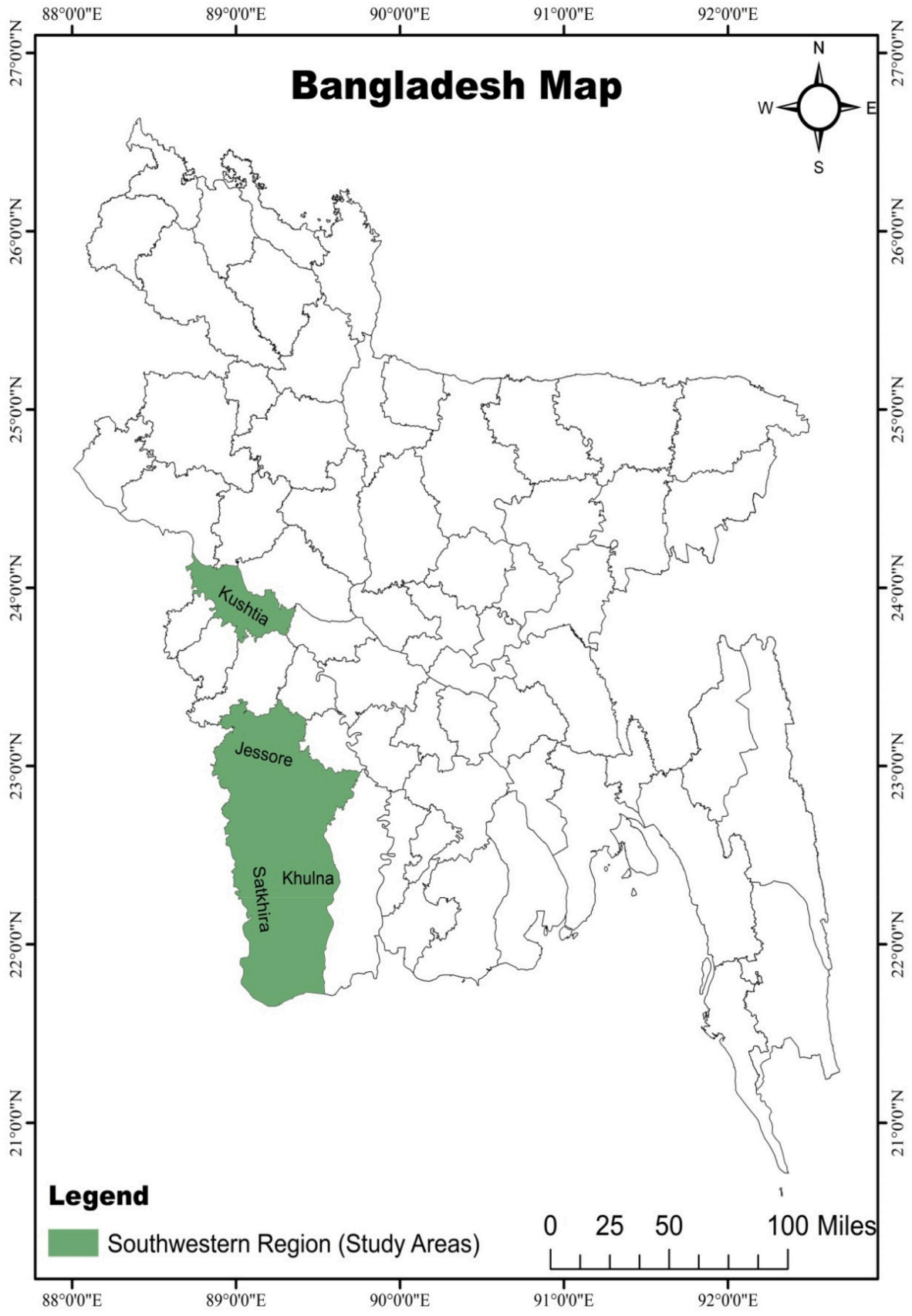

Fig. 1. Mapping of the study area.

sanitizer, and maintaining physical distance during interactions. Furthermore, data enumerators were instructed about the necessary knowledge and skills to conduct interviews sensitively and ethically. The interviewer explained the objectives and procedure of the study. When they agreed to participate in the survey, a written consent form was taken from the respondents. A bilingual expert prepared the questionnaires in English and translated them into Bengali. The two English versions (originally translated and back-translated) were compared to ensure that the meaning of the items in the two versions stayed the same.

4.3. Dependent variable

The Household Food Insecurity Access Scale (HFIAS) of the FAO-FANTA guidelines was employed to evaluate household food security access [30]. Comprising nine occurrence questions, the HFIAS questionnaire gauges the escalating severity of food insecurity experienced over the past month. Initially, the participant was presented with an inquiry about an event, specifically whether the described situation had transpired within the preceding four weeks. This required a binary response to each occurrence question, categorized as either non-occurrence (0) or occurrence [1]. If the participant responded affirmatively ('yes') to the occurrence question, a subsequent query was posed to ascertain the event's frequency. Additionally, respondents were queried about the frequency of each occurrence, using a three-point scale: non-occurrence, rarely (once or twice in the past four weeks), sometimes (three to ten times in the past four weeks), and often (more than ten times in the past month). These were scored on a scale of 0–3. The cumulative scores for the nine items, ranging from 0 to 27, reflect the household's level of food insecurity, where higher scores indicate greater food insecurity and lower scores indicate higher food security. The household food insecurity (access) assessment was conveyed through the Household Food Insecurity Access Prevalence (HFIAP) Status indicator. This indicator classifies households into four levels of access to food insecurity: food security, mild food insecurity, moderate food insecurity, and severe food insecurity. The HFIAS indicator guide contains the comprehensive calculation methodology. This analysis combined mild and moderate food insecurity households into a single category of mild-to-moderate food insecurity. As a result, the final dataset comprised three distinct household types: food security, mild-to-moderately food insecurity, and severe food insecurity households. As households responded affirmatively to more severe conditions and encountered them more frequently, their classification shifted towards increased food insecurity. The HFIAS indicator guide was utilized to ascertain household food insecurity status [29,30].

4.4. Independent variables

Explanatory variables considered in this study were selected based on an extensive literature review [4,5,17,30]. We considered socio-demographic variables, including location, gender (male, female), age (20–30 years, 30–40 years, 40–50 years, and >50 years), educational level (illiterate, up to class 5, up to class 12, and above class 12), household head occupation (farmer, maidservant, day labor, vendors, and job holder), family income per month in Bangladeshi Taka (BDT) where 1 USD~ 84.79 BDT, (<58.96 USD, 58.96–117.93 USD, 117.93–176.91 USD, and >176.91 USD), family member (2–4, 5–8, and ≥8), earned less income during COIVID-19 (yes, no) than pre-pandemic were considered as independent variables.

4.5. Data analysis

Descriptive statistical methods encompassing frequencies, percentages, and univariate analysis, such as cross-tabulations, were employed to assess the distribution of food insecurity across various social and demographic factors. For qualitative variables, either the chi-square ($\chi 2$) test or Fisher's exact test was utilized. The Household Food Insecurity Access Scale (HFIAS) for Measuring Food Access: Indicator Guide VERSION 3′ was adopted to gauge household food insecurity indicators. Multinomial logistic regression analyses were conducted to explore the association between outcome variables and predictor variables. The primary outcome variable of this study was food security status. This study utilizes a database that delineates household food insecurity into three distinct categories: food security, mild-to-moderate food insecurity, and severe food insecurity. The household food insecurity prevalence classification is determined solely by the individual household's food security status. Given this classification structure, an ordered probability model appears to be the most appropriate analytical approach. To investigate the severity of food insecurity and its associated factors across these three categories, we employed a multinomial logit model, a commonly used method for analyzing unordered discrete outcome models. This model allows for the utilization of a categorical dependent variable. These analyses generated relative risk ratios (RRR) with 95 % confidence intervals (CIs), facilitating the identification of factors contributing to heightened odds of food insecurity. Predictors with a p-value below 0.05 were incorporated into the multivariate multinomial logistic regression models. The statistical software STATA (V.14) was employed for all data analysis.

5. Result

5.1. Socio-demographic characteristics of participants

The socio-demographic characteristics of the study participants are shown in Table 1. Male respondents were a notable majority (64.8 %) of the participants. A substantial proportion of the respondents were within the age range of 30–40 years (33.2 %) and 40–50 years (36.5 %). Most participants were illiterate (44.8 %) and completed education up to class 5 (30 %). Approximately 32.5 %, 32.3 %, and 30.6 % of the participants were farmers/day laborers, and small vendors, respectively. The monthly income per capita was <58.96 USD monthly for 61.9 % of the participants. Nearly 75 % of the households had ≥5 members in their family. Additionally, a majority of the respondents (87.3 %) had less Income during the COVID-19 pandemic.

Table 1
Characteristics of the respondents among rural households in the south-western region of Bangladesh, 2021.

Characteristics		N	%
Location	Khulna	80	25.8
	Satkhira	75	24.2
	Jashore	75	24.2
	Kushtia	80	25.8
Gender	Male	201	
	Female	109	35.2
Age	20–30 years	63	20.6
	30–40 years	103	33.2
	40–50 years	113	36.5
	>50 years	30	9.7
Level of education	Illiterate	139	44.8
	Up to class 5	93	30.0
	Up to class 12	26	8.4
	Above class 12	52	16.8
Occupation	Farmer/Day labor	101	32.5
	Housewife	100	32.3
	Small vendors	95	30.6
	Job holder	14	4.6
Family income per month	<58.96 USD[a]	192	61.9
	58.96–117.93 USD[a]	73	23.5
	>117.93 USD[a]	45	14.6
Household family member	2–4	78	25.2
	≥5	232	74.8
Earned less Income during COVID-19 than pre-pandemic	Yes	271	87.3
	No	39	12.7

[a] 1 USD~ 84.79 BDT.

5.2. Prevalence of household food insecurity access

We found that 59 % were mild-to-moderately food insecure, and 27.5 % were severely food insecure (Table 3). The prevalence of household food insecurity is depicted in Table 2. In Satkhira, 25.3 % of the respondents were food secure and contributed the most food security among all districts. Regarding severe food insecurity, Kusthia and Khulna contributed 76.2 % and 72.5 % of respondents, respectively. It revealed that 58.7 % of males and 59.6 % of females were mild-to-moderate food insecure (MMFI) and 26.4 % of males and 29.4 % of females were severely food insecure respectively. Respondents aged between 30-40 years and 40–50 years had 65.1 % and 62.8 % mild-to-moderate food insecure but nearly 35 % (20–30 years) and 27 % (40–50 years) had severely food insecure. Furthermore, 57.6 % and 30.2 % were illiterate and exhibited mild-to-moderate food insecurity and severe food insecurity, while 58.1 % of respondents who completed primary education had mild-to-moderate food insecurity. In terms of occupation, 64.2 % and 30.7 % of farmers/day laborers were mild-to-moderate food insecure and severely food insecure while 56.5 % of small vendors were mild-to-moderate food insecure. Our study outlined that respondent who has monthly family income below the poverty line (<58.96 USD) were food insecure (54.2 % mild-to-moderate food insecure and 32.8 % severely food insecure). In addition, respondents who have a monthly family income between 58.96 and 117.93 USD (64.4 %) were mild-to-moderate food insecure. Participants with more than four family members also demonstrated 59.5 % severely food insecure. Furthermore, we also found that respondents who had earned less income during COVID-19 than pre-pandemic were 31.1 % mild-to-moderate food insecure and 62.7 % severely food insecure. In essence, 13.6 %, 27.4 %, and 59 % of the respondents were food secure, moderate food insecure, and severe food insecure, respectively.

The prevalence of occurrence of nine conditions of Household Food Insecurity and Access (HFIAS) during COVID-19 are depicted in Table 3. We found that the prevalence of anxiety and uncertainty regarding inadequate access to food was 85.4 %; it also indicated that 30.3 % and 13.8 % of the total respondents sometimes and often worried about

Table 2
Prevalence of Household Food Insecurity among rural households in the south-western region of Bangladesh, 2021.

Characteristics		Food security n (%)	Mild-to-moderate food insecurity n (%)	Severe food insecurity n (%)	P-value
Location	Khulna	14 (17.5)	8 (10.0)	58 (72.5)	<0.001
	Satkhira	19 (25.3)	30 (40.0)	26 (34.7)	
	Jashore	7 (9.3)	30 (40.0)	38 (50.7)	
	Kushtia	2 (2.5)	17 (21.3)	61 (76.2)	
Gender	Male	30 (14.9)	118 (58.7)	53 (26.4)	0.04
	Female	12 (11.0)	65 (59.6)	32 (29.4)	
Age	20–30 years	13 (20.7)	28 (44.4)	22 (34.9)	0.01
	30–40 years	10 (9.7)	67 (65.1)	26 (25.2)	
	40–50 years	12 (10.6)	71 (62.8)	30 (26.6)	
	>50 years	7 (23.3)	16 (53.4)	7 (23.3)	
Level of education	Illiterate	17 (12.2)	80 (57.6)	42 (30.2)	0.002
	Up to class 5	16 (17.2)	54 (58.1)	23 (24.7)	
	Up to class 12	6 (23.1)	12 (46.2)	8 (30.7)	
	Above class 12	37 (77.5)	12 (18.2)	3 (4.3)	
Occupation	Farmer/Day labor	13 (17.8)	57 (56.5)	31 (30.7)	0.25
	Housewife	18 (18.0)	53 (53.0)	29 (29.0)	
	Small Vendors	10 (10.5)	61 (64.2)	24 (25.3)	
	Job holder	12 (85.8)	1 (7.1)	1 (7.1)	
Family income per month	<58.96USD[a]	25 (13.0)	104 (54.2)	63 (32.8)	0.03
	58.96–117.93 USD[a]	12 (16.4)	47 (64.4)	14 (19.2)	
	>117.93 USD[a]	16 (35.5)	23 (51.2)	6 (13.3)	
Household family member	2–4	8 (10.2)	27 (34.6)	43 (55.2)	0.45
	≥5	31 (13.3)	63 (27.2)	138 (59.5)	
Earned less Income during COVID-19 than pre-pandemic	Yes	17 (6.2)	84 (31.1)	170 (62.7)	0.001
	No	23 (58.8)	12 (30.9)	4 (10.3)	

[a] 1 USD~ 84.79 BDT.

Table 3
Prevalence of occurrence of nine conditions of the Household Food Insecurity and Access (HFIAS) during COIVID-19 among rural households in the south-western region of Bangladesh, 2021.

(i) Frequency of occurrence of nine conditions of Household Food Insecurity Access Scale (HFIAS) (n, (%))

Domain	HFAIS Conditions	Never	Rarely	Sometimes	Often
Anxiety and uncertainty about the household food supply	(Q1) Worry about food	45 (14.6)	128 (41.3)	94 (30.3)	43 (13.8)
Inadequate quality of food	(Q2) Unable to eat preferred foods	40 (12.9)	123 (39.6)	135 (43.6)	12 (3.9)
	(Q3) Eat a limited variety of foods	44 (14.3)	116 (37.5)	136 (43.7)	14 (4.5)
	(Q4) Eat foods that you did not want to eat	48 (15.6)	163 (52.5)	95 (30.6)	4 (1.3)
Insufficient food intake	(Q5) Eat a smaller meal	59 (19.1)	119 (38.4)	130 (41.5)	3 (1.0)
	(Q6) Eat fewer meals in a day	69 (22.3)	102 (32.8)	135 (43.7)	4 (1.2)
	(Q7) No food to eat of any kind in the household	103 (33.2)	166 (53.5)	39 (12.6)	2 (0.6)
	(Q8) Go to sleep at night hungry	138 (44.5)	162 (52.3)	10 (3.2)	0
	(Q9) Go a whole day and night without eating	248 (80)	55 (17.7)	7 (2.3)	0

(ii) Household Food Insecurity Access-related Domains (Yes to at least one condition of a domain (n (%))

	Total n (%)
Anxiety and uncertainty	265 (85.4)
Inadequate quality of food	262 (84.4)
Insufficient food intake	252 (80.9)

(iii) Household Food Insecurity Status (n (%)

Food Secure	42 (13.6)
Mild-to-moderate Food Insecurity	85 (27.4)
Severe Food Insecurity	183 (59.0)

inadequate access to household food. In our study, we also found that the prevalence of inadequate food quality and insufficient food intake was 84.4 % and 80.9 %, respectively. Inadequate quality of the preferred food segment demonstrated that 43.6 % of total respondents were unable to eat preferred family foods sometimes, respectively. Nearly, 44 % sometimes eat a limited variety of foods. The insufficient food intake segment revealed that 41.5 %, 43.7 %, and 12.6 % of the total study population sometimes eat a smaller meal, eat fewer meals in a day, had no food to eat of any kind in the household, respectively.

The logistic regression analysis illustrates the determinants of COVID-19-related household food insecurity (Table 4). In terms of severe food insecurity, Kusthia (RRR = 6.65, CI: 3.37–9.22) outclassed Khulna (RRR = 1.57, CI:1.17–2.58) and Satkhira (RRR = 1.07 CI: 0.67–2.40). We also found that Kustia (RRR = 5.56 CI: 2.67–8.4) surpassed Khulna (3.46 (RRR = 5.56, CI: 2.24–4.6) and Satkhira (RRR = 2.36 CI: 1.67–4.32) in moderate food security. The analysis represents that the odds of being severely food insecure increased among females (RRR = 1.75, 95 % CI: 1.22–3.78), aged between 30 and 40 years (RRR = 1.87, 95 % CI: 1.48–3.97), 40–50 years (RRR = 1.95, 95 % CI: 1.75–3.26), Illiterate respondents (RRR = 1.85, 95 % CI: 1.70–3.20), who had completed education up to class 5 (RRR = 1.42, 95 % CI: 1.31–2.19), small vendors (RRR = 2.43, 95 % CI: 1.12–3.74), farmer/day labor (RRR = 1.65, 95 % CI: 1.48–2.62), monthly family income <58.96 USD (RRR = 2.18, 95 % CI: 1.29–3.17), those family had ≥5 members (RRR = 1.89, 95 % CI: 1.72–2.98), and who had earned less income during COVID-19 than pre-pandemic (RRR = 2.75, 95 % CI: 1.23–4.29) related to their respective counterparts.

Additionally, the odds of being mild-to-moderate food insecure among females were 2.75 times (RRR = 2.75, 95 % CI: 1.23–4.55), aged between 30 and 40 years (2.32 times), aged between 40 and 50 years (1.87 times), illiterate respondents (2.56 times), who had completed education up to class 5 (1.93 times), small vendors (3.27 times), farmer/day labor (2.55 times), monthly family income <58.96 USD (3.38 times), those family had ≥5 members (2.68 times), and who had earned less income during COVID-19 than pre-pandemic (4.25 times) had higher than their respective counterparts.

Table 4
Determinants of household food insecurity among rural households in the southwestern region of Bangladesh, 2021.

Variables	Severe food insecurity	Mild-to-moderate food insecurity
	RRR (95%CI)	RRR (95%CI)
Location (reference category: Jashore)		
Khulna	1.57 (1.17–2.58)**	3.46 (2.24–4.63)***
Satkhira	1.07 (0.67–2.40)	2.36 (1.67–4.32)***
Kusthia	6.65 (3.37–9.22)**	5.56 (2.67–8.40)***
Gender (reference category: Male)		
Female	1.75 (1.22–3.78)**	2.75 (1.23–4.55)**
Age (reference category: 20–30 years)		
30–40 years	1.87 (1.48–3.97)** *	2.32 (1.84–3.77)** *
40–50 years	1.95 (1.75–3.26)**	1.86 (1.46–3.82)**
>50 years	0.75 (0.26–1.25)	0.54 (0.12–1.60)
Level of education (reference category: Above class 12)		
Illiterate	1.85 (1.70–3.20)***	2.56 (1.13–4.87)***
Up to class 5	1.42 (1.31–2.19)**	1.93 (1.29–3.68)**
Up to class 12	1.25 (0.30–2.26)	1.6 (0.40–2.87)
Occupation (reference category: Job holders)		
Farmer/Day labor	1.65 (1.48–2.62)**	2.55 (1.37–4.34)**
Housewife	0.79 (0.15–1.50)	1.27 (1.07–1.89)**
Small Vendors	2.43 (1.12–3.74)***	3.27 (1.34–5.10) ***
Family income per month (reference category: above 117.93 USD[a])		
<58.96 USD[a]	2.18 (1.29–3.17)***	3.38 (1.47–5.33)***
58.96–117.93 USD[a]	1.61 (0.56–1.77)	1.65 (0.61–2.88)
Household family member (reference category: 2–4 members)		
≥5 members	1.89 (1.72–2.98)**	2.68 (1.27–4.23)**
Earned less Income during COVID-19 than pre-pandemic (reference category: No)		
Yes	2.75 (1.23–4.29) ***	4.25 (2.13–6.41)***

$p < 0.05$.
$p < 0.01$.
[a] 1 USD∼ 84.79 BDT, RRR= Relative risk ratio, CI= Confidence interval.

6. Discussion

The COVID-19 lockdown has represented an unprecedented economic and social burden in rural South Asian countries. Stay-home orders have affected almost half of the population in these areas, putting them under movement restrictions. Consequently, restrictions on movement have led them to extreme employment reduction and poverty, with significant food insecurity [4,17,19]. In the context of global concerns about the impact of COVID-19 on food security, our study revealed the prevalence of household food insecurity and associated factors among rural households in the southwestern regions of Bangladesh. Despite the geographical variation, socioeconomic conditions, illiteracy, and natural disasters were responsible for the pre-existing vulnerability to food insecurity situation in the southwestern region of Bangladesh [26,31]. This COVID-19 pandemic played a major blow to jeopardizing the food security situation by disrupting the local supply chains and affecting the availability and affordability of food items in rural households in Bangladesh [27]. In fact, the ratification of food security conditions is equally applicable to our neighboring countries and nations [32,33]. Several studies conducted in India, a contagious border to Bangladesh, demonstrated the unprecedented challenge in food security amid COVID-19 [33]. In our study population, the prevalence of moderate to severe food insecurity was 59 % and 27.5 %, respectively, while only 13.5 % of people were food secure during this pandemic.

Literacy is a parameter widely known to alleviate poverty and carry more opportunities for individuals in society [34]. The southwestern regions have a lower literacy rate than the rest of the country [35,36]. The majority of the population in this area leads their life by farming agricultural land, fishing, and working as day laborers [37]. To control the dissemination of the pandemic, movement restrictions imposed by the government translated into a vast curtail of the labor market, resulting in mass employment reduction among low-income population groups [17,38]. Several previous study suggests that during the COVID-19 shutdown, the majority of low-income middle-aged and young adult family heads have lost their jobs and income, creating a twin problem of food insecurity [14,39]. In agreement with that, our study also demonstrates that street vendors and farmers/daily workers were more vulnerable to moderate to severe food insecurity than others. COVID-19 lockdown had a detrimental effect on the daily earnings of working class and day laborer people, which was directly associated with food insecurity. Population-based studies in Bangladesh depict that more than 70–90 % of the daily workers have lost a significant amount of their everyday earnings due to movement restrictions during COVID-19 [27]. Moreover, we also found that about 83.7 % of respondents experienced reduced earnings during COVID-19, which was significantly associated with food insecurity. Several studies demonstrate a significant correlation between household food security and household income [40]. Findings from a study suggest that family income was directly linked to high dietary diversity scores and household food security [41]. In agreement with these findings, our study depicts individuals with a monthly income of <58.96 USD and 58.96–117.93 USD as having more moderate to severe food insecurity. Among all the districts, Satkhira outclassed the other three districts regarding vulnerabilities from geographical location, natural disasters, deprivation of education, and poverty. A previous study's findings also supported our findings [42,43]. Factors like gender, and household size were responsible for ensuring food security among individuals, households, and communities which is similar to other studies [17,44,45]. The combination of resource constraints, physical challenges, limited employment opportunities, and inadequate social safety nets likely contributes to the increased likelihood of moderate food insecurity in larger households in the southwestern region of Bangladesh. In the past, the majority of southern Asian rural women have experienced gender inequity and

disparities in nutrition and dietary preferences [46] In light of gender considerations, we found that women faced more food insecurity than male during this pandemic time.

In response to tackling the initial sock fitted by the COVID-19 pandemic, the government of Bangladesh undertook several initiatives to ensure food security and financial stability. During the pandemic, the Bangladesh government allocated 65,900 metric tons of rice country-wide and 369,000 U S. dollars to meet food demand for children. Moreover, the Bangladesh government launched a $8.5 billion stimulus program to help the economy recover from pandemic shocks [47]. The government of Bangladesh has provided social security to 8 million people (socioeconomically disadvantaged, older people, widows, and breastfeeding mothers), as well as staple foods and monetary assistance to impoverished households. Despite that, only 12 % of the people nevertheless received government assistance, and despite this program, we saw a rise in food insecurity, particularly severe food insecurity [48] Regarding courses of action measured by NGOs, especially in fund-raising, the country's non-governmental organizations (NGOs) demonstrated commendable initiative and engagement during the COVID-19 response [49].

However, the latter government incentives only addressed the economic sector and did not address issues related to livelihood or health [47]. The government needed to ensure food for those in need and expand safety-net programs in rural areas. The COVID-19 lockdown has exacerbated food and nutrition insecurity globally, including in Bangladesh. Our research identifies key factors contributing to varying degrees of food insecurity during the pandemic. Urgent intervention is needed to address these challenges. Government and policymakers must understand the underlying risk factors and provide targeted support to affected households across all economic levels [50]. The lockdown's repercussions have impacted both socioeconomically disadvantaged and skilled workers' families alike. Assistance must be comprehensive, reaching all families experiencing income reduction, regardless of prior poverty status. Collaborating with NGOs to offer loans to small and medium-sized businesses can enhance household food security amid future pandemics.

6.1. Strength and limitation

The primary strength of the current study lies in its possession of evidence that investigates the factors contributing to food insecurity in the southwestern region of Bangladesh during the COVID-19 pandemic. Despite the familiarity of the results with the challenges faced by regions of high social vulnerability during the COVID-19 pandemic, the study on food insecurity among rural households in the south-western region of Bangladesh in 2021 contributes uniquely to the national and international scene by providing localized insights into the specific determinants affecting this area. These regions are crucial to explore due to their disproportionate vulnerability to food insecurity, exacerbated by factors such as poverty, limited access to resources, and geographical isolation. In 2024, the study's innovation lies in its potential to inform targeted interventions and policies tailored to the unique needs of these communities, thereby addressing longstanding disparities and fostering resilience in the face of ongoing and future crises. Our study will pave the way for future research to understand the effect of the pandemic on FINS in lower-income people and local communities in developing countries. This study also used a face-to-face survey to identify respondent households that integrated several socioeconomic, income, and food access features as confounders that are associated with food insecurity. The primary constraint in this study stems from its cross-sectional design, preventing the establishment of causal relationships. The absence of randomization in participant selection introduces the possibility of bias, potentially limiting the generalizability of the results to our specific study population. Furthermore, a notable constraint of this study is that all the data relied on self-reporting and was derived from subjective perceptions.

7. Conclusion

A strict countrywide lockdown was imposed to prevent the spread of the COVID-19 pandemic, which caused income loss and food insecurity among rural households in the southwestern region of Bangladesh. Our study findings reveal that almost three-quarters of the study population struggled with mild-to-moderate and severe food insecurity during the lockdown period. Moreover, ther is a significant association between respondents residing in Kusthia, aged 30–40 and 40–50 years, and experiencing mild-to-moderate and severe food insecurity. Additionally, individuals with a monthly family income of less than 58.96 USD, households consisting of $\geq$5 family members, and those facing financial difficulties during the pandemic were more prone to moderate and severe food insecurity. The potential causes of household food insecurity must be considered by policymakers from both government and non-governmental organizations. Any unprecedented household food insecurity situation will be alleviated by implementing a complementary approach.

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Conflict of interest

There is no conflict of interest among the authors.

Availability of data and materials

The data may be released for the reviewers and editor not for the public due to the policy of the authors and university.

Ethics approval

Ethical approval and prior permission were obtained from the institutional Ethical Review Committee before the commencement of the study. Ethical approval for the study was obtained from the Jashore University of Science and Technology Institutional Review Board (*Ref: ERC/FBST/JUST/2021-55*). Meetings with household representatives were held, the aims and procedure of the study were explained, and written informed consent forms were obtained.

Consent to participate

To keep confidentiality in data collection, the data collector, supervisor, and investigator used a code number instead of the student's name. All participants provided written consent of their willingness to participate in the study.

Consent for publication

Not applicable.

Author's contribution

SDS was involved in the study, design, data collection, entry and analysis, interpretation of the results, and writing the manuscript. Material preparation, data collection, and analysis were performed by SDS, MMH, TKS, MEH, and TA. The first draft of the manuscript was written by SDS, MMH, TKS, MEH, TA, MR, and MSH and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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