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# Determinants and dynamics of food insecurity during COVID-19 in rural Bangladesh<sup>☆</sup>

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## ABSTRACT

COVID-19 has threatened food security of the poor due to the lockdown of markets amidst poor institutions and lack of social safety nets in the developing world. To provide rapid evidence on the determinants and dynamics of food insecurity and to understand the coping strategies adopted by rural households during the pandemic, we carried out a telephone survey of roughly 10,000 rural households in Bangladesh, three weeks after the country went into lockdown. We found that roughly 90% of households reported experiencing a negative income shock after the countrywide lockdown was implemented. Households that primarily depend on daily casual labor for their income were affected the most, while households with regular jobs were affected the least in terms of food insecurity. Households adversely hit by income shock due to the pandemic were also found to rely more on past savings, food stocks, and loans from various sources to cope with the food crisis. When we followed-up 2402 households, about 3 to 4 weeks after the first survey, to understand the dynamics of food insecurity, we found that food insecurity increased significantly across households and began affecting groups that were in an advantageous position during the first survey. This poses a threat to the poor as food security has already worsened since the crisis hit and would presumably worsen further in the future unless rapid measures are taken to attenuate it at the earliest.

## 1. Introduction

The 2019 coronavirus disease (COVID-19) has brought about unprecedented challenges to the food security situation, particularly in the developing world. The United Nations (UN) estimates that more than a quarter of a billion people could face starvation during the pandemic (UN, 2020). The World Health Organization (WHO) also expressed concern over the potential impact of COVID-19 on food shortages, hunger, and malnutrition which would only increase the vulnerability to diseases further (WHO, 2020). On the global food crisis during COVID-19, the UN World Food Programme Executive Director, David Beasley, stated, "In a worst-case scenario, we could be looking at famine in about three dozen countries" (CSIS, 2020). About 80% of the world's poorest

and most food-insecure people live in remote rural areas. As a result of COVID-19 lockdown and movement restrictions imposed by many countries, these poor people are unable to work due to loss of jobs, businesses, and livelihoods, and with limited access to markets, both their lives and livelihoods have been threatened (Barrett, 2020). Thus, economic lockdown measures imposed by many developing countries carry a serious trade-off in terms of economic welfare, hunger, and poor nutrition (Ravallion, 2020). Moreover, 140 million additional people, primarily in Africa and South Asia, were estimated to be in extreme poverty in 2020 (Laborde et al., 2020), and the number is expected to rise in 2021 (World Bank, 2020). Thus, food insecurity among these people will not only further deteriorate health and physical wellbeing but may also affect their mental health and psychosocial wellbeing

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(Perez-Escamilla and de Toledo Vianna, 2012), particularly among women and children.

In this paper, we investigate the determinants and dynamics of food insecurity during the COVID-19 crisis using data collected via two surveys from rural households in Bangladesh. In particular, we explore the factors that determine food insecurity across rural households during the crisis, coping strategies adopted by them, and how food insecurity transitions over time.<sup>1</sup> We attempt to identify those most at risk of severe hunger and food insecurity in a vulnerable population so that households can be quickly identified, effective policies can be designed, and resources can be allocated at the earliest before hunger and malnutrition in its worst forms manifest in the time of such a crisis. We study Bangladesh for a number of reasons. First, Bangladesh started implementing countrywide lockdown measures on 26 March 2020 due to the pandemic, 18 days after detecting its first COVID-19 positive patient (WHO Bangladesh, 2020). Second, households in Bangladesh had poor food security standing to begin with. According to 2019 estimates, about 51 million people in Bangladesh (31.5% of its population) were either moderately or severely food insecure prior to the pandemic (FAO, 2020). This ranked Bangladesh 83 out of 113 countries globally, which was worse than many of its neighboring countries, such as India, Nepal, Pakistan, and Myanmar (Global Food Security Index, 2019). Third, 13 million people were immediately out of work with no fallbacks after the lockdown (Abi-Habib, 2020), and an additional 16.4 million people (of which 12.7 million are from rural areas) are expected to be in extreme poverty due to COVID-19 in Bangladesh (Laborde et al., 2020). Therefore, the adverse effects of such a countrywide lockdown may extend beyond income shocks, and may also affect people's food security. Thus, food security will only deteriorate further if new policies to protect the vulnerable are not implemented at the earliest.

Our first survey on roughly 10,000 households reveals that households that experienced income loss, primarily rely on daily casual labor, and have memberships to microcredit programs were food insecure immediately after the lockdown was implemented in Bangladesh. As coping strategies, these households turned to draw down their savings and stored food, while households with severe food insecurity also relied on borrowings as an additional coping mechanism. Our follow-up on about 2,400 households (conducted 3–4 weeks after the first survey) shows that a large number of households that were food secure during the first survey turned food insecure during the second survey, and the situation of food-insecure households from the first survey did not improve. Furthermore, households that reported to be well-equipped to handle emergencies experienced a significant improvement in food security than households that are poorly equipped. Overall, our rapid surveys help shed light on the main factors that explain food insecurity among rural households in Bangladesh during the COVID-19 pandemic, how food insecurity deteriorated during the pandemic, and coping mechanisms adopted by households in response to the pandemic shock.

## 2. Data collection

This study focuses on respondents from three already existing surveys (from three large scale RCTs in 2019) conducted in the south-western region of Bangladesh. To collect rapid information on food insecurity, we collaborated with a local NGO, Global Development Research Initiative (GDRI), to conduct brief telephone surveys (or tele-survey) on these respondents. We collected our data via two surveys. Data collection during the first survey (Survey 1 hereinafter) started on 14 April 2020, 19 days after the lockdown, and ended on 3 May 2020. In Survey 1, we covered 9,847 rural households that are distributed across

423 villages. Then, about 3–4 weeks after the first survey, a follow-up survey was conducted on 2,402 households (out of the 9,847 households) that are distributed across 410 villages (Survey 2 hereinafter).

**Sampling.** We leverage the local network of GDRI in Khulna and Satkhira districts to collect our data over the phone. Enumerators tele-surveyed one adult member from each household (either male or female head of households). From the list of 13,450 households available in GDRI directory, 12,625 households (93.8% of 13,450) had at least one mobile phone number registered. Enumerators from GDRI made phone calls to households with phone numbers and found that, (i) 1,263 numbers were invalid (e.g., one or a few digits were possibly wrong) or inactive, (ii) 579 numbers belong to non-household members (e.g., belong to relatives or distant relatives), and (iii) 778 numbers were always switched off throughout the data collection period. Among the households that could be reached over the phone (10,005 households), only 158 households (1.25%) did not want to participate in the survey after being invited. Eventually, we surveyed 9,847 out of 12,625 households with phone numbers, giving us an overall response rate of 78% in Survey 1. For Survey 2, we randomly selected 2,500 out of 9,847 households that took part in Survey 1. The response rate was about 96%, which led us to collect data from 2,402 households in Survey 2. The main reasons for attrition during Survey 2 were due to phones being constantly switched off (35 households), calls not answered repeatedly (41 households), or numbers being inactive (22 households). However, those who answered our phone calls during the follow-up also took part in Survey 2.

**Surveys.** In Survey 1, we collected data on household-level food insecurity (our outcome), income loss, current membership in micro-finance, remittance inflows, household head's primary occupation, and coping strategies. For outcome variables, we construct a range of indicators based on the Food Insecurity Experience Scale (FIES), following Ballard et al. (2013). In addition to indicators, we also use the continuous FIES score in our analysis.<sup>2</sup> FIES is a powerful tool in this situation as it lays emphasis on direct responses of individuals and can capture different situations ranging from anxieties related to lack of food to short term discomforts related to lack of quality and quantity to life-threatening characteristics such as hunger, related to the access dimension of food security. While FIES is designed to identify degrees of food insecurity at the individual-level, we framed FIES questions to measure food insecurity at the household-level.<sup>3</sup> We used FIES instead of other widely used experience-based food insecurity scales, such as the HFIAS or the ELCSA (see INDDEx Project, 2018), because FIES is relatively shorter with 8 questions, which was crucial given the interview time constraints.<sup>4</sup> Although one respondent per household gives us less precise indications of household-level food insecurity, interviewing all adult members per household was not feasible due to time constraints.<sup>5</sup> However, FIES has been found to be successful at producing results comparable to those of the HFIAS and the ELCSA scales (INDDEx Project, 2018). During the follow-up (Survey 2), we only collected information on household-level food insecurity (i.e., FIES questions).

To explore the drivers of household-level food insecurity during the pandemic, we consider explanatory variables that have been reported in the literature as important factors influencing food security, particularly

<sup>2</sup> See Appendix B for a detailed discussion of the FIES score and how we construct our indicators, and see Table B1 and Fig. B1 in the same Appendix for its summary.

<sup>3</sup> For instance, while asking "...you went without eating for a whole day?", we framed it as "...you or any household member went without eating for a whole day?" when asking the respondents in Bengali.

<sup>4</sup> In contrast, HFIAS has 18 (including subquestions) and ELCSA has 15 questions.

<sup>5</sup> Besides, households in this context often share and consume the same food; thus, distinguishing one member's access and availability of food from another member was not a viable option.

<sup>1</sup> Although macro-level factors, such as trade restrictions, have a strong impact on food supply and prices, and, thus, affects the food security of the poor (Glauber et al., 2020; Sulser and Dunston, 2020), we focus primarily on household-level factors of food insecurity in this study.

**Table 1**  
Summary statistics and variable descriptions.

Variables	Mean	Std. Dev.	N	Type	Description
<i>Panel A: Food insecurity during survey 1 (All sample)</i>					
FIES Score	2.778	1.971	9,847	C	FIES score is between 0 and 8, where a higher score corresponds to high food insecurity
Food secure	0.189	0.392	9,847	D	1 = Household never faced food insecurity in the last 2–3 weeks; 0 = Otherwise
Food insecure	0.811	0.392	9,847	D	1 = Household faced at least some food insecurity in the last 2–3 weeks; 0 = Never faced insecurity
Mild food insecurity	0.240	0.427	9,847	D	1 = Household worry about food intake, were unable to eat healthy food, or ate few varieties of food in the past 2–3 weeks; 0 = Otherwise
Moderate food insecurity	0.506	0.500	9,847	D	1 = Household had to skip a meal, ate less than usual, or ran out of food during the past 2–3 weeks; 0 = Otherwise
Severe food insecurity	0.065	0.247	9,847	D	1 = Household members were hungry yet did not eat or did not eat for a whole day during the past 2–3 weeks; 0 = Otherwise
<i>Panel B: Household income loss (All sample)</i>					
Complete income loss	0.561	0.496	9,847	D	1 = Stopped earning income completely; 0 = Otherwise
Partial income loss	0.361	0.480	9,847	D	1 = Earn income partially; 0 = Otherwise
Income unchanged	0.078	0.268	9,847	D	1 = Income remained unchanged; 0 = Lost income partially or completely
<i>Panel C: Primary occupation of the household (All sample)</i>					
Agricultural farmer	0.169	0.374	9,847	D	1 = Agricultural farmer by occupation; 0 = Otherwise
Farm laborer	0.090	0.286	9,847	D	1 = Farm wage laborer by occupation; 0 = Otherwise
Day laborer	0.325	0.468	9,847	D	1 = Daily wage laborer by occupation; 0 = Otherwise
Self-employed/Business	0.256	0.437	9,847	D	1 = Self-employed/Business owner by occupation; 0 = Otherwise
Government job	0.036	0.186	9,847	D	1 = Public servant by occupation; 0 = Otherwise
Private job	0.053	0.223	9,847	D	1 = Private servant by occupation; 0 = otherwise
Others	0.072	0.259	9,847	D	1 = Other occupations; 0 = Listed occupations

**Table 1 (continued)**

Variables	Mean	Std. Dev.	N	Type	Description
<i>Panel D: Change in Remittances and Microcredit (All sample)</i>					
Complete remittance loss	0.014	0.119	9,847	D	1 = Stopped receiving remittance completely; 0 = Never receive remittance
Partial remittance loss	0.008	0.090	9,847	D	1 = Receive remittance less than before; 0 = Never receive remittance
Remittance unchanged	0.003	0.055	9,847	D	1 = Remittance amount remain unchanged; 0 = Never receive remittance
Microcredit loan taken	0.506	0.500	9,847	D	1 = Enrolled in a microcredit program; 0 = Not enrolled
<i>Panel E: Coping strategies (Subsample: excludes income unchanged)</i>					
Past savings	0.760	0.427	9,082	D	1 = Using savings to purchase food; 0 = Otherwise
Previously stored food	0.566	0.496	9,082	D	1 = Consuming previously stored food; 0 = Otherwise
Help from friends/relatives	0.048	0.214	9,082	D	1 = Received help from friends/relatives; 0 = Otherwise
Help from the Government	0.093	0.290	9,082	D	1 = Received government relief; 0 = Otherwise
Help from NGOs	0.005	0.073	9,082	D	1 = Received relief from NGO; 0 = Otherwise
Other loans taken	0.335	0.472	9,082	D	1 = Borrowed money; 0 = Otherwise
Other sources	0.061	0.240	9,082	D	1 = Availed food via any other means not listed; 0 = All listed means
<i>Panel F: Other Household Characteristics (Subsample: collected in 2019)</i>					
Agricultural land possession (in '00 decimals)	0.358	2.130	2,691	C	Area of land possessed (approx. 1/100 acre)
Never went to school	0.099	0.298	2,691	D	1 = If never went to school; 0 = Otherwise
Completed Primary	0.617	0.486	2,691	D	1 = If completed primary education; 0 = Otherwise
Completed Secondary	0.150	0.357	2,691	D	1 = If completed secondary education; 0 = Otherwise
Completed Higher Secondary	0.082	0.274	2,691	D	1 = If completed higher secondary education; 0 = Otherwise
Beyond Higher Secondary	0.052	0.223	2,691	D	1 = If completed any degree after higher secondary; 0 = Otherwise
Bottom 25% of income	1.667	0.377	673	C	Average monthly income (in '000 BDT) of households that falls within the bottom 25% income
Middle 50% of income	2.745	0.540	1,362	C	Average monthly income (in '000 BDT) of households that falls within the middle 50% income
Top 25% of income	4.795	1.825	656	C	Average monthly income (in '000 BDT) of households that falls

(continued on next page)

Table 1 (continued)

Variables	Mean	Std. Dev.	N	Type	Description
Equivalized savings	0.522	2.782	2,691	C	within the top 25% income Household savings divided by square root of household size
Proportion of female household members	0.518	0.169	2,691	C	Female household members divided by total household members
Women's decision-making power	0.151	0.358	2,691	D	1 = If women are involved in family expenditure decisions 0 = Otherwise

**Note:** Data presented in Panels A-E were collected during Survey 1, while data in Panel F were collected previously in 2019 (as part of a different research project). In Panel C, only one occupation (which is the primary occupation) per household was recorded. Coping mechanisms do not add up to 1 as a household may use more than one coping strategy; also, coping mechanism questions were only asked to households that lost their incomes (either complete or partial). 'Type' column specifies whether a variable is dummy (D) or continuous (C).

in the context of rural households in low and middle-income countries. We consider four broad variable categories that are applicable to rural households in Bangladesh: (i) *income loss*, where negative income shock has been found to be associated with worsening individual and household-level food insecurity (Ansah et al., 2020); (ii) *primary occupation*, where formal, skilled, and stable occupations are related to lower levels of food insecurity across households (Dzanku, 2019) (iii) *remittance inflow*, where households that receive regular remittance are found to be better-off in terms of food security (Mabrouk and Mekni, 2018), and (iv) *microfinance*, where access to microcredit is associated with increased food security and calorie intake across households (Islam et al., 2016). Similarly, we also consider coping strategies, such as using savings, stored food, borrowings, help from the government and NGOs, etc., highlighted in the literature as frequently used measures to cope with food shortages during crises (Chagomoka et al., 2016). Summary statistics and descriptions of these variables are presented in Table 1 (Panels B-E).

Since conducting comprehensive tele-survey on a large sample was not feasible, we matched a subsample of the tele-surveyed households to data collected previously (for a different research project) to explore whether household characteristics, such as financial decision-making power of women within households, the proportion of female household members, education, income, equivalized savings, and agricultural land possession, can also help explain food insecurity. This data was collected in June 2019 and comprises 2,691 households (out of 9,847 rural households surveyed in Survey 1).<sup>6</sup> Table 1 (Panel F) also provides summary statistics and descriptions of these additional characteristics.

**Non-participation and attrition.** To check if any household-level characteristics explain non-participation in Survey 1, we use the 2019 data that is available for 2,691 (out of 9,847) households that took part in Survey 1 (listed in Table 1, Panel F) and 816 (out of 3,603) households that could not be surveyed due to various reasons (see **sampling**). We then regress the non-participation dummy (that equals 1 if could not be interviewed in Survey 1 and 0 otherwise) on all household-level characteristics listed in Table 1, Panel F, and find that non-participating households have less education beyond higher secondary relative to households that took part in Survey 1 ( $p < 0.10$ ). Otherwise, households are fairly similar. Besides, we fail to reject the  $F$ -test that all

characteristics jointly explain attrition ( $F$ -test  $p = 0.331$ ). These estimates are presented in Column 1 of Table A1 in Appendix A. Similarly, to check if the information collected during Survey 1 explain attrition in Survey 2, we regress the attrition dummy (that equals 1 if attrited in Survey 2 and 0 otherwise) on all explanatory variables collected during Survey 1.<sup>7</sup> These estimates are presented in Columns 2–3 in Table A1 in Appendix A. We find that attritors (98 households or 4% of 2,500 households) and non-attritors (2,402 households) are fairly similar across all characteristics ( $F$ -test  $p = 0.739$  in Column 2 and  $p = 0.638$  in Column 3). Given the similarities between attritors and non-attritors, we do not believe attrition has considerably biased our sample or its representativeness.

**Mobile phone survey.** In Bangladesh, roughly 94% of rural households own at least one mobile phone (Bangladesh Demographic and Household Survey, 2019). While wider mobile phone coverage minimizes the concern for undercoverage biases, it does not entirely rule out the concern that our study sample might be biased to those possessing working mobile phone connections, affecting the sample's overall representativity. Thus, to understand the representativeness of our study sample, we compare the characteristics of our sample (using the data collected in 2019) to the rural sample of the Bangladesh Household Income and Expenditure Survey 2016 (HIES) data (Bangladesh Bureau of Statistics, 2016). These comparisons are reported in Table B2 in Appendix B. Our comparisons indicate that our survey households have very similar characteristics to average rural households in Bangladesh.

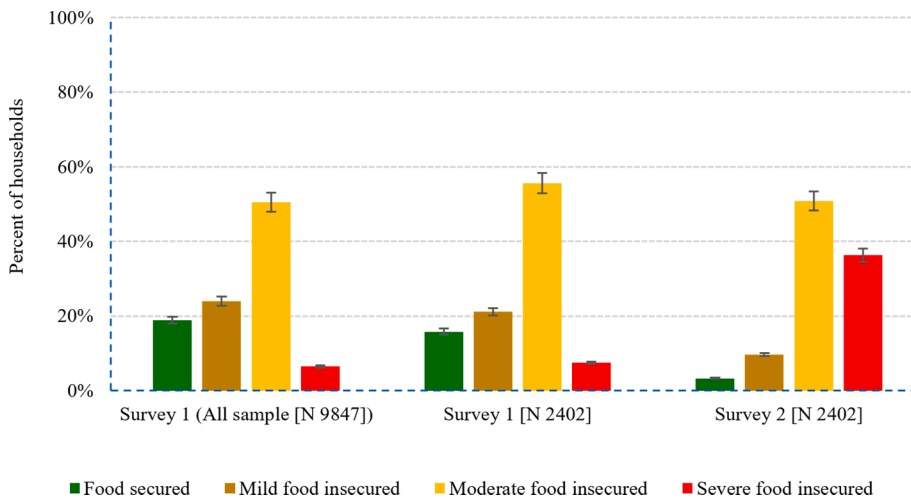
Although surveys via mobile phones is a relatively new practice in the context of rural Bangladesh, we are confident that phone data quality is comparable to face-to-face data quality.<sup>8</sup> During data collection, we closely followed Block and Erskine (2012) to carefully address the three major concerns of data validity in phone surveys—sample, tools, and medium. First, we considered all households available in the NGO directory to have a large sample size (see **sampling** for more details). Second, we did not ask any sensitive questions during the survey, and response scales were limited to five (with many questions having yes/no responses). Also, questions and response scales were always repeated before recording responses. Third, often distance and anonymity induce respondents to answer differently over the phone, as it affects the expressiveness and trust of respondents towards enumerators. Here GDRI's reputation and previous engagement with the sample households helped attenuate this concern. For instance, enumerators are locals and known to households through previous face-to-face interviews and interactions. Besides, enumerators always called twice, first to establish rapport and find a convenient time for the interview, and second for the interview itself. Considering various constraints in the pandemic, we were successful at conducting surveys without any reports of rushed interviews or dropouts in the middle of interviews.

**Lessons learned during COVID-19.** This study benefited notably from our already-installed research infrastructure in the southwest region of Bangladesh. First, the local research-focused NGO, GDRI, has a wide local network with up-to-date contact information of numerous households in this area. This allowed us to reach out to as many as 10,000 households during the first survey and also conduct a follow-up on a subset of households. Second, many of the surveyed households (for this study) were previously surveyed by GDRI, which gave us access to various additional household-level information. Besides, households responded positively as they were familiar with GDRI's social activities in this region. Third, enumerators at GDRI are highly trained with

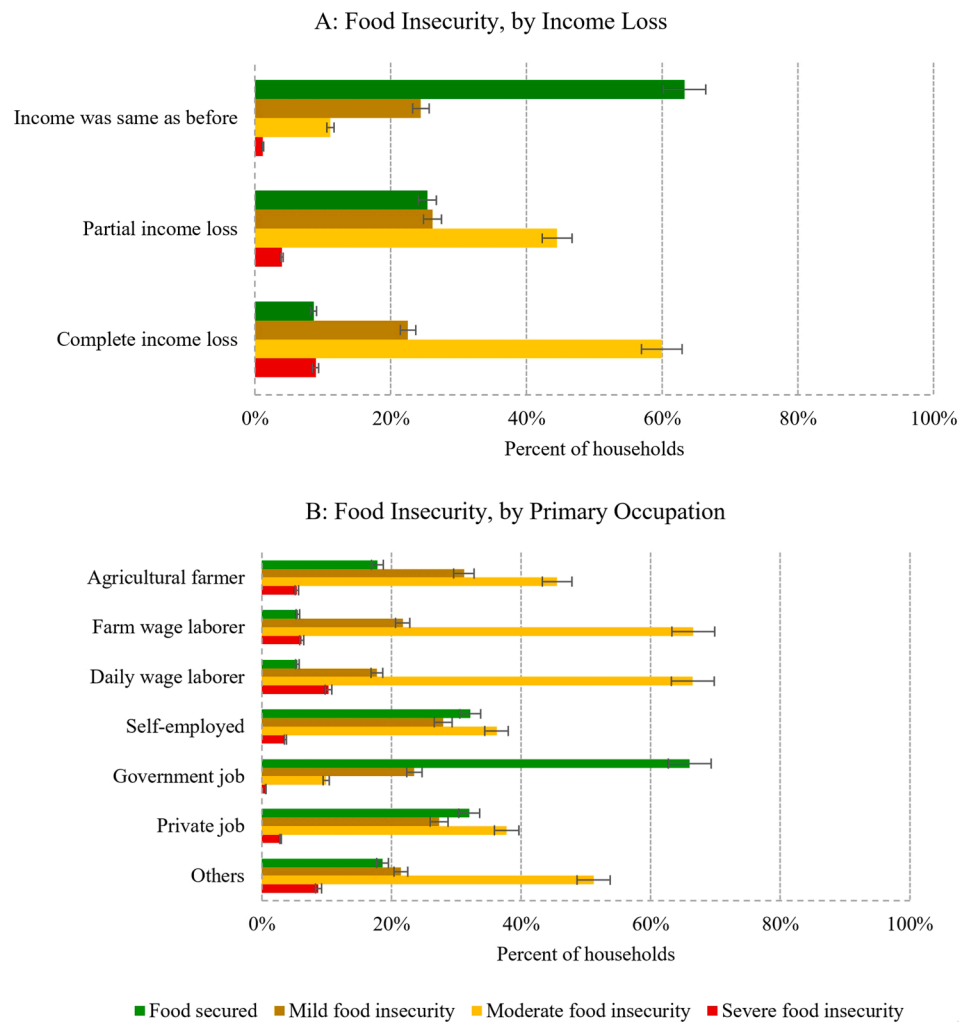
<sup>6</sup> Food insecurity measures across these households are not available prior to Survey 1; thus, we cannot compare food insecurity during the first few weeks of lockdown to that before the lockdown in this study.

<sup>7</sup> We do not examine attrition in Survey 2 using the 2019 data because this data is available for 672 (out of 2,402) households that participated in Survey 2 but for only 30 (out of 98) households that attrited in Survey 2; thus, it might not be sufficiently powered to test for a difference.

<sup>8</sup> Data collected via phone interviews provide estimates comparable to data collected through face-to-face interviews in both developed and developing country contexts (Weeks et al., 1983; Mahfoud et al., 2015).



**Fig. 1.** Food Insecurity Across the Two Surveys. **Note:** This figure summarizes food insecurity across the two surveys of data collection. ‘Food secured’ is an indicator for households that did not face any food insecurities in the past 2–3 weeks. ‘Mild food insecurity’ is a dummy variable that equals 1 if households worry about food intake, were unable to eat healthy food, or ate few varieties of food in the past 2–3 weeks and 0 otherwise; ‘Moderate food insecurity’ is a dummy variable that equals 1 if households had to skip a meal, ate less than usual, or ran out of food during the past 2–3 weeks and 0 otherwise; ‘Severe food insecurity’ is a dummy variable that equals 1 if household members were hungry yet did not eat or did not eat for a whole day during the past 2–3 weeks and 0 otherwise. Bars with 95% confidence intervals have been reported.



**Fig. 2.** Summary of Food Insecurity. **Note:** Bars with 95% confidence intervals have been reported. See Table 1 for variable descriptions.

substantial experience (working for at least five years) in interviewing and collecting quantitative data from similar respondents. This, along with access to previous data, resulted in our interviews being relatively short (20 min per household on average). During a brief pilot, we also learned that setting up an appointment prior to conducting interviews

lead to higher participation by households and reduced attrition during the follow-up. We believe both appointments and interview durations have improved our data quality. Finally, one of the investigators of this study (Firoz Ahmed) is affiliated with a public university located in the study region, which improved our communication with GDRI and



**Table 2**  
Determinants of Food Insecurity.

VARIABLES	Food Insecure		Mild		Moderate		Severe		FIES Score	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>Household income loss (omitted category: No income loss (odd columns)/ Partial income loss (even columns))</i>										
Complete Income Loss	0.412*** (0.023)	0.089*** (0.009)	0.305*** (0.029)	0.103*** (0.017)	0.511*** (0.023)	0.124*** (0.012)	0.302*** (0.026)	0.118*** (0.022)	1.906*** (0.081)	0.586*** (0.040)
Partial Income Loss	0.303*** (0.023)	–	0.180*** (0.029)	–	0.354*** (0.024)	–	0.081*** (0.022)	–	1.143*** (0.076)	–
<i>Occupation of the household head (omitted category: Farmer)</i>										
Farm Laborer	0.096*** (0.015)	0.067*** (0.014)	0.065* (0.035)	0.035 (0.034)	0.148*** (0.020)	0.106*** (0.018)	0.179*** (0.054)	0.105* (0.054)	0.586*** (0.077)	0.373*** (0.074)
Day Laborer	0.111*** (0.013)	0.069*** (0.012)	0.122*** (0.025)	0.095*** (0.027)	0.161*** (0.017)	0.104*** (0.015)	0.302*** (0.035)	0.198*** (0.035)	0.852*** (0.064)	0.572*** (0.059)
Self-employed/Business	–0.115*** (0.014)	–0.109*** (0.014)	–0.109*** (0.020)	–0.096*** (0.022)	–0.145*** (0.019)	–0.137*** (0.019)	–0.089*** (0.027)	–0.060** (0.026)	–0.563*** (0.066)	–0.507*** (0.064)
Government Job	–0.176*** (0.034)	–0.198*** (0.061)	–0.145*** (0.041)	–0.162* (0.089)	–0.195*** (0.033)	–0.187*** (0.067)	–0.065* (0.036)	–0.106 (0.064)	–0.667*** (0.121)	–1.175*** (0.203)
Private Job	–0.035* (0.021)	–0.042* (0.022)	–0.036 (0.032)	–0.038 (0.039)	–0.054** (0.026)	–0.061** (0.029)	–0.054 (0.037)	–0.087* (0.044)	–0.298*** (0.091)	–0.313*** (0.100)
Others	–0.002 (0.016)	–0.022 (0.016)	–0.045 (0.031)	–0.039 (0.033)	0.014 (0.021)	–0.011 (0.020)	0.041 (0.037)	0.036 (0.039)	0.228** (0.088)	0.094 (0.083)
<i>Change in Remittances (omitted category: No remittance)</i>										
Completely stopped	–0.076** (0.035)	–0.074** (0.034)	–0.140** (0.055)	–0.143** (0.060)	–0.066 (0.046)	–0.050 (0.047)	–0.080 (0.052)	–0.062 (0.050)	–0.151 (0.172)	–0.148 (0.161)
Partially stopped	–0.028 (0.043)	–0.027 (0.043)	–0.001 (0.063)	0.004 (0.068)	–0.027 (0.049)	–0.014 (0.051)	–0.044 (0.043)	–0.008 (0.053)	–0.271 (0.178)	–0.230 (0.196)
Unchanged	–0.081 (0.084)	–0.249* (0.130)	0.002 (0.104)	–0.503** (0.215)	–0.131 (0.082)	–0.259 (0.169)	–0.014 (0.086)	–0.447*** (0.128)	–0.276 (0.443)	–1.304* (0.774)
<i>Involved in microcredit program (omitted category: No loan taken)</i>										
Microcredit loan taken	0.045*** (0.007)	0.027*** (0.007)	0.070*** (0.015)	0.061*** (0.016)	0.044*** (0.009)	0.023** (0.009)	0.059*** (0.017)	0.035** (0.017)	0.226*** (0.037)	0.136*** (0.037)
<i>Coping strategies</i>										
Past savings	–	–0.107*** (0.013)	–	–0.135*** (0.027)	–	–0.145*** (0.017)	–	–0.189*** (0.035)	–	–0.761*** (0.067)
Previously stored food	–	–0.072*** (0.011)	–	–0.085*** (0.023)	–	–0.098*** (0.014)	–	–0.102*** (0.028)	–	–0.424*** (0.055)
Help from friends/relatives	–	0.005 (0.014)	–	0.066 (0.048)	–	0.002 (0.019)	–	0.162*** (0.045)	–	0.268*** (0.098)
Help from the Government	–	0.023** (0.011)	–	0.041 (0.037)	–	0.031** (0.014)	–	0.134*** (0.041)	–	0.282*** (0.071)
Help from NGOs	–	0.024 (0.025)	–	0.122* (0.073)	–	0.030 (0.032)	–	0.219** (0.101)	–	0.052 (0.215)
Other loans taken	–	0.070*** (0.010)	–	0.090*** (0.023)	–	0.097*** (0.014)	–	0.238*** (0.037)	–	0.536*** (0.055)
Others	–	–0.013 (0.019)	–	–0.034 (0.039)	–	–0.012 (0.025)	–	0.014 (0.040)	–	0.047 (0.099)
Village FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,847	9,082	4,225	3,554	6,844	6,275	2,506	2,013	9,847	9,082
R-squared	0.356	0.317	0.451	0.467	0.492	0.457	0.600	0.697	0.409	0.423

Robust standard errors clustered by village are in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Note:** OLS estimates reported. Dependent variables in columns 1–2 are a dummy that equals 1 if households have food insecurity and 0 if no food insecurity (full sample); columns 3–8 breaks down the sample into mild, moderate, and severe food insecurities (split-samples); i.e., dependent variables in columns 3–4 are a dummy that equals 1 if households have mild food insecurity and 0 if no food insecurity; dependent variables in columns 5–6 are a dummy that equals 1 if households have moderate food insecurity and 0 if no food insecurity; dependent variables in columns 7–8 are a dummy that equals 1 if households have severe food insecurity and 0 if no food insecurity; dependent variables in columns 9–10 are FIES score (between 0 and 8), where high number corresponds to high food insecurity. Even columns focus only on households that have experienced a negative income shock due to COVID-19 (i.e., experienced either complete or partial income loss). Since coping strategies only apply to households that reported income loss, odd columns do not report estimates for coping strategies. See Table 1 for other variable descriptions.

reduced various other costs. In terms of monetary costs, the total cost of data collection (by 25 enumerators) across the two surveys was about USD 11,000. This includes the costs of phone calls, enumerator training, enumerator salary, NGO overhead, etc. These costs are very low relative to the costs of collecting data in-person. Therefore, researchers looking to collect data from rural communities in developing countries during COVID-19 should take note.

### 3. Results

**Raw comparisons.** Fig. 1 (see Survey 1, all sample) provides a sense of the overall food insecurity experienced by rural households following the lockdown in Bangladesh. It is evident that more than 80% of households experienced mild to severe food insecurities and more than 50% of households experienced moderate to severe food insecurities. This summary is complemented with Table 1. In the summary presented in Table 1, three other characteristics stand out: (i) 90% of the households have experienced income loss during COVID-19, (ii) more than

50% of the head of households are either in farming or are day laborers, and (iii) use of savings, borrowings, and food stocks appear to be the main coping strategies to address food shortages during the pandemic. Additionally, Fig. 2 highlights some interesting variations in food insecurity. For instance, it appears income loss and food insecurity are strongly correlated across households. While households with no change in income are mostly food secured, food insecurity appears to increase with income loss (Graph A, Fig. 2). In terms of occupation, food insecurity falls relatively more in the moderate to severe category for households that are primarily farmers and wage laborers than among households with more stable occupations, such as having public sector jobs or owning businesses (Graph B, Fig. 2).

**Empirical method.** To examine in detail whether factors such as loss of income, primary occupations of households, remittances received from family members (from cities and/or abroad), and involvement in microcredit programs determine the incidence of food insecurity, we regress self-reported food security measures (indicator outcomes) on a range of explanatory variables using an OLS regression model. We use a linear probability model (LPM, which is OLS with binary outcomes) because coefficients are straightforward and easier to interpret than coefficients from binary probit or logit models.<sup>9</sup> Moreover, we also compute robust standard errors by taking the heteroskedastic error term of LPM into account. For robustness, we nevertheless report binary probit estimates in Appendix A.

Our main linear probability model is as follows:

$$Y_{ij} = \alpha + I' \beta + O' \gamma + R' \delta + \theta M_{ij} + \nu_j + \epsilon_{ij} \quad (1)$$

where the dependent variable  $Y_{ij}$  for household  $i$  in village  $j$  is, alternatively, (i) indicator for food insecurity, (ii) indicator for mild food insecurity, (iii) indicator for moderate food insecurity, (iv) indicator for severe food insecurity, or (v) FIES Score (between 0 to 8). See Table 1 (Panel A) and Section 1 in Appendix B for a brief discussion and construction of the outcome variables used in the analysis. Subsequent panels in Table 1 also defines the following explanatory variables:  $I$  is a vector of indicators for partial and complete income loss (Panel B);  $O$  is a vector of indicators for primary household occupations (Panel C);  $R$  is a vector of indicators for change in household remittances (Panel D); and,  $M$  is an indicator for households that are enrolled in microcredit programs (Panel D). In all specifications, we include village fixed effects,  $\nu_j$ , and cluster standard errors at the village level (423 clusters). We report these estimated coefficients in odd-numbered columns in Table 2. Columns 1 and 9 present estimates on the full sample while columns 3, 5, and 7 report estimates on subsamples.

Because both income loss and occupations (and also microcredit membership) enter in the regression model as independent variables, a potential concern regarding the results is that standard errors might be influenced due to high correlations between variables. Thus, to detect multicollinearity, we compute variance inflation factors (VIF) for all variables in all specifications to check how much standard errors were inflated (by  $\sqrt{VIF}$ ) due to multicollinearity compared to if variables had no correlations in between. Using the general rule of thumb that  $VIFs > 10$  as signs of serious multicollinearity (Neter et al., 2004), we find that none of the variables in any specification exceed this threshold.

Moreover, it is plausible that income loss (our main independent variable) caused food insecurity, but we believe that it is less likely that food insecurity would be the driving factor for income loss. However, involvement in microfinance programs and/or NGO and government supports could be endogenous with respect to household-level food

insecurity. Thus, the relationships discussed below are interpreted as correlational, without making any claims to causality. Given the lack of exogenous variations, valid instruments, etc., we cannot properly deal with the endogeneity concern. However, we carry out an exploratory analysis following Brodeur et al. (2020) to check how having different combinations of explanatory variables changes the coefficient on the income loss variable for instance. That is, we observe how removing, keeping, or adding variables in different combinations to the model (that also includes/excludes plausible endogenous variables) changes other estimates. Our results remain largely robust with all possible combinations of explanatory variables.<sup>10</sup>

**Determinants.** First, on income loss, we find that households that experienced a complete or partial loss of income are more likely to be food insecure than households that did not experience income loss. When we break down income loss into complete and partial, we find that both partial and complete income loss leads to being more food insecure. However, food insecurity among households that experienced partial income loss is statistically less severe than households that experienced complete income loss (F-test:  $p < 0.01$  while comparing these two estimated coefficients within all odd-numbered columns). Overall, income loss is positively correlated with food insecurity across households. This result corroborates findings from Elshahry et al. (2020) that used an online survey in Jordan to collect data from roughly 3,000 individuals and Kansime et al. (2020) that used social media and emails in Kenya and Uganda to collect data from 442 individuals during the COVID-19 lockdown.

Second, in terms of occupation, we find that households that rely on farm and day labor jobs are more likely to be food insecure than households that rely on agricultural farming (Columns 1 and 9). Moreover, positive, significant, and larger coefficients under 'moderate' and 'severe' panels relative to coefficients under 'mild' panel imply that households that are dependent on farm and day labor jobs experience more severe food insecurity (Column 3, 5, and 7). Besides, households that are reliant on day labor jobs experience statistically more severe food insecurity relative to households that are reliant on farm labor jobs (Column 7; F-test:  $p = 0.022$ ), while mild and moderate food insecurity across households dependent on farm and day labor jobs are statistically similar (F-test:  $p = 0.090$  (in mild, Column 3) and  $p = 0.350$  (in moderate, Column 5)). On the other hand, households that have their own businesses or households with primary income earners working in the public sector are less food insecure than households that depend on agricultural farming (Columns 1 and 9).<sup>11</sup> Also, government jobs appear to make households more food secure than having own businesses; however, the difference between the estimated coefficients is only marginally significant in column 1 (F-test:  $p = 0.064$  in column 1 but  $p > 0.10$  in subsequent columns). Interestingly, households that rely on private sector jobs are only marginally better off in terms of food security than those reliant on farming. However, households reliant on public sector jobs and own businesses are significantly more food secure than those that rely on private sector jobs (F-test:  $p < 0.01$  in all comparisons within odd-numbered columns). A reasonable interpretation of this fact is that public sector jobs tend to be more stable than any other jobs in Bangladesh.

Finally, on the involvement in microcredit programs, we find that households with membership to microcredit programs are more likely to be food insecure than households with no membership (Columns 1 and 9). The estimated coefficients on this indicator are also similar across specifications and suggest that membership to microcredit programs is

<sup>9</sup> According to King and Zeng (2001), if estimates from LPM are very extreme then probit/logit regressions should be preferred. However, in the case of non-extreme estimates, LPM and probit/logit models are equally ideal but LPM should be favored because of its ease of interpretation. Angrist (2001) also advocates using an LPM for binary outcomes.

<sup>10</sup> To economize on space, we do not report the results from VIF calculations and Brodeur et al. (2020) specification checks in the paper, but these results will be made available upon request.

<sup>11</sup> This result is different from Kansime et al. (2020), which finds that self-employed individuals in Kenya and Uganda are more likely to be food insecure than agricultural farmers.

correlated with household food insecurity, presumably due to repayment obligations that further weakens the purchasing power of the household. Surprisingly, remittance received from family members seems to explain food insecurity very little. For instance, only households that stopped receiving remittances during COVID-19 are less food insecure than households that receive no remittances (Column 1); although, this insecurity is rather mild (Column 3). One possible explanation for this negative and statistically significant coefficient is that households with family members working abroad or in the cities are usually better-off financially than households with no family members working abroad or in the cities. Thus, discontinuation of remittances still keeps these households relatively less food insecure. Besides, remittances that partially stopped or remain unchanged do not explain food insecurity across households.

To check the robustness of these results, we augment all specifications with additional household-level characteristics (collected in 2019) and find that results reported in Table 2 are robust to controlling for additional household-level characteristics. Among the household-level characteristics, only equalized savings significantly explain food insecurity across all specifications, while agricultural land possessions, education, households with female heads, etc. do not explain food insecurity (Columns 1–8).<sup>12</sup> This is consistent with Elshoryi et al. (2020) and Kansime et al. (2020), where education, gender, age, household head status, etc., do not explain food insecurity during COVID-19. These results are reported in Table A2 in Appendix A. Our results also remain robust and qualitatively similar across all specifications using probit (for dummy outcomes in columns 1 through 7) and ordered probit (for FIES score outcome in column 9) models. These results are provided in Table A3 in Appendix A. Since other household characteristics of our sample (collected in 2019) explain food insecurity very little (also listed and defined in Panel F, Table 1), we focus the remainder of the analysis without controlling for these characteristics.

**Coping mechanisms.** Next, we discuss how households are coping with the negative income shock. Panel E in Table 1 and Fig. A1 in Appendix A highlight some major coping strategies. It appears households primarily rely on previous savings and stored food to cope with income loss. Also, households with complete income loss are more likely to take out loans than households with partial income loss. Similarly, Fig. A2 in Appendix A provides a sense of the association between food insecurity and coping strategies. This figure highlights two noteworthy relationships. First, households with higher savings and access to stored food from the past are less food insecure. Second, the more food-insecure households are, the more likely they are to borrow/loan money. Other crucial mechanisms, particularly NGOs and government aid, supported these households to some extent during the crisis.

To explore these relationships more in detail, we augment our LPM model by adding coping strategies (listed and defined in Panel E, Table 1) as additional explanatory variables. We report these augmented specifications in even-numbered columns in Table 2.<sup>13</sup> Focusing on coping strategy estimates, we see that households that rely on previous savings and stored food to cope with the crisis are less likely to be food insecure, as indicated by negative and statistically significant coefficients (even-numbered columns), corroborating findings from Kansime et al. (2020). Likewise, household borrowing/loans is also positively associated with food insecurity, where severely food insecure households take out more loans than households with mild to moderate

<sup>12</sup> However, agricultural land possession and education are statistically significant when the ordered FIES score is used as the dependent variable (Columns 9–10). Although the significance of these variables disappear when the dependent variable is an indicator, implying this result is not robust.

<sup>13</sup> Since coping strategies only apply to households that experienced income loss due to COVID-19, specifications in even-numbered columns only focus on households that experienced an income loss and, thus, have smaller samples than specifications in odd-numbered columns in the same Table.

**Table 3**  
Improvement and Deterioration in Food Insecurity Over Time.

Incidence of food insecurity in survey 1	Incidence of food insecurity in survey 2		Total
	Food Secure	Food Insecure	
Food Secure	47 (1.96%) (Always food secured)	333 (13.86%) (Deterioration) (Mild = 67, Moderate = 236, Severe = 30)	380 (15.82%)
Food Insecure	31 (1.29%) (Improvement) (Mild = 31, Moderate = 0, Severe = 0)	1,991 (82.89%) (Always food insecure) (Mild = 165, Moderate = 984, Severe = 842)	2,022 (84.18%)
N (%)	78 (3.25%)	2,324 (96.75%)	2,402 (100%)

**Note:** The break-ups for the extent of food insecurity are presented in the brackets below.

food insecurities (also highlighted in Fig. A2 in Appendix A). Moreover, severely food insecure households go to friends and relatives for help (Column 8); the government and NGOs have also been successful to an extent in effectively targeting, identifying, and helping the food insecure households.<sup>14</sup> This is in line with findings from Ceballos et al. (2020), where individuals relied on borrowings and government support as a coping strategy in India.

**Dynamics.** Is food insecurity deteriorating rapidly? To explore this possibility, we followed-up on a subset of households from the first survey ( $N = 2,402$ ) to investigate whether food insecurity among rural households is deteriorating further during the pandemic-lockdown.<sup>15</sup> We look back at Fig. 1 (Surveys 1 and 2,  $N = 2,402$ ), which also provides an ocular depiction of household-level food insecurity dynamics. It is evident from this figure that the proportion of food secure and mildly insecure households dropped relative to their Survey 1 insecurities (roughly by 10 percentage points), while the number of severely insecure households drastically increased during the second survey (roughly by 30 percentage points), implying a probable shift. Table 3 matrix complements these summary data. For instance, among the households that were food secure in survey 1 ('Food Secure' row), roughly 88% of such households experienced a deterioration in food security status, i.e., became food insecure from secured (333 of 380 households). In contrast, among the households that were food insecure in survey 1 ('Food Insecure' row), only 1.5% of households experienced an improvement in their food security status, i.e., became food secured from insecure (31 of 2,022 households). 85% of households (of 2,402 households)

<sup>14</sup> The Bangladeshi Government announced a program to allocate subsidized rice to the 5 million most vulnerable people, but the measures were inadequate compared to its poor population. Please note that according to the Bangladesh Bureau of Statistics, there are now about 20% people, or 35 million of the country's 164 million population, who live below the poverty line in 2019. This rate is substantially higher if one considers the World Bank's definition of USD 1.9 a day for the poverty line (Islam, 2020). In addition, the government promised to provide BDT 2,500 (USD 30) to 5 million poor households by May 18, but it could not be disbursed in due time and none of the households in our survey area received any such transfers by the time the second survey was completed (TBS Report, 2020).

<sup>15</sup> We present some basic statistics to show a balance of characteristics between households that participated in both survey and households that only participated in the first survey. We present these statistics in Table A4 in Appendix A. While there are a few significant differences, these differences do not follow a particular pattern (i.e., differences in both directions), suggesting characteristics are similar between these two groups of households.



**Table 4**  
Dynamics of Food Insecurity

VARIABLES	Change		Improved		Deteriorated	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Household income loss (omitted category: No or partial income loss)</i>						
Complete Income Loss	−0.113*** (0.017)	−0.071*** (0.018)	−0.007 (0.007)	−0.005 (0.007)	−0.109*** (0.017)	−0.066*** (0.017)
<i>Occupation of the household head (omitted category: Farmer)</i>						
Farm Laborer	−0.084*** (0.029)	−0.073*** (0.027)	−0.008 (0.011)	−0.002 (0.011)	−0.078*** (0.028)	−0.072*** (0.026)
Day Laborer	−0.097*** (0.023)	−0.063*** (0.022)	−0.011 (0.008)	−0.006 (0.008)	−0.089*** (0.022)	−0.060*** (0.021)
Self-employed/Business	0.095*** (0.029)	0.089*** (0.029)	0.016 (0.012)	0.017 (0.011)	0.088*** (0.028)	0.081*** (0.028)
Government Job	0.222*** (0.065)	0.191* (0.103)	0.109** (0.054)	−0.009 (0.009)	0.184*** (0.066)	0.196* (0.103)
Private Job	0.010 (0.049)	−0.010 (0.049)	0.006 (0.026)	−0.005 (0.029)	0.011 (0.045)	−0.007 (0.045)
Others	−0.007 (0.035)	−0.007 (0.030)	−0.016 (0.011)	−0.007 (0.011)	0.006 (0.034)	−0.000 (0.029)
<i>Change in Remittances (omitted category: No remittance)</i>						
Completely stopped	0.023 (0.055)	0.035 (0.048)	−0.002 (0.008)	0.006 (0.006)	0.023 (0.055)	0.031 (0.048)
Partially stopped	0.041 (0.097)	−0.052 (0.085)	−0.006 (0.014)	−0.022 (0.016)	0.049 (0.098)	−0.034 (0.085)
Unchanged	0.294* (0.177)	0.128 (0.213)	0.138 (0.140)	−0.013 (0.019)	0.294 (0.212)	0.132 (0.206)
<i>Involved in microcredit program (omitted category: No loan taken)</i>						
Microcredit loan taken	−0.054*** (0.016)	−0.031** (0.016)	−0.009 (0.005)	−0.002 (0.005)	−0.050*** (0.015)	−0.031** (0.015)
<i>Coping strategies</i>						
Past savings	—	0.110*** (0.021)	—	0.005 (0.008)	—	0.112*** (0.021)
Previously stored food	—	0.057*** (0.021)	—	0.003 (0.007)	—	0.056*** (0.020)
Help from friends/relatives	—	−0.030 (0.024)	—	−0.004 (0.013)	—	−0.023 (0.025)
Help from the Government	—	−0.045** (0.020)	—	−0.012* (0.007)	—	−0.035* (0.020)
Help from NGOs	—	−0.067 (0.076)	—	−0.003 (0.023)	—	−0.062 (0.080)
Other loans taken	—	−0.054*** (0.018)	—	0.001 (0.007)	—	−0.049*** (0.018)
Others	—	−0.044 (0.039)	—	0.006 (0.010)	—	−0.048 (0.038)
<i>Can manage money during emergency (omitted category: Not manageable)</i>						
Fairly manageable	—	−0.010 (0.018)	—	0.007 (0.005)	—	−0.015 (0.017)
Very easily manageable	—	−0.010 (0.033)	—	0.047** (0.022)	—	−0.046 (0.029)
Self-sufficient/no help required	—	−0.028 (0.036)	—	0.046** (0.019)	—	−0.064* (0.035)
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,402	2,247	2,069	1,981	2,371	2,225
R-squared	0.390	0.414	0.291	0.293	0.393	0.424

Robust standard errors clustered by village are in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

**Note:** OLS estimates reported. Dependent variables in columns 1–2 (Changed) are a dummy variable that equals 1 if households experienced a change in their food security status (either became insecure in survey 2 from secured in survey 1 or vice versa) and 0 if food security status did not change. Dependent variables in columns 3–4 (Improved) are a dummy variable that equals 1 if households experienced an improvement in food security status in survey 2 (i.e., became food secured) and 0 if food security status did not change. Dependent variables in columns 5–6 (Deteriorated) are a dummy variable that equals 1 if households experienced a deterioration in food security status in survey 2 (i.e., became food insecure) and 0 if food security status did not change. In addition, ‘Can manage money during emergency’ specifically asks, “In case of an emergency, if you/family needed BDT 2,000 (or USD 25) in the next 7 days, do you think you can manage?” with responses ranging from not possible, fairly possible, very easily possible and self-sufficient (do not need help). The latter three responses are then converted into indicators for selecting these responses and 0 being “not possible/manageable”. See Table 1 for other variable descriptions.

nevertheless did not experience any change in their food security status.

When the change in food insecurity is regressed on the same set of variables as in the linear probability model (1), it becomes apparent which groups are experiencing deterioration in terms of food insecurity in the second survey. Table 4 presents the estimates. Columns 1 and 2 in

Table 4 demonstrate the change in food insecurity status (improved or deteriorated) vis-à-vis no change, while columns 3 and 4 focus on improvement (against no change), and the final two columns look at the deterioration of food insecurity status (against no change) across households. We find that households that already faced complete

income loss (in survey 1) experienced less deterioration in terms of food insecurity than households that had no or partial income loss (negative and statistically significant coefficient in column 5). This implies that food insecurity must be rapidly dispersing among the previously 'better-off' groups. A similar scenario can also be observed across occupations. For instance, farm and day laborers, who were significantly more food insecure than farmers during the first survey, experienced less deterioration in food insecurity status than farmers in the second survey. Moreover, self-employed or business-dependent households experienced more deterioration than farmers in the second survey, which might be due to limitations imposed on shops and businesses during the pandemic. Public servants, on the other hand, experienced both improvement and deterioration in food security status in the second survey (Columns 3 and 5 respectively). Their improvement in food security is in line with the fact that their salary from government jobs might not have changed and perhaps, initially (in survey 1), they were concerned about job and income losses due to the lockdown. However, it is puzzling why their food security deteriorated in the second survey. Furthermore, households under microcredit programs have also experienced relatively less deterioration than households that are not part of any microcredit programs.

When we also explore the role of coping strategies (OLS estimates in even-numbered columns), we observe an interesting pattern. The most common coping strategies such as using savings, food stocks, and loans did not help households in improving food insecurity (Column 4). Instead, households that were using up their savings and stored food during the first survey have experienced a significant deterioration in food insecurity during the second survey (Column 6). One reasonable interpretation of this pattern is that resources, such as savings and food stocks, are getting depleted during the pandemic. Hence, once used up, food insecurities were meant to deteriorate. Also, households that borrowed money in the first survey experienced less deterioration in food insecurity in the second survey. This implies that borrowing is emerging as an important coping mechanism, which could affect livelihoods and wellbeing and food security in the long term, even after the lockdown restrictions are relaxed (assuming households would have to repay the lenders post lockdown).

Finally, when we explore whether the preparedness to tackle emergencies (in terms of managing a substantial amount of money within a week) can explain changes in food insecurity, we find that households that are self-reliant or are well-equipped to handle emergencies have experienced a significant improvement in food security than households that are poorly equipped (Column 4). Self-reliant households also experienced relatively less deterioration in food security than poorly equipped households (negative coefficient in Column 6), but this coefficient is only marginally significant at 10% level. Therefore, the ability of households in handling emergencies appears to be an important factor in dealing with food insecurity.

These results are also qualitatively similar when Probit estimates are used (Table A5 in Appendix A) and the standard errors for all coefficients do not appear to be inflated due to multicollinearity, suggesting that our results are robust throughout.

#### 4. Conclusion

Overall, our results from this study suggest that the countrywide lockdown due to COVID-19 led to a drastic increase in income loss and food insecurity across rural households in Bangladesh. We also find that households that are primarily in occupations without job security, such as farm and day laborers, were initially affected the most in terms of food insecurity. Besides, households with higher savings and access to

stored food from the past are relatively less food insecure, and households are more likely to take out loans when they are more food insecure. Our survey evidence also indicates that food insecurities appear to be dispersing rapidly into groups that were formerly food secured. With no indication of improvement in food security among the affected households, the pattern on such transmission suggests that food insecurity would inevitably catch-up on the remaining food-secure households if drastic measures are not taken by policymakers to arrest the spread at the earliest.

Note that our study is based on a rapid telephone survey, which is often not as interactive as face-to-face discussions. Thus, we cannot altogether rule out the possibility of biased reporting during interviews. Although, given the data collection experience of enumerators and familiarity of the NGO and its enumerators to the locals, we are confident that such biases were very low and does not explain the findings. In addition, results presented in this study should be interpreted as mere correlations, as addressing the endogeneity issue under various data and interview constraints and the lack of exogenous variations was outside the scope of this paper. However, our rapid survey evidence is useful to gain important insights into the major determinants of food insecurity across households during the COVID-19 pandemic. Besides, we also learn about the major coping strategies undertaken and the rapid dispersion of food insecurities across households. This informs policymakers about the factors to be targeted while designing new policies to support the poor and vulnerable during this pandemic. For example, properly identifying households that experienced a drastic fall in income during the pandemic and support them via cash or food transfers (from the government) seems to be an important policy action. Our rapid research suggests that the government should also consider collaborating with regional NGOs and organizations to leverage their widespread local networks to reach out to and support as many vulnerable households as possible, particularly given the absence of a well-structured social registry system to track people's socioeconomic well-being. In the long-run, strengthening job security of the self-employed and casual laborers or improving the social protection system should also be considered to deal with similar pandemics in the future or to address other crises that could affect job security, and eventually food security, of poor households.

#### CRedit authorship contribution statement

**Firoz Ahmed:** Project administration, Software, Supervision, Validation, Visualization. **Asad Islam:** Conceptualization, Formal analysis, Funding acquisition, Writing - review & editing. **Debayan Pakrashi:** Data curation, Investigation, Project administration. **Tabassum Rahman:** Methodology, Supervision, Validation, Visualization, Writing - original draft. **Abu Siddique:** Methodology, Writing - original draft, Writing - review & editing.

#### 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.

#### Appendix A. Additional tables and figures

Tables Tables A1–A5.  
See Figs. A1 and A2.

**Table A1**  
Non-participation and attrition.

VARIABLES	Survey 1	Survey 2	
	(1)	(2)	(3)
<i>Household characteristics (collected in 2019)</i>			
Agricultural land possession	−0.002 (0.001)	−	−
Completed primary	−0.031 (0.021)	−	−
Completed secondary	−0.028 (0.026)	−	−
Completed higher secondary	−0.007 (0.031)	−	−
Beyond higher secondary	−0.053* (0.032)	−	−
Income	0.006 (0.004)	−	−
Equivalized savings	−0.002 (0.001)	−	−
Proportion of female members	−0.003 (0.032)	−	−
Women's decision making	0.024 (0.019)	−	−
<i>Household income loss (omitted category: No or partial income loss)</i>			
Complete Income Loss	−	−0.012 (0.026)	−0.001 (0.011)
Partial Income Loss	−	−0.013 (0.027)	
<i>Occupation of the household head (omitted category: Farmer)</i>			
Farm Laborer	−	0.006 (0.019)	0.009 (0.019)
Day Laborer	−	−0.006 (0.016)	−0.003 (0.016)
Self-employed/Business	−	−0.022 (0.015)	−0.018 (0.015)
Government Job	−	−0.026 (0.033)	−0.084* (0.048)
Private Job	−	−0.010 (0.029)	0.007 (0.033)
Other jobs	−	−0.006 (0.023)	−0.001 (0.023)
<i>Change in remittance (omitted category: No remittance)</i>			
Completely stopped	−	−0.013 (0.010)	−0.009 (0.011)
Partially stopped	−	0.103 (0.092)	0.146 (0.092)
Unchanged		0.051 (0.117)	−0.055 (0.060)
<i>Involved in microcredit program (omitted category: No loan taken)</i>			
Microcredit loan taken	−	−0.000 (0.012)	0.001 (0.012)
<i>Coping strategies</i>			
Past savings	−	−	−0.004 (0.012)
Previously stored food	−	−	−0.006 (0.012)
Help from friends/relatives	−	−	0.011 (0.026)
Help from the Government	−	−	0.000 (0.017)
Help from NGOs	−	−	−0.043 (0.029)
Other loans taken	−	−	−0.006 (0.013)
Others	−	−	−0.028 (0.024)
Village FE	Yes	Yes	Yes
Joint test <i>p</i> -value	0.331	0.739	0.638
Observations	3,507	2,500	2,337
R-squared	0.471	0.218	0.240

Robust SE clustered by village are in parentheses.

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

**Note:** The dependent variable is a dummy for non-participation/attrition, where it equals 1 if households could not be interviewed during Survey 1 (in column 1) or Survey 2 (in columns 2–3) and 0 otherwise. All columns present estimates using a linear probability model. The joint test *p*-value is derived from a joint *F*-test that tests whether all variables are jointly zero. Variables in column 1 are defined in Panel F and variables in column 2–3 are defined in Panel B-E in Table 1.

**Table A2**  
Determinants of Food Insecurity with Other Household Characteristics

VARIABLES	Food Insecure		Mild		Moderate		Severe		FIES Score	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Agricultural land possession	0.001 (0.002)	0.002 (0.001)	0.002 (0.001)	0.002* (0.001)	-0.004 (0.010)	0.004 (0.009)	-0.012 (0.012)	-0.005 (0.011)	-0.025** (0.010)	-0.018*** (0.006)
Completed Primary	-0.022 (0.017)	-0.016 (0.018)	-0.045 (0.048)	-0.018 (0.053)	-0.013 (0.023)	-0.019 (0.023)	-0.030 (0.059)	0.026 (0.062)	-0.193* (0.101)	-0.199** (0.098)
Completed Secondary	-0.028 (0.022)	-0.007 (0.022)	-0.035 (0.061)	-0.007 (0.066)	-0.035 (0.027)	-0.019 (0.027)	-0.029 (0.059)	0.018 (0.064)	-0.347*** (0.119)	-0.316*** (0.117)
Completed Higher Secondary	-0.052* (0.028)	-0.024 (0.027)	-0.114 (0.076)	-0.072 (0.072)	-0.024 (0.034)	-0.023 (0.034)	-0.033 (0.069)	0.042 (0.076)	-0.123 (0.153)	-0.055 (0.156)
Beyond Higher Secondary	-0.081* (0.043)	-0.061 (0.040)	-0.120 (0.088)	-0.115 (0.088)	-0.085* (0.045)	-0.072 (0.049)	-0.030 (0.067)	0.015 (0.072)	-0.315* (0.175)	-0.212 (0.181)
Middle 50% Income	0.005 (0.013)	-0.001 (0.012)	-0.010 (0.039)	-0.025 (0.041)	0.002 (0.015)	-0.003 (0.015)	-0.005 (0.039)	-0.046 (0.038)	0.061 (0.067)	0.034 (0.066)
Top 25% Income	-0.008 (0.019)	-0.020 (0.018)	0.018 (0.048)	0.030 (0.048)	-0.028 (0.021)	-0.044** (0.021)	0.007 (0.052)	-0.059 (0.054)	0.023 (0.094)	-0.063 (0.092)
Equivalized savings	-0.007*** (0.002)	-0.005** (0.002)	-0.008*** (0.002)	-0.007** (0.003)	-0.006*** (0.002)	-0.006*** (0.002)	-0.005*** (0.002)	-0.003** (0.002)	-0.032*** (0.008)	-0.030*** (0.007)
Proportion of female household members	0.035 (0.039)	0.028 (0.037)	0.131 (0.099)	0.063 (0.112)	0.013 (0.045)	0.007 (0.042)	0.017 (0.092)	0.013 (0.091)	-0.193 (0.180)	-0.175 (0.171)
Women's decision-making power	0.011 (0.020)	-0.005 (0.020)	0.004 (0.052)	-0.023 (0.062)	0.004 (0.024)	-0.000 (0.023)	0.051 (0.041)	0.060 (0.047)	0.179* (0.094)	0.138 (0.094)
Income Loss	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Occupation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Remittances	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Microcredit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coping Strategies	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Village FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,691	2,512	911	756	2,044	1,910	632	520	2,691	2,512
R-squared	0.376	0.366	0.484	0.540	0.494	0.485	0.677	0.778	0.418	0.451

Robust standard errors clustered by village are in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Note:** We merge our previously collected household survey data (from 2019) with the current survey data to carry out this analysis. The reference group of education dummy variables is 'Never went to school'. Middle 50% is a dummy that equals 1 if income of a household falls within the middle 50% and 0 if falls within the bottom 25%; Top 25% is a dummy that equals 1 if income of a household falls within the top 25% and 0 if falls within the bottom 25%; See Table 1 for all other variable descriptions.

**Table A3**  
Determinants of Food Insecurity (using Probit and Ordered Probit)

VARIABLES	Food Insecure		Mild		Moderate		Severe		FIES Score	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>Household income loss (omitted category: No income loss (odd columns)/ Partial income loss (even columns))</i>										
Complete Income Loss	1.747*** (0.090)	0.584*** (0.051)	1.252*** (0.116)	0.470*** (0.070)	2.250*** (0.118)	0.692*** (0.065)	2.697*** (0.463)	0.922*** (0.184)	1.462*** (0.069)	0.420*** (0.028)
Partial Income Loss	1.069*** (0.087)	–	0.731*** (0.116)	–	1.441*** (0.116)	–	1.436*** (0.427)	–	0.956*** (0.065)	–
<i>Occupation of the household head (omitted category: Farmer)</i>										
Farm Laborer	0.742*** (0.110)	0.554*** (0.118)	0.360** (0.162)	0.214 (0.181)	0.907*** (0.127)	0.697*** (0.135)	0.731*** (0.283)	0.460 (0.333)	0.385*** (0.050)	0.261*** (0.051)
Day Laborer	0.818*** (0.080)	0.620*** (0.087)	0.572*** (0.113)	0.472*** (0.129)	0.979*** (0.094)	0.767*** (0.103)	1.490*** (0.200)	1.390*** (0.258)	0.560*** (0.042)	0.397*** (0.040)
Self-employed/Business	-0.465*** (0.065)	-0.423*** (0.073)	-0.411*** (0.082)	-0.387*** (0.095)	-0.526*** (0.084)	-0.469*** (0.096)	-0.767*** (0.185)	-0.648*** (0.215)	-0.394*** (0.044)	-0.371*** (0.044)
Government Job	-0.705*** (0.139)	-0.671*** (0.227)	-0.618*** (0.176)	-0.653* (0.351)	-1.128*** (0.222)	-0.610** (0.273)	-1.721** (0.761)	-0.884 (0.819)	-0.626*** (0.103)	-0.919*** (0.157)
Private Job	-0.162 (0.099)	-0.209* (0.119)	-0.187 (0.132)	-0.183 (0.165)	-0.206* (0.123)	-0.268* (0.147)	-0.231 (0.359)	-0.804 (0.491)	-0.179*** (0.063)	-0.197*** (0.070)
Others	-0.031 (0.087)	-0.074 (0.099)	-0.191 (0.123)	-0.185 (0.143)	0.066 (0.109)	0.032 (0.121)	0.128 (0.212)	0.179 (0.276)	0.162*** (0.058)	0.070 (0.056)
<i>Change in Remittances (omitted category: No remittance)</i>										
Completely stopped	-0.511*** (0.168)	-0.549*** (0.191)	-0.674*** (0.253)	-0.688** (0.287)	-0.325 (0.217)	-0.392 (0.257)	-0.539 (0.344)	-0.685 (0.603)	-0.094 (0.117)	-0.102 (0.114)
Partially stopped	-0.097 (0.203)	-0.115 (0.213)	0.055 (0.275)	0.012 (0.305)	-0.165 (0.249)	-0.119 (0.261)	-5.329*** (0.256)	-5.848*** (0.410)	-0.194 (0.134)	-0.173 (0.145)
Unchanged	-0.389 (0.395)	-1.558*** (0.580)	-0.214 (0.466)	-1.800** (0.817)	-1.143** (0.559)	-1.810** (0.826)	0.264 (1.141)	-10.173*** (0.439)	-0.249 (0.398)	-0.927 (0.579)

(continued on next page)



Table A3 (continued)

VARIABLES	Food Insecure		Mild		Moderate		Severe		FIES Score	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
<i>Involved in microcredit program (omitted category: No loan taken)</i>										
Microcredit loan taken	0.226*** (0.043)	0.130*** (0.048)	0.293*** (0.062)	0.277*** (0.070)	0.197*** (0.052)	0.066 (0.057)	0.532*** (0.131)	0.330** (0.163)	0.168*** (0.025)	0.104*** (0.026)
<i>Coping strategies</i>										
Past savings	–	–0.753*** (0.095)	–	–0.571*** (0.128)	–	–0.903*** (0.117)	–	–0.921*** (0.207)	–	–0.544*** (0.046)
Previously stored food	–	–0.516*** (0.077)	–	–0.407*** (0.109)	–	–0.627*** (0.095)	–	–0.694*** (0.234)	–	–0.304*** (0.038)
Help from friends/relatives	–	0.538** (0.212)	–	0.521** (0.260)	–	0.766*** (0.277)	–	1.391*** (0.466)	–	0.185*** (0.067)
Help from the Government	–	0.380*** (0.123)	–	0.252 (0.191)	–	0.503*** (0.140)	–	0.870*** (0.314)	–	0.191*** (0.049)
Help from NGOs	–	5.226*** (0.205)	–	5.473*** (0.152)	–	5.045*** (0.186)	–	8.409*** (0.465)	–	0.048 (0.146)
Other loans taken	–	0.598*** (0.082)	–	0.472*** (0.114)	–	0.731*** (0.096)	–	1.256*** (0.220)	–	0.368*** (0.038)
Others	–	–0.179 (0.117)	–	–0.168 (0.164)	–	–0.173 (0.146)	–	–0.022 (0.284)	–	0.024 (0.069)
Village FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,847	9,082	4,225	3,554	6,844	6,275	2,506	2,013	9,847	9,082
Pseudo R-squared	0.408	0.423	0.424	0.454	0.510	0.524	0.678	0.759	0.137	0.140

Robust standard errors clustered by village are in parentheses

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Note:** Probit (columns 1–8) and Ordered Probit (columns 9–10) regression estimates reported. See Table 1 and the note under Table 2 for variable descriptions.

Table A4

Comparison between Households from survey 1 and surveys 1 & 2

	Survey 1 Only		Surveys 1 & 2		Difference
Variables of Interest	Mean	Std. Dev.	Mean	Std. Dev.	
<i>Household income loss (N = 9,847)</i>					
Complete income loss	0.55	0.50	0.59	0.49	−0.04***
Partial income loss	0.37	0.48	0.35	0.48	0.02
Income unchanged	0.08	0.27	0.06	0.25	0.02**
<i>Primary occupation of the household (N = 9,847)</i>					
Agricultural farmer	0.17	0.37	0.17	0.38	0.00
Farm laborer	0.09	0.28	0.10	0.30	−0.01**
Day laborer	0.32	0.47	0.33	0.47	0.00
Self-employed/Business	0.26	0.44	0.23	0.42	0.03**
Government job	0.04	0.19	0.03	0.18	0.01
Private job	0.06	0.23	0.04	0.21	0.02**
Others	0.07	0.25	0.09	0.28	−0.02***
<i>Change in Remittances and Microcredit (N = 9,847)</i>					
No remittance	0.98	0.16	0.97	0.16	0.01
Complete remittance loss	0.01	0.11	0.02	0.13	−0.01*
Partial remittance loss	0.01	0.09	0.01	0.08	0.00
Remittance unchanged	0.00	0.05	0.00	0.05	0.00
Microcredit loan taken	0.50	0.50	0.52	0.50	−0.02
<i>Coping strategies (N = 9,082)</i>					
Past savings	0.77	0.42	0.75	0.44	0.02*
Previously stored food	0.57	0.49	0.55	0.50	0.02*
Help from friends/relatives	0.05	0.21	0.05	0.21	0.00
Help from the Government	0.09	0.29	0.09	0.29	0.00
Help from NGOs	0.01	0.07	0.01	0.08	0.00
Other loans taken	0.33	0.47	0.35	0.48	0.00
Other sources	0.06	0.24	0.06	0.24	0.00

**Note:** Comparisons in characteristics (collected during the first survey) between households that only participated in survey 1 (columns Survey 1 Only) and households that participated in both surveys (columns Surveys 1 & 2). *p*-values are from two sample T-test with unequal variances. See Table 1 for all variable descriptions. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

**Table A5**

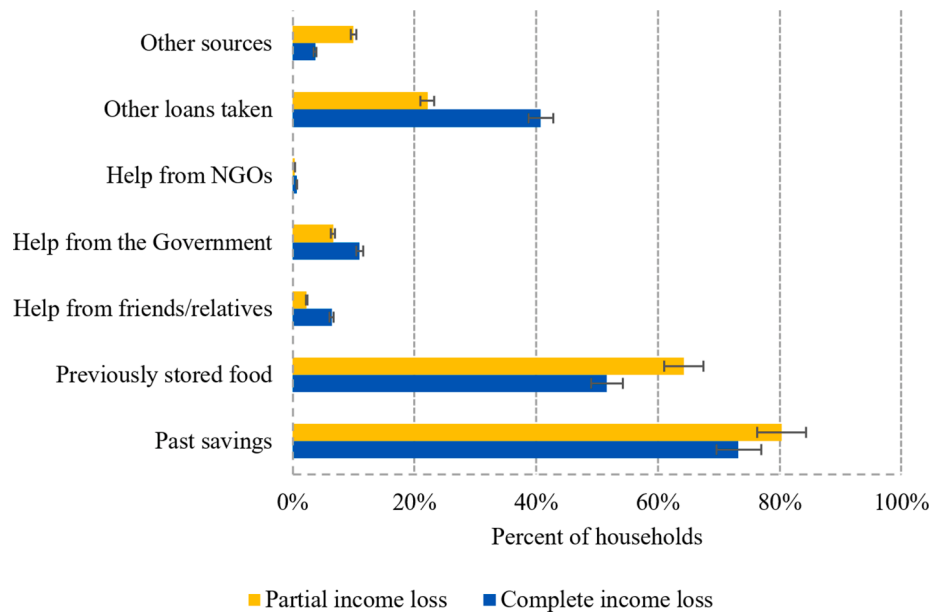
Dynamics of Food Insecurity using Probit

VARIABLES	Change		Improved		Deteriorated	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Household income loss (omitted category: No or partial income loss)</i>						
Complete Income Loss	−0.831*** (0.126)	−0.674*** (0.161)	−0.304 (0.379)	2.377* (1.218)	−0.894*** (0.135)	−0.714*** (0.171)
<i>Occupation of the household head (omitted category: Farmer)</i>						
Farm Laborer	−0.912*** (0.277)	−0.964** (0.377)	−0.607 (0.764)	−8.686*** (1.609)	−0.986*** (0.323)	−1.114*** (0.420)
Day Laborer	−0.884*** (0.192)	−0.534** (0.243)	−10.006*** (0.748)	−16.730*** (3.618)	−0.828*** (0.197)	−0.506* (0.258)
Self-employed/Business	0.503*** (0.178)	0.647*** (0.218)	0.697 (0.613)	−0.307 (0.460)	0.508*** (0.184)	0.660*** (0.237)
Government Job	0.971*** (0.312)	1.158** (0.465)	1.868** (0.911)	−1.792 (0.000)	0.856*** (0.330)	1.205*** (0.464)
Private Job	0.052 (0.242)	0.047 (0.320)	0.152 (0.746)	−2.063* (1.189)	0.155 (0.249)	0.129 (0.347)
Others	−0.095 (0.236)	0.044 (0.288)	−11.616*** (0.538)	−19.718*** (2.993)	0.040 (0.239)	0.160 (0.306)
<i>Change in Remittances (omitted category: No remittance)</i>						
Completely stopped	0.178 (0.369)	−0.103 (0.553)	−0.743 (0.000)	−1.361 (0.000)	0.164 (0.368)	−0.168 (0.580)
Partially stopped	0.310 (0.561)	−0.039 (0.658)	−4.776 (0.000)	−5.896 (0.000)	0.471 (0.602)	0.218 (0.704)
Unchanged	2.289*** (0.771)	2.111** (0.907)	10.170*** (0.893)	1.296 (0.000)	2.468*** (0.957)	1.970** (0.880)
<i>Involved in microcredit program (omitted category: No loan taken)</i>						
Microcredit loan taken	−0.371*** (0.116)	−0.069 (0.158)	−0.663 (0.418)	−0.186 (0.925)	−0.368*** (0.123)	−0.044 (0.170)
<i>Coping strategies</i>						
Past savings	−	1.531*** (0.350)	−	2.137* (1.296)	−	1.691*** (0.396)
Previously stored food	−	0.747*** (0.273)	−	2.267 (1.534)	−	0.802*** (0.283)
Help from friends/relatives	−	−1.443*** (0.427)	−	−3.944*** (0.680)	−	−5.024*** (0.186)
Help from the Government	−	−0.796** (0.357)	−	−7.256*** (0.733)	−	−0.705* (0.394)
Help from NGOs	−	−11.194*** (0.793)	−	2.173 (0.000)	−	−11.732*** (0.826)
Other loans taken	−	−0.732*** (0.243)	−	−11.140*** (3.942)	−	−0.662*** (0.247)
Others	−	−0.237 (0.457)	−	−1.797 (2.350)	−	−0.374 (0.508)
<i>Can manage money during emergency (omitted category: Not manageable)</i>						
Fairly manageable	−	0.033 (0.179)	−	0.804 (0.778)	−	0.014 (0.190)
Very easily manageable	−	−0.117 (0.304)	−	5.146*** (1.128)	−	−0.540* (0.317)
Self-sufficient/no help required	−	−0.109 (0.240)	−	6.353*** (1.784)	−	−0.479* (0.268)
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,402	2,247	2,069	1,981	2,371	2,225

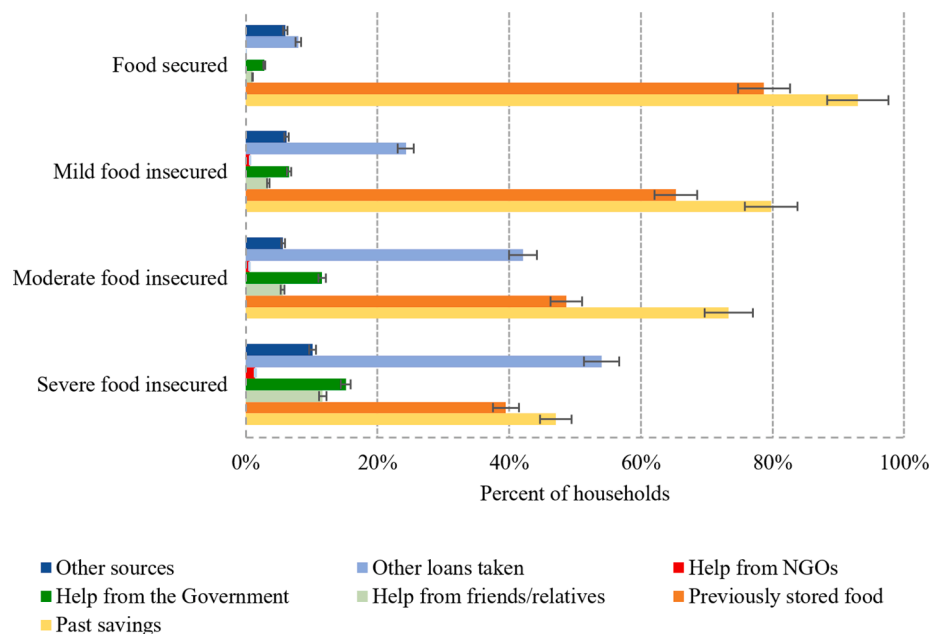
Robust standard errors clustered by village are in parentheses

\*\*\* p&lt;0.01, \*\* p&lt;0.05, \* p&lt;0.1.

**Note:** Probit estimates reported. Dependent variables in columns 1–2 (Changed) are a dummy variable that equals 1 if households experienced a change in their food security status (either became insecure in survey 2 from secured in survey 1 or vice versa) and 0 if food security status did not change. Dependent variables in columns 3–4 (Improved) are a dummy variable that equals 1 if households experienced an improvement in food security status in survey 2 (i.e., became food secured) and 0 if food security status did not change. Dependent variables in columns 5–6 (Deteriorated) are a dummy variable that equals 1 if households experienced a deterioration in food security status in survey 2 (i.e., became food insecure) and 0 if food security status did not change. See Table 1 for other variable descriptions.



**Fig. A1.** Income Loss by Coping Strategies. **Note:** Summary of income loss by coping strategies in the first survey are presented. Bars are with 95% confidence intervals. See Table 1 for descriptions of coping strategies.



**Fig. A2.** Coping Strategies by Food Insecurities. **Note:** Summary of coping strategies by food insecurities in the first survey are presented. Bars are with 95% confidence intervals. See Table 1 for descriptions of coping strategies.

## Appendix B. The food insecurity experience scale

We conducted the telephone survey in April-May 2020 in two southwestern districts, Khulna and Satkhira, of Bangladesh. The study covers five Upazilas (sub-districts) of these two districts including Asasuni and Tala from Satkhira district, and Dumuria, Paikgacha, and Koyra from Khulna District.

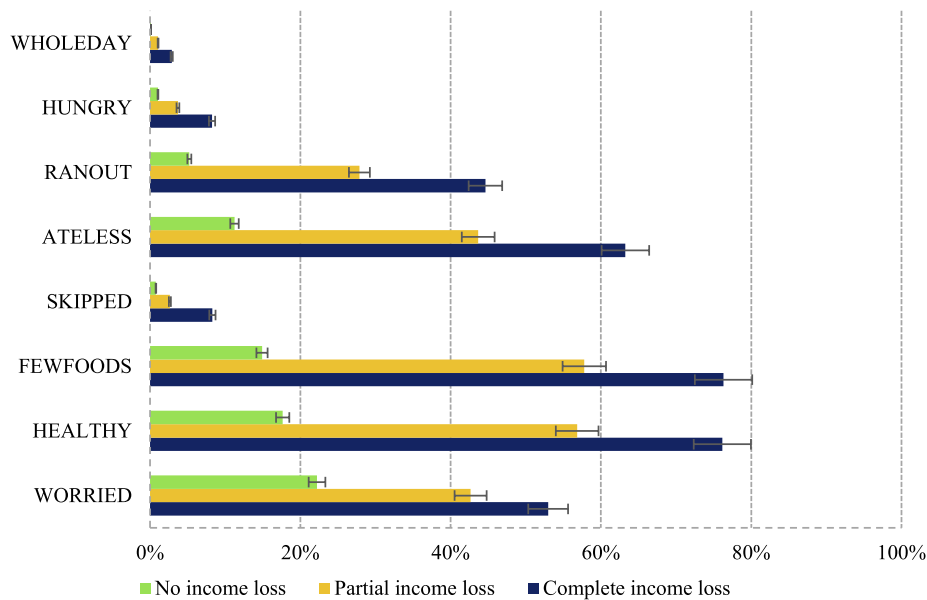
In defining food security, we follow [FAO \(2009\)](#), “Food security exists when all people, at all times, have physical, social and economic access to sufficient safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life.” This definition recognizes availability, access, utilization, and stability as the four principal pillars in the concept of food security.

**Table B1**

Summary statistics

Variables of Interest	Obs.	Mean	Std. Dev.	Min	Max
WORRIED	9,847	0.47	0.50	0.00	1.00
HEALTHY	9,847	0.65	0.48	0.00	1.00
FEWFOOD	9,847	0.65	0.48	0.00	1.00
SKIPPED	9,847	0.06	0.23	0.00	1.00
ATELESS	9,847	0.52	0.50	0.00	1.00
RANOUT	9,847	0.36	0.48	0.00	1.00
HUNGRY	9,847	0.06	0.24	0.00	1.00
WHOLEDAY	9,847	0.02	0.14	0.00	1.00
FIES	9,847	2.78	1.97	0.00	8.00

**Note:** The FIES variable is created by adding up responses from the eight food security questions. Thus, FIES is between 0 and 8.



**Fig. B1.** Household food security status (using the FIES questions) by income loss. **Note:** Bars are with 95% confidence interval.

We constructed the food security indicators (Food Insecurity Experience Scale) based on the eight questions to identify those at risk of severe hunger and food insecurity in the population (see Ballard, et al. (2013) for details). During survey 1, we asked the following questions to the households using a reference period of the last 2–3 weeks (after the COVID-19 outbreak): was there a time when, because of lack of money or other resources: [1] **WORRIED**: You or any household member were worried you would not have enough food to eat?; [2] **HEALTHY**: You or any household member were unable to eat healthy and nutritious food?; [3] **FEWFOOD**: You or any household member ate only a few kinds of foods?; [4] **SKIPPED**: You or any household member had to skip a meal?; [5] **ATELESS**: You or any household member ate less than you thought you should?; [6] **RANOUT**: Your household ran out of food?; [7] **HUNGRY**: You or any household member were hungry but did not eat? and [8] **WHOLEDAY**: You or any household member went without eating for a whole day? We summarize these responses in Table B1 below. We also provide a summary of these responses by income loss

experienced by households using a bar chart in Fig. B1.

We follow Ballard et al. (2013) to identify households as mildly food insecure [MILD] if they responded affirmatively to any of the first three questions: [1]–[3]; moderately food insecure [MODERATE] if they responded affirmatively to any of the questions in [4]–[6] and finally, severely food insecure [SEVERE] if they responded positively to either [7] or [8]. Households that belonged to none of these categories were categorized as food secure. Later, we use these indicator variables in our regression analysis.

### Appendix C. Representativeness of our survey households

We compare household characteristics of the rural sample of nationally representative Household Income and Expenditure Survey (HIES) of Bangladesh collected in 2016 with the household characteristics of the 2019 survey sample (2,691 households out of 9,847 households surveyed in survey 1). Comparisons are presented in Table B2. It is apparent in this Table that the observable characteristics of our 2,691 households are similar to that of the overall rural households in Bangladesh. If we restrict the overall rural sample of HIES in terms of the 90th percentile of average monthly household expenditure (in BDT), then our 2019 sample represents the average monthly expenditure of rural Bangladesh. Moreover, if we restrict the overall rural sample of HIES in terms of the 99th percentile of agricultural land owned (acres), then our 2019 sample represents the households of rural Bangladesh.

**Table B2**

Comparison of HIES 2016 and the 2019 sample characteristics.

Variables	(A) HIES 2016 Rural Sample			(B) The 2019 Sample		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Average monthly household expenditure (in BDT)	31,827	10,670	12,028	2,691	9,467	4,187
Agricultural land owned (acres)	32,002	0.55	5.22	2,691	0.36	2.13
Male headed household	32,089	0.87	0.34	2,691	0.91	0.29
Household size	32,089	4.06	1.57	2,691	4.33	1.15
Proportion of female household members	32,089	0.49	0.19	2,691	0.52	0.17
Average education (years of schooling)	32,089	3.58	2.60	2,691	2.82	2.01

**Note:** Panel A shows the characteristics of rural household samples collected under the Household Income and Expenditure Survey (HIES) of Bangladesh collected in 2016 and Panel B shows the characteristics of a subset of households from our previously collected data from June 2019.

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