

The impact of the COVID-19 pandemic on fish consumption and household food security in Dhaka city, Bangladesh

Shankar C. Mandal^a, Puja Boidya^b, Md. Inja-Mamun Haque^a, Anwar Hossain^a, Zubair Shams^c, Abdullah-Al Mamun^{d,*}

^a Department of Fisheries, University of Dhaka, Dhaka 1000, Bangladesh

^b Department of Fisheries and Marine Bioscience, Jashore University of Science and Technology, Jashore 7408, Bangladesh

^c Save the Children, Dhaka 1212, Bangladesh

^d Department of Fisheries & Marine Science, Noakhali Science and Technology University, Noakhali 3814, Bangladesh

ARTICLE INFO

Keywords:

Food security
Urban livelihoods
Fish consumption
SARS-CoV-2
Grocery shopping

ABSTRACT

The effects of COVID-19 are continuing to increase around the world as the pandemic claims thousands of lives. Bangladesh is no exception and has been greatly affected by SARS-CoV-2. Apart from the number of people who are or have been directly getting infected with this disease, millions of people are directly or indirectly facing many challenges to their livelihoods and the security of their food and nutritional supply, along with other societal issues created by the pandemic. In this study, a hybrid approach of online and telephone questionnaire surveys was used to investigate the food security of Dhaka city's inhabitants at household level. Approximately 80% of the respondents reported reduced income, and a quarter of respondents lost their jobs between March and June 2020. The frequency of fish consumption, an essential component of Bangladeshi diets, significantly reduced during the pandemic. This was especially apparent in affluent segments of the community. Out of the respondents, 75% reported an increase in the price of fish in Dhaka city. A range of coping strategies were observed: including decreasing the frequency of grocery shopping, shifting to online shopping, reducing consumption of high price commodities, reducing junk food consumption, cleaning fish and meat with hot water and vinegar, and increasing the consumption of protein and vitamin C rich food items. Prior to COVID-19, 80% of the households surveyed bought fish from wet markets. This number dropped to 45% during the pandemic. Many households substituted fish and meat with poultry, eggs and dried fish. About half of the households stockpiled rice, lentils and potatoes during the peak of the pandemic. However, if the pandemic lasts for a prolonged period, those living on low incomes in urban areas will experience some level of food insecurity from a reduced income or loss of work. Because of this, a large-scale sustainability policy should be undertaken to secure the food and nutritional security of low-income and middle-class household.

1. Introduction

The novel coronavirus, or SARS-CoV-2, was first identified and reported in Wuhan, China before becoming a global pandemic (WHO, 2020). This pandemic is expected to affect the food and nutritional security of many people in low- and middle-income countries (LMICs), including Bangladesh. Because the virus is easily transmitted, people are extremely concerned about their health. Also, in spite of the vaccines that are being used in many countries (including the UK, the USA and Canada), this pandemic will only be over when the virus is controlled globally (The Lancet Microbe, 2021). Although mass vaccinations began

in Bangladesh on 7 February 2021, the country had already reported 537,465 positive cases of SARS-CoV-2 with a death toll of 8182 (IEDCR, 2021).

Due to worldwide shutdowns, the pandemic affects every sphere of life including transport, trade, labour mobility, economics, livelihood, food system, trade, nutrition, social safety nets, food supply chains and on-farm food production sectors (Reardon et al., 2020; Liverpool-Tasie et al., 2020; Pu and Zhong, 2020; Sharma et al., 2020; Torero Cullen, 2020). The IMF (International Monetary Fund), Department of Economic and Social Affairs Economic Analysis of United Nations and The World Bank predicted that diminishing of global economy would shrink

* Corresponding author.

E-mail address: mamun_au22@yahoo.com (A.-A. Mamun).

<https://doi.org/10.1016/j.gfs.2021.100526>

Received 17 August 2020; Received in revised form 26 February 2021; Accepted 1 March 2021

Available online 12 March 2021

2211-9124/© 2021 Published by Elsevier B.V.

in 2020 by 3, 4.2 and 5.2%, respectively (Gopinath, 2020; Yongyi and Francesca 2020; The World Bank, 2020). The COVID-19 pandemic could drive between 71 and 150 million people into extreme poverty, particularly in South Asia and Sub-Saharan Africa (Me and Fu, 2020; Laborde et al., 2020). It could also lead to the creation of an additional 132 million people suffering to distress from undernourishment in 2020 (Yongyi and Francesca, 2020). The households of another 90–117 million children in developing countries might become monetarily poor by the end of 2020 (Yongyi and Francesca, 2020). The pandemic could push 265 million people into a state of acute food insecurity in low- and middle-income countries (WFP, 2020) where one fifth (45 million) have been added between February and June 2020 (Global Panel, 2020).

Due to industrial shutdown, garment workers and urban day laborers in Bangladesh lost their jobs. As a result, many people (with no/low income) moved from urban to rural areas. This changed normal usage trends. Approximately 50 million people in the informal sector faced even more dire consequences of the lockdown (Aneja and Islam, 2020). In addition, more than 63% of Bangladesh's urban slum dwellers became economically stagnant. The overall income of slum dwellers plummeted by 82% during this outbreak (Ahmed et al., 2020). About 34 million people (equivalent to 20% of the country's total population) are in danger of joining the 20.9% of people who have already been below the poverty line for years (BRAC, 2018). This is due to a drop in family incomes (SANEM, 2020).

Because of the need to shutdown formal and informal markets and implement containment measures, the coronavirus's escalation has created financial hardships at the local level and instigated a global economic recession (Cardwell and Ghazalian, 2020). From 23 March to 30 May 2020, all public and private sectors in Bangladesh, with the exceptions of some medical facilities and essential service providers, were closed by the state's lockdown measures to prevent the spread of the virus. This created many transportation difficulties and hurdles to rationing and distributing essential goods. Food supply systems are heavily dependent on having access to transport facilities and an available workforce. Farias et al. (2020) reported the disruption of supply chains in food distribution centres in Brazil during the COVID-19 pandemic. Moreover, Cranfield (2020) observed that the price of commodities was more affected than demand for them in Canada. In Bangladesh, there are ten major food groups with rice, fish, eggs, vegetables, lentils and meat as the key items (INFS, 2013). Egg and milk prices decreased by approximately 45 and 35%, respectively. The village areas of Bangladesh also reported a decrease in the price of vegetables from March to April 2020 (Holy, 2020). However, the prices of fish, depending on the size and type, have been more volatile during the pandemic.

In Bangladesh, fish is an irreplaceable and essential animal source of food and a critical part of maintaining food security. In developing countries, the nutritional contribution of fish consumption, increased income through the sale of fish and, improved economic solvency of women through their involvement in aquaculture are indicators of the contribution of fish to household food security (Béné and Kawarazuka, 2010). A large portion of low-income urban dwellers is involved in the fish supply chain, and their livelihood largely depends on this sector. Moreover, the average per capita daily consumption of fish in urban households is higher than that of rural households (BBS, 2012). In Bangladesh, the per capita fish consumption was reported as 62.58 g/day. This would account more than 60% of a household's animal protein intake (DoF, 2018). In urban areas, however, the per capita fish consumption increased to approximately 68 g/day, and a household's consumption frequency exceeded that of any other animal food source (Belton et al., 2014). Fish and fishery products offer high quality protein (USDA, 2012), essential micronutrients, vitamins and, long-chain n-3 polyunsaturated fatty acids (LC-PUFA) (Bell et al., 2006). Fish is an iron-rich food, which plays an important role in preventing iron-deficiency anaemia. Currently, one third of the world's population suffers from this disease (HLPE, 2014). An increase in the price of fish

and a shortage in availability during the COVID-19 pandemic increases lower-income households' risk of malnutrition.

The Covid-19 pandemic has the potential to negatively impact food and nutritional security at every level, particularly that of lower to middle class households and marginalised people in urban settings. Depending on the incomes of each individual, a job loss during the pandemic creates significant strain on a household. The food supply chain was hampered by the restrictions placed on movement during the lockdown, and the purchasing power of low income households in urban areas decreased. Dhaka city, one of the largest cities in the world with residents making a wide range of incomes, has experienced a high number of COVID-19 cases. The prevalence of this disease is expected to have a negative impact on Dhaka city's population through a variety of factors like changes in income and access to food. Thus, the study was designed to investigate the impacts of COVID-19 on household food security through an emphasis on the availability and affordability of fish at Dhaka city of Bangladesh.

2. Materials and methods

2.1. Study area

The survey was conducted at the household level in the mega city Dhaka, Bangladesh. In Bangladesh approximately 19% of total population lives in urban settings (PopulationStat, 2021). The estimated population of Dhaka city's urban areas is 21.451 million with a population density of 47,400 residents per square kilometre (PopulationStat, 2021). The dense population contained in a small area create many careers and income opportunities. People from different social strata co-exist in the city. Until the first week of June 2020, more than half of the COVID-19 cases in Bangladesh were identified in Dhaka city (IEDCR, 2020). For this reason, Dhaka city was selected for this study.

2.2. Data collection

The survey was conducted between May and June 2020. The design for this electronic survey was based on published literature and surveys about households, food security, the economic impact of the COVID-19 pandemic, and personal experiences. The questionnaire was tested, uploaded and shared on Google's online survey platform. A link of the Google form was then distributed among peers and friends through emails and other social media messaging systems (including Facebook Messenger™, WhatsApp™ and Twitter™). Participants of online portion were required to read and accept Google's privacy policy (<https://policies.google.com/privacy?hl=en>).

Because they rely on access to technology and the internet, Google forms are typically used in well-off households. A large portion of marginalised communities in the urban areas are unable to access the internet. Also, literacy levels of these vulnerable groups are a concern for using Google forms to collect data. To overcome this, five research assistants were hired and trained to collect the necessary data by telephone. In the training session, demonstration data were collected through telephone surveys. The snowball approach (Noy, 2008) was utilised which allowed the team to collect the mobile numbers of marginal respondents (like barbers, drivers, housemaids, carpenters, rickshaw pullers and hawkers). The first respondent participated in the survey and shared their peers' contact numbers for the next survey. Telephone surveys may have a higher risk of response bias than face to face interviews (Lau et al., 2019). This challenge, however, was reduced through proper rapport building.

The survey was voluntary, confidential and anonymous. Consent taking was mandatory before introduction to the main survey tool. The survey was prepared in English and translated into Bengali (the local language) for easy processing and understanding. The survey covered different thematic areas including food consumption, access to foods, purchasing methods, coping mechanisms during the COVID-19

pandemic and comparisons with pre-confinement life.

2.3. Data analysis

Descriptive statistics were used to define the proportion of responses. Weighted mean was used to calculate the changes in fish prices. To do this, the increase or the decrease in price of each fish species was collected. For each fish, the mean increase or decrease was calculated by calculating its weighted mean. The local price units were then converted to USD at a conversion rate of 1.0 USD = 84.8 Bangladeshi Taka (BDT) (Source: Bangladesh Bank, accessed on 15 October 2020). Four income groups were created for the households based on their monthly income, following the method explained by HIES (2016). Some modifications were made for the suitability of analysis. Data were analysed using SPSS (*Statistical Package for the Social Sciences*) (version 26.) The study was executed during the first wave of COVID-19 over a short period of time to address the food security issues created by COVID-19. Therefore, this study relied on self-reported data and telephone surveys that considered proxy indicators of reported income and consumption rather than detailed calculations of these indicators.

3. Results

3.1. Demographic profile

The social-demographic information collected with the questionnaire include the age and gender of the participants (Table 1). The participants were 80% male and 20% female. A wide variety of professions, from high-ranking government official to day labourer, were found in Dhaka city (Table 1). There are two dominant job sectors in Bangladesh: government and non-government (BBS, 2019). Non-government job opportunities include self-employment and other informal jobs like ready-made garment work, rickshaw pulling, maid and street hawking work. The low income households were day labourers, rickshaw pullers, bus helpers, barbers, shop keepers, and CNG (compressed natural gas driven vehicle) drivers around the area. The majority (28.7%) of the respondents worked in private sectors. This was followed by respondents who were government professionals (22%), business professionals (11.9%), CNG driven auto rickshaw drivers (10.2%), self-employed (6.3%) and those with other jobs (21%). At the national level, the households were stratified into 19 categories based on income levels. For a concise representation, those categories were divided into four sub-sets, all of which are aligned with the national level data (BBS, 2019). Among the four categories of social well-being, approximately 20% of the surveyed households fell in the ultra-poor category (income <120 USD per month), 34% in the poor category

Table 1
Demographic profile of the respondents in Dhaka city, Bangladesh.

Variables	Category	Number of respondents	Respondents in %
Gender	Male	326	82.1
	Female	71	17.9
Age group	18–30	166	41.8
	31–50	204	51.4
	>50	27	6.8
Profession	Govt. job/autonomous	87	22.1
	Private job	113	28.7
	Self-employed	25	6.3
	CNG and auto driver	40	10.2
	Business	47	11.9
	Others (Informal job)	82	20.8
Monthly income	<120 USD	69	17.8
	120–240 USD	134	34.5
	241–480 USD	63	16.3
	>480 USD	122	31.4

(income level 121–240 USD), 16% in the medium category (241–840 USD) and 30% in the rich category (>480 USD) (Table 1).

3.2. COVID-19's impact on livelihoods

3.2.1. Impact on regular income

The low-income level households tended to lose a higher proportion of income over the first 100 days of COVID-19 restrictions (Table 2). In the lower-income group (ultra-poor), over 95% of households were impacted in some way, and more than one third of households completely lost their regular sources of income. Overall income for nearly 80% of households changed, and richer segments were less affected.

3.2.2. Impact on the frequency of grocery shopping

The frequency of daily and every other day grocery shopping was reduced during the COVID-19 pandemic for most households (Table 3). Weekly and bi-weekly grocery shopping trips increased by up to seven times the pre-COVID-19 amount across different income groups during the pandemic from pre-COVID-19. Households from all four income groups showed a similar pattern of changes away from high frequency shopping to a lower frequency of shopping over the same period.

3.2.3. Impact on the frequency of fish consumption

The reduction in the frequency of fish consumption per week was observed for all four income groups during the pandemic. The total number of households in the high frequency fish consumption group (>10 times per week), decreased from approximately 29% of all households before the pandemic to approximately 9% during the pandemic (Table 4). Similarly, half of the households from the medium frequency fish consumption group (5–10 times per week) began consuming fish at the same frequency as the lower frequency fish consumption group. Moreover, compare to pre-pandemic, number of households consuming fish less than five times a week increased two to five times during the pandemic. The number of households in the poor income group who consumed fish less than five times a week before the pandemic (5.91%) grew by approximately five times after the beginning of the pandemic (28.53%). The poor income group also had drastic changes in the households that consumed fish more than 10 times a week before the pandemic. Due to extreme financial duress, the number of households in this group eating fish at this level dropped from 37% (nearly 10% of the respondents) to 1% (less than 1% of the respondents) during the pandemic. Higher income groups (rich and medium) in the medium frequency category (6–10 times per week) maintained their consumption trends from before COVID-19 to during the COVID-19

Table 2

Percentage of households from different income groups (based on monthly income) experiencing various degrees of income reduction during the COVID-19 pandemic. The total number of households that responded to this question was N = 362).

Changes in income	Income groups (USD per month)				Changes (%)
	<120	120–240	241–480	>480	
	Ultra-poor	Poor	Medium	Rich	Average
Jobless (100% reduction of income)	36.9	31.0	16.1	10.7	23.5
51–75% reduction of income	20.0	19.4	12.5	10.7	15.7
26–50% reduction of income	24.6	21.7	23.2	11.6	19.3
0–25% reduction of income	13.8	17.1	21.4	22.3	18.8
No reduction of income	4.6	10.9	26.8	44.6	22.7
Number of households	65	129	56	112	

Table 3

Grocery shopping frequencies pre-COVID-19 (N = 380) and during COVID-19 (N = 365) for the households of Dhaka city. The number in parenthesis denotes the percentage of total respondents for pre-COVID-19 and COVID-19-related questions.

Income groups (income, USD/month)	Grocery shopping frequency							
	everyday		every other day		once a week		every 15 days	
	Pre-COVID-19	COVID-19	Pre-COVID-19	COVID-19	Pre-COVID-19	COVID-19	Pre-COVID-19	COVID-19
<120	23 (6.05)	10 (2.74)	37 (9.74)	23 (6.30)	5 (1.32)	27 (7.40)	1 (0.26)	3 (0.82)
120–240	33 (8.68)	10 (2.74)	70 (18.42)	34 (9.32)	28 (7.37)	60 (16.44)	1 (0.26)	23 (6.30)
241–480	3 (0.79)	1 (0.27)	41 (10.79)	10 (2.74)	17 (4.47)	39 (10.68)	0 (0)	11 (3.01)
>480	8 (2.11)	1 (0.27)	53 (13.95)	17 (4.66)	52 (13.68)	59 (16.16)	8 (2.11)	37 (10.14)
Total	67 (17.63)	22 (6.03)	201 (52.89)	84 (23.02)	102 (26.84)	185 (50.68)	10 (2.26)	74 (20.27)

Table 4

The change in fish consumption frequency (number of respondents) over time before and after COVID-19. The number in the parenthesis denotes the percentage of total respondents for pre-COVID-19 (N = 372) and COVID-19 (N = 368) related questions.

Income groups (income, USD/month)		Fish consumption frequency in a week					
		<5 times		6–10 times		>10 times	
		Pre-COVID-19	COVID-19	Pre-COVID-19	COVID-19	Pre-COVID-19	COVID-19
<120	Ultra-poor	25 (6.72)	58 (15.76)	29 (7.8)	1 (0.27)	8 (2.15)	3 (0.82)
120–240	Poor	22 (5.91)	105 (28.53)	69 (18.55)	21 (5.71)	37 (9.95)	1 (0.27)
241–480	Medium	11 (2.96)	24 (6.52)	39 (10.48)	33 (8.97)	12 (3.22)	5 (1.36)
>480	Rich	23 (6.18)	45 (12.23)	56 (15.05)	50 (13.59)	41 (11.02)	22 (5.98)
Total		81 (21.77)	232 (63.04)	193 (51.88)	105 (28.53)	98 (26.34)	31 (8.42)

crisis period. Two major changes occurred in the groups with a frequency of 6–10 times per week and more than 10 times per week and the group with a frequency of less than 5 times per week. The frequency of the first two groups was reduced by approximately 50% while the frequency of the less than 5 times a week group doubled during the pandemic. On top of this, approximately 5% of respondents stopped consuming fish during the pandemic (Supplementary Table S1).

3.3. Changes in availability and accessibility of food items

3.3.1. Availability of fish

The respondents were asked about the availability of fish before and after the start of COVID-19. Most of the respondents reported that Indian major carps, tilapia, pangas, small indigenous species (SIS), pabda catfish, shrimp/prawns and climbing perch were common fish in the urban markets during the pandemic (Fig. 1A). However, 10–20% of

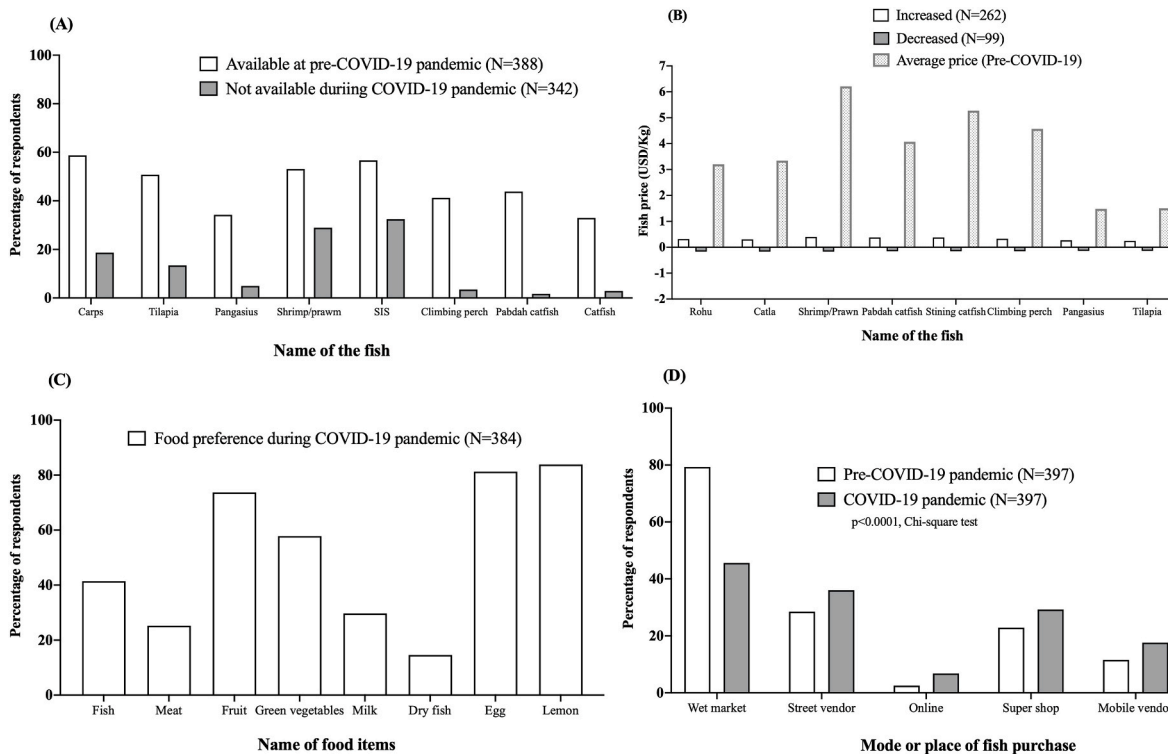


Fig. 1. Fish and other food items, their availability and methods for purchasing. The data on the availability of fish: (A) the change in pricing of fish, (B) food preference by the households (C) and their methods of purchasing fish (D) were collected from the inhabitants of Dhaka city through the questionnaire survey from May to June 2020.

respondents reported that Indian major carps and tilapia were not available during COVID-19. According to one third of respondents there were major decreases in the availability of SIS and shrimp/prawns.

3.3.2. Changes in fish prices

The change in fish prices during the COVID-19 pandemic was recorded. Approximately 72% of the respondents mentioned that fish prices increased during the pandemic, and about 28% said that fish prices decreased in some areas. For every fish species that the questionnaire asked about, some price fluctuation was reported. These fluctuations varied between different market settings (super shop/open market), shopping times and market locations. The pre-pandemic prices of commonly available fish were also collected. The mean prices of rohu, catla, pangas and tilapia were 3.2, 3.34, 1.48 and 1.5 USD per Kg, respectively (detail in Supplementary File 1). The mean increases in fish prices during the pandemic ranged between 0.24 and 0.48 USD/Kg while mean decreases were around 0.12 USD/Kg (Fig. 1B).

3.3.3. Food consumption strategies

During the pandemic, households made some adjustments to their daily diets. For instance, more than 70% of households reported avoiding junk foods and soft drinks, and one third of households stopped eating salad type foods including cucumbers, tomatoes and carrots (Supplementary File 1). More than 80% of households reported that they increased the consumption of fruits, particularly lemons. Most were increasing the amount of vitamin C rich foods in their daily diets

(Fig. 1C). On top of these changes, 80% of households reported that eggs became one of their key protein sources during the survey period. Approximately 40 and 25% of the respondents reported fish and meat consumption, respectively (Fig. 1C).

3.3.4. Mode or place of fish purchase

In general, the head of the household (who was typically male) used to buy fish from wet markets. Residents in better-off segments tended to buy fish from super stores and rarely utilised online shopping services. Depending on access and timing, households utilised multiple sources to buy fish. Households also purchased fish from wet markets and mobile vendors. Balcony shopping (buying fish from the mobile vendor at one's own doorstep and/or from the balcony) was also prominent in urban areas during the pandemic. The current study revealed that about half of the households avoided wet markets because of COVID-19. Pre-COVID-19, 80% of households bought fish from wet markets. This percentage dropped to 45% during the pandemic. Purchases from street vendors by the surveyed households, however, increased from 28% to 36%. During the study period shopping from super shops, mobile vendors and online vendors was trending up in response to the pandemic (Fig. 1D).

3.4. Household response to the COVID-19 pandemic

The variables considered in this study were coping strategies and precautions used by the households to minimise their chance of spreading of the virus, the different panic buying strategies used to

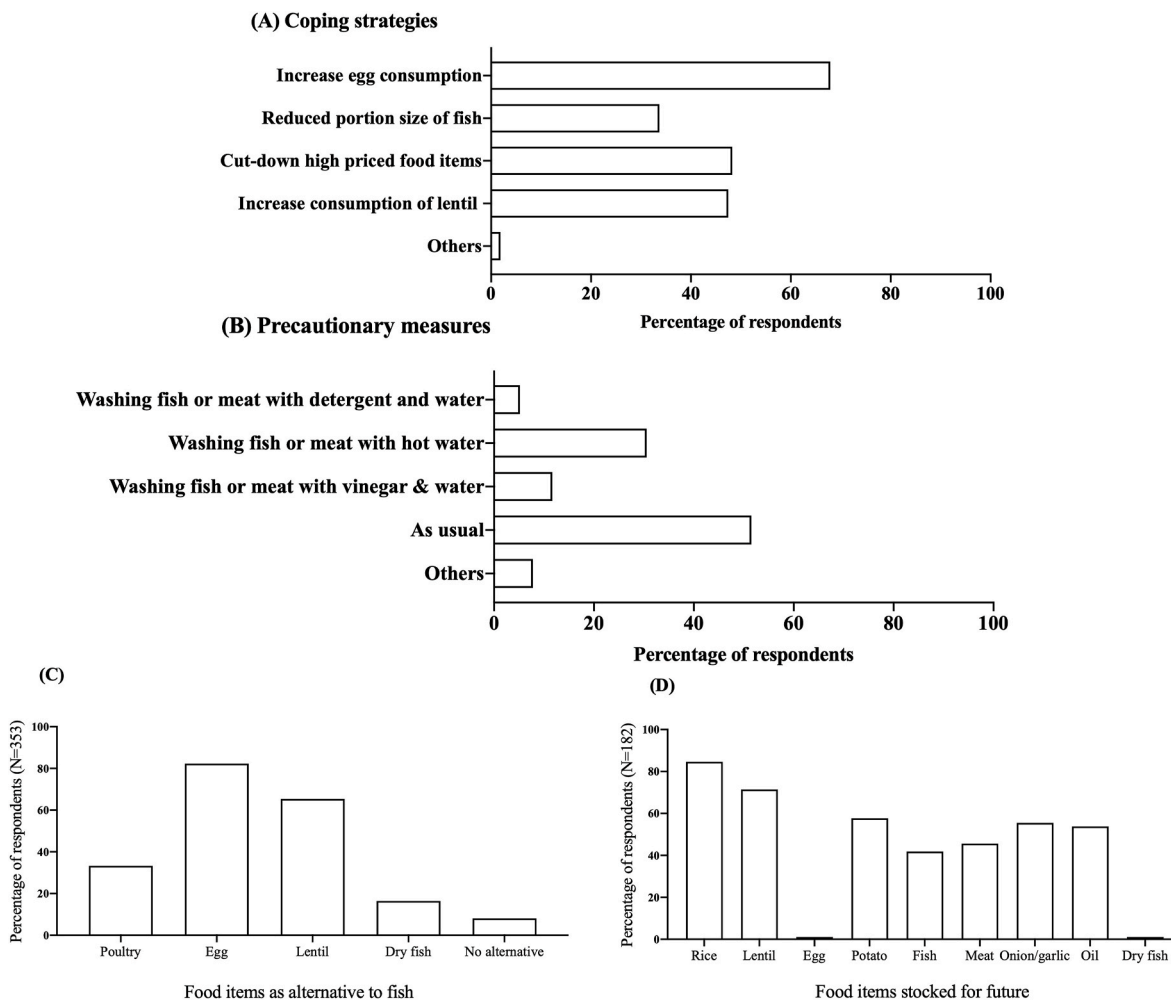


Fig. 2. Household responses to the COVID-19 pandemic. The data on the households' coping strategies: (A) precautionary measures taken, (B) alternative food items used to replace the protein supply from fish (C) and food items that were stocked for future use in response to the COVID-19 pandemic (D).

stockpile foods and the use of alternative protein sources.

3.4.1. Coping strategy

Almost all the surveyed households used at least one strategy to cope up with the pandemic. During the lockdown period (23 March 30 to May 2020), households increased consumption of some food items (Fig. 2A). Some households also cut down high-priced food commodities like fish and meat. Furthermore, one third of the households reduced fish portion sizes for each individual. Some households adopted more than one strategy and increased dependency on durable food stuffs.

3.4.2. Precautionary measures to avoid viral transmission

About half of the total surveyed households followed some precautionary measures to avoid viral contamination from food (Fig. 2B). Nearly one third of the respondents washed fish or meat with hot water before cooking, and about 12% of the respondents used vinegar and water to clean food commodities. A few used detergent, saltwater, ashes and water to reduce the risk of transmission (Fig. 2B) (some data not shown).

3.4.3. Alternatives to fish

Approximately 90% of the households surveyed in Dhaka city utilised available alternative food stuffs in varying amounts. Four types of foods including poultry, eggs, lentils, and dry fish were consumed as alternatives to fresh fish. Among the four, eggs were the primary substitute for fish. Of the respondents, 82% reported that they consumed eggs during the pandemic as an alternative to fish, and 65, 33 and 16% consumed lentils, poultry and dry fish, respectively (Fig. 2C). However, some households used multiple substitutions.

3.4.4. Panic buying

The beginning of the COVID-19 pandemic induced panic buying. Approximately 46% of households stocked food stuffs for future use. About 85% of the respondents stockpiled rice, 70% stockpiled lentils and 58% stockpiled potatoes (Fig. 2D). Onion, garlic, oils, fish and meat were also stocked for shorter periods by the households. Surprisingly, dried fish were not found to be a food items of choice for stockpiling.

3.5. Intra-household food allocation

Food distribution among the family members during the pandemic was also recorded. Nearly 53% of the households reported that none of the family members were deprived of food during the pandemic. Around 23%, however, reported that all members of the households experienced food shortage (Supplementary File 1). The remaining 24% of the households reported at least one family member (usually women, elderly and children) was deprived of food. Among household members, in approximately 10% of the households, elderly people (>65 years old) compromised food, in nearly 8% of the households, women compromised food, in about 6% of the households children compromised food.

4. Discussion

The present study aims to understand the livelihoods and food security of Dhaka city dwellers during the COVID-19 pandemic. The social distancing measures and country wide lockdowns have severely affected the food supply in Bangladesh. The informal job sectors play a vital role in the urban economy of many low- and middle-income countries (LMIC), including Bangladesh (Hasan and Tamanna, 2015). Likewise, Kar & Marjit (2009) reported that more than 51% of jobs in the urban regions of developing countries are in informal sectors. This study indicates that urban informal jobs are highly vulnerable. It also demonstrates that most households' incomes (especially in lower socio-economic groups) have been affected by the pandemic.

Job opportunities for members of lower income households are mostly linked to one's ability to move. The lockdown measures taken to

curve the spread of the disease produced many challenges to these households' abilities to earn a living. This study found that nearly 85% of the households from the low income group experienced a reduction of income between 25 and 100% during the pandemic. Overall, 23.5% of total households reported a job loss during the pandemic. Swapan (2020) demonstrated that 13% of the working people in Bangladesh have lost their jobs during the COVID-19 pandemic. Because urban settings provide better income-earning opportunities compared to rural parts, the social well-being stratification based on income created an ultra-poor group that is only half of what one for the national level might be (BBS, 2019). However, 30–40% of households from the higher income groups were financially unaffected during the pandemic. As an example, in Ethiopia, more poor households have lost their income compared to rich households (Abate et al., 2020). During the first 100 days of the COVID-19 pandemic, the income loss experienced by approximately 80% of households indicated the coming food crisis. The lockdown period brought with it an economic crisis for many individuals around the world, including those in Bangladesh (Banna, 2020).

COVID-19 related interruptions in shipping, trade and labour paired with uncertain supply and demand trends disrupted the supply chains of perishable items like fish and aquatic foods (CGIAR, 2020). Fish are largely farmed/caught in the rural, peri-urban areas of Bangladesh and then transported to local and distant markets. A major portion of the country's fish is shipped to urban areas like Dhaka city. The limitations on transport facilities during the pandemic hampered this process. This change in process may be responsible for the increase in the cost of fish that was reported by more than 70% of this study's respondents. The increase in the price of fish was approximately 0.35 USD per kg. However, 28% of the respondents in some areas of Dhaka city reported a decrease in the price of fish. The decrease might be because of market timing, species of fish, market locations and lack of customers at market places. Habib (2020) has reported that fish farmers in Bangladesh were facing huge economic losses because they were not getting proper prices for their fish. This dilemma was created by the lack of transport facilities. CGIAR (2020) has also shown that fish prices in retail markets fell because of customers' fears of becoming infected with SARS-CoV-2. Similarly, in Turkey, the volume of fish in retail and wholesale markets was significantly reduced during the pandemic (Akar et al., 2020).

In the present study, the frequency of fish consumption by the households in Dhaka city over a seven-day period was correlated with the income of the household before and during the pandemic. The more affluent households tended to consume fish at higher frequencies than households with lower socio-economic statuses. The overall consumption of fish, however, significantly reduced after the start of COVID-19. Households became dependent on other food items like eggs, lentils, and chicken as alternatives to fish. Akhtar et al. (2018) reported that the consumption of eggs saw the highest increase in consumers, followed by chicken and fish. However, Belton and Toufique, 2014 pointed out that the frequency of the consumption of fish by the consumers in Bangladesh was the highest followed by vegetables, fruits, eggs, milk and meat over a period of 14 days. In close agreement with these findings, Shahabuddin (2010) reported that the diets of the poorer segment of the society did not meet their nutritional needs. Because of the pandemic, however, many households in the current study reported reducing their fish portion sizes and dropping expensive animal products from their diets. This is in agreement with the findings from Addis Ababa, Ethiopia (Abate et al., 2020).

The current study observed that most households greatly reduced their frequency of grocery shopping during the pandemic. Most were aware of the pandemic and believed that the virus could be transmitted between humans. Intensive media coverage and government restrictions prevented people from leaving their homes and decreased physical trips to the grocery store. Instead, many people started relying on online marketplaces or e-commerce sites for their daily necessities (Shawki, 2020). There was a similar shift toward online shopping in other places like China, as reported by Ryan (2020), and Spain, as reported by Chaya

et al. (2020). Fluctuations in product prices and availability that are normally seen during natural disasters occurred as a result of the pandemic (Cavallo et al., 2014).

COVID-19 has made people more conscious of the amount of immune boosting foods in their diet (Naja and Hamadeh, 2020). The WHO has developed specific COVID-19 guidelines for food intake that include vitamin C rich foods (lemons), eggs, fruits, and green vegetables. These functional foods have been proven to boost the immune system, repair body tissues and reduce the spread of viruses (Edgar et al., 2012; Galanaskis, 2020; Joshi et al., 2010). In the present study, people emphasised having diets that included vitamin C rich foods (like lemons), and protein packed foods (like eggs and lentils). Certain food items, like junk foods, were dropped from the respondent's daily diet list. This might be because fast-food outlets were closed.

In this study, households used hot water, detergent, vinegar or saltwater to wash fish to avoid viral transmission. However, no scientific evidence was found in favour of these methods for limiting the spread of disease or any effects on nutritional quality of food items. However, out of fear, people became over conscious about taking virus-mitigation measures. The Centres for Disease Control and Prevention (CDC, 2021) made a statement highlighting the importance of not washing with soap, bleach, sanitizer, alcohol, disinfectant or any other chemical while handling and cleaning fresh produce. Though it was mentioned earlier that fish and meat have not been reported as a carrier of the virus, people in Asian countries like Bangladesh can reduce the chance of spreading this virus by cooking foods at sufficient temperatures, using separate utensils and following proper washing and handling guidelines.

Covid-19 pandemic has increased the vulnerability of certain groups of people. Generally, women and children are deprived in intra-household food allocations in Bangladesh (Ahmed et al., 2012), and the pandemic has worsened that situation as many households reduced their consumption of fish or other protein sources. In terms of health, women and children are the most vulnerable groups (The Lancet Global Health, 2020). In Bangladesh, people aged over 65 years, populations living in the slums, disabled persons, women and ethnic minority groups are the most vulnerable groups in terms of food security and nutrition (GoB, 2020). Bodrud-Doza et al. (2020) found that many of the urban poor lost their jobs and temporarily migrated to rural areas. Households with partial and full income losses were in worse positions to secure food and meet nutritional requirements. Meanwhile, households in high income groups with secured jobs have been less affected. Better-off appears to have diverse coping mechanisms, however, the pre-existing inequalities among social groups have been raised many folds during the pandemic (Belton et al., 2021).

The COVID-19 pandemic has awakened the global community to think on the food security and agricultural sustainability (Fan et al., 2021). To mitigate COVID-19's impacts, the immediate food needs of vulnerable people should be addressed. Food should be distributed to ensure that the most vulnerable families including beggars, day laborers, rickshaw pullers, van pullers, transport workers, restaurants workers, and small roadside tea stall owners are sufficiently provided food aids (Roy, 2020). A regular and equal distribution of food would ensure the social well-being of the entire population. Since pregnant women, adolescents, infants and elderly people are more vulnerable during the pandemic, they should be protected by meeting their dietary and nutritional requirements. Moreover, small holders who are a major part of the food systems should be supported by the government to run their business (Fan et al., 2021). At the same time, people must learn how to adapt to this new normal. To ensure a community's ability to secure food and make a living, innovation and research on context-based mechanisms should be placed at the centre of the economy.

The study was indicative, however, and should not be a representation since only a fraction of Dhaka city's population participated in the survey. In addition, because there were incomplete entries for some of the questions, the number of respondents was not the same for different indicators. Therefore, further research is needed to draw a constructive

conclusion about creating a sustainable policy that would ensure the present and future food security of urban dwellers during a pandemic.

Authors' contribution

SCM and AAM designed the main concept and outline of the proof for this study. The authors prepared the questionnaire, researched existing literature and collected the data for this study. SCM analysed the data and interpreted the findings. Each author contributed to and approved the manuscript prior to submission for publication.

Funding

This research did not receive grant funding agencies in the public, commercial, or non-profit sectors.

Declaration of competing interest

The authors have no conflict of interest

Acknowledgement

The authors would like to acknowledge all the survey respondents for using their valuable time to respond. This study would not have been possible without their participation. The authors would also like to thank their friends and colleagues who shared the survey links with their peers. The authors would like to thank Stacia Stetkiewicz (Lancaster University), John Taylor (FAO) and Wesley Malcorps (University of Stirling) for their comments on the initial draft of this manuscript.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.gfs.2021.100526>.

References

- Abate, G.T., Brauw, A.D., Hirvonen, K., 2020. Food and nutrition security in Addis Ababa, Ethiopia during COVID-19 pandemic. <https://doi.org/10.2499/p15738coll2.133731>, 1–28.
- Ahmed, A.M., Ahmed, T., Alam, N., Ali, M.M., Choudhury, F.P., Cravioto, A., Hossain, M. I., Ireen, S., Islam, M.M., Mahfuz, M., Rahman, S., Rahman, S.M., 2012. Nutrition of children and women in Bangladesh: trends and directions for the future. *J. Health Popul. Nutr.* 30 (1), 1–11. <https://doi.org/10.3329/jhpn.v30i1.11268>.
- Ahmed, T., Begum, S., Sakamoto, M., 2020. Vulnerabilities to COVID-19 in Bangladesh and a reconsideration of sustainable development goals. *Sustainability* 12 (13), 5296. <https://doi.org/10.3390/su12135296>.
- Akar, Ö., Can, M.F., Demirci, A., Demirci, S., Şimşek, E., 2020. Has the pandemic (COVID-19) affected the fishery sector in regional scale? A case study on the fishery sector in Hatay province from Turkey. *Mar. Life Sci* 2 (1), 13–17. <https://dergipark.org.tr/en/download/article-file/1174918>.
- Akhtar, S., Hossain, M.S., Islam, M.J., Liza, A.A., Sayeed, M.A., 2018. Consumers profile analysis towards chicken, beef, mutton, fish and egg consumption in Bangladesh. *Br. Food J.* 120 (12), 2818–2831. <https://doi.org/10.1108/BFJ-03-2018-0191>.
- Aneja, A., Islam, S.T., 2020. Bangladesh Faces a Crisis in Remittances amid COVID-19. *World Economic Forum*.
- Banna, H., 2020. Minimising the economic impact of coronavirus in Bangladesh. *The Business Standard*. <https://www.imperial.ac.uk/news/19>.
- BBS, 2012. *Statistical Year Book of Bangladesh-2011*. Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh, 31st Edition. BBS, Dhaka.
- BBS, 2019. *Household Income and Expenditure Survey 2016-17*. Bangladesh Bureau of Statistics, Ministry of Planning, Government of the People's Republic of Bangladesh. BBS, Dhaka.
- Bell, M.V., Karapanagiotidis, I.T., Little, D.C., Rakshit, S.K., Yakupitiyage, A., 2006. Polyunsaturated fatty acid content of wild and farmed tilapias in Thailand: effect of aquaculture practices and implications for human nutrition. *J. Agric. Food Chem.* 54, 4304–4310. <https://doi.org/10.1021/jf0581877>.
- Belton, B., Rosen, L., Middleton, L., Gazzali, S., Mamun, A.A., Shieh, J., Noronha, H.S., Dhar, G., Ilyas, M., Price, C., Nasr-Allah, A.M., Elsira, I., Baliarsingh, B.K., Padiyar, A., Rajendran, S., Mohan, A.B., Babu, R., Akester, M.J., Phyo, E.E., Khin, M. S., Olaniyi, A., Siriwardena, S.N., Bostock, J., Little, D.C., Phillips, M.J., Thilsted, S. H., 2021. COVID-19 Impacts and Adaptations in Asia and Africa's Aquatic Food Value Chains. Penang, Malaysia: CGIAR Research Program on Fish Agri-Food Systems. Working Paper: FISH-2021-02.

- Belton, B., Toufique, K.A., 2014. Is aquaculture pro-poor? Empirical evidence of impacts on fish consumption in Bangladesh. *World Dev.* 64, 609–620. <https://doi.org/10.1016/j.worlddev.2014.06.035>.
- Belton, B., van Asseldonk, L.J.M., Thilsted, S.H., 2014. Faltering fisheries and ascendant aquaculture: implications for food and nutrition security in Bangladesh. *Food Pol.* 44, 77–87. <https://doi.org/10.1016/j.foodpol.2013.11.003>.
- Béné, C., Kawarazuka, N., 2010. Linking small-scale fisheries and aquaculture to household nutritional security: an overview. *Food Secur* 2 (4), 343–357. <https://doi.org/10.1007/s12571-010-0079-y>.
- Bodrud-Doza, M., Rahman, M.M., Shammi, M., Islam, T.A.R.M., 2020. COVID-19 pandemic, socioeconomic crisis and human stress in resource-limited settings: a case from Bangladesh. *Heliyon* 6 (5). <https://doi.org/10.1016/j.heliyon.2020.e04063>.
- BRAC, 2020. Rapid perception survey on COVID-19 awareness and economic impact. Building resources across communities. http://www.brac.net/images/news/downloads/Final-draft_Rapid-Perception-Survey-on-COVID-19-Awareness-and-Economic-Impact-9-May-2020.pdf. (Accessed 12 July 2020).
- Cardwell, R., Ghazalian, P.L., 2020. COVID-19 and International Food Assistance: policy proposals to keep food flowing. *World Dev.* 135, 105059. <https://doi.org/10.1016/j.worlddev.2020.105059>.
- Cavallo, A., Cavallo, E., Rigobon, R., 2014. Prices and supply disruptions during natural disasters. *Rev. Income Wealth* 60 (S2), S449–S471. <https://doi.org/10.1111/roiw.12141>.
- CDC, 2021. Food and coronavirus disease 2019 (COVID-19). Centers for disease Control and prevention (CDC). <https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/food-and-COVID-19.html>. (Accessed 18 February 2021).
- CGIAR, 2020. Fish and aquatic food systems COVID-19 updates: Bangladesh. Research program on fish. <https://fish.cgiar.org/news-and-updates/news/fish-and-aquatic-food-systems-covid-19-updates-india>.
- Chaya, C., Fisman, S., Laguna, L., Puerta, P., Tárrega, A., 2020. The impact of COVID-19 lockdown on food priorities. Results from a preliminary study using social media and an online survey with Spanish consumers. *Food Qual. Prefer.* 86 (July), 104028. <https://doi.org/10.1016/j.foodqual.2020.104028>. (Accessed 30 June 2020).
- Cranfield, J.A.L., 2020. Framing consumer food demand responses in a viral pandemic. *Can. J. Agric. Econ.* 68, 151–156. <https://doi.org/10.1111/cjag.1224>.
- DoF, 2018. Yearbook of Fisheries Statistics of Bangladesh, 2017-18. Fisheries Resources Survey System (FRSS), Department of Fisheries, vol. 35. Ministry of Fisheries, Bangladesh, p. 129.
- Edgar, J.D., Gibson, A., Gilchrist, S.E.C.M., McKinley, M.C., Neville, C.E., Patterson, C.C., Woodside, J.V., Young, I.S., 2012. Effect of fruit and vegetable consumption on immune function in older people: a randomised controlled trial. *Am. J. Clin. Nutr.* 96 (6), 1429–1436. <https://doi.org/10.3945/ajcn.112.039057>.
- Fan, S., Teng, P., Chew, P., Smith, G., Copeland, L., 2021. Food system resilience and COVID-19 – lessons from the Asian experience. *Glob. Food Sec.* 28, 100501. <https://doi.org/10.1016/j.gfs.2021.100501>.
- Farias, de Paulo D., de Araújo, F.F., 2020. Will COVID-19 affect food supply in distribution centres of Brazilian regions affected by the pandemic? *Trends Food Sci. Technol.* 103, 361–366. <https://doi.org/10.1016/j.tifs.2020.05.023>.
- Galanakis, C.M., 2020. The food systems in the era of the coronavirus. *Foods* 9 (4), 1–10. <https://doi.org/10.3390/foods9040523>.
- Global Panel, 2020. COVID-19: safeguarding food systems and promoting healthy diets A policy brief by the global panel. Global panel on agriculture and food systems for nutrition. <https://scalingupnutrition.org/news/covid-19-safeguarding-food-systems-and-promoting-healthy-diets-a-policy-brief-by-the-global-panel/>.
- GoB (Government of Bangladesh), 2020. COVID-19: Bangladesh multi-sectoral anticipatory impact and needs analysis needs assessment working group date: needs assessment working group. Needs assessment working group Bangladesh. https://reliefweb.int/sites/reliefweb.int/files/resources/covid_nawg_anticipatory_impacts_and_needs_analysis.pdf.
- Gopinath, G., 2020. The great lockdown: worst economic downturn since the great depression – global economy, IMF blog. <https://blogs.imf.org/2020/04/14/the-great-lockdown-worst-economic-downturn-since-the-great-depression/>.
- Habib, B., 2020. Fish farmers facing losses due to coronavirus situation. *The Business Standard*. <https://tbsnews.net/coronavirus-chronicle/covid-19-bangladesh/fish-farmers-facing-losses-due-coronavirus-situation-69883>. (Accessed 26 June 2020).
- Hasan, M.K., Tamanna, M., 2015. Life in a megacity: livelihood strategies and survival mechanisms of rickshaw pullers in Dhaka city. *Millennial Asia* 6 (1), 44–60. <https://doi.org/10.1177/0976399614563224>.
- HIES, 2016. Bangladesh Household Income and Expenditure Survey. Bangladesh Bureau of Statistics, Dhaka, Bangladesh.
- HLPE, 2014. Food losses and waste in the context of sustainable food systems. A report by the high-level panel of experts on food security and nutrition of the committee on world food security, rome. <http://www.fao.org/3/a-i3901e.pdf>.
- Holy, I.J., 2020. COVID-19 in Bangladesh: a visual guide to the economic impact. <https://databd.co/stories/covid-19-in-bangladesh-a-visual-guide-to-the-economic-impact-11064#ref.6>. <https://www.weforum.org/agenda/2020/06/bangladesh-faces-a-remittances-crisis-amid->
- IEDCR, 2020. Bangladesh Covid-19 Update. Institute of Epidemiology, Disease Control and Research, Dhaka, Bangladesh. <https://www.iedcr.gov.bd/website/>. (Accessed 21 July 2020).
- IEDCR, 2021. Bangladesh Covid-19 Update. Institute of Epidemiology, Disease Control and Research, Dhaka, Bangladesh. <https://www.iedcr.gov.bd/website/>. (Accessed 6 February 2021).
- INFS, 2013. Food Composition Table for Bangladesh. Institute of Nutrition and Food Science, Centre for Advanced Research and Sciences, University of Dhaka, Dhaka, Bangladesh. http://www.fao.org/fileadmin/templates/food_composition/document/s/FCT_10_2_14_final_version.pdf.
- Joshi, F.P., Naik, S.R., Thakare, V.N., 2010. Functional foods and herbs as potential immunoadjuvants and medicines in maintaining healthy immune system: a commentary. *J. Compl. Integr. Med.* 7 (1), 2020. <https://doi.org/10.2202/1553-3840.1441>.
- Kar, S., Marjit, S., 2009. Urban informal sector and poverty. *Int. Rev. Econ. Finance* 18 (4), 631–642. <https://doi.org/10.1016/j.iref.2008.06.009>.
- Laborde, D., Martin, W., Swinnen, J., Vos, R., 2020. COVID-19 risks to global food security. *Science* 369 (6503), 500–502. <https://doi.org/10.1126/science.abc4765>.
- Liverpool-Tasie, L.S.O., Reardon, T., Belton, B., 20210. Essential non-essentials: COVID-19 policy missteps in Nigeria rooted in persistent myths about African food supply chains. *Appl. Econ. Perspect. Policy Applied Economic Perspectives and Policy*, 43, 205–2241–20. <https://doi.org/10.1002/aep.13139>.
- Lau, B.P.L., Marakkalage, S.H., Zhou, Y., Hassan, N.U., Yuen, C., Zhang, M., Tan, U.X., 2019. A survey of data fusion in smart city applications. *Inf. Fusion* 52, 357–374. <https://doi.org/10.1016/j.inffus.2019.05.004>.
- Me, A., Fu, H., 2020. How COVID-19 is changing the world: a statistical perspective. The Committee for the Coordination of Statistical Activities (CCSA). <https://openknowledge.worldbank.org/handle/10986/33773>. (Accessed 18 February 2021).
- Naja, F., Hamadeh, R., 2020. Nutrition amid the COVID-19 pandemic: a multi-level framework for action. *Eur. J. Clin. Nutr.* 74, 1117–1121. <https://doi.org/10.1038/s41430-020-0634-3>.
- Noy, C., 2008. Sampling knowledge: the hermeneutics of snowball sampling in qualitative research. *Int. J. Soc. Res. Methodol.* 11 (4), 327–344. <https://doi.org/10.1080/13645570701401305>.
- Population Stat, 2021. World population data. Dhaka, Bangladesh Population. <https://populationstat.com/bangladesh/dhaka>. (Accessed 9 February 2021).
- Pu, M., Zhong, Y., 2020. Rising concerns over agricultural production as COVID-19 spreads: lessons from China. *Glob. Food Sec.* 26, 100409. <https://doi.org/10.1016/j.gfs.2020.100409>.
- Reardon, T., Mishra, A., Nuthalapati, C.S.R., Bellemare, M.F., Zilberman, D., 2020. COVID-19's disruption of India's transformed food supply chains. *Econ. Polit. Wkly.* 55 (18), 18–22, 2020/06/08/covid-19-to-plunge-global-economy-into-worst-recession-since-.
- Roy, R., 2020. Mitigating covid-19 impacts on food and agriculture. The financial express. <https://thefinancialexpress.com.bd/views/mitigating-covid-19-impacts-on-food-and-agriculture-1585932264>.
- Ryan, V., 2020. Asian consumers are rethinking how they eat post COVID-19 rethink. Nielsen. <https://www.nielsen.com/au/en/insights/article/2020/asian-consumers-are-rethinking-how-they-eat-post-covid-19/>.
- SANEM, 2020. SANEM researchers assess poverty impacts of COVID-19. South Asian Network on Economic Modelling. <http://sanemnet.org/sanem-researchers-assess-poverty-impacts-of-covid-19/>. (Accessed 30 June 2020).
- Shahabuddin, Q., 2010. The right to food: Bangladesh perspectives. *The Bangladesh development studies.* JSTOR 33 (1/2), 91–138. <https://www.jstor.org/stable/23339886>.
- Sharma, R., Shishodia, A., Kamble, S., Gunasekaran, A., Belhadi, A., 2020. Agriculture supply chain risks and COVID-19: mitigation strategies and implications for the practitioners. *Int. J. Logist. Res. Appl.* <https://doi.org/10.1080/13675567.2020.1830049>.
- Shawki, A., 2020. Shift in consumer behaviour silver lining for e-commerce firms. *The Business Standard*. <https://tbsnews.net/economy/industry/shift-consumer-behavior-silver-lining-e-commerce-firms-72835>.
- Swapan, H.U.R., 2020. In Bangladesh 13 % of working people have lost their jobs due to COVID-19- 19 pandemic: BIDS (in Bengali). DW.COM. <https://p.dw.com/p/3eOdh>.
- The Lancet Global Health, 2020. Food insecurity will be the sting in the tail of COVID-19. *The Lancet Global Health* 8 (6), e737. [https://doi.org/10.1016/S2214-109X\(20\)30228-X](https://doi.org/10.1016/S2214-109X(20)30228-X).
- The Lancet Microbe, 2021. COVID-19 vaccines: the pandemic will not end overnight. *The Lancet Microbe* 2 (1), e1. [https://doi.org/10.1016/S2666-5247\(20\)30226-3](https://doi.org/10.1016/S2666-5247(20)30226-3).
- The World Bank, 2020. COVID-19 to plunge global economy into worst recession since world war II. <https://www.worldbank.org/en/news/press->
- Torero Cullen, M., 2020. Coronavirus: food supply chain under strain: what to do? Rome: food and agriculture organization of the united Nations. https://socialprotection.org/sites/default/files/publications_files/FAO.pdf.
- USDA, 2012. USDA National Nutrient Database for Standard Reference, Release 25. Washington DC.
- WFP, 2020. COVID-19 will double number of people facing food crises unless swift action is taken. <https://www.wfp.org/news/covid-19-will-double-number-people-facing-food-crisis-unless-swift-action-taken>.
- WHO, 2020. Coronavirus disease (COVID-19- 2019) situation reports. Accessed June 30, 2020. <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/>. (Accessed 26 June 2020). world-war-ii.
- Yongyi, M., Francesca, P., 2020. Impact of COVID-19 on SDG progress: a statistical perspective, UN/DESA Policy Brief #81. <https://www.un.org/development/desa/dpad/publication/un-des-a-policy-brief-81-impact-of-covid-19-on-sdg-progress-a-statistical-perspective/>. (Accessed 18 February 2021).