

Households' Socioeconomic Vulnerability Assessment Due to COVID-19 Outbreak: A Web-Based Survey in Bangladesh

Md. Ayatullah Khan ^{1*}, Kazi Humayun Kabir ¹, Kamrul Hasan ¹, Rashmia Sultana ¹, Farhana Hoque ¹,
Sardar Al Imran ¹, Sanju Karmokar ¹

¹Development Studies Discipline, Khulna University, Khulna, BANGLADESH

*Corresponding Author: ayatullah.ku@gmail.com

Citation: Khan MA, Kabir KH, Hasan K, Sultana R, Hoque F, Imran SA, Karmokar S. Households' Socioeconomic Vulnerability Assessment Due to COVID-19 Outbreak: A Web-Based Survey in Bangladesh. *Electron J Gen Med.* 2022;19(3):em365. <https://doi.org/10.29333/ejgm/11797>

ARTICLE INFO

Received: 18 Nov. 2021

Accepted: 6 Feb. 2022

ABSTRACT

Aim: COVID-19, which can be considered a disastrous event, has created not only a public health emergency but also a major socio-economic crisis in Bangladesh. This study, therefore, aimed to assess households' socioeconomic vulnerability due to the COVID-19 outbreak in the country.

Methods: A quantitative cross-sectional survey was performed among 404 households from different districts in Bangladesh. The socioeconomic vulnerability index (SeVI) was developed using data collected from participants via an online-based self-reported questionnaire that included demographic, social, economic, and physical characteristics as well as exposure to COVID-19.

Results: The socioeconomic vulnerability index (SeVI) was calculated as an index score of 0.405 where social, economic, and COVID-19 exposure were reported to be the more impactful components of adaptive capacity, sensitivity, and exposure, respectively. Furthermore, the economic options for households were greatly limited by the consequences of the COVID-19 pandemic.

Practical implications: This study may help to identify the socioeconomic issues that resulted from the COVID-19 outbreak in the country and instruct the policymakers and corresponding authorities on which areas to emphasize for policy implementation so that households become socially and economically less susceptible to the COVID-19 outbreak as well as related infectious diseases and disastrous events in the upcoming years.

Conclusion: This study found socioeconomic vulnerability among Bangladeshi households. The corresponding authorities should adopt policy initiatives to minimize the socioeconomic vulnerability due to the COVID-19 outbreak in the country.

Keywords: COVID-19, socioeconomic vulnerability, SeVI, Bangladesh

INTRODUCTION

The novel coronavirus outbreak in 2019, also called the COVID-19 pandemic, is a world health crisis that has led to an unparalleled human life and livelihood disaster, disrupted economic processes across industries, stopped public transport networks, and limited global social interactions [1]. At the end of December 2019, the outbreak of COVID-19 started in China and spread rapidly around the globe, with 2,961,025 deaths and 137,322,644 positive cases as of April 13, 2021 [2]. COVID-19 was mentioned as a global emergency by the World Health Organization (WHO), which took place on January 30, 2020, and as a global pandemic thereafter on March 11, 2020 [3], while Bangladesh announced their first three cases on March 8, 2020 [4]. A total of 691,957 confirmed cases were recorded, comprising 9,822 deaths in Bangladesh as of April 13, 2021 [5]. In order to combat the spread of COVID-19 disease, the government declared a general holiday from March 26, 2020 through the first wave. With the exception of essential services, all government and non-government institutions have been closed since the lockdown began [6]. After a step-by-step

extension of those holidays with the increase of confirmed cases, all the offices were reopened to a limited extent in compliance with health rules on May 31, 2020 [7]. But, nine months later, the government was again forced to announce a lockdown on April 5, 2021 due to the second wave of the COVID-19 outbreak and further imposed a week-long strict lockdown from April 14, 2021 due to a high increase in confirmed cases and deaths [8, 9]. All the government and non-government institutions, as well as public transport, were again closed throughout the country, apart from emergency services. On the other hand, all schools, colleges, and universities have remained closed since March 18, 2020, and have extended this closure till May 23, 2021 [10].

Overall, this pandemic situation is not constrained to health crisis anymore, instead, it is becoming an unparalleled crippling effect on the social and economic contexts, and it appears with prolonged effects over time [11]. The economic sector throughout the corona outbreak confronted a sharp decline and its potential impacts and consequences have now been discussed under the name "Coronanomics" [12] and some of which as well call it "black swan" [13]. The world has

been experiencing an emerging “de-globalization” as a result of this pandemic, which has resulted in inter-national lockdown, halting normal product progressions, and unprecedented market and manufacturing breakdowns [14]. Bangladesh is also not exceptional from the world, rather facing this downward situation in various sectors of the country, equivalently [15]. It has already experienced an enormous economic and social instability as a result of the emerging COVID-19 pandemic [16]. For instance, the price rise in regular necessities has been noticed due to limited supplies and business owners and vendors have discontinued functioning because of countrywide lockdown and fear of infection. In addition, due to the loss of employment and wages during this situation, middle-income, lower-income, and daily-wage earner households found themselves in a serious financial dilemma. They are dropped into the extremely poor with their last savings consumed [17,18]. Moreover, decrease of export earnings and income from tourism due to the enforced border constraints and extended lockdowns has already been seen as the main contributors to a coming socioeconomic shock, as millions of populations of the country are engaged in these sectors [19]. Furthermore, according to the UN report “World Economic Situation and Prospects 2021”, the country is estimated to have decreased its economic growth from 8.4 percent in the 2018-2019 fiscal year to 4.3 percent in the 2019-2020 fiscal year due to the COVID-19 outbreak [20]. Thus, this indicates that the socioeconomic status of all forms of people has been greatly impacted due to this pandemic. An analysis revealed that the income of households due to COVID-19 outbreak has been decreased by 29 percent and specifically in Dhaka Metro, it has been decreased by 34 percent. Besides the economic impact, they are also adversely impacted on their social networks and physical capital. For example, as result of COVID-19 pandemic, households have lost their remittance support from the earning members and 40 percent of households reported an expansion in food spending [21]. Human Development Research Centre (HDRC) undertook another study to determine both the immediate and long-term socioeconomic effects of the COVID-19 outbreak on urban deprived populations. The findings revealed that 22.7 percent of households’ children are not continuing their study since lockdown and only 2 percent have the facilities for television-broadcasted academic programmes or virtual classes. Furthermore, 11 percent, 54.9 percent, 81 percent, 69.3 percent, and 85.2 percent of the beneficiary households have lost their asset, jobs (permanently or temporarily), amount of savings, rent payment capacity, and food consumption capacity, respectively [22]. Aggregately, the country is experiencing a severe surge in socioeconomic crisis and a hazardous situation.

Previous research has also demonstrated that the COVID-19 pandemic has triggered a socio-economic crisis in several countries around the world, including Bangladesh. There was a study that investigated regional variations in socioeconomic vulnerabilities connected to the COVID-19 outbreak. The findings revealed that India’s COVID-19 risk remained highly variable between states and union territories. The risks associated with COVID-19 in India were driven by the country’s inherent demographic, socioeconomic, and health infrastructure features [1]. Another research determined the socioeconomic vulnerability of communities in the state of Ceará, which is the epicenter of the COVID-19 outbreak in the northeastern region of Brazil. The findings demonstrated the consequences of the pandemic in an economic framework

dominated by the service industry, which is characterized by high levels of human contact and social interaction. Ceará is affected by the crisis as a result of a number of demographic, social, and economic factors that are unique to the region [23]. There was additional study on socio-economic vulnerability to COVID-19 in the Greater Kampala Metropolitan Area (GKMA). The most vulnerable parishes (24.5%) are located in metropolitan cities with retail malls, banks, and transportation centers. About half of the parishes in the GKMA were moderately vulnerable (47.3%), with 28.2% being lowly vulnerable [24]. Further research examined the pandemic’s socioeconomic effects on households, adults, and children in low-income nations. According to that survey, 256 million people, or 77% of the population, live in homes that have lost income due to the outbreak. Food insecurity and a lack of access to medical and fundamental foods made it difficult to cope with the loss [25]. Similarly, a previous study discovered that many people in a Bangladeshi metropolitan city had lost their jobs, particularly day laborers, maid servants, and private car drivers, among other occupations. Furthermore, financial stress has been exerted on people of all socioeconomic backgrounds [15]. Likewise, a study identified socioeconomic crises like unemployment, deprivation, hunger, and social conflicts among Bangladeshis as a result of COVID-19 [17]. In a recent study, it was shown that the COVID-19 lockdown has caused untold misery and suffering to all, especially those residing in Bangladeshi low-income areas. A lot of people lost employment and enterprises. Many people cannot even manage the minimal amount of food required for a healthy lifestyle due to income reductions. They are forced to liquidate household assets, spend savings, and take out loans that they will struggle to pay back. Domestic violence has escalated due to economic hardship, frustration, and apathy. Many types of health vulnerabilities exist. and many children are dropping out of school [22].

Socioeconomic vulnerability analysis is, therefore, the requisite to take the long-term and suitable response as well as to develop adaptation strategies to COVID-19 outbreak-induced hazardous circumstances around the country. In addition, vulnerability assessment guides us in conceptualizing the distinct spectrum of components that contribute significantly to household adaptive capacities, and it determines the broad scope of initiatives used to extensively accommodate and properly assess interconnectedness between humans and their socio-physical surroundings. Moreover, recognizing a society’s socioeconomic vulnerability may help to explain why the effects of a comparable catastrophe may vary from one place to another [26]. Moreover, the socioeconomic vulnerability research has the potential to improve crisis response measures by improving knowledge of catastrophic repercussions at the household level [27,28]. Although there were numerous researches have been conducted in response to COVID-19 pandemic in Bangladesh, most of them were based on mental health issues. A few studies were found on the perspective of socioeconomic issues in Bangladesh [15,17,22]. However, the main point which encouraged the authors to conduct this research that no study was found that assessed socioeconomic vulnerability to COVID-19 outbreak at the household level by using the socioeconomic vulnerability index (SeVI). To fill up this gap, this research was designed with the aim to assess households’ socioeconomic vulnerability to COVID-19 outbreak in Bangladesh. This study may help to identify the contributors of socioeconomic issues that derived from the COVID-19 outbreak

in the country and persuade the corresponding authorities in the development of policy measures to tackle this significant crisis.

CONCEPTUALIZATION OF VULNERABILITY

The physical or ethical vulnerability of specific societal groups or communities to possible risks or losses induced by catastrophic occurrences is referred as social and economic vulnerability [29]. Crisis like the COVID-19 pandemic have an impact on global dimensions resulting in physiological, sociopolitical, economic, and social uncertainty [23,30]. Similarly, Bangladesh is experiencing an unparalleled economic and social hardship as a result of the current novel Corona virus outbreak [16,31]. Throughout this pandemic, it is unavoidable that a substantial humanitarian and socioeconomic catastrophe has emerged in the country, resulting in long-term effects with a variety of weaknesses which are probably to produce the harshest outcomes. However, the concept of vulnerability has been taken into account by a number of assessments in the globe [1,23,24,32]. In addition, there are also various techniques for measuring vulnerability that take into account socioeconomic factors for particular hazards [33-35], but this study has employed the dimensions of the intergovernmental panel on climate change (IPCC) framework to measure socioeconomic vulnerability according to the domains of [27]. This assessment has considered the engagement among demographic, social, economic, physical, and exposure to COVID-19 in developing the vulnerability index. Adaptive capacity, sensitivity, and exposure (see **Table 1** for details) are the three dimensions by which vulnerability will be described. Considering COVID-19 outbreak in Bangladesh, the term 'adaptive capacity' here refers to a summation of capacities and social capital among households' in a community or country that can help mitigate the socioeconomic implications of COVID-19 outbreak. At the same time, sensitivity, in this context, focuses on the aspects

underlying economic and physical predisposition to COVID-19 outbreak. Similarly, exposure refers to individuals, residents, or other aspects present in the impact areas, which are thus adversely affected as a result of significant COVID-19 outbreak risks. Finally, vulnerability is the extent to which the socioeconomic system of a household is vulnerable or unable to comply with the consequences of COVID-19 outbreak. We used a range of 0 to 1 for developing the socioeconomic vulnerability index where 0 indicates lower vulnerability and 1 indicates higher vulnerability.

METHODS

Survey Settings and Study Design

This was an online-based quantitative cross-sectional survey study using primary data. This study utilized primary data because primary data are data collected specifically for a research problem using processes tailored to the specific research problem. Primary data collection adds original insights to the current social knowledge base. Moreover, the broader research community may be able to utilize content generated by different scholars [36]. Data collection was conducted among the households of different districts in Bangladesh. Data was gathered from 10th to 28th June of 2021. The responses were extracted through an online self-reported survey questionnaire (using the google survey tool-Google Forms), employing a convenience sampling technique. Since this study was based on primary data, we used web-based data collection rather than publicly accessible and nationally representative data for this analysis. In addition, this study used a web-based survey methodology because it was challenging to conduct a physical survey during the COVID-19 pandemic. A pretesting survey was conducted prior to the questionnaire design. After that, expert consultations were used to finalize the questionnaire. In order to validate the participants' understanding of the questionnaire items and to

Table 1. Major dimensions, components, and survey questions comprising for SeVI

| Dimension | Component | Indicator | Survey question | Unit | Adapted source |
|-------------------|-----------|--|---|--------------------|--|
| Demographic | | Standardized mean of household heads age | What is the age of your household head? | Years | [22] |
| | | Percentage of female-headed households | What is the gender of your household head? | 1=male 0=female | [22] |
| | | Percentage of urban-based households | Place of residence of your family | 1=urban 0=rural | Developed for the purposes of the questionnaire |
| | | Standardized mean of number of family members | Numbers of your family member | Number | [22] |
| | | Percentage of dependent population | Do your family have any person whose age is under 15 and/or over 65 years? | 1=yes 0=no | Developed for the purposes of this questionnaire |
| Adaptive capacity | | Standardized mean of household heads schooling year | Years of schooling of your household head | Years | [22] |
| | | Percentage of households not borrowed money | In the past 12 months, did your family borrow money from friends or relatives or neighbors? | 1=yes 0=no | [22] |
| Social | | Percentage of households with access to aid-grant | In the past 12 months, have you or someone in your family gone to your community leader for help? | 1=yes 0=no | [22] |
| | | Percentage of households with access to CBOs and local organizations | Do your household have membership in any community-based organizations (CBOs) and local organizations? | 1=yes 0=no | [22] |
| | | Percentage of households with access to community hygiene | Were there any arrangements for handwashing at a specific place in your area from the government or private or own initiatives due to the coronavirus outbreak? | 1=yes 0=no | [22] |

Table 1 (Continued). Major dimensions, components, and survey questions comprising for SeVI

| Dimension | Component | Indicator | Survey question | Unit | Adapted source |
|-------------|----------------------|---|--|---------------------|--|
| Economic | | Percentage of households without government employee | Do your household have any government employee? | 1=yes 0=no | Developed for the purposes of this questionnaire |
| | | Standardized mean of households' monthly income | Approximate family income per month | Number (BDT) | [22] |
| | | Percentage of households without stable income | Has your family income lost during past 12 months? | 1=yes 0=no | Developed for the purposes of this questionnaire |
| | | Percentage of households lost wealth and savings | Has your family lost wealth and/or savings in the last 1 year? | 1=yes 0=no | [22] |
| | | Percentage of households with single income person | Do your household have more than one earning person? | 1=yes 0=no | Developed for the purposes of this questionnaire |
| Sensitivity | | Percentage of households with rented house | Ownership type of the house where your family is stayed | 1=owned 0=rented | [22] |
| | | Percentage of households with food insecurity | Do your family have adequate food the whole year? | 1=yes 0=no | [22] |
| | | Percentage of households without technological support for children's education | Do your family children's have technological support for online class? | 1=yes 0=no | [22] |
| Physical | | Percentage of households with chronic ill person | Is anybody in your family chronically ill (they get sick very often)? | 1=yes 0=no | [22] |
| | | Percentage of households without access to quality treatment | Do your household generally have access to qualified doctor for treatment? | 1=yes 0=no | [22] |
| | | Percentage of households without access to WASH | Do your household have access to safe water and/or soap? | 1=yes 0=no | [22] |
| | | Percentage of households with afraid members | Are your family members afraid of COVID-19? | 1=yes 0=no | Developed for the purposes of this questionnaire |
| Exposure | Exposure to COVID-19 | Percentage of households not following national guidelines | Do your family members follow the national guidelines related to COVID-19? | 1=yes 0=no | [22] |
| | | Percentage of households not well-known about COVID-19 symptoms | Do your family members well-known about COVID-19 symptoms? | 1=yes 0=no | [22] |
| | | Percentage of households reported infected persons | Have anyone of your family members been infected by COVID-19? | 1=yes 0=no | Developed for the purposes of this questionnaire |
| | | Percentage of households reported died persons | Did anyone of your family members die due to COVID-19? | 1=yes 0=no | Developed for the purposes of this questionnaire |

BDT: Bangladeshi Taka (Currency); WASH: Water, sanitation, and hygiene

fix the issues in wording, the questionnaire was also tested on a small sample of randomized internet users. The questionnaire was first written in the Bengali language and then converted to English for preparing the study report. The questionnaire was circulated through Facebook, Messenger, LinkedIn, WhatsApp, email, and other networks of the authors. We narrowed our survey to eight divisions of the country in order to prevent the data from being skewed or biased towards a certain region by using stratified sampling. The questionnaire was then circulated by the authors and our known networks, each of whom resided in one of the eight divisions. Each of them was instructed to collect a minimum of 50 responses from their particular division. It was secured by the responses to a question such as "From which division are you from?" which was included in the introduction section of the questionnaire along with the consent agreement. The main survey questions from the questionnaire have been presented in **Table 1**.

However, we received a total of 415 responses where only two participants did not give their consent to participate, as well as nine responses that were not usable as a result of missing and confusing cases. Finally, 404 respondents were included in the analysis. The main respondents of this study were the household heads of Bangladesh. However, as this was an online-based study and most of the household heads were not experienced in using online platforms, we have relaxed the participation inclusion criteria. Thus, the eligibility to participate in the survey included any adult member of a

household using the internet, able to understand the aims of the research, and prepared to participate voluntarily. The purpose of the study was explained in the first section of the online questionnaire. Each of the participants had read the purpose carefully and had voluntarily given consent to participate.

Development of Socioeconomic Vulnerability Index (SeVI)

The SeVI was created using a combined indicator-based model that included three key dimensions: adaptive capacity, sensitivity, and exposure [27,37]. All those dimensions were divided into five components: demographic, social, economic, physical, and exposure to COVID-19. The index collectively constituted several characteristics of an individual component in accordance with the COVID-19 outbreak in terms of numerical meaning, and therefore reflected the household's condition in reference to these components. The SeVI was developed based on five components, including 26 indicators (for more information, see **Table 1**). Each indicator was standardized as an index value as they were calculated on different scales. To produce an index score for each indicator for Bangladesh 'i', we employed the given Equation 1, which was adapted from a UNDP life expectancy index [27,38].

$$\text{Indicator index score}_i = \frac{X_i - X_{min}}{X_{min} - X_{max}} \quad (1)$$

where, X_i is original value of indicator for the household/country, X_{max} is the highest value of indicator for the household/country, and X_{min} is the lowest value of indicator for the household/country. Thus, the indicator index generated numerical values which signified the relative vulnerability status of the country (collected by an aggregated response of households). The numerical values ranged from zero to one for each indicator.

Once each contributing indicator accumulated the index score, the average index score of all indicators within the same component was taken into account to determine the component vulnerability score through Equation 2.

$$DO_i = \frac{\sum_{k=1}^n (SIS)_k}{k} \tag{2}$$

where DO_i is the component-scores of vulnerability index ‘ i ’, SIS_k is the standardized mean score of each indicator within the component (here k is the number of indicators within the concerned component indicated in **Table 1**).

After accomplishing the component value of vulnerability, we continued with the dimension value of vulnerability through Equation 3 to Equation 5. In this study, dimensions were taken into assessment as adaptive capacity, sensitivity, and exposure to COVID-19 outbreaks following the framework of IPCC [39].

$$DM_{Adaptive\ Capacity}_i = \frac{\sum_{j=1}^2 DO_j}{2} \tag{3}$$

$$DM_{Sensitivity}_i = \frac{\sum_{l=1}^2 DO_l}{2} \tag{4}$$

$$DM_{Exposure}_i = \sum_{m=1} DO_m \tag{5}$$

where j , l , and m indicate numbers of components under adaptive capacity, sensitivity, and exposure (given in **Table 1**), respectively, while ‘ i ’ represents the whole country, Bangladesh. Utterly, Equation 6 has determined the socio-economic vulnerability index of the country ‘ i ’.

$$SeVI_i = \frac{(1 - DM_{AC}_i) + DM_{Sensitivity}_i + DM_{Exposure}_i}{3} \tag{6}$$

where AC means adaptive capacity. We hypothesized that the interaction among the three vulnerability factors was undetermined and determined simply by the geographical features of the area in which they were found. However, we also hypothesized that $SeVI$ had a direct connection with the system’s exposure and sensitivity, and an inverse linkage with its adaptive capacity [40]. As a result, when calculating the index, we utilized an inverse value of adaptive capacity (1 minus dimension score). In this study, the $SeVI$ was ranged from 0 to 1, where 0 indicates lower vulnerability and 1 indicates higher vulnerability. The $SeVI$ was developed by utilizing descriptive statistics. The frequency and percentage of the scheduled variables were analyzed by employing descriptive statistics. Microsoft Excel 2019 and the Statistical Package for Social Science (SPSS) 20.0 Windows version were used to process and analyze the data. Finally, the output was interpreted as the final report of this study.

Ethical Considerations

Prior to starting filling out the questionnaire, participants provided their consent and remained anonymous. All respondents were informed about the aim of the study in the introduction section of the questionnaire. The dataset has confirmed the anonymity and confidentiality. Furthermore, this study was reviewed and ethically approved by the Khulna University Research Cell, Khulna-9208, Bangladesh (Reference number: KUECC-2021/06/21).

RESULTS

First, we have outlined the socio-demographic profile of the participants (**Table 2**). We have then examined the key outcomes from the component (**Figure 1**) and dimension-based vulnerability analysis (**Figure 2**). In two segments, component-based and dimension-based, we have reported findings of statistical assessment for the socioeconomic vulnerability of this study.

Socio-Demographic Profile

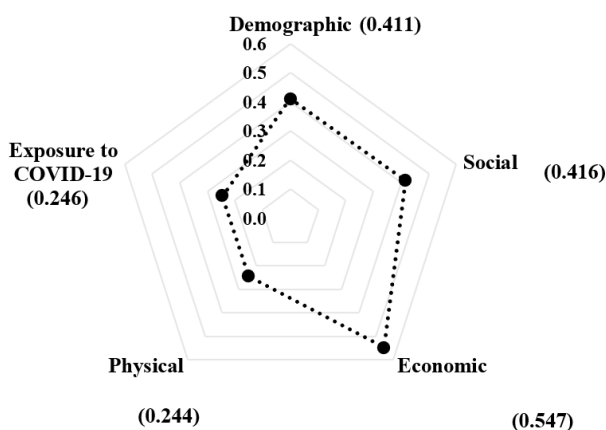
The prevailing socio-demographic characteristics of the participants in this sample have been listed in **Table 2**. The trend of age indicated that the household heads in the preceding five and a half decades observed substantial shifts in different issues in the country. The country had a higher

Table 2. SeVI indicator values with minimum and maximum values

| Component | Indicator | Unit | Value | Maximum | Minimum |
|--|--|------------------------------------|-------------|---------|---------|
| Demographic | Age of the household heads | Mean(years) | 54.94 | 88 | 24 |
| | ≤60 years | Percent | 65.1 | 100 | 0 |
| | >60 years | Percent | 34.9 | 100 | 0 |
| | Percentage of female-headed households | Percent | 10.6 | 100 | 0 |
| | Percentage of urban-based households | Percent | 59.2 | 100 | 0 |
| | Number of family members | Mean(numbers) | 4.72 | 14 | 2 |
| | ≤5 members | Percent | 76.7 | 100 | 0 |
| | >5 members | Percent | 23.3 | 100 | 0 |
| | Percentage of dependent population | Percent | 63.6 | 100 | 0 |
| | Social | Schooling years of household heads | Mean(years) | 12.28 | 21 |
| ≤12 years | | Percent | 53.2 | 100 | 0 |
| >12 years | | Percent | 46.8 | 100 | 0 |
| Percentage of households not borrowed money | | Percent | 54.0 | 100 | 0 |
| Percentage of households with access to aid-grant | | Percent | 13.1 | 100 | 0 |
| Percentage of households with access to CBOs and local organizations | | Percent | 29.0 | 100 | 0 |
| Percentage of households with access to community hygiene | | Percent | 53.2 | 100 | 0 |

Table 2 (Continued). SeVI indicator values with minimum and maximum values

| Component | Indicator | Unit | Value | Maximum | Minimum |
|----------------------|---|------------|-----------|---------|---------|
| Economic | Percentage of households without government employee | Percent | 69.3 | 100 | 0 |
| | Monthly income of the households | Mean (BDT) | 39,148.51 | 500,000 | 5,000 |
| | ≤20000 BDT | Percent | 41.3 | 100 | 0 |
| | >20000 BDT | Percent | 58.7 | 100 | 0 |
| | Percentage of households without stable income | Percent | 68.3 | 100 | 0 |
| | Percentage of households lost wealth and savings | Percent | 69.3 | 100 | 0 |
| Physical | Percentage of households with single income person | Percent | 59.9 | 100 | 0 |
| | Percentage of households with rented house | Percent | 31.4 | 100 | 0 |
| | Percentage of households with food insecurity | Percent | 16.6 | 100 | 0 |
| | Percentage of households without technological support for children's education | Percent | 20.0 | 100 | 0 |
| | Percentage of households with chronic ill person | Percent | 48.0 | 100 | 0 |
| | Percentage of households without access to quality treatment | Percent | 26.5 | 100 | 0 |
| Exposure to COVID-19 | Percentage of households without access to WASH | Percent | 3.7 | 100 | 0 |
| | Percentage of households with afraid members | Percent | 78.0 | 100 | 0 |
| | Percentage of households not following national guidelines | Percent | 10.6 | 100 | 0 |
| | Percentage of households not well-known about COVID-19 symptoms | Percent | 14.1 | 100 | 0 |
| | Percentage of households reported infected persons | Percent | 19.1 | 100 | 0 |
| | Percentage of households reported died persons | Percent | 1.2 | 100 | 0 |

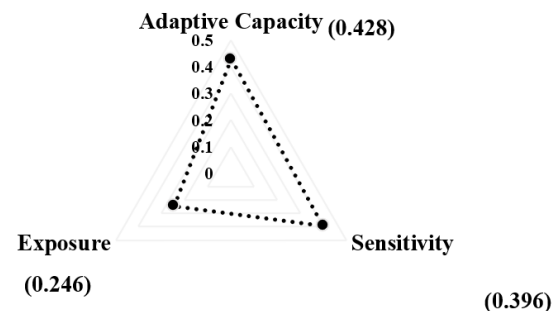
**Figure 1.** Indexed major components

prevalence of male-headed families. The average size of the household was 4.72 members, which is marginally greater than the national average (4.06 people) [41]. At the same time, a large proportion of households were affected by a loss of consistent income (68.3%), a loss of wealth and savings (69.3%), an absence of availability of community hygiene (53.2%), and the presence of chronically ill individuals (48.0%).

Component-Based Vulnerability

Demographic vulnerability

The vulnerability component score of demographic indicators was noted as 0.411 (details in **Table 3**). The findings revealed that households were the most vulnerable demographically, with 63.6 percent of solely dependent people (children and older adults). Furthermore, 59.3 percent of households were demographically vulnerable to the pandemic due to their urban location. At the same time, household heads had an average age of 54.94 years, with an index score of 0.483, where 34.9 percent of the household heads age was identified as over 60 years. Moreover, the index score of household size was found at 0.389, where 23.3 percent of households had more than 5 members in their family. The lowest demographic vulnerability was identified as the gender of household heads, where only 10.6% of the households were female-headed.

**Figure 2.** Indexed major dimensions

Social vulnerability

The social vulnerability index was measured as 0.416 (details in **Table 3**). Indicators of this component demonstrated that the highest social vulnerability was listed for the years of schooling of the household heads, with an index score of 0.585, where the average schooling year of the household heads was found to be 12.28 years. In contrast, the lowest proportion was recorded for those households that received assistance from community leaders (13.1 percentage). Similarly, 54.0 percent of households were identified as socially vulnerable as a result of not borrowing money from friends, family, or neighbors. On the contrary, the indicators of the social component demonstrated that 29.0 and 53.2 percent of the households had access to CBOs and local organizations as well as community hygiene (arrangements for handwashing at a specific place in the community from government/private/own initiatives due to the coronavirus outbreak), respectively.

Economic vulnerability

We found the highest component-based vulnerability index for economic issues where the index score of this component was calculated as 0.547 (details in **Table 3**). The study findings indicated that the highest economic vulnerability was identified for the participating households without any government employee as well as the loss of their wealth and savings (69.3 percent). Our study noted about 68.3 percent of households were economically vulnerable without stable income. In the same way, this study results listed about 59.9

Table 3. Indexed indicators, major components, and score for SeVI

| Indicator | Score | Component | Score |
|---|-------|----------------------|--------------|
| Standardized mean of household heads age | 0.483 | | |
| Percentage of female-headed households | 0.106 | | |
| Percentage of urban-based households | 0.592 | Demographic | 0.411 |
| Standardized mean of number of family members | 0.389 | | |
| Percentage of dependent population | 0.636 | | |
| Standardized mean of household heads schooling years | 0.585 | | |
| Percentage of households not borrowed money | 0.540 | | |
| Percentage of households with access to aid-grant | 0.131 | Social | 0.416 |
| Percentage of households with access to CBOs and local organizations | 0.290 | | |
| Percentage of households with access to community hygiene | 0.532 | | |
| Percentage of households without government employee | 0.693 | | |
| Standardized mean of households' monthly income | 0.069 | | |
| Percentage of households without stable income | 0.683 | Economic | 0.547 |
| Percentage of households lost wealth and savings | 0.693 | | |
| Percentage of households with single income person | 0.599 | | |
| Percentage of households with rented house | 0.314 | | |
| Percentage of households with food insecurity | 0.166 | | |
| Percentage of households without technological support for children's education | 0.200 | Physical | 0.244 |
| Percentage of households with chronic ill person | 0.480 | | |
| Percentage of households without access to quality treatment | 0.265 | | |
| Percentage of households without access to WASH | 0.037 | | |
| Percentage of households with afraid members | 0.780 | | |
| Percentage of households not following national guidelines | 0.106 | | |
| Percentage of households not well-known about COVID-19 symptoms | 0.141 | Exposure to COVID-19 | 0.246 |
| Percentage of households reported infected persons | 0.191 | | |
| Percentage of households reported died persons | 0.012 | | |
| Overall socioeconomic vulnerability index (SeVI) | | | 0.405 |

percent of households economically vulnerable with single income person, where the average monthly income of the households recorded as 39,148.51 BDT (\approx 461.40 the US Dollar) with the index score of 0.069 and 41.3 percent of the households had monthly family income as \leq 20,000 BDT (\approx 235.79 the US Dollar).

Physical vulnerability

The vulnerability index of the physical component was determined as 0.244, which was the lowest component-wise vulnerability score of this study (details in [Table 3](#)). The households with chronically ill people (48.0 percent) were identified as having a high vulnerability indicator. In contrast, the lowest physical vulnerability noticed for the households WASH (access to safe water and/or soap) behavior, which was found highly satisfactory, where only 3.7 percent of the responding households had no access to WASH facilities. Simultaneously, 31.4 percent of the sample households were found to be physically vulnerable while living in rented housing. Furthermore, in our study, 26.5 percent of households were physically vulnerable due to a lack of access to quality treatment. Moreover, our study outcomes indicated that 20 percent of the households were physically vulnerable without having enough technological support for their children's online education. Furthermore, our research managed to find that 16.6 percent of participating households experienced physical vulnerability due to food insecurity over the last year.

Exposure to COVID-19

The index score of exposure to the COVID-19 component was found to be 0.246 (details in [Table 3](#)). The highest COVID-19 exposure was found in households with members who were afraid of COVID-19 (78 percent). On the contrary, our results demonstrated that studied households had lower exposure to COVID-19 with the satisfactory practices of the national

guidelines regarding the COVID-19 pandemic in the country, where 10.6 percent of households did not follow the national guidelines. Similarly, our findings showed that most of the household's members had proper knowledge about the symptoms of COVID-19, including 14.1 percent of households that were not well-known about COVID-19 symptoms. In a similar way, our study reported 19.1 percent of households with infected persons and 1.2 percent of households with a dead person.

Dimension-Based Vulnerability

Following the IPCC dimensions together with exposure, sensitivity, and adaptive capacity, this study measured the dimension-based vulnerability ([Figure 2](#)).

Exposure

In this study, exposure was encircled by exposure to the COVID-19 component (details in [Figure 3](#)). The results demonstrated that the index of exposure was quantified as 0.246, which was the lowest dimension-wise vulnerability score ([Figure 2](#)). The contributing indicators of this dimension indicated that households with members afraid of COVID-19 increased their exposure to COVID-19 ([Table 2](#)).

Sensitivity

Sensitivity covered the economic and physical components in this study (details in [Figure 3](#)). The sensitivity index score in the study included an index score of 0.396 ([Figure 2](#)). The sensitivity was heightened by the worsening economic situation of households, particularly those without a government employee, as well as the loss of wealth and savings ([Table 2](#)).

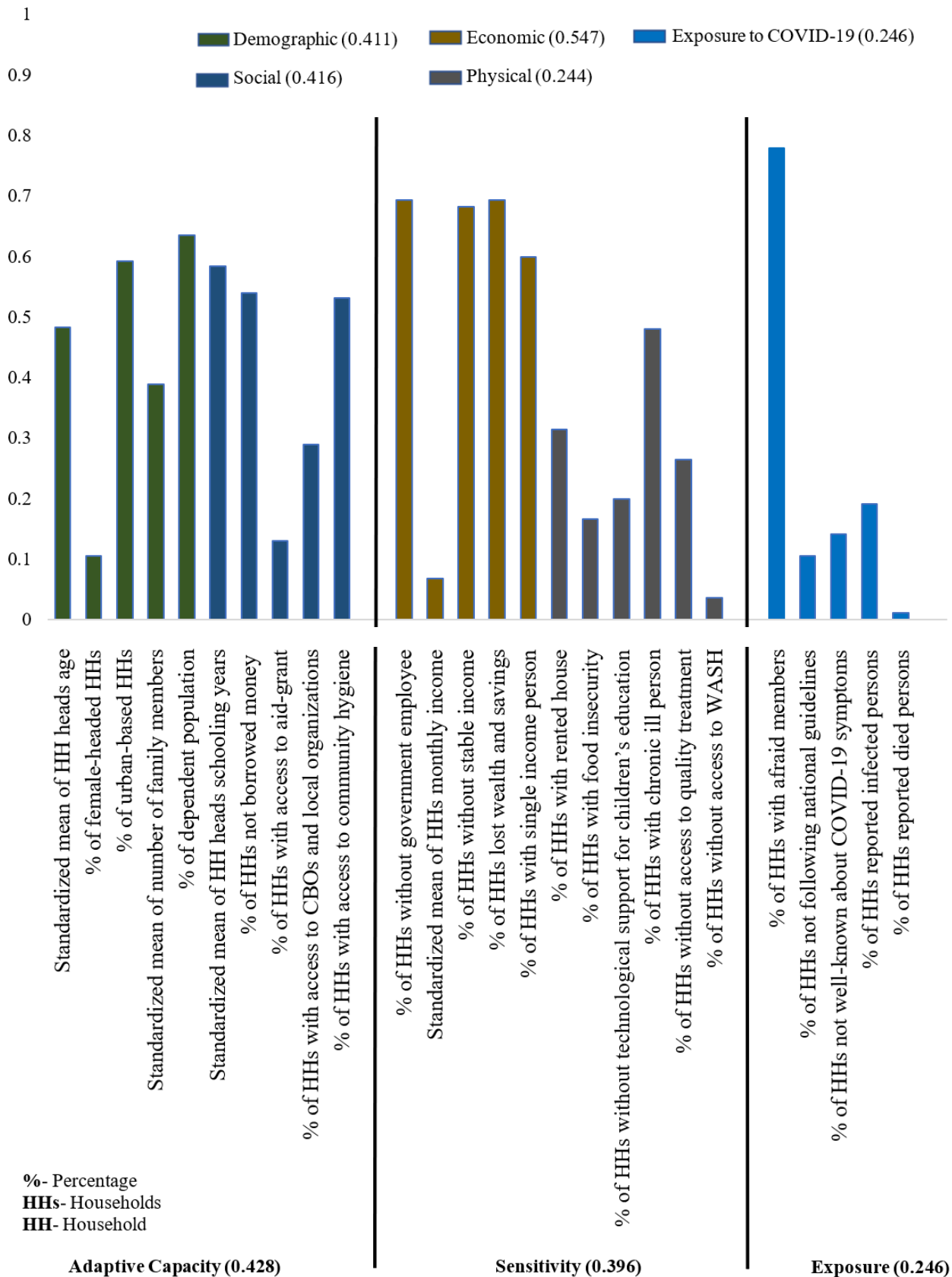


Figure 3. Volume of indicators within the dimensions across Bangladesh

Adaptive capacity

Adaptive capacity also comprised two components, including demographic and social components (details in **Figure 3**). The highest dimension-wise vulnerability score was

evidenced for adaptive capacity with an index score of 0.428 (**Figure 2**). The adaptive capacity of households was underscored by the demographic profile, which was primarily characterized by the predominance of solely dependent populations (**Table 2**).

Overall Vulnerability Score

This study also measured the overall socioeconomic vulnerability score by following the IPCC dimensions together with exposure, sensitivity, and adaptive capacity. The overall socioeconomic vulnerability index was determined as 0.405 (details in [Table 3](#)). A supplemental graph ([Figure 3](#)) was also constructed to demonstrate the volume of the relevant indicators (individually) across Bangladesh and inside the specified dimension using a scale of 0 to 1 (more vulnerable if the score is close to 1).

DISCUSSION

The continuing novel Corona virus (COVID-19) outbreak has produced an unparalleled economic and social catastrophe in Bangladesh, despite the fact that the COVID-19 outbreak is deemed a public health disaster [16]. In both countryside and metropolitan regions, COVID-19 induced lockdown has intensified the detrimental effects on job opportunities, household earnings, and livelihood. Simultaneously, the social situation of a plethora number of households across the country has deteriorated as a consequence of employment and income loss during the pandemic. To deal with the difficulties, many families curtailed their consumption of food and sought assistance from their savings, relatives, and governments [31]. Overall, there is a sharp rise of socioeconomic vulnerability has been observed in the country. This study therefore aimed to assess socioeconomic vulnerability due to COVID-19 outbreak in Bangladesh. According to the authors' best knowledge, this is the first study in Bangladesh that measures socioeconomic vulnerability due to the COVID-19 outbreak by utilizing a SeVI following the domains of [27]. The results of the statistical analysis of socioeconomic vulnerability were presented in this study in two sections: component-based and dimension-based. The findings showed the socioeconomic vulnerability index (SeVI) with an index score of 0.405, while the dimension-based index had index scores of 0.246, 0.396, and 0.428, respectively, for exposure, sensitivity, and adaptive capacity. Furthermore, social, economic, and COVID-19 exposure were demonstrated as more influential components of adaptive capacity, sensitivity, and exposure, correspondingly. Additionally, the economic options of the households were severely constrained due to the implications of the COVID-19 outbreak.

A major demographic crisis was observed in this study due to the COVID-19 outbreak, which had a significant impact on boosting the socioeconomic vulnerability in Bangladesh. Several demographic indicators were included to assess socioeconomic vulnerability in this study. Among them, the presence of solely dependent populations, urban-based households, and the age index of the household heads were identified as the top three index indicators. This outcome may occur for several reasons. Because previous research indicated that a greater dependency ratio and the extreme aged population (<5 or >65 years) maximized the chances of social and economic vulnerability in a disaster situation [27,42]. Evidence also suggested that areas with a larger proportion of elderly people were more likely to experience serious illnesses or mortality than those with a younger population. Those aged 60 and over tended to have a higher risk of being very ill from COVID-19. Moreover, disease transmission could be accelerated in urban areas due to population density [43].

Therefore, all of these demographic issues mainly contributed to fostering the socioeconomic vulnerability in this study.

Simultaneously, a considerable increasing trend in social vulnerability was documented among the households in this study, highly attributed to the household heads' schooling years. Our study found that households with lower-educated heads were vulnerable to COVID-19 outbreaks. However, literature shows that education can contribute to mitigating the harmful effects of an emergency situation in both direct and indirect approaches. Directly or indirectly, formal education is seen as the major means by which people gain information, skills, and competencies that enhance their adaptive capacity, including cognitive skills, problem skills, better knowledge, and risk perception [44]. Moreover, well-educated people are more knowledgeable about the catastrophic risks [45] and more inclined to plan for crises [46]. Furthermore, a better educational level may lower vulnerability indirectly through a variety of ways and means, including poverty reduction, improved socioeconomic position, and increased social capital. As a consequence, it is logical to anticipate that when confronted with catastrophic hazards, educated citizens, households, and communities are increasingly empowered and adaptable in their reaction to, preparedness for, and recuperation from catastrophes [44]. For the time being, all of these estimates were opposite in this research since the household heads were not well educated enough, and so suffered from an unprecedented socioeconomic vulnerability due to the COVID-19 pandemic. At the same time, a growing amount of literatures promoted the relevance of social network in crisis response, in particular cases starting from natural catastrophes [47] to pandemics [48, 49]. But social capital is insufficient when it might offer partial support to households or communities. Rather, maximum gains can be obtained by full social capital support including bonding, bridging, and linking [50,51]. Anyway, evidence suggested adverse impacts resulting from disparities in bonding, bridging, and linking which ultimately reduced the community resilience. For instance, several nations are competing with each other to tackle the ongoing COVID-19 situation. The national government, corporate enterprise, and international players are being survived to supply personalized protection materials such as N95 protective suits and face shields due to the lack of bonding, bridging, and linking among them [50]. Yet, there was an inadequacy of social capital in this study, notably due to the limited access to CBOs or local organizations. In addition, over half of the households in the survey did not have access to community hygiene, indicating a linkage and bridging gap. As a result, these types of social crises exacerbated the country's socioeconomic fragility.

In this study, economic disruptions of households were identified as having the highest level of vulnerability as contributors. According to this study's findings, households without a government employee as well as those with the loss of their assets and savings were the most vulnerable in terms of economic instability. Such an outcome resulted because the previous report noted that Bangladesh has experienced two forms of job loss in every sector except government jobs as a result of the coronavirus pandemic: temporary lockdown-induced joblessness and persistent loss of employment. That study also added that between 12 and 17 million people have lost their jobs as a result of the country's two-month shutdown. Consequently, they utilized their assets and savings to deal with the reduction in income [31]. Furthermore, our research

found that households with unstable income and single income earners were economically susceptible in the midst of the pandemic. Such outcomes are noticeable because a substantial number of households have already lost their income as a result of the COVID-19 pandemic-induced employment loss, which ultimately triggered income instability among them [31]. For this reason, households with only one income person may experience economic vulnerability in the country.

Physical vulnerability was another component that contributed to the development of socioeconomic vulnerability. But physical vulnerability was demonstrated to be lower in intensity in this study when compared to demographic, social, and economic vulnerability. However, households with chronically ill people were found to have the maximum level of physical risk in this study. According to scientists, COVID-19 disease is considered to be more harmful to those with chronic diseases, so this observation seemed expected [52]. Additionally, in a prior study, households having a family member with a chronic disease were identified as a key physical vulnerability indicator for developing socioeconomic vulnerability to hazard-related risks [27].

Similarly, COVID-19 exposure was an important component that contributed to the development of a socioeconomic vulnerability index in this study, with households with afraid family members ranking first. This result was significant since an earlier study indicated that the COVID-19 outbreak fostered fear among the Bangladeshi people, leading to socioeconomic crises such as unemployment, hardship, starvation, as well as social conflict [17].

Likewise, this study found higher level of adaptive capacity comparing exposure and sensitivity. Literature suggests that exposure, sensitivity, and adaptive capacity all play a role in determining vulnerability. A lower adaptive capacity in comparison to exposure and sensitivity adds to a high level of vulnerability (top). Higher adaptive capacity, on the other hand, serves to mitigate the consequences of exposure and sensitivity, which in turn helps to minimize vulnerability (bottom) [53].

To reiterate, social, economic, and COVID-19 exposure were supposed to be the most influential components of adaptive capacity, sensitivity, and exposure, respectively in this study. Furthermore, as a result of the COVID-19 outbreak, the economic options of the households were severely constrained. The outcomes of this research may provide guidance to decision-makers and other relevant agencies on where to focus policy implementation efforts in the next years so that households become less socially and economically vulnerable to COVID-19 outbreaks and associated hazards and disasters.

LIMITATIONS AND FUTURE DIRECTIONS

To begin with, the survey respondents used the internet to participate in the study, indicating that their socioeconomic status is greater than the general population. As a result, the findings' generalizability was hindered. Second, a typical weakness was the study's cross-sectional design. Thus, determining the type of influence was challenging, and we were restricted from drawing causal conclusions from our findings. Then, the study sample was small which did not represent the whole situation of the country. Furthermore, this

analysis was based on self-reported responses regarding experiences with the COVID-19 outbreak that could not be supported by qualified data enumerators or experts. Longitudinal, face-to-face survey, and district-specific further research with a larger and dynamic sample in consideration of socioeconomic vulnerability issues among the same population are therefore strongly suggested.

CONCLUSION

In response to the COVID-19 outbreaks in Bangladesh, we performed a cross-sectional survey to investigate and measure the socioeconomic vulnerability status of Bangladeshi households. This study aimed to develop the socioeconomic vulnerability index for Bangladesh. This index (SeVI) also measured the component-based and dimension-based socioeconomic vulnerability. The findings of our study indicated that the SeVI was a manageable and viable technique that captured the vulnerability situation of Bangladeshi households. Overall, the socioeconomic vulnerability is prevalent among the households of Bangladesh due to the COVID-19 outbreak. The economic possible options for the households were greatly limited by the consequence of the COVID-19 pandemic. These phenomena were illustrated in the SeVI of this research. The index scores of SeVI indicators demonstrated which components were more responsible for developing the vulnerability. As a whole, the findings of this study may instruct the policy-makers and corresponding authorities where to place emphasis in policy implementation so that households become socially and economically less susceptible to COVID-19 outbreaks and related hazards and disastrous events in upcoming years. Also, SeVI will improve crisis response interventions by improving understanding of catastrophe consequences at the household level [27,28].

Author contributions: All authors have sufficiently contributed to the study, and agreed with the results and conclusions.

Funding: No funding source is reported for this study.

Acknowledgements: All authors would like to recognize the kind assistance of the participants in this study. Moreover, all authors would like to express their heartiest gratitude to all the individuals whose have their immense support during data collection.

Data availability: The data that support the findings of this study are not publicly available as the authors did not have ethical permissions to publish the data in a public repository. However, the data set may be available from the corresponding author upon request.

Declaration of interest: No conflict of interest is declared by authors.

REFERENCES

1. Pathak PK, Singh Y, Mahapatro SR, Tripathi N, Jee J. Assessing socioeconomic vulnerabilities related to COVID-19 risk in India: A state-level analysis. *Disaster Med Public Health Prep.* 2020;1-4. <https://doi.org/10.1017/dmp.2020.348> PMID:32907661 PMCID:PMC7711356
2. Worldometer. COVID-19 coronavirus pandemic. Worldometer. 2021. Available at: <https://www.worldometers.info/coronavirus/> (Accessed: 13 April 2021).
3. WHO. Listings of WHO's response to COVID-19. World Health Organization. 2020. Available at: <https://www.who.int/news/item/29-06-2020-covidtimeline> (Accessed: 13 April 2021).

4. Hasan K, Shaon AI. First 3 cases of coronavirus confirmed in Bangladesh. DhakaTribune, Dhaka, March 08, 2020.
5. Worldometer. World/countries/Bangladesh. Worldometer. 2021. Available at: <https://www.worldometers.info/coronavirus/country/bangladesh/> (Accessed: 13 April 2021).
6. Mamun S. Coronavirus: Bangladesh declares public holiday from March 26 to April 4. DhakaTribune, Dhaka, March 23, 2020.
7. Offices resume today in compliance with health rules. Daily Bangladesh, May 31, 2020.
8. Nayak M. Bangladesh imposes 7-day total lockdown from April 5, emergency services allowed. india.com, Dhaka, April 3, 2021.
9. Noman M. Seven-day strict lockdown from 14 April. The Business Standard, Dhaka, April 9, 2021.
10. Reopening of schools, colleges postponed to May 23. DhakaTribune, Dhaka, March 25, 2021.
11. UNDP. Humanity needs leadership and solidarity to defeat COVID-19. United Nations Development Programme, 2020. Available at: <https://www.tr.undp.org/content/turkey/en/home/presscenter/articles/2020/03/COVID-19-dayanisma.html> (Accessed: 14 April 2021).
12. Eichengreen B. Coronanomics 101: Which policy tools will contain the economic threat of COVID-19? World Economic Forum. 2020. Available at: <https://www.weforum.org/agenda/2020/03/coronavirus-economics> (Accessed: 14 April 2021).
13. Dineri E, Cütcü I. The COVID-19 process and the exchange rate relation: An application on Turkey. *Int J Econ Polit Humanit Soc Sci.* 2020;4(4):182-93. <https://doi.org/10.21203/rs.3.rs-49026/v1>
14. Barua S. Understanding coronanomics: The economic implications of the coronavirus (COVID-19) pandemic. *SSRN Elec J.* 2020. <https://doi.org/10.2139/ssrn.3566477>
15. Haque MN, Bin Ansar S, Biswas G, Islam MR, Al Mamun A. The impact of COVID-19 on socio economic condition of city people: Lessons from the selected KCC area. *J Eng Sci.* 2020;11(2):117-26. <https://doi.org/10.3329/jes.v11i2.50903>
16. Kumar B, Pinky SD. Addressing economic and health challenges of COVID-19 in Bangladesh: Preparation and response. *J Public Aff.* 2020;1-8. <https://doi.org/10.1002/pa.2556> PMID:33349743 PMCID:PMC7744919
17. Shammi M, Bodrud-Doza M, Towfiqul Islam ARM, Rahman MM. COVID-19 pandemic, socioeconomic crisis and human stress in resource-limited settings: A case from Bangladesh. *Heliyon.* 2020;6(5). <https://doi.org/10.1016/j.heliyon.2020.e04063> PMID:32462098 PMCID:PMC7242967
18. Islam R. Focus both on saving lives, livelihoods: Experts to govt. United News of Bangladesh, April 17, 2020.
19. Banna H. Minimising the economic impact of Coronavirus in Bangladesh. The Business Standard, March 15, 2020.
20. UN. World economic situation & prospects: Report 2021. Department of Economic and Social Affairs, United Nations. 2021. Available at: <https://www.un.org/development/desa/dpad/publication/world-economic-situation-and-prospects-2021/>
21. Ali S, Nazrul S. Impact of Coronavirus on livelihoods: Low- and lower middle-income population of urban Dhaka. LightCastle Partners. 2020. Available at: <https://www.lightcastlebd.com/insights/2020/04/impact-of-coronavirus-on-livelihoods-low-and-lower-middle-income-population-of-urban-dhaka>
22. HDRC. Socio-economic assessment of COVID-19 under national urban poverty reduction programme. United Nations Development Programme. 2020. Available at: <https://www.undp.org/content/dam/undp/library/covid19/undp-bd-Socio-EconomicAssessmentCOVID-19-2021.pdf>
23. Câmara SF, Pinto FR, da Silva FR, Gerhard F. Socioeconomic vulnerability in the face of COVID-19 in municipalities of Ceará. *Rev Adm Publica.* 2020;54(4):1037-51. <https://doi.org/10.1590/0034-761220200133x>
24. Bamweyana I, Okello DA, Ssengendo R, et al. Socio-economic vulnerability to COVID-19: The spatial cse of greater Kampala Metropolitan Area (GKMA). *J Geogr Inf Syst.* 2020;12(4):302-18. <https://doi.org/10.4236/jgis.2020.124019>
25. Josephson A, Kilic T, Michler JD. Socioeconomic impacts of COVID-19 in low-income countries. *Nat Hum Behav.* 2021;5(5):557-65. <https://doi.org/10.1038/s41562-021-01096-7> PMid:33785897
26. Morrow B. Community resilience: A social justice perspective (The community and regional resilience initiative research report 4). Community and Regional Resilience Initiative. 2008.
27. Ahsan MN, Warner J. The socioeconomic vulnerability index: A pragmatic approach for assessing climate change led risks-A case study in the south-western coastal Bangladesh. *Int J Disaster Risk Reduct.* 2014;8:32-49. <https://doi.org/10.1016/j.ijdr.2013.12.009>
28. Sorg L, Medina N, Feldmeyer D, et al. Capturing the multifaceted phenomena of socioeconomic vulnerability. *Nat Hazards.* 2018;92(1):257-82. <https://doi.org/10.1007/s11069-018-3207-1>
29. Hand MS, Eichman H, Triepke FJ, Jaworski D. Socio-economic vulnerability to ecological changes to national forests and grasslands in the Southwest. Fort Collins, CO: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. 2018. <https://doi.org/10.2737/RMRS-GTR-383>
30. Li R, Pei S, Chen B, et al. Substantial undocumented infection facilitates the rapid dissemination of novel coronavirus (SARS-CoV2). *Science.* 2020;368(6490):489-93. <https://doi.org/10.1126/science.abb3221> PMID:32179701 PMCID:PMC7164387
31. Hossain MI. COVID-19 impacts on employment and livelihood of marginal people in Bangladesh: Lessons learned and way forward. *South Asian Surv.* 2021;28(1):57-71. <https://doi.org/10.1177/0971523121995072>
32. Mikolai J, Keenan K, Kulu H. Intersecting household-level health and socio-economic vulnerabilities and the COVID-19 crisis: An analysis from the UK. *SSM-Popul Heal.* 2020;12(July):100628. <https://doi.org/10.1016/j.ssmph.2020.100628> PMID:32838017 PMCID:PMC7330575
33. Welle T, Depietri Y, Angignard M, Birkmann J, Renaud F, Greiving S. Vulnerability assessment to heat waves, floods, and earthquakes using the MOVE framework: Test case Cologne, Germany. Elsevier Inc.; 2014. <https://doi.org/10.1016/B978-0-12-410528-7.00005-9>
34. Karagiorgos K, Thaler T, Heiser M, Hübl J, Fuchs S. Integrated flash flood vulnerability assessment: Insights from East Attica, Greece. *J Hydrol.* 2016;541:553-62. <https://doi.org/10.1016/j.jhydrol.2016.02.052>

35. Jelínek R, Krausmann E, González M, Álvarez-Gómez JA, Birkmann J, Welle T. Approaches for tsunami risk assessment and application to the city of Cádiz, Spain. *Nat Hazards*. 2012;60(2):273-93. <https://doi.org/10.1007/s11069-011-0009-0>
36. Hox JJ, Boeije HR. Data collection, primary vs. secondary. *Encycl Soc Meas*. 2004;1:593-9. <https://doi.org/10.1016/B0-12-369398-5/00041-4>
37. IPCC. Contribution of working group II to the fourth assessment report of IPCC on climate change. Impacts, adaptations and vulnerability. Cambridge University Press. 2007. [Online]. Available at: https://www.ipcc.ch/site/assets/uploads/2018/03/ar4_wg2_full_report.pdf
38. UNDP. Human development report 2007/2008. Fighting climate change: human solidarity in a divided world. Palgrave Macmillan, New York. 2007. [Online]. Available at: http://hdr.undp.org/sites/default/files/reports/268/hdr_2_0072008_en_complete.pdf
39. IPCC. Climate change 2007: Impacts, adaptation and vulnerability. Cambridge University Press, New York. 2007. [Online]. Available at: https://www.ipcc.ch/site/assets/uploads/2018/03/ar4_wg2_full_report.pdf
40. Ford JD, Smit B. A framework for assessing the vulnerability of communities in the Canadian Arctic to risks associated with climate change. *Arctic*. 2004;57(4):389-400. <https://doi.org/10.14430/arctic516>
41. BBS. Comparative matrix of household income and expenditure survey (HIES). Bangladesh Bureau of Statistics, Ministry of Planning, Statistics and Informatics Division, Government of the People's Republic of Bangladesh. 2016.
42. Chen W, Cutter SL, Emrich CT, Shi P. Measuring social vulnerability to natural hazards in the Yangtze River Delta region, China. *Int J Disaster Risk Sci*. 2013;4(4):169-81. <https://doi.org/10.1007/s13753-013-0018-6>
43. Kaneda T, Greenbaum C. How demographic changes make us more vulnerable to pandemics like the Coronavirus. Population Reference Bureau. 2020. Available at: <https://www.prb.org/resources/how-demographic-changes-make-us-more-vulnerable-to-pandemics-like-the-coronavirus/> (Accessed: 2 July 2021).
44. Muttarak R, Lutz W. Is education a key to reducing vulnerability to natural disasters and hence unavoidable climate change? *Ecol Soc*. 2014;19(1). <https://doi.org/10.5751/ES-06476-190142>
45. Ainuddin S, Kumar Routray J, Ainuddin S. People's risk perception in earthquake prone Quetta city of Baluchistan. *Int J Disaster Risk Reduct*. 2014;7:165-75. <https://doi.org/10.1016/j.ijdr.2013.10.006>
46. Paul BK, Bhuiyan RH. Urban earthquake hazard: Perceived seismic risk and preparedness in Dhaka City, Bangladesh. *Disasters*. 2010;34(2):337-59. <https://doi.org/10.1111/j.1467-7717.2009.01132.x> PMID:19863568
47. Aldrich DP. Building resilience: Social capital in post-disaster recovery. University of Chicago Press. 2012. <https://doi.org/10.7208/chicago/9780226012896.001.0001>
48. Chuang YC, Huang YL, Tseng KC, Yen CH, Yang LH. Social capital and health-protective behavior intentions in an influenza pandemic. *PLoS One*. 2015;10(4):1-4. <https://doi.org/10.1371/journal.pone.0122970> PMID:25874625 PMCID:PMC4398366
49. Rönnerstrand B. Social capital and immunization against the 2009 A(H1N1) pandemic in the American States. *Public Health*. 2014;128(8):709-15. <https://doi.org/10.1016/j.puhe.2014.05.015> PMID:25132391
50. Pitas N, Ehmer C. Social capital in the response to COVID-19. *Am J Heal Promot*. 2020;34(8):942-4. <https://doi.org/10.1177/0890117120924531> PMID:32394721 PMCID:PMC8689111
51. Nakagawa Y, Shaw R. Social capital: A missing link to disaster recovery. *Int J Mass Emerg Disasters*. 2004;22(1):5-34.
52. Douglas J, Gold R. COVID-19 poses more risk to patients with chronic illnesses—and that's bad for the U.S. *The Wall Street Journal*. 2020. Available at: <https://www.wsj.com/articles/covid-19-poses-more-risk-to-patients-with-chronic-illnessesand-thats-bad-for-the-u-s-11595595601> (Accessed: 3 July 2021).
53. Engle NL. Adaptive capacity and its assessment. *Glob Environ Chang*. 2011;21(2):647-56. <https://doi.org/10.1016/j.gloenvcha.2011.01.019>