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Analysis of the health, economic and environmental impacts of COVID-19: The Bangladesh perspective

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ABSTRACT

Although COVID-19 has given an opportunity to the earth to restore her ecosystem, its role in bringing changes in every sector including social, economic, agricultural, industrial, education and health is enormous. The study was conducted to assess the socio-economic impacts of COVID-19 in Bangladesh by collecting data from different sources. The result depicted that during the first wave of COVID-19, the detection rate was less than 5%, exceeding almost 30% after detecting the deadlier Indian variant where 65% of the death is noticed by the people older than 50 years. Among all the frontline service providers during Covid, the highest rate of death was observed for doctors in Bangladesh. This study also discussed the impact of COVID-19 on mental health and found that women faced more depression and anxiety than men as well as 43% of children had subthreshold mental disturbances. Three-fourths of the adolescents have been distressed with household stress during the pandemic. Women and girls have encountered increased domestic violence whereas early marriages dropped out many rural girls from education. Decreasing remittance from non-residents and shutting down of RMG industry resulted loss of job and have badly affected economic section. Almost 20 million workers lost their jobs in Bangladesh from the informal sector. Moreover, the healthcare workers who have treated the corona virus patients have been socially stigmatized due to the fear of infection. Corona Virus has jeopardized the agriculture sector and 66% farmers (53% crop and vegetables, 99% fish farmers) got lower price than they used to get in a normal situation. Together with Government, non-government organizations, researchers, doctors, industrialists, international organization as well as individuals should come forward to handle this pandemic.

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Introduction

The world is currently facing the pandemic of COVID-19 since its first outbreak in Wuhan, China, in December 2019. COVID-19 is caused by the new Novel Corona Virus (CoV), the 7th coronavirus invaded human life with 217 million confirmed cases and over 4.51 million deaths worldwide until 31 August 2021 (Worldometer, 2021). WHO announced it a global pandemic on 11 March 2020 (WHO, 2021). The 2019-nCoV with common fever, dry cough, a runny nose, fatigue and difficulty in breathing is to the same family of Severe Acute Respiratory Syndrome (SARS) virus. Two hundred and fifty countries reported 700,000 infections and

33,000 deaths cases of COVID-19 by the end of March, 2020. Total COVID-19 cases rose to 490,958 with total deaths of 3,01,616 on 14 May, 2020 (Worldmeter, 2021). Direct contact with contaminated surfaces and respiratory droplets of injected persons spreading air is mainly responsible for the transmission of CoV, threatening older people and those with underlying medical problems. Lockdown enforcement for reducing virus outbreaks has brought great disaster worldwide global economy including Bangladesh.

Recent facts of the International Labor Organization (ILO) discovered that 50% of the global staff might also lose their livelihoods because of the coronavirus pandemic, as 1.6 billion workers inside the simple economic system are at immediate hazard of losing their income supply (Billah, 2020). People have been suffering from fear, panic, concerns, anxiety, stigma, depression, racism, and xenophobia by the accelerating spread of COVID-19 (Wang et al., 2020). This disaster has significantly tormented the mental fitness

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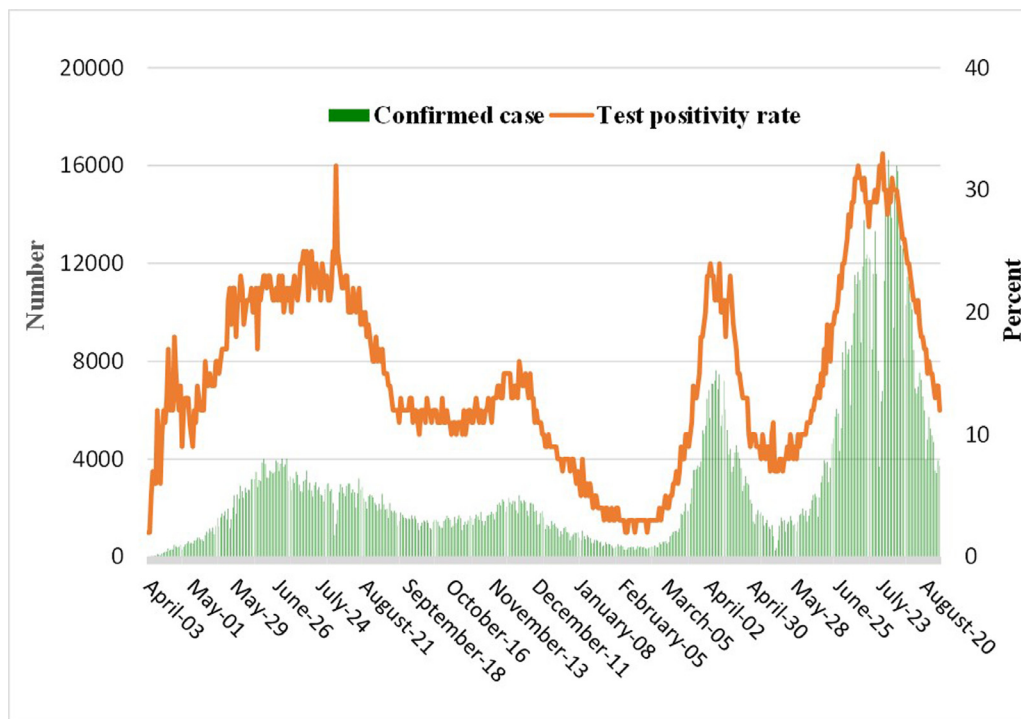


Fig. 1. Daily active cases in Bangladesh from COVID-19 (Adopted from MIS-DGHS, 2021).

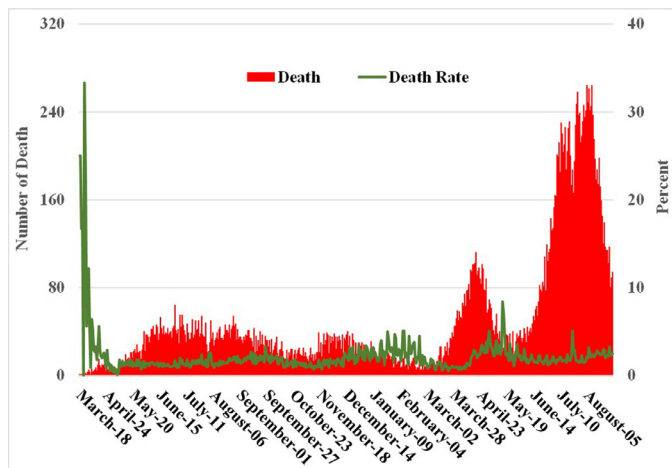


Fig. 2. Daily number of deaths in Bangladesh from COVID-19 (Adopted from MIS-DGHS, 2021).

and well-being of all societies. Plenty of human beings are distressed due to the instantaneous fitness influences of the virus and the consequences of physical isolation, fear of losing cherished ones, and fear of death from starvation (Committee, 2020; Rajkumar, 2020; Shammi et al., 2020). Socioeconomic situations of the mass of human beings in developing nations, compelled lockdown without ensuring the fundamental human needs, vulnerable governance, communication, infrastructure, and health care centers would create public tension and disturbance in existence (Parvin et al., 2021).

COVID-19 impacts country's long-standing macroeconomic stability and disrupts people's livelihood by rising poverty up to 40.9%

in 2020. Fragile health system, education, human development, public service delivery and social upliftment badly overemphasized by COVID-19 pandemic (UNDP Bangladesh, 2021). The pandemic has disrupted lives across all countries and communities and negatively affected global economic process in 2020 beyond anything experienced in nearly a century. Global trade is estimated to have fallen by 5.3% in 2020, but is projected to grow by 8.0% in 2021 (July and Jackson, 2021). The continued COVID-19 pandemic has created an unprecedented disaster in Bangladesh endangering the good-sized progress in household incomes and poverty reduction accomplished during the recent past. The sharp decrease in request for manufactured goods, especially from the export-oriented Ready-Made Pieces of clothing segment, is expected to influence business creation in urban regions, a critical driver of poverty reduction in the past (World Bank, 2020). The number of humans residing in poverty will increase by means of 2% for each percentage point of world monetary slowdown (Vos et al., 2020). COVID-19 poses a real challenge to the UN Sustainable Development Goal of ending poverty by 2030 (Sumner et al., 2020). Institute of Epidemiology, Disease Control and Research (IEDCR) is the research institute under the Ministry of Health responsible for monitoring COVID-19 situation in Bangladesh. Government enforced first nationwide lockdown of all educational institutes, government and private offices, and industries from 26 March, 2020 by deploying armed forces to ensure social distancing and disease prevention. More than 11 million people left Dhaka City after the lockdown announcement and initiated the spreading risk of CoV in Bangladesh (IEDCR, 2020). Middle and working class people including daily wage earners are the major victims of lockdown. Many of them lost their jobs resulting in significant shrinkage of purchase capacity which was further worsened with the price hikes of some daily necessities leads to food insecurity, famine and social conflict in Bangladesh. It is plausible that humanitarian crisis especially psychological, socio-economic and health impact may be arisen during the pandemic in a developing country

like Bangladesh. Several manuscripts have been published regarding outbreak of COVID-19 throughout the world (Ambade et al., 2021; Chelani and Gautam, 2021; Gautam, 2020a, 2020b; Gautam and Trivedi, 2020; Anwar et al., 2020) but most of them are concentrated on medical aspect of the pandemic whereas limited information is available for environmental and socioeconomic aspects of COVID-19 pandemic (Gollakota et al., 2021; Gautam and Hens, 2020). In-depth assessment regarding socioeconomic and environmental impact of COVID-19 could bring fruitful information to assess forthcoming situation and tackle both epidemiological and socio-economic impacts. This article overviews the socioeconomic impacts of COVID-19 in Bangladesh by collecting data from primary and secondary sources that could help policymakers undertake pragmatic and judicious policies to tackle socioeconomic issues in Bangladesh due to such pandemics. Data from various sources have given opportunity to discuss various aspects of COVID-19. The main limitation of the work is that this is work has been performed by collecting data and information from secondary sources.

Present situation of COVID-19 in Bangladesh

The first case of COVID-19 was identified on March 11, 2020 whereas the first death was confirmed on March 18, 2020. After that, Bangladesh Government imposed a lockdown from 26 March to 30 March to control the spread of the COVID-19 Virus. In Bangladesh, 14,77,930 cases were detected so far (25 August, 2021) (Ministry of Health and Family Welfare, 2021) while the total deaths were 25,627 and total recovered cases were 13,89,571 (Figs. 1 and 2).

At the beginning of the identification of COVID-19, Government of Bangladesh arranged 112 ICU (intensive care unit beds). Later, DGHS (Directorate General of Health Services) increased the number of ICU beds to 1316 for coronavirus patients throughout the country (25 August, 2021) (Ministry of Health and Family Welfare, 2021). Out of 1316 ICU beds, more than 50% are in private hospitals. According to the bulletin of DGHS on 17 August, there are 6334 beds in 46 coronavirus-dedicated hospitals and clinics in the capital while 4272 are in government hospitals and 2062 are in private hospitals. It is challenging to get an ICU bed in government hospitals as most (and general) patients prefer this because of much less expensive than those in private hospitals. Many patients cannot afford the expenditure of ICU facilities in private hospitals. It was very difficult for the authorities to arrange a normal bed when a large number of people are getting infected with Indian delta variant (B. 1.617). During the first wave of COVID-19, the detection rate was less than 5%, exceeding almost 30% after detecting the deadlier Indian variant on May 8, 2021 (The daily star, 2021). Bangladesh sealed its border with India from April 25, 2021 whereas air travel has been suspended since April 14, 2021.

2.1. Demographic distribution

From the Fig. 3, it is apparent that more than 50% of the infected people are in the aged group between 21 and 40 while more than 65% of the death is noticed by the people older than 50 years. Both infected and death rates are much higher for male (>70%) compared to female (IDARE, 2021; Fig. 3). This is maybe due to the higher expression of angiotensin-converting enzyme-2 (ACE 2; receptors for coronavirus) in male than female, immunological differences of sex hormone and chromosome between male and female. Gender lifestyle and attitude are also responsible for higher morbidity and mortality in males than females. For instance, higher levels of smoking, drinking and irresponsible attitude for maintaining social distancing and using preventive measures are noticed for men (Bwire, 2020).

2.2. Impact of COVID-19 on healthcare worker

There is considerable disparity between the number of doctors and patients. WHO estimated that only 3.05 doctors and 1.07 nurses are working per 10,000 people in Bangladesh. Among all the frontline service providers during Covid, the highest rate of death was observed for doctors in Bangladesh. Hussain et al. (2021) conducted research using semi-structured questionnaire to depict the issues faced in 'Priority Intervention Areas' (PIA) during Covid pandemic and the summary findings of the author have been given in Table 1. The result revealed that both doctors and nurses did not get sufficient unsealed PPE (Personal Protective Equipments). Infected patients did not get proper treatment due to lack of ICU, insufficient doctors and nurses. Mismanagement and lack of coordination among the responsible authorities were also observed by the research work conducted by Shammi et al. (2020).

Impact of COVID-19 on mental health

A higher number of people are affected mentally with various levels of severity. Das et al. (2021) investigated the impact of COVID-19 pandemic on four major mental health issues of the general Bangladeshi people and found that the prevalence rates of loneliness, depression, anxiety and sleep disturbance were 71%, 38%, 64% and 73%, respectively (Fig. 4). They also indicated that women were facing more depression and anxiety than men. A research work conducted by Yeasmin et al. (2020) on the impact of COVID-19 on children's mental health in an urban city and the results showed that 43% of children had subthreshold mental disturbances, 30.5% had mild, 18.3% had moderate, and 7.2% had severe disorders.

Impact of COVID-19 on adolescent mental health

Three-fourths of the adolescents have been distressed with household stress during the pandemic in Bangladesh (Baird et al., 2020). Adolescents are worried about their study and examination. Most of the girls complained that boys can go out anytime and meet their friends without any restriction but they cannot. Nearly one-fourth of the beneficiary household respondents (Fig. 5) have alarming level depression (1.5% severe and 21.9% moderately severe). Depression, a psychological disorder, is very common among people. Physical and psychological stress, anxiety, frustration, negative experiences, fear often cause depression. The Patient Health Questionnaire-9 (PHQ-9) was used as part of a household survey to investigate depression. The situation of women members is worst in this pandemic situation (Barkat et al., 2020).

4.1. Economic impact

COVID-19 badly impacts Bangladesh's economy through the government enforcement of lockdown in different sectors. According to 'The Economist', Bangladesh has been listed as the 9th strongest economy, who recently reported on the financial strength of the 66 emerging economies in the wake of the COVID-19 fallout. The pandemic has resulted in a significant decrease in national output. Agriculture, Industry and Service are the three prominent economic sectors of Bangladesh where their contribution to country GDP are 18%, 29% and 53%, respectively (Nath et al., 2020) adversely affected by COVID-19. Bangladesh is the biggest economy among the most developed countries and by 2024 expected to leave the LDCs. Almost 20 million workers lost their jobs in Bangladesh from the informal sector. According to CPD (center for Policy Dialogue), out of 60.8 million people working in both formal and informal sectors, 14 million people get

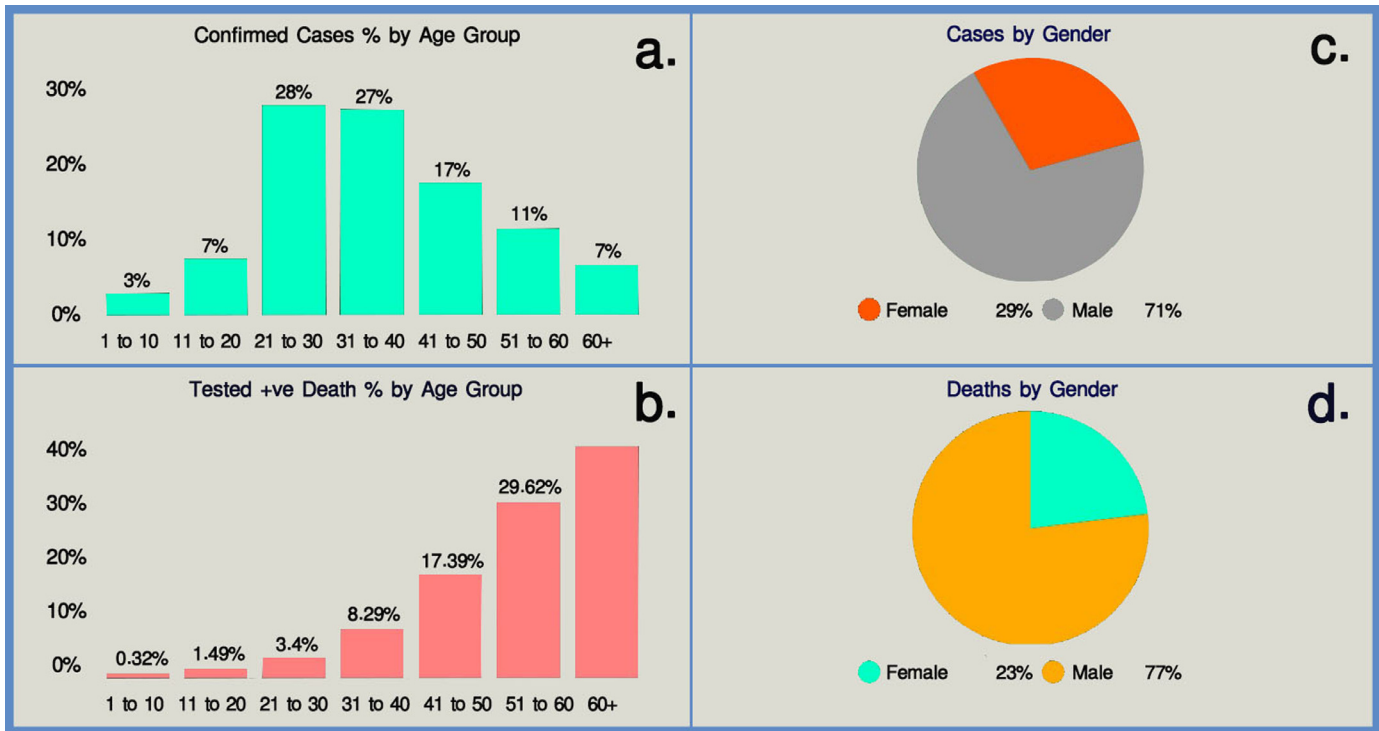


Fig. 3. Demographic Distribution of Coronavirus infected people in Bangladesh (Adopted From IDARE, 2021).

Table 1
Summary findings according to PIA framework (Adopted from Hussain et al., 2021).

PIA Framework	Findings	Doctors	Nurses
Surveillance	Weak surveillance	Agree	Agree
Basic infrastructure and cleaning	Poor time and queue management	Agree	Agree
	Inadequate cleaning	Agree	Agree
Patient and staff and infection control	Shortage of PPE	Agree	Agree
	Insufficient healthcare workers	Agree	Agree
	Missing parts of PPE	Disagree	Agree
Case management	Lack of treatment experience	Agree	Disagree
	Lack of training	Disagree	Agree
Maintenance of other routing services	Absence of routine cleaning	Agree	Agree
Cultural aspects and community engagement	Patient improper behavior	Agree	Agree

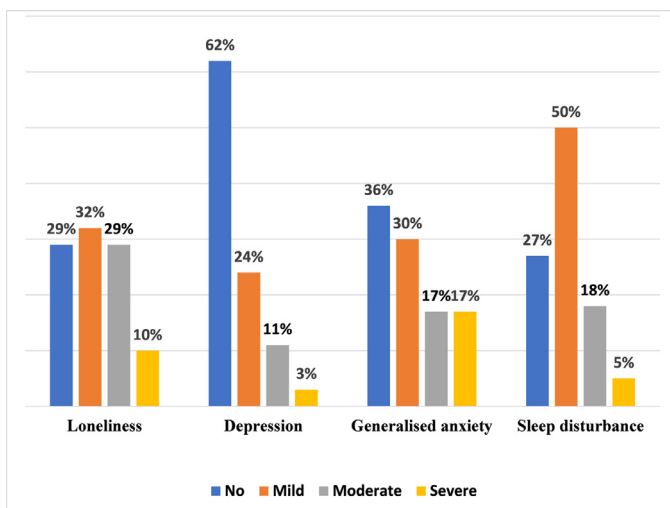


Fig. 4. Mental health problems during COVID-19.

their monthly salary from employers, 10 million are day laborers and 27 million are self-employed. Among them, the day laborers and self-employed have temporarily become jobless with zero earning in a current pandemic situation (Mahmud et al., 2021). Altig et al. (2020) used economic uncertainty indicators and observed that COVID-19 is causing great economic uncertainties and economic fallouts in USA and UK. The existing and the upcoming economic programs under government to government (G2G) cooperation particularly between China and other economies are affected (Barua, 2020). For example, in Bangladesh, major undertakings like Padma Bridge, Padma Rail Link, Karnaphuli Road Tunnel and the Greater Dhaka Sustainable Urban Transport Project that include monetary and specialized contribution from China are highly influenced by COVID-19 situation. Middle-income, lower-income and daily-wage earners have fallen into a severe financial crisis due to loss of job. Global FDI (Foreign Direct Investment) flows up to 40% in 2020 from \$ 1.4 trillion value in 2019. In 2021 FDI projected to decrease further 5–10%. Asia performed positive FDI inflows to China and India in the high-tech sectors in terms of merger and acquisition in ICT and pharmaceuticals respectively (Islam and Hussain, 2021). Despite the global economic downturn

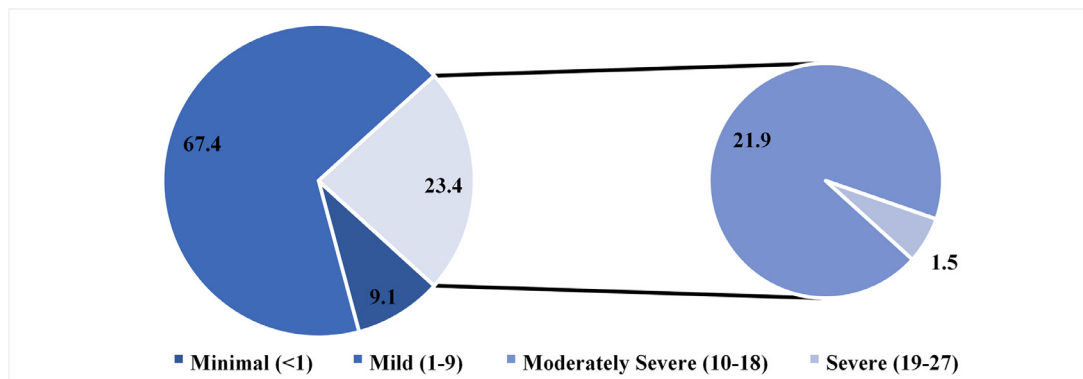


Fig. 5. Severity score using PHQ-9 (beneficiary group, in%) (Adopted from Barkat et al., 2020).

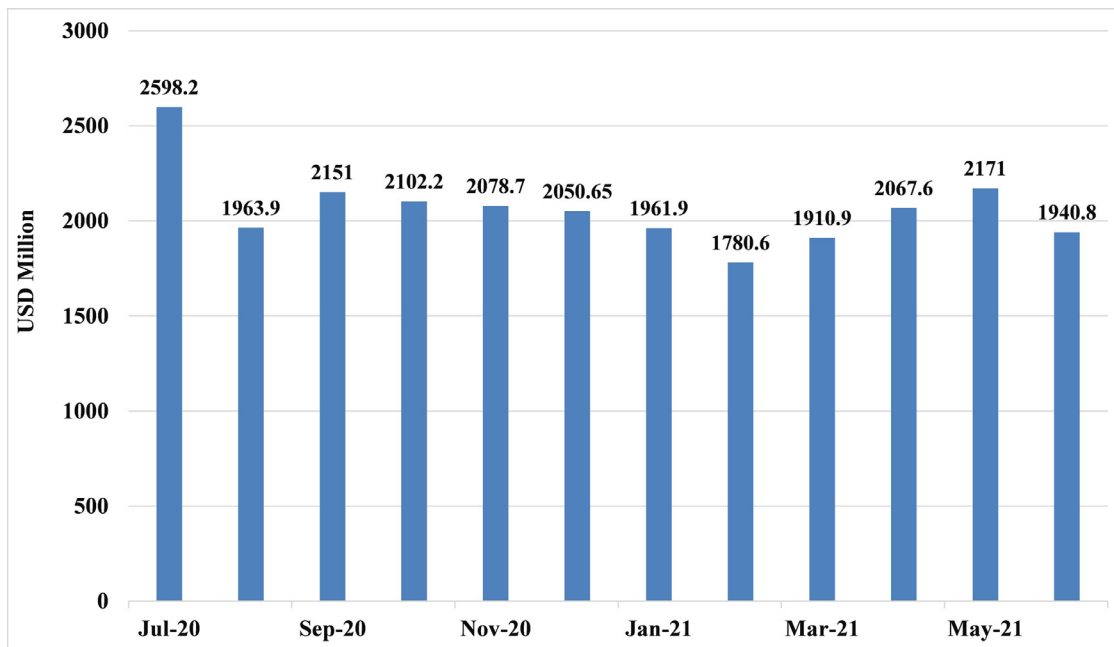


Fig. 6. Bangladesh Remittances 2020–2021 Data (source: Bangladesh bank).

Bangladesh economy shows positive growth in 2020 indicating to be more macro-economic resilient. Many international economic surveys show that Bangladesh remains among the top five resilient economies during the pandemic adversaries and is considered one of the global business communities (Islam and Hussain, 2021).

According to Barua (2020), banks around the world could face increased credit and default risk as businesses run out of money during pandemic and post-pandemic times. Although the Federal Reserve has already cut interest rates to increase liquidity and handle shocks, the move has raised heightened financial health concerns. The World Bank anticipates that coronavirus's monetary effect will mitigate around 24 million individuals reducing poverty in East Asia and the Pacific alone (Vaswani, 2020). The impact of remittances could be enormous for developing countries that are major migrant labor exporters and dependent on foreign remittances like India and Bangladesh (Barua, 2020). Ten million Bangladeshis working overseas such as Saudi Arabia, Italy and the United States transferred around \$ 18 billion in fiscal 2018–2019. Remittances in Bangladesh decreased (Fig. 6) to \$ 1940.81 million in June 2020 from \$ 2171.03 million in May of 2021 (Trading Economics, 2021). Prime Minister of Bangladesh declared \$ 11.90

billion stimulus package in 19 sectors to boost up economy from this crisis (Islam et al., 2020).

4.2. Social impact

More than 1.4 million confirmed cases with 23,810 deaths, which harms the life and livelihood of Bangladeshi people. Corona Virus outbreak after the SARS Virus has had a significant impact on China Society and worldwide, including Bangladesh. Earlier outbreak of COVID-19 creates a panic situation in the society through the spread of rumors and lack of trustful information by social media, mobile phone, internet, people gossip and others ways. Amidst the lockdown of the COVID-19 pandemic, Bangladesh also has been facing other problems like social stigma, fear, and threat. The primary healthcare treatments in the hospitals and private clinics were disrupted in the lockdown.

Many emergency service providers such as frontline doctors, healthcare staff, caregivers, police and armed forces, bankers, and government authorities were infected, isolated, and even died. Private hospitals and clinics in suburban and rural areas were shut down due to the fear of infection. The healthcare workers who

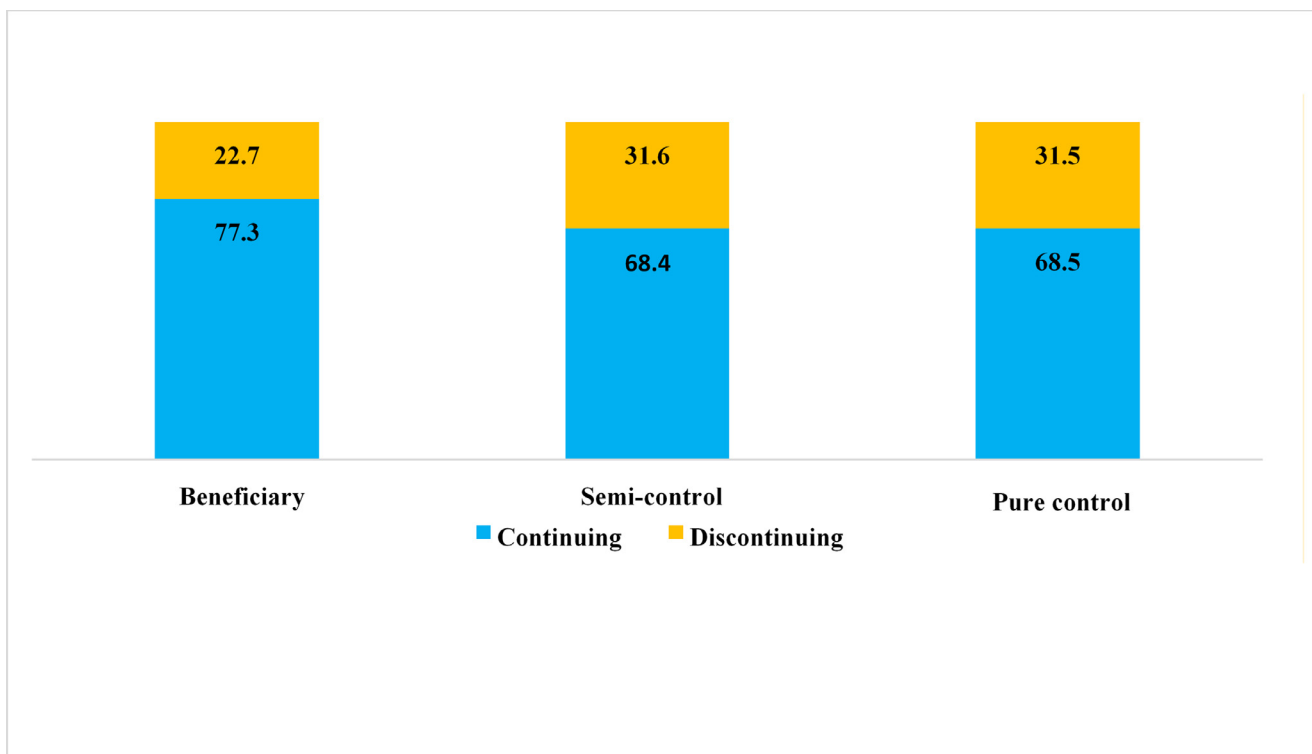


Fig. 7. Children (5–16 years) continuing their study during lockdown (in%, Adopted from Barkat et al., 2020).

have treated the corona virus patients have been socially stigmatized. Besides, the deceased was even denied burial in the local graveyards which are basic human rights and, in most cases, handled by the government authority (The Business Standard, 2020). The rickshaw/auto-rickshaw puller are getting solely a meagre variety of passengers. The hawkers and roadside providers can't run the business suitable as there are many restrictions from the authorities while the customers are going through hardship, the quantity of income have decreased notably. Across the towns, many of the development workers do not have work as many of the building works have been paused. The COVID-19 pandemic has resulted in severe impacts on household income and expenditure. The relatively poorer section of the society living in low-income settlements face the negative consequences more acutely than other segments of the people. The first outcome they face is a severe contraction in employment opportunities, and accordingly, their income is reduced significantly (Barkat et al., 2020). Price of hand sanitizers, soap, and face mask has been increasing in an alarming rate in Bangladesh during this situation although large amounts were available in the markets. In the urban areas, most people lost their jobs and were forced to return to their native places, which plays an essential role in virus transmission. For bearing household expenditure, people move to sell their furniture, necessary things and take loans from NGOs, which significantly impact our society. Live stream worship is arranged by many countries as physical attend worship in mosque, temple and churches are prohibited during pandemic situation (Parke, 2020). COVID-19 pandemic is a health crisis challenging food security and nutrition of more than ten million urban poor people of Bangladesh. Many urban poor people living in cities and towns are already suffering from food insecurity, food deficiency, and malnutrition. Rapid Assessment of Food and Nutrition Security in the Context of COVID-19 in Bangladesh conducted by Food and Agriculture Organization (FAO) suggested that consumer basket's cost increased in the urban areas (FAO, 2020).

4.3. Impact on agriculture

Corona Virus has jeopardized the agriculture sector, due to the decline of demand in the market, the price of vegetables, fruits and eggs has bought down (The Daily Independent, 2020). Around 12 to 15 million liters of milk remain unsold everyday across the country, which caused Tk 570 million in daily losses to the marginal dairy farmers (Sarker, 2020). COVID-19 pandemic brought a great impact on agricultural sector by pricing down nearly all agricultural products. 66% farmers (53% crop and vegetables, 99% fish farmers) got lower price than they used to get in a normal situation (BRAC, 2020). The country's dairy farmers are in deep disaster due to the fact they are pressured to promote milk at Tk 10 to Tk 12 per liter someplace in Bangladesh whilst in different areas they can't promote at all (Roy, 2020). On different hand, Bangladesh's fares make up over 70% of the crabs in the Chinese market. China stopped bringing crabs due to the possibility of spread of COVID-19 (Khaled, 2020). While every sub-sector is dealing with fees and grant chain issues, 34% of respondents have reported damages of their products. The monetary loss in terms of common earnings of the farmers approximated BDT 20,79,761 throughout the cease of March - first half of May 2020 period. Getting lower prices and higher expenses of inputs, decrease demand for dairy, fisheries and fowl products. In the case of vegetables, it is assumed that Bangladesh will lose \$ 20 million export earnings due to the outbreak of COVID-19 (BRAC, 2020). Bangladesh Poultry Industries Central Council (BPICC) said that price of poultry chicken and eggs dropped in the market due to nationwide shutdown. BPICC as of now anticipated their misfortune will be between 1150 and 1650 Crore Taka (The Business Standard, 2020). Flower farmers experienced 3000 million BDT losses as they could not sell their blooms on last spring in the market (Sarker, 2020). Suppose COVID-19 scenario continues even in the subsequent season. In that case, many of the farmers will quit this profession, and it will bear a significant impact on food produc-

tion, supply chain, food system ultimately country's overall food security.

4.4. Impact on industry

COVID-19 pandemic creates "ripple effects" in the garments sectors by affecting millions of workers and enterprises in the supply chains. In the first half of 2020 Global garment trade virtually collapsed mainly in the Asia's garments by canceling buyer's contract about 70% (International Labour Organization, 2020). Bangladesh financial system stays rather established on the ready-made clothes enterprise for manufacturing employment, overseas reserve, and female empowerment. The enterprise contributes 11.2% to the gross home product of the country. With 61% female employment, the RMG enterprise has performed a critical position in female empowerment and gender equity. Bangladesh exceptionally exports to the European Union (62%) and the United States of America and Canada (21%) (Asian Development Bank, 2020). Bangladesh's RMG sector started facing obstacles by posting nationwide lockdown, fall of global economic trade and buyer's order cancellation. According to the Bangladesh Garment Manufacturers and Exporters Association (BGMEA), over 900 million pieces of garments order worth \$ 2.9 billion had already been cancelled or were being held up in April, 2020. The Bangladesh Knitwear Manufacturers and Exporters Association (BKMEA), claimed until July 2020, more than \$ 3 billion orders had been cancelled or suspended (Bhattacharjee, 2020). RMG exports fell by 54.8% to \$ 3.7 billion from \$ 8.2 billion from March 2002 to May 2020 with 1150 factories reported 2.28 million workers affected by the cancellation of \$ 3.18 billion orders (CPA Institute, 2020). Bangladesh Government announced 5000 crore stimulus package to the export oriented industries for paying salaries and allowances.

COVID-19 pandemic creates growing higher demand for hand sanitizers, face mask and other medicines in Worldwide. On the supply side, active pharmaceutical ingredients (API), the raw materials for the pharmaceutical sector, are heavily dependent on imports. Every year, Bangladesh imports around 95% of all APIs valued at 5 billion Taka from abroad, the largest amount from China, followed by South Korea and India. Although the COVID-19 outbreak has not had a major impact on the local pharmaceutical sector so far, the spread of the pandemic is expected to lead to API shortages in the short term. India heralds difficult times for the import-dependent industry.

In the food retail e-commerce market, Chaldal.com, Direct Fresh, Khass Food, Meena Click, etc. are all thriving before the pandemic. During lockdown, they received large number of orders on their platform, but failed to deliver. In most cases, they had to restrict their daily orders, and in some cases the product took more than a day to deliver. Leading food manufacturer E-commerce platform like Aarong Dairy, Kazi Farms, Golden Harvest even Daraz, Priyoshop.com and othoba.com. offer home delivery as people were unable to go outside during lockdown. That is how the grocery retail e-commerce market system evolved during the ongoing coronavirus crisis.

4.4. Impact on industry

COVID-19 has paid off havoc around the world and every critical sector like education has been hit hard since its late outbreak in December 2019. Students, teachers, colleges and universities badly impacted. United Nations Educational, Scientific and Cultural Organization (UNESCO) said that, over 800 million learners around the world have been affected, 1 in 5 students cannot go to school, 1 in 4 cannot attend college and more than 102 countries have ordered schools to close across the country, while 11

have local school closings carried out (Global Campaign for Education, 2020).

The number of students is about 17 million in primary, 13 million in secondary, and 4 million in tertiary education in Bangladesh (BBS, 2017). COVID-19 pandemic has brought a disaster in the education sector by declaration of shutting down all educational institutions for uncertain period. On March 16, 2020 all educational institutions went to vacation for the next April 04, 2020 but later extending period declares September 31, 2021 one by one declaration from the Ministry of Education. This longer period vacation results in increasing tension, mental stress, lack of confidence among the students ultimately leads attempt to suicide. Bangladesh has recorded 70% more suicides than COVID-19 deaths in the last year and 180 students died from suicide during COVID-19 (Amader Shomoy, 2021). Family problems, relationship stress, financial crisis and educational reasons responsible for suicidal cases 35%, 24%, 4% and 1% respectively in Bangladesh (Dhaka Tribune, 2021).

The COVID-19 pandemic is likely to result in significant long-term education costs. By quantifying learning loss in terms of job market performance, the average Bangladeshi student will face a decrease in annual income of around \$ 335, nearly 6.8% of their annual income for all students in Bangladesh. For all Bangladeshi graduates entering into the labor market for a projected period of 10 years, it would cost the country's economy up to \$ 114 billion in gross domestic product. Since educational institutions closed March 2020, nearly 38 million students in Bangladesh have lost the opportunity to receive adequate learning and interact with their peers, which affects their educational experience. Based on simulation tool of developed by World Bank's Global Education Practice, it is estimated that the COVID-19-induced school closings will result in an average student losing 0.5 to 0.9 years of adapted learning time. In the scenario of 9 months of school closure, Learning Adjusted Years of Schooling (LAYS) could drop to 5.3 years (Rahman and Ahmed, 2021).

A UNDP household survey reports stated that about 22.7% of the children in the beneficiary group (out of 77.5% attending school) did not continue their education after the shutdown of educational institutions. More than 30% of children in the semi-control group (31.6% of 78.6% enrolled in school) and the pure control group (31.5% of 72.3% enrolled in school) dropped out due to forced closure schools on the part of COVID-19 (Fig. 7). They may be uncertain about their future learning and risk dropping out (Barkat et al., 2020).

A rapid assessment Impact of COVID-19 on Education in Bangladesh from BRAC stated that 16% students have expressed anxiety and panic due to the pandemic (Change and Programme, 2020). With a total of 31 million school-going children, the number can be as many as 5 million panic-stricken children in the country. 34% of the panic-stricken students have become cranky, show tantrums or remain agitated most of the time. 28% of them have lost enthusiasm to study or play while 25% hesitant to speak to outsiders. 20% of them are suffering from monophobia, and 28% scared of seeing outsiders. The students with disabilities (16%) have been the worst victims of abuse. Survey data suggest that only 2% of female students were the victims of abuse. The coronavirus pandemic seems to have made 13% of students less interested in studying while 14% do not study (Change and Programme, 2020).

Impact of COVID-19 on physical environment

COVID-19 acts as a blessing for the Mother Earth by reducing environmental impact worldwide (Gautam et al., 2021a). Shutdown of industry, lockdown and quarantine people longer period of time results in less environmental pollution. On the other hand, increasing demand for PPE (Personal Protective Equipment), increasing

use of face mask & hand gloves, growing demand for pharmaceuticals products responsible for water and plastic pollution by generating too much medical waste. Nearly 50% reduction of N_2O and CO observed in China through the enforcement shutdown in industry. Due to COVID-19 lockdown, 30–60% NO_2 emission dropped from many European cities including Barcelona, Madrid, Milan, Rome and Paris (EEA, 2020). ESA (2020) reported that level of NO_2 reduced significantly in Asian countries (70%–India, 20 to 30%–China) during COVID-19 lockdown. Similarly, many studies conducted to update the improvement of Asian air quality due to lockdown during COVID-19 (Naqvi et al., 2021a, 2021b; Gautam et al., 2021b, 2020; Lalwani and Gautam, 2021; Naqvi et al., 2020). Air quality of Dhaka city was improved considerably during the lockdown and Air Quality Index (AQI) level dropped 16.74% in 2020 compared to 2019 (Roy et al., 2020). Restriction of international flights in many countries reducing CO_2 concentration in the atmosphere like China deducted nearly 17% CO_2 emission compared to January 20, 2020 (Zogopoulos, 2020). Increasing amount generation of medical waste due to COVID-19 possess a great hazard to human health and environment. Approximately, 206m tons of medical waste are generated in Dhaka City per day because of COVID-19 (Rahman et al., 2020). As medical waste is hazardous waste, their proper management has become a significant challenge to the concerned authorities. In developing country like India and Bangladesh, water pollution is a major phenomenon as domestic and industrial waste water discharge in the environment without treatment. During the lockdown period, water pollution has reduced in the beach area in many countries, including Bangladesh, Malaysia, Thailand, Maldives, and Indonesia (Rahman, 2020).

Conclusions

This study gives a synopsis of the socio-economic and environmental impact of the COVID-19 in Bangladesh. This is not only an economic crisis but also an immense social crisis. The detection rate varied from less than 5% to 30% during COVID-19 and both infected and death rates are much higher for male than female. There are insufficient ICU beds with ventilators facilities, a shortage of personal protective equipment (PPE) for health care workers, testing kits, and sufficient national funds. A large number of people are suffered mentally from depression and anxiety. The health-care workers who have treated the corona virus patients have been socially stigmatized. Almost 20 million workers lost their jobs in Bangladesh from the informal sector out of 60.8 million people working in both formal and informal sectors. Corona Virus has jeopardized the agriculture sector, due to the decline of demand in the market. 66% farmers (53% crop and vegetables, 99% fish farmers) got lower price than they used to get in a normal situation. COVID-19 pandemic creates “ripple effects” in the garments sectors by affecting millions of workers and enterprises in the supply chains. COVID-19 pandemic has brought a disaster in the education sector by declaration of shutting down all educational institutions for uncertain period that resulted tension, mental stress, lack of confidence among the students. Although increasing amount and new types of medical waste generated due to COVID-19, air quality of Dhaka city was improved considerably during the lockdown. The government tried hard and soul with limited resources to protect the pandemic outbreak by buying necessary testing kits, sufficient amount of vaccines, providing social protective measures and food and cash directly to the poor people. Proper full vaccination and raising awareness among the people to wear face mask, social distancing, use sanitizers is important to control Corona Virus spreading in Bangladesh. As vaccination is a long-term process, collaboration of native pharmaceuticals industry with the Government is warranted. Together with Government, non-government organizations, researchers, doctors, industrialists, international organization

as well as individuals should come forward to handle this pandemic. By and large, the country's partners ought to make an execution approach to play down the widespread impacts by bringing innovation, monetary speculation, and investigation in each division.

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Declaration of Competing Interest

This study was not financially supported by any public or private institution. Moreover, the authors declare that they have no competing interests.

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References

- Ambade, B., Sankar, T.K., Kumar, A., Gautam, A.S., Gautam, S., 2021. COVID-19 lockdowns reduce the Black carbon and polycyclic aromatic hydrocarbons of the Asian atmosphere: source apportionment and health hazard evaluation. *Environ. Dev. Sustain.* 23, 12252–12271.
- Altig, D., Baker, S., Barrero, J.M., Bloom, N., Bunn, P., Chen, S., Davis, S.J., Leather, J., Meyer, B., Mihaylov, E., Mizen, P., Parker, N., Renault, T., Smietanka, P., Thwaites, G., 2020. Economic uncertainty before and during the COVID-19 pandemic. *J. Public Econ.* doi:10.1016/j.jpubeco.2020.104274.
- Anwar, S., Nasrullah, M., Hosen, M.J., 2020. COVID-19 and Bangladesh: challenges and how to address them. *Front. Public Heal.* 8, 1–8. doi:10.3389/fpubh.2020.00154.
- Asian Development Bank, 2020. COVID-19 and Readymade Garments Industry in Bangladesh. COVID-19 Act. Response Expend. Support Progr. (RRP BAN 54180), 1–5.
- Baird, S., Seager, J., Sabarwal, S., Guglielmi, S., Sultan, M., 2020. Adolescence in the Time of COVID-19: Evidence from Bangladesh. World Bank, Washington, DC <https://openknowledge.worldbank.org/handle/10986/34801>.
- Barkat, A., Ahamed, F., Mamun, M., Rabby, M., Begum, L., Nurunnhanar, M., Sarwer, M., 2020. Socio-economic assessment of COVID-19 under National Urban Poverty Reduction Program. *Hum. Dev. Res. Cent.*
- Barua, S., 2020. Understanding coronanomics: the economic implications of the coronavirus (COVID-19) pandemic. *SSRN Electron. J.* 1–44. doi:10.2139/ssrn.3566477.
- BBS, SID, MoP, 2017. Bangladesh Statistics 2017. Bangladesh. Bur. Stat. Informatics Div. Minist. Plan. 1–73. http://bbs.portal.gov.bd/sites/default/files/files/bbs.portal.gov.bd/page/a1d32f13_8553_44f1_92e6_8ff80a4ff82e/Bangladesh%20%20Statistics-2017.pdf. Accessed 27 August 2021.
- Bhattacharjee, J., 2020. Bangladesh: COVID-19 badly impacts garment industry. *Obs. Res. Found.* <https://www.orfonline.org/research/bangladesh-covid19-badly-impacts-garments-industry-65275/>. Accessed 27 August 2021.
- Billah M., 2020. Hunger or Coronavirus – Who will get us first? <https://www.tbsnews.net/thoughts/hunger-or-coronavirus-who-will-get-us-first-78034> (Accessed 27 August 2021).
- BRAC, 2020. A rapid assessment “Vulnerabilities of agricultural producers during COVID-19 pandemic. <http://www.brac.net/program/wp-content/uploads/2021/03/Report-A-rapid-assessment-Vulnerabilities-of-agricultural-producers-during-COVID-19-pandemic.pdf> (Accessed 27 August 2021).
- Bwire, G.M., 2020. Coronavirus: why Men are More Vulnerable to Covid-19 Than Women? *SN Compr. Clin. Med.* doi:10.1007/s42399-020-00341-w.
- Change, S., Programme, B.E., 2020. Impact of COVID-19 on Education in Bangladesh. <http://www.brac.net/program/wp-content/uploads/2020/07/Rapid-assessment-impact-of-COVID-19-education-in-Bangladesh.pdf> (Accessed 29 August 2021).
- Chelani, A., Gautam, S., 2021. Lockdown during COVID-19 pandemic: a case study from Indian cities shows insignificant effects on urban air quality. *Geosci. Front.* 101284. doi:10.1016/j.gsf.2021.101284.

- Committee, I.S., 2020. Inter-agency standing committee reference group for mental health and psychosocial support in emergency settings. Briefing Note on Addressing Mental Health and Psychosocial Aspects of COVID-19 Outbreak 1–20. <https://www.socialserviceworkforce.org/system/files/resource/files/Briefing-Note-Addressing-Mental-Health-and-PSS-COVID-19.pdf> (Accessed 29 August 2021).
- CFA Institute, 2020. COVID-19 Impact on Bangladesh Economy. Lanka-Bangla Asset Management Co <https://www.arx.cfa/en/research/2020/06/soc290620-covid-19-impact-on-bangladesh-economy>.
- Das, R., Hasan, M.R., Daria, S., Islam, M.R., 2021. Impact of COVID-19 pandemic on mental health among general Bangladeshi population: a cross-sectional study. *BMJ Open* 11, 1–11 <https://doi.org/10.1136/bmjopen-2020-045727>.
- Dhaka Tribune, 2021. 70% More Suicides Than Covid-19 Deaths in the Last Year <https://www.dhakatribune.com/bangladesh/2021/03/13/70-more-suicides-than-covid-19-deaths-in-the-last-year>.
- EEA, 2020. Air pollution goes down as Europe takes hard measures to combat Coronavirus. European Environmental Agency (EEA), Copenhagen. <https://www.eea.europa.eu/highlights/air-pollution-goes-down-as> (Accessed 28 August 2021).
- ESA (European Space Agency), 2020. <https://www.esa.int/> (Accessed 27 August 2021).
- FAO (Food and Agriculture Organization), 2020. 'Second rapid assessment of food and nutrition security in the context of COVID-19 in Bangladesh', May – July 2020. <https://doi.org/10.4060/cb1018en>
- Gautam, A.S., Dilwaliya, N., Srivastava, A., Kumar, S., Baudh, K., Singh, D., Gautam, S., 2020. Temporary reduction in air pollution due to anthropogenic activity switch-of during COVID-19 lockdown in northern parts of India. *Environ. Dev. Sustain.* 23, 8774–8797. doi:10.1007/s10668-020-00994-6.
- Gautam, S., 2020a. The influence of COVID –19 on air quality in India: a boon or inutility. *Bull. Environ. Contam. Toxicol.* 104, 724–726. doi:10.1007/s00128-020-02877-y.
- Gautam, S., 2020b. COVID –19: air pollution remains low as people stay at home. *Air Qual. Atmos. Health* 13, 853–857. doi:10.1007/s11869-020-00842-6.
- Gautam, S., Hens, L., 2020. SARS-CoV-2 pandemic in India: what might we expect? *Environ. Dev. Sustain.* 22, 3867–3869. doi:10.1007/s10668-020-00739-5.
- Gautam, S., Sammuell, C., Gautam, A.S., Kumar, S., 2021a. Strong link between coronavirus count and bad air: a case study of India. *Environ. Dev. Sustain.* 23, 16632–16645. doi:10.1007/s10668-021-01366-4.
- Gautam, A.S., Kumar, S., Gautam, S., Anand, A., Joshi, A., Baudh, K., Singh, K., 2021b. Pandemic induced lockdown as a boon to the Environment: trends in air pollution concentration across India. *Asia Pac. J. Atmos. Sci.* 57, 741–756. doi:10.1007/s13143-021-00232-7.
- Gautam, S., Trivedi, U., 2020. Global implications of bio-aerosols in pandemic. *Environ. Dev. Sustain.* 22, 3861–3865. doi:10.1007/s10668-020-00704-2.
- Global Campaign for Education, 2020. Corona Virus_ Don't let our children down! Global Campaign For Education', 2021. <https://campaignforeducation.org/en/2020/03/18/coronavirus-dont-let-our-children-down/> (Accessed 27 August 2021).
- Hussain, M., Begum, T., Batul, S.A., Tui, N.N., Islam, M.N., Hussain, B., 2021. Healthcare workers during the COVID-19 pandemic: experiences of doctors and nurses in Bangladesh. *Int. J. Health Plann. Manag.* 36, 174–181. doi:10.1002/hpm.3154.
- IDARE, 2021. COVID-19 status for Bangladesh . <https://covid19bd.idare.io/> (Accessed 31 August, 2021) .
- IEDCR (Research Institute of Epidemiology, Disease Control), 2020. "Coronavirus info 2019 ". <https://iedcr.gov.bd/> (Accessed 22 August 2021).
- International Labour Organization, Better Work, ILR School, 2020. Research brief - The supply chain ripple effect: How COVID-19 is affecting garment workers and factories in Asia and the Pacific. *ILO Br.* 1–23. https://www.ilo.org/wcmsp5/groups/public/-asia/-ro-bangkok/documents/briefingnote/wcms_758626.pdf (Accessed 22 August 2021).
- Islam, M.S., Hussain, S., 2021. The impact of COVID-19 on global FDI and Bangladesh Economy .The Daily Star. <https://www.thedailystar.net/law-our-rights/news/the-impact-covid-19-global-fdi-and-bangladesh-economy-2102717> (Accessed 24 August, 2021) .
- Islam, M.T., Talukder, A.K., Siddiqui, M.N., Islam, T., 2020. Tackling the COVID-19 pandemic: the Bangladesh Perspective. 9. *J. Public Health Res.* 9, 389–397. doi:10.4081/jphr.2020.1794, <http://doi.org/>
- July, U., Jackson, J.K., 2021. Global Economic Effects of COVID-19. *Congr. Res. Serv.* 78. <https://sgp.fas.org/crs/row/R46270.pdf>. Accessed 24 August, 2021.
- Khaled, S.M.S., 2020. 'The way COVID-19 is affecting Bangladesh economy'. <https://www.theindependentbd.com/post/237519> (Accessed 25 August, 2021) .
- Mahmud, S., Zubayer, S.A., Ahmed, I., Eshtiaq, A., Nasim, M.H., 2021. Economic Impact of COVID-19 on the Vulnerable Population of Bangladesh. *SSRN Electron. J.* doi:10.2139/ssrn.3741890, <http://doi.org/>
- Ministry of Health and Family Welfare, 2021. <http://www.mohfw.gov.bd/> (Accessed 26 August, 2021).
- MIS-DGHS (Management Information System-Directorate General Health System), 2021. Covid-19 dynamic dashboard for Bangladesh. <https://dashboard.corona.gov.bd/webportal> (Accessed 23 August 2021).
- Nath, J., Chowdhury, A.F., Nath, A.K., 2020. Analyzing COVID-19 Challenges in Bangladesh. Preprints, 2020070129. <https://doi.org/10.20944/preprints202007.0129.v1>.
- Naqvi, H.R., Datta, D., Mutreja, G., Siddiqui, M.A., Naqvi, D.F., Naqvi, A.R., 2020. Improved air quality and associated mortalities in India under COVID-19 lockdown. *Environ. Pollut.* 268 (Part-A). doi:10.1016/j.envpol.2020.115691.
- Naqvi, H.R., Mutreja, G., Shakeel, A., Siddiqui, M.A., 2021a. Spatio-temporal analysis of air quality and its relationship with major COVID-19 hotspot places in India. *Remote Sens. Appl.* doi: 10.1016/j.rsase.2021.100473.
- Naqvi, H.R., Mutreja, G., Hashim, M., Singh, A., Nawazzozha, Naqvi, D.F., Siddiqui, M.A., Shakeel, A., Chaudhary, A.A., Naqvi, A.R., 2021b. Global assessment of tropospheric and ground air pollutants and its correlation with COVID-19. *Atmos. Pollut. Res.* 12 (9). doi:10.1016/j.apr.2021.101172.
- Parke, C., 2020. Churches Cancel Sunday Service, Move Online Amid Coronavirus Outbreak. Fox News <https://www.foxnews.com/us/coronavirus-update-church-sunday-service-online>.
- Parvin, R.A., Islam, M.S., Akter, M.S., Mohammad, S.S., Hossain, M.B., Rashid, S., 2021. Psychosocial Anxiety from Lockdown Due to COVID-19 to Income Earner of the Family: an Evidence from Northern Bangladesh. *Sociol. Mind* 11, 65–80. doi:10.4236/sm.2021.113006.
- Rahman, M., 2020. Rare dolphin sighting as Cox's Bazar lockdown under COVID-19 coronavirus. <https://www.youtube.com/watch?v=gjw8ZIIIIBQ> (Accessed 23 August 2021).
- Rahman, M.M., Bodrud-Doza, M., Griffiths, M.D., Mamun, M.A., 2020. Biomedical waste amid COVID-19: perspectives from Bangladesh. *Lancet Glob. Health* 8 (10), e1262. doi:10.1016/S2214-109X(20)30349-1.
- Rahman, T., Ahmed, R., 2021. Combatting the impact of COVID-19 school closures in Bangladesh. <https://blogs.worldbank.org/endpovertyinsouthasia/combating-impact-covid-19-school-closures-bangladesh> (Accessed 27 August 2021).
- Rajkumar, R.P., 2020. COVID-19 and mental health: a review of the existing literature. *Asian J. Psychiatr.* 52. doi:10.1016/j.ajp.2020.102066.
- Roy, R., 2020. Mitigating Covid-19 impacts on food and agriculture. *Financ. Express.* <https://thefinancialexpress.com.bd/print/mitigating-covid-19-impacts-on-food-and-agriculture-1585932264>. Accessed 28 August, 2021.
- Roy, S., Chowdhury, N., Mamun, M., Bhuyan, M., 2020. COVID-19 Induced Lockdown Consequences on Air Quality and Economy – A Case Study of Bangladesh. *J. Environ. Pollut. Hum. Heal.* 8, 55–68. doi:10.12691/jephh-8-2-3.
- Sarker, M.A., 2020. Impact of COVID19 on Bangladesh agriculture global conference on 'emerging agricultural research to Prof Dr M ASarker. https://www.researchgate.net/profile/Mohammed-Sarker-2/publication/346963104_Impact_of_COVID19_on_Bangladesh_Agriculture/links/5fd4784fa6fcdcc8bb0d1e/Impact-of-COVID19-on-Bangladesh-Agriculture.pdf (Accessed 29 August, 2021).
- Shammi, M., Bodrud-Doza, M., Towfiqul Islam, A.R.M., Rahman, M.M., 2020. COVID-19 pandemic, socioeconomic crisis and human stress in resource-limited settings: a case from Bangladesh. *Heliyon* doi:10.1016/j.heliyon.2020.e04063.
- The Business Standard, 2020. Deadly Covid-19 Pandemic Impact: poultry sector stares at over Tk1,150 crore losses . <https://www.tbsnews.net/economy/industry/poultry-sector-stares-over-tk1150-crore-losses-63472> (Accessed 29 August, 2021).
- The Daily Independent, 2020. Coronavirus: prices fall in Dhaka kitchen markets . <https://m.theindependentbd.com/home/printnews/242976> (Accessed 29 August, 2021).
- The Daily Star, 2021. Indian Variant Coronavirus found in Bangladesh <https://www.thedailystar.net/coronavirus-deadly-new-threat/news/indian-variant-covid-19-found-bangladesh-2090309>.
- Trading Economics, 2021. Bangladesh Remittance. 2021 Data | 2022 Forecast | 2012–2020 Historical <https://tradingeconomics.com/bangladesh/remittances> (Accessed 29 August 2021).
- UNDP (United Nations Development Programme), Bangladesh, 2021. Beyond Recovery: Towards 2030 <https://www.bd.undp.org/content/bangladesh/en/home/coronavirus/support-to-national-response.html>.
- Vaswani, K., 2020. Coronavirus: Millions will be Left in Poverty. World Bank warns. *Bbc.* <https://www.bbc.com/news/business-52103666>.
- Vos, R., Martin, W., Laborde, D., 2020. As COVID-19 spreads, No Major Concern for Global Food Security Yet | IFPRI. International Food Policy Research Institute. IFPRI blog <https://www.ifpri.org/blog/covid-19-spreads-no-major-concern-global-food-security-yet>.
- Wang, G., Zhang, Y., Zhao, J., Zhang, J., Jiang, F., 2020. Mitigate the effects of home confinement on children during the COVID-19 outbreak. *Lancet* 395 (10228), 945–947. doi:10.1016/S0140-6736(20)30547-X.
- WHO, 2021. WHO Director-General's opening Remarks at the Member States Information Session On COVID-19 - 11 March 2021. World Heal. Organ. <https://www.who.int/director-general/speeches/detail/who-director-general-s-opening-remarks-at-the-member-states-information-session-on-covid-19-11-march-2021> Accessed 30 August 2021.
- , 2020. Losing Livelihoods: the Labor Market Impacts of COVID-19 in Bangladesh. *World bank Gr.*, pp. 1–16. doi:10.13140/RG.2.2.32438.42569.
- Worldometer, 2021. COVID Live Update: 173,332,025 Cases and 3,727,759 Deaths from the Coronavirus. *Worldometer* <https://www.worldometers.info/coronavirus/>.
- Yeasmin, S., Banik, R., Hossain, S., Hossain, M.N., Mahumud, R., Salma, N., Hossain, M.M., 2020. Impact of COVID-19 pandemic on the mental health of children in Bangladesh: a cross-sectional study. *Child Youth Serv Rev* 117, 105277. doi:10.1016/j.childyouth.2020.105277.
- Zogopoulos, E., 2020. COVID-19: the curious case of a green virus. *Energy Ind. Rev.* <https://energyindustryreview.com/analysis/covid-19-the-curious-case-of-a-green-virus/>. Accessed 31 August 2021.