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Insights Into the First Seven-months of COVID-19 Pandemic in Bangladesh: Lessons Learned from a High-risk Country

Md. Hasanul Banna Siam
Biomedical Research Foundation, Dhaka, Bangladesh

Md.Mahbub Hasan
Biomedical Research Foundation, Dhaka, Bangladesh

Shazed Mohammad Tashrif
National University of Singapore - Kent Ridge Campus: National University of Singapore

Md. Hasinur Rahaman Khan
University of Dhaka: Dhaka University

Enayetur Raheem
Biomedical Research Foundation, Dhaka, Bangladesh

Mohammad Sorowar Hossain (sorowar.hossain@brfbd.org)
Biomedical Research Foundation https://orcid.org/0000-0001-7143-2909

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Abstract

Background

South Asian countries including Bangladesh have been struggling to control the COVID-19 pandemic despite imposing months of lockdown and other public health measures. In-depth epidemiological information from these countries is lacking. From the perspective of Bangladesh, this study aims at understanding the epidemiological features and gaps in public health preparedness and risk communication.

Methods

The study used publicly available data of seven months (8 March 2020–10 September 2020) from the respective health departments of Bangladesh and Johns Hopkins University Coronavirus Resource Centre. Human mobility data were obtained from Google COVID-19 Community Mobility Reports. Spatial distribution maps were created using ArcGIS Desktop. Descriptive statistics was used to report the incidence, case fatality rates (CFR), and trend analysis.

Results

Despite nationwide lockdown, an increase in human mobility linked to specific public events was observed. During this period, a total of 47,153 cases and 650 deaths were reported. As lockdown ended, the incidence rate was increased by around 50% within a week. In seven months, about 350,000 cases were identified with a CFR of 1.4%. Males were disproportionately affected in terms of infection (71%) and death (77%) than females. The CFR for males was higher than females (1.4% versus 1.11%). Over 50% of infected cases were reported among young adults (20-40-year age group). Trends of the cumulative incidence were slower in South Asia with lower mortality compared to the EU and USA. As of 10 September 2020, over 20,000 frontline health workers were affected, and more than 2100 unofficial deaths were reported. Reduced testing capacity was observed as compared to other countries. Although a downward trend in laboratory test positive percentage was seen, the number of new deaths per day remained largely unchanged.

Conclusion

We identified critical gaps in public health preparedness and risk communication in battling COVID-19 pandemic. We believe our findings, observations and recommendations will function as a valuable resource to facilitate better public health decisions for managing current and future infectious disease like COVID-19 in the settings of developing countries.

Background

The novel coronavirus disease 2019 (COVID-19) has triggered a public health emergency of international concern. Within a period of six months, the Severe Acute Respiratory Syndrome Coronavirus-2 (SARS-

CoV-2) has spread to more than 200 countries/territories, infected more than 30 million people worldwide, and claimed over 900,000 lives. The COVID-19 causes a plethora of clinical manifestations; the severity and outcomes of the disease may vary depending on the underlying comorbidities (diabetes, heart diseases, hypertension, COPD), age, sex, and geographic locations (1). In South Asia, despite implementing various public health measures, the overall response to containing the viral spread remains questionable as there is no indication of the anticipated growth curve for the pandemic to flatten. As of 10 September 2020, over 5 million cases and 94,000 deaths have been reported in the South Asia, and hence created an alarming situation as one-third of the world's population (~ 1.7 billion) with similar socio-economic characteristics live in these densely populated and resource-limited regions. In this regard, Bangladesh could be an interesting setting to understand the characteristic of the COVID-19 pandemic from the South Asian perspective.

With a population of over 160 million, Bangladesh is one of the most densely populated (1265 per square km) countries in the world. About 60% of its population is between 15 to 64 years old and only 4.7% is above 65 years of age (2). The care-home facility is virtually non-existent and the extended family structure combines the aged with the young in the same household. Because of economic growth, the country has undergone a rising trend of unplanned urbanization, and more than 32 per cent of people are currently living in urban areas. Bangladesh is also experiencing nutrition and epidemiologic transition with a higher burden of noncommunicable diseases (NCDs). A recent meta-analysis has shown that overall prevalence for metabolic syndrome (a cluster of health problems including high blood pressure, abdominal fat, high triglycerides, high blood sugar, and low HDL cholesterol) is higher in Bangladesh compared to the estimated world prevalence (30% versus 20–25%) (3). Besides, approximately 34% of adults are overweight and NCDs account for 67% of deaths in Bangladesh (4, 5).

The capital of Bangladesh, the Dhaka city, has a population of nearly 20 million, and is currently the epicenter of COVID-19 infection in the country. The first three official COVID-19 cases were reported on March 8, 2020, which included two men returning from Italy. The first official death was confirmed on 18 March 2020 amidst the upsurges of unofficial deaths of people with COVID-19 like symptoms. With more than one million slum dwellers and marginal communities who live in close proximity, the capital Dhaka city remains at high risk since these people are deprived of adequate facilities for maintaining personal hygiene as bathroom/toilets and water reservoirs are shared between several families (6, 7). Notably, Bangladesh also hosts the world's largest refugee camp in Ukhia, Cox's Bazar where nearly 1 million refugees reside in crowded surroundings.

Since adequate information on in-depth epidemiological features of the COVID-19 pandemic is lacking from the setting of developing countries, particularly from South Asia; in this context, we aimed to (1) understand the gaps in public health preparedness, and (2) analyze the epidemiological characteristics including incidence, mortality, and geospatial distribution of the COVID-19 pandemic in Bangladesh. Moreover, comparative epidemiological trends were analyzed between Bangladesh and other countries with significant incidences of the disease.

Methods

Data sources

Mobility data

Country-level mobility data for Bangladesh were obtained from Google COVID-19 Community Mobility Reports (www.google.com/covid19/mobility) based on the google maps/location usage from smartphones, over a period of 3 January 2020 to 19 September 2020. The data was normalized and the baseline was used as the median value of 5 weeks (3 January 2020 to 6 February 2020). Five different categories of mobility data were plotted: (i) mobility at grocery and pharmacy, (ii) mobility at parks, (iii) mobility at retail & recreation, (iv) mobility at transit stations and (v) mobility at workplaces. Mobility of grocery and pharmacy data was constructed on user-visits to grocery markets, drugstore, food warehouse, etc. In parks, mobility involves public gardens, national forests, castles, etc. Retail and recreation mobility include restaurants, cafes, shopping centers, theatres. At transit stations, mobility includes bus stations, airports, railway stations, public transport hubs, etc. Workplace mobility covers offices, factories, etc.

Incidence and mortality

Data were obtained from the Directorate General of Health Services (DGHS), the Government of Bangladesh (8). Information on COVID-19 infected frontline professionals (medical doctor, health workers, police, and journalists) were extracted from the websites of Bangladesh Medical Association, major newspapers and online portals, professional societies and then verified with the government press releases whenever possible (9–13). Unofficial death counts with COVID-like symptoms were collected from weekly bulletins published by Bangladesh Peace Observatory, Centre for Genocide Studies (CGS) at the University of Dhaka along with the official death counts (14).

Geospatial analysis

District-wise case reports data was collected from the Institute of Epidemiology, Disease Control and Research (IEDCR), a sister organization of DGHS and COVID-19 Bangladesh situation reports by World Health Organization (WHO) (15,16). The population data were retrieved from the Bangladesh Population Census 2011 dataset. The spatial map was created using layers downloaded from the Bangladesh Geospatial Data Sharing Platform (GeoDASH) on ArcGIS Desktop (Esri Inc., Redlands, California, United States) (17). District-wise data for active COVID-19 cases were plotted on a map

Trends and statistical analysis

Descriptive statistics were used to report incidence, mortality, age, and gender-specific attributes. Data from the Johns Hopkins University Coronavirus Resource Centre was used to analyze the current trend of Bangladesh compared to South Asian countries (India, Pakistan, and Nepal) and other countries with higher incidence (Saudi Arabia, Brazil, UK, USA, and Italy) (18).

Result

After the first case was reported in March 2020, flights were limited, educational institutions were closed, and health screening was mandatory in the airport. Two weeks after the first confirmed case, a nation-wide lockdown was imposed by the government. During this period, all offices, public transportation and large gatherings were shut, prayers in places of worship were suspended, and mandatory stay-at-home order was imposed. The lockdown was relaxed after 66 days, and within a week, reporting of new cases increased by nearly 50%. Figure 1 represents an overall timeline of COVID-19 related major events in the first four months of the pandemic in Bangladesh.

Figure 2 shows human mobility in Bangladesh during the COVID-19 pandemic. Human mobility was drastically declined after declaration of the first official COVID-19 case (8 March and nationwide lockdown (23 March 2020) (Figure 2 and Supplementary Table 1). However, during lockdown, an increase in human mobility was documented linked with public events Eid festival (the biggest Muslim festival, 24 May 2020). Afterwards, the gradual increment of human mobility was observed with a sharp peak during another muslin festival, Eidul Adha (13 July 2020).

More than 50% of patients infected with SARS-CoV-2 were aged between 21 and 40 years (Figure 3A). Children and elderly people belonged to the least infected group. Deaths due to COVID-19 in Bangladesh increased with the age of patients (Figure 3B). About 40% of cases aged over 60 years were four times more likely to die than the age group of 31–40 years. Males were infected (71%) and died (77%) in a higher proportion than females (Figure 3C). Overall case fatality rate (CFR) in Bangladesh was 1.4% (Figure 3D), and the CFR for males was higher than females (1.52% vs 1.11%). Most of the patients had mild to moderate complications as compared to only 3.41% of patients requiring critical care (Supplementary Figure 1A). Among the patients who died, the most common pre-existing comorbidity was diabetes (38%) followed by hypertension (28%) and heart failure (11%) (Supplementary Figure 1B).

As of April 15, the infection rate was very low as 27 districts out of 64 did not report any COVID-19 positive cases. Among others, none of the districts had more than a total of 30 cases except for Chittagong (n=31), Gazipur (n=53), Narayanganj (n=214), and Dhaka (n=546). The district-wise analysis of cases per million between April 15, 2020 to September 10, 2020 revealed that the number of positive cases in Dhaka, Munshiganj, Cox’s Bazar, Narayanganj, and Chittagong rose rapidly in June (Figure 4). After the lockdown period, the infection rate increased from 275 cases per million on June 07 to 521 cases per million on June 30 – nearly a 90% increase over three weeks. Interestingly, the incidence rate in Dhaka had a 13% reduction as the number of cases decreased from 1735 to 1507 cases per million. This could suggest that, following the cessation of lockdown measures, the disease was spreading out from

the epicenter Dhaka towards the peripheral districts. The rapid spread of the disease was observed in Tangail (from 15 cases per million to 168 cases) and Khulna (from 66 cases to 742 cases per million). By September 2020, the districts at the peripheral parts of Bangladesh have seen a sharp increase in the number of COVID-19 positive cases. The Bandarban district had only 12 cases per million in May, whereas the number escalated to 1752 cases per million population in September. So far, the Dhaka division has the highest number of COVID-19 cases of which nearly 70% were in the capital Dhaka city. The rest of the divisions in order of a total of case numbers include Chittagong, Khulna, Rajshahi, Sylhet, Rangpur, Barishal, and Mymensingh.

The trends of incidence and mortality in Bangladesh were compared with some South Asian and other countries with significant COVID-19 infections. In Figure 5A, we found that Bangladesh had a similar trend of incidence during the initial phase of the pandemic (first 30 days or so). After that, the incidence in Bangladesh and other South Asian countries slowed down compared to Brazil, the USA, and European countries. As for mortality, the South Asian countries had significantly fewer deaths over time compared to the other countries in the EU and the USA (Figure 5B). Interestingly, both incidence and deaths in Nepal started to pick up after more than one and a half months since the first confirmed case.

The testing capability was minimal in the first month of the outbreak (March 2020) and increased to 99 laboratories nationwide. Albeit the overall testing rate was still only 10,560 tests per 1 million people and was below the rate of India, Pakistan, Sri Lanka, and other South Asian countries (Supplementary Figure 2A). Among the number of laboratories confirmed cases, the death rate was found to be lower in Bangladesh as compared to Western countries (Supplementary Figure 2B). Among the South Asian region, the trends between Bangladesh and Pakistan were found to be close as both recorded 29 deaths per million population and performed 10,560 vs 13,510 tests per million population, respectively.

After six months, the case rates began to drop below 15% which was as high as 40% at the beginning of the pandemic in March. Based on the test positive case-rate data, a steady increase was observed throughout March to July and a probable peak of infection occurred in late July 2020. However, the number of new deaths per day due to COVID-19 has not declined, rather the numbers have increased over time to some extent (Figure 6). While the case-rate indicates a downward trend, the death rate has remained largely unchanged since the first week of June. Notably, the number of total RT-PCT tests performed has also decreased. On April 15, the number of RT-PCR test was 1740, and by June 26, the numbers increased to 18,498; however, the test numbers reduced to 10,723 by September 12.

As of 10 September 2020, over 20,000 frontline health workers (5483), law enforcement officers, and journalists were infected (Table 1). A high CFR (3.16%) was recorded for frontline physicians. A total of 2100 unofficial deaths with COVID-19 like symptoms were reported (Figure 7). In the first three weeks of April, the unofficial death of COVID-19 suspects increased rapidly in the Dhaka division while the number of deaths increased alarmingly in Chattogram in post-lockdown period. The trend of an increase in the number of deaths was slow in other division including Barishal, Rangpur, Mymensingh, Sylhet, Khulna, and Rajshahi as compared to Dhaka and Chattogram.

Table 1
Infections and Deaths among frontline COVID-19 fighters (Police, health workers, Army, Journalists)

Frontliners	Infected (n)	Death n (%)
Physicians	2753	87 (3.16%)
Nurse	1949	NA
Medical Staff	3243	NA
Police	11302	44 (0.38%)
Army**	3477	NA
Journalists	378	06 (1.58%)
**Both in service and retired		

Discussion

The COVID-19 pandemic has appeared as a daunting disaster for Bangladesh. With constrained resources and a gigantic population, the experience of Bangladesh illustrates some of the common challenges faced by the developing countries concerning the public health response to an infectious disease such as COVID-19. This article thus attempted to describe the scenario of public health preparedness and epidemiological characteristics of the first seven-months of the COVID-19 pandemic in Bangladesh.

Ineffective public health crisis communication and countermeasures

After the official announcement of COVID-19 cases in Dhaka, the Government took a number of initiatives to revamp the testing facility, medical equipment supply, and nationwide surveillance. The lockdown measures with the deployment of police and armed forces were routed to enforce the law. However, our study showed that public health countermeasures were not up to the mark to flatten the curve as the country was witnessing a steep rise in the number of confirmed cases. The human mobility data also confirms the gradual increase in mobility during the lockdown periods. A series of events such as the mobilization of 11 million mobile users from city to rural areas, local violence, massive gathering for Janaza prayer (funeral), and purposive rule-breaking indicated that people, by and large, failed to take into account the importance of maintaining social distancing. While strict lockdown policy has shown some success in China, New Zealand, Italy, and largely in the developed countries, a similar approach did not achieve the desired outcome in Bangladesh, for which the underlying socioeconomic and

demographic factors were at fault. At the beginning of April during the lockdown period, Bangladesh had only 54 cases, but it increased to about 50,000 cases by the end of May as the lockdown ended. A similar trend was also observed in India and Pakistan where the early lockdown measures might have helped in the preparation of medical logistics but ultimately failed to contain the viral spread.

One recent study in Bangladesh has shown that people were confused about the "english" terms such as “stay at home,” “social distancing,” “quarantine,” and “lockdown” (19). The upward trajectory of positive cases despite an extended period of nationwide lockdown and restrictions indicate the inefficiency of public health risk communication. The gap in the public health preparedness in battling COVID-19 can be minimized by taking into account the nuances of geographical & cultural contexts and devising specific strategies. Significant investment and support are required to generate sufficient data for improving the efficiency of public health decisions.

Gender disparity and spatial distribution of infection

In Bangladesh, the proportion of men catching the virus was 2.5 times more than women, although studies around the world suggest that both men and women are equally susceptible to the virus (15,20). A similar observation was noted in India and Pakistan where men comprised about 65% and 70% of confirmed cases, respectively (21,22). This disparity in susceptibility might be due to cultural aspects since men dominate the outdoor activities and are less careful towards keeping up with personal hygiene. Also, the percentage of susceptibility might vary since COVID-19 is more fatal for men, causing them to seek medical care and subject to testing (23). The death rate among males was found higher in various studies around the world. In South Asia, males died in a higher proportion: India (64%), Pakistan (74%), and Bangladesh (77%). Studies showed that men over 60 years of age are twice as likely to die of COVID-19 than women (23,24). This could partly be explained by the presence of higher comorbidity and the smoking habit in men, although the exact reason remains to be elucidated (25). However, women in India had a higher case fatality rate compared to males (CFR: 2.9% versus 3.3%) which contrasts the scenario of Bangladesh (CFR: 1.4% versus 1.11%) (20,21). Future studies are warranted to understand the disparity in sex-specific mortality risk in South Asia.

In Bangladesh, the existing data suggest that the infection rate in people from urban areas is higher than in rural villages. This is unsurprising because urban settings offer a higher chance of catching the virus. For instance, the Dhaka or Chittagong city relies heavily on congested infrastructures where the population density is the highest, and the citizens receive reduced sunlight exposure. Vitamin D deficiency in city areas is well documented, and some early studies indicated that vitamin D deficiency could be a risk factor for COVID-19 adversity (26,27).

However, the rural remote regions of the country suffer from a lack of proper medical support. Out of 64 districts, almost half of the districts have over 100,000 people who are aged above 65 years, and data show that the proportion of the elderly is higher in rural areas (28,29). As hospital facilities and medical assistance are more centered towards urban residents, about 3 million people from 50 tribal and ethnic

minor communities living in remote areas remain vulnerable to COVID-19 (28). In Brazil, around 9.1% of indigenous people infected with the disease died, and the rate of infection is soaring in distant communities (30). Correspondingly, the Rohingya refugee forcibly displaced from Myanmar are living in crowded quarters in Cox's Bazar area, Bangladesh, where they are subject to several health issues such as malnutrition, limited medical access, food- and water-borne diseases, reproductive health, and communicable diseases. In addition to Bangladesh Government's support, the UN initiative to mobilize women in spreading awareness regarding COVID-19 in Rohingya camps might lessen the disease burden; however, additional international aid is necessary to cope up with the challenges (31).

Low fatality rate as compared to other countries

Interestingly, despite the official numbers jumping above 339,332 (as of 15 September 2020) cases, the death rate remained fairly low (1.4%) in Bangladesh and close to the other South Asian countries such as India (1.64%), and Pakistan (2.11%). This trend contrasts to the other countries such as Spain (4.88%), China (5.44%), France (7.36%), the UK (10.44%), Mexico (10.58%), and Italy (12.34%) (32). The lower mortality rate in the developing countries may be due to the fact that the overall life expectancy is within 64 to 72 years, leaving out the overly elder population; and there is a higher proportion of young populations in Pakistan, India, and Bangladesh. By comparison, the proportion of people aged over 70 years is much higher in the western settings (33).

Speculations regarding the low death rate in developing countries questioned the under-reporting of actual death cases as testing facilities were very limited. The unofficial sources indicated that a slightly higher number of deaths (n=2100) occurred in Bangladesh during the initial phase of the outbreak. However, the combined overall mortality rate remains surprisingly lower than what has been observed in the western world. The western countries offer care home facilities that are practically non-existent in South Asian culture where the extended family structure incorporates the elderly with the young in the same household. As opposed, the rapid spread of the infection among the elderly in care homes contributed to half of the total deaths in the western world. In France, the deaths linked to care homes were 51%, and in Canada, as many as 82% of COVID-19 deaths occurred among care home residents (34).

Slow progression of COVID-19 pandemic in South Asian countries

Despite higher population density and low awareness of personal hygiene, the South Asian countries have witnessed a rather noticeable slow progression. While Afghanistan and Pakistan's curves have flattened, India continues to see a sharp increase in the number of new infections. It is speculative that COVID-19 was already circulating in this region since South Asian countries are closer to and have strong economic relations with China. Of note, the first COVID-19 positive case was identified on January 30 in

India, February 26 in Pakistan, and March 8 in Bangladesh. Despite such early detection, the subsequent numbers of infection and mortality continued to rise slowly. Several factors might influence the disease progression such as the wide-scale adaptation of facemask, tropical climate, or cross-immunity from other viruses as the region is under the high burden of disease (35,36). However, the most probable reason is that unlike China that locked down Wuhan city, the South Asian countries went for a nationwide total lockdown which slowed down the disease progression. Such actions had a tremendous impact on the daily lives of people, especially the daily wage earners and the measures turned out to be unsustainable. As the countries eased down on lockdown measures, the numbers began to soar up. In Bangladesh, a dramatic shift in the percent-change of disease transmission was observed as the post-lockdown COVID-19 infection was dispersing quickly from the cities towards the peripheral districts. This underpins the fact that relaxing social distancing measures might bring about similar infection rates for developing countries.

Overburden of healthcare system

A significant number of medical personnel and law enforcement workers were infected during the first wave of the COVID-19 epidemic. In particular, the fatality rate among the doctors in Bangladesh (3.16%) was higher than the healthcare workers in Pakistan (1.01%) and slightly lower than India (3.30%) and Afghanistan (3.75%) (37). The higher proportion of frontliners contracting the virus implies the lack of personal safety and inconsistency in management. The quality of personal protective equipment (PPE) and its training of proper handling remains in doubt. Moreover, hospitals suffer from the scarcity of intensive care units. With only 733 intensive care unit (ICU) beds in government hospitals, the healthcare has crumbled as the COVID-19 infection rate increases in torrent (38). It is surmised that the number of deaths in the age range of 60–70 could be subverted if proper ICU and medical support were provided. This underscores the need for urgent investment and remodeling of the healthcare sector.

Undoubtedly, the biggest problem with social distancing in Bangladesh lies in the population density and city-based centralized facilities. Besides, the healthcare system in Bangladesh is also largely centralized in metropolitan settings especially the capital Dhaka and divisional cities. The disaster of the COVID-19 pandemic thus points out the fragility of the existing system and urges to prioritize the decentralization of healthcare facilities. The steps can also ensure the minimization of the urban-rural disparity in the healthcare facilities. The establishment of universal health care should also be directed as a long-term goal.

Limited testing facility

The abrupt onset of critical patients at the hospitals has strained medical resources; and expensive PCR (polymerase chain reaction) based testing facilities and related workforce remained in pestilence to meet the demand. As shown in our results, the RT-PCR based test positive case rate has started to decline while the number of new deaths per day has remained largely unchanged, which could indicate that the current

positive case rate is subject to the number of RT-PCR test performed. Since the laboratory test numbers have decreased, the incidence rate and the case rate may not be representative of the current situation of the COVID-19 pandemic. With regard to laboratory tests per million of population, Bangladesh is also lagging behind the race. Interestingly, the total number of tests performed by Japan (1,718,055) is fewer than Bangladesh (1,742,696), yet Japan has about 75,657 total cases as opposed to 339,332 cases in Bangladesh. This indicates that proper contact tracing and quarantining are equally important than simply performing massive tests.

Since public health measures in the developing countries are constrained by resources both in terms of financial support and trained workforce, it is essential to devise a strategy that is most suitable for such settings. It is recommended that instead of depending on RT-PCR based tests that are costly and time-consuming, the low-middle income countries could focus on syndromic diagnosis based on the constellation of symptoms and signs of COVID-19 in a disease afflicted area (39). This way, the burden of expensive testing could be largely reduced, the suspected patients identified earlier, and the investment channeled out into rebuilding healthcare facilities. Moreover, patients who were denied hospital admittance because of the absence of a COVID-19 test report will also receive early medical support. While the pandemic situation will not be under control very soon, the COVID-19 testing laboratories should be turned into regional surveillance centers instead of dissolving them by the time COVID-19 ends. Because only a national framework of proactive monitoring can assist in prompt action in the event of future outbreaks

Our study has a few limitations. First, we used publicly available recent data for analysis, which was both a weakness and a strength in itself. Second, unofficial death counts with COVID-19 like symptoms (not confirmed by the test) were extracted from well-established national news media and thus, these should be considered as probable death cases. Due to limited healthcare infrastructure and testing facilities, it was not possible to confirm all suspected deaths.

Conclusion

We found that despite imposing a number of public health measures to ‘flatten the curve’ the outbreak continued to grow and spread across Bangladesh. Males were disproportionately infected and died at a higher percentage. Case fatality rates were relatively higher among frontline medical workers and law enforcement officials. South Asian countries including Bangladesh had significantly fewer deaths over time compared to the other western countries. Our finding on gaps in public health preparedness and communication, and epidemiological characteristics would contribute to better public health decisions for managing current and future pandemic like COVID-19 in Bangladesh and other similar settings elsewhere in the world, particularly in South Asia.

List Of Abbreviations

CFR: case fatality rates

COVID-19: coronavirus disease 2019

CGS: Centre for Genocide Studies

DGHS: Directorate General of Health Services

IEDCR: Institute of Epidemiology, Disease Control and Research

ICU: intensive care unit

PCR: polymerase chain reaction

PPE: personal protective equipment

SARS-CoV-2: Severe Acute Respiratory Syndrome Coronavirus-2

WHO: World Health Organization

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that there is no conflict of interest regarding the publication of this article.

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Available

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Author Contributions

MSH conceived the idea. MSH, MHBS and MMH designed and prepared the draft. MMH, MHBS, ER. MSH, SMT amd MHRK contributed to the result preparation. All authors critically reviewed and edited the manuscript.

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Figures

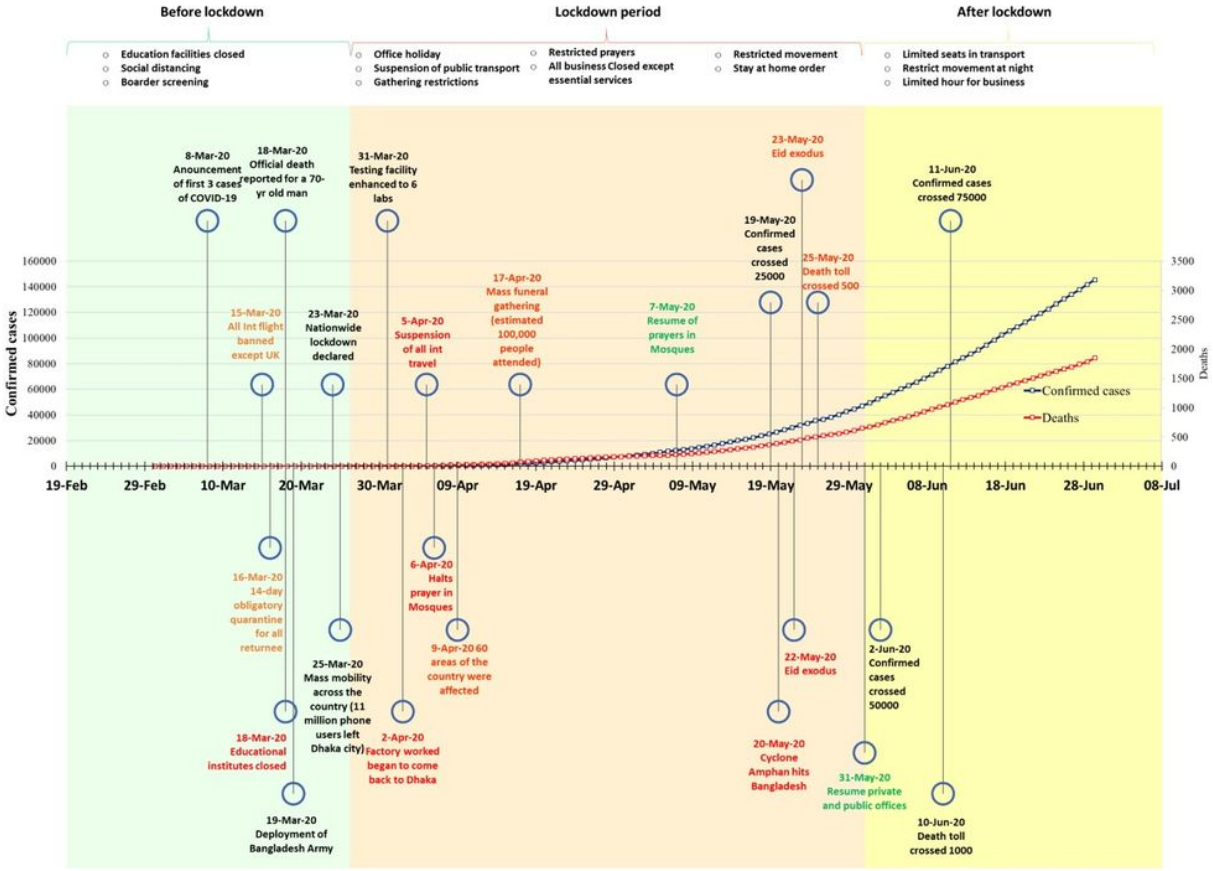

Figure 1

Major events and public health measures in COVID-19 in Bangladesh before and after lockdown periods. Deaths over time are represented in the secondary axis.

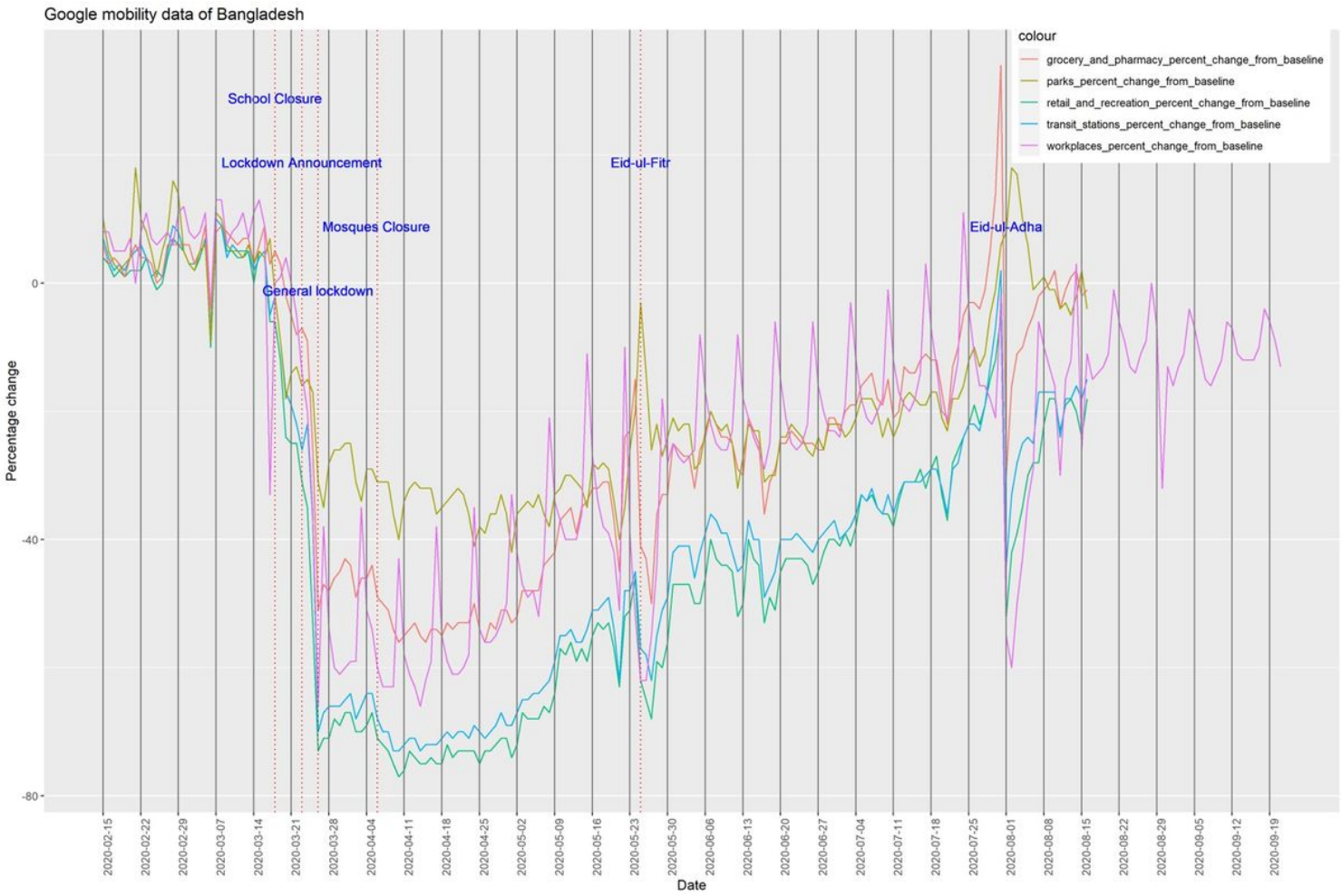

Figure 2

Human mobility in Bangladesh during COVID-19 pandemic (8 March 2020 to 19 September 2020)

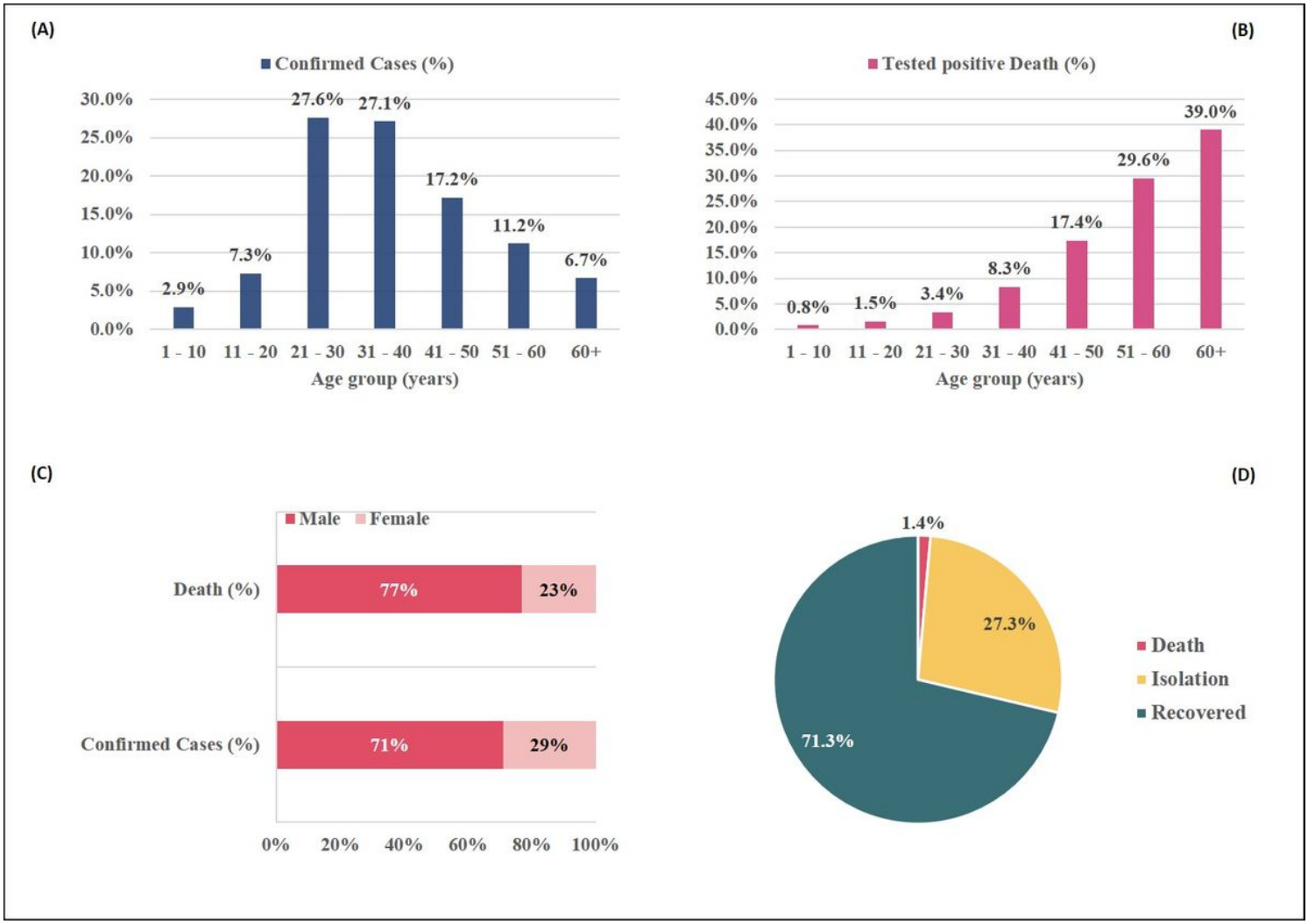

Figure 3

Demography of reported COVID-19 cases and deaths in Bangladesh (8 March 2020 – 9 September 2020). (A) Age group specific cases, (B) Age group specific deaths, (C) Sex specific cases and deaths, (D) Percentage of recovered, isolation and deaths.

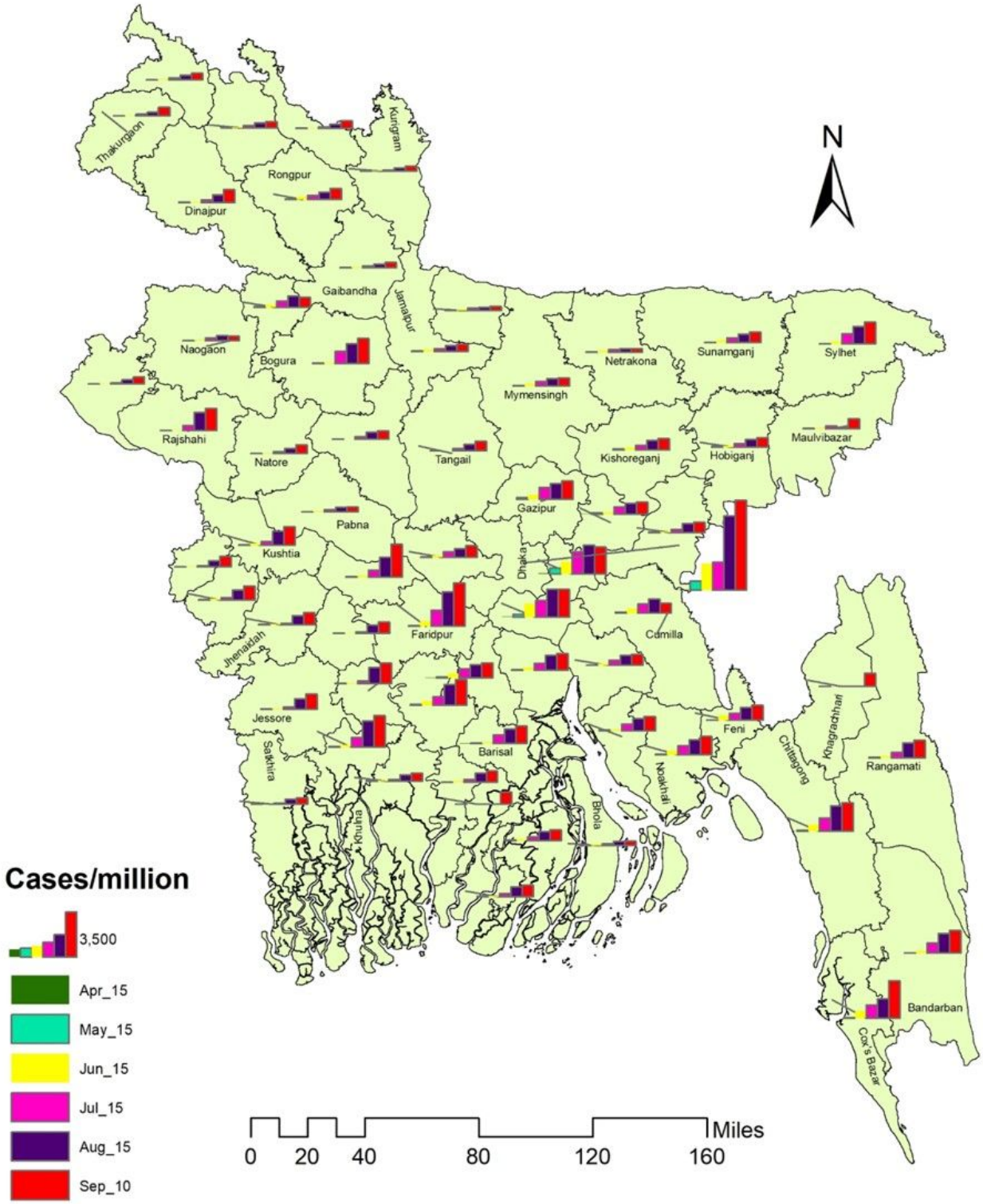

Figure 4

District-wise geospatial distribution of COVID-19 cases per million between April 15, 2020 and September 10, 2020 in Bangladesh.

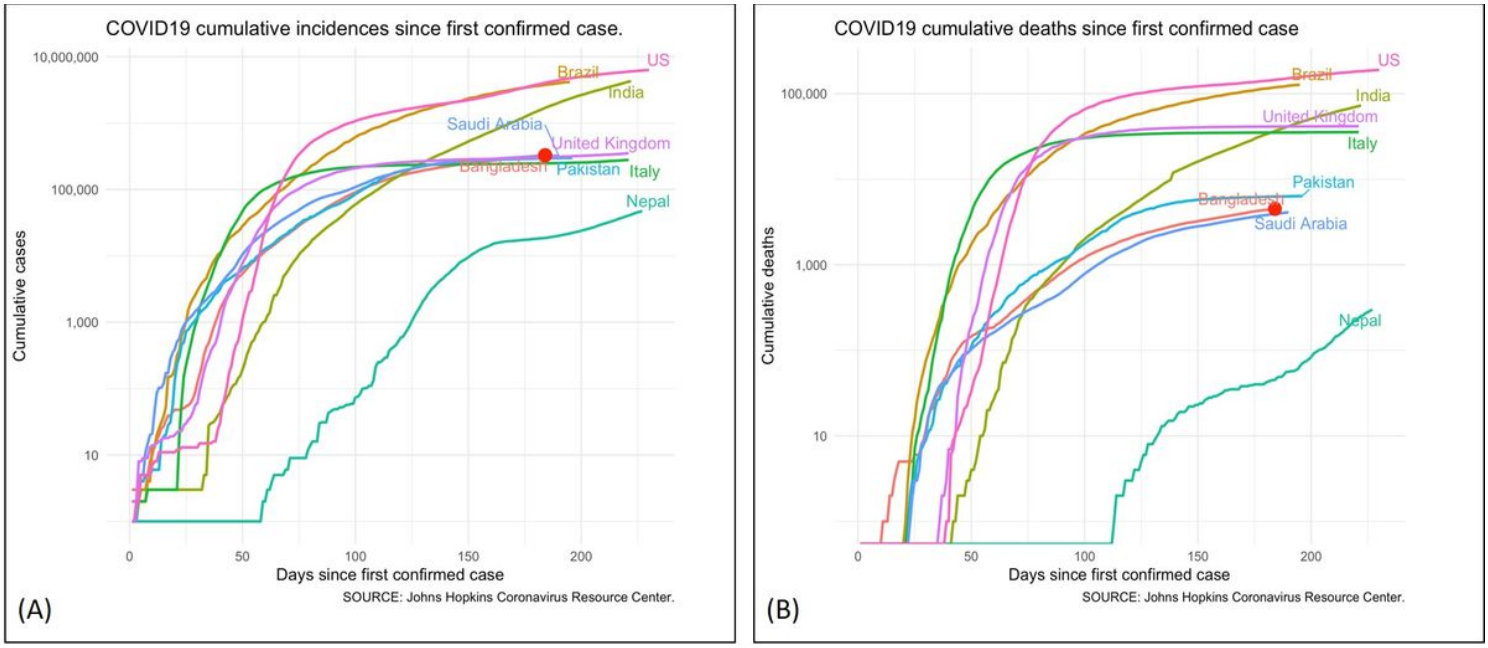

Figure 5

Progression COVID-19 pandemic in South Asia and other countries. A) Trends of COVID-19 cumulative incidences B) Trends of cumulative deaths

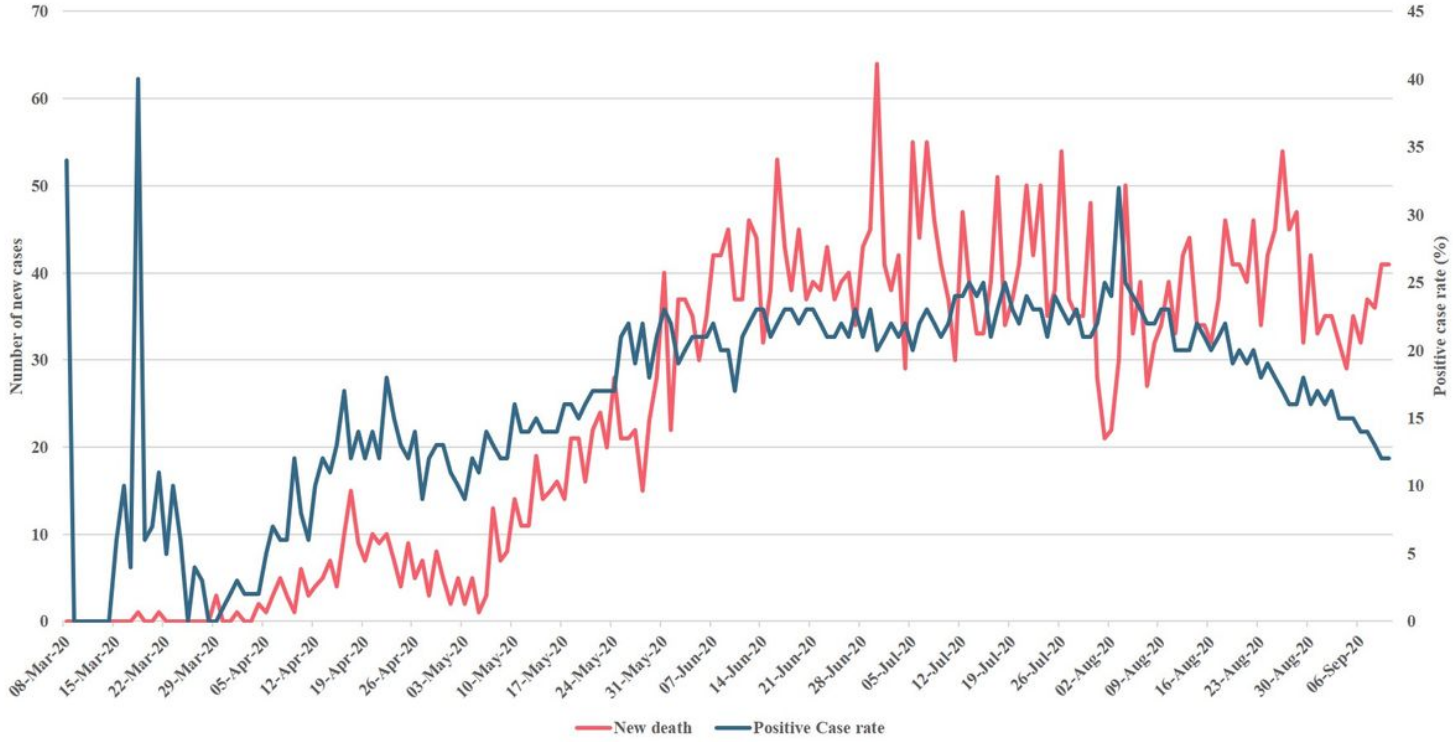

Figure 6

Trends of the number of daily new deaths and the percentage (%) of test positive rate

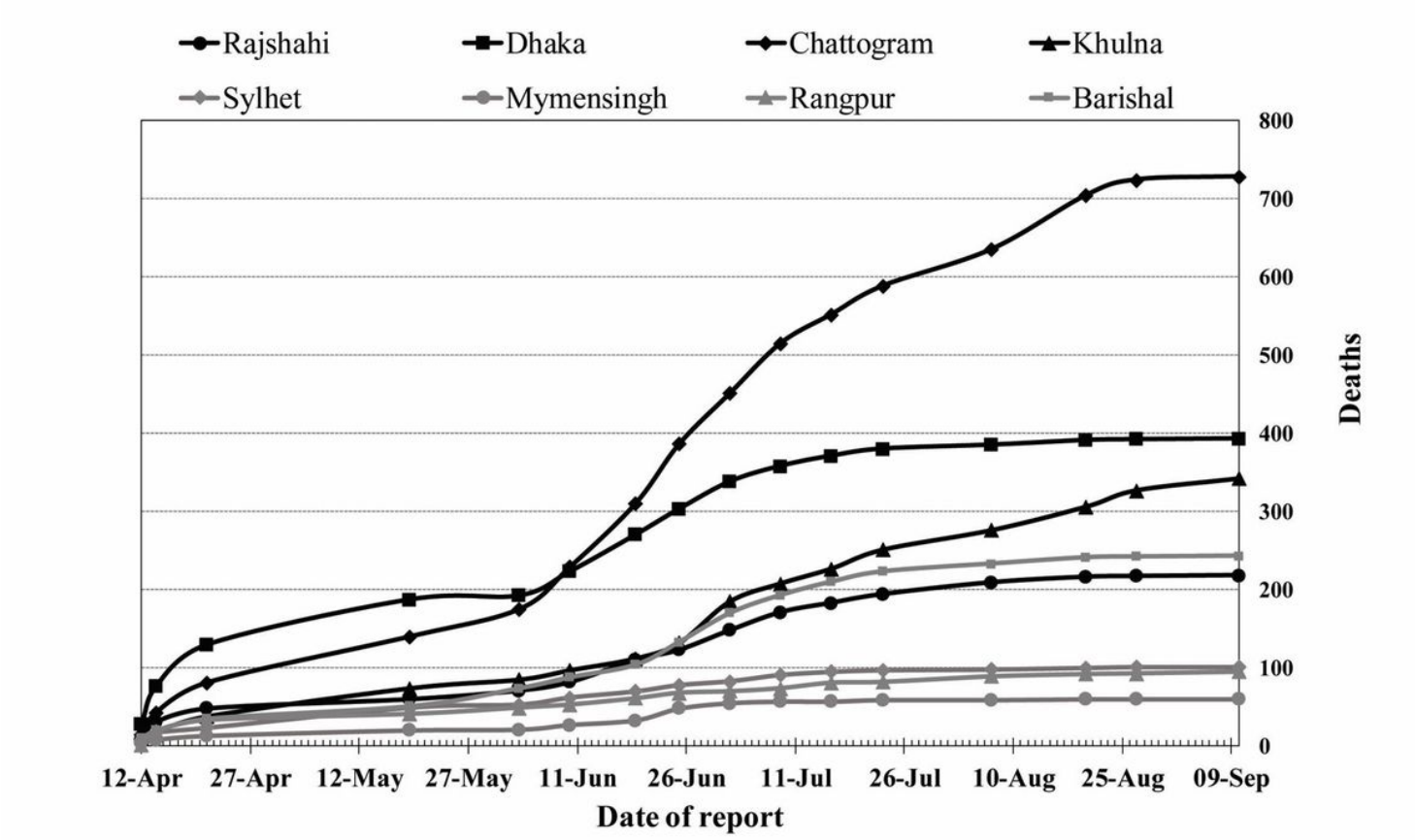

Figure 7

Trends of unofficial deaths with COVID-19 like symptoms in different divisions across Bangladesh

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Suppl.Table1.docx
- SuppFigure2.jpg
- SuppFigure1.jpg