

EPIDEMIOLOGICAL SURVEILLANCE OF COVID-19 OUTBREAK IN BANGLADESH: A PUBLIC HEALTH CONCERN

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Abstract: Bangladesh has been going through the coronavirus Disease 2019 (COVID-19) pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) from March 08, 2020. The aim of this study is to investigate the epidemiological status of Bangladesh till July 31, 2020. **Methods:** The epidemical data of COVID-19 outbreak in Bangladesh was evaluated and compared with the most ten COVID-19 affected countries of the world and six selected South Asian countries. **Results:** The overall SARS-CoV-2 infection rate in Bangladesh was 1398 cases/million people where women were less susceptible to the infection than men. The north-east region of the country is more infected by SARS-CoV-2, while Dhaka is assumed to be the most vulnerable zone in terms of the rate of infection. The COVID-19 progression in Bangladesh was almost at the same speed as the most affected countries of the world. However, the mortality rate of Bangladesh was lower than that of the studied COVID-19 affected countries. **Conclusion:** Bangladesh is the third most affected country in South Asia. It is assumed that the upcoming weeks would also be critical for Bangladesh. This study will significantly contribute in preventing further outbreak of COVID-19 in Bangladesh.

Keywords: Coronavirus disease 2019, Severe acute respiratory syndrome-coronavirus 2, Epidemiology, Public Health.

Introduction

The novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus first broke out in China in December 2019, and caused an infectious disease called coronavirus disease 2019 (COVID-19), becoming a pandemic in less than three months by quickly spreading the virus throughout the world.¹⁻⁸

Bangladesh, a country of South Asia, is one of the world's most densely populated countries, where more than 170 million people⁹ including more than 728,000 refugees from Myanmar (Rohingya) who fled across the border since August 2017,¹⁰ live in an area of 147,570 square kilometers (Km²). It is a matter of public concern that Bangladesh is currently passing through the ongoing COVID-19 pandemic flow as the country reported its first three COVID-19 cases on March 8, 2020, confirmed by the country's epidemiology institute named Institute of Epidemiology, Disease Control and Research (IEDCR). As the country is one of the most densely populated countries in the world, it is highly susceptible to COVID-19 infection by community transmission. Until July 31, 2020, the country registered more than a total of 200 thousand confirmed COVID-19 cases with more than three thousand deaths and 100 thousands recoveries. According to the present data, more than 2 million confirmed COVID-19 cases with more than 29 thousands confirmed deaths were registered.¹¹ As a result, it can be said that the country is now in a stage of public health emergency of COVID-19 outbreak.

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Although different online dashboards are available for providing up to date data, latest stats and information of COVID-19 from around the world. However, no research has yet been conducted about the current epidemiological situation of this populous country. It is high time to compile and aggregate all of the updates of COVID-19 cases of Bangladesh in order to investigate the severity of COVID-19 for adopting more protective measures and controlling future outbreak of the disease in the country.

In this study, the epidemiological stage of COVID-19 in Bangladesh was investigated and then compared with the ten most COVID-19 affected countries in the world and also six selected South Asian countries.

Methods

Collection of data

The epidemic data of Bangladesh was collected from the press release of Institute of Epidemiology, Disease Control and Research (IEDCR) and the situation reports of WHO Bangladesh.¹¹⁻¹² The epidemic data of ten most COVID-19 affected countries in the world, i.e., Brazil, France, India, Italy, Mexico, Russia, Spain, South Africa, UK, and USA were collected from the dashboard of the Center for Systems Science and Engineering (CSSE) of Johns Hopkins University (JHU), USA.¹³ While the epidemic data of six selected South Asian countries, i.e., India, Indonesia, Malaysia, Pakistan, Sri Lanka, and Thailand were collected from the situation reports of WHO.¹⁴

Mapping of Bangladesh for COVID-19 cases

The district wise epidemiological map of Bangladesh for COVID-19 cases was adopted from Wikipedia¹⁵ compiled by DGHS and IEDCR. The number of reported COVID-19 cases in all districts of Bangladesh were manually added.

Analysis of reported COVID-19 data

The reported daily COVID-19 data of Bangladesh, ten most affected countries and six South Asian countries were used for computation and subsequent comparison of different parameters, i.e., total COVID-19 cases, total deaths due to infection, age distribution of COVID-19, growth of cases starting from 100 cases reporting day, case fatality rate (CFR) etc. CFR of Bangladesh and the studied countries was calculated as the ratio of the total number of deaths due to COVID-19 and the total number of people diagnosed with the disease. Furthermore, testing coverage of Bangladesh was also evaluated by calculating the total COVID-19 test conducted for one thousand and one million people while comparing with the studied countries.

Results and Discussion

A. Current epidemiological stage of COVID-19 in Bangladesh

As of July 31, 2020, the worldwide infections due to SARS-CoV-2 surpassed sixteen million, with the death toll more than six hundred thousand and more than ten million people have recovered.¹³

i. Countrywide distributions of COVID-19:

Figure 1a and 1b shows the epidemic status of the COVID-19 around the world. Since the COVID-19 outbreak, the total confirmed cases and deaths in Asia (excluding China) on July 31 was more than 4 million and more than 90 thousand respectively. The SEAR countries have more than 2 million confirmed cases and more than ~45 thousand deaths due to COVID-19.¹² In Bangladesh, the first three known cases¹⁶ and the first death¹⁷ due to COVID-19 were reported on March 8 and March 18 respectively. Since then, the pandemic has spread gradually over the whole nation causing the

increased number of affected people.¹⁶ Figure 1c and 1d shows the epidemic phase of Bangladesh due to COVID-19. The severity of infections caused by SARS-CoV-2 was low until the end of March. However, the number of detected cases has multiplied for the next couple of weeks. With an uptrend from April to the first week of July, the number of COVID-19 cases in Bangladesh kept skyrocketing by raising its total cases (Figure 1c). After 2nd July, the total number of cases decreased very slightly. According to the epidemiology of coronavirus in Bangladesh, it is clear that Bangladesh has been fighting against COVID-19 since the first week of April, 2020, resulting in massive contribution to the alarming upward trend of daily COVID-19 cases (Figure 1c). Since the day when the country's first three coronavirus cases were reported (March 8, 2020), the highest single day record for daily COVID-19 cases (~4000 cases) has been reported on July 2, 2020. The average death rate of the country was 20 since March 8, 2020. However, the trend in the number of deaths fluctuated throughout the epidemic period of the country (Figure 1d). It is to be noted that July 2, 2020 marks the highest single day death toll (> 60) till July 31, 2020.

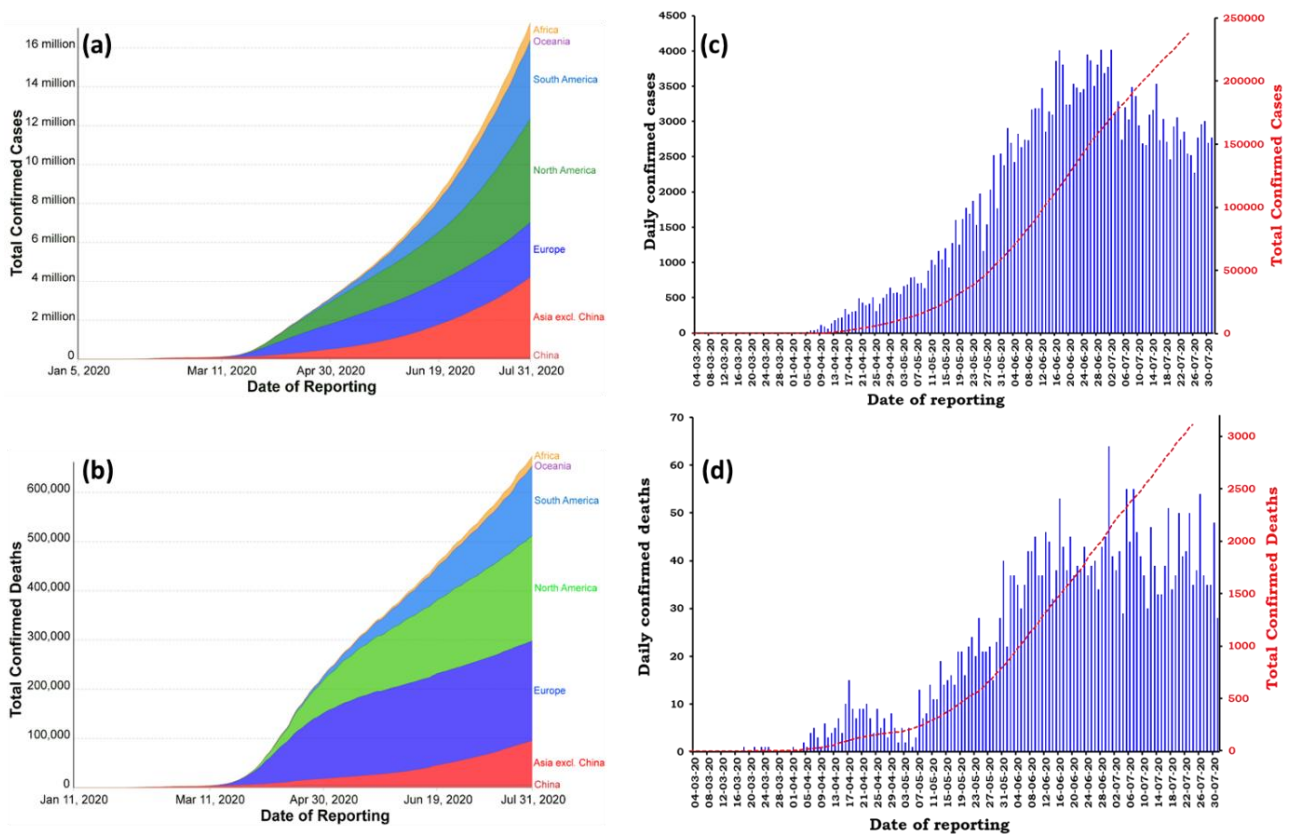


Figure 1. Distribution of confirmed COVID-19 cases and deaths as of July 31, 2020: a) worldwide total confirmed cases by continents; b) worldwide total confirmed deaths by continents; c) daily and total (secondary y-axis) confirmed cases in Bangladesh; d) daily and total (secondary y-axis) confirmed deaths in Bangladesh.

ii. District wise distribution of COVID-19:

Figure 2 (map) illustrates the latest epidemiological distribution of COVID-19 cases of Bangladesh. As observed, most of the districts of the country were affected by COVID-19. The overall COVID-19 infection rate in Bangladesh was 1398 cases/million (237661 cases/170 million). As observed in Figure 2, Dhaka (formerly known as Dacca), the capital of Bangladesh and the sixth most densely populated city in the world with a population of twenty million¹⁸, currently has the largest number of COVID-19 (more than 14 thousand) patients of Bangladesh.¹¹ According to the epidemiological map of Bangladesh for COVID-19 (Figure 2), it is shown that around 52 percent (%) of the total positive COVID-19 cases were from the capital. Dhaka is assumed to be the most vulnerable zone in Bangladesh for SARS-CoV-2 infection. While the districts Narayanganj, Gazipur, Munshiganj,

Comilla, Chattogram and Cox's Bazar are assumed to be six most COVID-19 affected districts after Dhaka. Therefore, the map clearly shows that the north-east region of the country is more infected by SARS-CoV-2.

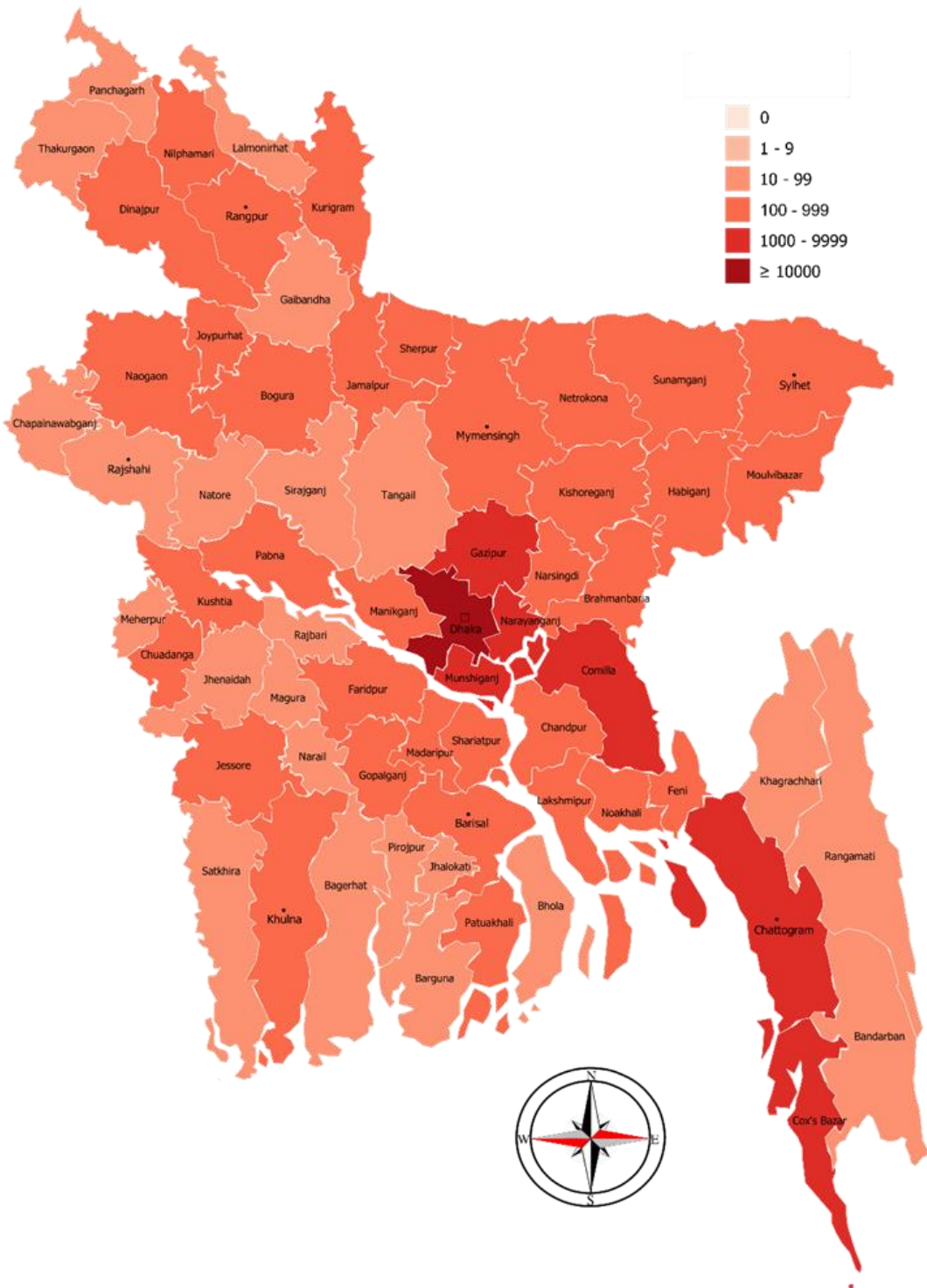


Figure 2. District wise epidemiological map of Bangladesh for COVID-19 confirmed cases (as of July 31, 2020).

iii. Demographic distribution of COVID-19:

According to the gender distribution analysis for COVID-19 infection and death (Figure 3a and 3b), it was found that 71% of confirmed COVID-19 cases and 78% of confirmed COVID-19 deaths were male. Therefore, it is revealed that women in Bangladesh are less susceptible to SARS-CoV-2 infection than men. It was reported that there are some sex-specific differences in susceptibility to SARS-CoV and perhaps other coronavirus infections¹⁹. For example, the protective effect of estrogen receptor signaling in females increases the resistance of women to SARS-CoV infections. In addition, lifestyle patterns of Bangladeshi male with much outside exposure and social engagement can be linked with the higher rates of infection. While the reported age-based analysis of COVID-19 cases and deaths (Figure 3a and 3b) indicates that the highest cases and deaths were noticed for the age group of 21-30 and ~60 years respectively. The second highest cases and deaths were found for the age group of 31-40 and 51-60 years respectively. The demographic distribution of Figure 3a and 3b warns that young and middle aged people are more susceptible to the coronavirus infection in Bangladesh, while people more than 50 years old are at high risk of death.

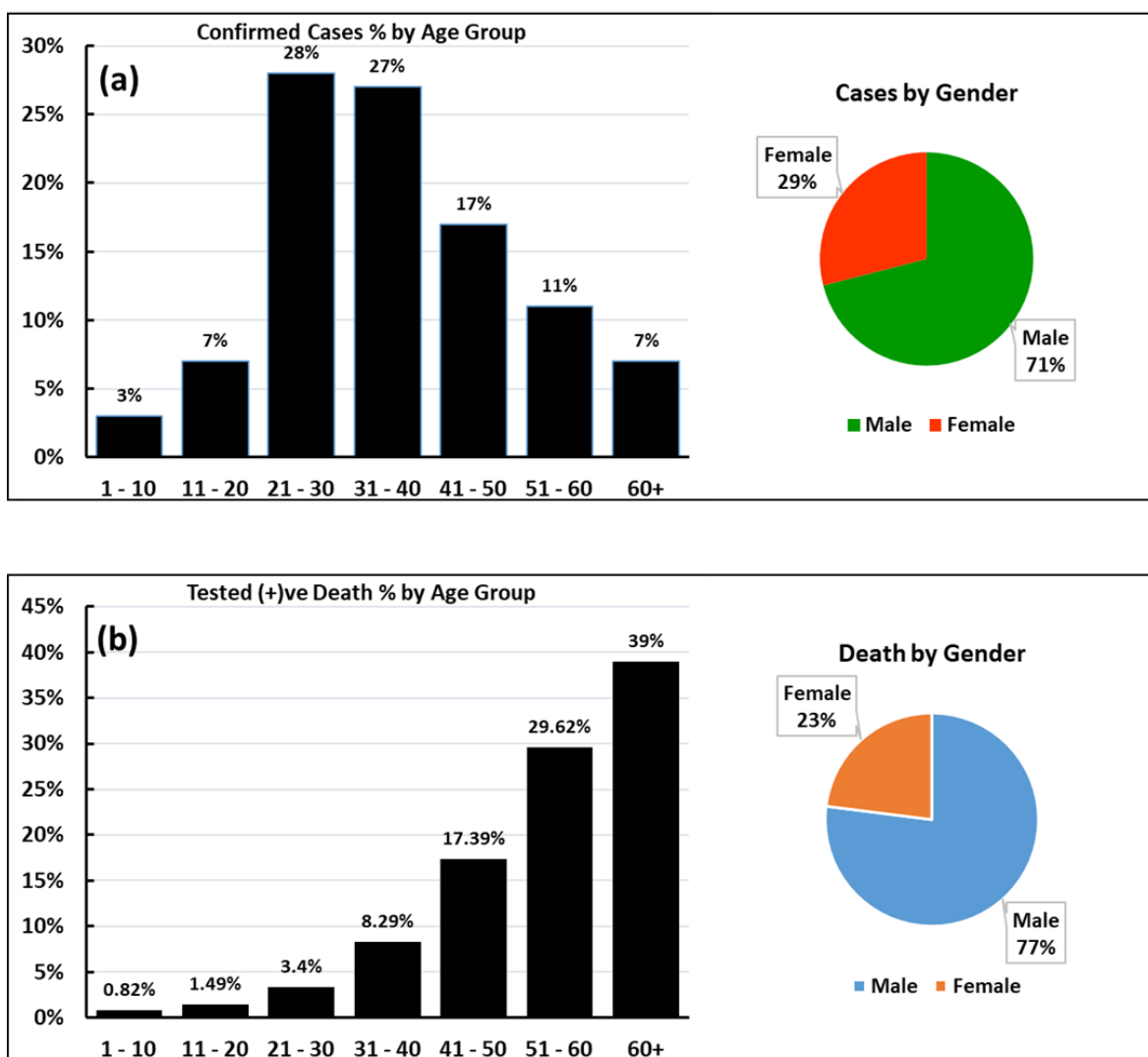


Figure 3. Demographic distribution of COVID-19 cases in Bangladesh for: a) confirmed cases; b) confirmed death.

iv. Comparison the epidemiological situation of Bangladesh with other countries:

Comparison of COVID-19 Figure 4a shows the comparison of speed of COVID-19 cases in Bangladesh with the most affected countries in the world along with selected South Asian countries since the day of 100 cases. It is already known that Bangladesh reached its 100th confirmed COVID-19 cases on April 09, 2020. The slope of Bangladesh for the propagation of COVID-19 cases was steeper since 100 COVID-19 cases and continued till July 31, 2020. Therefore, the severity of the disease in Bangladesh at 112th days since the 100 confirmed cases quickly increased compared with some of the South Asian countries and is in the same speed as of some of the most COVID-19 infected countries.

Figure 4b shows the comparison of case fatality rate (CFR) values of Bangladesh with most affected countries as well as South Asian countries in order to reflect the outcome of the ongoing outbreak. As observed, the CFR has changed over time in Bangladesh as well as most COVID-19 affected countries that have had over 100 confirmed cases. During the outbreak period in Bangladesh, the highest CFR was found on April 09 (10%), which means that ten people have died among 100 people infected by coronavirus. The CFR continued to decrease till July 31 (< 2%). The low severity of the COVID-19 in Bangladesh disease can also be revealed here in terms of death rate of COVID-19 while the country has the lowest CFR among the studied countries. The CFR of Bangladesh decreased over time because of the change in responses and the characteristics of the infected population, such as age, or sex. However, the probability of death of COVID-19 infected people depends on the type of symptoms of the disease itself, the treatment they receive, and the patient's recovering capability from it. Therefore, accurate estimation of the true risk of death is difficult to make.

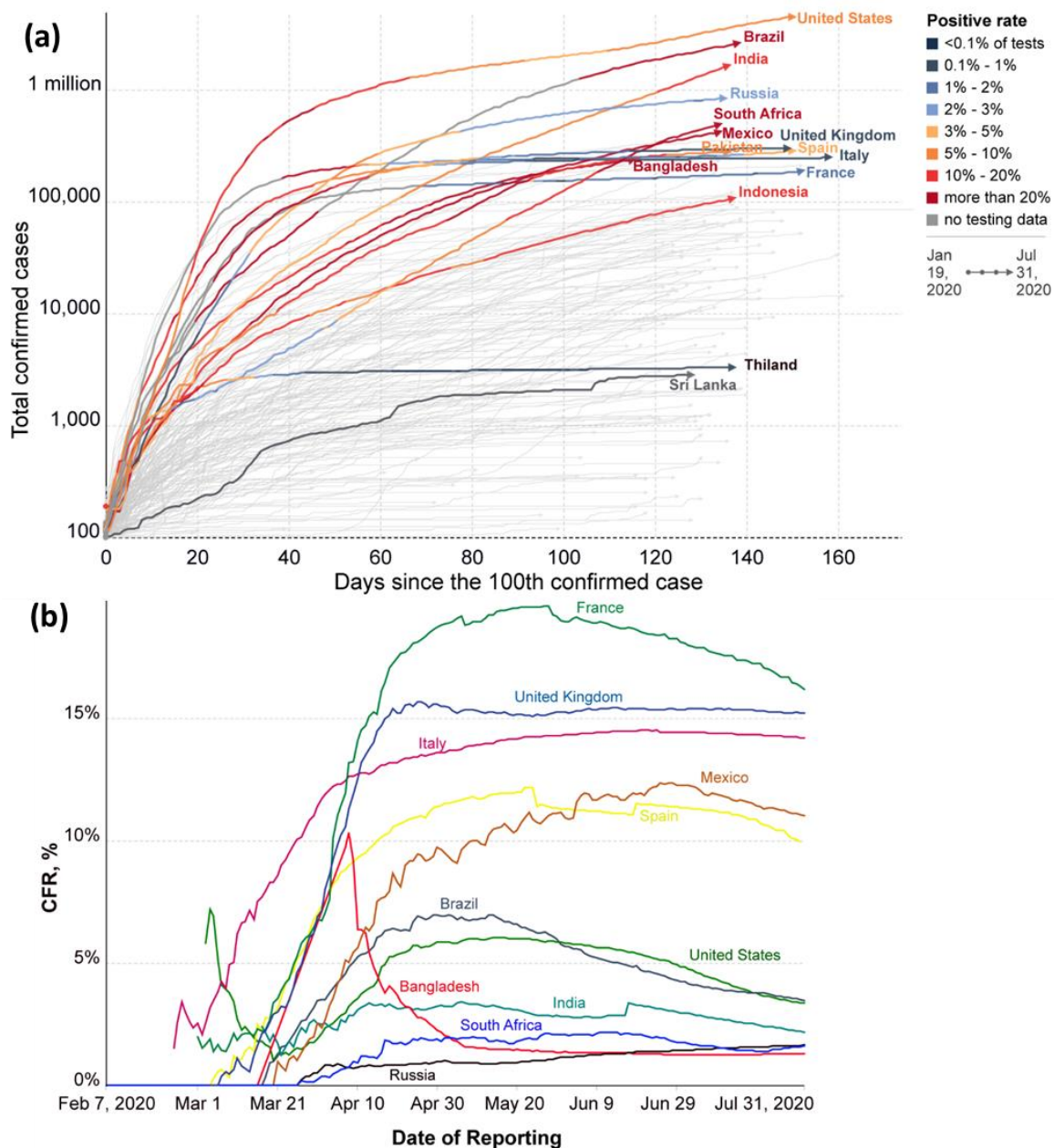


Figure 4. The magnitude of COVID-19 in Bangladesh till July 31, 2020 by comparing the country with the studied countries: a) total confirmed COVID-19 cases versus days since reporting of 100 confirmed cases: b) Case fatality ratio (CFR) of COVID-19.

Table 1 shows a comparison of case/death/test per million people of Bangladesh with the studied countries. The case and death per million people of Bangladesh was lower than the most COVID-19 affected countries of the world. While Bangladesh has the highest case/1M and third most death/1M people among the studied South Asian countries. As of July 31, 2020, the testing ratio of Bangladesh per million was 7,140,^{12, 20-21} which was higher than Indonesia but lower than all other studied countries. The number of cases per million people of Bangladesh was 34.7, which was higher than India, Sri Lanka and Indonesia.

Table-1: Comparison of case/death/test per million people of Bangladesh with ten most COVID-19 affected countries of the world and six selected South Asian countries up to July 31, 2020

Countries	Population (Million)	Total Cases	Case/1M people	Total Deaths	Death /1M people	Total Recovered	Total Tests	Test/1M people
World								
Brazil	212.69	2,666,298	12,536	92,568	435	1,884,051	12,601,096	59,246
France	65.29	187,919	2,878	30,265	464	81,500	2,982,302	45,680
Italy	60.45	247,537	4,095	35,141	581	199,974	6,820,613	112,824
Mexico	129.05	416,179	3,225	46,000	356	272,187	968,536	7,505
Russia	145.94	839,981	5,756	13,963	96	638,410	28,161,461	192,966
South Africa	59.37	493,183	8,307	8,005	135	326,171	2,959,535	49,848
Spain	46.76	335,602	7,178	28,445	608	N/A	6,678,414	142,834
UK	67.92	303,181	4,464	46,119	679	N/A	16,019,907	235,874
US	331.17	4,705,889	14,210	156,775	473	2,327,572	58,493,713	176,627
South Asian Countries								
Bangladesh	164.83	237,661	1,442	3,111	19	135,136	1,176,809	7,140
India	1381.16	1,697,054	1,229	36,551	26	1,095,647	18,832,970	13,636
Indonesia	273.77	108,376	396	5,131	19	65,907	1,506,191	5,502
Malaysia	32.40	8,976	277	125	4	8,644	970,644	29,957
Pakistan	221.24	278,305	1,258	5,951	27	247,177	1,973,237	8,919
Sri Lanka	21.42	2,815	131	11	0.5	2,391	155,540	7,261
Thailand	69.82	3,310	47	58	0.8	3,125	717,814	10,282

Figure 5a illustrates the testing coverage of Bangladesh in comparison with most COVID-19 affected countries per thousand people. As of July 31, 2020, the testing coverage of all of the studied countries except Mexico is higher than Bangladesh, while Russia has the highest number of tests per thousand people. Figure 5b shows comparison of the number of COVID-19 tests per confirmed case for Bangladesh with the studied COVID-19 affected countries. As of July 31, 2020, Bangladesh conducted five tests for each confirmed case, which is higher than that of Mexico. For countries like Russia, UK etc the number of tests is many times higher than the number of confirmed cases. The Table 1 and Figure 5 indicate that the current testing coverage of Bangladesh is still modest compared with the South Asian countries while it is low as compared with the most affected countries in the world. The reasons behind this lower number of tests performed may be reluctance of COVID-19 patients to get tested due to fear of isolation and stigma. As it has already been experienced from other affected countries, e.g., South Korea that the testing ratio of a country can play a key role in the containment of the disease. Therefore, it would be expected that a greater degree of testing provides the actual infection status of Bangladesh with a larger 'sample' of people and thus deal with the quickly spreading SARS-CoV-2 as well as reduce the spread of the pandemic.

From the above discussions, it can be revealed that the coronavirus infection and death rate is incredibly low in Bangladesh as compared to the most COVID-19 affected countries of the world. Although inadequate testing facilities may result in the reduced number of confirmed cases, the overall mortality of the country is actually much less as well which might have resulted from careful monitoring and starting appropriate treatment for severe cases. Besides, one of the possible factors behind the increased chances of Bangladeshi people to fight against the corona virus and their likely stronger immune system may be the exposure to the intense sunlight (great source of melanin and vitamin D); and lifestyle (like eating spicy foods, drinking river water, street foods; constant living of lower-income people in unhygienic health conditions in germs, viruses, and pathogens) as well as having herd immunity.²² However, as Bangladesh is now in the epidemic phase of COVID-19 infections, the country must be ready to tackle this pandemic. As a result, the response of Bangladesh to the current pandemic may direct whether the current trajectory of COVID-19 will sustain, rise, or

flatten in the coming days.

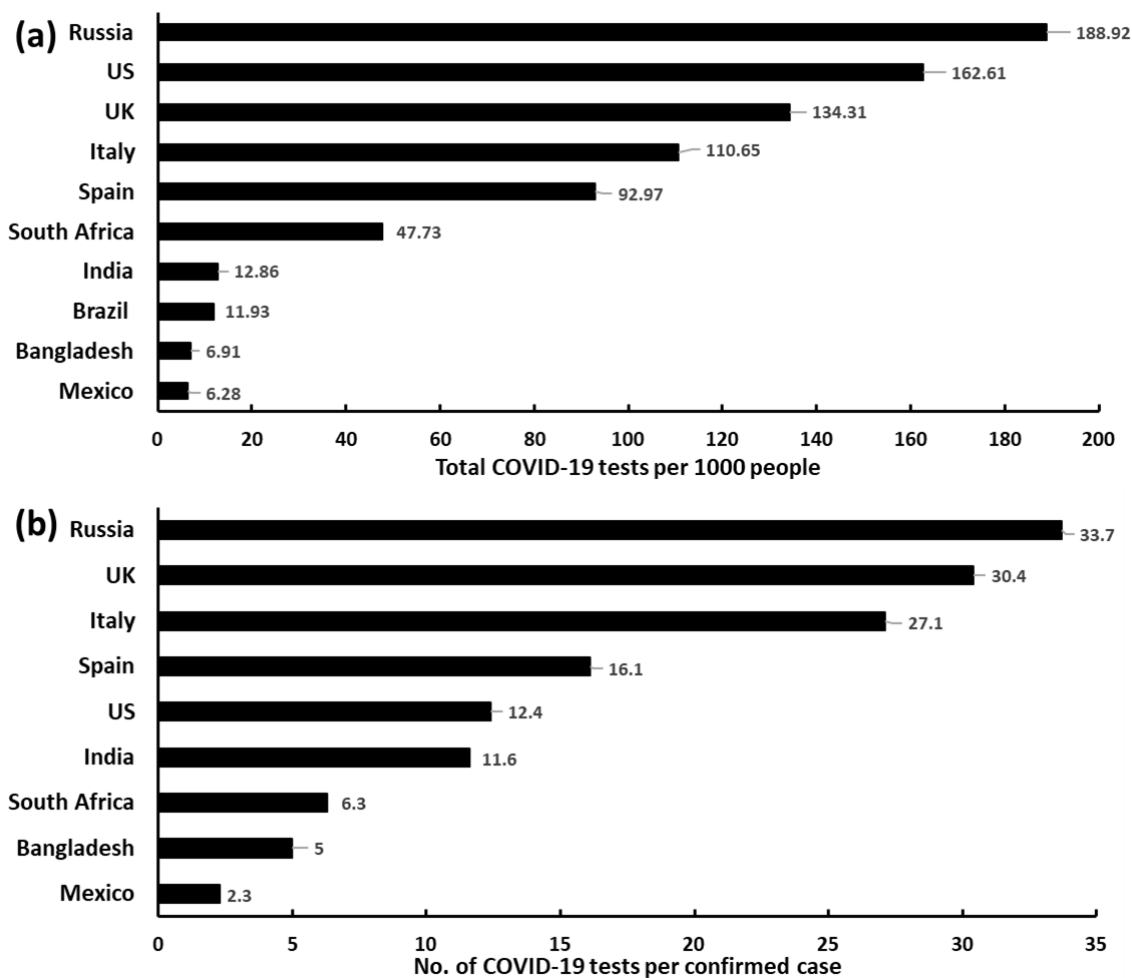


Figure 5. Testing coverage of Bangladesh in comparison with the studied countries as of July 31, 2020: a) Total COVID-19 tests per 1000 people; b) Number of COVID-19 tests per confirmed case.

B. Current and Future perspective of COVID-19 for Bangladesh

i. Need of sero-surveillance survey for the groups of population:

Bangladesh, like all other countries in the globe has been struggling to manage this global crisis. The country has shown capacity to respond, as it has already been confronting climate and other disasters. As observed in the epidemic curve of Bangladesh in the previous section, the country seems to be nowhere near the epicenter of the COVID-19 crisis. The current global pandemic will be a major challenge for this country due to some major factors like high density of population, large number of low-income people, migrant workers returning from COVID-19-affected countries, massive influx of Rohingya refugees from Myanmar²³ etc. In Bangladesh, more than 70% of the country's population live in rural areas.²⁴ Currently, most of the people among ~646,000 in Dhaka city are poor day laborers and rickshaw pullers, who live in over 3,300 slums. A serosurveillance survey should be performed in the slum population in order to check the exposure of the infection as well as the presence of antibodies against the virus, which will be useful in order to understand herd immunity and disease transmission.

ii. Monitoring the environmental qualities:

Another major concerning factor is the extreme level of air pollution in Dhaka city for which Bangladesh has been struggling for a long time.²⁵ As a result, the citizens of Dhaka are more susceptible to numerous respiratory diseases, such as asthma, lung cancer, and cardiovascular, chronic obstructive pulmonary disorders etc.²⁶ It has recently reported that the death rate from COVID-19 in air-polluted areas is higher.²⁷⁻²⁸

iii. Pre-preparation for COVID-19 post-pandemic situation:

The Coronavirus pandemic is devastating the lives of people as well as the economy across the world. Basically, Bangladesh has been graduated to lower-middle-income country status in 2015.²³ Since 2015, sustainable economic growth and achievements of significant development especially on universal primary education, gender parity in basic education, child and maternal mortality, and declining poverty have added to the country's bucket list.²³ However, the lockdown measures to reduce the impact of the COVID-19 outbreak may have a negative impact on the economy of Bangladesh.

According to a recent survey conducted on 5,471 households in urban slums and rural areas earlier in April, 2020, the average income in the slums of Bangladeshi cities and among the rural poor has dropped by more than 80% since the outbreak of COVID-19.^{24, 29} Around 31.5% of the total population of the country living under the poverty line²³ became economically inactive due to a long lockdown time. Although many public and private organizations of Bangladesh have been taking initiatives to help COVID-19 affected families and poor people during this pandemic, which is definitely a symbol of solidarity and humanity. However, it would be very difficult for the country to provide such a huge amount of relief to people if lockdown continues and there is a risk of starvation during post corona pandemic.

Conclusion

In this study, we have discussed the current epidemiological status of the country. According to the epidemiological characteristics of COVID-19 in Bangladesh, the most susceptible area to infection is the capital of the country, Dhaka, which may be due to higher levels of air pollution. The COVID-19 progression of Bangladesh reflects that the country is the third most affected South Asian country where the number of COVID-19 patients are increasing day by day with a similar speed that was observed for the most infected countries in the world. Although the fatality rate was low compared to the most affected countries, the upcoming weeks should still be very critical. The country is trying to control the spreading of the coronavirus tactfully and has imposed non-pharmaceutical interventions by lockdown. Last but not the least, as Bangladesh is more prone to natural disasters and health risks of climate change like some of the South Asian countries, it has already faced a number of natural calamities in the past. After all of these challenges faced during the current pandemic, it is hoped that Bangladesh can cope with the clutches of coronavirus as well as overcome the future challenges of COVID-19. Therefore, there is no reason to be panicked and frustrated and together the people of Bangladesh can beat this pandemic.

Conflict of interest statement

The authors declare that there are no conflicts of interest.

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