EAS Journal of Parasitology and Infectious Diseases
Abbreviated Key Title: EAS J Parasitol Infect Dis
ISSN: 2663-0982 (Print) & ISSN: 2663-6727 (Online)
Published By East African Scholars Publisher, Kenya

OPEN ACCESS

Volume-2 | Issue-4 |July-Aug 2020 | DOI: 10.36349/EASJPID.2020.v02i04.001

Research Article

Epidemiological Information about COVID-19 Outbreak in Bangladesh: A Descriptive Study

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Article History
Received: 30.06.2020
Accepted: 18.07.2020
Published: 30.07.2020

Journal homepage:
https://www.easpublisher.com/easjpid

Quick Response Code

Abstract: COVID-19 caused by SARS-CoV-2, first emerged in Wuhan, China, on December 2019. Subsequently, it has spread rapidly around the globe with severe public health burden. The authentic epidemiological information is important to guide public health decision-making. However, epidemiological and clinical characteristics of COVID-19 patients in Bangladesh have not well documented. In this critical situation, we aimed to accumulate the epidemiological features of COVID-19 outbreak in Bangladesh. All the information of COVID-19 cases in Bangladesh were accumulated from national and international sources as of June 24, 2020. Extracted data were categorized according to potential epidemiologic parameters**.** A total of 1,22,660 confirmed cases and 49,666 recoveries were recorded until 24 June 2020 in Bangladesh. Among the confirmed cases a total of 1,582 deaths have confirmed with overall case fatality rate of 1.30%. In the regional distribution of COVID-19 infection, the highest magnitude of confirmed cases (56.20%) and deaths (77.20%) was observed in Dhaka division. Among the age groups of COVID-19 patients, ≥60 years group (39%) was severely fatal than young patients, whereas young individuals of 20-39 years were highly infected (55%). Regardless of age, a total of 70% cases with 72% fatality in males and 30% cases with 28% deaths were observed in females. A significant number of cases and deaths were also reported in different professionals of COVID-19 front-liners. COVID-19 has spread countrywide rapidly among all age and sex groups. Older with high comorbidities and male COVID-19 patients are at the higher risk of fatality in Bangladesh.

Keywords: COVID-19, SARS-CoV-2, Epidemiology, Fatality, Bangladesh.

INTRODUCTION

Coronaviruses are a diverse group of positive-sense single-stranded RNA virus that cause diseases in mammals, birds and humans with mild to severe respiratory tract infections (Fehr and Perlman 2015). People around the world commonly get infected with human coronaviruses; 229E (alpha), NL63 (alpha), OC43 (beta), and HKU1 (beta) (Zhang *et al*., 2018). Middle East respiratory syndrome coronavirus (MERS-CoV), severe acute respiratory syndrome coronavirus (SARS-CoV) and in very recent SARS-CoV-2 are the example of most severe variety of coronaviruses; people are get infected by these viruses through infected animals (Petrosillo *et al*., 2020; Xie and Chen 2020).

The present global pandemic COVID-19 appears with the emergence of a novel coronavirus; SARS-CoV-2 that has not previously detected in human being. It was first reported in December 2019 in Wuhan, China and identified as the cause of an outbreak of viral pneumonia in January 2020 (Jun *et al*., 2020; Zaim *et al*., 2020). SARS-CoV-2 is mainly transmitted from person to person by direct contact or respiratory droplet of infected people (Acter *et al*., 2020). Subsequently COVID-19 has spread globally showing normal flu like symptoms including fever, dry cough, shortness of breath, loss of smell and taste in some extent severe lung inflammation, multiorgan failure and blood clots have also been observed (Tarek and James 2020; Huipeng *et al*., 2020; Heng *et al*., 2020; T. Wang *et al*., 2020; and Willyard 2020).

Studies have shown people with high number of comorbities are at higher risk for severe illness by COVID-19 (Guan *et al*., 2020; Wang *et al*., 2020). Particularly, no effective drugs or vaccines have been found that can cure COVID-19, while several drugs and vaccines trials are ongoing worldwide (Tobaiqy *et al*., 2020; Chih-Cheng *et al*., 2020).

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COVID-19 data set showed that USA and Mexico in North America, China and Iran in Asia, Italy, Spain, UK, France, Germany, Turkey and Belgium in Europe are the most severely affected countries with high fatality("Mortality Analyses - Johns Hopkins Coronavirus Resource Center," n.d.)(Javed 2020).

Institute of Epidemiology Disease Control and Research (IEDCR), Bangladesh had confirmed first COVID-19 case on March 8th 2020 in Narayangoanj and Madaripur district under Dhaka division of Bangladesh("Bangladesh Confirms Its First Three Cases of Coronavirus - Reuters" n.d.).

To date COVID-19 has created horrible conditions having a severe public health burden globally, and Bangladesh is in a more vulnerable position with poor medical facilities and limited healthcare providers to battle the COVID-19 outbreak. Authentic epidemiological and clinical data may guide for proper public health delivery with a solid decision making. However, epidemiological and clinical features of COVID-19 patients in Bangladesh have not been properly demonstrated.

Therefore, in this study we have reported descriptive and exploratory analysis of epidemiological data of COVID-19 outbreak in Bangladesh, which is important to prevent and mitigate the severity of incidents caused by SARS-CoV-2 infection.

METHODS

Study Design

This was a descriptive and exploratory study of COVID-19 pandemic reported nationwide in Bangladesh that includes,–the first detection of COVID-19 cases on March 8th 2020 and continued until June 24, 2020. To aid our meticulous reporting for this observational study we have used the STROBE Guidelines (www.equatornetwork.org). Although individual informed consent was not required for this study, we have categorized our data into several epidemiologic parameters-(tests, cases, death or recovery), geofinding, age and sex.

Data Sources

The data were collected from several national and international sources to conduct the study. Data of COVID-19 patients were collected from the government's official source, Institute of Epidemiology Disease Control and Researches (IEDCR), Bangladesh (https://www.iedcr.gov.bd). COVID-19 suspected individuals were identified by WHO recommended guidelines and further confirmed with RT-PCR analysis. The prevalence data of COVID-19 was also taken from the WHO official website (https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/), and from the database of Worldometers (https://www.worldometers.info/coronavirus/worldwide-graphs/), regarding COVID-19 pandemic in Bangladesh. Furthermore, the data pertaining from international organization has been cross checked with the Bangladesh government's source.

Statistical Analysis

The statistical analysis of data set in the study was performed with RStudio 4.0.0, GraphPad Prism 8 and Microsoft Excel 2010 by an R programmer. The epidemiological data was further categorized into different groups and analyzed with different methods as to our demands. The epidemiological profile as trajectory charts was constructed by plotting the number of each parameter on Y-axis versus date on X-axis. Linear regression analysis was performed on the confirmed cases and deaths of each day over the study period of March to June 24, 2020. Age and sex distribution graphs were constructed using patients age and sex group at baseline with percentage value of confirmed cases and death at vertical line.

RESULTS

Epidemiological Profile of COVID-19 Infection in Bangladesh

Bangladesh reported its first confirmed COVID-19 case on 8 March 2020 and death on March 18, 2020. To understand the epidemiological profile, we first analyzed the incidence and spread of COVID-19 infection among the people in Bangladesh. As of June 24, 2020, Bangladesh has reported 1,22,660 confirmed cases of SARS-CoV-2 infection and a total of 6,63,444 tests have been conducted (Fig 1A). Among the confirmed COVID-19 cases, 49,666 (40.49%) patients have recovered and there have been 1,582 deaths (Fig 1A). These data sets of COVID-19 indicated that cumulative number of cases deaths and recoveries were associated with cumulative number of test, as well as cumulative deaths were associated with cumulative number of confirmed cases through the study period (Fig 1A and 1C)**.** We summarized the growth factor (GF) of COVID-19 confirmed cases in figure 1B, which expressed the transmission of the diseases among the population each day compare to the previous day. A GF **above 1 indicates an increase of incidence**, whereas **between 0 and 1 is a sign of declined incidence("Coronavirus Cases: Statistics and Charts - Worldometer" n.d.)**. GF data (Fig 1B) depicted that during early and end of the March it was between 0 and 1, expressed new confirmed cases of the day were lower than the previous day; even no cases were found and rest of study period it was constantly above 1 indicated increased incidence of SARS-CoV-2 transmission among the people with time.

In this study we performed linear regression analysis to investigate the relationship between new deaths and new confirmed cases of COVID-19 over the study period of March to June 24, 2020. Though, no significant correlation was observed in March, interestingly significant correlations with *p*-value 0.003,

0.0001 and 0.005 were observed in April, May and June respectively (Fig 1C). These data suggested that new number of deaths and cases were positively associated during the study period of COVID-19 outbreak in Bangladesh.

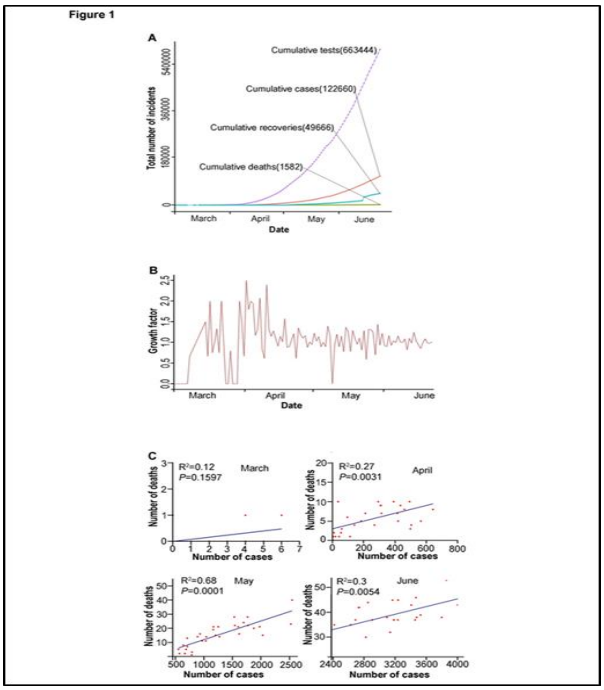

Figure 1

(A) Epidemiological profile curve of COVID-19 outbreak in Bangladesh. Trajectory charts show the comparison and change in tests, confirmed cases, deaths and recoveries over the study time. Each line represents the value of cumulative tests, confirmed cases, deaths and recoveries in per thousands. **(B)** Growth Factor of COVID-19 cases in Bangladesh. **GF above 1 indicates an increase; between 0 and 1 is a sign of decline;** constantly above 1 could signal exponential growth of infection. **(C)** Correlation between deaths and confirmed cases of ongoing COVID-19 pandemic in Bangladesh caused by SARS-COV-2, it represents the proportion of new deaths and cases of each single day over the study period March, April, May and June 11, 2020. The data depicted in this figure showed *p*-value = 0.1597 at March, *p*-value = 0.003 at April, *p*-value = 0.0003 at May and *p*-value = 0.005 at June 11, 2020.

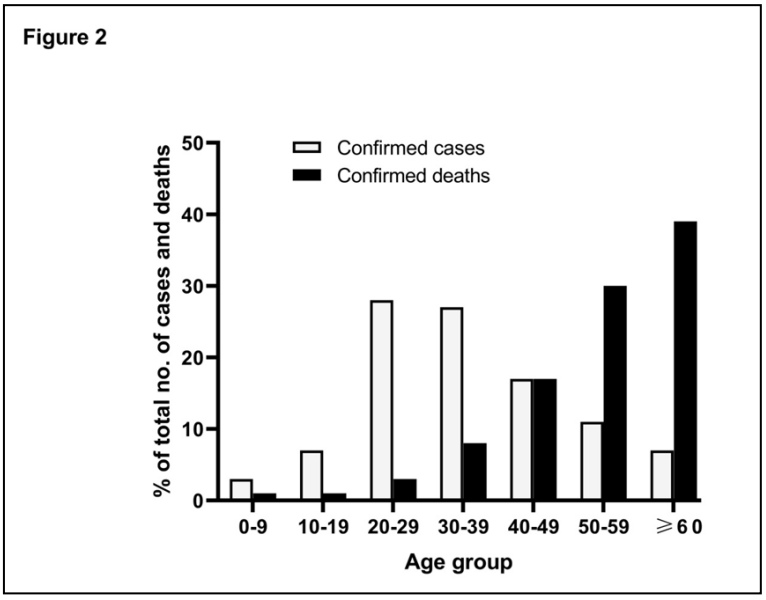

Figure 2

Age distribution of confirmed cases and deaths by COVI-19 reported in Bangladesh until June 11, 2020. Vertical bars are showed percentage of cases and deaths count in each age group, where black bars denoted percentage of deaths and white bars denoted percentage of cases.

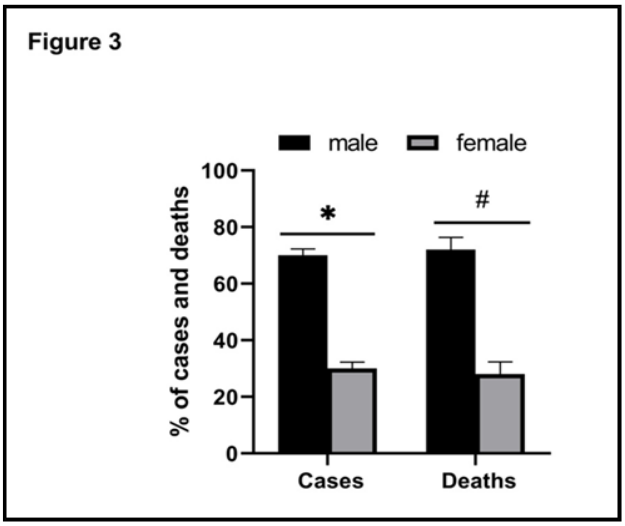

Figure 3

Comparison of both COVID-19 cases and deaths between male and female patients in Bangladesh. Bar graph showing the parentages values of each groups, where black bars denoted males and gray bars denoted females. Data are expressed as the mean ± SD. $^{*}P < 0.001$ versus female confirmed cases and $^{\#}P < 0.001$ versus female confirmed deaths (unpaired t-test).

Table 1. Regional distribution of COVID-19 pandemic in Bangladesh (June 24, 2020)

Division	District (n)	N (%)	ND (CFR, %)	Division	District (n)	N (%)	ND (CFR, %)
Capital City	Dhaka City(39000)	39000 31.8%	744 (1.90%)	**Sylhet**	Moulovi Bazar (422)	5209 (4.2%)	43 (0.83%)
	Dhaka (4506)				Sunamganj (1254)		
	Gazipur (4797)				Hobiganj (539)		
	Kishoreganj (1724)				Sylhet (5209)		
	Madaripur (968)			**Khulna**	Khulna (1919)	4423 (3.60%)	36 (0.81%)
	Manikganj (796)				Jessore (603)		
Dhaka	Narayanganj(7268)	29949 (24.4%)	477 (1.59%)		Bagerhat (188)		
	Munshigonj (2954)				Narail (169)		
	Narshingd(1999)				Magura (131)		
	Rajbari (387)				Meherpur (75)		
	Faridpur (2354)				Satkhira (172)		
	Tangail (710)				Jhenaidah (236)		
	Shariatpur (657)				Kushtia (629)		
	Gopalganj (829)				Chuadanga (301)		
	Chattogram(10313)			**Mymensingh**	Mymensingh (2227)	4013 (3.3%)	61 (1.52%)
	Cox’s bazar (3258)				Jamalpur (801)		
	Cumilla (4572)				Netrokona (638)		
Chattogram	B. Baria (974)	26690 (21.8%)	113 (0.42%)		Sherpur (347)		
	Khagrachari (255)			**Barishal**	Barguna (267)	3504 (2.9%)	27 (0.77%)
	Laksmipur (1079)				Bhola(299)		
	Bandarban (255)				Barishal (2029)		

Rangpur	Rangmati (1079) Noakhali (2879) Feni (1039) Chandpur (987) Rangpur (1246) Gaibandha (336) Nilphamari(474) Lalmonirhat (121) Kurigram (191) Dinajpur (807) Panchagar (201) Thakurgaon (286)	3662 (2.9%)	18 (0.50%)	**Rajshahi**	Potuakhali (398) Pirojpur (247) Jhalokathi (264) Rajshahi(364) Joypurhat(406) Pabna (535) Bogra (3708) Natore(236) Naogaon (380) Sirajganj (446) Chapainawabganj (140)	6215 (5.1%)	61 (0.99%)

n=Number of infection in district, N= Total number of infection in division, ND= Total number of death in division, CFR, % = Percentage value of case fatality rate in division. CFR was calculated as number of deaths per 100 confirmed cases.

Table 2. Occupational distribution of COVID-19 cases and deaths in Bangladesh (June 24, 2020)

Occupation	No. of infected	No. of death	CFR (%)
BD police	8848	31	0.35
Doctor	3164	59	1.86
Nurse	1233	5	0.40
BD Army	4253	15	0.35
BD Ansar Bahini	305	1	0.32
Firefighters	176	-	-
Garment workers	327	52	15.90
Bankers	80	6	7.50
Journalists	127	7	5.51

CFR (%) = Percentage value of case fatality rate.
CFR was calculated as number of deaths per 100 confirmed cases

Regional and Occupational Distribution of COVID-19 Cases and Deaths in Bangladesh

On March 8, 2020, Institute of Epidemiology Disease Control and Research (IEDCR), Bangladesh had confirmed the first case of COVID-19 infections from Narayangoanj and Madaripur in Dhaka division. Later on, it has spread over the country, thereby- table 1 showed the regional distribution of COVID-19 from March to 24 June time period. The highest magnitude of COVID-19 cases (68,949, 56.20%) and deaths (1,221, 77.18%) has been detected in Dhaka division among all the eight division in Bangladesh. More importantly, a total of 31.80% (39,000) cases and 47.02% (744) deaths were reported only in Dhaka city until June 24, 2020 **(**Table. 1). However, 21.8%, 2.9%, 4.20%, 3.60%, 3.30%, 2.90% and 5.10% cases with 0.42%, 0.50%, 0.83%, 0.81%, 1.52%, 0.77% and 0.99% fatality rate were recorded in Chattogram, Rangpur, Sylhet, Khulna, Mymensingh, Barishal and Rajshahi division respectively. These evidences indicated that highly populated places are more tended to rapid spread of COVID-19.

We summarized the occupational distribution of COVID-19 cases in Table 2; Our data has shown that Bangladesh Police forces were mostly COVID-19 affected professionals with 8,848 cases and 31 deaths, 2nd highest was observed in Bangladesh Army, 4253 cases and 15 deaths. Furthermore, 3,164 physicians and 1233 nurses were found affected with 59 and 5 deaths respectively, who were directly involved for the management and treatment of COVID-19 patients. A significant number of COVID-19 incidents have also been observed in journalists, bankers and garment workers with high fatality as 5.51%, 7.50% and 15.90% respectively.

Age and Sex Susceptibility of Covid-19 Cases and Deaths in Bangladesh

Individual's age is one of the important risk factor, which is associated with an increased threat of viral infection (Yang *et al*., 2020). Some studies on SARS-CoV-2 outbreaks have been revealed the risk of different age groups in COVID-19 incidents over the world (Jian-Min *et al*., 2020). In Bangladesh, first three COVID-19 cases were detected in 20-35 years age group on March 8, 2020 then it has spread among almost all age groups. Our data showed that a total number of 1,22,660 cases and 1,582 deaths, the highest number of deaths 617 (39%) were observed in ≥ 60 age

group, whereas the 2nd highest number, 475 (30%) were found in 50-59 years age group and 269 (17%) deaths were recorded in 40-49 years age group with 8,586 (7%), 13,493 (11%) and 20,852 (17%) cases respectively, until June 24, 2020 (Fig 2). The lowest number of cases (3,680, 3%) and deaths (16, 1%) were found in 0-9 years age group, and the highest number of cases 34,345 (28%) were in 20-29 years age group with 47 (3%) deaths, the 2nd highest cases, 33,118 (27%) were observed in 30-39 years age group with 127 (8%) deaths.

Several research data have demonstrated that males and females are equally vulnerable to SARS-CoV-2 infection globally, but men have a higher risk of severe illness and death(Wenham, Smith, and Morgan 2020). The data set of our study indicated that regardless of age 70% (85,862) of total COVID-19 cases were males and 30% (36,798) were females. However among the total number of deaths 72% (1,139) were males and 28% (443) were females until June 24, 2020 (Fig 3).

DISCUSSION

The COVID-19 outbreak that caused by SARS-COV-2 has run the whole world through a severe public health crisis (Arshad Ali *et al*., 2020). It has imposed the world to adopt measures such as flight bans both domestic and international routes, mandate or harder lockdowns or curfew and social distancing to prevent the COVID-19 infection among the community("Updated WHO Recommendations for International Traffic in Relation to COVID-19 Outbreak" n.d.).

Initial data set of COVID-19 incidents for March 2020 in Bangladesh; a total of 1602 tests were performed with the standard and approved RT-PCR method and total 49 cases were detected COVID-19 positive with 5 deaths, which was relatively poor number compared to other infected countries in parallel("Coronavirus Disease 2019 (COVID-19): Situation Report - 71 (31 March 2020) - World | ReliefWeb" n.d.). This was might be due to inadequate facilities or limited skilled personnel over the country. In the COVID-19 data set of March - June 24, 2020, we observed that cumulative numbers of deaths were associated with cumulative number of cases. Growth factor of COVID-19 has also showed the positive correlation with increased number of cases through the study time period (Fig 1A and 1B).

Approximately a total of 9.52 million COVID-19 cases and 0.49 million deaths (5.15%) have been reported globally till on 24 June, 2020. In our study we showed that Bangladesh has reported 1,22,666 cases and 1,582 deaths (1.30%) with 49,666 (40.49%) recoveries. The overall mortality rate (1.30%) by COVID-19 in Bangladesh was almost 4 times lower than the overall mortality rate (5.26%) by COVID-19 worldwide.

Most of the COVID-19 hardest countries in Europe have had the case fatality rate within 2-11% on 31st March 2020; as their first case was detected in March(Javed 2020). Moreover, 9.06% mortality was observed in Bangladesh at the same time, although the number of tests (1602) and cases (51) were relatively lower. Importantly, accumulating data has supported that it is reduced with increased number of test and times (2.19% in April, 1.38% in May and 1.30% in June 24, 2020). However, the growth factor value and the significant positive association between deaths and confirmed cases over the study period indicated that COVID-19 race may continue for long time in Bangladesh (Fig 1C).

First COVID-19 patient of Bangladesh was identified in Dhaka city (capital city); the main communication route of Bangladesh and one of the most densely populated city in the world. Approximately one-third of the total cases (31.80%) and 47.02% deaths have been reported only in Dhaka city. Moreover, Dhaka (56.20%) and Chattogram (21.80%) divisions were highly affected as these are densely populated and commercially important regions in Bangladesh.

Health workers, security forces, armed forces and others professionals, as they are committed to serve the nation during this pandemic having a higher risk for SARS-COV-2 infection. Occupational data set of this study have clearly indicated that direct or closed contact with the infected person and civil contact must be responsible for the rapid spread of COVID-19 infection among the people. Therefore, a significant number of incidents have been observed in different professionals during this COVID-19 pandemic in Bangladesh (Table 2)

The age-relation pattern of SARS-COV-2 infection is mostly similar globally, while older patients (≥60 years) with high number of comorbidities are associated with higher mortality rate and young aged (20-39 years) were tended to more infected group (BULUT and KATO 2020). It may due to the fact that young aged are more active, having stronger immunity and release of more sex hormones which stimulate the expression of ACE-2 receptor; may influenced the potency of SARS-COV-2 infection (Ling *et al*., 2020). In this study, we showed that above 50 years of patients having 6.27 times (69%) higher fatality than patients of 20-39 years (11%) aged groups, on the other hand 2.2 (69%) times higher than the overall aged groups (31%) (Fig 2). It has it's evidence that clinical complications including cancer, diabetes, asthma, acute respiratory distress and kidney or liver dysfunctions are more likely occurred in the aged people (≥ 50 years) in Bangladesh which make them more susceptible to COVID-19

infection("Bangladesh Reports First Coronavirus Death -Officials" 2020).

In the case series of COVID-19 infection, it has been reported that males and females had the same susceptibility but males tend to have higher mortality than females globally (Jin *et al*., 2020), where the underlying reasons are not clearly understood. However, a few studies have suggested females having two X chromosomes are associated with large number of immune-related genes; boost up the immunity to protect and fight against SARS-COV-2 (Conti and Younes 2020). In this study, we have shown that a total of COVID-19 cases males (70%) were 2.33 times greater than females (30%). Importantly, the mortality rate of males (72%) was about 2.57 times higher than females (28%) by COVID-19 in Bangladesh. Accumulating evidence has indicated that males are highly susceptible to SARS-COV-2 than females with higher fatality in Bangladesh (Fig 3). The less COVID-19 infectivity for females in Bangladesh may results from their less frequent in public places or having strong immunity, though the relationship of COVID-19 infection with these parameters is not yet determined.

CONCLUSION

In conclusion, the fatality rate and the degree of severity are lower in Bangladesh than that of the hardest hit COVID-19 countries. However, considering the cumulative data set with time period (March–June 24, 2020), the scenario of Bangladesh is getting worse day by day, while others were getting improved. Additionally, males are more susceptible to COVID-19 infection than females in context with morbidity and mortality in Bangladesh, although males and females have similar susceptibility to COVID-19 globally. Finally, it can be estimated that COVID-19 incidents more likely to be increased and may continue for long time in Bangladesh.

Acknowledgments

The authors like to thanks Dr. Zahidul Islam, and Adib Afzal for their technical and administrative assistance.

Competing Interest

None declared

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