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Case Study

Epidemiological Characteristics of COVID-19 in Bangladesh: A Cross Sectional Study

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ABSTRACT

A total of 922K cases of COVID-19 have been confirmed in Bangladesh up to the 11th of July 2021. The study aims to investigate the epidemiological characteristics of COVID-19 patients in Bangladesh. We conducted a cross sectional study on patients with COVID-19 in the Shaheed Suhrawardy Medical College Hospital in the capital city Dhaka. Data of the patients who were recovered from COVID-19 up to the 26th of June 2021 were recorded *via* COVID-19 report form. A total of 12095 patients were included in this study. The median age was 55 years. About 1330 (11%) needed to be hospitalized, among them 242 (2%) needed to go to ICU and 731 (55%) needed to stay in hospital for less than 7 days. Around 4717 (39%) experienced further health problems after recovery from COVID-19. Such faced problems were psychological (3018, 64%), musculoskeletal pain (330, 7%), numbness (283, 6%), physical frailty (377, 8%), functional immobility (235, 5%), leg swelling (188, 4%), Parkinson's and Alzheimer's disease (429, 9.1%). About 5442 (45%) had more than one sign and symptom. Those ages more than 60 year, urban residence people, male gender, and having cardiovascular disease were critical condition (483, 4%) of COVID-19 from others. Implementing wearing face masks and observing social distancing would help in protecting against infection with COVID-19.

Keywords: Bangladesh; COVID-19; Epidemiology; Public health

Abbreviations: ICU: Intensive Care Unit; RT-PCT: Reverse Transcription Polymerase Chain Reaction; WHO: World Health Organization.

INTRODUCTION

On January 30, 2020, the WHO declared that the novel coronavirus (COVID-19) is the 6th public health emergency of an international proportion. COVID-19 was officially declared as a pandemic by WHO on 11 March 2020. The novel coronavirus 2019, known as Severe Acute Respiratory Syndrome Coronavirus-2 and is currently transmitted to the world pandemic. On April 11, 2020, the incidence of COVID-19 was confirmed in 210 countries and territories [1]. On the 8th of March 2020, Bangladesh confirmed a cluster of COVID-19 in Tolarbag, Dhaka - when a man and two of his family members came from Italy. To date, the scientific community had described the clinical course of COVID-19, counted the cases, and the virus spread in the world, and is trying to develop an effective available vaccine. However, COVID-19 has a very high infection rate and relatively high mortality rate. COVID-19 has a mortality rate of about 1.6% in Bangladesh, much lower than the other two coronavirus epidemics of the 21st century [2]. The source of the infection is probably from zoonotic or environmental contact. Human-to-human transmission is responsible for most of the infections in Bangladesh.

Some pharmaceutical companies have recently announced the development of a vaccine for COVID-19, with a high efficacy level [3]. However, such is at the initial stage and will require a long time for its mass production, storage, and distribution until it becomes widely available. In the absence of an available vaccine, strict measures to prevent the spread of COVID-19 must be observed. All Viruses can be mutated. Some mutation in the variation can be raising international alarms by rapidly spreading. Recently a new variant of coronavirus found many

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countries with more transmissible than previous version. Some variant can be harmful, some are not. But there is strong evidence about severity of these new variants. Bangladesh neighbor country Indian variant has strong evidence about COVID-19 severity. Recently Bangladesh health ministry announced a Bangladeshi COVID-19 patient who came from India and died with Indian variant [4]. Scientists' communities are hopeful that COVID-19 vaccine will be also effective for this variant. Only human behavior (maintain social distance, use mask etc) can prevent spread of this new variant of SARS-CoV-2 and this mutation should be monitoring carefully. Otherwise it will create longer duration for this pandemic. Learning about the epidemiological characteristics of this disease would aid in devising appropriate strategies to limit the rate of infection. In this study, we report the initial epidemiological features of 12095 patients with confirmed COVID-19 infection who recovered, and the investigation of coronavirus epidemiology is discussed [5].

CASE PRESENTATION

The interview administrators conducted a cross-sectional interview study purposively selected Shaheed Suhrawardy medical college hospital in the capital city Dhaka to collect data from the patients who were recovered from COVID-19 up to the 16th of June 2021 [6].

Study subjects

COVID-19 diagnoses were made on the basis of oropharyngeal and nasopharyngeal swab samples by RT-PCR in Bangladesh. Up to 26th May, 2021, 217852 COVID-19 patients discharged from hospital. We conducted a cross-sectional, hospital-based study on patients with COVID-19. Data of patients who recovered from COVID-19 up to June 26th, 2021 were recorded *via* the COVID-19 Test Form. We evaluated the epidemiological characteristics of the positive-tested patients [7]. At first, we collected information from "COVID- 19 Report Form" of the molecular laboratory, Department of Microbiology, Shaheed Suhrawardy Medical College.

Patient information-accuracy, completeness of information, and inclusion criteria

Bangladeshi citizens (infected by coronavirus and diagnosed on the basis of oropharyngeal and nasopharyngeal swab samples by RT-PCR) who were infected by COVID-19 were eligible participants in this study [8]. In the official COVID-19 report form, all positive and negative patients were included. We conducted this cross-sectional study on positive patients only [9-11].

Statistical analysis

Data analysis was performed using Microsoft Excel 2019 and IBM SPSS Statistics version 25.0. Microsoft Excel was used for editing, sorting, and coding. Next, the excel file was imported into SPSS software. Descriptive statistics (frequencies, percentages) were executed using SPSS software [12-14]. The main result of the study was to assess the epidemiological prevalence of COVID-19 positive patients in Bangladesh and assessing the risk level of these variables [15-17]. Regressions were used to find univariate and multivariate associations in the results. The association of variables was considered statistically significant if the p-value was less than to 0.05.

RESULTS

A total of 12095 COVID-19 patients were included in this study [18-20]. The most significant variables of COVID-19 infection were age of 50 to 60 and age more than 60, urban residence, government staffs, hypertension and diabetes patients, smokers, patients who needed go to hospital, patients who facing problem after recovery from COVID-19 infection, patients who needed go to ICU and O blood group patients. These variables remain significant after adjusting all other variables except O blood group patients. The median age was 55 years (25th to 75th percentile, 51-60 years). Among them, 9071 (75%) were urban residence calculated RR, 3.16 (95% CI: 1.7-9.10), 7861 (65%) were male [calculated RR, 1.86 (95% CI: 0.76-2.1), and 6652 (55%) were smokers calculated RR, 1.22 (95% CI, 0.33-2.1) [21-23]. The most common occupation was government organization staff 4717 (39%) calculated RR, 1.8 (95% CI: 1.43-1.99), 4838 (40%) did not know where they were get infected and 5201 (43%) had at least one comorbidity. About 1330 (11%) needed to be hospitalized, among them 242 (2%) needed to go to ICU and 731(55%) needed to stay in hospital for less than 7 days. Around 4717 (39%) experienced further health problems after recovery from COVID-19 [24-26]. Such faced problems were psychological (3018, 64%), musculoskeletal pain (330, 7%), numbness (283, 6%), physical frailty (377, 8%), functional immobility (235, 5%), leg swelling (188, 4%), Parkinson's and Alzheimer's disease (429, 9.1%). Among patients, 4596 (38%) had the blood group O positive or negative calculated OR, 3.17 (2.1 to 4.3). Infection in 3265 (27%) of the cases was caused by a family member. About 5442 (45%) had more than one sign and symptom calculated RR, 3.2 (95% CI: 1.6-3.3) [27-29]. Those age more than 60 year (RR(95%of CI), p value: (10.1 (6.2-12.8), 0.002)), urban residence people RR (95% of CI), p value: 1.2(1.1-3.2), 0.001, male gender RR (95% of CI), p value: 0.2 (0.01-4.19) 0.0001, and having cardiovascular disease [RR (95% of CI), p value: 5.3 (0.2-6.9), 0.001 were critical condition for COVID-19 from others (Tables 1-3) [30-32].

Table 1: Epidemiological characteristics of COVID-19 patients.

Variables		Prevalence (%)	RR (95% of CI)	aRR (95% of CI)
Age	<10 years	19 (0.15%)	0.86 (0.64-0.89)	0.66 (0.44-0.79)
	11 to 20	25 (0.2%)	0.73 (0.57-0.93)	0.43 (0.37-0.81)
	21 to 30	604 (7%)	0.41 (0.35-0.54)	0.52 (0.12-0.49)
	31 to 40	1324 (10.95%)	1.21 (0.89-1.76)	1.21 (0.89-1.76)
	41 to 50	2382 (19.7%)	1	1
	51 to 60	3991 (33%)	3.26 (2.55-3.96)	3.26 (2.55-3.96)
	>60	3507 (29%)	4.56 (1.43-5.63)	5.16 (2.11-9.67)
Residence	Urban	9071 (75%)	3.16 (1.7-9.10)	6.12 (2.2-13.2)
	Rural	3023 (25)	1	1
Gender	Male	7861 (65%)	1.86 (0.76-2.10)	1.12 (0.52-3.20)
	Female	4233 (35%)	1	1
Occupation	Government staff	4717 (39%)	1.8 (1.43-1.99)	1.1 (0.9-1.32)
	Non-government staff	3749 (31%)	References	References
	Self-employment	1814 (15%)	0.38 (0.21-0.63)	0.21 (0.14-0.91)
	Student	604 (5%)	0.17 (0.11-0.34)	0.21 (0.1-0.42)
	Other	1209 (10%)	0.67 (0.10-1.10)	0.1 (0.01-2.2)
Previous medical condition	Hypertension	3991 (33%)	1.55 (1.43-1.67)	2.9 (1.2-5.12)
	Diabetes	2781 (23%)	1.04 (1.34-1.53)	2.1 (1.2-3.12)
	Cardiovascular	2661 (22%)	References	References
	Kidney injury	1209 (10%)	0.31 (0.21-0.43)	0.11 (0.01-0.73)
	HIV infection	847 (7%)	0.24 (0.11-0.42)	0.04 (0.02-0.81)
	Pregnancy	242 (2%)	0.08 (0.08-0.09)	0.1 (0.01-0.2)
	Surgery	242 (2%)	0.08 (0.07-0.09)	0.3 (0.1-0.7)
	Having one or more co-morbidity	5201(43%)	1.9 (1.03-2.99)	4.9 (2.3-6.8)
Smoking habit	Yes	6652 (55%)	1.22 (0.33-2.10)	3.7 (1.9-7.2)
	No	5442 (45%)	1	1
Possible place of contracting COVID-19 infection	Workplace	2902 (24%)	1	1
	Nosocomial	1331 (11%)	0.22 (0.90-0.41)	0.1 (0.01-0.93)
	Family member	3023 (25%)	0.38 (0.23-0.45)	0.2 (0.03-0.95)
	Unknown	4838 (40%)	0.38 (0.21-.063)	0.08 (0.01-1.3)

Are any new psychological/ physical problems you faced after recovery COVID 19?	Yes	Psychological problem (3018, 64%)	1.56 (1.10-2.10)	2.32 (2.2-7.8)
		Musculo-skeletal pain (330, 7%)		
		Leg swelling (188, 4%)		
		Numbness (283, 6%)		
		Physical frailty (377, 8%)		
		Functional immobility (235, 5%)		
		Parkinson's and Alzheimer's disease (429, 9.1%)		
	No	7377 (61%)	1	1
Did you need to go to the hospital?		Others (136, 2.9%)		
	Yes	1330 (11%)	1.08 (1.00-2.10)	2.8 (1.9-7.2)
	No	11006 (91%)	1	1
Did you need to go to the ICU?	Yes	242 (2%)	3 (0.09-3.90)	2.1 (1.9-4.43)
	No	11853(98%)	1	1
How many days did you have to stay in the hospital?	Less than 7 days	731 (55%)	1	1
	More than 7 days	599 (45%)	0.82 (0.01-1.30)	0.32 (0.11-2.10)
You were infected with COVID-19 and you hadn't gone to hospital. What treatment did you take at home?	Rest	11853(98%)	1	1
	Fluid intake	10522(87%)	1.89 (0.01-3.00)	1.69 (0.21-4.01)
	Using pain relievers	4112(34%)	0.83 (0.10-1.50)	0.21 (0.19-2.1)
	Others	4959(41%)	2.39 (1.90-3.30)	1.09 (0.01-9.1)
Blood group	A	2056(17%)	1.82 (1.10-2.30)	1.2 (1.01-3.08)
	B	3749(31%)	2.58 (2.10-3.10)	1.18 (1.09-4.21)
	AB	1451(12%)	1	1
	O	4596 (38%)	3.17 (2.10-4.30)	2.02 (1.9-6.02)
	Unknown	242 (2%)	0.16 (0.10-2.90)	0.9 (0.01-1.8)
Patient condition	Mild	5442 (45%)	1	1
	Moderate	4354 (36%)	0.33 (0.10-1.10)	0.2 (0.1-2.10)
	Severe	1814 (15%)	0.80 (0.50-2.10)	0.01 (0.001-1.9)
	Critical	483 (4%)	1.27 (1.10-6.59)	1.71 (0.8-8.29)

Is your any family member affected by COVID 19?	Yes	3265(27%)	0.37 (0.12-1.12)	0.21 (0.02-2.34)
	No	8829 (73%)	1	1

Table 2: Signs and symptoms of COVID-19.

Symptom	Prevalence (%)	RR (95% of CI)	aRR (95% of CI)
Fever (≥ 38° C) or history of fever	8587 (71%)	3.38 (1.20-4.30)	4.18 (2.9-5.2)
Sore throat	2540 (21%)	1	1
Runny nose (rhinorrhea)	362 (3%)	0.14 (0.01-1.10)	0.01 (0.001-2.2)
Cough	4959 (41%)	1.95 (1.10-2.70)	2.25 (1.9-4.4)
Shortness of breath (dyspnea)	4354 (36%)	1.71 (1.19-3.20)	1.92 (1.4-9.2)
Other respiratory symptoms	145 (12%)	0.57 (0.10-0.90)	0.17 (0.01-0.9)
Chills	604 (5%)	0.23 (0.10-1.00)	0.3 (0.1-1.8)
Vomiting	725 (6%)	0.29 (0.10-1.00)	0.4 (0.02-4.1)
Nausea	483 (4%)	0.19 (0.01-2.00)	0.8 (0.21-3.01)
Diarrhea	1451 (12%)	0.57 (0.10-0.90)	0.3 (0.2-0.8)
Rash	12 (0.1%)	0.01 (0.01-0.02)	0.1 (0.01-0.4)
Conjunctivitis	242 (2%)	0.1 (0.01-0.70)	0.1 (0.01-0.70)
Muscle aches	1451 (12%)	0.57 (0.10-0.90)	0.3 (0.1-0.7)
Joint ache (myalgia)	846 (7%)	0.33 (0.10-0.80)	0.04 (0.01-0.6)
Loss of appetite	4233 (35%)	1.67 (1.10-2.10)	3.23 (1.9-7.12)
Loss of smell (anosmia)	5442 (45%)	2.14 (1.10-3.20)	4.91 (2.7-13.9)
Loss of taste (ageusia)	2660 (22%)	1.05 (0.90-2.00)	3.15 (2.9-9.04)
Nose bleed	24 (0.2%)	0.01 (0.01-1.00)	0.07 (0.01-1.2)
Fatigue	3870 (32%)	1.52 (1.10-2.10)	2.02 (1.7-6.9)
Seizures	12 (0.1%)	0.01 (0.01-0.09)	0.009 (0.01-1.02)
Altered consciousness	12 (0.1%)	0.01 (0.01-0.02)	0.06 (0.01-2.12)
Other neurological signs	120 (1%)	0.05 (0.04-0.30)	0.01 (0.003-1.3)
Other symptoms	1451 (12%)	0.57 (0.10-0.70)	0.12 (0.01-0.9)
No sign and symptom	2660 (22%)	3.05 (1.02-9.10)	6.05 (1.9-21.7)
More than one sign and symptom	5442 (45%)	3.20 (1.60-3.30)	9.21 (2.9-23.8)

Table 3: Characteristics of COVID-19 patients.

Variables		Mild	Moderate	Severe	Critical
		RR (95% of CI), p value	RR (95% of CI) , p value	RR (95% of CI) , p value	RR (95% of CI) , p value
Age	11 to 20	0.30 (0.1-0.6), 0.541	0.2 (0.1-2.1), 0.546	0.21 (0.04-3.32), 0.862	0.63 (0.05-2.93) , 0.38
	21 to 30	0.45 (0.1-5.2), 0.232	0.5 (0.3-3.2), 0.873	0.25 (0.08-1.45), 0.765	0.57 (0.05-8.65), 0.123
	31 to 40	3.41 (1.2-6.3), 0.31	0.02 (0.02-2.3), 0.01	1.5 (1.1-6.8), 0.322	6.5 (1.1-7.8), 0.532
	41 to 50	1.2 (0.1-2.2), 0.235	1.32 (1.2-3.3), 0.03	4.19 (2.1-7.1), 0.01	5.1 (1.3-6.4), 0.03
	51 to 60	1.7 (1.1-9.1), 0.26	1.27 (1.1-4.8) , 0.01	9.81 (1.2-11.3), 0.001	9.9 (1.2-12.3), 0.001
	>60	9.3 (4.2-11.2), 0.41	5.1 (0.01-7.2), 0.007	12.1 (7.2-16.9), 0.001	10.1 (6.2-12.8), 0.002
Residence	Urban	1.7 (0.5-1.9), 0.006	0.01 (0.001-1.2), 0.761	1.2 (1.1-3.2), 0.252	1.2 (1.1-3.2), 0.001
	Rural	1	1	1	1
Gender	Male	1.9 (1.01-7.16), 0.001	0.26 (0.14-8.2) , 0.0001	0.65 (0.5-8.11) , 0.0008	0.2 (0.01-4.19), 0.0001
	Female	1	1	1	1
Previous medical condition	Hypertension	0.16 (0.03-3.1), 0.431	0.1 (0.01-4.12), 0.761	0.19 (0.03-8.84), 0.0078	0.01 (0.001-2.96), 0.001
	Diabetes	1.1 (1.01-7.8), 0.781	1.2 (1.01-7.3), 0.0001	0.7 (0.07-8.22), 0.762	0.01 (0.03-6.21), 0.041
	Cardiovascular	3.67 (1.1-9.1), 0.321	2.4 (2.1-7.3), 0.971	1.2 (1.1-5.8), 0.009	5.3 (0.2-6.9), 0.001
	Kidney injury	1.7 (0.1-4.2), 0.232	2.9 (0.1-4.3), 0.005	3.6 (2.1-7.9), 0.435	4.9 (1.3-8.2), 0.441
	HIV infection	0.07 (0.01-3.2), 0.232	0.1 (0.01-4.3), 0.005	1.2 (1.5-3.3), 0.665	3.5 (2.1-4.8), 0.321
	Pregnancy	1	1	1	1
	Surgery	1.8 (0.3-4.7), 0.351	0.6 (0.1-5.1), 0.451	1.79 (1.14-9.01), 0.0001	3.57 (1.1-12.91), 0.321
	Having one or more co- morbidity	0.1 (0.01-2.5), 0.51	0.5 (0.2-3.1), 0.001	1.5 (1-3.8), 0.005	0.1 (0.01-2.8), 0.001
Smoking habit	Yes	0.9 (.2-3.2), 0.581	0.2 (0.1-3.2), 0.564	1.1 (1-1.8), 0.005	3.1 (1.8-5.8), 0.001
	No	1	1	1	1
Are any new psychological/physical problems you faced after recovery COVID-19?	Psychological problem	0.1 (0.01-4.7), 0.981	1.3 (0.2-2.9), 0.004	0.45 (0.1-5.2),0.152	0.5 (0.3-3.2), 0.03
	Musculo-skeletal pain	1	1	1	1
	Leg swelling	3.12 (2.2-9.9), 0.431	0.2 (0.01-7.1), 0.008	2.2 (1.2-34.22), 0.001	3.2 (2.2-19.2), 0.002
	Numbness	1.6 (0.1-3.1), 0.9	2.6 (1.1-5.1), 0.01	0.8 (0.012), 0.326	0.9 (0.2-2.6), 0.0031
	Physical frailty	9.5 (2.8-17.3), 0.002	0.1 (0.02-3.2), 0.432	6.4 (1.3-9.7), 0.003	6.4 (3.3-19.7), 0.438
	Functional immobility	2.2 (1.2-34.22), 0.541	3.2 (2.2-19.2), 0.002	0.12 (0.01-2.4), 0.234	2.29 (1.2-5.9), 0.0012
	Parkinson's and Alzheimer's disease	4.2 (2.2-8.9), 0.429	0.7 (0.1-7.1), 0.57	2.1 (1.1-4.3), 0.14	3.1 (1.3-5.3), 0.004
	No	3.1 (1.1-8.2), 0.542	0.5 (0.2-3.1), 0.003	0.5 (0.01-3.2), 0.325	0.2 (0.1-6.2), 0.351

DISCUSSIUON

The epidemiology of COVID-19 can vary according to age, residence, gender, occupation, previous medical condition, smoking habit, and possible place of contracting COVID-19 infection, admission to ICU, and problems after recovery from COVID-19, blood group type, and sign symptoms. These variables could vary from country to country. In this study, it was shown that 7% of 21 to 30 years old were affected by coronavirus. But another study showed that it was 23% of Bangladesh-compared to 8.1% in China, 9.7% in Italy, 0.1% in America, 25.4% in Spain, and 23.5% in South Korea for people in the age of 21 to 30 years. Our study showed that 11% needed to go to hospital, compared to 4.9% in Spain. This study showed that 2% needed to go to the ICU. Previous studies showed that in Bangladesh 20 % needed to go ICU, in India 45%, in China 29%, 43% in America, 21% in France, and 35% in Italy. Fever was common in COVID-19 infection near to 71% of patients in our study. A previous study showed that prevalent fever symptom in Bangladesh was 78.6%, 43.1% in America, 60% in India, 75% in Italy, 87.9% in China, and 56.2% of Brazil. Anosmia was also present in COVID-19 infection, which was in 45% of the cases in our study. A previous study showed that anosmia in Bangladesh was 35.05%, 43.3% in Spain, and 62.9% in Brazil. Nearly 40% of patients were asymptomatic in this study. More than 90% of all patients had asymptomatic, in China, in Spain 21.9% to 35.8%, Italy 8% and in 51% were asymptomatic in France [33-35].

The government staff members (healthcare workers, policemen, and bankers) were affected at a higher rate than those in other occupations in Bangladesh. Calculated RR is, 1.8 (95% CI: 1.43-1.99); 1.8 times from non-government staff. It is believed that coronavirus had originated from wildlife and then crossed to infect humans. The first occupational groups at risk were working in the seafood industry, wet animal wholesale market workers and visitors in China. Then, health care workers were the next high-risk group to acquire this infection, followed by police officers. In Bangladesh, the affected rate of doctors is higher than at other locations in the world. After withdrawal of the lockdown of COVID-19 in Bangladesh; government's staff, non-government's staff, retail, health care workers, transport workers, security workers, construction workers, migrant workers, the meat and poultry processing industries workers as risk groups become more vulnerable. Occupations in risky areas vary from early outbreak (sales workers, transport and religious professionals) to late outbreak (health-care workers, transport workers, cleaning and domestic workers, and police officers. Health-care workers have been infected by the laboratory environment or community environment. The required supplies of personal protective equipment are limited, the high cost to test COVID-19, changing behavior (use facemasks, hand washing, physical distancing in overcrowded places) are challenging in Bangladesh. Because of lack of adequate protection, COVID-19 mortality is high among healthcare workers and their families are at higher risk in Bangladesh [36-37].

People with multiple comorbidities have a high risk of death with COVID-19 infection. The most common complications associated with death in COVID-19 are hypertension, chronic obstructive pulmonary disease, diabetes, and coronary heart disease. Those with multiple comorbidities had a higher chance of affecting coronavirus, calculated RR, 1.9 (95% CI: 1.03-2.99); 1.9 times from those who have cardiovascular problems. A high prevalence rate of hypertension is seen in SARS-CoV-2 patients (COVID-19). The presence of hypertension is found to be a determinant of severity and mortality. In this study, data were analyzed to find out the prevalence of comorbidity and COVID-19. It was revealed that COVID-19 primarily affects males and older comorbidities, especially lung disease, Arterial hypertension, and Diabetes mellitus-as what has been reported. Studies have shown that among 119015 COVID-19 patients in China and the United States had hypertension 35.4%, diabetes 21.2%, heart disease 12.55%, smokers 8.45%, chronic kidney disease 6.95%, and Coronary obstructive pulmonary disease 4.8%. Among these male patients -51% had a median age 50.2 years in other studies. In Bangladesh, hypertension is estimated at 24.7%, chronic obstructive pulmonary disease at 12.5%, 4.4% for diabetes and 5% for coronary heart disease. Since patients with high blood pressure in China and the US are more likely to be infected with COVID-19; then, Bangladesh is facing this risky situation due to the high number of hypertensive patients. To understand the pandemic of infectious disease outbreaks, it is necessary to examine the interplay between hosts, pathogens and the environment.

Bangladesh achieved remarkable progress in child health over the past 30 years and is one of six countries that are on track to achieve the Millennium Development Goal for reducing child health problems. Due to the outbreak of COVID-19, this currently being hampered. The COVID-19 pandemic has rapidly escalated into a global crisis. COVID-19 is a viral infection associated with increased morbidity and mortality in immunocompromised children. Immunocompromised children with cancer infected with severe acute respiratory syndrome are scarce. In this contest, children are less likely to develop a severe illness than adults. COVID-19 is much more widespread than other pandemics. The detected positive cases 3% age is 1 to 10 years, among them 0.1% is death; 7% age is 11 to 29 years, there is 0.3% death. Children with COVID-19 have a simple transmission mode by close contact with infected adults and infected areas. Although fever, dry cough, and mild pneumonia are common manifestations, nearly half of children patients have neither obvious symptoms nor abnormal radiological findings. The proportion of asymptomatic cases indicates the difficulty in identifying children without clear epidemiological information. They can lead to a dangerous situation if community-acquired infections occur. Case definitions and management strategies for children are absent because of the limited number of children with COVID-19. Although extreme,

isolation and social distance are one of the best available measures to limit spread. While COVID-19 continues to spread across the globe, many countries have decided to close schools as part of a physical distancing policy to slow transmission and ease the burden on health systems. Half of the children in Bangladesh live in poverty, schools are not only a place for learning, but also for eating healthily. The midday meal is associated with improvements in academic performance, whereas nutrition is associated with low educational attainment and substantial risks to the physical health and mental wellbeing of children. Therefore, due to COVID-19, children fall into malnutrition. Online learning needs computer and internet connection, which are not possible for children due to low-income in the family. Because of this shortcoming, they lag in their education facilities and get depressed. The government takes a method of broadcasting education by television. Children are infected with many mental health issues like frustration and loss of appetite, sleep problems, feeling stress, depression, fear, anxiety and domestic violence. Also, In the long run, children could be victims of abuse, exploitation, and difficulty adjusting back to their education). As the pandemic continues the children and adolescents can face bereavement and issues related to parental unemployment or loss of household income. This also can affect their mental health status.

The affected male sex rate is higher in Bangladesh, calculated RR, 1.86 (95% CI, 0.76-0.2.1) 1.86 times higher than that of the female sex. Data indicate that men are more prone to being affected than female in COVID-19 and male sex is an independent risk factor for refractory disease and death. Male mortality rate exceeded that of women in every adult age group in Bangladesh. There are different responses in males and females, which may be related to the effect of COVID-19 on certain enzymes. The angiotensin-converting enzyme-2 acts as the receptor for COVID-19 which is influenced by sex hormones. Men with pre-existing cardiovascular conditions, higher plasma levels of innate cytokines and chemokines including IL-8, IL-18 and CCL5, along with more robust induction of non-classical monocytes indicate a risk group. Females have more robust T cells for activation, higher immune cytokine for worst disease progress, estrogens in particular estradiol but also synthetic estrogen (ethinylestradiol) could protect women. The use of medications that keep hormonal levels high and stable could play a protective role.

Smokers are at a higher risk to be infected with coronavirus, 1.22 times more than non-smokers, the risk ratio 1.22 (95% CI, 0.33-2.1) in Bangladesh. Smoking is vulnerable to COVID-19. Smoking has an association with a plethora of respiratory diseases. It is associated with increased risk of morbidity and mortality associated with coronavirus. The effect of smoking on cerebrovascular and neurological dysfunction in COVID-19 patients is very serious. Smokers are 2 times more possibility to COVID-19 infection than other and there are higher mortality rate than other SARS outbreak. A study in China had reported there are no statistically significant difference between the smoking rates of died patient and survived patients (p=0.21) with regard to mortality from COVID-19. A study calculated that smokers were more at risk (calculated OR: 1.4, 0.98-2.00) to have severe coronavirus infection and 2.4 times more to be admitted to an ICU, require automatic ventilation or die than non-smokers (calculated OR: 2.4,1.43-4.04).

The main portal of entry of infectious agents, the oral cavity is directly related to the respiration of airborne particles and the evolutionary process of COVID-19 in the capillaries. Viral particles can detect host receptors through spike glycoproteins, enter host cells through membranes in the fusion process, replicate in host cells, and suppress immunity [36]. On gaining entry to the host, coronavirus reaches the appropriate site of the olfactory epithelium from the nasal cavity. Then it binds with coronavirus to multiplication and survives. Coronavirus can be transmitted through the digestive tract, urine, orchitis of the eyes and semen. Nasopharyngeal swabs remain positive for 22 days, but the eyelids remain positive for 2 weeks after nasopharyngeal swabs become negative. The coronavirus can survive in the external environment after leaving the human body (negatively affected by ozone with concentrations ranging from 48.8 $\mu g/m^3$ to 94.7 $\mu g/m^3$; high temperatures -13.2 to 19.0°C and low humidity 23.3 to 82.7%). This may not cause the death of the host but creates low-grade immunity so that the host is repeatedly vulnerable to the same infection. Incubation period is fundamental in COVID-19 epidemiological studies. The minimum incubation period is 2 to 19 days. The median incubation period is 7.6 days and for asymptotic it can be 9.3 days. The average incubation period is 14 days. In actual practice we seldom know precisely that the incubation period of COVID-19 and when the outbreak of disease occurs in a family as a small and close group. The mean serial interval varies from different studies 3.96 days (95% CI 3.53-4.39 days) or mean serial interval of 7.5 days (95% CI, 5.3-19) or at 4.8 days (95% CI: 3.1-10.1). Tracing is important in the COVID-19 epidemiology. It may happen in the seafood wholesale market in Wuhan of China., travel-related, wastewater-based epidemiology, and/or the paper-based device.

CONCLUSION

At this time of the pandemic many countries depend on vaccines to prevent COVID-19. But Bangladesh goes to shutdown (instead of lockdown) to control third wave from 1st July, 2021 due to its unavailability of COVID-19 vaccine. Indian (B.1.617.2), UK (B.1.1.7), South Africa (B.1.351), Nigeria (B. 1.525) and Brazilian (P1) variants are the five coronavirus variants detected in Bangladesh. Recently Indian and South Africa variant muted on delta variant made a critical situation in India. The delta variant is also increasing in Bangladesh. Now the government needs these following recommendations: Not only depend on shutdown but also ensure maintain public health measures that work (masking, physical distancing, hand washing, respiratory and cough hygiene, avoiding crowds, and ensuring good ventilation) and longer shutdown people may lose their financial status. Bangladesh started demonstrating COVID-19 ChAdOx1 (a replication-deficient simian adenovirus vector ChAdOx1 nCoV-19 from Oxford University and AstraZeneca) vaccine on 27 January, 2021 which was mass administration on 7 February, 2021. As far as 5.6 million people received the first dose of vaccine among 164 million people and

0.7 million received the full dose. But there is no strong evidence either the vaccinated people can transmit coronavirus or not, for this all have to maintain public health measures to control the spread of infection. The efficacy of ChAdOx1 nCoV-19 against the B.1.351 variant was only 10.4% and this transmissibility of the variance of concern causes risk of high to very high for the general people and very high for susceptible individuals. For that the demonstrated vaccines effectiveness should be investigated. For this along with the test of COVID-19 genome sequencing is needed. Prepared for any kind of shortage as when the delta variant spread India, there were many shortages of medical equipment (ICU bed, PPE, oxygen etc) for that Bangladesh had to be ready to control this third wave. Bangladesh is surrounded on three sides by India and for that border along with India have to close and those people who come to India have to maintain 14 days of quarantine. For March 17, 2020 all school, college and university is closed in Bangladesh and many students and institutions are unable to continue online education due accessories. For that in the vaccine priorities categories students and teachers should give priorities. And as soon as possible institutions have to open by completing vaccination.

Ethics approval and consent to participate

For COVID-19 test, Health Ministry of Bangladesh had made a sheet of information (for approved laboratory) of the people who will test the COVID-19, which is known as "COVID-19 test form". Any person who was tested for COVID-19 had to fill up this sheet, as being compulsory. We (Jahangirnagar University, department of public health informatics) offered the molecular laboratory, department of microbiology, Shaheed Suhrawardy medical college to give their COVID-19 report form information to which it was agreed. The study was approved by the Biosafety and Biosecurity Public Health Ethical Committee of Jahangirnagar University, Bangladesh (kha 2021/2451) and by the Shaheed Suhrawardy medical college ethical committee. The participants were informed about this study orally. The orally informed consent was obtained from a parent or guardian for participants under 16 years old.

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