



Critical Analysis of the Possible Determining Factors of COVID-19 Epidemiological Trend in Bangladesh: A Review

Asif Ahmed¹, Mohammad Mahmudur Rahman²

¹Associate Professor, Biotechnology and Genetic Engineering Discipline, Khulna University, Khulna, Bangladesh; ²Associate Professor, Department of Medical Biotechnology, Bangladesh University of Health Sciences, Dhaka, Bangladesh

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Abstract

Since its first report on March 08, 2020, COVID-19 positive cases and number of deaths have increased which reached the peak in late June and started to decline slowly in late August in Bangladesh. COVID-19 transmission and disease progression depends on multifaceted determinants e.g. virus genetics, host immunity, social distancing, co-morbidity, socio-demographic and environmental parameters. Therefore observed epidemiological trend may not follow predicted models and thus warrant detail investigation of the contributing factors. In this perspective, in the light of literature we hypothesize that preventive intervention strategies, socioeconomic limitations, climatic and meteorological indexes, acquired immunity of Bangladeshi population, demographic characteristics, health indicators and food habits contributed toward the observed COVID-19 trend. The key limiting factor was number of diagnostic tests in getting real epidemic scenario. Strong immunity of young people compared to the elderly and low prevalence of non-communicable diseases might have kept most of them asymptomatic, less severe with silent recovery. Climatic parameters, less population density in rural areas and certain food habits perhaps helped to restrict and combat the infection up to a level. Genetic polymorphism can also be driving factor in disease progression. Despite several helpful determinants in Bangladesh, person to person contact is still the leading risk factor for COVID-19 transmission. Infection may increase rapidly if safe distance and preventive measures are not strictly followed especially in the coming winter. Expansion of test capacity, intelligent work and vacation planning and public awareness should continue to reduce the infection rate and disease catastrophe. [*Bangladesh Journal of Infectious Diseases*, June 2021;8(1):36-41]

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Correspondence: Asif Ahmed, *PhD*, Associate Professor, Biotechnology and Genetic Engineering Discipline, Khulna University, Khulna-9208, Bangladesh; **Email:** asif@bge.ku.ac.bd; ORCID: <http://orcid.org/0000-0001-7401-821X>

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Introduction

Bangladesh has experienced gradual rise in COVID-19 cases and deaths since its first report on 08 March, 2020. As of 30 October 2020, a total of 404,760 confirmed cases, 321,281 recovery and 5,886 deaths have been recorded¹. After the first incidence in Wuhan, China in December 2019, COVID-19 spread to most of countries mostly via international travelers. Bangladesh government initially started with 10 day travel ban across the country from 26 March along with office and educational institutional shut down which was further extended². People were advised to stay home and to maintain social distance, however it was difficult for daily wage earners and for the people staying in very dense premises³. During official leave and transport ban some unexpected mass gathering took place including back and forth movement of garments workers to capital Dhaka, large funeral prayer and crowded journey toward rural areas¹. Despite these events, as fear of rapid transmission was high in a highly dense population, the COVID-19 scenario in Bangladesh was relatively moderate.

Epidemiological models like susceptible, infected and recovered (SIR) is a classic closed compartment model to predict disease trajectory⁴. After the initial spread of COVID-19 several SIR and modified SIR based prediction have been reported⁵⁻⁸ and classic SIR model is claimed to show less complexity and better prediction compared to modified models⁹. These predictions are not always perfectly accurate as disease progression is determined by multiple factors. However, such predictions help to visualize possible intervention mediated outcomes and action planning can be directed accordingly.

In a study, SIR based prediction of COVID-19 in Bangladesh was done with different percentage of possible social distancing intervention⁵. Based on another survey and practical scenarios it was speculated that around 60.0% social distancing could be possible in Bangladesh¹⁰. In accordance, it was predicted that COVID-19 in Bangladesh might reach its peak in early June and would be slowed down at the end of August. However, when real data was compared, confirmed cases did not follow the prediction trend. Overall positive number was way low in reality. As COVID-19 incidence is being controlled by multifaceted parameters, we tried to connect the possible reasons behind the ongoing COVID-19 trend of Bangladesh. We considered demographic and climatic parameters, logistic and intervention strategies taken by

Bangladesh in coordination with published literature to support the possible reasons.

In this perspective review, we investigated the observed pattern of COVID-19 in Bangladesh. We also tried to explain and hypothesize possible reasons behind this trend and limiting factors in the light of Bangladeshi data and literature. We followed some key events in Bangladesh during this period as well as environmental and behavioral pattern that might have influenced the outcome. Based on our hypothesis, several research avenues are recommended which will be helpful to further validate the issues and to design policies and strategies for the upcoming winter season and long term COVID-19 management.

Hypothesis

As COVID-19 is transmitted through human to human contact via sneeze, cough and fomites, it was feared to have rapid disease progression in Bangladesh when some countries were struggling with high death toll. High population density, lack of awareness, weak coordination among healthcare providing authorities were among major concerns. Compared to the population size, number of tests was limiting factor to get wider picture. Despite limited test data, based on observed scenario it can be hypothesized that climatic and demographic parameters, nutrition and environment acquired immunity, genetic polymorphisms might have helped to restrict catastrophic disease severity. These hypotheses need to be further validated by different groups of scientist with large scale data to be more evident.

Global vs. Bangladesh COVID-19 Incidence

Bangladeshi COVID-19 major parameters were compared with global mean values. Global COVID-19 data¹¹ were retrieved from worldometers on October 30, 2020. Based on positive cases over 1000, data of total 152 countries were taken after removing countries with missing values. JASP v. 0.14.0.0 was used for data plotting and figure was constructed in Inkscape graphics software.

As of October 30, 2020, the important COVID-19 outcome in Bangladesh compared with global data shows case fatality rate (1.45%) of Bangladesh is lower than global mean (2.07%) (Figure IA). However, positive test rate is 17.5% compared to global mean of 10.96% and population test rate is only 1.4% whereas global mean value is 17.23% (Figure IB and IC).

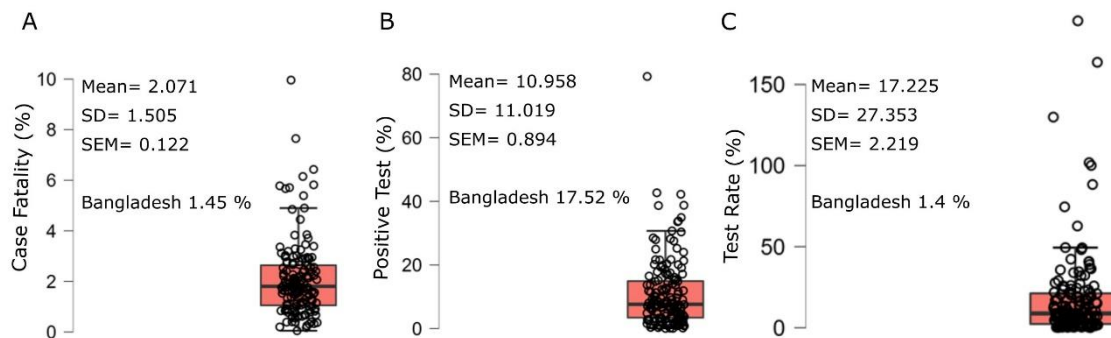


Figure I: Global data on case fatality (%), positive test rate (%) and population test rate (%) as of 29 October 2020 (n=152). Descriptive statistics along with Bangladeshi data are shown inset

Possible Factors behind COVID-19 Pattern in Bangladesh

Test Number is a Critical Limiting Factor: To understand the prevalence and distribution pattern of COVID-19, number of tests performed by a country plays critical role. Without enough testing true number of cases cannot be obtained. In addition, sufficient testing is required to properly declare COVID-19 related deaths and recovery. In a study, analyzing 91 countries' number of tests performed per 100 K population data, positive as well as negative correlation was found with positive cases and positive test (%) respectively with statistical significance¹². Countries where limited numbers of tests were performed positive test (%) was comparatively higher. They also reported that at that point global mean of positive test was 9.94 ± 1.25 % and countries with high number of tests (>500 tests per 100 K population) had test positive value well below 10% and countries with fewer tests (<500 tests per 100 K population) had average positive test rate of about 20% cases. As of 29 October, global mean of positive test is 10.96% and in Bangladesh 17.52%. As most of the samples tested were either contact traced known of previous positive cases or people with very definite symptoms, test positive rate of Bangladesh was indicative of moderate to high infection in community with insufficient number of test.

In the initial stage, Bangladesh Institute of Epidemiology, Disease Control and Research (IEDCR) alone collected and performed PCR test of suspected samples. Gradually test capacity was extended to public and private hospitals, universities, research organizations around the country which is at present more than 100 in number. Bangladesh is one of the low investing countries in health sector and currently health expenditure is 36.28 USD per capita¹³, thus the

extension of test center and recruitment and training of expertise was relatively slow and still way below the need compared to large number of populations. Especially with the increasing rate of infection this can be vital limiting factor to know real case scenario in Bangladesh. These extended centers however are mainly in divisional headquarters or in large cities, where rural people staying away from the facility had difficulty to test as inter-city transport was closed.

This has resulted some samples to become non usable and false negative as samples might have been deteriorated due to longer transport and improper sample collection. We also identified that due to social non-cooperation toward the COVID-19 positive or health care practitioners, many suspected individual were reluctant to give sample due to social fear. Although government hot line is open for all, many people had dissatisfactory experience calling for sample collection. Lack of management, long queue, waiting time in sample collection and test centers and delayed result also had negative impact, fear and rejection tendency among test seekers. These factors altogether had negative impact on uniform and evenly distributed data collection raising reliability issues on reported case numbers so far.

Population Median Age and Obesity Prevalence:

It has been postulated that countries with high median age showed strong association with COVID-19 case fatality rate¹². This was mainly due to reduced immunity and high prevalence of non-communicable diseases in elderly people as contributing factors for comorbidity. Bangladesh has median age of 27.90 years¹⁴, with less elderly people compared to many developed country. This could be one reason that young age group being dominant in the society are the most infected among all which is 55.0% belong to 21 to 40 years age

group¹⁵. Their inherent strong immunity might be a reason for silent infection and recovery with mild or even no symptoms at all. The case fatality rate of Bangladesh is 1.45% which is below the global average of 2.07% which could be due to less proportion of elderly in Bangladesh compared to the countries with high median age where case fatality climbed up to 10.0%. Prevalence of obesity is tightly linked to non-communicable diseases which is low in Bangladeshi adult population and it is 3.6% cases¹⁶. Thus low obesity prevalence might have helped to minimize the co morbidity related complexity in Bangladeshi COVID-19 infected people.

Environmental Parameters: Scientists are having a wave of optimism that warmer weather might improve COVID-19 scenario¹⁷. Temperature, absolute humidity, relative humidity (RH), sunlight, ambient air flow, and altitudes were mostly studied parameters¹⁸⁻¹⁹. Respiratory viruses usually follow seasonal pattern, preferring either winter or summer, whereas some of them prefer to be year around virus²⁰. Information regarding SARS-CoV-2 is still insufficient to label its seasonality; however, known other human corona viruses had shown clear preferences to winter. COVID-19 data so far showed temperate regions as the prevalence hot zone, but tropical areas are not completely out of the list. In one particular season, incidence peak or hot spot may vary from virus to virus and usually they avoid overlapping.

Temperature and humidity determine the route of transmission and viral stability both in indoor and outdoor settings. Cold and dry weather dominate transmission via aerosol and small droplets whereas hot and humid weather facilitate transmission via fomites. Temperature above 30⁰ C showed to block aerosol mediated Influenza virus transmission at variable relative humidity, but contact mode transmission was still possible²¹. Surface stability and viability of SARS-CoV was shown to be lost at high temperature and high relative humidity²². Bangladesh with monthly high temperature above 30°C and average temperature above 25°C from March to October may have reduced aerosol mediated viral transmission slowing community level infection rate. A study with multiple linear regression suggested that high temperature and humidity might help to reduce COVID-19 transmission in Bangladesh²³. However, in another study compound Poisson generalized linear modeling revealed that increase in 1 mm rainfall was associated with incidence number by 30.99% whereas 1°C rise in temperature was found to reduce confirmed cases by 14.2% cases²⁴.

UV index and air pollution may also play contributing role in viral transmission. Anthropogenic pollutants and microbes share common mechanism to confer immune deficiency¹. These pollutants prepare the ground for COVID-19 like pandemic and further worsen the outbreak. Air particulate materials were found to be positively associated with COVID-19 incidence. Due to government imposed travel ban, reduced industrial effect air particulate emission was also low for the last two months which might have helped to reduce particulate material mediated virus transmission.

Bangladesh has very high UV index during summer months with average of 10 or above with increased daylight hours²⁵. UV index and daylight is related to ozone concentration which was found to reduce viability of viruses and COVID-19 transmission in a study conducted in Chinese cities²⁶. In Bangladesh, ozone level in summer daylight may have helped to reduce viability of the viruses in environment²⁷. Sunlight exposure which is also related to vitamin D production and immunity had helped to provide population level immunity to fight COVID-19 in Bangladesh²⁸. Besides, with official leave, many people left capital city to stay with families in rural areas, where factors like low population density, air velocity, and sunlight exposure were helpful to restrict virus transmission.

Heterologous Immunity, Genetic Predisposition and Food Habit: Heterologous immunity, a form of cross reactivity is acquired from previously challenged unrelated microorganisms providing wider vaccine induced effectiveness and natural immunity against new infections²⁹⁻³⁰. Memory CD8+ T cells can help to detect newly infected viruses, but due to strain variation in RNA viruses less effective immunity is observed in human and in some cases show immune pathology³¹.

Bangladesh is a densely populated country and people are exposed to different microorganisms during their lifetime, thus highly likely acquire heterologous immunity from natural infections. One study with cholera vaccination in Bangladesh showed natural immunity were long lasting compared to the oral vaccine³². In another study, Bangladeshi children were found to express more effector T cell activity compared to American children, supporting the 'hygiene hypothesis'³³. According to this hypothesis early exposure to infectious agents may provide better immunity and in contrast lack of exposure may lead to allergies and autoimmune diseases. This also explains in part, reduced or less severe COVID-19 incidence in

Bangladesh could be due to childhood acquired immunity against a variety of organisms.

Genetic polymorphism across different population was also investigated and was found to be linked with disease severity. In a study genome wide genetic polymorphism data on virus receptor angiotensin converting enzyme 2 (ACE2) and transmembrane serine protease 2 (TMPRSS2) revealed that deleterious variant were highly prevalent among African/African-American population, with lower frequency in south Asian population³⁴. These can be major determining factor for disease severity irrespective to age or comorbidity which need to be analyzed further.

Co-infection of viruses is another aspect where one or more viruses may compete with another minimizing the virulence of the other³⁵. Viral co-infection was reported in COVID-19 infectin³⁶⁻³⁷ and in Bangladesh as viral co-infection was observed in case of other viruses³⁸, co-infection of other respiratory viruses may have inhibitory effect on COVID-19 transmission and virulence. Food which boosts immune systems e.g. seasonal fruits, vegetables and spices could also play a positive role in slowing COVID-19 in Bangladesh. Climatic parameters may slow down COVID-19 transmission pattern and duration, however considering the size of pandemic its effect is modest³⁹.

Conclusion

Based on existing literature and COVID-19 data of Bangladesh we specifically recommend research line to test and validate our hypotheses. Firstly, detail large scale epidemiologic study with demographic and environmental data need to be conducted. Secondly, genetic polymorphism analysis can help to identify genetic predisposition and medical intervention can be taken accordingly. Thirdly, population immunity status need to be evaluated. Indigenous food ingredients that can prevent disease progression or severity need to be identified to incorporate them into disease management protocol for long term preventive measures. Although many factors seemed to help Bangladesh to an extent, other factors like population density, urban population percentage and negligence toward health precautions still pose high risk of person to person disease transmission especially when offices and transport will be open. Countries in both temperate and tropical regions must prepare for the possibility of severe outbreak; however, climatic variation will help to determine the local endemic cycle and seasonal peak. Step by

step precautions are necessary to reduce sudden spike in infection number. Coming winter may face a second wave, so extended measures should be in place to contain the COVID-19 in Bangladesh. Especially young population are at risk of being silent carrier should maintain all health precautions. Public health policy and strategies need to be carefully adjusted considering these aspects to slow down the pandemic pace so that effective medical facilities can be provided to maximum possible people using available resources.

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