

Coronavirus Pandemic

The risk of public mobility from hotspots of COVID-19 during travel restriction in Bangladesh

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Abstract

Bangladesh reported the first three laboratory-confirmed COVID-19 cases on March 8, 2020 in Dhaka and Narayanganj cities. As of April 8, 2020, 218 confirmed cases across the country, they have mostly detected from Dhaka (56.4%) and Narayanganj (21%) cities where the hotspots of an outbreak of COVID-19 disease. There were 6 cases in Dhaka district excluding metropolitan areas and rest of 43 (20%) cases in the 19 other regions. Local government-enforced completely shut down the hotspots areas on April 8 2020. However, peoples from hotspots travelled openly to the other districts.

We aimed to understand the risk of open movement from hotspots. We studied 40 individuals who were infected with SARS-CoV-2 virus later at their destination. We developed a route map and density maps using Geographic Information System (GIS). Among the studied people, the average distance was 140.1 (75.1) kilometers (Km), and the range of distance was from 20.3 to 321.7 kilometers. Among them, 42.5% traveled <100 Km, 40.0% traveled between 100 and 200 Km and 17.5% traveled above 200 Km. Case numbers were increased 13.5 times more on April 20 than the cases as of April 8, 2020.

Our analysis suggests that relaxed travel restriction could play an important role to spread COVID-19 transmission domestically. To reduce further spread of COVID-19, the government should closely monitor the public health intervention to stop the casual movement.

Key words: COVID-19; SARS-CoV-2; outbreak; hotspots; Bangladesh.

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Introduction

Coronaviruses are RNA virus that can transmit from animal-to-human and also spread from human-to-human [1–3]. The first outbreak of novel coronavirus disease 2019 (COVID-19) had rapidly spread within Wuhan, the capital city of Hubei province originating from a seafood and live animal market in December 2019. Soon after, there was a rapid person-to-person transmission of SARS-COV-2 that reported inside Hubei province and adjacent provinces [1, 4]. About 5 million people from Wuhan city travelled to their hometown all over China in to celebrate the Chinese Lunar New Year holidays during the ongoing outbreak of COVID-19 on January 25 to February 7, 2020. Consequently, the highest number of infected cases were reported in ten provinces outside Hubei and then infections spread to the USA and many countries of Europe within a few days [4]. In China, implementing the social distancing, travel restriction, isolation and quarantine for infected people proved to be instrumental to limit local transmission for 2 weeks and subsequently the COVID-19 outbreak has been controlled [5].

Bangladesh identified the first three novel coronavirus disease (COVID-19) cases on March 8, 2020 [6] and then there was a slow increase in the number of cases in the major cities as of April 8, 2020. Bangladesh government announced the closure of school and shutdown in the form of a national holiday for all offices across the country since March 26, 2020, and extended till May 5, 2020, as public health interventions to impede and control the spread of SARS-COV-2 [7]. Dhaka, the capital city and adjacent cities, Narayanganj and Gazipur became hotspots of the COVID-19 outbreak [8]. These cities were locked down completely from April 8, 2020 [9,10]. Interventions like travel restriction, social distancing, public awareness creation, quarantining and isolating infected persons were implemented as they were proven effective intervention strategies to reduce the increase of COVID-19 in China [11,12] and during 1918-19 influenza pandemic in New York City [13]. Therefore, we aimed to describe the risk of human migration from the hotspots of COVID-19 diseases during the initial days of the outbreak in Bangladesh.

Table 1. Summary of laboratory-confirmed cases as of April 8 and as of April 20, 2020.

	As of April 8 2020	As of April 20 2020
Reported cases	218	2948
Death cases	20	101
Number of affected districts	21	54

Methodology

Data source

We collated data on laboratory-confirmed positive cases of COVID-19 disease from the Directorate General of Health Services, Ministry of Health and Family Welfare (DGHS) website [14]. The DGHS website has no detail information on patient-level. We collated data on individual SARS-COV-2 infected patient who has travel history from the daily online newspapers reporting from April 8, 2020 to April 20, 2020 to assess the risk of human movement during the outbreak from hotspots (Supplementary Table 1). We searched the geographical coordination points of the patient’s departure and destination locations in Google maps to develop the route map.

Data analysis

We summarized the laboratory-confirmed cumulated case data reported on April 8 and April 20, 2020 by using frequency distribution for spatial analysis. QGIS software was used to develop case density maps for each district. We created bar graphs for cases outside the hotspots of COVID-19 outbreak over the prior mentioned time. QGIS software was used to visualize the travel routes in a map for individual SARS-COV-2 infected patients.

We calculated the linear distance in kilometer from their departure location to destination and then summarized the travel distance by using descriptive statistics.

Results

Based on the case density map, the cumulative number of 218 cases as of April 8, 2020, several districts were different (Table 1 and Figure 1). The density map shows the varied spreading in the 21

districts; most of infected people were in Dhaka city at 56.4% (123), the central city in Bangladesh and neighboring city Narayanganj at 21% (46) in Bangladesh. During the public health intervention, we found that 40 peoples travelled from the hotspots to 27 districts in eight divisions between April 8 and April 20, 2020. In terms of the 40 individuals travel histories, 17 (42.5%) peoples came from Dhaka and 23 (57.5%) left Narayanjanj city to their home (Figure 2).

Figure 1. Density map of COVID-19 cases up to April 8, 2020.

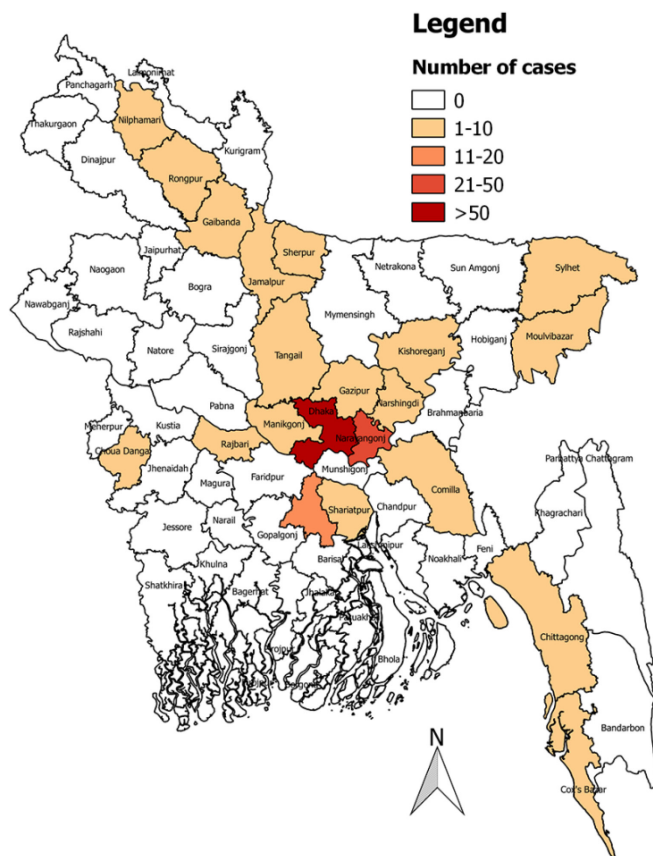


Table 2. Summary of 40 individual’s travel history data.

Distance	Overall	Dhaka	Narayanganj
Number of cases (%)	40	17 (42.5)	23 (57.5)
Distance			
Mean ± SD (km)	140.1 ± 75.1	131.1 ± 73.2	146.9 ± 77.6
Min	20.3	20.3	22.9
Max	321.7	273.6	321.7
≤100 (%)	17 (42.5)	8 (47.1)	9 (39.1)
101-200 (%)	16 (40.0)	6 (35.3)	10 (43.5)
>200 (%)	7 (17.5)	3 (17.6)	4 (17.4)

Figure 2. Route map of migration between April 8 and April 20, 2020 from hotspots.

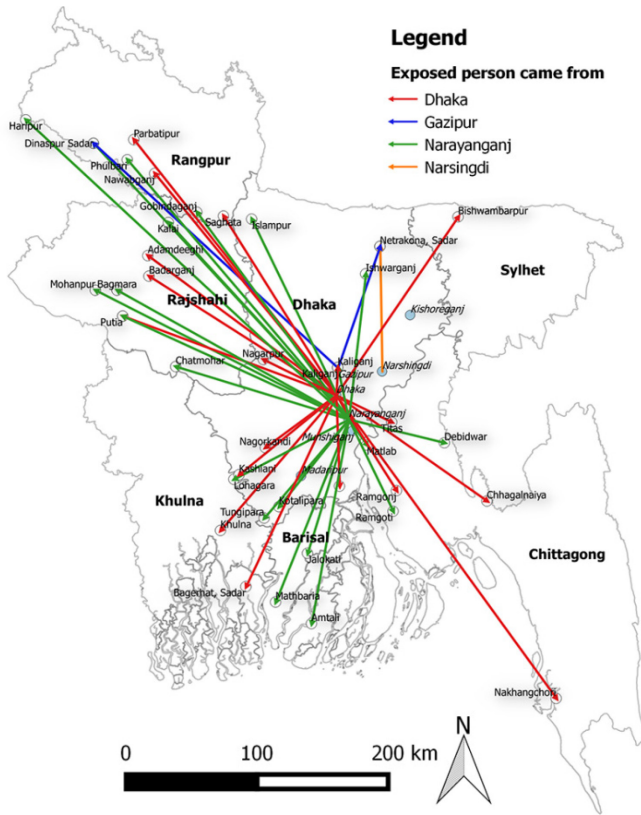


Figure 3. Individuals moved from hotspots to their home between April 8 and April 20, 2020.

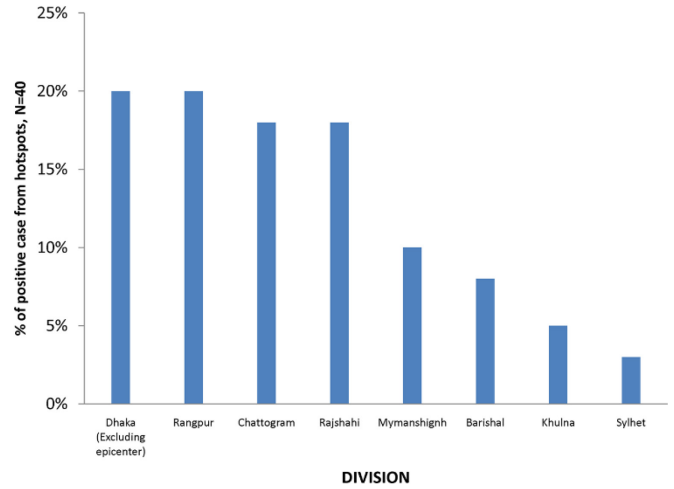


Figure 4. Density map of COVID-19 cases up to April 20, 2020.

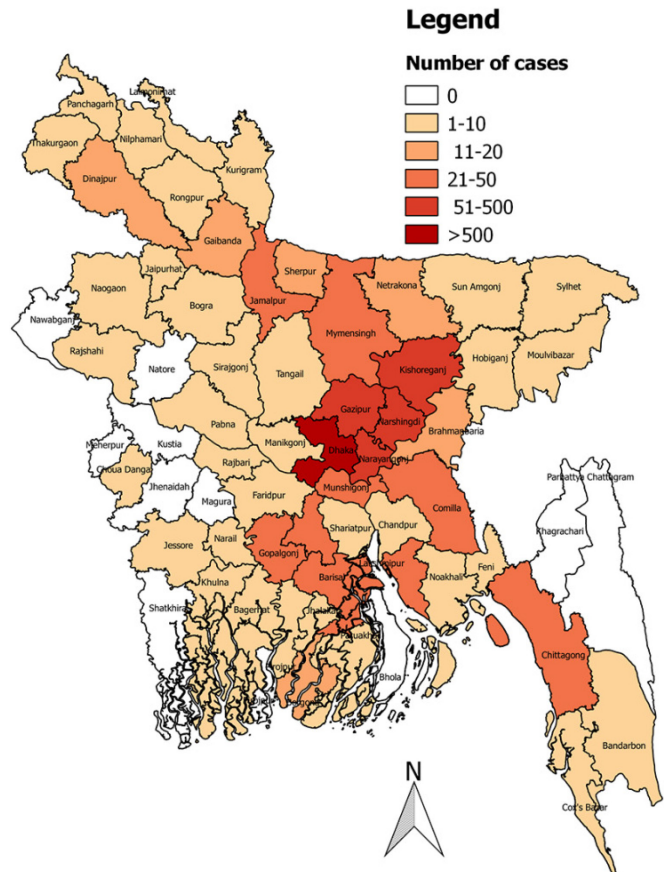
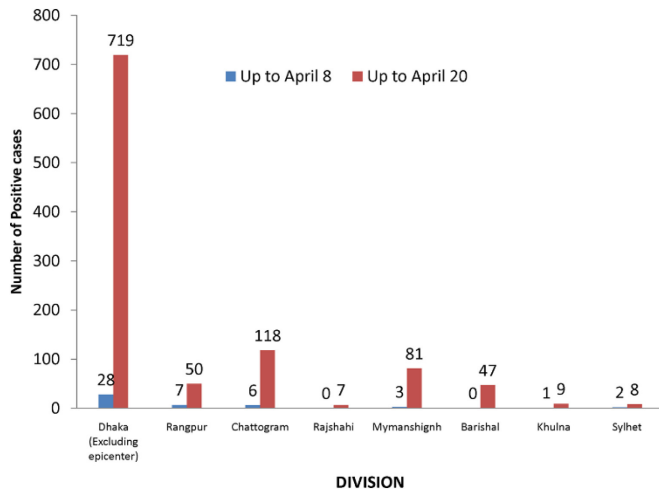


Figure 5. Cases were distributed by division excluding cases of hotspots.



The average (Standard deviation (SD)) distance of the individual's travel was 140.1 (SD: 75.1) kilometers, and the range of travel distance was from 20.3 to 321.7 kilometers. Among them, a person travelled the minimum distance (20.3 kilometers) from Dhaka city to Kaliganj in Gazipur district and a person who moved the highest travel distance (321.7 kilometers) from Narayanganj city to Hariapur, Thakurgaon district. We found 42.5% peoples travelled in less than 100 kilometers, 40.0% travelled between 101 and 200 kilometers and 17.5% travelled above 200 kilometers (Table 2). We found the 8 (20%) of 40 individuals in Rangpur, 8 (20%) in Dhaka excluding hotspot cities, 7 (18%) in Chattogram, 7 (18%) in Rajshahi, 4 (10%) in Mymensingh, 3 (8%) in Barishal, 2 (5%) in Khulna and 1 (3%) in Sylhet divisions (Figure 3).

As of April 20, 2020, the cumulative number of infections has increased to 2948 cases across the 54 districts in eight divisions in Bangladesh (Table 1). Dhaka (40%) and Narayanganj (13%) cities were persisted the highest case density as hotspots (Figure 4). All eight divisions have spread the SARS-CoV-2 infected cases. Dhaka division excluding the hotspots has risen from 28 to 719 cases. Chattogram Division has increased more than 100 cases (from 6 to 118 cases) while other six divisions, the figures were grown in different number (Rangpur: from 7 to 50 cases; Rajshahi: from 0 to 7 cases; Mymensingh: from 3 to 81 cases; Barishal: from 0 to 47 cases; Khulna: from 0 to 9 cases and Sylhet: from 2 to 8 cases) (Figure 5).

Discussion

The findings from this risk of the human mobility study suggest that the people flee from the hotspots during the precautionary control intervention, including travel restriction and social distancing, has increased transmissibility of SARS-CoV-2 virus across the country. The daily number of COVID-19 disease cases has increased in other multiple regions since mid-week of April. However, a rapidly growing of COVID-19 transmission is possible because of people scattered from hotspots domestically.

During the outbreak of COVID-19 disease, Bangladesh government was concerned that a mass movement population in the general public holiday on March 26, 2020, would magnify the spread of SARS-CoV-2 virus across the country. Moreover, individuals left from the infected areas during the lockdown. They were suffered from COVID-19 disease after a week, which is in the incubation period at their destination [15–17]. Therefore, the human-to-human transmission of SARS-CoV-2 virus is established domestically

during the period between April 8 and April 20, 2020 [5,18,19]. We found the exponentially growing of reported case numbers, completely blocking the infected areas is essential for public health planning and controlling countrywide. This study shows that the expanded of COVID-19 disease from hotspots to other multiple rural areas. Our findings suggest that human-to-human spread is already present in Dhaka and neighboring cities, many of which are garment's industries with a large number of people movements [20,21].

In conclusions, the public health interventions are actively applied. The further early lockdown in rural districts might become necessary to reduce the SARS-CoV-2 virus transmission locally. On the present transmission route, COVID-19 disease could be a local outbreak in the relaxed of travel restriction. The substantial preventive measures that restrict human mobility should be seriously and immediately considered in imported areas to reduce within-population contact rates through actively manage the quarantine, isolation and social distancing.

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Annex – Supplementary items

Supplementary Table 1. Summary of COVID-19 transmission events where the people exposed and subsequently infected were known since April 8, 2020. The information reported in the table were collected in the following websites: www.banglanews24.com; www.unb.com.bd; www.thedailystar.net, www.ittefaq.com.bd.

Patient exposition location	Onset location	District	Test date (2020)
Narayanganj	Mohanpur	Rajshahi	16-April
Dhaka	Putia	Rajshahi	12-April
Narayanganj	Bagmara	Rajshahi	13-April
Narayanganj	Putia	Rajshahi	14-April
Narayanganj	Kalai	Joypurhat	16-April
Narayanganj	Chatmohar	Pabna	16-April
Dhaka	Adamdeeghi	Borga	16-April
Dhaka	Chhagalnaiya	Feni	17-April
Dhaka	Khulna	Khulna	13-April
Dhaka	Nagorkandi	Farithpur	13-April
Narayanganj	Mathbaria	Pirojpur	13-April
Narayanganj	Jalokati	Jalokati	11-April
Dhaka	Nakhangchori	Cox's Bazar	16-April
Narayanganj	Debidwar	Comilla	11-April
Dhaka	Titas	Comilla	8-April
Narayanganj	Lohagara	Norail	13-April
Dhaka	Badarganj	Rangpur	16-April
Dhaka	Parbatipur	Dinaspur	15-April
Narayanganj	DinaspurSadar	Dinaspur	13-April
Gazipur	DinaspurSadar	Dinaspur	13-April
Dhaka	Nawabganj	Dinaspur	13-April
Narayanganj	Phulbari	Dinaspur	13-April
Narayanganj	Gobindaganj	Gaibandha	11-April
Dhaka	Saghata	Gaibandha	12-April
Narayanganj	Islampur	Jamalpur	14-April
Narshingdi	Netrakona, Sadar	Netrakona	11-April
Gazipur	Netrakona, Sadar	Netrakona	11-April
Narayanganj	Ishwarganj	Mymensingh	11-April
Narayanganj	Matlab	Chandpur	11-April
Narayanganj	Ramgoti	Laxmipur	11-April
Dhaka	Ramgonj	Laxmipur	11-April
Dhaka	Nagarpur	Tangail	12-April
Dhaka	Damudya	Shariatpur	18-April
Dhaka	Kashiani	Gopalganj	16-April
Narayanganj	Kotalipara	Gopalganj	16-April
Narayanganj	Tungipara	Gopalganj	9-April
Dhaka	Bishwambarpur	Sunamganj	13-April
Narayanganj	Amtali	Barguna	16-April
Narayanganj	Kaliganj	Gazipur	13-April
Dhaka	Kaliganj	Gazipur	13-April
Narayanganj	Haripur	Thakurgaon	17-April