

Title: An Epidemiological, Strategic and Response Analysis of the COVID-19 Pandemic in South Asia: A Population Based Observational Study

Hafiz Muhammad Salman

Service Institute of Medical Sciences

Javaria Syed

Sargodha Medical College

Atif Riaz

Fatima Memorial Medical and Dental College

Zouina Sarfraz

Fatima Jinnah Medical University

Azza Sarfraz (✉ azza.sarfraz@aku.edu)

Aga Khan University

Syed Hashim Abbas Ali Bokhari

Aga Khan University

Ivan Cherrez Ojeda

Universidad de Especialidades Espíritu Santo

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Abstract

Background: South Asia has performed relatively better than initially during the COVID-19 pandemic. The overall burden and response have remained dynamic in the region with certain countries outperforming others despite limitations in health resources.

Methodology: Using a population-based observational design, all 8 South Asian countries were analyzed using a step-wise approach. Data were obtained from government websites and publicly available data for population dynamics and other facilities.

Results: South Asian countries have a younger average age of their population. Our findings demonstrate the inequitable distribution of resources centered in urban metropolitan cities within South Asian countries. Certain densely populated regions in these countries have better testing facilities and healthcare facilities that correlate with lower COVID-19 incidence per million populations. Trends of urban-rural disparities are not clear given the lack of clear reporting of the gap within these regions. COVID-19 vaccination lag has become apparent in South Asian countries with the expected time to complete the campaign being unfeasible as the COVID-19 pandemic progresses.

Conclusion: The focus on response in the South Asia countries has been on controlling peaks rather than curbing them. With a redesign of governance policies on preventing the rise of COVID-19 promptly, the relief on the healthcare system and healthcare workers (HCWs) will allow for adequate time to roll out vaccination campaigns with equitable distribution.

1. Background

Eight countries constitute South Asia including Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka, together forming the South Asian Association for Regional Cooperation (SAARC). As of May 10, 2021, this region is responsible for 25.26 million (15.83%) of the total number of COVID-19 cases and 0.29 million (8.69%) COVID-19 deaths globally (1). The South Asian countries are home to 23.75% of the global population and the transmission of COVID-19 in this region has remained dynamic (2). Initial projections predicted a higher burden of COVID-19 cases and deaths given the lack of adequate healthcare infrastructure to support the COVID-19 pandemic in South Asia (3, 4). Additionally, the presence of highly dense populations within urban settings and overall socioeconomic vulnerabilities in South Asia led to great concern from public health bodies across the globe (5). Within the developed countries, many patients that were admitted to the hospitals and at higher risk of mortality were minority ethnic groups including South Asians (6). Various underlying factors that were cited included a higher risk of comorbidities, especially diabetes which has been shown to increase the relative risk of the hazard ratio for mortality due to COVID-19 (7). The triad of compromised public health infrastructure, under-trained human resources, and contributory environmental factors have all been cited as vectors for further viral transmission in the South Asian region (8, 9). We aimed to elucidate the epidemiology,

preparedness, and strategies contributing to the dynamic spread of COVID-19 in this region. Further, we expanded on specific countries that have been unable to contain the pandemic.

2. Methodology

The study follows a population-based observational survey by obtaining data from government websites of SAARC (iedcr.gov.bd, covid.gov.pk, corona.mygov.in, covid19.gov.lk, <https://heoc.mohp.gov.np/>, updateon-novel-corona-virus-covid-19/, moh.gov.bt/novel-coronavirus-2019-ncov/, <https://covid19.health.gov.mv/dashboard/>, af.usembassy.gov/covid-19-information/), Statista, Worldometer, the European Center for Disease Control and Prevention (CDC), John Hopkins University of Medicine Coronavirus Resource Center, and the World Health Organization (WHO) dashboard. Population dynamics were obtained from country-specific latest Census Statistics and Statista when applicable. Other sources including peer-reviewed articles on the MEDLINE database, and journals including the New England Journal of Medicine (NEJM), The Lancet, British Medical Journal (BMJ), and the Journal of American Medical Association (JAMA) were also reviewed to obtain the latest updates on countries within SAARC. The analysis was conducted using data from government websites reporting reliable data (Fig. 1).

3. Current Situation In Saarc

Data were monitored between March 1, 2020, to May 10, 2021, to understand the transmission patterns among people within SAARC. Three countries have had the highest burden of reported COVID-19 infections, namely India, Pakistan, and Bangladesh, which have the highest population amongst the eight SAARC countries. As of May 10, 2021, over 24.63 million cases have been identified among these three countries, which is likely to be underestimated. Screening methods have incorporated airport screening from international travelers with no testing for intra-country travelers. Such screening is beneficial yet does not capture all the patients who are in their incubation period. Government-imposed social distancing and lockdown measures have been beneficial in the SAARC countries. However, the testing capacity and facilities have been sub-optimal. The three most impacted countries, India, Pakistan, and Bangladesh, had continued to report high cases in the post-lockdown period after June 2020.

3.1. Age-distribution Patterns

The median age of the population in SAARC countries ranges from 22.8 to 34 years in 2020 (Fig. 2). Among SAARC countries, the COVID-19 was reported most frequently among the age group below 50 years (10). A higher number of younger and middle-aged populations have been infected by COVID-19 in the SAARC countries. Attributed factors include environmental and individual including potential ignoring of social distancing protocols due to their compelling reason to continue working and maintaining employment (8). Higher incidence in the younger age groups has also been suspected due to effective following of social distancing and social welfare programs among older age groups (11). The case-fatality ratio (CFR) among the SAARC countries was 1.14%, lower than the global CFR of 2.08%. India has

the highest burden of deaths within the SAARC countries yet has a CFR of 1.09% which may be understood by its age distribution pattern. Globally, the most vulnerable age group to contract COVID-19 infection is within the age range of 18–64 years. However, the rate of death was 45 times higher among 30-39-year-olds and 8,700 times higher among those aged 85 years and older (12). Given the younger population of SAARC countries, it may be an underlying reason for the relatively lower CFR in this region.

3.2. The capacity of COVID-19 Testing

The testing capacity of SAARC countries has received attention with Bangladesh being criticized for testing a maximum of 15,000 tests for a population of 165 million (13). All the SAARC countries that had a high positivity ratio expanded their testing centers in the past year. The overall tests conducted in the countries with the heaviest burden of COVID-19 per 100 million people were the highest in India. Further, the number of testing facilities available per 100 million people is demonstrated in Fig. 3. Interestingly, India has performed the highest number of tests per million people followed by Bangladesh and Pakistan when compared to their testing capacity, demonstrated in Fig. 3. However, the overall burden of COVID-19 remains the highest in India. Across all these countries, there has been a gap between the testing centers in proportion to the population density. There is the minimal infrastructure to access rural and remotely-located districts, compounded with social distancing protocols, which points towards the availability of testing centers primarily in urban and semi-urban settings (14). There has been a recent spike in the incidence of COVID-19 across the SAARC countries which has been attributed to the downplaying of the nature of the pandemic, lack of precautionary measures taken among citizens, and delayed responses by the governments to contain the pandemic. Countries including Bhutan, Maldives, Nepal, and Sri-Lanka have performed much better than their SAARC counterparts due to timely action, and effective measures such as social distancing (9).

3.3. Responses to COVID-19

Following the confirmation of the first COVID-19 diagnosed case in each SAARC country, the number of critical days it took for the government to impose a lockdown was variable with Sri Lanka taking action before its first confirmed case. All the South Asian countries had imposed a lockdown within 1 month of the first diagnosed case except India, which took nearly 7 weeks to implement on March 25, 2020. However, South Asia took formidable action quicker than the United States, United Kingdom, and European countries. Despite nationwide lockdowns being implemented between March 15 to 25, 2020, the number of COVID-19 cases has continued to rise. The interventions in South Asia have focused on implementing strict lockdown measures through suppression. In-depth analysis has demonstrated the lack of adequate containment of COVID-19 among five countries including Afghanistan, Bangladesh, India, Nepal, and Pakistan. Overall, the CFR in South Asia has been observed to be lower than that of the developed countries. However, individual analysis of Pakistan and India places both these countries in the top 20 countries with the CFR and deaths per 100,000 populations. Figure 4 demonstrates the cumulative COVID-19 cases for all 8 South Asian countries since the start of the pandemic.

The majority of the heavily burdened countries in South Asia (India, Pakistan, and Bangladesh) have their population residing in rural areas with their economy dependent upon agriculture. The healthcare system

in South Asia follows a decentralized system with healthcare provision available through public and private hospitals in three countries (India, Pakistan, and Bangladesh). Limitations of healthcare resources among different states or regions within India, Pakistan, and Bangladesh have been cited as causative for inadequacy to limit community transmission. As of May 10, 2021, India has set up 2,542 testing facilities for its total population of nearly 1.38 billion people. The number of testing centers in Pakistan is 139 with its total population of 224 million people. Bangladesh received criticism for its inadequate number of testing facilities and since has set up 459 centers for its population of 166 million. There is a significant gap in the capacity of the testing center to serve more populated districts. The number of COVID-19 testing facilities per population density falls short as the most densely populated states have a relatively lower number of testing centers and a higher burden of case per million populations (table 1). In the South Asian region, there has been a shortage of hospital beds per state division. For instance, the number of beds in Islamabad, Pakistan, shows the availability of beds to be 1 for every 38 patients on average per 1 million people. States such as Uttar Pradesh in India and Dhaka in Bangladesh are observed to be more competitive due to a stronger healthcare system before the COVID-19 pandemic.

Table 1

Population density and COVID-19 resources among 5 districts of India, Pakistan, and Bangladesh. Five states with the highest population density were selected. *Not available for each district.

Country		Population density per sq. Km.	Number of COVID-19 testing facilities	COVID-19 cases per 1 million people	Number of hospital beds
India	Bihar	1,102	65	5,682	30,857
	West Bengal	1,029	128	10,878	113,535
	Kerala	859	159	56,965	99,227
	Uttar Pradesh	828	241	7,525	281,402
	Haryana	573	60	25,248	36,141
Pakistan	Islamabad	889	22	98,200	2,571
	Punjab	358	54	4,376	60,387
	Khyber Pakhtunkhwa	238	19	7,084	24,329
	Sindh	216	38	9,679	38,623
	Baluchistan	19	6	3,584	7,797
Bangladesh	Dhaka	1,751	454*	15,053	131,248*
	Mymensingh	1,074		852	
	Rajshahi	1,007		1,754	
	Rangpur	960		1,153	
	Chattogram	831		3,339	

Regardless, the data demonstrated in table 1 does not account for rural-urban divisions. The testing centers in terms of the highest population and density in India, Pakistan, and Bangladesh highlight a significant gap in the state of Bihar, and Kerala in India, and Islamabad and Khyber Pakhtunkhwa divisions in Pakistan. The gap has also been noted in Dhaka, and Mymensingh divisions of Bangladesh (13). These gaps identify a centrality of testing centers in urban metropolitan regions within the country as well as concentrated tertiary healthcare provision. It can be stated that these South Asian countries have a higher discrepancy in terms of allocation of hospital services, and testing centers. In India's recent wave, the number of testing centers and hospital bed facilities did not rise in proportion to the number of COVID-19 cases as well as medical staff and other technical facilities (15). The healthcare system in these countries has been cited as under-equipped to serve all the population not only in rural and remote settings but also urban settings as the cases increase in the metropolitan areas.

4. Vaccination Efforts

Lagging rollout of vaccinations has been noted in the SAARC countries as countries with higher burden including India, Pakistan, and Bangladesh relaxed physical restrictions and detection of new variants of COVID-19. Vaccine efforts are collective efforts by pharmaceutical firms and public health agencies. In the early phase of the COVID-19 pandemic in June 2020, the World Health Organization (WHO), Coalition for Epidemic Preparedness Innovations (CEPI), and Gavi, the Vaccine Alliance funded by the Gates Foundation, developed a global initiative to improve access to the COVID-19 vaccine (16). To distribute two billion vaccine doses in 2021, the initiative has started its roll-out in February 2021. Further, the pandemic response has been supplemented with aid from the World Bank to aid in vaccination access and rollout in the South Asian countries. Of all the South Asian countries, both Maldives and Bhutan have successfully administered the highest vaccinations per percentage of the total population. Per week, Maldives and Bhutan vaccinated 5.5% and 8.9% respectively. However, the three countries with the highest burden of COVID-19, namely India, Pakistan, and Bangladesh, had administered an average of 0.8%, 0.1%, and 0.4% per week of the total population. At this rate, India, Pakistan, and Bangladesh require 2.4 years, 19.2 years, and 4.8 years respectively to vaccinate their entire population. Other South Asian countries including Afghanistan, Nepal, and Sri Lanka also have a lag in access and rollout of the COVID-19 vaccines with respective countries requiring 19.2 years, 3.8 years, and 6.4 years. The percentage of the total population having received one COVID-19 dose is summarized in Fig. 5 with the latest estimates until May 19, 2021.

With a substantial amount of vaccination supply being provided by COVAX partners, two primary roadblocks need to be addressed during the vaccination campaign by South Asian countries that have lagged. There is an immediate need to increase the vaccine supply and re-strategize the setting for the distribution campaign. For instance, the rural population constitutes 63–65% of the three countries with the highest burden of COVID-19 (17). However, these settings have a scarcity of public health and primary care clinics (18). This warrants an equitable distribution through collaboration with primary care facilities and their communities. Alongside, as the vaccination campaign is rolled out, it is pertinent to control to high rate of COVID-19 transmission witnessed by certain South Asian countries. Such containment measures may be possible through transparent reporting of the data in a timely manner by the government, stopping mass religious or political gatherings, tracking hotspots, and necessitating masks and social distancing.

5. Discussion

There has been a notable difference in the testing strategies, laboratory strategies, and healthcare provision among and within South Asian countries (9). The differences across regions result in the presentation of inhomogeneous data. So far, South Asia has been observed to have lower CFRs which may be underestimated. The CFR of Pakistan is the highest in the South Asian region yet Pakistan has the lowest testing capacity in the South Asian region as noted in our analysis. However, in the initial phase of the COVID-19 pandemic, Pakistan's CFR was significantly lower which leads to the importance

of an inadequate surveillance system. With a growing number of cases, the CFR has increased in Pakistan which presents two possible dilemmas: 1) the number of individuals being tested is more severely ill resulting in an overestimation of CFR, and 2) the number of mild-to-moderate COVID-19 cases are under-represented due to under-testing of patients. A bias noted in the trends of CFR in South Asian countries may be present due to ongoing improvement in the testing capacity. The insufficient facilities and the ensuing community transmission during the early stage of the pandemic have not been met with adequate governance in the South Asian countries due to premature and discontinuation of social distancing policies (19).

Following trajectories of lockdown and post-lockdown trends in the SAARC countries, smaller countries were able to control their COVID-19 transmission. However, the three most affected countries (India, Pakistan, and Bangladesh) eased lockdowns without curbing the transmission of COVID-19 cases. Before recommending nationwide lockdowns during the ongoing wave of the COVID-19 pandemic, certain highly dense hotspots need to be taken into consideration such as Mumbai, Karachi, and Dhaka, the three most populated urban cities in India, Pakistan, and Bangladesh (9). Selective hotspots require localized lockdowns for 2–3 weeks with active surveillance and strict quarantine measures to control the outbreak from aggravating in these countries. A public health approach necessitates curbing the peak (the exponential growth in COVID-19 infection requiring medical supplies) a few weeks before it occurs. Gaps in response preparedness including shortages in hospital beds, ventilators, quarantine facilities, and lack of standardized treatment protocols due to different variants present delays in the healthcare system (20). SAARC countries have received resources such as testing kits, ventilators, vaccinations, and aid from international regulatory bodies. However, the overall health expenditure in the three most impacted and populated countries (India, Pakistan, and Bangladesh) is less than 1% of GDP (21). The total availability of hospital beds is lower than 10 per 1000 populations in all the SAARC countries except Bhutan (22). Further, the World Bank has predicted that SAARC countries will face their worst economic crisis due to the ongoing COVID-19 pandemic.

Within the socio-economic context of South Asia, the health systems already witnessed a scarcity in healthcare resources. The COVID-19 pandemic further aggravated the gaps in healthcare resources (14). The pressure to ease lockdowns was also felt due to the economic losses faced by these countries. As such, in the South Asian context, the lack of clarity within the urban-rural disparity in testing, vaccination access, and treatment presents as a challenge. High-burden countries (India, Pakistan, Bangladesh, Sri Lanka, and Afghanistan) have reported shortages in medical supplies such as oxygen, hospital beds, and personal protective equipment (PPE) (23). Alongside, the detection of emerging strains in India was compounded with a lack of mitigation strategies and the catastrophic second wave of COVID-19 in the country (15). With South Asia and other countries overestimating their status of herd immunity, it is pertinent to eliminate false reports (24). Misinformation concerning COVID-19 infection and vaccination needs to be addressed through education in attempts to eliminate vaccine hesitancy and application of safety protocols (masks, distancing) (25). A limitation of the available data from the government sites is the potentially substantial underestimation of the actual scenario.

6. Conclusions

The South Asian countries consist of a younger average population age demographic with urban settings being more densely populated. The urban-rural disparities have not been documented in national datasets despite the high ratio of populations belonging to rural settings. Medical supplies and health infrastructures are primarily focused in urban cities. Trends of COVID-19 burden in more populated regions are associated with an overwhelmed healthcare system and healthcare workers (HCWs) with draining medical supplies. The focus on restructuring the COVID-19 response in these countries ought to shift by curbing peaks before they occur and prepare vaccination campaigns with equitable distribution within these countries.

Declarations

Ethics approval and consent to participate: NA

Consent for publication: All authors consent to publication.

Availability of data and materials: The datasets generated and/or analyzed during the current study are available in country-specific government and publicly-available data repositories: iedcr.gov.bd, covid.gov.pk, corona.mygov.in, covid19.gov.lk, <https://heoc.mohp.gov.np/>, moh.gov.bt/novel-coronavirus-2019-ncov/, <https://covid19.health.gov.mv/dashboard/>, af.usembassy.gov/covid-19-information/, <https://www.statista.com/page/covid-19-coronavirus>, <https://www.worldometers.info/coronavirus/>, <https://www.ecdc.europa.eu/en/covid-19>, <https://coronavirus.jhu.edu/>, <https://covid19.who.int/>.

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Figures

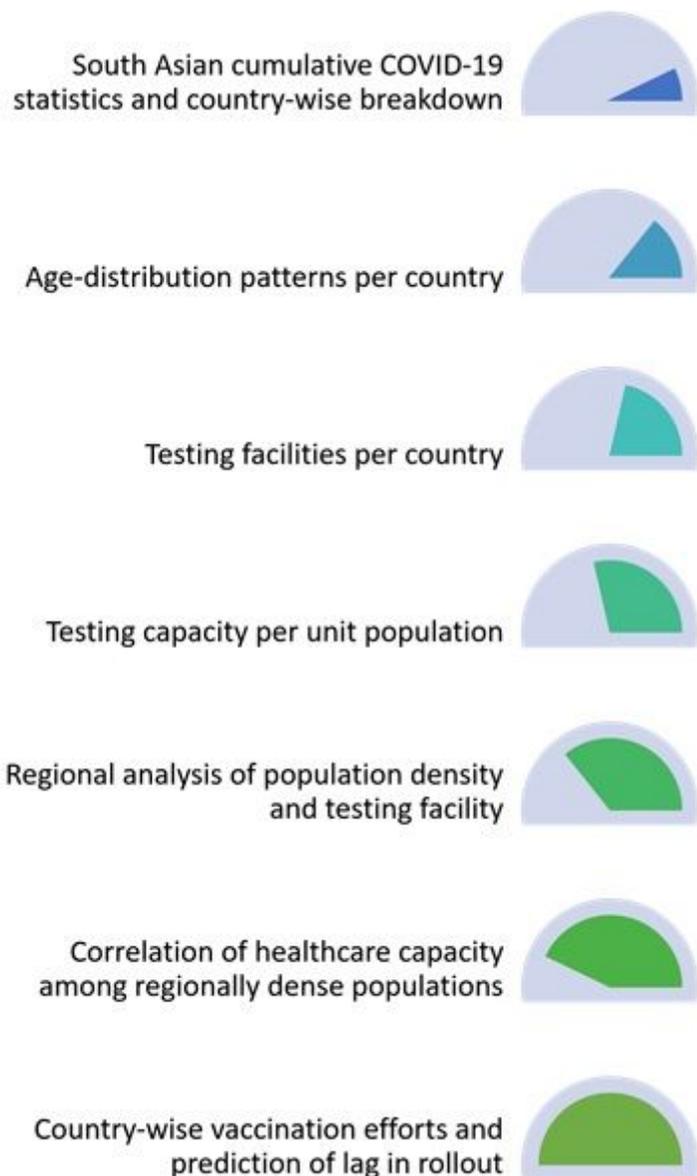


Figure 1

Step-wise breakdown of the employed methodology of epidemiological analysis.

MEDIAN AGE OF POPULATION IN YEARS

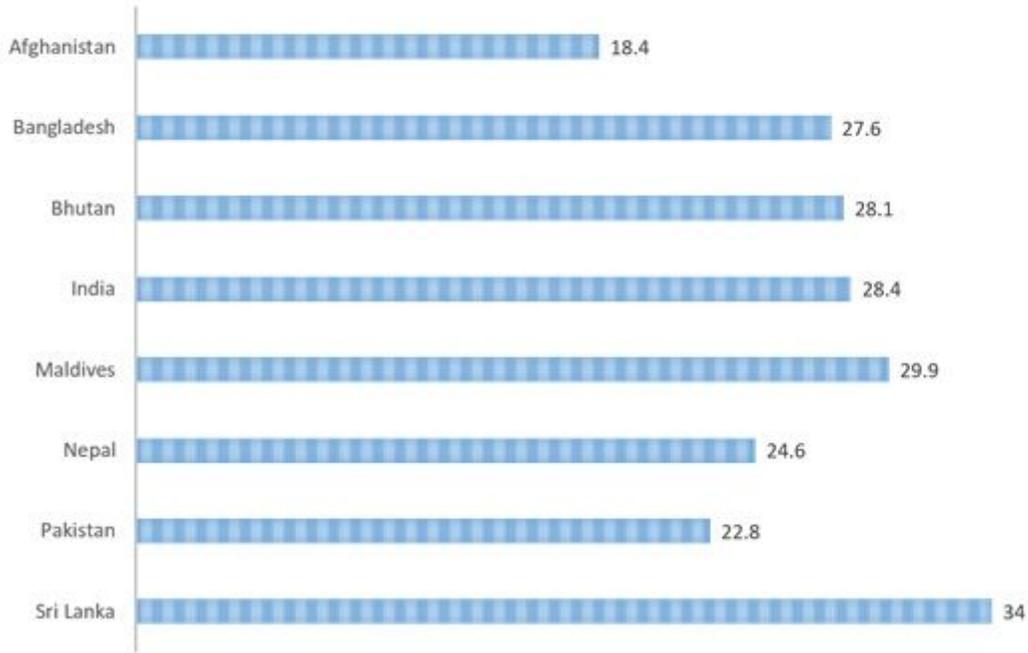


Figure 2

Median Age of SAARC Countries in 2020.

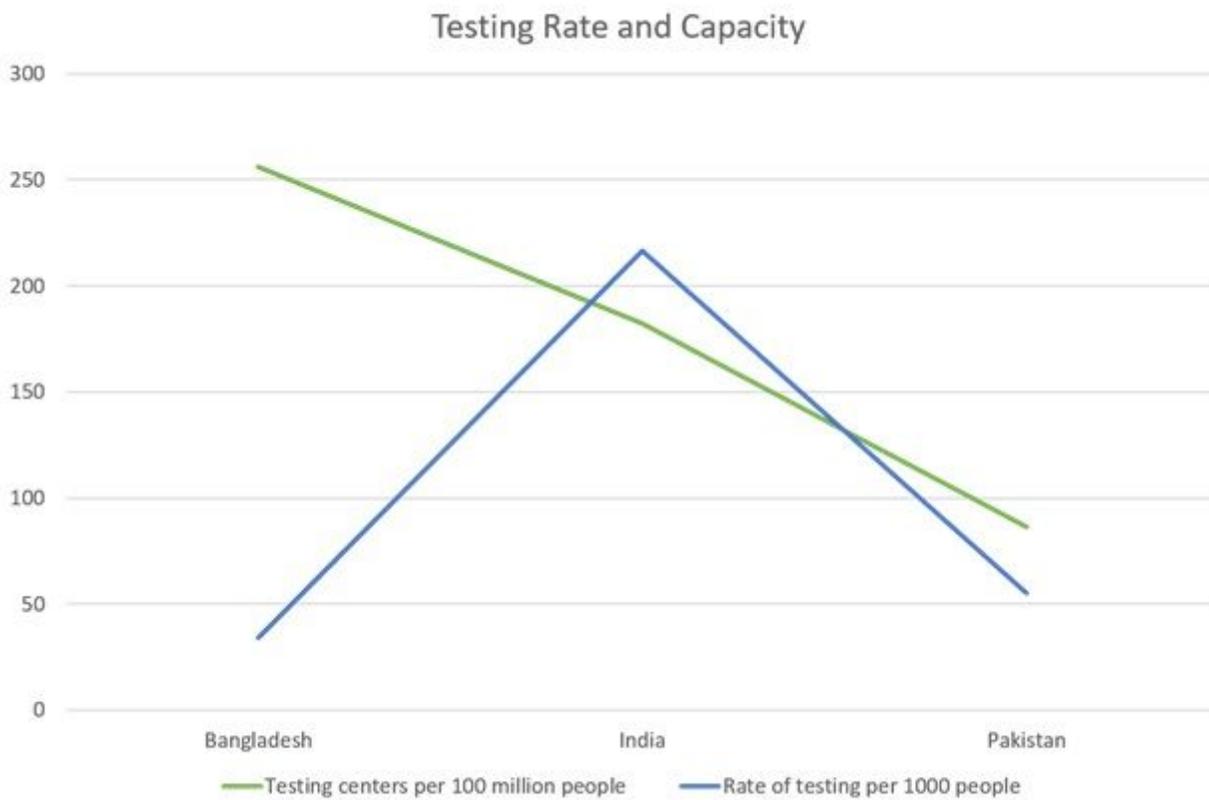
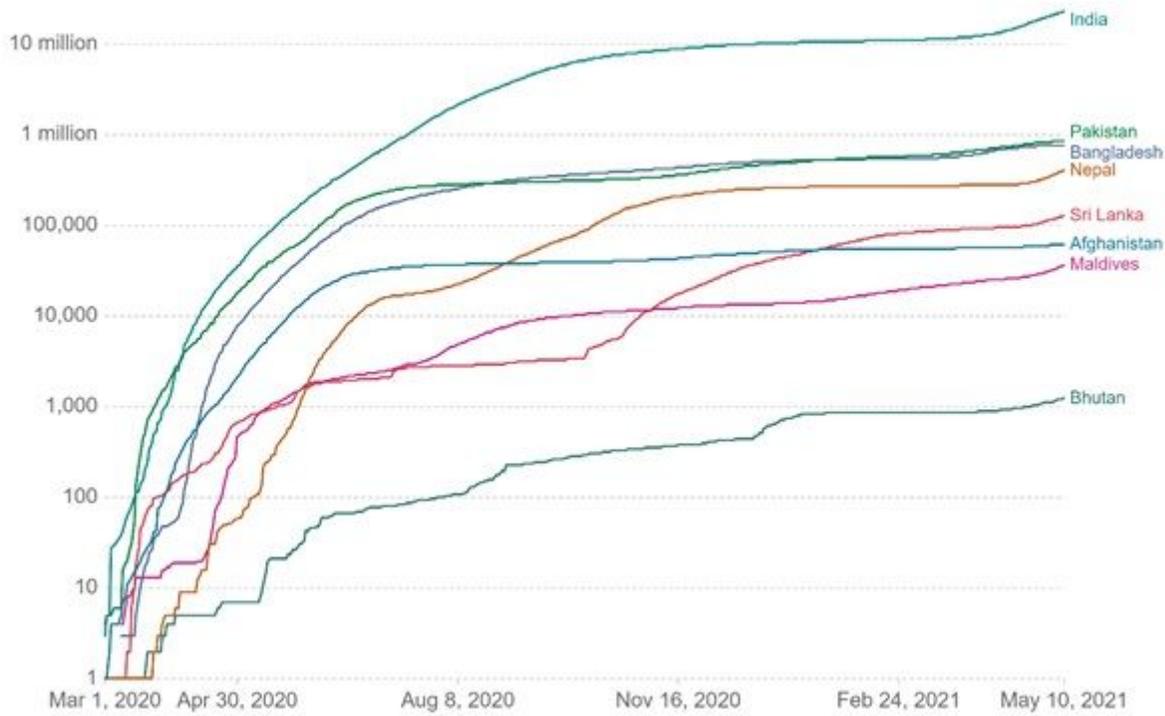


Figure 3

The number of testing centers per 100 million people and rate of testing per 1000 people in the SAARC countries with the highest COVID-19 cases.

Cumulative confirmed COVID-19 cases

The number of confirmed cases is lower than the number of actual cases; the main reason for that is limited testing.



Source: Johns Hopkins University CSSE COVID-19 Data

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Figure 4

Confirmed COVID-19 cases among SAARC countries.

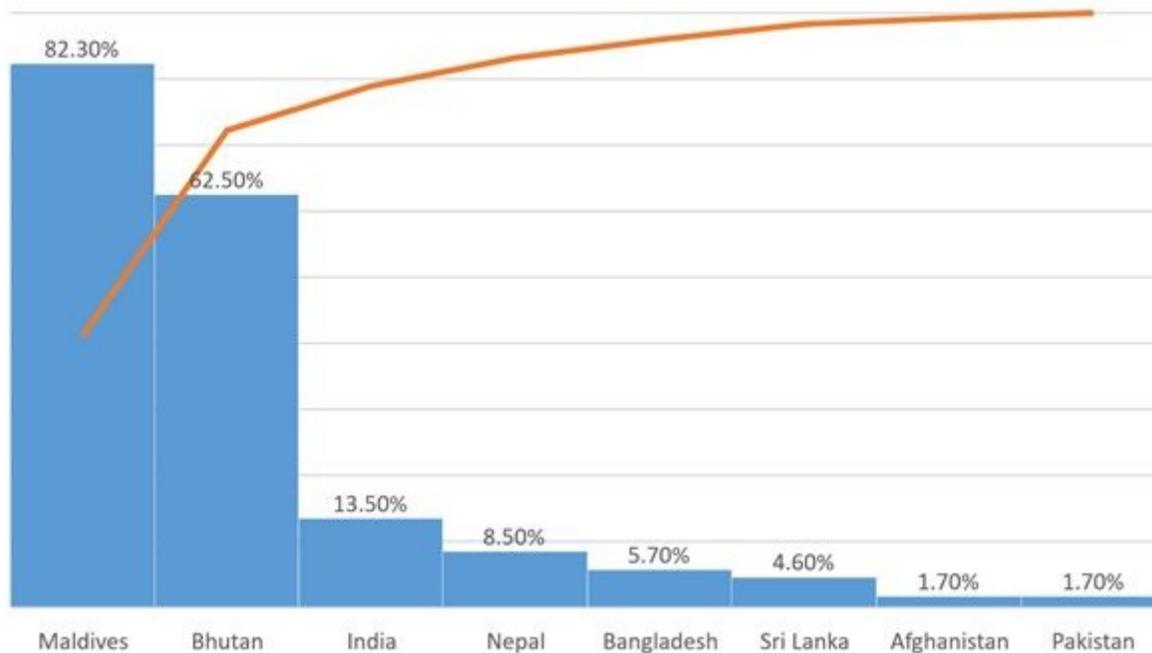


Figure 5

Percentage of the total population vaccinated among SAARC countries until May 19, 2021.