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A Descriptive Comparison of the Epidemiological Characteristics of Delta and Omicron Variant-Driven Outbreaks in Bhutan

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Simple Summary: This study aims to compare the epidemiological characteristics of Bhutan's two major SARS-CoV-2 outbreaks, driven by the Delta and Omicron variants. The findings corroborate the higher transmissibility of the Omicron variant compared to Delta. While symptoms of Omicron infection are largely similar to those of Delta, significant reductions were noted in the prevalence of symptoms such as shortness of breath and the loss of taste and smell. Additionally, a higher proportion of asymptomatic cases was observed with Omicron, suggesting reduced viral virulence. Though breakthrough infections among vaccinated individuals were common, the relatively mild clinical outcomes are likely due to high vaccination coverage and the decreased virulence of Omicron. The present study also highlights a shorter incubation period for Omicron, suggesting that the measures taken by the country in reducing the quarantine duration for international travelers and primary contacts were appropriate.

Abstract: SARS-CoV-2 rapidly mutated, causing different waves of outbreaks worldwide. Bhutan experienced three major outbreaks of COVID-19 before experiencing the outbreak driven by the Omicron variant in January 2022. The data collected by the National Outbreak Investigation and Surveillance Team during the Delta variant-driven outbreak and Omicron outbreak were accessed and analyzed. The data were analyzed using R statistical software. Descriptive analysis was carried out for the entire dataset and the statistical comparison between the two outbreaks was carried out using student's *t*-test and Pearson's chi-square test. During the Delta variant-driven outbreak, a total of 1648 cases were reported, with a daily average of 13 cases. The highest one-day case number reported was 99. On the contrary, within 33 days, a total of 3788 cases were reported with a daily average of 115 cases during the Omicron outbreak. The highest one-day case number reported was 312. The median incubation period was 3 days (range = 0–18 days) and 1 day (range = 0–14 days) during the Delta and Omicron-driven outbreaks, respectively. The number of symptomatic cases was significantly higher during the Delta outbreak (p-value < 0.0001). Of the total cases reported during the Delta outbreak, 1175 (71.3%) had received a single dose of the vaccine, 79 (5%) received two doses, while 394 (24%) were unvaccinated. During the Omicron outbreak, 1957 (52%) cases had received their booster (third dose), 904 (23.8%) received two doses and only 40 (1%) received a single dose of the vaccine. The number of unvaccinated cases was 887 (23.4%), of which 375 (10%) were children below 12 years. Our findings corroborate the enhanced transmissibility of the Omicron variant as reported elsewhere. We report significantly less symptomatic cases during the Omicron outbreak. Further, our data show that the incubation period for the Omicron variant is shorter compared to the Delta variant (p-value < 0.0001).

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1. Introduction

Coronavirus disease 2019 (COVID-19) caused by the severe acute respiratory syndrome virus 2 (SARS-CoV-2) was first reported in Wuhan, China, in December 2019. Subsequently, the outbreak spread rapidly across the world. On 30 January 2020, the World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern and a pandemic on 11 March 2020. As of 9 February 2022, COVID-19 has caused more than 401 million cases of infection and 5.7 million deaths [1]. Since the first outbreak in Wuhan, SARS-CoV-2 has mutated rapidly, resulting in the emergence of several new variants, consequently causing different waves of outbreaks [2,3]. Currently, the Omicron variant (B.1.1.529) and its subvariants continue to drive outbreaks around the world [4]. Omicron is known to have higher transmissibility and potential to evade a vaccine-induced immune response compared to the previous variants of concern [5,6]. However, there are reports of this variant being less virulent than the previous variants [7,8].

Bhutan experienced four major waves of outbreaks since the beginning of the pandemic in 2020. The first and second outbreaks were reported in August and December 2020, respectively. The third outbreak started in Phuentsholing municipality, a border town in the south of the country on 16 April 2021, two weeks after the first round of vaccination was completed in March 2021. The outbreak was driven by the Delta variant of SARS-CoV-2 and took around five months to contain [9]. Subsequently, the second round of vaccination was rolled out in July 2021, along with the rolling out of the primary dose of the vaccine for children between 12 and 17 years. In light of the emergence of the Omicron variant, the third round (first booster) of vaccination was initiated in December 2021 for prioritized groups of the population and is currently being carried for the entire population.

Later, the fourth outbreak of COVID-19 was officially declared on 7 January 2022, following the detection of a community case in Phuentsholing [10]. Sequencing of the viral variant during the early phase of the outbreak confirmed that the Omicron variant was driving the outbreak in the country [11]. Since then, cases have rapidly spread across the country. The aim of this study was to compare the epidemiological characteristics of the Omicron-driven outbreak with the Delta variant as these variants have dominated transmission globally within a short period of time.

2. Methods

2.1. Data Collection and Analysis

As per the National Preparedness and Response Plan for the outbreak of novel coronavirus (COVID-19)-2020, a National Outbreak Investigation and Surveillance Team has been formed which has remained active during the entire pandemic period, carrying out disease outbreak investigations, surveillance and contact tracing. Following the confirmation of a SARS-CoV-2 case using RT-PCR [12], the team collected details of the case through a telephonic interview and recorded the data in a Google Sheets-based database. The positive case was categorized as a community, contact or imported case based on the ability to determine the source of infection, thus informing the surveillance and response measures. The data collected during the Delta variant outbreak (16 April to 21 August) and the Omicron outbreak (7 January to 8 February) were accessed and analyzed using R statistical software (version 4.4.1) and the associated packages "dplyr", "ggplot", "stringr", "tidyverse", "janitor", "lubridate", "googlesheet4" and "ggpubr" [13].

Descriptive analysis was conducted for the entire dataset. The frequencies of the categorical socio-demographic variables were compared using Pearson's chi-square test. The mean of the continuous variables was compared using student's *t*-test. A 5% significant level was used to test statistical association.

The spatial mapping of the cases was carried out by districts, and the choropleth map was generated using the Quantum Geographical Information System (QGIS) [14]. The shapefiles for the political boundary and districts of Bhutan were obtained from the National Land Commission Secretariat of Bhutan.

For symptom reporting, information on the date of onset of symptoms and the types of symptoms was collected. Those who had either or both types of information were listed as symptomatic; however, symptom type was computed only for those who had provided their symptom details. For the purpose of analysis, symptoms were grouped under 21 broad categories, namely, headache, cough, fever, sore throat, nasal congestion, body ache, loss of taste, loss of smell, runny nose, diarrhea and abdominal discomfort, dizziness, malaise, chills, nausea, shortness of breath, vomiting, chest pain, eye pain, rashes, sneezing and loss of appetite. Symptoms like itchy throat, throat pain and dryness of throat were grouped under sore throat, nose block under nasal congestion, joint pain, backache, shoulder pain, lower back ache, neck pain and myalgia under body ache, tastelessness under loss of taste, giddiness under dizziness, red eyes, swollen eyes and tearing under eye pain, abdominal discomfort, stomach ache and diarrhea under diarrhea and abdominal discomfort, and fatigue, weakness and restlessness under malaise. Those who reported having flu-like symptoms were grouped under fever, runny nose and sore throat.

The incubation period was estimated by taking the difference between the date of onset of symptoms and the date of last contact with a positive case. The difference values which did not make epidemiological sense were removed. For instance, the differences with negative values, which could have resulted due to errors in data entry or due to the recall bias of the respondents, were discarded. Furthermore, as the duration of quarantine for primary contacts and those individuals entering the country was 21 days until the completion of the Delta variant outbreak, differences of more than 21 days were removed during the analysis.

2.2. Patient Involvement

Since this study involves secondary data analysis, no patients were involved. When the data were obtained for the analysis, all of the personal information was deleted.

2.3. Ethics Approval

Ethical approval was not sought for this study because the data were collected as part of an emergency response during a COVID-19 outbreak by the National Outbreak Investigation and Surveillance Team.

3. Results

3.1. Distribution of Cases

During the Delta outbreak, a total of 1648 cases were reported with a daily average of 13, and the highest one-day peak recorded was 99 cases (Figure 1). Of twenty districts, five Dzongkhags (districts) reported cases in the community, while four other Dzongkhags reported cases in the quarantine facility among international travelers and domestic travelers traveling from high-risk to low-risk districts.

Among the districts that experienced outbreaks in the community, Phuentsholing municipality under Chukha district was the worst affected (n = 757, 46%), followed by Samtse (n = 449, 27%), Samdrup Jongkhar (n = 220, 13.3%), Trashigang (n = 41, 2.5%) and Pemagatshel (n = 15, 0.9%). Chukha reported the highest number of imported cases (n = 127, 41.5%), followed by Paro (n = 90, 29.4%), Thimphu (n = 58, 16.3%) and Sarpang (n = 16, 5.2%). Of the total cases, 292 (17%) were community cases, while 1050 (64%) were contacts and 306 (19%) were imported cases from travelers traveling from high-risk to low-risk areas (Figure 2A). Only two mortalities were reported during the outbreak.

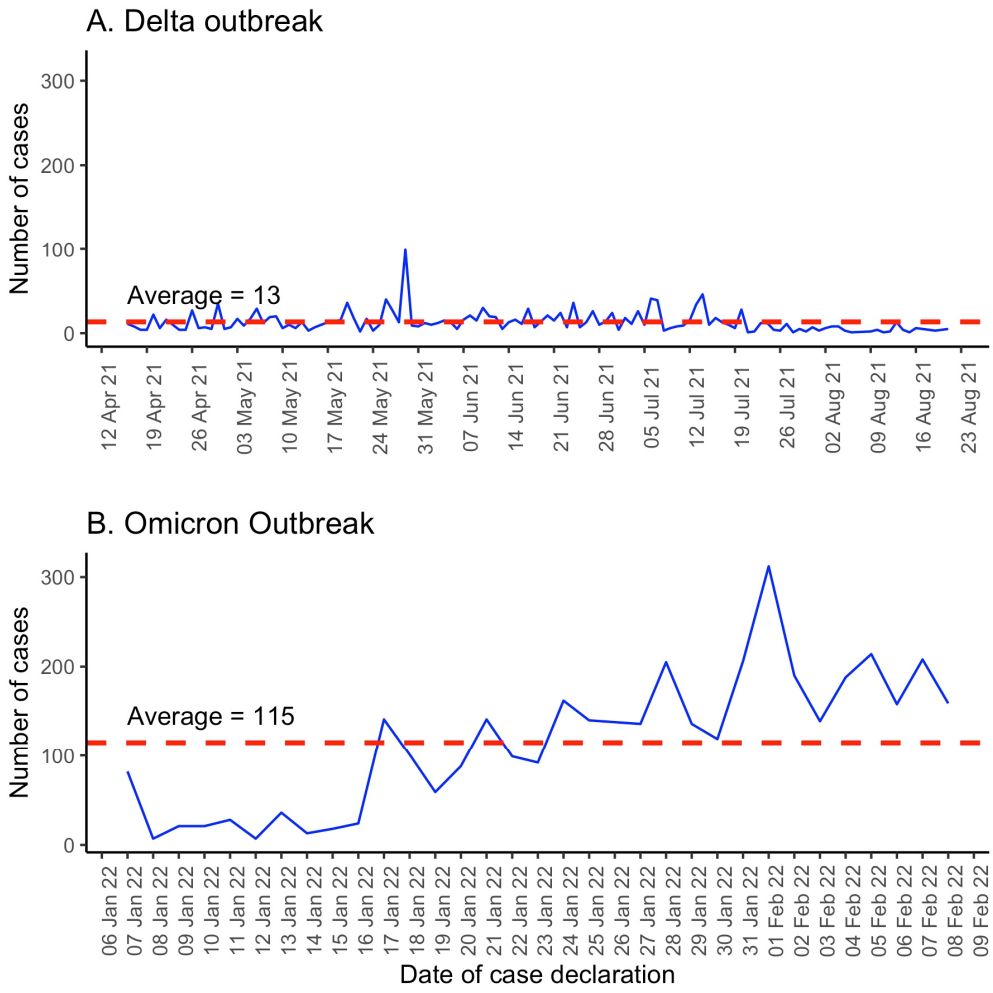

Figure 1. Trend of cases reported during Delta and Omicron outbreaks in Bhutan.

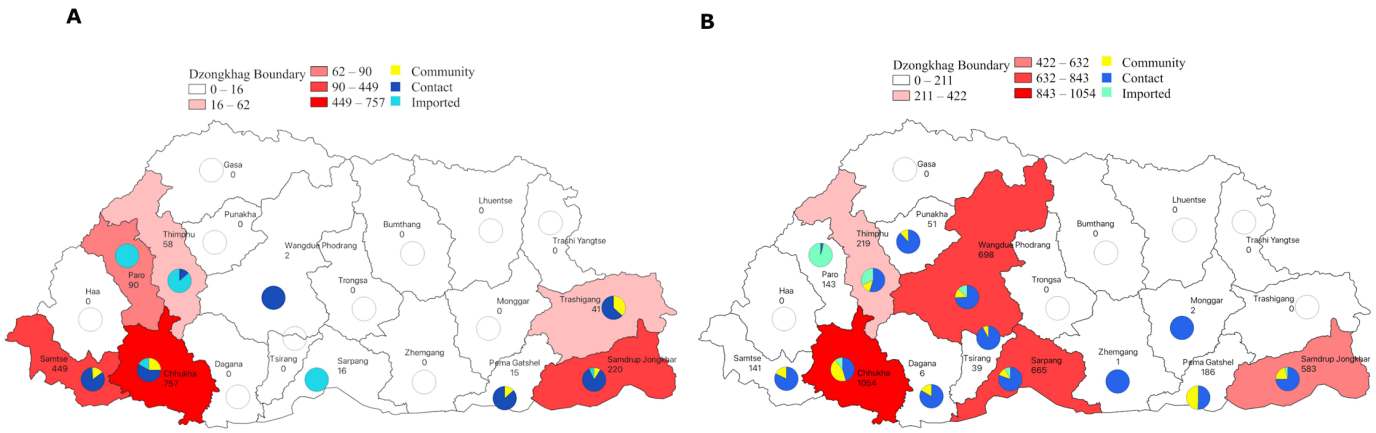

Figure 2. The choropleth map of Bhutan showing the distribution of cases by different case categories during the Delta (**A**) and Omicron outbreaks (**B**).

During the Omicron outbreak, in the span of 33 days, a total of 3788 cases were reported with a daily average of 115 cases (Figure 1). The highest one-day peak was 312 cases. Of the thirteen districts that were affected, the five most affected districts were Chukha (n = 1054, 28%), followed by Wangdue Phodrang (n = 698, 18.4%), Sarpang (n = 665, 17.5%), Samdrup Jongkhar (n = 583, 15.4%) and Thimphu (n = 219, 5.7%). A total of 905 (24%) were community cases, while 2394 (63%) were contacts and 488 (13%) were

imported (Figure 2B). Similarly, only two mortalities were reported during this period of the outbreak.

3.2. Socio-Demographic Characteristics

During the Delta outbreak, 942 (57%) cases were male and 706 (43%) were female. The mean age of the cases was 32.14 years (median 30 and range 0.08–93). The mean age of the male and female cases was 32.6 and 31.6, respectively. The difference in the mean age of male and female cases was not statistically significant. The vulnerable age group (those below 12 years and above 64 years) constituted 15% (246) of the total cases, while the rest of the proportion was between 13 and 64 years. In total, only 240 (14.5%) cases reported having comorbidities, of which 44 (2.6%) were among the vulnerable age group.

In the Omicron outbreak, the mean age of the cases was 30.2 years (median 28 and range 0.08–99). The mean age of the male and female cases was 32 and 27.8 years, respectively. The mean age of the male (32 years) cases was significantly higher than the female cases ($p < 0.05$). The vulnerable age group (those below 12 years and above 64 years) constituted 13% (463) of the total cases, while the rest of the proportion was between 13 and 64 years. In total, 412 (11%) cases reported having comorbidities. Only 54 (1.4%) cases among the vulnerable age group reported having comorbidities. The mean age of the cases was significantly lower than during the Delta outbreak (p-value < 0.0001).

The top four occupational groups reporting positive cases during the Delta outbreak were students, followed by private sector employees, farmers and house wives. Only six health workers were infected. Similarly, during the Omicron outbreak, most cases were students, followed by private sector employees, foreign expats and house wives. The details of the socio-demographic characteristics of positive cases during the two outbreaks are presented in Table 1.

Table 1. Socio-demographic characteristics of positive cases during Delta and Omicron outbreaks in Bhutan.

Socio-Demographic Characteristics	Categories	Delta Outbreak (n = 1648)		Omicron Outbreak (n = 3788)		Chi-Squared Test p-Value
		Frequency	Percent	Frequency	Percent	
Age group	0–5	66	4.0%	145	4.0%	<0.0001
	6–11	98	6.0%	223	6.0%	
	12–18	160	10.0%	284	7.0%	
	19–35	714	40.0%	1920	51.0%	
	36–64	528	32.0%	1121	30.0%	
	Above 64	82	5.0%	95	3.0%	
		1648	97.00%	3788	101.00%	
Gender	Female	706	43.0%	1510	40.0%	0.043
	Male	942	57.0%	2278	60.0%	
		1648	100.00%	3788		
Comorbidity	No	1408	85.0%	3376	89.0%	0.00014
	Yes	240	15.0%	412	11.0%	

Table 1. *Cont.*

Socio-Demographic Characteristics	Categories	Delta Outbreak (n = 1648)		Omicron Outbreak (n = 3788)		Chi-Squared Test p-Value
		Frequency	Percent	Frequency	Percent	
Occupation	Business personnel	25	1.5%	130	3.4%	<0.0001
	Civil servant	57	3.5%	142	3.7%	
	Corporate employee	59	3.6%	124	3.3%	
	Dependent/minor	77	4.7%	204	5.4%	
	Dessup (volunteers)	57	3.5%	246	6.5%	
	Driver	46	2.8%	217	5.7%	
	Farmer	183	11.1%	123	3.2%	
	Foreign expat	54	3.3%	395	10.4%	
	Health worker	6	0.4%	71	1.9%	
	House wife	136	8.3%	323	8.5%	
	Military	45	2.7%	201	5.3%	
	Private employee	296	18.0%	454	12.0%	
	Religious personnel	68	4.1%	45	1.2%	
	Student	356	21.6%	735	19.4%	
	Unemployed	63	3.8%	125	3.3%	
	Others	120	7.3%	253	6.7%	
		1648	100.20%	3788	99.90%	

3.3. Vaccination Status

During the Delta outbreak, 1175 (71.3%) of the cases had received a single dose of the vaccine, while 79 (5%) were fully vaccinated. Of the 394 (24%) unvaccinated cases, 298 were below 18 years of age and were not eligible for vaccination. Only 96 (6%) cases that were eligible for vaccination were unvaccinated (Figure 3)

In the Omicron outbreak, 1957 (52%) cases had received their booster shots (third dose), while 904 (23.8%) were fully vaccinated. Only 40 (1.1%) cases had received a single dose of the vaccine. The number of cases who were eligible for the vaccine but did not receive any vaccine was 512 (13.5%), while 375 (10%) cases were below 12 years of age and were not eligible for the vaccine (Figure 3).

3.4. Clinical Symptoms

In the Delta outbreak, the proportion of symptomatic and asymptomatic cases was 73.5% (1210) and 26.5% (438), respectively. Among the symptomatic cases, 317 (26.2%) cases reported having a single symptom, while 889 (73.5%) reported two or more symptoms. Four cases (0.33%) reported having symptoms but their symptoms were not recorded. The seven most commonly reported symptoms were cough (662), followed by fever (585), headache (542), sore throat (378), body ache (311), loss of smell (184) and loss of taste (152) (Figure 4).

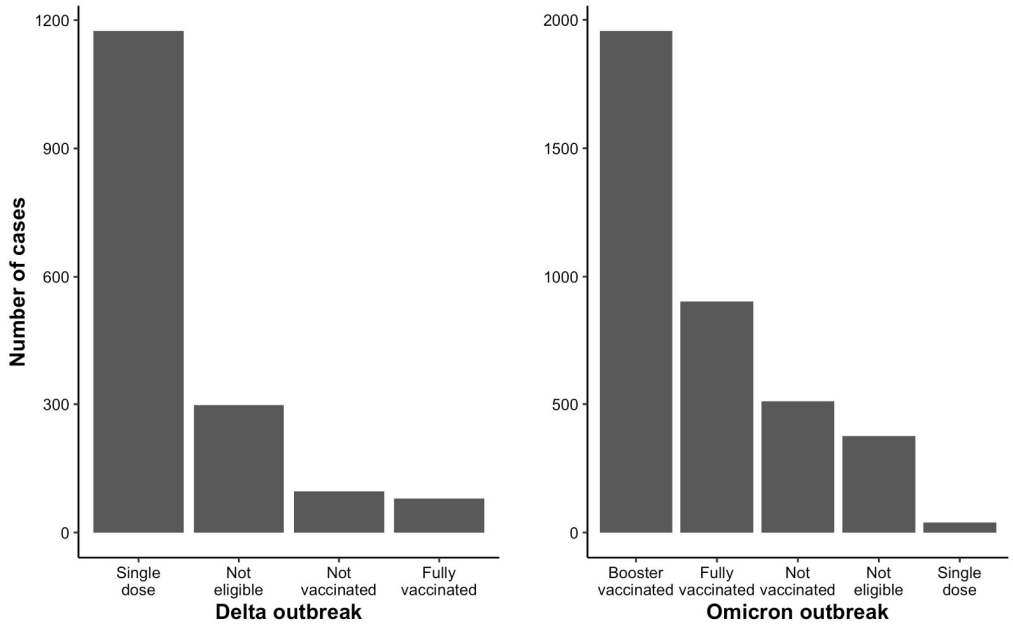

Figure 3. Vaccination status among the positive cases during the Delta and Omicron outbreaks.

During the Omicron outbreak, the percentages of symptomatic and asymptomatic cases were 56% (2123) and 44% (1665), respectively. Of the symptomatic cases, 785 (20.7%) cases reported having only one symptom, while 1296 (34.2%) reported having a combination of two or more symptoms.

The most commonly cited symptoms were cough (1243), fever (688), sore throat (642), headache (578), body ache (345), runny nose (283) and nasal congestion (258). Loss of smell was reported by 25 cases and loss of taste by 35. Of the total cases, only fourteen individuals reported experiencing shortness of breath (Figure 4). The number of symptomatic cases was significantly higher during the Delta outbreak compared to the Omicron outbreak (p-value < 0.0001).

3.5. Incubation Period

For the Delta outbreak, of the 298 observations with a record of the last date of contact and the date of onset of symptoms, 146 observations with values less than 0 and more than 21 were removed. The incubation period was estimated based on 152 observations. The mean incubation period was estimated as 4.29 days (95% CI = 3.7–4.9 days). The median incubation period was 3 days (range 0–18 days) (Figure 5).

For the Omicron outbreak, 491 observations were removed and the incubation period was estimated based on 402 observations. The mean incubation period was 2.15 days (95% CI = 1.9–2.4 days), and the median incubation period was 1 day (range 0–14 days) (Figure 5). When the difference of 0 days was removed from the analysis, the mean incubation period for Delta was 4.75 days and the median was 3 days; the mean incubation period for Omicron was 2.88 days and the median was 2 days. The incubation period during the Omicron outbreak was significantly shorter than during the Delta Outbreak (p-value < 0.0001).

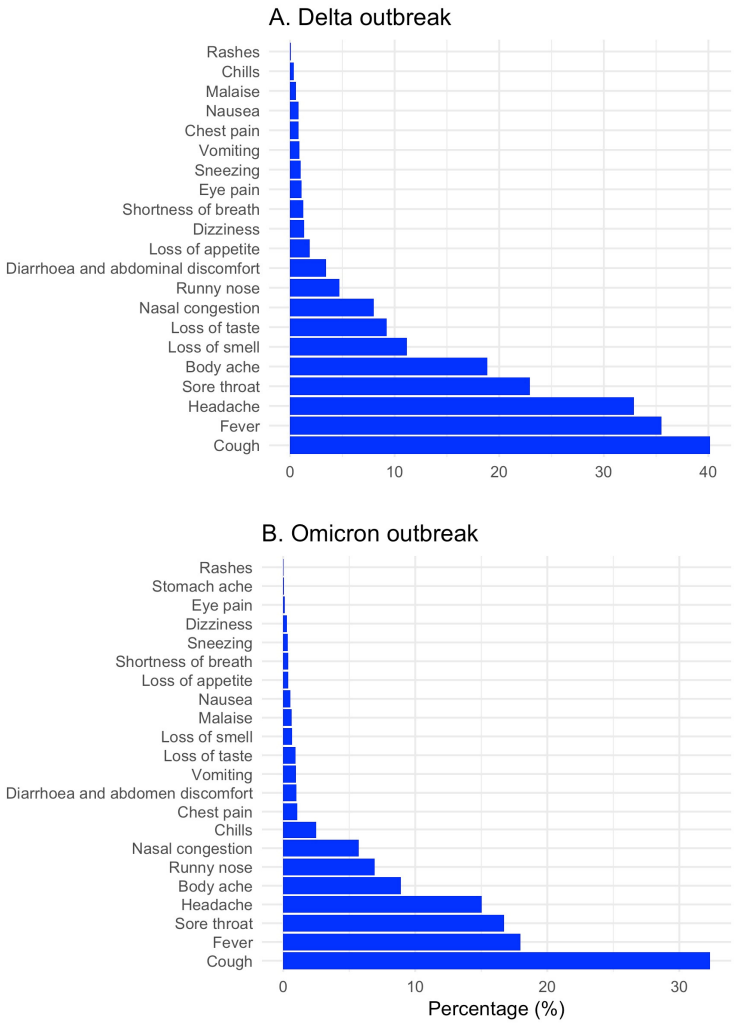

Figure 4. The distribution of symptoms reported during the Delta and Omicron outbreaks in Bhutan, presented as percentages of the total cases.

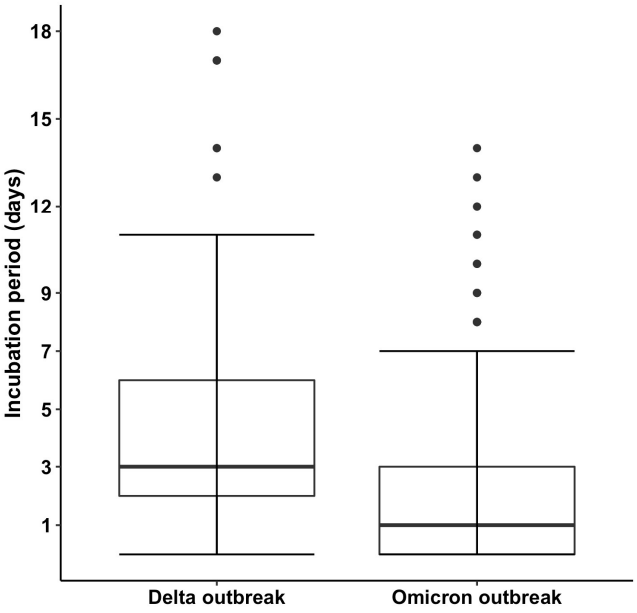

Figure 5. The distribution of incubation period (in days) during the Delta and Omicron outbreaks.

4. Discussion

Early evidence available detailing the characteristics of the Omicron variant showed that it is highly transmissible compared to the previous variants of SARS-CoV-2 [15]. The higher transmissibility of the Omicron variant was apparent from the manner in which the transmission occurred during the Omicron outbreak in Bhutan. Despite the conservative COVID-19 response measures implemented in the country, the high compliance of the general public to the public health and social measures, and the high vaccination coverage among the general population, the outbreak spread rapidly across the country. The number of cases reached 3788 within 33 days, with a daily average of 115 cases, compared to a total of 1648 cases with a daily average of 13 cases during the Delta outbreak. This observation supports the findings of the enhanced transmissibility of the Omicron variant reported elsewhere [16–23]. The occupational groups of the cases were similar during both outbreaks. However, a notable difference was the higher infection rate among frontline workers. The number of frontline volunteers, those who are engaged in essential supply deliveries and managing quarantine facilities, amongst others, and health workers infected during the Omicron outbreak was 246 and 71, respectively, compared to 57 and 6 during the Delta outbreak.

The frequency and magnitude of outbreaks can be linked to the level of ongoing economic activities and human population density within the district. For example, both outbreaks started from Phuentsholing town under Chukha district, the commercial hub of Bhutan. Despite the closure of international borders on 23 March 2020, the outbreak occurred due to the continued trade to maintain the supply of essential goods. A notable observation was that outbreaks primarily affected bordering districts, likely attributable to illegal movements across the border during the outbreak period. Similarly, the large number of positive cases in Wangduephodrang during the Omicron outbreak can be associated with the economic activities related to the two ongoing hydropower projects involving a large number of foreign expatriates working in the district and adding to the existing population. Additionally, Thimphu, the capital city of Bhutan, has consistently reported a higher number of COVID-19 cases during both outbreaks, which can be primarily attributed to its high population density facilitating the rapid spread once the infection was introduced.

During the Omicron outbreak, the five most commonly reported symptoms were cough, fever, sore throat, headache and body ache. Similar symptoms were reported for Omicron infection in the United Kingdom [24]. Unlike the Delta variant, symptoms like loss of taste (0.7%) and loss of smell (0.5%) were not commonly reported. This finding was in contrast to the symptoms reported from cases in France, where the loss of taste and smell were reported at a higher proportion, 8.3% and 9%, respectively [25]. Compared to the Delta variant, the number of asymptomatic cases was significantly higher for the Omicron outbreak. Our finding is in agreement with other studies that reported a higher proportion of asymptomatic cases during the Omicron outbreak [26,27]. This can be one of the indications of the reduced viral virulence, as reported elsewhere.

Both the Delta and Omicron variants have been reported to cause vaccine breakthrough infection [28–31]. Likewise, vaccine breakthrough infection was observed among individuals with different vaccination statuses during both outbreaks. Bhutan has achieved a very high vaccination coverage. About 98.3% of the eligible population has received at least one dose of the vaccine, while 94.5% has received two doses of the vaccine and 44.5% has received their third dose. The high vaccination coverage could be the reason for the lower mortality and decreased severity in both outbreaks. During the Delta outbreak, only two mortalities were reported in patients with comorbidities. Similarly, two mortalities have been reported in the Omicron outbreak in patients with renal failure and end-stage hepatic carcinoma. While there are no clinical data to compare the severity during the previous outbreaks, the Omicron infection in Bhutan is found to be milder, as reported in other countries [32–36]. The severity and mortality being reported in COVID-19 cases with comorbidities during both outbreaks underscore the need to protect the vulnerable population (those with comorbidities and the older section of the population).

Since the beginning of the pandemic, Bhutan has adopted one of the most conservative measures in combating COVID-19. This was in view of the limited health infrastructure, health workforces and scarce information about the virus. In doing so, Bhutan managed to keep morbidity and mortality from COVID-19 to the minimum level, for which Bhutan's response to the pandemic has been cited as exemplary and applauded across the world [37,38]. One such measure was the requirement for international travelers and primary contacts to undergo a mandatory 21-day quarantine, a policy that was based on the evidence of the longer incubation period reported for the previous variants of SARS-CoV-2 [39,40]. However, with the availability and uptake of vaccines and reports of a short incubation period for the Omicron variant, the quarantine duration for international travelers and primary contacts was reduced to 14 and 10 days, respectively. This decision was supported by data from the Omicron outbreak in Bhutan, which confirmed that the variant had a shorter incubation period compared to Delta [41]. Now, looking back, Bhutan's swift adaptation to evolving evidence—while maintaining public health safety—illustrates its dynamic and successful approach to managing the pandemic.

This study has several limitations. The information about the positive cases was collected immediately after a positive test, generally a period when they are worried and anxious. This will most likely have influenced the accuracy of the information that was collected. Furthermore, a recall bias must have been present in collecting the information about the last date of contact and the date of onset of symptoms as information collection requires the recall of memory. In addition, while estimating the incubation period, we removed the difference in days between the onset of symptoms and the last day of contact with a positive case that was more than 21 days. While we acknowledge this may affect the estimates for the incubation period, the authors feel that it was a reasonable approach given that the incubation period of COVID-19 is between 5 and 6 days, with the possibility of going up to 14 days [42]. Additionally, since it is established that asymptomatic carriers can contribute to the spread of infection, our work lacks data accounting for transmission from asymptomatic individuals. Due to the nature of our data collection method, we were unable to track transmission chains involving individuals who remained asymptomatic throughout the study period.

5. Conclusions

Our study corroborates the high transmissibility of the Omicron variant compared to the Delta variant. Further, we report that the symptoms of Omicron infection are similar to those of Delta infection; however, there is a substantial reduction in symptoms like shortness of breath, loss of taste and loss of smell. The asymptomatic proportion among cases was significantly higher in the Omicron outbreak, which could be an indicator for the decreased viral virulence. We also report a significantly shorter incubation period for the Omicron variant compared to the Delta variant. While breakthrough infection is common among vaccinated individuals, the observation of relatively milder clinical outcomes in the cases reported thus far can be attributed to the high vaccination coverage and the decreased virulence of the virus, as previously reported.

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