J Nepal Health Res Counc 2024 Apr.-Jun.; 22 (63): 252-257

Epidemiological and Spatial Distribution of COVID-19 Morbidity and Mortality in Nepal

Amod Kumar Poudyal,[1] Karuna Laxmi Shakya,[2] Vishnu Prasad Sapkota,[3] Rajan Paudel,[1] Salau Din Myia,[2] Pranil Man Singh Pradhan,[4] Dipak Prasad Upadhyaya,[1] Naresh Prasad Joshi,[1] Shital Shrestha[2]

[1]Central Department of Public Health, Tribhuvan University, [2]CiST College, Pokhara University,[3] Nepal Commerce Campus, Tribhuvan University, [4]Department of Community Medicine and Public Health, Maharajgunj Medical Campus.

ABSTRACT

Background: The Coronavirus (SARS-CoV-2) infection termed as COVID-19 was first detected in Wuhan, Hubei Province of China, in December 2019 and has been declared as a pandemic by the World Health Organization on January 30, 2020. The study aims to understand the time, place and person distribution of covid-19 morbidity, mortality of COVID-19 in Nepal.

Methods: The analysis produces the descriptive epidemiological features of COVID-19 pandemic in Nepal. The data was analysed to produce disaggregated case rate and case fatality rate across various time, place and personal characteristics aggregated at national and subnational level

Results: The study found that the observed case rate was significantly higher among males compared to females. Similarly, case rate was the highest among males of 31-40 years and females of 51- 60 years. Case fatality rate increased with age group. Above the age of 41-50 years, case fatality rate was higher among males compared to females. We observed that case fatality rate was disproportionately concentrated among the poor districts in terms of GDP

Conclusions: The observed case rate is significantly higher among males compared to females, however case fatality rate increased with age group. Case rate was found the highest in the Bagmati province followed by the Gandaki Province. However, case fatality rate was found the highest in hilly and mountain districts of Province 1, Gandaki and Karnali. Case fatality rate was disproportionately concentrated among the poor districts in terms of GDP.

Keywords: COVID19; morbidity; mortality; Nepal.

INTRODUCTION

Globally over 304 million COVID-19 cases have been confirmed and over 5.4 million deaths have been reported as of January 9, 2022.[1] Nepal has had more than 1,000,000 confirmed cases with over 12000 deaths with case fatality of 1.2% and a recovery of 98.1%.[1] Nepal reported its first case on January 13, 2020, and has undergone three waves of COVID-19.[2]

The impact of COVID-19 on Nepal has been multidimensional and significant effects were observed in the socio-economy and health sector.[3] As per the Asian Development Bank, there will be a 13% reduction in the gross domestic product, and more than 15000 people will lose their jobs.[4] The health sector suffered due to disruption in healthcare services putting vulnerable populations at risk. The pandemic affected the provision and utilization of health services.[5]

The country-level morbidity and mortality were studied to a limited extent, mostly focusing on the raw data of cases and deaths. We found no analysis covering socio-economic disparities for COVID-19 morbidity and mortality. It aims to understand the distribution of

Correspondence: Dr Pranil Man Singh Pradhan, Department of Community Medicine and Public Health, Maharajgunj Medical Campus, Institute of Medicine, Tribhuvan University, Kathmandu, Nepal. Email: pranil.pradhan@gmail.com, Phone: +9779841238435.

COVID-19 morbidity, and mortality of COVID-19 in Nepal. This analysis also uses district-wise data to cover the socio-economic distribution of COVID-19 morbidity and mortality.

METHODS

This section covers design, variables covered in the analysis, data collection techniques and tools, data management and analysis and methods to ensure reliability and validity.

The analysis produces the descriptive epidemiological features of COVID-19 pandemic in Nepal covering the period of June 2020-September 2021 using information from multiple secondary data sources.

The study variables were number of COVID-19 cases, deaths and recoveries on age, gender and districts, age and sex wise population across districts, district specific Gross Domestic Product (GDP) and per capita income. The sources of data were daily situation updates of COVID-19 produced by Ministry of Health and Population. Geographic Information System (GIS) map of Nepal was obtained from Central Bureau of Statistics (CBS). The age and sex wise distribution of population was obtained from the forecast report produced by CBS (population monograph).[6] The shape files for GIS map of Nepal was obtained from Ministry of Land Management, Cooperatives and Poverty Alleviation.[7] The district specific GDP was obtained from Nepal Human Development Report produced by UNDP.

Data was analysed in R software for statistical computing and graphics.[8] Based on the total number of reported COVID-19 cases and deaths, case rate (number of cases per 1000 population), case fatality rate (number of deaths per 100 cases) and survival rate (number of cases survived per 100 cases) were calculated. While calculating these three indicators, number of cases and number of deaths were age adjusted. Therefore, the indicators were standardized for the total population in each age group and gender using age weighing scheme. After getting weighted indicators, the indicators were calculated across age and sex, administrative boundaries and districts. 95% CI was calculated assuming a standard t-distribution. The district wise indicators were plotted in a GIS map. The distribution of COVID-19 across socioeconomic status was measured using concentration curve and index. The data was IC2 package in R(7).

The ethical clearance was obtained from Ethical Review Board of Nepal Health Research Council (Reference number 1924/2021).

RESULTS

This section covers findings related to COVID-19 morbidity, mortality and its distribution across demography, geography, administrative boundaries and economic status.

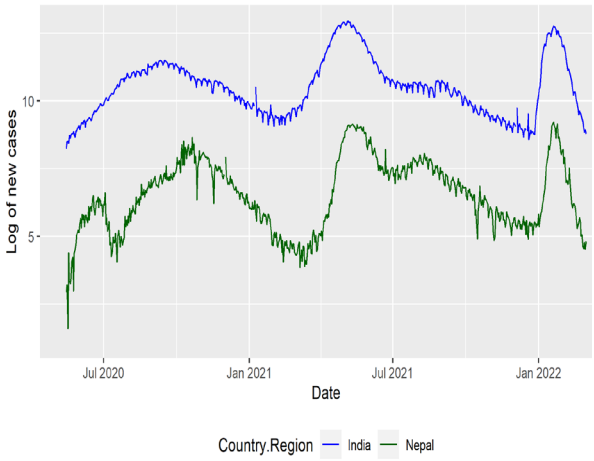

Figure 1. Distribution of COVID-19 cases over time.

Figure 1 shows the new cases (in natural log) between July 2020 and Jan 2022. When the series is expressed in the natural log, the difference in log of new cases between two points can be interpreted as time rate change of new cases over the period. Three periods of pandemic can be clearly observed in the trend-line, with peaks in October 2020, May 2021 and January 2022.. Each period is shorter than the former and the peak is slightly higher. Similarly, a clear lag can be observed in increase and decreases of cases between Nepal and India.

Table 1 shows case rate (cases per 1000 population)

across age and gender. The observed case rate is significantly higher among males compared to females. Among males, case rate is the highest among the age group of 31-40 years followed by 41-50 years. However, among females, case rate was the highest among the 51-60 years age group followed by 31-40 years age group.

Table 1. Age and sex wise distribution of COVID-19 morbidity and mortality.

Age group (years)	Case rate (per 1000)		Case fatality (per 100)	
	Male	Female	Male	Female
10 or less	2.73	2.10	0.660	1.862
11-20	6.89	4.90	0.434	0.433
21-30	40.57	20.30	0.352	0.492
31-40	54.01	24.62	1.247	1.337
41-50	42.34	22.69	2.777	4.192
51-60	40.26	25.47	6.634	4.253
61-70	31.75	21.58	9.418	6.432
71-80	31.28	22.88	16.815	11.758
80 or more	36.74	23.03	21.826	19.390

Similarly, case fatality rate (deaths per 100 cases) across age and gender is shown in last two columns. The case fatality rate increased with age group. This pattern holds consistently for both male and females. The case fatality rate was found nearly same up to the age group of 31-40 years. For the age group of 41-50 years, case fatality rate was found higher among females. Highest case fatality in both males and females was observed in age group of 80 years and above. Above the age of 41-50 years case fatality rate was found higher among males.

Table 2 shows distribution of COVID-19 morbidity and mortality across provinces. Case rate was found the highest in the Bagmati province followed by the Gandaki province. It is the lowest among Karnali Province and Province 1. The case fatality rate of COVID-19 shows different pattern. Province 1 was found on the highest position. Gandaki, Karnali and Lumbini provinces occupied 2nd, 3rd and 4th higher positions. In general, case fatality rate is higher among those provinces where case rate was lower.

Table 2. COVID-19 morbidity and mortality across provinces.

Province	Cases per 1000 population (95% CI)			Deaths per 100 cases (95% CI)		
	Average	Lower CI	Upper CI	Average	Lower CI	Upper CI
Koshi	11.91	5.16	18.67	2.25	1.46	3.04
Madhesh	12.85	3.16	22.54	1.13	0.86	1.39
Bagmati	44.26	17.71	70.80	1.12	0.76	1.48
Gandaki	25.15	12.60	37.70	1.79	0.83	2.75
Lumbini	17.97	9.95	25.99	1.61	0.94	2.27
Karnali	11.56	2.86	20.25	1.67	0.70	2.64
Sudur Pashchim	13.54	8.08	19.00	0.62	0.33	0.90

Figure 2 shows distribution of COVID-19 morbidity and mortality across geography. Upper part of the figure reports the case rate and lower part shows case fatality rate. Case rate was observed higher among the districts of Bagmati, Gandaki. Similarly, case rate was relatively higher among terai and hilly districts of Koshi, Lumbini and Sudurpachhim Province. Lowest level of case rate was observed among Upper hilly and mountain districts of Karnali, Sudurpachhim Provinces.

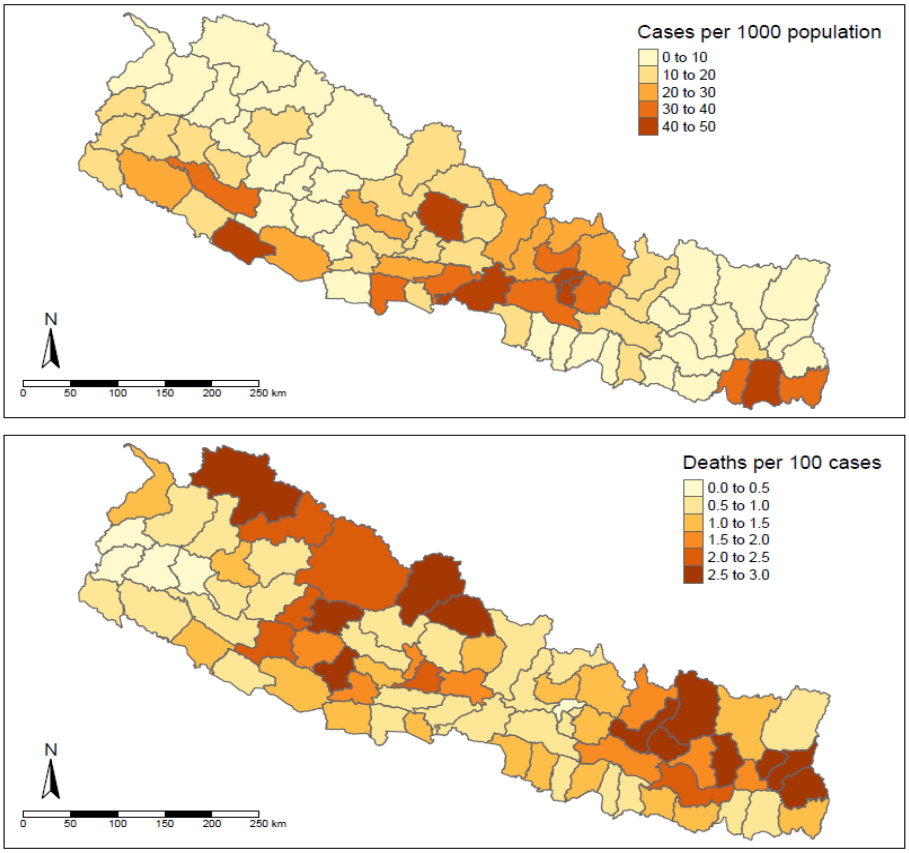

Figure 2. Distribution of COVID-19 cases and fatality rate over geography.

Lower part of the Figure 2 shows the geographical distribution of case fatality rate of covid-19. Case fatality rate was strikingly higher on the upper hilly and mountain districts of the provinces except for Gandaki province. Similarly, hilly districts of Karnali province and Province 1 cover higher case fatality rate. Some of the southern districts of Madhesh and Lumbini province also exhibit relatively higher COVID-19 case fatality rate.

Concentration curves measure the distribution of health variable across income.

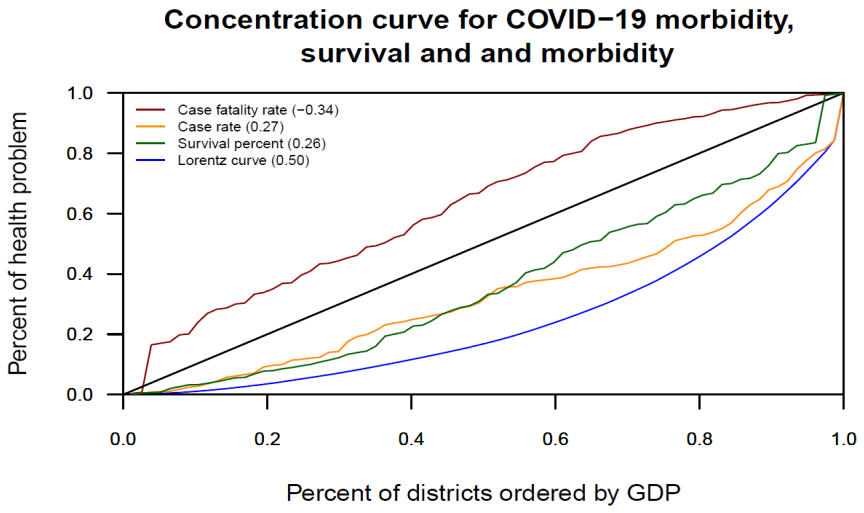

Figure 3. Distribution of COVID-19 cases and fatality rate over socio-economic status of districts.

Both case rate and survival rate curves are below the diagonal line. This indicates being infected and survival are concentrated relatively among the rich districts. The corresponding concentration indices are 0.27 and 0.26 respectively. The concentration curve for case fatality rate is above the diagonal line. This indicates that case fatality rate is disproportionately concentrated among the poor districts in terms of GDP. The concentration index for case fatality rate was found -0.34. (Figure 3)

DISCUSSION

The study found that the observed case rate was significantly higher among males compared to females. Similarly, case rate was the highest among males of 31-40 years and females of 51- 60 years. Case fatality rate increased with age group. Above the age of 41-50 years, case fatality rate was higher among males compared to females. Case rate and survival percent were concentrated relatively among the rich districts. However, case fatality rate was disproportionately concentrated among the poor districts in terms of GDP.

We found several studies reporting COVID-19 morbidity and mortality across age and sex that match with our findings using data of Nepal. A recent study in Brazil analyzed mortality differentials across demographic characteristics.[9] Specifically, the study found that death probability is lower among females and it also increasing with age. Another study in Ecuador also reported that COVID-19 cases were not uniform across age groups and gender.[10] Similarly, another study in Rajasthan-an Indian state, Hazard rate higher among the older age group.[11] A study conducted covering all the states of US showed that higher deaths among all age groups among males as compared to females.[12]

A few studies also explained the variation in mortality of COVID-19 across socio-economic status of the geographical areas. A study based on large-scale dataset of US reported that morbidity and mortality rates are higher in the geographies with higher level of poverty and unemployment rate. Similarly, the same study also reported differences in morbidity and mortality across states classified by Human Development Index.[12] Similarly, another study covering all the countries in Europe reported that for the COVID deaths, the highest association was found in Italy, Croatia, Slovenia, Austria. The moderate association was documented for Hungary, Greece, Switzerland, Slovakia, and the lower association was found in the United Kingdom, Ireland, Netherlands, Cyprus.[13] This suggests that the selected demographic and socio-economic components, including total population, poverty, income, are the key factors in regulating overall casualties of COVID-19 in the European region as well.

Despite the useful findings, this study is not without limitations. The COVID-19 morbidity and mortality is based on reported figures from the selected testing centres and hospitals. Actual cases can be higher than that reported as majority of COVID-19 infections are asymptomatic. Similarly, this pattern is likely to be the highest among the remote districts of Nepal. We used GDP of districts reported by World Development Report 2016.[14] This was the latest data on GDP of the districts. We used it to explain the variation in COVID-19 morbidity and mortality across the districts.

CONCLUSIONS

The observed case rate is significantly higher among males compared to females. Similarly, case rate was found the highest among males of 31-40 years and females of 51-60 years. Case fatality rate increased with age group. Above the age of 41-50 years, case fatality rate was found higher among males compared to females. Case rate was found the highest in the Bagmati province followed by the Gandaki Province. However, case fatality rate was found the highest in hilly and mountain districts of Province 1, Gandaki and Karnali. Case rate and survival percent were concentrated relatively among the rich districts. However, case fatality rate was disproportionately concentrated among the poor districts in terms of GDP. Case rate and case fatality rate are higher among higher age group individuals and among males compared to females. This information should be used while preparing treatment priority setting and strategies during pandemic. Case rate and survival percent were concentrated relatively among the rich districts. This should be used while prioritizing and allocating resources to districts for COVID-19 management. Poor districts should be prioritized in strengthening the capacity of health systems at national level to address COVID-19.

ACKNOWLEDGEMENTS

The authors acknowledge the University Grants Commission for supporting this study (CoV-76/77-03). The authors would also like to acknowledge Prof. Bishnu Raj Tiwari and Dr. Tarja Kinnunen for their input and support during the study.

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