Evolution of the pandemic: Analysis of demographic characteristics of COVID-19-infected patients during its two waves in Gwalior district of central India

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Abstract

Background: Studies of pandemics in past centuries have suggested that the second wave was always more lethal and devastating as compared to the first wave. Regarding coronavirus disease (COVID) pandemic also, various speculations were made that during the second wave virus changes its nature either for age structure, gender or rural–urban differential. Present study was aimed to compare the demographic and mortality profile of COVID-19 patients during the two waves. **Materials and Methods:** A total of 51,425 individuals with 16,538 cases from first wave and 34,887 cases from the second wave were included in the study. Frequency, percentage, case fatality rate (CFR) and OR (95% CI) were calculated. Level of significance was considered at 5%. **Results:** Maximum cases were observed in the age group 21–30 years (23.7%). During the first wave, 29.5% females were infected while during the second wave 38.5% females were infected. Infection in rural areas increased to 5.7% as compared to 4.8% in the first wave. Among the females, CFR increased to 37% in second wave which was 25.2% in the first wave. Disease load was at its peak in the month of April 2021. **Conclusion:** During the second wave, infection rate and mortality were higher in females and patients residing in rural areas showing extension of community spread. Patients with age above 50 years succumbed more. Occurrence of more than two-fifth of the cases in a single month (April 2021) shows a need for better planning for the supposed third wave to tackle any unwanted situation.

Keywords: Age, case fatality rate (CFR), first wave, pandemic wave, second wave

Introduction

Coronavirus disease 2019 (COVID-19) pandemic and the havoc and devastation caused by it across the globe have dominated the scientific and social discourse since early 2020. As we enter in second half of year 2021, more than 17.3 crore have been infected worldwide, of which more than 37 lakhs have succumbed to it.[1] The damage done to livelihoods, economy and psyche of human race is beyond any measure. India was able to put up a brave fight against this enemy throughout 2020. Through proactive approach of a very stringent lockdown, our country was able to minimize the damage. Although even with very high total number of cases, India could claim to have lowest mortality rate and highest recovery rate among the large countries of the world.[2] With the dawn of New Year 2021 came the good news and two indigenous manufactured vaccines were approved and largest vaccination programme was rolled out.[3] It seemed that war with COVID was about to be won by January–February, daily average cases came down to 12,000/day from peak of 96,000 (September) and daily fatality fell below 100/day.[4,5]

Restrictions and lockdown were eased and all social, political, cultural and economic activities were limping back to

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pre-COVID era. Experts kept on warning about the risk of second wave, about the mutation of virus, about continuation of precaution and COVID appropriate behaviour. The communication from the government and of experts seems to go unheard. Daily cases began increasing by March 2021, "which marked the beginning of second wave."[6] Association of Schools of Public Health in the European Region defined second wave as a resurgence of the incidence rate during a pandemic, which cumulatively presents an exponential increase in the number of cases of the disease in a given time period and specific territorial zone. This exponential increase follows from the disappearance or near disappearance of cases of the disease and may be influenced by a new behavioural characteristic of the infectious agent or a modified characteristic from another already known.[7] Within few weeks daily case and fatalities grew exponentially and crossed previous peak by many folds. By April end as daily case crossed 400,000 per day, India broke world records of both daily cases and fatalities reported in any nation ever.[8] The entire health system collapsed. The scenes of shortage of oxygen, hospital beds, medicines and even cremation spaces would continue to haunt the nation's consciousness for decades to come. These scenarios clearly show that the second wave was much larger in magnitude, as compared to the first wave but very little information exist about the demographic characteristics like age, sex and rural–urban differential. For a country like India, primary care physicians are the backbone of its health system; their role in pandemic has been significant which involved screening of suspected COVID-19 patients, specimen collection, maintenance of fever outpatient services, treatment and follow-up of mild or moderate COVID-19 cases in a hospital and management of staff involved in COVID-19-related activities.[9] But for some private primary care physicians, this pandemic has affected their practices and resulted in loss of livelihood.[10] Taking into consideration the non-specific manifestations of this infection, even more pressure is placed on primary care physicians in making decisions on which suspected/confirmed COVID-19 patients to send home, refer to a specialist or send to hospital.[11] Despite the rapidly evolving body of literature on COVID-19 disease, the level of primary healthcare physicians' knowledge about the disease and the available interventions is lacking which has only added up to the panic.[12] Primary physicians can be an important link in early interception of the disease and educating them is the only way to fight it out.

So, the present study was planned to elucidate the change in epidemiology of the coronavirus and characterize its potential impact in Gwalior district during the two waves. Analysis of health data was done with the following objectives:
(1) To study and compare the demographic profile of COVID-positive cases during the two waves in Gwalior.
(2) To study case fatality rate (CFR) as mortality indicator with its association with demographic determinants during the two waves.

Materials and Methods

The present study was a cross-sectional study done in Gwalior, Madhya Pradesh, India. In this, COVID-19-related data were collected from the integrated disease surveillance programme (IDSP) unit of Gwalior district and were analysed. The study is based on the analysis of available secondary data. Written permission was taken for data retrieval and its utilization for research purpose only. All confirmed COVID-19 cases reported between 30 March 2020 and 17 May 2021 (till the data retrieved) were taken. For the given period, a total of 51,425 individuals were found as confirmed infected cases of COVID-19 while 506 deaths were reported among them. For the given data set, during the first wave, cases started declining from the end of month January 2021 and it reached to one case on 20 February 2021 and then again resurgence in the number of COVID-positive cases; thus, the period of 30 March 2020 to 20 February 2021 is considered as first wave period and 21 February 2021 to 17 May 2021, as second wave period of COVID-19 wave. During the first wave, total 16,538 cases were reported while during the second wave just in the 3-month duration, 34,887 cases were reported. Mean, median and percentages were computed and univariate Chi-square test was performed for the categorical variables. Baseline characteristics of the study participants were summarized and categorized in two groups based on survival after COVID-19 or mortality. CFR was also calculated. Logistic regression was used to check independent association of different factors affecting the deaths of the COVID-19-infected individuals. The data were entered into a Microsoft Excel spreadsheet. All the statistical analysis was carried out using SPSS version 20.0. A *P* value of less than 0.05 was considered statistically significant at 95% confidence level.

Results

A total of 51,425 patients of COVID-19 were included in the analysis [Table 1]. Mean age of the patients was 40.57 (±17) years. The most affected age group was 21–30 years with 23.7% of all the patients. During the first and second wave, the most affected age group was 21–30 years, followed by 31–40 years, followed by 41–50 years, followed by 51–60 years. This was showing the significantly decreasing trend after the age group 21–30 years. Male were found to be more affected (64.4%) with COVID-19 pandemic in the district. As compared with the first wave, females were affected 1.50 times more in the second wave. Majority of patients were residents of urban areas (94.6%). As compared with first wave, residents of rural areas were affected 1.18 times more during the second wave. Maximum patient preferred to stay at home (82.3%) instead of getting themselves admitted to the hospital. Total 1% deaths occurred in all (cumulative) the infected patients. During first wave 98.6% patients survived and during second wave 99.2% of the total patients recovered [Table 1].

The age–sex distribution of patients during the two waves is shown in [Figure 1].

Table 1: Distribution of demographic characteristics of COVID-19 cases in two waves					
Variables	**Total *n*=51,425**	**First wave *n*1=16,538**	**Second wave *n*2=34,887**	**Chi-square, *P***	**Crude odds ratio for the second wave OR (95% CI)**
Age group					
≤10	1094 (2.1%)	348 (2.1%)	746 (2.1%)	25.677, 0.002	0.93 (0.48-1.80)
11-20	4027 (7.8%)	1311 (7.9%)	2716 (7.8%)		0.90 (0.47-1.73)
21-30	12,177 (23.7%)	3983 (24.1%)	8194 (23.5%)		0.89 (0.46-1.71)
31-40	10,782 (21.0%)	3281 (19.8%)	7501 (21.5%)		0.99 (0.52-1.90)
41-50	8453 (16.4%)	2677 (16.2%)	5776 (16.6%)		0.93 (0.49-1.79)
51-60	7865 (15.3%)	2601 (15.7%)	5264 (15.1%)		0.88 (0.46-1.68)
61-70	4739 (9.2%)	1594 (9.6%)	3145 (9.0)		0.85 (0.44-1.64)
71-80	1792 (3.5%)	583 (3.5%)	1209 (3.5%)		0.90 (0.46-1.74)
81-90	453 (0.9%)	147 (0.9%)	306 (0.9%)		0.90 (0.46-1.78)
91-100	43 (0.1%)	13 (0.1%)	30 (0.1)		1
Gender					
Female	18,324 (35.6%)	4876 (29.5%)	13,448 (38.5%)	401.856, 0.0001	1.50 (1.44-1.56)
Male	33,101 (64.4%)	11,662 (70.5%)	21,439 (61.5%)		1
Place of residence					
Rural	2774 (5.4%)	799 (4.8%)	1975 (5.7%)	15.139, 0.0001	1.18 (1.09-1.29)
Urban	48,651 (94.6%)	15,739 (95.2%)	32,912 (94.3%)		1
Isolation status					
Home isolation	42,330 (82.3%)	9104 (55%)	33,226 (95.2%)	12448.14, 0.0001	16.33 (15.41-17.31)
Admitted in treatment facility	9095 (17.7%)	7434 (45%)	1661 (4.8%)		1
Death status					
Recovered	50,919 (99.0%)	16,308 (98.6%)	34,611 (99.2%)	41.403, 0.0001	1.77 (1.48-2.11)
Death	506 (1.0%)	230 (1.4%)	276 (0.8%)		1

Table 2 shows that the age group 61–70 years was worst affected in terms of fatalities with maximum deaths (28.1%). CFR in age group 61–70 years was 4.27% and 2.35%, respectively, for first and second wave. During the first and second wave, CFR was highest in the 81–90 age groups, that is, 15.65% and 5.23%, respectively. A total of 68.4% deaths occurred among the males. In both waves, CFR was also seen to be higher among males 1.47% and 0.81%, respectively. Among the residents of urban areas, CFR during first and second waves was observed as 1.43% and 0.80%, respectively. During the second wave CFR was increased to 16.13% from 2.77% in the first wave for the patients who were admitted in treatment facilities, showing the high fatal nature of virus during the second wave.

By observing Table 2, it was found that for all the variables during the second wave CFR was lesser as compared to the first wave except for two situations. First, among the people residing in the rural areas and second, among individuals admitted in the treatment facility.

The month of April (2021) bears the brunt of the cases as maximum cases (43.5%) were reported in this month only; in other words, the peak of the second wave was observed in April [Figure 2]. While during first wave maximum cases were seen in September 2020 which recorded 10.22% cases (peak of first wave) followed by August 2020 (6.34%), in the remaining months, proportion were less than 5%. CFR was seen highest in the month of February 2021 (2.5%) period of end of first wave, second highest CFR was seen
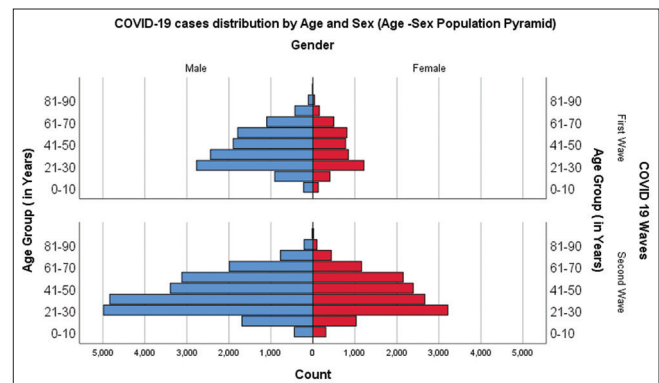
Figure 1: Showing age and sex wise distribution of COVID-19 cases

in August 2020 just before the peak of first wave, followed by May 2020 (1.68%), October 2020 (1.68%), September 2020 (1.46%). In the months of April 2021 and May 2021, CFR was 1.12% and 0.14%, respectively. Overall case fatality was found as 0.98% [Table 3].

Discussion

The first case of COVID-19 in Gwalior was reported in the last week of March 2020, the total number of infected had reached 51425 and the number of deaths had reached 506 as of 17 May 2021. This article compares the demographic characteristics of and response to the two waves of COVID-19 in Gwalior during 2020–2021 to provide a reference for the next step in epidemic prevention and control and also as a means
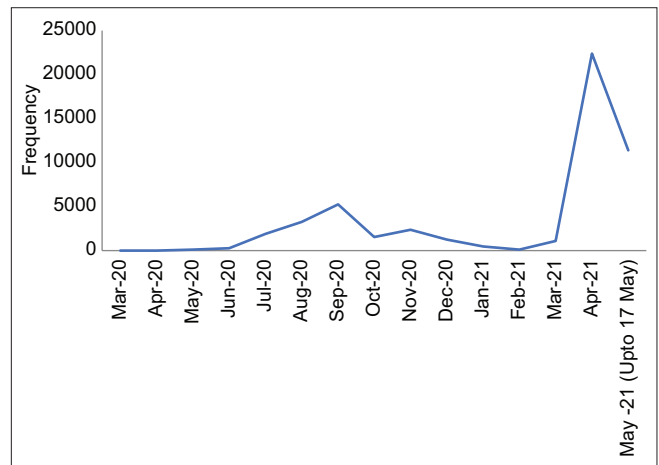
Table 2: Case fatality rates (CFRs) during two waves for the demographic characteristics of patients					
Variables	Total deaths n=506 (%)	First wave		Second wave	
		Deaths (*n*=230) *n* (%)	Case fatality rate (%)	Deaths (*n*=276) *n* (%)	Case fatality rate (%)
Age group					
≤10	1 (0.2)	1 (0.4)	0.29	0 (0.0)	0.00
11-20	1 (0.2)	1 (0.4)	0.08	0 (0.0)	0.00
21-30	15 (3.0)	8 (3.5)	0.20	7 (2.5)	0.09
31-40	25 (4.9)	9 (3.9)	0.27	16 (5.8)	0.21
41-50	65 (12.8)	21 (9.1)	0.78	44 (15.9)	0.76
51-60	114 (22.5)	40 (17.4)	1.54	74 (26.8)	1.41
61-70	142 (28.1)	68 (29.6)	4.27	74 (26.8)	2.35
71-80	102 (20.2)	58 (25.2)	9.95	44 (15.9)	3.64
81-90	39 (7.7)	23 (10)	15.65	16 (5.8)	5.23
>90	2 (0.4)	1 (0.4)	7.69	1 (0.4)	3.33
Gender					
Female	160 (31.6)	58 (25.2)	1.19	102 (37.0)	0.76
Male	346 (68.4)	172 (74.8)	1.47	174 (63.0)	0.81
Place of residence					
Rural	18 (3.6)	5 (2.2)	0.63	13 (4.7)	0.66
Urban	488 (96.4)	225 (97.8)	1.43	263 (95.3)	0.80
Isolation status					
Home isolation	32 (6.3)	24 (10.4)	0.26	8 (2.9)	0.02
Admitted in treatment facility	474 (93.7)	206 (89.6)	2.77	268 (97.1)	16.13

Table 3: Monthly trend of COVID-19 cases and its mortality				
Month	Year	Cases *n* (%)	Deaths *n* (%)	CFR (%)
March	2020	1 (0.002)	0 (0.0)	0
April	2020	5 (0.01)	0 (0.0)	0
May	2020	119 (0.23)	2 (0.40)	1.68
June	2020	276 (0.54)	1 (0.20)	0.36
July	2020	1906 (3.71)	12 (2.37)	0.63
August	2020	3258 (6.34)	58 (11.46)	1.78
September	2020	5258 (10.22)	77 (15.22)	1.46
October	2020	1549 (3.01)	26 (5.14)	1.68
November	2020	2367 (4.60)	31 (6.13)	1.31
December	2020	1247 (2.42)	14 (2.77)	1.12
January	2021	474 (0.92)	6 (1.19)	1.27
February	2021	120 (0.23)	3 (0.59)	2.50
March	2021	1089 (2.12)	9 (1.78)	0.83
April	2021	22,376 (43.51)	251 (49.60)	1.12
May (up to 17/05/21)	2021	11,380 (22.13)	16 (3.16)	0.14
Total		51,425 (100.0)	506 (100.0)	0.98

Figure 2: Showing monthly distribution of COVID-19 cases

for general practitioners and family physicians to improve their adaptive performance in various dimensions in response to COVID-19.[9] Looking at the total number of COVID-positive cases during the first and second waves, it is obvious that the second wave is much more aggressive and have approximately double the number of cases than the first wave. There could be several factors responsible for the increased number of cases in the second wave. It is observed that the mutant virus has more effective transmission capability and its incubation period is also lesser. There has been a widespread disregard to the 'COVID appropriate behaviours or CAB' by the public and the quality of masks used are highly variable. N-95 masks are

not much favoured masks in India, due to their higher costs, and the majority public are using either the indigenous masks made of clothes or are repeatedly using the same and worn-out masks. The sharp rise can also be attributed to the higher testing.[13] Comparing the age-wise percentage distribution of cases during both the waves, it was found that the percentage distribution was more or less the same, mean age of the cases during the first wave was 40.80 ± 17.13 years while in the second it is 40.46 ± 16.94 years. This is in contrast with the general perception that older population was infected in the first wave and younger population in the second.[13] Dr. VK Paul, member of the Niti Aayog, in a press conference said that there is no significant shift in the age distribution of COVID-19 cases in the second wave as compared to the first. Data show that in the last pandemic wave people under 30 years of age constituted 31%

of the total cases and it is 32% this year. Twenty-one per cent of cases have been reported in both the waves under 30–40 years age group. These findings are similar to this study where percentage of cases under 30 years of age is 34.1% and 33.4% and percentage of cases in the age group of 21–30 years is 19.8% and 21.5%, respectively.[14] The total age-wise percentage of COVID cases in Gwalior district is in line with the national data where maximum number of cases were seen in the age group 21–40 years and the percentage shows a decreasing trend with each passing decade.

In the second wave, the pattern of sex-wise case distribution was similar, where males are more infected than females, but gender difference was smaller than those of the first wave. A rise of 9% can be seen in the female cases from first wave to the second, a finding similar to that of a study conducted in Babol, North of Iran by Seyed Farzad Jalali *et al.*[15] where 8.8% increase was seen in the female cases during the second wave. Current study shows that the odds for infection were 1.5 times higher in females during the second wave, possibly because they are over-presented in the care professions and hence are more exposed to infections.[16] Moreover, women are usually responsible for family and domestic work and become the primary caregivers of people affected by COVID-19 in their household (especially children and the elderly), a situation that has been amplified during confinement.[17,18]

Urban and rural distributions of cases were similar in both the waves with maximum number of cases residing in the urban areas, although there was an increase in the confirmed cases and the risk of infection among the people residing in rural areas in the second wave. Urban living conditions such as population density, agglomeration of people in transport infrastructures and crowding in educational, shopping and healthcare centres facilitate virus transmission.[19] Gupta *et al.*[20] in a study reported that there was a gradual shift of infections from urban to rural areas; however, the numbers kept increasing in the former. Resumption of limited public transports and human movements transmitted the virus from highly infected areas to villages and towns.

A significant increase in the home-isolated cases as compared to those admitted in treatment facility was seen during the second wave. Also, the home-isolated cases were approximately 3.5 times more in the second wave than the first. This was partly due to the clearer picture about the disease and its classification and partly due to acute shortage of beds in the treatment facilities. With the increase in the testing capacity and change in the testing guidelines over the time, the number of cases increased unexpectedly, hospitals overwhelmed and medical system was in crisis. Increased burden of number of patients added to the misery of poor doctor patient ratio. The primary care physicians working in hospitals serving COVID-19 patients were forced to not only urgently face the demands of coping with medical issues related to COVID-19 but also to immediately figure out how to deliver information on dealing with suspected COVID-19 patients and mapping institutional flows to cope with COVID-19.[9] As per

the media report, on 31 March, Madhya Pradesh said it had provision for 20,139 isolation, oxygen and ICU beds and there was no need for concern. The state then had only 2332 new cases and 17,096 active cases. Within 2 weeks, the state had 68,576 active cases, of which 12,248 were new infections and the total number of afflicted overtook installed bed capacity in the state. To ease the burden, doctors are advising mild patients to opt for home isolation or a homecare package with a reliable hospital.[21]

Another important observation of this study is that the percentage of deaths increased in the age group 31–60 years during the second wave while the percentage of death was more in the age group 61–90 years during the first wave. The mean age of dead individuals was 64.16 ± 15.42 years in the first wave while it is 59.97 ± 13.56 years in the second; this clearly shows that comparatively more mortality occurred in the younger age group in the second wave. Similarly in Spain the proportion were significantly higher for young deaths in the second wave.[22] Surprisingly the second wave did not witness overall deaths in the same proportion as with the increased number of confirmed cases. In fact, the percentage of total deaths during the second wave was less than that of the first; this can be attributed to the different recommendations regarding timely diagnosis and treatment; studies worldwide suggest that mortality levels were significantly reduced in the second wave.[15,19,23] Widespread use of corticosteroids proved to be a game changer in limiting the mortality.[23]

In the gender-wise distribution of deaths, males were in higher number in both the waves but the percentage decreased in proportion to the decrease in the percentage of confirmed cases of males in the second wave. The Global Health 50/50 project has reported that men have more severe cases of COVID-19 and more deaths[24] due to several factors. First, biological differences: women generally have a stronger immune system than men, which could explain their lower susceptibility to infection.[25] Second, some chronic COVID-19-related diseases (such as chronic respiratory diseases) are more common in men. Third, men have a higher prevalence of smoking and excessive alcohol consumption, which is also related to chronic diseases.[24] In Barcelona, the rates of excess mortality during the two waves were higher among men.[26]

In this study, it was seen that the overall CFR and the variable-wise CFR had decreased in the second wave except for two situations: first, among people residing in the rural areas probably due to higher number of cases in the second wave and low health infrastructure and facilities in the rural settings, and second, among individuals admitted in treatment facility because in the second wave due to the unexpected rise in the number of cases only the more severe once or the critically ill patient got the opportunity to acquire a bed in the treatment facility hence more mortality and high CFR. Guihong Fan *et al.*[27] proposed that harvest effect, better testing capacity, age structure of the infected people, increased transmissibility of virus in young healthy adults and children, and favourable environmental factors might have led to a reduced CFR in the second wave.

Looking at the monthly trend of COVID-19 cases in the Gwalior city [Figure 2], the two waves had distinct characteristics. The first wave was insidious in onset and progressed gradually reaching its peak in 6 months with maximum number of cases and deaths in September 2020 while the second wave took off quickly reaching its peak in just 1.5 months' time in April 2021 and the numbers in terms of cases and deaths were devastating. Initially during the first wave the city was in a state of complete lockdown and the fear of acquiring the disease was high; this did not let the disease grow exponentially, but as soon as the state went into the different phases of unlock, the migration and the reverse migration started with more and more people interacting with each other, the disease kept on spreading and finally reaching its peak. In October 2020 the cases started declining, various research shows that seasonality is a common feature of viral infections in humans and various animals.[28,29] In fact, mounting evidence suggests that COVID-19 has the potential to become a seasonal illness like seasonal influenza.[30] Legislative assembly by-elections in the month of November 2020 resulted in the surge of COVID cases and deaths due to increased interaction among population.

With the decrease in temperature in coming months, the cases and deaths started declining significantly; this shows that a particular range of temperature may be required for virus replication and growth.[31] The government was satisfied with preventive measures to control the first wave since the infection rate declined during the end of 2020 reaching its lowest during the first week of February 2021. People became complacent not knowing what they were about to face in the near future; March 2021 saw an acute surge in the cases and in April 2021 the cases and deaths went out of proportion flooding the hospitals with severe cases. Several independent factors like arrival of new, more contagious, variants of the virus, mask hesitancy, a widespread disregard to the 'CAB' probably from adherence fatigue were working side by side leading to such a situation.[13,32-35] While human-to-human interactions play a great role in viral diffusion, temperature and humidity can still alter human behaviour in the external environment; all these factors ultimately contribute to high SARS-CoV-2 transmission.[36-39] It is important to emphasize that no single variable is sufficient to explain the evolution of the pandemic. There are multiple vulnerabilities that, combined over space and time, lead to a greater or lesser incidence of the virus.[19] As the pandemic shows no sign of slowing, it is critical that primary care physicians continue to be supported in their front-line role, which involves reaching out to their communities and being sensitive to their needs as guardians of their local communities. Primary healthcare will need to continuously reinvent and transform itself as any healthcare system's ability to manage infectious disease outbreaks will undoubtedly be crippled without an effective primary care sector.[9,12,40]

Limitation

The work profile of the individual was not included which may have an effect on the infectivity and the outcome of the disease.

There was no direct contact with the participants so it was not possible to incorporate all the socio-demographic variables of the study participants.

Conclusion(s)

The world is witnessing something extraordinary generations have never seen; the virus is continuously evolving and so should be the knowledge regarding its characteristics and measures to control it. Lockdowns cannot be sustained indefinitely so a data-driven approach should be adopted to curb the transmission and to prevent severe illness and deaths from COVID-19 and to minimize the social and economic loss resulting from this pandemic. This study recommends that more stringent action to be taken when a surge is detected, premature relaxation of some intervention must be avoided and public must be made aware of the strict implementation of CAB (COVID appropriate behaviours). The effect of climatic variables on the transmission of the disease should be integrated into disease prevention and mitigation strategies and finally involving primary care physicians in the planning and action for this emerging pandemic and structuring the policies according to the needs of specific areas.

Key Points

(1) The mean age of infected individuals was almost similar in first and second wave while more mortalities occurred in the younger age group during the second wave as compared to the first.
(2) Males were infected more in both the waves but there was 9% rise in infection among females during the second wave; also the risk of infection was 1.5 times higher among females in the second wave.
(3) The distribution of cases were higher in urban areas in both the waves but second wave saw an increase in the number and risk of cases among rural population.
(4) Due to the enormous number of cases during the second wave, the home-isolated cases were 3.5 times more as compared to the hospitalised once.
(5) Lack of predictability and preparedness were evident in the second wave.

Conflicts of interest

There are no conflicts of interest.

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