International Journal of Allied Medical Sciences and Clinical Research (IJAMSCR)

ISSN:2347-6567

IJAMSCR |Volume 11 | Issue 1 | Jan - Mar - 2023
www.ijamscr.com

Research article Medical research

A Retrospective Comparative Study Of Covid-19 Mortality In First, Second And Third Wave Of Pandemic In District Sonipat, Haryana.

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ABSTRACT

Background: In the state of Haryana, a total number of 10,54,381 samples were found positive for Covid-19; out of which 10,699 deaths have been occurred since September 2022. Same way, a total of 59,901 samples were found positive for Covid-19 in District Sonipat, Haryana since September 2022. Out of which 277 deaths have been reported.

***Aims and Objectives*:** To compare the age wise distribution, gender distribution, month-wise distribution, vaccination status, co-existing co-morbidities and causes of COVID-19 related deaths during the three COVID-19 pandemic waves in district Sonipat, Haryana.

Materials and method: The study conducted was retrospective analysis of morbidity and mortality parameters of COVID-19 positive deaths during the three waves of the COVID-19 pandemic in district Sonipat, Haryana. Three groups were formed corresponding to three consecutive waves of pandemic. First group consisted of the deaths (between July 01, 2020 to December 31, 2020), second group (between March 01, 2021 to June 30, 2021) and the third group (January 01, 2022 to March 15, 2022) corresponding to the Covid-19 deaths in wave-1, wave-2 and wave-3 respectively.

Result: Diabetes was the highly contributing risk factor for Covid-19 positive deaths in first and second wave. Hypertension was the adversely affecting co-morbidity in third wave. Wave-2 was highly mortal consisting of 113 (62%) followed by wave-1 with 62 (34%) and wave -3 with 7(4%) Covid-19 deaths. July-2020 (24.2%), May-2021 (49.6%) and January-2022 (71.4%) were highly mortal months during the pandemic.

Keywords: Covid-19; Pandemic; Co-morbidity; Covid-19 wave; vaccination status; Hypertension; Diabetes.

INTRODUCTION

The Corona-Virus Disease 2019 (COVID-19) caused by the severe acute respiratory syndrome corona-virus 2 (SARS-CoV-2), a virus from the large corona-virus family, was first detected on December 31st, 2019 in Wuhan, China, and has been deemed a global pandemic by the World Health Organization (WHO). A variety of regulations has been designed, among which wearing of mask, restriction of non-essential travel, imposition of social distancing, declaration of lock-downs on big cities, banning mass gatherings and many more to prevent the spread of the novel corona virus. It is the nature of pandemics to come in waves. The deadliest

epidemic in the past 120 years – the Spanish flu pandemic of 1918, is described as having several waves. [1, 2, 3]

COVID-19 death is defined as the death of a patient admitted to the assigned COVID-19 wards or intensive care units with laboratory-confirmed COVID-19 infection during their hospital stay with any cause other than due to accident or suicide. All such deaths have been audited by Covid Death Audit Committee, Sonipat and agreed covid-19 as a direct cause of death.

India has seen a three-wave pattern of COVID-19 infections. With the looming threat of recurrent waves with mutated strains, it is important to understand the demographic and clinical characteristics of the deceased COVID-19 patients in these waves to identify the vulnerable population and guide public health interventions to decrease COVID-19 related mortality. Although all strains produce predominant respiratory symptoms, they differ in their spread and lethality. The COVID-19 deaths in these pandemics also may differ in their demographic profile, clinical manifestations, and causes of death but data are scarce. As of September 20th 2022 a total of 609,247,113 confirmed cases were diagnosed all over the world with a total death of 6,503,894. A total of 44,539,046 confirmed cases and 528,355 deaths were recorded in India. This figure keeps changing every day. [4, 5]

The causative agent for the first wave was the wild or alpha strain; the second wave was mutant strains primarily the delta variant (B.1.617.2) and for the third wave, the main agent was the Omicron variant (B.1.1.529 lineage. As per the media bulletin on Covid-19 dated September 20, 2022 in the state of Haryana a total of 1054381 samples were found positive for Covid-19; out of which 10699 deaths have been occurred. 100% coverage for the 1st dose of vaccine has been achieved in population above 18 years of age. For 2nd dose a target of 88% coverage has been achieved for 15 years above population. Same way, a total of 59901 samples were found positive for Covid-19 in District Sonipat, Haryana since September 20, 2022. Out of which 277 deaths have been reported. [6,7]

Age and sex were already observed as major risk factors for COVID-19 deaths early on in the pandemic, with a higher risk for males and an exponentially increasing risk with age. Age standardized excess death rates were higher in men than women in almost all countries. A research observation found that coastal states and union territories of India have larger number of daily cases of COVID-19 and mortality as compared to other geographical locations of the country. The observation also found that islands have least number of cases and deaths (115 per 100000) due to covid-19 pandemic. This study also gives rise to hypothesis that coastal locations are at greater risk of covid-19 infection and mortality whereas islands are safest places in covid-19 pandemics. Urbanization was the factor with the strongest correlations, possibly indicating that both cases and deaths from COVID-19 are higher when the population, demographic density, and absolute and relative built areas are higher.[8, 9, 11, 13]

Even with poor infrastructure and health facilities found in India, compared to other countries with more robust health facilities such as in Italy, Spain, United Kingdom and United States of America; the mortality data in India is a fraction to that seen in Western countries. India's recovery rate from COVID-19 is higher than those of many nations at the same level of infection and can be due to high suspicion of diagnosis, timely detection, and treatment. The possible reasons behind lower mortality figures in India are ambiguous, with many theories described for this.[10]

The substantial shift in the age distribution of COVID-19 deaths in countries that rapidly implemented vaccination predominantly among elderly provides evidence for the population level-effectiveness of COVID-19 vaccination and a favorable evolution of the pandemic towards endemic with fewer elderly deaths.[12]

Patients with COVID-19 with cardiovascular disease, hypertension, diabetes, congestive heart failure, chronic kidney disease and cancer have a greater risk of mortality compared to patients with COVID-19 without these co-morbidities. In addition of prioritizing by age, vaccination priority groups should also include younger population with multiple co-morbidities. The mortality rate for hospitalized COVID-19 patients is 17.18%. Hypertension, cardiovascular disease, and diabetes were the most common co-morbidity in patient's death due to COVID-19. More than half of the patients had two or more co-morbidities. [14, 15, 16].

This comparative study has been conducted to analyse the contributing factors towards the case fatality rate of Covid-19 for different waves and their impacts. Also, to compare the trends of mortality among three waves of pandemic on different grounds so that policies could be revised if required.

Aims and Objectives

The study was done to compare the age distribution, gender distribution, month-wise distribution, vaccination status, co-existing co-morbidities and causes of COVID-19 related deaths during the three COVID-19 pandemic waves.

1. To compare the age-wise, gender-wise and month-wise distribution of Covid-19 deaths across three pandemic waves.
2. To analyse the co-existing morbidities, vaccination status and its effect on Covid-19 mortalities.
3. To find out the major cause of death for Covid-19 mortalities.

MATERIALS AND METHODS

A retrospective analysis of mortality parameters of COVID-19 deaths during the three waves of the COVID-19 pandemic has been performed in Sonipat, Haryana.

Settings and Sample

The study was conducted in District Surveillance Unit, IDSP-Sonipat which included the analysis of all the audited deaths occurred in concerned district through different pandemic waves. Three groups were constructed on the basis of three consecutive waves. First group was of COVID-19 deaths occurred between July 01, 2020 and December 31, 2020 (6 months), corresponding to first wave deaths. Second group was of COVID-19 deaths occurred between March 01, 2021 and June 30, 2021 (4 months) corresponding to second wave deaths. The third group was of COVID-19 deaths occurred from January 01, 2022 to March 15, 2022 corresponding to third-wave deaths. A gap of a few months was maintained between groups to decrease overlap between waves. The data-set for the first wave was frozen on December 31, 2020; for the second wave on June 30, 2021 and on March 15, 2022 for the third wave.

Inclusion Criteria

All deceased patients were confirmed for COVID-19 by real-time polymerase chain reaction, or a rapid antigen test during the specific study period and audited by Covid Death Audit Committee, Sonipat were included in the study.

Exclusion Criteria

COVID-19 positive patients who died due to causes other than Covid 19, such as suicide or accidents, were excluded from the study.

Data Collection Technique

Data abstraction forms included demographic data, vaccination data, associated co-morbidities and cause of death. Data was then reviewed and double-checked independently by District Surveillance officer, Sonipat and Civil Surgeon, Sonipat. Reports which could not be retrieved were excluded from the mortality analysis.

Statistical Analysis

Categorical data are presented as frequency and proportions and continuous data as mean, median, and standard deviation as appropriate. Microsoft Excel and SPSS Statistics (IBM) were used for analysis. Data obtained was analyzed in terms of objectives and results were recorded accordingly.

RESULTS

This study was performed on 182 Covid-19 deaths which states that 62 (34%) in the first wave, 113 (62%) in the second wave and 7 (4%) in the third wave. The demographic characteristics of deaths in the three pandemic waves are summarized in Table 1. The stratification of age was defined by analysing WHO standards. The two age groups were combined resulting in formation one strata i.e., 0-4 years and 5-9 years were combined forming 0-9 years. Nine more age strata's were formed likewise to simplify the results and for better understanding.

Table 1: Comparison of Covid deaths on different criteria across three waves of pandemic

Demographic and details of co-morbid conditions of covid-19 deceased through three waves of pandemic			
Characteristics	**Wave 1 (July 1– December 31, 2020) (n=62)**	**Wave 2 (March 1– June 30, 2021) (n=113)**	**Wave 3 (January 1– March 31, 2022) (n=7)**
Age (in years)			
Mean ± SD Median	64.05±12.9164.5	63.07±15.6265	64.29±11.5760
Sex: No. (%)			
Female	39 (62.9)	70 (61.9)	6 (85.7)
Male	23 (37.1)	43 (38.1)	1 (14.3)
Co-morbidities:	**No. (%)**	**No. (%)**	**No. (%)**
Diabetes	27 (43.5)	23 (20.4)	1 (14.3)
Hypertension	23 (37.1)	23 (20.4)	2 (28.6)
Chronic heart disease	7 (11.3)	6 (5.3)	1 (14.3)
Chronic liver disease	2 (3.2)	1 (0.9)	0
Chronic kidney disease	5 (8.1)	5 (4.4)	1 (14.3)
Chronic respiratory illness	15 (24.2)	7 (6.2)	0
Hypothyroidism	4 (6.5)	2 (1.8)	0
Cerebro-vascular Disorder	3 (4.8)	5 (4.4)	0
Malignancy	5 (8.1)	0	1 (14.3)

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During the Wave-1 maximum of deaths occurred in age group of 60-69 years which was 29% of Covid deaths occurred in first wave. Similarly, 28% Covid-19 deaths in age group of 70-79 years and 43% Covid-19 deaths in age group of 50-59 years during second and third wave respectively.

Most of the Covid-19 deceased were males (63.19%). In the first wave 62.9% of Covid deaths were males, 61.9% in second wave and 85.7% in third wave.

Table 2: Month-wise distribution of covid-19 deaths in three waves

Sr.No.	**Wave-1**		**Wave-2**		**Wave-3**	
	Month	**No. Of Deaths**	**Month**	**No. Of Deaths**	**Month**	**No. Of Deaths**
1	July	15	March	1	January	5
2	August	9	April	53	February	2
3	September	5	May	56	March	0
4	October	7	June	3		
5	November	13				
6	December	13				
Total	**62**		**113**		**7**	

As per the Table 2; July-2020, May-2021 and January-2022 were identified as the highly fatal months for first, second and third waves of Covid-19 respectively.

Majority of the Covid deaths in first (88.7%) and third wave (57.1%) have been occurred in Co-morbid patients, whereas in second wave non co-morbid Covid deaths (58.4%) were higher comparatively.

Diabetes and Hypertension were the most prevalent co-morbid conditions for Covid-deaths among all three waves followed by Chronic Respiratory illness. Diabetes was contributing 48.1% of co-morbid deaths followed by hypertension with 45.3%. 20.8% of co-morbid deaths were associated with chronic respiratory illness.

Vaccination was not introduced during Wave-1; while in wave-2 a total of 15 cases were vaccinated (13.3%) and all the 7(100%) death cases were vaccinated in Wave-3.

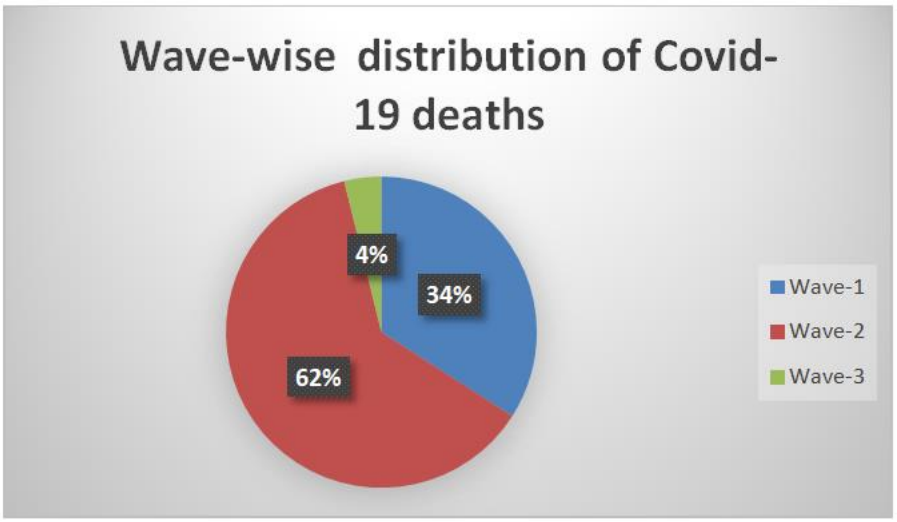


Fig 1: Distribution of deaths among Wave-1, Wave-2 and Wave-3

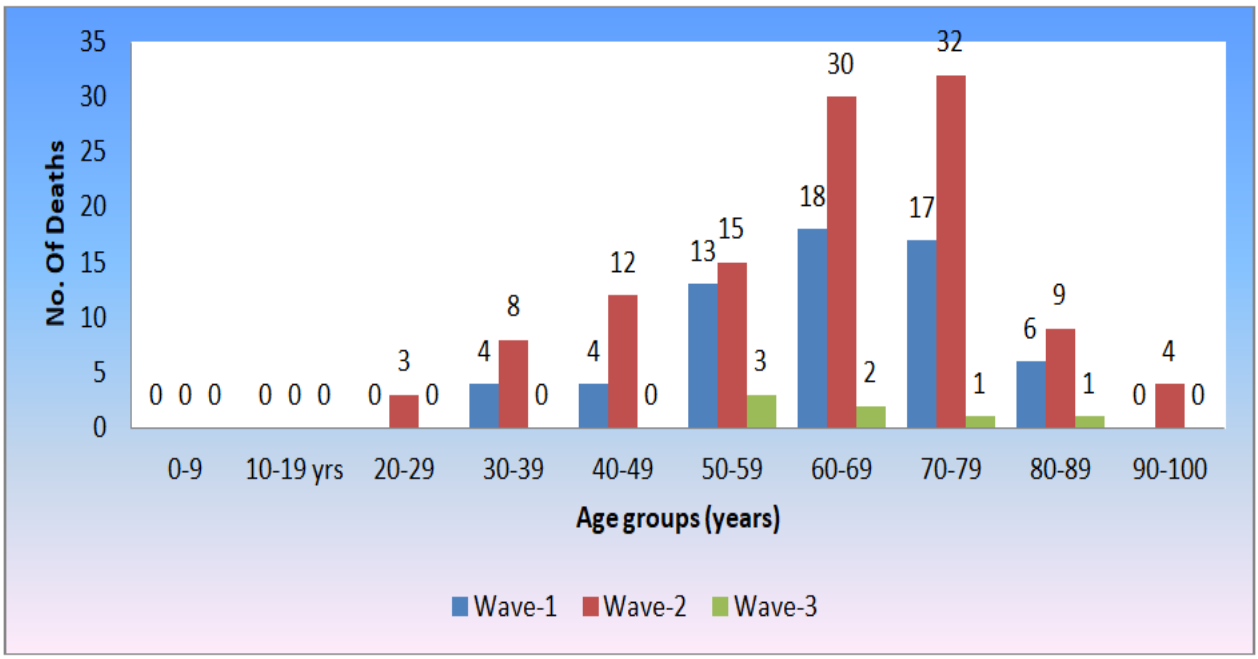


Fig 2: Comparative analysis of Covid-19 deaths among different age-groups during three waves of pandemic

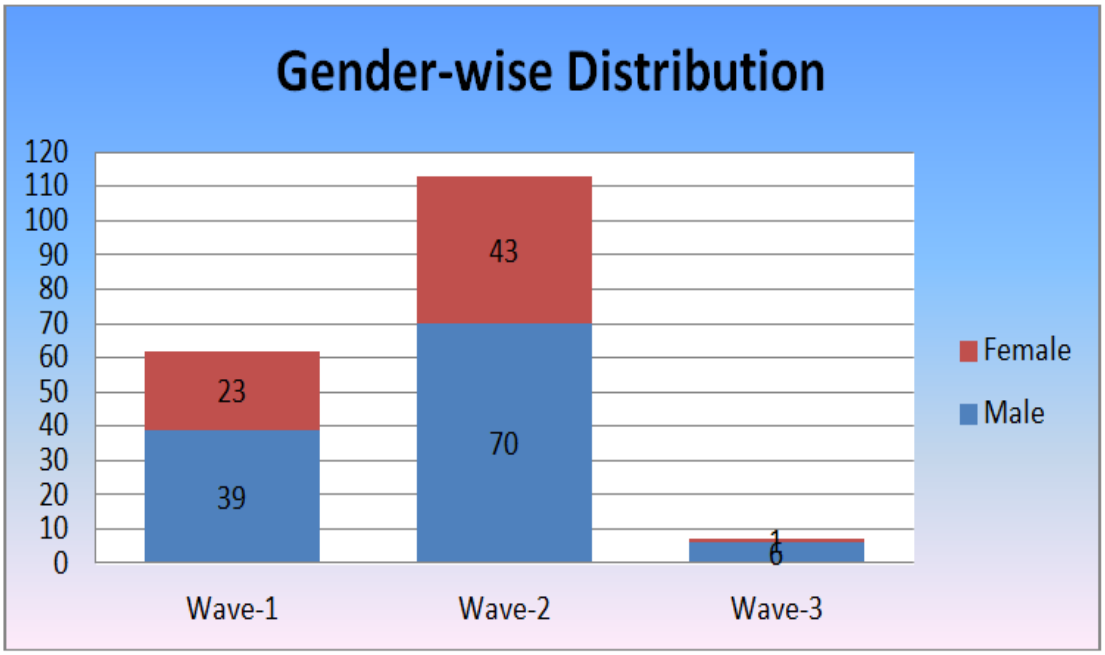


Fig 3: Gender-wise distribution of Covid-19 deaths in first, second and third wave.

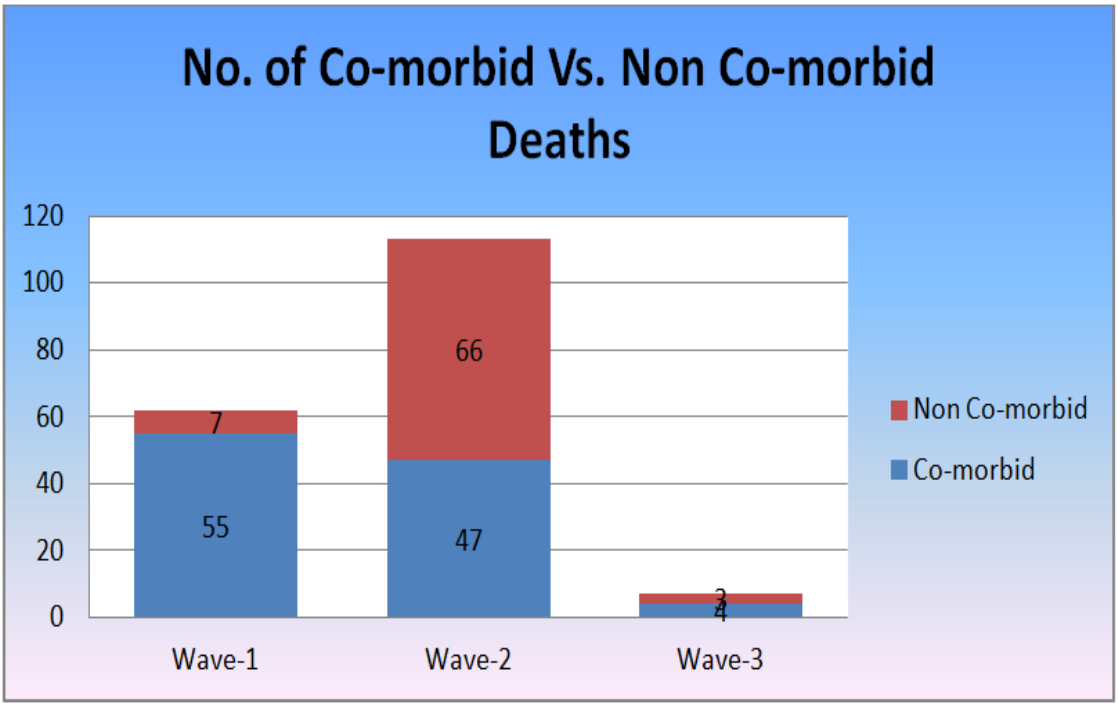


Fig 4: Comparison of deaths with non-co-morbid and pre-existing co-morbid conditions

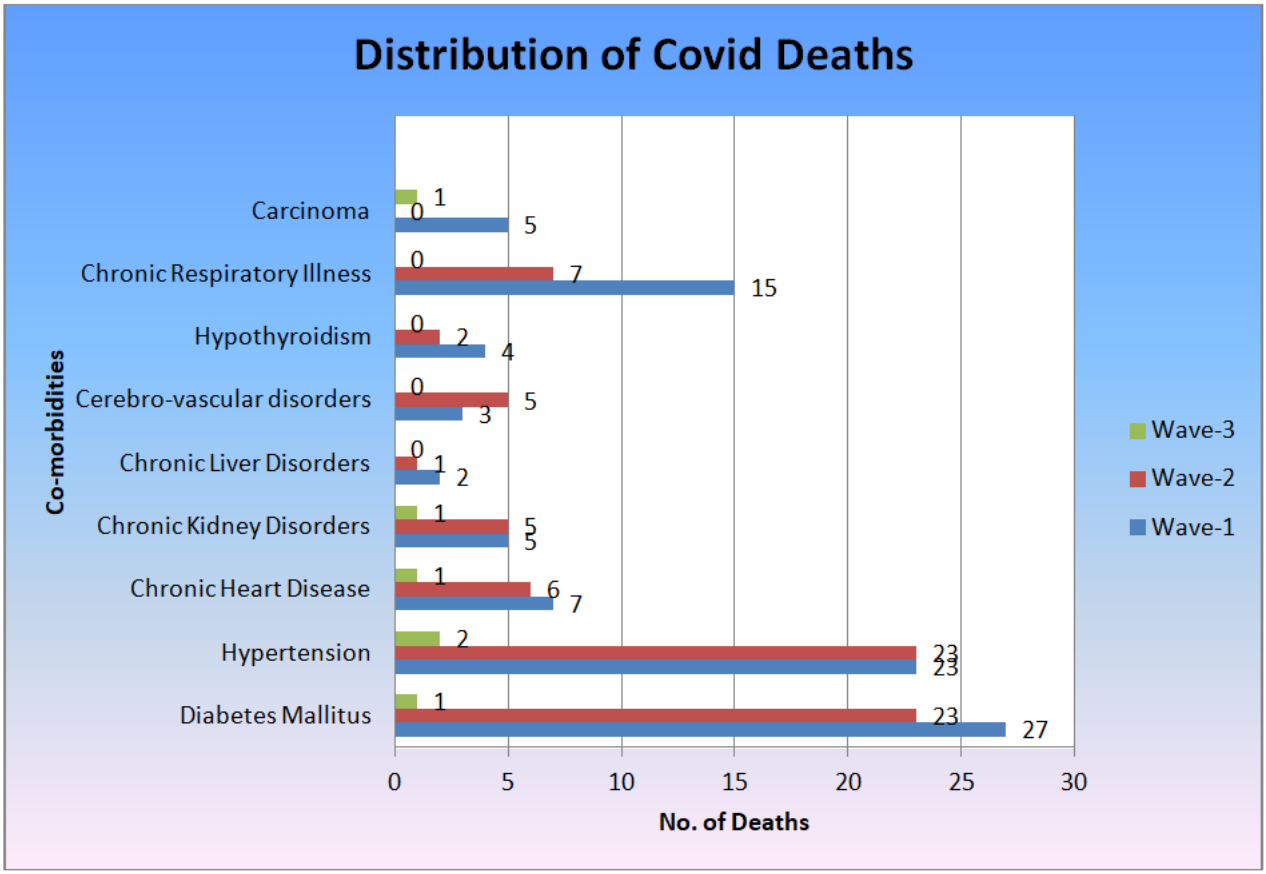


Fig 5: Distribution of Covid-19 deaths on the basis of pre-existing Co-morbidities.

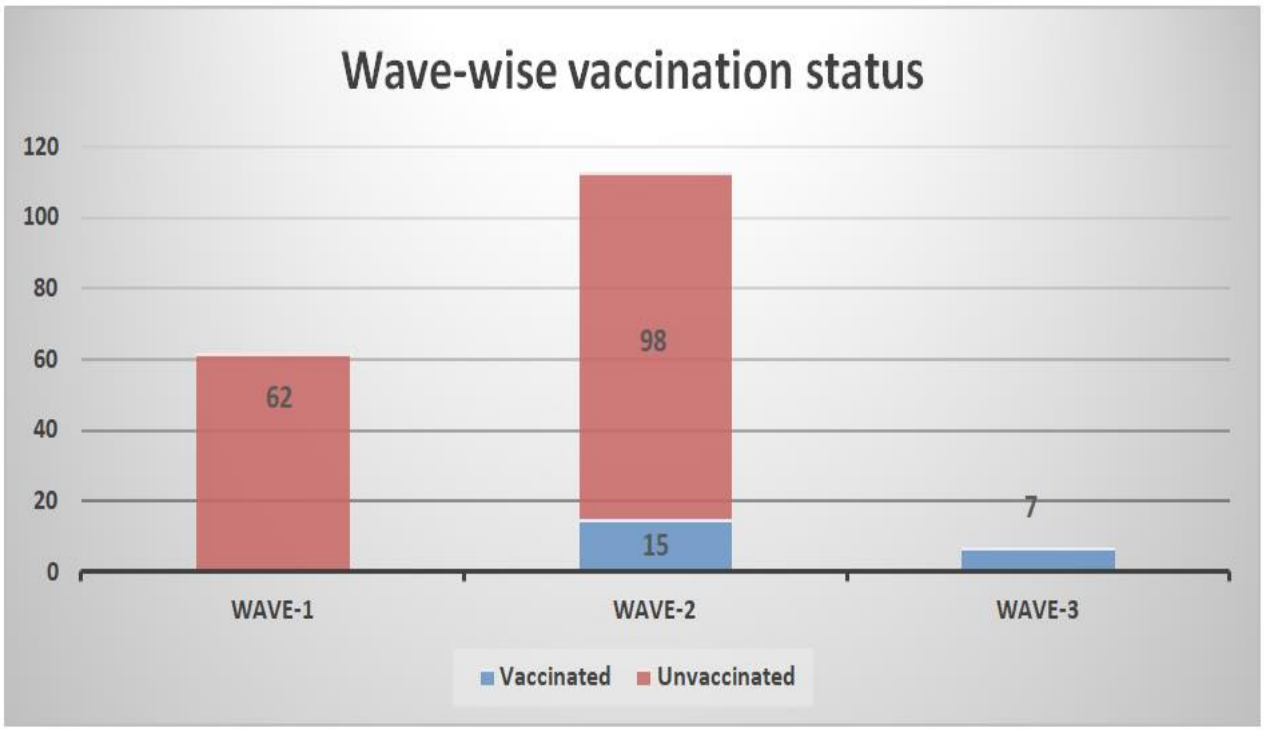


Fig 6: Vaccination status of deceased in three pandemic waves

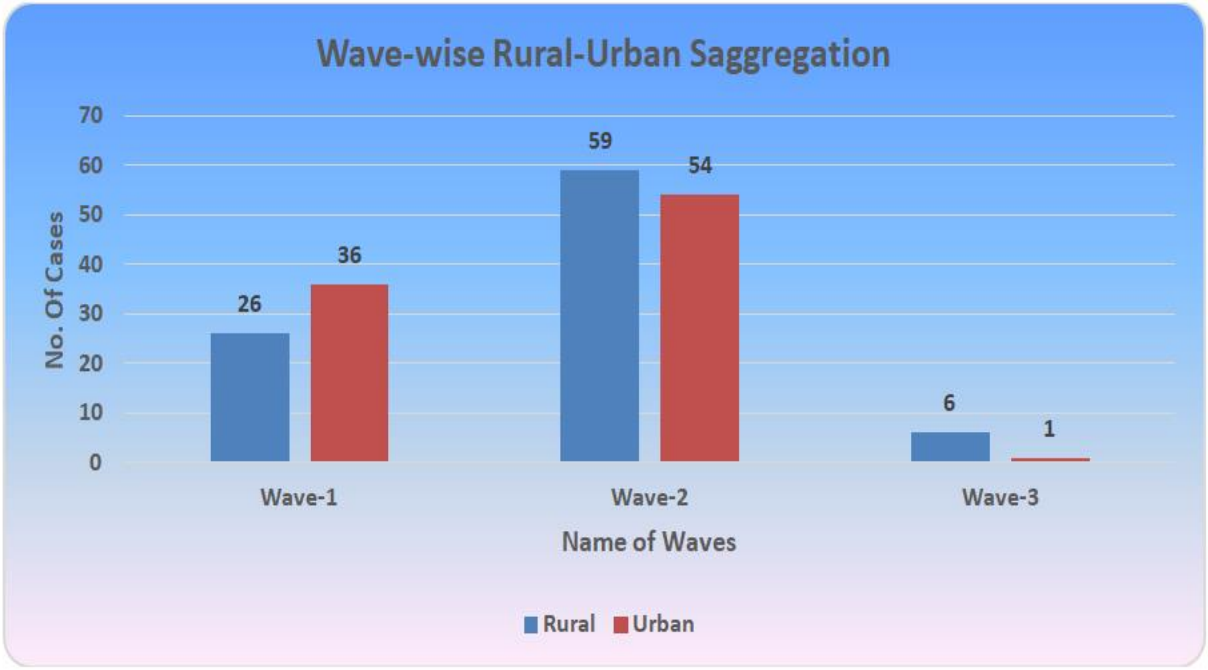


Fig 7: Rural-urban segregation of Covid deaths in different waves

DISCUSSION

A total of 277 Covid-19 deaths have been occurred during pandemic in district Sonipat which were audited by District Covid Death Audit Committee, Sonipat. Out of those 277, 182 deaths met the inclusion criteria and were included in the study. The second wave of Covid was highly mortal comparatively which means the responsible variant of second wave was most fatal. Covid-19 deaths were more prevalent in males. Maximum number of deaths has been occurred in 2 strata of age group 60-69 years and 70-79 years stating these strata as high risk group. Mean age for all the three waves was around 64 years. Association of co-morbidities in elderly age groups and Covid mortality rates are also evident in this study.

Table 2 shows the monthly distribution of Covid deaths during three waves of pandemic. July-2020 was consisting 24.2% of deaths during wave-1 which could be a result of lockdown withdrawal resulting into increment of exposure to opportunistic infections. In the similar way, May-2021 and January-2022 were more prevalent consisting 49.6% and 71.4% of Covid deaths in wave-2 and 3 respectively. These prevalent months are entirely different in seasonality. So, we may conclude that seasonal variations do not affect the infectivity and mortality due to Covid virus and its mutants. But the vaccination in elderly and high risk population played a significant role during these months to explain the mortality trends especially for May-2021.

Covid deaths were higher in urban population during wave-1. The case fatality rates were found higher among rural population in wave-2 and 3. The potential factors for this were refusal to get vaccinated, fear of isolation and hospitalisation. Presence of co-morbidity was a contributing factor to Covid deaths. A total of 58.2% Covid positive deaths were having co-morbidities as a contributing factor and rest 41.8% were not associated with any kind of co-morbidities. During the Wave-1, n=55 (88.7%) deaths were among co-morbid patients and n=7 (11.3%) deaths were non co-morbid. In Wave-2, co-morbidity was present in 47 (41.6%) death cases and rest of 66 (58.4%) were non co-morbid. There were more deaths without pre-existing co-morbidities during the second wave in our study. This shows that the mutant viruses in the second wave were more capable of producing negative outcomes in healthy population. During Wave-3 ratio of co-morbid deaths to non-co-morbid death was 4:3. During wave-3; 57.1% death cases were co-morbid whereas 42.9% were non-co-morbid.

Diabetes Mellitus and Hypertension were the most prevalent co-morbidities followed by chronic respiratory illnesses. 43.5%, 20.4% and 14.3% death cases were diabetic in wave-1, wave-2 and wave-3 respectively. In the same manner 37.1% in wave-1, 20.4% in wave-2 and 28.6% death cases were hypertensive. Hypertension was the most prevalent co-morbidity during wave-3. This was followed by diabetes, chronic heart diseases, Chronic Kidney Diseases and malignancy which were 14.3% for each. Table 1 depicts the percentile distribution of deaths on the basis of co-morbidities.

Vaccination was introduced on January 16, 2021 for health care workers, February 4, 2021 for front line workers in India and was accessible for co-morbid and elderly population from March 1, 2021. 87.9% of Covid deaths were not vaccinated. So, full vaccination reduced the prevalence of Covid mortalities among the population.

CONCLUSION

The present comparative study shows that the three pandemic waves differ in their demographic, co-morbidity and vaccination status. In all the three waves, there were more deaths in middle age population (≥50 years of age). Males were more affected in all waves, though the gender impact was statistically not significant among the three waves. Most of the deceased had co-morbidities, diabetes being the most

common co-morbidity in the first and second waves and hypertension in the third wave. Mortality in those without any preexisting co-morbidities was higher in the second wave. Identification of high risk population for mortality, enhancing the vaccination drive and booster dose in vulnerable populations can help to decrease the positivity and mortality rates of Covid-19. Healthy lifestyle to decrease co-morbidities and following Covid related guidelines would be the most important strategy to prevent further deadly waves of COVID-19.

ACKNOWLEDGEMENT

Authors acknowledge the invaluable efforts of Covid warriors of health department, administrative department and Non government organisations for their contribution to conquer covid-19 pandemic.

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