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Impact of COVID–19 on mortality trends and patterns in a tertiary care hospital of Central India: A retrospective study

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ABSTRACT

Objective: To investigate the impact of COVID-19 on the mortality trends and patterns in a tertiary teaching hospital in Raipur, Chhattisgarh, India.

Methods: A hospital-based retrospective study was conducted to analyze the case reports of all deaths from January 2016 to December 2021 in a tertiary teaching hospital in Raipur, Chhattisgarh, India. The socio-demographic profile and the pattern of causes of death were recorded. The deaths were classified according to the 10th revision of the International Classification of Diseases.

Results: A total of 6128 deaths were registered from 2016 to 2021 and the maximum death number was observed in 2021 (38.2%) followed by 2020 (32.5%) when the country was hit by the COVID-19 pandemic. The highest number of deaths was observed in the age group of 51 to 65 years *i.e.*, 31.1% of the total deaths. In all five years, male deaths were more than female deaths, and more than 50% occurred within three days of hospitalization during the study period.

Conclusions: Even though there is a rise in the death rate due to the sudden hit of COVID-19, the burden of both communicable and non-communicable diseases remains gradually increasing over the five years. There is a need for health awareness in the community about changing lifestyles and their harmful effects on health.

KEYWORDS: Mortality; COVID-19; Communicable disease; Non-communicable disease; Trend; Pattern

1. Introduction

Mortality is an important demographic parameter and a critical

indicator of population health and public health systems[1]. The analysis of its trend over time can help to improve understanding of the evolution of mortality in a given geographical area[2]. It helps us to infer how the health of the population is changing. The most important global causes of death are associated with three general themes: cardiovascular, respiratory, and neonatal conditions. All the causes of death can be classified into three categories: communicable diseases, non-communicable diseases (NCDs), and injuries[3]. One group of conditions assumes more importance than others at different stages of life, across different geographies, and among distinct social and economic groups. Some common risk factors, such as poor nutrition, predispose patients to death due to

Significance

The analysis of these trends over time can help to improve understanding of the evolution of mortality in a given geographical area. In countries like India, non-communicable diseases account for 60% of mortality, while communicable diseases also continue to remain high, presenting a healthcare twin challenge. The accurate measurement and estimation of mortality levels help identify the major causes of premature death they provide a valuable benchmark for evaluating progress in increasing years of healthy life.

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communicable and NCDs[4]. The rise of NCDs and their impact in low and middle-income countries has gained increased attention in recent years.

NCDs encompass a vast group of diseases such as cardiovascular diseases, cancer, respiratory diseases, and diabetes. According to the World Health Organization's report in 2021, NCDs kill 41 million people yearly, equivalent to 71% globally[5]. Another report in 2008 from India shows 5.2 million deaths from NCDs, which increased in 2015 to 5.8 million[6]. That means 1 in 4 Indians risk dying from an NCD before they reach the age of 70. Between the ages of 30 to 69, more than 15 million people die each year from non-communicable diseases. The four major NCDs account for 80% of all premature NCD-related deaths: cardiovascular 17.9 million per year followed by cancers (9.3 million), respiratory diseases (4.1 million), and diabetes (1.5 million)[7].

In countries like India, NCDs account for 60% of mortality, while mortality of communicable diseases also continues to remain high, presenting a healthcare twin challenge[8]. Infant mortality rate due to communicable diseases like acute respiratory infections and diarrhea is a significant challenge[9]. Unsanitary conditions are common in India which creates a perfect breeding ground for mosquitoes, thus increasing the burden of vector-borne diseases. The commitment done in 2015, as a part of the Sustainable Development Goal – Agenda 2030 to reduce NCDs burden by one-third, requires a proper trend assessment of mortality. To achieve this goal, the Government of India has launched the National Program for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases, and Stroke, focusing on strengthening infrastructure, human resources, health promotion, early diagnosis, treatment, and referral[10].

As India approaches the peak of COVID-19 incidence, lessons from its disease burden history can help guide public health strategy. This study aims to understand the socio-demographic profile and pattern of mortality of all the diseases (non-communicable diseases and communicable diseases) and the impact of COVID-19 on the mortality trends in a Tertiary Care Hospital in Chhattisgarh.

2. Patients and methods

2.1. Study design and setting

A hospital-based, retrospective study was carried out at Tertiary Care Hospital, Raipur, Chhattisgarh, India from January 2016 to December 2021. The hospital was established in the year of 2012, and the number of deaths in the year of 2016 was proportionate to the number of inpatient beds available in the hospital.

2.2. Ethical statement

Ethical clearance for this study was obtained from the Institutional Ethical Committee of All India Institute of Medical Sciences, Raipur, Chhattisgarh Vide letter no. AIIMSRRPR/IEC/2021/937 dated 11.10.2021.

2.3. Data collection

All the deaths were retrospectively analyzed based on data from the Medical Records Department, including the socio-demographic profile and the pattern of causes of death. Demographic data such as age, sex, year of death, and the reason for death were recorded. The deaths were classified according to the International Classification of Diseases-Tenth Revision.

2.4. Statistical analysis

The data was analyzed using IBM SPSS Statistics version 26. The data were expressed as frequency and percentage.

3. Results

A total of 6128 deaths were registered from 2016 to 2021 at All India Institute of Medical Sciences, Raipur, Chhattisgarh, India. The number of deaths increased 36-fold over the study period (Figure 1).

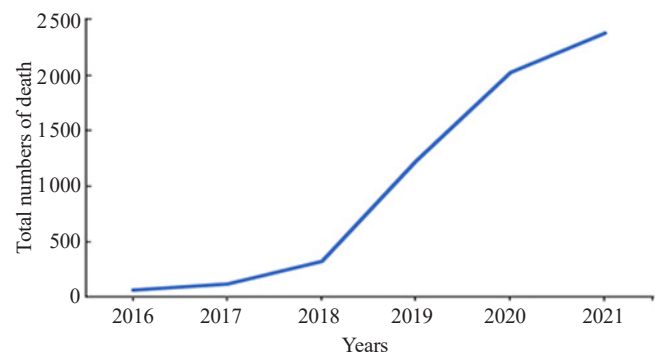


Figure 1. Trend of deaths from 2016 to 2021 (n=6218).

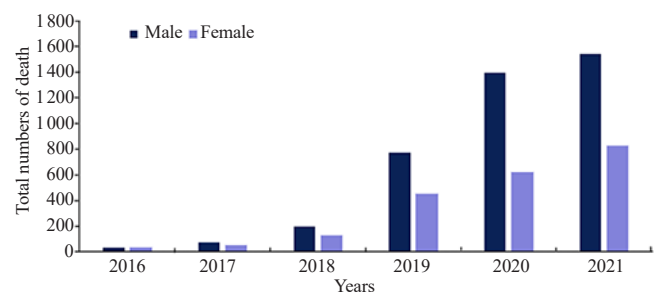


Figure 2. Sex distribution of the deaths from 2016 to 2021 (n=6218).

Table 1. Age distribution of deaths occurred between 2016 to 2021 (n=6218).

Age	2016 (n)	2017 (n)	2018 (n)	2019 (n)	2020 (n)	2021 (n)	Overall total (n, %)
< 1 year	11	18	30	41	76	38	214 (3.5)
1 to 5 years	4	11	9	27	27	52	130 (2.1)
6 to 18 years	2	14	16	58	91	58	239 (3.9)
19 to 35 years	11	15	67	228	325	373	1 019 (16.6)
36 to 50 years	9	13	56	301	457	581	1 417 (23.1)
51 to 65 years	14	25	80	335	650	803	1 907 (31.1)
> 65 years	14	27	64	234	395	468	1 202 (19.6)

Table 2. Deaths as per the duration of hospital stay (n=6218).

Duration of hospital stay	n (%)
< 1 day	1447 (23.6)
1-3 days	1948 (31.8)
3 -7 days	1 163 (19.0)
> 7 days	1 570 (25.6)

3.1. Demographic characteristics

The maximum and minimum death number was observed in the year 2021 (38.2%) and 2016 (<1%), respectively. Figure 2 shows more male deaths than female deaths in all five years, where male deaths were almost twice the number of female deaths due to the COVID-19 pandemic.

Table 1 shows maximum death occurred in the age group of 51 to 65 years with 1 907 deaths (31.1%), followed by 36 to 50 years with

1 417 deaths (23.1%), and the age group above 65 years with 1 202 deaths (19.6%).

Maximum deaths, *i.e.*, more than 50%, occurred within three days of the hospitalization during the study period. One-fourth of the patients stayed for more than a week in the hospital before they died (Table 2).

3.2. Causes of death

Table 3 shows the maximum death was caused by the COVID-19 pandemic (1017, 16.6%), followed by deaths due to circulatory (987, 16.1%), due to symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified (981, 16.0%) and deaths due to respiratory conditions (890, 14.5%).

Table 4 shows major reasons for the death were non-communicable (46.3%) and communicable diseases (41.8%).

Table 3. Distribution of causes of death (n=6218).

Causes	2016 (n)	2017 (n)	2018 (n)	2019 (n)	2020 (n)	2021 (n)	Total (n, %)
Certain infectious and parasitic diseases	12	17	32	161	127	124	473 (7.7)
Neoplasms	5	3	5	9	20	51	93 (1.5)
Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism	4	3	8	36	39	52	142 (2.3)
Endocrine, nutritional and metabolic diseases	5	11	32	135	268	237	688 (11.2)
Mental and behavioral disorders	0	0	0	1	0	3	4 (0.1)
Diseases of the nervous system	1	5	6	20	21	30	83 (1.4)
Diseases of the eye, adnexa, ear, and mastoid process	0	0	0	0	0	0	0 (0.0)
Diseases of the circulatory system	14	33	72	253	346	269	987 (16.1)
Diseases of the respiratory system	8	14	42	185	334	307	890 (14.5)
Diseases of the digestive system	5	7	22	44	55	87	220 (3.6)
Diseases of the skin and subcutaneous tissue	0	1	1	13	4	10	29 (0.5)
Diseases of the musculoskeletal system and connective tissue	0	2	1	10	7	15	35 (0.6)
Diseases of the genitourinary system	4	3	18	76	141	91	333 (5.4)
Pregnancy, childbirth, and the puerperium	0	0	0	0	2	5	7 (0.1)
Certain conditions originating in the perinatal period	1	6	9	7	15	13	51 (0.8)
Congenital malformations, deformations, and chromosomal abnormalities	1	5	5	4	5	17	37 (0.6)
Symptoms, signs, and abnormal clinical and laboratory findings, not elsewhere classified	5	13	68	262	380	253	981 (16.0)
Injury, poisoning, and certain other consequences of external causes	0	0	1	7	16	19	43 (0.7)
Codes for special purposes (COVID-19)	0	0	0	0	240	777	1017 (16.6)
External causes of morbidity and mortality	0	0	0	1	1	1	3 (0.0)
Factors influencing health status and contact with health services	0	0	0	0	0	11	11 (0.2)

Table 4. Major reasons for deaths in categoriesh ($n=6218$).

Categories of reasons	2016 (n)	2017 (n)	2018 (n)	2019 (n)	2020 (n)	2021 (n)	Total (n, %)
Non-communicable diseases	41	70	159	672	845	772	2559 (41.8)
Communicable disease	19	40	94	363	940	1381	2837 (46.3)
Brought dead	2	8	60	179	216	194	659 (10.8)
Congenital	2	5	7	7	16	15	52 (0.8)
Road traffic accident	1	0	2	3	4	11	21 (0.3)

4. Discussion

Mortality data provide us with a snapshot of current health problems, suggest persistent patterns of risk in specific communities, and show trends in specific causes of death over time. Many causes of death are preventable or treatable through effective public health intervention. The accurate measurement and estimation of mortality levels help identify the major causes of premature death and provide a valuable benchmark for evaluating progress in healthy life[11].

Various studies suggest that male life expectancy is shorter than female life expectancy in most countries[12,13]. This gender gap in longevity was evident during the COVID-19 pandemic, which kills men disproportionately[14]. The WHO report about the distribution of mortality by age and sex during 2020 and 2021 shows that the global death toll was higher in men than women (57% male, 43% female) and higher among older adults[15].

A study finds that children aged under 10 years were less susceptible to infection in comparison with adults given the same exposure[16]. Older age is linked with more underlying health conditions and weaker immune systems[17]. Jin *et al.* reported males and females have the same prevalence of COVID-19, but male patients have higher mortality, and age and sex were associated with disease severity and mortality[18]. Our study shows higher mortality rates in the male and elder adult age groups. The male deaths were twice the female deaths (65.4% male, 34.4% female), and more the in the age group of 51 to 65 years.

In the past decades, the burden of non-communicable disease was higher suggesting an epidemiological shift in the pattern of the disease, but this seemed to be reversed due to the pandemic. A higher number of deaths from communicable diseases was observed in 2020 and 2021. This finding is consistent with the Pan American Health Organization, which refers that people with comorbidities such as non-communicable diseases, including cardiovascular disease, diabetes, and cancer are more likely to die from COVID-19[19]. The WHO report shows every year, 15 million people die from NCDs between the age of 30 and 69 years and more than 85% of these premature deaths occur in low and middle-income countries[20]. Similarly, our studies show the major reasons for deaths were communicable and non-communicable diseases and the COVID-19 pandemic increased the mortality rate and earlier death

during hospitalization.

Our study has a few limitations due to a hospital-based retrospective descriptive study in a referral hospital. The sample may not represent the general population, the causes of mortality may be multifactorial and the study lacks a comparison group, so it may not provide a causative association.

In conclusion, there was a sudden rise in death rates in the last two years of 2020 and 2021 due to the sudden hit of COVID-19. The burden due to both communicable and non-communicable diseases shows a gradually increasing trend over the five years. There is a need for health awareness in the community about changing lifestyles and their harmful effects on health.

Conflict of interest statement

The authors report no conflict of interest.

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Authors' contributions

SA: conceptualization, methodology, analysis and original draft preparation. AG: methodology, critical review of the manuscript for important intellectual content and resources. SKS: methodology and original draft preparation. SR: methodology, analysis, original data preparation and interpretation of data.

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