Profile of Deaths Due to COVID-19 in Three Zones of Ahmedabad City during the all Three Waves of Pandemic: A Record Based Study

Rachna Kapoor[1], Sheetal Vyas[2], Mayank Patel[3], Kaushika Chaudhari[4], Vandana Shah[5], Mona Panchal[5]

[1]Associate Professor, [2]Professor & Head, [3]Assistant Professor (Statistics), Department of Community Medicine, Narendra Modi Medical College, Ahmedabad, Gujarat, India.
[4]Associate professor, Department of Medicine, Narendra Modi Medical College, Ahmedabad, Gujarat, India.
[5]Assistant Professor, Department of Anaesthesia, Narendra Modi Medical College Ahmedabad, Gujarat, India.
Correspondence: Dr RachnaKapoor, Email:drrk_kap@ymail.com

Abstract:

Introduction: Mortality due to COVID- 19 was observed in India including Gujarat during the pandemic. Death audit of all the deaths among cases of COVID- 19 during the pandemic was carried out in Municipal Corporation area of a city of Gujarat in India. **Objectives:** Present research was carried out to describe socio-demographic and clinical profile among deceased due to COVID-19. **Method:** Descriptive cross sectional record-based study was carried out.Case papers of 1078 deaths from three zones of municipal corporation were allotted for death audit to a tertiary care teaching hospital and the findings were described as proportions, mean, median and associations were demonstrated through appropriated tests like Chi square test, t-test. **Results:** Mean age of deceased was 63.66+11.99 years. Male:Female ratio was 2.5:1.The median duration of stay of the deceased in the hospital was 7 (IQR: 3-12). The most commonly recorded immediate cause of death was Type 1 Respiratory failure 533(49.44%).Proportion of comorbidities increased with increase in age and this was statistically highly significant. However, there was no gender-wise association of comorbidities. There was no association of SpO2 levels with age.However,SpO2 levels were significantly associated with fever, sore throat, breathlessness and ischaemic heart disease. **Conclusion:** Based on the findings of the study, individuals more than 60 years of age were identified as high risk group,Emphasis on early referral and proper management of comorbidities is required to decrease the mortality.

Keywords: Comorbidities, COVID -19, Death Audit, Immediate cause of death

Introduction:

A new human coronavirus, SARS-CoV-2, that causes pneumonia and other complications named as COVID-19 was first reported in Wuhan, China in 2019.[1] Control of the COVID-19 pandemic rely largely on non-pharmaceutical interventions.[2-8] As of 2 August 2023, there have been 768,983,095 and 44,995,665 confirmed cases of COVID-19 globally and in India, respectively with 531,917 deaths in India.[9,10]

In Gujarat, as of 6th August,2023 there were 12,91,367confirmed cases and 11,079 deaths.[11] Ahmedabad is the largest and most populous city of state of Gujarat. The population of city is approximately 8 million and this is seventh largest metropolis in India. During all the three waves of COVID-19, the city had great proportion of morbidity and mortality out of the total for the state. Since the pandemic was new hence the evidences for the

Quick Response Code	Access this article online	How to cite this article :
	Website : www.healthlinejournal.org	KapoorR, Vyas S, Patel M, Chaudhari K, Shah V, Panchal M. Profile of Deaths Due To COVID-19 in Three Zones of Ahmedabad City during the Three Waves of Pandemic: A Record Based Study. Healthline. 2024; 15 (1): 72-79
	DOI : 10.51957/Healthline_ 592_2024	

disease were nonexistent and there was a need to study all the aspects of the disease.

In view of this, the present study was carried out to know the trend, immediate cause of death and associated factors of mortality among COVID-19 cases from 62 public and private hospitals of a Municipal Corporation.

Method:

A descriptive cross-sectional record-based study was carried out, encompassing 1078 case records of COVID-19-related deaths. These records were obtained from hospitals situated in the East, North, and South zones of the Municipal Corporation. The death audit cases were referred to current institute for analysis, covering the period from June 1, 2020 to March 25, 2022.

Study area:

The city of Ahmedabad is divided in to seven zones namely Central, East, West, North, South, South West and North West for the administrative purpose. All the public and private health facilities (except civil hospital, Ahmedabad) from three zones of Ahmedabad Municipal corporation namely East, North and South were allotted to current tertiary care institute for the purpose of Death audit of all hospital deaths.

Study method:

Scanned copy of case papers from around 62hospitals where death occurred were sent to the current institute for death audit. From each public and private hospital, one nodal person was identified who used to coordinate with the death audit team of our institute. In case of need for some additional information,that nodal person would help in providing the same.The death audit team of our institute comprised of three faculties one each from departments of Medicine, Anaesthesia and Community Medicine respectively. A standard "COVID-19 Death Audit Proforma" introduced by the health department of State Government was used to audit all the deaths .The data used in this study are a part of the audit and permission to publish this data has been taken from Deputy Municipal Commissioner of the Corporation. Permission from the Institutional Review Board of the Institute was taken regarding ethical aspects of the study.

Study variables:

Authors examined data on age, gender, duration of hospital stay between date of admission and date of death of patients, symptoms of the patients at the time of admission,SpO2 level of the patients, comorbidities and cause of death.

Statistical analysis:

The data on discrete variable is presented as number and percentage. The data on continuous variable is presented as Mean, Standard Deviation (SD), Median and Inter Quartile Range (IQR). Kolmogorov-Smirnov test was used to check the normality of the continuous variable. Two continuous groups were compared by unpaired t-test/Mann-Whitney U test. Categorical groups were compared by Chi-Square test. Z test was used to check the significance difference between to proportions. The entire data is analysed using Statistical Package for Social Sciences (SPSS version 26.0, IBM Corporation, USA)

Results:

Of the 1078 deaths, two-thirds of the deceased were males 770 (71.43%). The mean age at death was 63.66$\pm$11.99 years. The results showed that there is no statistically significant difference between mean age of female and male patients (t=-0.777, P value: 0.437) (Table 1)

Of all the 1078 patients, 55 (5.1%) died within 24 hours, while 375 (34.8%) died within 1 to 5 days and 308(28.5%) died between 6 to 10 days of hospitalization. The median duration of stay of the deceased in the hospital was 7 days (IQR: 3-12). There was no statistically significant difference between males and females with respect to hospital stay.(Z=-0.127, P value: 0.899). (Table 2)

Table 1: Age and Gender wise distribution of deceased (N=1078)

Age (years)	Female n (%)	Male n (%)	Total n (%)
21-30	5 (1.62)	5 (0.65)	10 (0.93)
31-40	11 (3.57)	20 (64.52)	31 (2.88)
41-50	26 (8.44)	68 (8.83)	94 (8.72)
51-60	95 (30.84)	190 (24.67)	285 (26.44)
61-70	92 (29.87)	271 (35.19)	363 (33.67)
71-80	49 (15.90)	171 (22.20)	220 (20.41)
81-90	26 (8.44)	42 (5.45)	68 (6.31)
91-100	4 (1.30)	3 (0.39)	7 (0.65)
Mean±SD	63.21±12.85	63.84±11.64	63.66±11.99
Total	308 (28.57)	770 (71.43)	1078 (100)

Table 2: Gender wise distribution of duration of stay in the hospital among deceased (N=1078)

Days	Female n (%)	Male n (%)	Total n (%)
<1 Day	15 (4.87)	40 (5.19)	55 (5.11)
1-5	107 (34.74)	268 (34.80)	375 (34.78)
6-10	87 (28.24)	221 (28.70)	308 (28.57)
11-15	54 (17.53)	130 (16.88)	184 (17.07)
16-20	22 (7.14)	67 (8.70)	89 (8.25)
21-25	11 (3.57)	26 (3.37)	37 (3.43)
26-30	7 (2.27)	10 (1.30)	17 (1.57)
>30	5 (1.62)	5 (0.65)	10 (0.92)
Median duration (IQR)	7 (3-12)	7 (3-12)	7 (3-12)
Total	308 (28.57)	770 (71.43)	1078 (100)

Type 1 Respiratory failure was the most commonly recorded immediate cause of death 533 (49.44%), followed by acute respiratory distress syndrome (ARDS) 323 (29.96%). Other immediate causes of death were sudden cardiac death 106 (9.83%), septicaemia 73 (6.77%),multiple organ dysfunction syndrome (MODS) 24 (2.26%) and acutecoronary Syndrome (ACS) 19 (1.76%). (Figure 1)

Association of presence of various comorbidities was studied with age among COVID 19 patients. Highest proportion of comorbidities were present in people aged 60 and above. Proportion of comorbidities increased with increase in age and this was statistically highly significant. (χ^2 =36.59, p=0.0000). Total 774 (71.80%) cases had comorbidities, of which males accounted for 70.93% of comorbidities but there was no significant association between gender and comorbidities. (Table 3)

Most common comorbidities were hypertension 536 (49.72%), diabetes 457 (42.39%), ischaemic heart disease 148(13.73%), lung cancer 34(3.15%), hypothyroidism 67(6.21%). Asthma accounted for only 7(0.65%) of the comorbidities. Chronic illnesses included chronic kidney disease, chronic obstructive pulmonary disease and mental illness. (Table 4)

Figure 1: Immediate cause of death of admitted patients (N=1078)

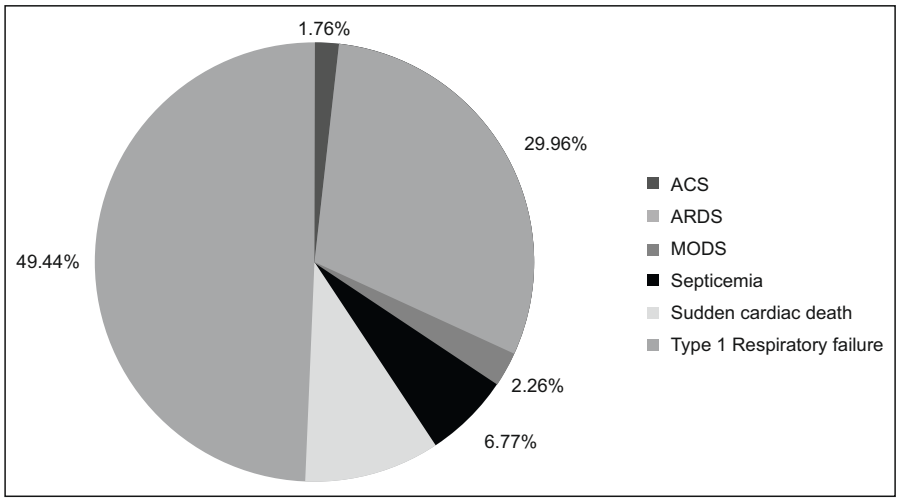

Table 3: Age and Gender wise Comorbidities among deceased (N=1078)

Variable	Comorbidities		Total n (%)	Chi-square (p value)
	Present n (%)	Absent n (%)		
Age (years)				
21-30	4 (0.52)	6 (1.97)	10 (0.93)	36.589 (<0.000)
31-40	11 (1.42)	20 (6.58)	31 (2.87)	
41-50	62 (8.01)	32 (10.52)	94 (8.72)	
51-60	193 (24.93)	92 (30.26)	285 (26.44)	
>60	504 (65.11)	154 (49.34)	658 (61.04)	
Gender				
Female	225 (29.07)	83 (27.30)	308 (28.57)	0.334 (0.563)
Male	549 (70.93)	221 (72.70)	770 (71.43)	
Total	774 (71.80)	304 (28.20)	1078 (100)	

The leading symptoms were breathlessness 792 (73.47%), followed by fever 753 (69.85%) and cough 681 (63.17%). Association of age versus SpO2 levels were studied. SpO2 levels were categorized as < 95 % and 95- 100 %. Age wise distribution of SpO2 levels showed that there was no significant difference in age wise SpO2 levels. (X^2=1.45, P value: 0.93). SpO2 levels were also studied as per presenting symptoms of patients. There was a significant association between breathlessness and SpO2 level < 95 % (Z=4.503, p value =0.000). Also, COVID 19 patients with fever and sore throat reported low SpO2 levels. (Z=2.247, p value= 0.025 & Z=2.034, p value=0.042 respectively).There was no significant association of SpO2 levels with other symptoms.As far as comorbidities are concerned Ischaemic heart disease was significantly associated with SpO2 levels <95%. (Z=-3.147, p value=0.002).Other comorbidities like hypertension, diabetes mellitus, asthma, hypothyroidism cancer, were also investigated for association with SpO2 levels; however, the results were not significant (Table 4)

Discussion:

The mean age of death in our study was 63.66 (± 11.99) years which was slightly higher than the study conducted by Baruah TD et al where mean age was 57.6±(2.4) years.[12] But was much lower than the study conducted by Bhargav et al., DU RH et al and

Table 4: Age, Association of Age, Symptoms and Comorbidities with SpO2 levels of study population (N=1078)

Variable	SpO2 (%)		Total (N=1078) n (%)	Chi-Square/ Z value	p value
	<95 (N=726)	95-100 (N=352)			
	n (%)	n (%)			
Age (years)					
21-30	7 (0.96)	3 (0.85)	10 (0.93)	1.447	0.935
31-40	22 (3.03)	9 (2.55)	31 (2.87)		
41-50	62 (8.54)	32 (9.09)	94 (8.72)		
51-60	199 (27.41)	86 (24.43)	285 26.44)		
>60	436 (60.06)	222 (63.08)	658 61.04)		
Symptoms*					
Cough	462 (63.63)	219 (62.21)	681(63.17)	0.453	0.650
Fever	523 (72.04)	230 (65.34)	753 (69.85)	2.247	0.025
Breathlessness	564 (77.68)	228 (64.77)	792 (73.47)	4.503	0.000
Sore throat	80 (11.01)	25 (7.10)	105 (9.74)	2.034	0.042
Weakness	189 26.03)	88 (25.00)	277 (25.69)	0.364	0.716
Running nose	4 (0.55)	5 (1.42)	9 (0.83)	1.471	0.141
Diarrhoea/Vomiting	15 (2.06)	11 (3.12)	26 (2.41)	-1.063	0.288
Headache/Body ache	27 (3.72)	7 (1.99)	34 (3.15)	1.524	0.127
Loss of smell & taste	1 (0.13)	1 (0.28)	2 (0.18)	-0.523	0.601
Chest pain	8 (1.10)	2 (0.56)	10 (0.92)	0.857	0.391
Comorbidities*					
Diabetes mellitus	299 41.18)	158 44.88)	457 42.39)	-1.153	0.249
Hypertension	372 51.24)	164 46.59)	536 49.72)	1.431	0.152
Ischaemic heart disease	83 (11.43)	65 (18.46)	148 13.73)	-3.147	0.002
Hypothyroidism	45 (6.19)	22 (6.25)	67 (6.21)	-0.033	0.974
Other Malignancies	13 (1.79)	7 (1.99)	20 (1.85)	-0.226	0.821
Lung Cancer	23 (3.16)	11 (3.12)	34 (3.15)	0.038	0.970
Asthma 5 (0.69)	2 (0.57)	7 (0.65)	0.231	0.817	
Any chronic illness	27 (3.72)	21 (5.96)	48 (4.48)	-1.677	0.093
CV stroke	4 (0.55)	3 (0.85)	7 (0.65)	-0.574	0.564

* Multiple Responses

Salije et al where mean age of COVID 19 mortality was 70.4 years ,70.2 years and 79 years respectively.[13-15] Torres et al also reported 75 % of COVID 19 mortality occurred in patients aged more than 75 years.[16] Findings of study conducted by deSouza et al. was almost at par with our study where majority of deaths occurred in more than 60 years of age.[17] Some studies mention that the elderly group having a higher risk of death.[18]

In present study majority (71.43%) of COVID 19 deaths were inmales.Thesefindings were in agreement with theglobal data on case fatality rates

where COVID 19 case fatality rates were more in males.Our study was also in agreement with the audit report conducted by Koya SF et al[19] and Salije H H. et al.[15] where 73 % and 60.3 % of the fatalities due to COVID 19 were in males but was in total disagreement with the study conducted byJohns Hopkins University of Medicine where data showed that in India female morality due to COVID 19 was more as compared to males.[20] Also Case fatality rates in Nepal, Vietnam, and Slovenia are also higher among women than men.[21] This was again in sharp contrast to our study. The reasons for these contrasting findings could be attributed to males being associated with increased outdoor activities due to their employment and subsequent more exposure as compared to females.

Regarding duration of stay in hospital before death, only 5.1% died occurred within 24 hours which was much less than the study conducted by Koya SF et al where 20 % of COVID 19 fatalities occurred within 24 hours while 25 % of the deaths occurred within 1 to 3 days. This was slightly less than our study where 34.8% of case fatalities occurred within 1 to 5 days.[21] The median duration of stay of the deceased in the hospital was 7 (IQR 3-12) in our study which was slightly higher than the study conducted by Baruah TD et al. where the median stay in the hospital before they succumbed was 5.5 days. (IQR 3-9).[12]

Less number of deaths within first 24 hours could be due to intense surveillance and testing activities amongst population and early referral.

In this study the leading symptom was breathlessness(73.47%) which was slightly less than the study conducted by Du RH et al.[14] where 85.7 % of the deceased had dyspnea but was higher than the study conducted by Zhang B et al where 63.4 % of deceased suffered from dyspnea.[22] 69.85 % of the patients in our study had fever which was slightly less than the study by Zhang B et al (78 %)[22] But weakness as a symptom was present in 25.69 % of deceased which was almost 50 % less than the study by Du RH[14] and slightly less than half in the study conducted by Zhang B et al[22] where 46.3 % of patients had fatigue. Cough in our study was present in 63.17 % of patients which was almost similar to study conducted by Zhang et al (64.6 %).[22] Sore throat was higher in this study (9.74%) than study conducted by Zhang et al where 4.9 % patients suffered from this symptom.[22] Headache in our study was present in (3.15 %) of patients which is again much less than the study conducted by DuRH et al where 23.4% of patients suffered from headache.[14] This discrepancy in symptoms could be explained by different demographic features.

In current study most common comorbidities were hypertension (49.72%), diabetes (42.39%) and past history of ischemic heart disease (13.73%) which were much higher as compared to Chinese studies where Hypertension, diabetes and cardiovascular diseases accounted to 6% , 7.3% and 10.5 % respectively[23] but was less than the study conducted by Koya SF et al where diabetes and hypertension were present in 66 % and 54% of the patients.[19] Ischemic heart disease (18.3%), was similar in study conducted by Koya SF et al but hypothyroidism (8.3) was higher in this study as compared to study conducted by Koya SF et al. (4%).[19] Asthma accounted for only 0.9% of the comorbidities which is drastically less as compared to study conducted by Koya SFet al where 3% of deceased had asthma.[19] The prevalence of Asthma in current study (0.9%) is smaller than the 5.5% population prevalence reported for India.[24]

This difference in data could be due to higher mean age of patients in this study.

Type 1 Respiratory failure was the most commonly recorded immediate cause of death (49.4%) in present study which was lower than study conducted by Zhang et al[22] and Kiageng Nico PN etal.[25] where respiratory failure was responsible for 69.5% and 95.06% of COVID 19 fatalities. ARDS was

recorded as immediate cause of death in 30 % of deceased which was double than study conducted by Elezkurtaj S et al (15.4%).[26] Sudden cardiac death in this study was responsible for 9.83 % of COVID 19 fatalities which was almost four times greater than study conducted by KiagengNico PN et al(2.47%).[25] Septicaemia in this study accounted for 6.8% of deaths which was almost six times greater than the study conducted by KiagengNico PN et al.(1.23 %).[25] The findings are similar to other studies which reveal that respiratory and cardio-vascular systems are the two major systems contributing to COVID 19 deaths.

The main finding of this study indicated that there existed a significant association between presence of fever and SpO2< 95 % in hospitalised patients. This was in agreement with the study conducted by Lahav et al. in children[27] and Tharakan Set al[28] in adultsbut this was in contradiction to study by Mphekgwana PM et al.[29] Also in current study there was a significant association between breathlessness and SpO2 level < 95 % which was in contrast to the study conducted by Mphekgwana PM et al.[29] where no relationship existed between breathlessness and SpO2 levels. This could be attributed to the different cohorts of hospitalised patients and groups sampled in these studies.

Conclusions and recommendations:

The mean age of death in the study was 63.66 (± 11.99) years with male predominance. The median duration of stay of the deceased in the hospital was 7 days. Most common presenting symptom was fever and breathlessness. Most common comorbidities were hypertension, diabetes and past history of ischemic heart disease.

Numbers of deaths included in this study were right from beginning of COVID 19 pandemic from the year 2020 onwards. Thereafter vaccination was also included in prevention strategy of disease. However the impact of vaccination could not be assessed but definitely this can reduce the mortality. Early identification of home isolated cases based on these three symptoms (fever, dyspnoea & sore throat) and low SpO2 levels can also lead to early referrals and subsequent decrease in mortality. Proper management of comorbid conditions like hypertension, diabetes, old cases of ischaemic heart disease etc. can reduce mortality amongst COVID 19 cases.

Declaration:

Funding: Nil

Conflict of Interest: Nil

References:

1. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J, Zhao X, Huang B, Shi W, Lu R, Niu P, Zhan F, Ma X, Wang D, Xu W, Wu G, Gao GF, Tan W; China Novel Coronavirus Investigating and Research Team. A Novel Coronavirus from Patients with Pneumonia in China, 2019. N Engl J Med. 2020 Feb 20;382(8):727-733.
2. Hunter DJ. Covid-19 and the Stiff Upper Lip - The Pandemic Response in the United Kingdom. N Engl J Med. 2020 Apr 16;382(16):e31.
3. Gates B. Responding to Covid-19 - A Once-in-a-Century Pandemic? N Engl J Med. 2020 Apr 30;382(18):1677-1679.
4. Gostin LO, Wiley LF. Governmental Public Health Powers During the COVID-19 Pandemic: Stay-at-home Orders, Business Closures, and Travel Restrictions. JAMA. 2020 Jun 2;323(21):2137-2138.
5. Cowling BJ, Aiello AE. Public Health Measures to Slow Community Spread of Coronavirus Disease 2019. J Infect Dis. 2020 May 11;221(11):1749-1751.
6. Fong MW, Gao H, Wong JY, Xiao J, Shiu EYC, Ryu S, Cowling BJ. Nonpharmaceutical Measures for Pandemic Influenza in Nonhealthcare Settings-Social Distancing Measures. Emerg Infect Dis. 2020 May;26(5):976-984.
7. Haushofer J, Metcalf CJE. Which interventions work best in a pandemic? Science. 2020 Jun 5;368(6495):1063-1065.
8. Hale T, Angrist N, Goldszmidt R, Kira B, Petherick A, Phillips T, Webster S, Cameron-Blake E, Hallas L, Majumdar S, Tatlow H. A global panel database of pandemic policies (Oxford COVID-19 Government Response Tracker). Nat Hum Behav. 2021 Apr;5(4):529-538.
9. WHO Coronavirus (COVID-19) Dashboard .Available on https:// COVID 19.who.int:Last accessed on 7th August 2023
10. COVID -19 State wise status. Government of India. Available on https://www.mygov.in/corona-data/covid19-statewise-status/ Last accessed on 7th August 2023
11. Baruah TD, Kannauje PK, Ray R, Borkar N, Panigrahi S, Kumar D, Pathak M, Biswas D. Hospital mortality among COVID-19

patients - Experience of a multi-disciplinary tertiary care teaching hospital of Chhattisgarh in Central India. J Family Med Prim Care. 2022 Oct;11(10):6499-6505.

12. Bhargava A, Szpunar SM, Sharma M, Fukushima EA, Hoshi S, Levine M, Gandhi N, Zhao W, Michael S, Tanveer F, Youssef D, Coyle M, Leonard J, Saravolatz L. Clinical Features and Risk Factors for In-Hospital Mortality From COVID-19 Infection at a Tertiary Care Medical Center, at the Onset of the US COVID-19 Pandemic. J Intensive Care Med. 2021 Jun;36(6):711-718.
13. Du RH, Liang LR, Yang CQ, Wang W, Cao TZ, Li M, Guo GY, Du J, Zheng CL, Zhu Q, Hu M, Li XY, Peng P, Shi HZ. Predictors of mortality for patients with COVID-19 pneumonia caused by SARS-CoV-2: a prospective cohort study. EurRespir J. 2020 May 7;55(5):2000524.
14. Salje H, Tran Kiem C, Lefrancq N, Courtejoie N, Bosetti P, Paireau J, Andronico A, Hozé N, Richet J, Dubost CL, Le Strat Y, Lessler J, Levy-Bruhl D, Fontanet A, Opatowski L, Boelle PY, Cauchemez S. Estimating the burden of SARS-CoV-2 in France. Science. 2020 Jul 10;369(6500):208-211.
15. Moreno-Torres V, de la Fuente S, Mills P, Muñoz A, Muñez E, Ramos A, Fernández-Cruz A, Arias A, Pintos I, Vargas JA, Cuervas-Mons V, de Mendoza C. Major determinants of death in patients hospitalized with COVID-19 during the first epidemic wave in Madrid, Spain. Medicine (Baltimore). 2021 Apr 23;100(16):e25634.
16. de Souza R, Mhatre S, Qayyumi B, Chitkara G, Madke T, Joshi M, Bharmal R, Asgaonkar DS, Lakhani P, Gupta S, Chaturvedi P, Dikshit R, Badwe R. Clinical course and outcome of patients with COVID-19 in Mumbai City: an observational study. BMJ Open. 2021 May 6;11(5):e042943.
17. Ho FK, Petermann-Rocha F, Gray SR, Jani BD, Katikireddi SV, Niedzwiedz CL, Foster H, Hastie CE, Mackay DF, Gill JMR, O'Donnell C, Welsh P, Mair F, Sattar N, Celis-Morales CA, Pell JP. Is older age associated with COVID-19 mortality in the absence of other risk factors? General population cohort study of 470,034 participants. PLoS One. 2020 Nov 5;15(11): e0241824.
18. Koya SF, Ebrahim SH, Bhat LD, Vijayan B, Khan S, Jose SD, Pilakkadavath Z, Rajeev P, Azariah JL. COVID-19 and Comorbidities: Audit of 2,000 COVID-19 Deaths in India. J Epidemiol Glob Health. 2021 Jun;11(2):230-232. doi: 10.2991/jegh.k.210303.001. Epub 2021 Mar 9. PMID: 33876594; PMCID: PMC8242123.
19. Johns Hopkins University of MedicineNew cases of COVID-19 in world countries.Available on https://coronavirus.jhu.edu/data/new-casesLast accessed: August 8, 2023
20. The Sex, Gender, and COVID-19 ProjectThe COVID-10 sex-disaggregated data tracker.Available onhttps://globalhealth5050.org/covid19/Last accessed: August 8, 2023.
21. Zhang B, Zhou X, Qiu Y, Song Y, Feng F, Feng J, Song Q, Jia Q, Wang J. Clinical characteristics of 82 cases of death from COVID-19. PLoS One. 2020 Jul 9;15(7):e0235458.
22. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. JAMA. 2020 Apr 7;323(13):1239-1242.
23. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72314 cases from the Chinese Center for Disease Control and Prevention. JAMA. 2020; 323(13):1239–1242.
24. Kumar P, Ram U. Patterns, factors associated and morbidity burden of asthma in India. PLoS One. 2017 Oct 26;12(10): e0185938.
25. KiagengNico PN, K., Rudiardi, A., Cahyaharnita, R. A., &Djunaedi, D. (2022). Causes of Death in Patients with COVID-19 at Muhammadiyah University General Hospital of Malang. KnE Medicine, 2(3), 428–436.
26. Elezkurtaj S, Greuel S, Ihlow J, Michaelis EG, Bischoff P, Kunze CA, Sinn BV, Gerhold M, Hauptmann K, Ingold-Heppner B, Miller F, Herbst H, Corman VM, Martin H, Radbruch H, Heppner FL, Horst D. Causes of death and comorbidities in hospitalized patients with COVID-19. Sci Rep. 2021 Feb 19;11(1):4263.
27. Lahav DZ, Picard E, Mimouni F, Joseph L, Goldberg S. [The effect of fever on blood oxygen saturation in children]. Harefuah. 2015 Mar;154(3):162-5, 213, 212. Hebrew. PMID: 25962244.
28. Tharakan S, Nomoto K, Miyashita S, Ishikawa K. Body temperature correlates with mortality in COVID-19 patients. Crit Care. 2020 Jun 5;24(1):298.
29. Mphekgwana PM, Sono-Setati ME, Maluleke AF, Matlala SF. Low Oxygen Saturation of COVID-19 in Patient Case Fatalities, Limpopo Province, South Africa. Journal of Respiration. 2022; 2(2):77-86.