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Comorbidities and COVID-19: A Retrospective Analysis of Disease Severity

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Abstract

Aim: To evaluate the association between common comorbidities and the clinical severity, radiological findings, and in-hospital outcomes of patients admitted with coronavirus disease 2019 (COVID-19) at a tertiary care center in South India. Subject and **Methods:** This retrospective observational study included 202 adult patients with laboratory-confirmed COVID-19 admitted to Princess Esra Hospital, Hyderabad, between February and November 2021. Clinical data, comorbidity status, computed tomography (CT) severity scores, and duration of hospital stay were collected from medical records. The COVID-19 Reporting and Data System (CORADS) was used to assess radiological suspicion levels. Statistical comparisons were made using t-tests and chi-square tests with a significance level of $p < 0.05$. **Results:** Patients with diabetes and hypertension showed significantly higher CT severity scores (mean scores of 20.04 and 20.77, respectively) compared to those without these conditions. These groups also had longer hospital stays. Mortality increased proportionally with the number of comorbidities, reaching 87.5% in patients with more than three. CT severity scores were significantly higher in non-survivors than survivors, whereas CORADS scores showed no meaningful difference. Patients with malignancy or chronic kidney disease also had prolonged recovery times despite moderate radiological severity. **Conclusion:** Comorbidities such as diabetes and hypertension are associated with more severe COVID-19 as indicated by higher CT severity scores, longer hospitalization, and increased mortality. CT severity scoring showed a stronger prognostic association with mortality than CORADS in this cohort. These findings support the prioritization of early, aggressive care in patients with multiple chronic conditions.

Subject Areas

Diabetes & Endocrinology

Keywords

COVID-19, Comorbidities, CT Severity Score, Diabetes, Hypertension

1. Introduction

Coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has presented a significant global health challenge since its emergence in late 2019 [1] [2]. The infection exhibits a broad clinical spectrum ranging from asymptomatic cases to severe pneumonia, multi-organ failure, and death [3]. As of mid-2021, millions of infections and deaths have been reported worldwide, prompting the urgent need for a deeper understanding of disease risk factors, particularly those influencing disease severity and outcomes [4].

Several studies have identified comorbidities such as diabetes mellitus, hypertension, obesity, cardiovascular disease, and chronic kidney disease as important determinants of adverse clinical outcomes in COVID-19 [5] [6]. These comorbidities have been associated with increased risk of hospitalization, mechanical ventilation, intensive care admission, and death [7] [8]. However, the strength and consistency of these associations have varied across geographic regions and populations, likely due to differences in genetic factors, healthcare infrastructure, comorbidity prevalence, and study design [9]. Despite the abundance of data from Western countries and East Asia, there remains a relative paucity of data from the Indian subcontinent, where demographic and epidemiologic characteristics may alter the risk landscape.

Hyderabad, the capital of Telangana, is one of the largest metropolitan cities in South India with an estimated population exceeding 10 million [10]. During the second wave of COVID-19 in India (February-November 2021), Telangana reported more than 660,000 confirmed cases [11]. The surge was characterized by widespread community transmission, limited ICU bed availability, and shortages of oxygen and critical-care resources. The prevalence of metabolic disorders such as diabetes and hypertension in urban Telangana populations likely contributed to the higher disease burden observed in hospitalized patients [12] [13]. Given the growing burden of non-communicable diseases in India and the evolving understanding of COVID-19 pathophysiology, our study sought to evaluate the association between pre-existing comorbidities and COVID-19 severity in a cohort of hospitalized individuals in Hyderabad, India. We hypothesized that patients with diabetes, hypertension, and other chronic conditions would have significantly higher severity scores and worse outcomes compared to those without such comorbidities. This study aims to fill existing knowledge gaps by providing region-specific evidence that may inform risk stratification and clinical decision-making in similar low- and middle-income settings.

2. Methodology

2.1. Study Design and Setting

This retrospective observational study was conducted at Princess Esra Hospital, a tertiary care facility located in Hyderabad, Telangana, India from February to November 2021. The hospital was one of the designated COVID-19 treatment centers during the second wave of the pandemic. Given the retrospective nature of the study and the use of anonymized data, the requirement for informed consent was waived. All data were handled with strict confidentiality. All procedures were conducted in accordance with the ethical standards of the institutional and national research committees.

2.2. Study Population and Eligibility Criteria

The study included adult individuals aged 18 years and above who were admitted to Princess Esra Hospital between February and November 2021 with a laboratory-confirmed diagnosis of COVID-19. Confirmation of infection was established using reverse transcriptase-polymerase chain reaction (RT-PCR) testing of nasopharyngeal swab samples, as per the guidelines issued by the Indian Council of Medical Research (ICMR) along with documented clinical outcome (either discharged or deceased). Individuals with missing data regarding disease severity (CT score or CORADS) or with unknown or undocumented primary outcomes (discharge or death) were excluded. A total of 234 hospital records were initially screened for eligibility. After applying the predefined inclusion and exclusion criteria, 202 patients were included in the final analysis, while 32 records were excluded because of missing disease severity data (CT severity score or CORADS), undocumented primary outcomes, or incomplete medical records.

2.3. Data Collection Procedures

A standardized case report form (CRF) was developed for the purpose of this study. Data were collected retrospectively from the electronic medical records (EMRs) maintained by the hospital. Trained members of the research team extracted and cross-verified the data to minimize data entry errors. Demographic variables included age and sex. Clinical parameters included comorbidity status (presence or absence of diabetes mellitus, hypertension, obesity, cardiovascular diseases, chronic kidney disease, asthma, malignancy, hemiplegia, rheumatoid arthritis, and hypothyroidism), date of symptom onset, date of hospital admission, duration of hospital stay, and final outcome (discharged or deceased). Comorbidity status was determined from the electronic medical records based on documented pre-existing physician diagnoses and findings recorded during the admission evaluation.

Radiologic findings were obtained from the imaging database linked to the EMR. High-resolution chest computed tomography (CT) scans were performed at the time of hospital admission as part of the initial clinical workup and were evaluated to determine CT severity scores and CORADS scores. CT severity scoring was conducted by trained radiologists and validated using a standardized pro-

tocol that divides both lungs into 20 regions (10 per lung) [14]. Each region was assigned a score based on the degree of opacification as follows: 0 (0% involvement), 1 (<50% involvement), or 2 (>50% involvement), leading to a cumulative score ranging from 0 to 40.

CORADS (COVID-19 Reporting and Data System) is a categorical assessment scale used to standardize the level of suspicion for COVID-19 infection based on CT findings. The scores range from 1 to 5, with CORADS 1 indicating very low suspicion and CORADS 5 indicating very high suspicion of COVID-19 [15]. All scans were independently reviewed by two board-certified radiologists, and discrepancies were resolved by consensus.

3. Outcome Measures

The primary outcome of interest was the severity of COVID-19 pneumonia, as assessed by CT severity scores. Secondary outcomes included CORADS scores, duration of hospital stay (in days), and in-hospital mortality.

4. Statistical Analysis

The data were entered into a pre-coded Microsoft Excel spreadsheet and exported to IBM SPSS Statistics software version 20.0 (IBM Corp., Armonk, NY, USA) for analysis. Descriptive statistics were computed for all study variables. Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables were reported as frequencies and percentages. To assess the association between comorbidities and COVID-19 severity, independent sample t-tests were used to compare mean CT severity scores and mean duration of hospital stay between groups (e.g., diabetic vs. non-diabetic, hypertensive vs. non-hypertensive). Chi-square tests were employed to analyze associations between categorical variables such as comorbidity status and mortality. A p-value of <0.05 was considered statistically significant. Quality control measures included double-entry of a subset of the dataset and cross-validation by a second reviewer to ensure data reliability and internal consistency. All statistical analyses were unadjusted. Therefore, the observed associations may have been influenced by potential confounding factors, including age, sex, and the coexistence of multiple comorbidities.

5. Results

Of the 234 hospital records initially screened, 202 met the eligibility criteria and were included in the final analysis, while 32 records were excluded because of missing disease severity data, undocumented primary outcomes, or incomplete medical records. A total of 202 individuals with laboratory-confirmed COVID-19 infection were included in the final analysis. Of these, 107 (53%) were male and 95 (47%) were female. The majority of the study population was between 41 and 60 years of age (n = 98, 49%). Among the included individuals, 29 (14.4%) died during hospitalization due to complications related to COVID-19. Comorbidities were commonly observed in this cohort. Diabetes mellitus was the most prevalent

comorbidity (n = 84, 42%), followed by hypertension (n = 68, 34%). Demographics of the study cohort have been detailed in Table 1.

Table 1. Characteristics of the study cohort.

CHARACTERISTIC		N (%)
Gender	Male	107 (53%)
	Female	95 (47%)
Age groups	20 - 40 yrs	61 (30%)
	41 - 60 yrs	98 (49%)
	61 - 80 yrs	43 (21%)
Comorbidities	Diabetics	84 (42%)
	Hypertensives	68 (34%)
	Obesity	12 (6%)
	CVD	11 (5.5%)
	Asthma	6 (3%)
	CKD	6 (3%)
	Malignancy	5 (2.5%)
	Hypothyroid	2 (1%)
	Hemiplegia	2 (1%)
	Rheumatoid arthritis	1 (0.5%)
Gender distribution of diabetic patients	Male	44 (52%)
	Female	40 (48%)
Gender distribution of hypertensive patients	Male	30 (44%)
	Female	38 (56%)
Age range of diabetic patients	20 - 40 yrs	16 (19%)
	41 - 60 yrs	52 (62%)
	61 - 80 yrs	16 (19%)
Age range of hypertensive patients	20 - 40 yrs	12 (18%)
	41 - 60 yrs	39 (57%)
	61 - 80 yrs	17 (25%)

Diabetic individuals exhibited significantly higher CT severity scores than non-diabetics (20.04 ± 8.29 vs. 16.13 ± 8.99; p = 0.0008) and required longer hospitalization (19.76 ± 6.10 vs. 12.34 ± 7.00 days; p = 0.003). Similarly, hypertensive individuals had higher CT scores (20.77 ± 9.36 vs. 16.22 ± 8.22; p = 0.0002) and prolonged hospital stays (20.4 ± 7.30 vs. 13.29 ± 6.69 days; p = 0.002). CORADS scores were comparable between these groups (p > 0.05) (Table 2). Individuals

with other comorbidities experienced significantly longer recovery times compared to those without (19.38 ± 6.77 vs. 14.93 ± 7.55 days; p = 0.015) and had lower mean CORADS scores (4.67 ± 0.61 vs. 4.95 ± 0.24; p = 0.007). CT severity scores were not significantly different between these groups (Table 2).

Table 2. Comparison of clinical outcomes according to comorbidity status.

Variable	Diabetic (n = 84)	Non-Diabetic (n = 118)	p-value	HTN (n = 68)	No HTN (n = 134)	p-value	With Other Comorbidities	Without Other Comorbidities	p-value
CT Severity Score	20.04 ± 8.29	16.13 ± 8.99	0.0008	20.77 ± 9.36	16.22 ± 8.22	0.0002	18.17 ± 9.86	17.68 ± 8.71	0.4
Hospital Stay (days)	19.76 ± 6.10	12.34 ± 7.00	0.003	20.40 ± 7.30	13.29 ± 6.69	0.002	19.38 ± 6.77	14.93 ± 7.55	0.015
CORADS Score	4.92 ± 0.32	4.91 ± 0.36	0.42	4.89 ± 0.39	4.92 ± 0.30	0.35	4.67 ± 0.61	4.95 ± 0.24	0.007

Out of 202 individuals, 29 (14.4%) died during hospitalization. Non-survivors had significantly higher CT severity scores compared to survivors (23.90 ± 9.95 vs. 16.72 ± 8.26; p = 0.0003). Mortality was higher in individuals with comorbidities. However, the CORADS score was comparable between the non-survivor and survivor groups (4.79 ± 0.49 vs. 4.93 ± 0.30; p = 0.07).

Of the 29 deceased individuals, 17 (59%) were male and 12 (41%) were female. The highest proportion of deaths occurred in the 41 - 60 age group (n = 18, 62%). Mortality increased with the number of comorbidities: 13.4% in those with one comorbidity, 15.5% with two, 37.5% with three, and 87.5% with more than three. The mean CT severity score was highest in individuals with more than three comorbidities (Table 3) (25.25 ± 10.5), and recovery duration was longest among individuals with three comorbidities (Table 3). Demographics of non survivors have been summarized in Supplementary Table S1 along with their demographics in Table S2.

Table 3. Distribution according to the number of comorbidities.

NUMBER OF COMORBIDITIES	Patients	CTSS	DURATION	DEATHS
1	52 (27 M/25 F)	19.10 ± 7.42	15.76 ± 5.16	13.4%
2	45 (22 M/23 F)	20.30 ± 9.5	21.71 ± 5.95	15.5%
3	8 (3 M/5 F)	16.75 ± 6.98	25.00 ± 6.44	37.5%
>3	8 (6 M/2 F)	25.25 ± 10.5	12.00	87.5%

Older individuals (61 - 80 years) had higher CT severity scores (19.68 ± 8.48) and longer recovery durations (17.43 ± 6.4 days) compared to younger groups. Female participants had slightly higher CT scores (18.04 ± 8.76) and longer hospital stays (15.88 ± 7.76 days) than males (Supplementary Table S3).

6. Discussion

This study demonstrates that individuals with pre-existing comorbidities, espe-

cially diabetes and hypertension, exhibited significantly higher COVID-19 severity as indicated by CT severity scores, prolonged hospitalization, and increased mortality. Our findings support an association between pre-existing comorbidities and worse clinical outcomes in SARS-CoV-2 infection while highlighting the prognostic utility of CT severity scoring in hospitalized patients in a low- and middle-income setting.

While multiple international studies have established associations between comorbidities and COVID-19 mortality or ICU admission rates, region-specific studies with radiological correlation remain limited [5]-[7]. The results from our Hyderabad-based cohort mirror global patterns but provide critical local data. Notably, the CT severity score consistently differentiated survivors from non-survivors (23.90 ± 9.95 vs. 16.72 ± 8.26; $p = 0.0003$), whereas CORADS did not, reinforcing findings from Hadad and Afzelius (2023) that CT severity score is superior to CORADS for severity stratification [16]. It was also observed that individuals with three or more comorbidities had markedly higher mortality rates, peaking at 87.5% in those with >3 conditions. This is consistent with the findings of Marušić *et al.* (2024), who reported a dose-dependent relationship between multimorbidity and poor COVID-19 outcomes [9]. The observed increase in CT severity score and hospital stay with rising age also supports well-documented associations between aging, immunosenescence, and poorer viral clearance [17] [18]. Several region-specific factors likely accentuate these effects in South India. Hyderabad and other metropolitan areas in Telangana report a high prevalence of type 2 diabetes (12% - 15%) and hypertension (30%) substantially higher than national averages, creating a population with heightened baseline vulnerability to severe infection [19]-[21]. During the second wave (February-November 2021), health systems in Hyderabad experienced unprecedented strain, with shortages of oxygen supplies, ICU beds, and critical-care staff, which may have contributed to delayed admission and poorer outcomes compared to cohorts in high-resource settings [22]. Differences in healthcare access between public and private facilities, socioeconomic disparities, and a large proportion of unvaccinated individuals during early 2021 could have further exacerbated disease severity and mortality. These region-specific challenges underline the importance of local epidemiological data to inform preparedness and management strategies in future respiratory pandemics.

The prolonged hospital stay and increased severity in diabetics may be explained by several mechanisms, including impaired neutrophil and lymphocyte function, chronic hyperglycemia-induced oxidative stress, and upregulation of ACE2 receptors facilitating viral entry [23] [24]. Hypertension is associated with endothelial dysfunction, heightened cytokine activity, and increased thrombotic tendency, factors known to exacerbate COVID-19 [25] [26]. These pathophysiological pathways support our findings and the observed radiologic burden in these patient subsets. Another important finding was that patients with other comorbidities such as malignancy and chronic kidney disease also had prolonged hospitalizations, even though their CT severity scores were not significantly elevated.

This discrepancy may be due to delayed immune recovery or treatment-related immunosuppression in malignancy and CKD patients [8] [27]. Although gender-based differences were not statistically significant, females had marginally higher CT scores and recovery durations, which could be due to estrogen and progesterone modulating immune response [28] [29].

This study benefits from a robust sample size for a single-center analysis, radiological correlation using standardized CT scoring, and inclusion of multiple clinically relevant comorbidities. However, several limitations should be acknowledged. The retrospective design may introduce selection and reporting biases. While imaging was performed using standardized protocols, inter-observer variability in CT scoring was not formally quantified. As a single-center study from South India, the generalizability of these findings may be limited to similar demographic settings. HbA1c data were not uniformly available in medical records; hence, correlation of glycemic control with COVID-19 severity could not be performed. Future prospective studies should include HbA1c measurements to better characterize this association. We also lacked data on inflammatory markers (e.g., CRP, IL-6, D-dimer) and vaccination status, both of which are known to influence disease trajectory. Additionally, the subgroup of patients with three or more comorbidities was relatively small; therefore, the corresponding mortality findings should be interpreted with caution and confirmed in larger multicenter studies.

Our findings underscore the critical need for early triage and intensive monitoring of COVID-19 patients with diabetes, hypertension, and multimorbidity. CT severity score showed a stronger prognostic association with mortality than the CORADS score in this cohort. Given the high mortality in patients with >3 comorbidities, these individuals should be prioritized for aggressive care and possibly early therapeutic interventions. Although our dataset could not support derivation of a formal prognostic score due to limited sample size and absence of key biomarkers, future prospective, multicenter studies integrating clinical, radiological, biochemical, and immunologic parameters are needed to expand upon our findings and to develop validated region-specific severity prediction models. Follow-up studies evaluating post-discharge outcomes and long COVID manifestations in high-risk groups would further inform long-term management strategies.

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Author Contributions

Mohammed Shariq Siddiqui contributed to the study conception. All authors contributed to the study design. Mohammed Shariq Siddiqui, Numeera Arjuman, Sadia Sarwath, Ruhina Mirza, Aamena Fathima, Mustafa Kagalwala and Moham-

mad Faizuddin collected and curated the data. Mohammed Shariq Siddiqui supervised data analysis, and critically revised the manuscript. All authors contributed to manuscript writing and approved the final version for submission.

Conflicts of Interest

The authors declare no conflicts of interest.

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Supplementary

Table S1. Demographics of non-survivors.

Characteristic		N (%)
Gender	Male	17 (59%)
	Female	12 (41%)
Age groups	20 - 40 yrs	3 (10.3%)
	41 - 60 yrs	18 (62%)
	61 - 80 yrs	8 (27.5%)
Comorbidities	Diabetes	14 (48.2%)
	Hypertension	18 (62%)
	Both Diabetes and Hypertension	11 (38%)
	Other comorbidities	14 (48.2%)

Table S2. Age-wise distribution of non-survivors along with cause of mortality.

Age group	Deaths	Male	Female	Comorbidities	CTSS
20 - 40 y	3	2	1	MALIGNANCY, CKD, OBESITY	23.67 ± 18.4
41 - 60 y	18	9	9	DM (12), HTN (12), OBESE (4), CVSD (5), CKD (2), ASTHMA (1), HEMIPLEGIA (1)	23 ± 8.63
61 - 80 y	8	6	2	DM (2), HTN (6), OBESE (4), CVSD (2), MALIGNANCY (1), CKD (1), HEMIPLEGIA (1)	25.87 ± 10.6

Table S3. Relationship between CT severity scores, CORAD scores, demographic variables, and rate of recovery.

Variable	Age			Gender	
	20 - 40 y	**41 - 60 y**	**61 - 80 y**	**Male**	**Female**
CTSS (Mean ± SD)	16.28 ± 9.6	17.83 ± 8.46	19.675 ± 8.48	17.49 ± 8.986	18.04 ± 8.76
CORADS (Mean ± SD)	4.9 ± 0.37	4.93 ± 0.3	4.907 ± 0.37	4.879 ± 0.405	4.91 ± 0.336
Duration of stay (Mean ± SD)	14.12 ± 7.9	15.31 ± 7.7	17.43 ± 6.4	14.85 ± 7.4	15.88 ± 7.76