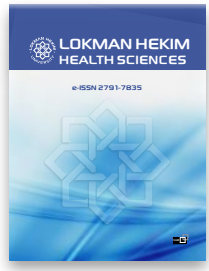
LOKMAN HEKIM HEALTH SCIENCES

DOI: 10.14744/lhhs.2026.18279
Lokman Hekim Health Sci 2026;6(4):700–708



lokmanhekimhs.com

ORIGINAL ARTICLE

Clinical and Laboratory Predictors of COVID-19 Severity and the Need for Intensive Care: A Retrospective Cohort Study

Feray Aycan Yılmaz[1], Ali Acar[2]

[1]Department of Infectious Diseases and Clinical Microbiology, Ankara Etlik City Hospital, Ankara, Türkiye
[2]Department of Infectious Diseases and Clinical Microbiology, Acıbadem Bayındır Söğütözü Hospital, Ankara, Türkiye

Abstract

Introduction: To identify demographic, clinical, imaging, and laboratory predictors of disease severity and intensive care unit (ICU) requirement in patients with coronavirus disease 2019 (COVID-19).

Methods: This retrospective cohort study was conducted between March and August 2020 in the Department of Infectious Diseases. The study included suspected or confirmed cases of COVID-19. Patients' data were retrieved from the hospital's electronic medical records and patient files.

Results: The study included 500 patients. Increasing age and elevated ferritin levels were independently associated with severe COVID-19. Although not statistically significant, delayed admission showed a trend toward increased disease severity. Patients requiring ICU care had significantly higher C-reactive protein (CRP), lactate dehydrogenase (LDH), ferritin, and aspartate aminotransferase (AST) levels, along with lower absolute lymphocyte counts at admission. The multivariable model demonstrated good calibration (Hosmer-Lemeshow p=0.978) and acceptable discrimination (area under the curve=0.76).

Discussion and Conclusion: Advanced age and elevated ferritin levels were independent predictors of severe COVID-19. Higher CRP, LDH, ferritin, and AST levels, along with lower absolute lymphocyte counts, were associated with ICU requirement. Early assessment of these routinely available laboratory parameters may facilitate timely risk stratification and improve clinical management.

Keywords: COVID-19; Pandemic; Risk factors

The coronavirus pandemic, first identified in Wuhan, Hubei Province, China, on December 31, 2019, and later named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has become one of the most widespread and prolonged pandemics in modern history.[1,2] As of November 2, 2025, the number of confirmed COVID-19 cases worldwide has reached 778,900,250, with 7,103,247 reported deaths.[3] The global burden of COVID-19 remains substantial.

SARS-CoV-2, like other RNA viruses, undergoes continuous genetic evolution, resulting in the emergence of viral variants over time. Although differences in transmissibility and immune escape have been described in later phases of the pandemic, this study was conducted during the early

Cite this article as: *Yılmaz FA, Acar A. Clinical and Laboratory Predictors of COVID-19 Severity and the Need for Intensive Care: A Retrospective Cohort Study. Lokman Hekim Health Sci 2026;6(4):700–708.*

Correspondence: Feray Aycan Yılmaz. Ankara Etlik Şehir Hastanesi, Enfeksiyon Hastalıkları ve Klinik Mikrobiyoloji Kliniği, Ankara, Türkiye
E-mail: ferayaycan@gmail.com **Submitted:** 20.12.2025 **Revised:** 19.03.2026 **Accepted:** 27.03.2026 **Available Online:** 14.09.2026

phase of COVID-19, when variant-level analyses were not feasible. Therefore, the findings of this study reflect the clinical characteristics and outcomes observed before the widespread emergence of variant-specific differences.

Epidemiological, clinical, radiological, and laboratory data collected throughout the pandemic have improved understanding of disease mechanisms and contributed to advances in diagnosis and treatment. Nevertheless, reliable prognostic markers remain essential to identify high-risk patients and support early, individualized clinical management.[4] Therefore, this study aimed to identify demographic, clinical, and laboratory predictors of disease severity and intensive care unit (ICU) requirement in patients with COVID-19.

Materials and Methods

Study Design and Setting

This retrospective cohort study was conducted between March and August 2020 in the Infectious Diseases and Clinical Microbiology Clinic of a tertiary care hospital. The study included adult patients with possible or confirmed COVID-19 who were managed either as outpatients or inpatients during the study. Patients were eligible if they had polymerase chain reaction (PCR) positivity and/or lung imaging findings compatible with COVID-19.

Age was categorized into three groups (18–45, 46–65, and >65 years) based on commonly used clinical and epidemiological classifications. Patients older than 65 years were considered the older-adult group, since advanced age is a well-established risk factor for severe COVID-19.

Data Collection

Patient data were retrospectively retrieved from the hospital's electronic medical records and patient files. During the study, the Turkish Ministry of Health regularly updated its national COVID-19 Clinical Guidelines in response to the evolving pandemic and emerging scientific evidence. These guidelines defined the criteria for outpatient follow-up, hospital admission, and ICU referral.

Accordingly, all clinical management decisions, including outpatient follow-up, ward admission, and ICU referral, were based on the guideline version in effect at the time of patient presentation.[5] This approach ensured consistency with national standards despite ongoing revisions to case definitions and treatment algorithms during the early phase of the pandemic.

Patient Classification

Patients were categorized into three groups according to their clinical status at initial hospital admission. The asymptomatic group included patients without symptoms. The severe group comprised patients with bilateral ground-glass opacities on lung computed tomography (CT) and an oxygen saturation of ≤90% at initial evaluation or at any time during hospitalization. The mild–moderate group included patients who did not meet the criteria for the asymptomatic or severe categories.

Ethical Approval

Approval for the study was obtained from the Ministry of Health on May 27, 2020 (application date: May 06, 2020). This study was approved by the Dışkapı Yıldırım Beyazıt Training and Research Hospital Clinical Research Ethics Committee (Date: 21.09.2020, Decision no: 96/03). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical Analysis

Statistical analyses were performed using IBM Statistical Package for the Social Sciences Statistics for Windows, version 22.0 (IBM Corp., Armonk, NY, USA). The normality of continuous variables was assessed using the Kolmogorov–Smirnov test and homogeneity of variances was evaluated with Levene's test. Continuous variables were presented as mean±standard deviation if normally distributed and as median (interquartile range [IQR]) if non-normally distributed, whereas categorical variables were expressed as number and percentage.

Comparisons between groups were conducted using the chi-square test or Fisher's exact test for categorical variables. For continuous variables, Student's t-test was applied to normally distributed data, and the Mann–Whitney U test was used for non-normally distributed data. When comparing more than two groups, one-way analysis of variance was used for normally distributed variables, and the Kruskal–Wallis test was applied for non-normally distributed variables. For multiple comparisons, p-values were adjusted using the Holm–Bonferroni method.

To identify independent predictors of severe COVID-19, multivariable logistic regression analysis was performed. Variables with $p<0.10$ in univariate analyses were entered into the multivariable model. Model calibration was assessed using the Hosmer–Lemeshow goodness-of-fit test, and discriminative ability was evaluated using the area under the receiver operating characteristic curve (AUC).

A p<0.05 was considered statistically significant. Values reported as p=0.000 were expressed as p<0.001.

Results

Demographic and Epidemiological Characteristics

The study included 500 patients: 42 (8.4%) asymptomatic, 373 (74.6%) mild-moderate, and 85 (17%) severe. Of all cases, 269 (53.8%) were male. No statistically significant association was observed between disease severity and gender (p=0.228).

The median age of all patients was 48.0 (33.0–62.0) years. The median (IQR) ages of the asymptomatic, mild–moderate, and severe groups were 37.5 (26.3–47.8), 46.0 (32.0–60.0), and 62.0 (52.0–75.0) years, respectively, and age differed significantly across all disease severity groups (Kruskal–Wallis H(2)=66.509, p<0.001), with post hoc analyses confirming statistically significant differences between each pair of groups (all Holm-adjusted p<0.05).

Forty-five patients (9%) were healthcare professionals. Healthcare professional status was significantly associated with lower disease severity (p<0.001).

At least one chronic disease was present in 9 patients (29%) in the asymptomatic group, 168 (45.7%) in the mild–moderate group and 65 (76.5%) in the severe group. Disease severity was significantly higher among patients with comorbidities (p<0.001). Among chronic conditions, hypertension (HT) (p<0.001) and diabetes mellitus (DM) (p=0.011) were significantly associated with increased disease severity.

Smoking status differed significantly across disease severity groups (p=0.009). The prevalence of smoking was 33.3% in the asymptomatic group, 30.9% in the mild–moderate group, and 11.7% in the severe group.

The demographic and epidemiological characteristics and comorbidities of the study population are presented in Table 1.

Clinical Characteristics

The median duration of symptoms at hospital admission was 3 (2–5) days in the mild–moderate group and 4 (2–7) days in the severe group. Patients in the severe group presented 1 day later than those in the mild–moderate group, but this difference was not statistically significant (p=0.075).

The most common symptom among all patients was cough (63.8%), followed by fever (44.2%), weakness/fatigue (36%), dyspnea (35%), and myalgia (29.4%) (Table 2). Sputum and dyspnea were significantly more frequent in the severe group (p=0.019 and p=0.004, respectively). Among gastrointestinal symptoms, nausea and vomiting were significantly more frequent in the severe group (p=0.048 and p=0.018, respectively).

Laboratory and Imaging Features

The median lymphocyte count was 1700 (1400–2270) cells/μL in the asymptomatic group, 1565 (1120–2122) cells/μL in the mild–moderate group, and 1100 (790–1630) cells/μL in the severe group. Both lymphocyte count and lymphocyte percentage decreased significantly with increasing disease severity (p<0.001).

Aspartate aminotransferase (AST) levels differed significantly between the groups (p=0.001). Similarly, lactate dehydrogenase (LDH) levels were significantly higher in patients with severe disease (p<0.001).

Creatine kinase (CK), CK-myocardial band, and troponin-I levels did not differ significantly between the groups. Although not statistically significant, median CK levels were numerically higher in the severe group (99.5 [55.5–161.0]) than in the asymptomatic (88.0 [60.0–125.5]) and mild-moderate (86.0 [60.5–143.5]) groups.

Among acute-phase reactants, C-reactive protein (CRP) was significantly associated with disease severity (p<0.001), with higher levels observed in patients with more severe disease (Table 3).

Among the 500 patients, 433 (86.6%) underwent thoracic CT, and 41 (8.2%) underwent chest X-ray. Overall, 474 patients (94.8%) received pulmonary imaging. Pneumonia was identified in 286 patients (60.3%) overall.

Multivariable Logistic Regression Analysis for Severe COVID-19

A multivariable logistic regression analysis was performed including age, comorbidity status, lymphocyte count at admission, and ferritin level at admission.

Increasing age (odds ratio [OR] 1.036, 95% confidence interval [CI] 1.011–1.063, p=0.005) and higher ferritin levels (OR 1.001, 95% CI 1.000–1.002, p=0.029) were independently associated with severe COVID-19. Lymphocyte count showed a non-significant trend (p=0.071), while comorbidity status was not independently associated with disease severity (OR 1.208, 95% CI 0.490–2.981, p=0.682). The model demonstrated good calibration (Hosmer–Lemeshow p=0.978) and acceptable discriminative ability (AUC = 0.76) (Table 4).

Table 1. Baseline demographic and clinical characteristics according to COVID-19 severity (n=500)

Characteristics	Asymptomatic (n=42) (%)	Mild-moderate (n=373) (%)	Severe (n=85) (%)	p
Types of patient care				
Outpatient	25 (59.5)	79 (21.2)	–	$\chi^2(2)=60.587$, **p<0.001**
Hospitalized	17 (40.5)	294 (78.8)	85 (100.0)	
Age, years median (IQR)	37.5 (26.3–47.8)	46.0 (32.0–60.0)	62.0 (52.0–75.0)	H(2)=66.509, **p<0.001**
Gender (Male)	18 (42.9)	208 (55.8)	43 (50.6)	$\chi^2(2)=2.955$, p=0.228
Age				
18–45	29 (69.0)	182 (48.8)	13 (15.3)	$\chi^2(4)=58.341$, **p<0.001**
46–65	13 (31.0)	137 (36.7)	33 (38.8)	
>65	–	54 (14.5)	39 (45.9)	
Healthcare professional (Doctor, Nurse, Other)	12 (28.6)	31 (8.3)	2 (2.4)	$\chi^2(2)=26.245$, **p<0.001**
Any chronic disease	9 (29.0)	168 (45.7)	65 (76.5)	$\chi^2(2)=32.058$, **p<0.001**
Diabetes mellitus	2 (6.5)	53 (14.4)	22 (25.9)	$\chi^2(2)=9.017$, **p=0.011**
Hypertension	2 (6.5)	76 (20.7)	39 (45.9)	$\chi^2(2)=29.655$, **p<0.001**
Chronic kidney disease	–	17 (4.6)	7 (8.2)	$\chi^2(2)=4.631$, p=0.113
Coronary artery disease	–	32 (8.7)	12 (14.1)	$\chi^2(2)=5.768$, p=0.056
Asthma	–	26 (7.1)	6 (7.1)	$\chi^2(2)=2.345$, p=0.310
Chronic obstructive pulmonary disease	–	19 (5.2)	8 (9.4)	$\chi^2(2)=4.323$, p=0.115
Smoking	7 (33.3)	83 (30.9)	7 (11.7)	$\chi^2(2)=9.368$, **p=0.009**

Data are presented as n (%) or median (IQR). Pearson's Chi-square test was used for categorical variables. Kruskal–Wallis test; post hoc pairwise comparisons were performed using the Mann–Whitney U test with Holm correction. A two-sided p<0.05 was considered statistically significant. IQR: Interquartile range.

Table 2. Clinical characteristics of mild-moderate and severe COVID-19 patients at admission

Characteristics	Mild-moderate (n=373)	Severe (n=85)	p
Symptom duration, days - Median (ınterquartile range)	3 (2–5)	4 (2–7)	U=10,756.000, p=0.075
Symptoms (%)			
Fever	177 (47.5)	44 (51.8)	$\chi^2(1)=0.667$, p=0.414
Cough	259 (69.4)	60 (70.6)	$\chi^2(1)=0.043$, p=0.835
Sputum	40 (10.7)	17 (20.0)	$\chi^2(1)=5.466$, **p=0.019**
Dyspnea	131 (35.1)	44 (51.8)	$\chi^2(1)=8.122$, **p=0.004**
Nausea	41 (11.0)	16 (18.8)	$\chi^2(1)=3.896$, **p=0.048**
Vomiting	24 (6.4)	12 (14.1)	$\chi^2(1)=5.643$, **p=0.018**
Myalgia	124 (33.2)	23 (27.1)	$\chi^2(1)=1.125$, p=0.270
Weakness/Fatigue	146 (39.1)	34 (40.0)	$\chi^2(1)=0.021$, p=0.884

Continuous variables were compared using the Mann–Whitney U test; categorical variables were compared using Pearson's Chi-square test.

Table 3. Laboratory parameters at hospital admission according to disease severity

Laboratory parameters	Asymptomatic (n=42)	Mild-moderate (n=373)	Severe (n=85)	p
Hemogram Median (IQR)				
WBC (/µL)	6055 (4970–7985)	7025 (5282.5–9475)	7230 (5260–8970)	H(2)=3.161, p=0.206
Number of NEUs (/µL)	3550 (2535–4570)	4270 (2952.5–6627.5)	5170 (3500–6900)	H(2)=10.082, **p=0.006**
Number of LYMs (/µL)	1700 (1400–2270)	1565 (1120–2122.5)	1100 (790–1630)	H(2)=28.593, **p<0.001**
LYM%	31.5 (23.0–36.75)	23.7 (15.0–32.0)	17.0 (10.5–22.5)	H(2)=39.359, **p<0.001**
PLT (/µL)	225.500 (194.750–272.500)	227.500 (188.250–281.000)	209.000 (170.000–263.000)	H(2)=3.304, p=0.192
Biochemistry median (IQR)				
Cr (mg/dL)	0.725 (0.665–0.847)	0.800 (0.650–0.950)	0.880 (0.690–1.080)	H(2)=8.990, **p=0.011**
AST (U/L)	18.0 (14.0–21.0)	19.0 (15.0–26.0)	22.5 (17.0–33.75)	H(2)=13.508, **p=0.001**
ALT (U/L)	19.0 (14.0–22.0)	19.0 (13.0–30.25)	19.0 (12.0–28.0)	H(2)=0.627, p=0.731
LDH (U/L)	162.5 (146.5–197.0)	191.0 (164.0–226.0)	240.0 (197.0–284.75)	H(2)=31.959, **p<0.001**
Cardiac markers median (IQR)				
CK (U/L)	88.0 (60.0–125.5)	86.0 (60.5–143.5)	99.5 (55.5–161.0)	H(2)=0.559, p=0.756
CK-MB (U/L)	17.0 (14.0–19.5)	16.0 (13.0–19.0)	16.0 (12.5–21.0)	H(2)=0.928, p=0.629
TROPONIN-I (ng/mL)	0.10 (0.10–0.10)	0.10 (0.10–0.10)	0.10 (0.10–0.10)	H(2)=2.698, p=0.259
Acute phase reactants median (IQR)				
CRP (mg/L)	2.21 (1.02–3.74)	17.0 (2.94–69.0)	60.0 (27.0–131.0)	H(2)=38.853, **p<0.001**
Procalcitonin (µg/L)	0.04 (0.02–0.04)	0.06 (0.04–0.105)	0.13 (0.06–0.21)	H(2)=22.799, **p<0.001**
Ferritin (µg/L)	125.0 (76.5–146.5)	108.0 (50.0–246.0)	229.0 (82.25–429.75)	H(2)=11.049, **p=0.004**
Coagulation median (IQR)				
Fibrinogen (mg/dL)	310.0 (270.5–335.5)	371.0 (306.0–462.0)	430.0 (349.5–538.75)	H(2)=27.684, **p<0.001**
PRO-BNP (ng/L)	21.0 (6.36–39.5)	36.5 (13.0–119.25)	123.5 (46.25–435.75)	H(2)=27.313, **p<0.001**
D-Dimer (µg/mL)	0.20 (0.20–0.32)	0.26 (0.20–0.53)	0.47 (0.215–0.825)	H(2)=14.389, **p=0.001**
PT (sec)	9.2 (9.05–9.60)	9.4 (8.93–10.0)	9.3 (9.06–10.0)	H(2)=1.267, p=0.531
INR	1.03 (1.01–1.07)	1.05 (1.00–1.13)	1.04 (1.01–1.13)	H(2)=1.590, p=0.452

Data are presented as median (IQR). Overall comparisons among three severity groups were performed using the Kruskal–Wallis test. p-values for multiple laboratory parameters were adjusted using the Holm–Bonferroni method. Post-hoc pairwise comparisons were conducted using the Mann–Whitney U test with Holm correction. WBC: White blood cells; NEU: Neutrophil; LYM: Lymphocyte; PLT: Platelet; Cr: Creatinine; AST: Aspartate aminotransferase; ALT: Alanine aminotransferase; LDH: Lactate dehydrogenase; CK: Creatine kinase; CK-MB: Creatine kinase-myocardial band; CRP: C-reactive protein; PRO-BNP: Pro-B type natriuretic peptide; D-dimer: Fibrin degradation product; PT: Prothrombin time; INR: International normalized ratio; IQR: Interquartile range.

Evaluation of ICU Need

ICU care was required in 27 patients (5.4%) in the overall cohort, and all of these patients were in the severe disease group. Among the 85 patients categorized as severe, 31.8% required ICU admission. There was no statistically significant association between ICU admission and gender (p=0.759).

The median age was 68.0 (54.0–79.0) years in patients requiring ICU care and 62.0 (50.0–74.0) years in those managed in the ward (p=0.524).

The median time from symptom onset to hospital admission was 4.0 (3.0–7.8) days in ICU patients and 4.0 (2.0–6.0) days in non-ICU patients (p=0.159).

Regarding laboratory parameters, the median CRP level was significantly higher in ICU patients (102.0 mg/L [57.5–180.3 mg/L]) than in non-ICU patients (39.0 mg/L [12.0-107.0 mg/L]) (p=0.004). ICU patients also had significantly higher LDH levels (257.0 U/L [224.5-347.0

Table 4. Multivariable logistic regression analysis for severe COVID-19

Variables	Multivariate analysis		
	OR	95% CI	p
Age (years)	1.036	1.011–1.063	**0.005**
Comorbidity	1.208	0.490–2.981	0.682
LYM	1.000	0.999–1.000	0.071
Ferritin	1.001	1.000–1.002	**0.029**

The multivariable model showed good calibration (Hosmer–Lemeshow χ^2=2.08, p=0.978) and acceptable discriminative ability for predicting severe COVID-19 (AUC=0.76). LYM: Lymphocyte; OR: Odds ratio; CI: Confidence interval.

Table 5. Comparison of characteristics of patients requiring and not requiring intensive care

Characteristics	Severe patients followed up in the ward (n=58)	Severe patients transferred to ICU (n=27)	p
Gender (Male) (%)	30 (51.7)	13 (48.1)	$\chi^2(1)=0.094$, p=0.759
Age (years) median (IQR)	62.0 (50.0–74.0)	68.0 (54.0–79.0)	U=850.500, p=0.524
Number of chronic diseases (%)			
None	16 (27.6)	4 (14.8)	$\chi^2(2)=1.909$, p=0.385
1	19 (32.8)	9 (33.3)	
2 and above	23 (39.6)	14 (51.9)	
Smoke (%)	6 (14.6)	1 (5.3)	Exact test, p=0.414
Duration of symptoms (Days) at the time of admission median (IQR)	4.0 (2.0–6.0)	4.0 (3.0–7.75)	U=732.500, p=0.159
Laboratory features median (IQR)			
D-dimer (µg/mL)	0.47 (0.228–0.818)	0.43 (0.20–0.885)	U=617.500, p=0.946
CRP (mg/L)	39.0 (12.0–107.0)	102.0 (57.5–180.25)	U=770.500, **p=0.004**
LDH (U/L)	209.0 (179.0–261.5)	257.0 (224.5–347.0)	U=778.500, **p=0.003**
Troponin (ng/mL)	0.10 (0.10–0.10)	0.10 (0.10–0.125)	U=251.000, p=0.111
Ferritin (µg/L)	165.0 (73.75–304.5)	474.5 (248.5–791.5)	U=390.000, **p=0.001**
Number of LYMs (/µL)	1205.0 (845.0–1680.0)	960.0 (575.0–1355.0)	U=539.500, **p=0.022**
Number of NEUs (/µL)	5650.0 (3862.5–7690.0)	4560.0 (3130.0–5645.0)	U=578.500, p=0.054
CK (U/L)	96.0 (56.5–160.5)	137.0 (52.0–159.0)	U=627.000, p=0.645
AST (U/L)	21.0 (15.0–31.0)	26.0 (20.5–40.5)	U=1044.000, **p=0.009**
ALT (U/L)	17.0 (12.0–27.0)	20.0 (14.5–28.5)	U=886.000, p=0.333
Procalcitonin (µg/L)	0.12 (0.05–0.218)	0.14 (0.09–0.185)	U=354.500, p=0.565

Continuous variables were compared using Mann–Whitney U test; categorical variables using Pearson's Chi-square test. D-dimer: Fibrin degradation product; CRP: C-reactive protein; LDH: Lactate dehydrogenase; NEU: Neutrophil; LYM: Lymphocyte; CK: Creatine Kinase; AST: Aspartate aminotransferase; ALT: Alanine aminotransferase.

U/L]) and ferritin levels (474.5 µg/L [248.5–791.5]) than those managed in the ward (p=0.003 and p=0.001, respectively).

The median lymphocyte count was significantly lower in ICU patients (960 [575–1355] cells/µL) than in non-ICU patients (p=0.022). In addition, the median AST level was higher in the ICU group (26 U/L [20.5–40.5 U/L]), and this difference was statistically significant (p=0.009).

A comparison of clinical and laboratory characteristics between patients who required ICU care and those managed in the ward is presented in Table 5.

Among severe patients, 14 (16.5%) required high-flow oxygen therapy, 13 (15.3%) required non-invasive mechanical ventilation, and 11 (12.9%) underwent endotracheal intubation (all p<0.001). Among intubated patients, the median time from symptom onset to intubation was 4.0 (3.5–7.0) days. Oxygen therapy modalities and ventilatory support requirements according to disease severity are presented in Table 6.

Discussion

In this retrospective cohort, disease severity increased significantly with age. The median age rose progressively from the asymptomatic to the severe group, and increasing age remained an independent predictor of severe COVID-19 in multivariable analysis. This finding is consistent with previous reports demonstrating poorer outcomes among older adults.[6–8] Male patients constituted a slightly higher proportion of the cohort (53.8%), consistent with previous reports describing a male predominance in COVID-19 cohorts;[7,9–11] however, disease severity did not differ significantly by sex in our study (p=0.228). The mild-moderate group represented the largest subgroup in our cohort.

According to national data, 29,865 healthcare professionals, representing 10.9% of all COVID-19 cases in Türkiye, had been infected, and 52 had died as of September 02, 2020.[12] In our cohort, healthcare professionals accounted for 9% of cases and were more frequently represented in the

Table 6. Oxygen therapy and ventilatory support according to disease severity

Characteristics	Mild-moderate (n=373) (%)	Severe (n=85) (%)	p
Patient receiving oxygen therapy	69 (20.7)	85 (100.0)	$\chi^2(1)=183.490$, **p<0.001**
Amount of oxygen supplied*			
Between 0 and 2 L	50 (15.0)	28 (32.9)	$\chi^2(1)=23.820$, **p<0.001**
>2 L	19 (5.7)	57 (67.1)	
Oxygen therapy in ICU			
High-flow oxygen therapy	-	14 (16.5)	Exact test, **p<0.001**
Non-invasive mechanical ventilation	-	13 (15.3)	Exact test, **p<0.001**
Intubated patient	1 (0.3)	11 (12.9)	Exact test, **p<0.001**

P-values were adjusted for multiple comparisons using the Holm–Bonferroni method; all associations remained statistically significant after correction. ICU: Intensive care unit.

asymptomatic group (p<0.001). No mortality was observed among healthcare professionals in our study. This finding may reflect routine occupational health screening and earlier detection within this population.

According to data from the Turkish Statistical Institute's 2022 Türkiye Health Survey, HT is the most prevalent chronic condition among adults (16.1%), followed by diabetes mellitus (11.4%).[13] Consistent with these national data and previous reports,[14–16] HT was the most common comorbidity in our cohort, followed by diabetes mellitus. Although comorbidity was associated with greater disease severity in univariate analyses, it did not remain an independent predictor in the multivariable model.

The association between smoking and COVID-19 severity has been reported inconsistently. Some meta-analyses suggest that smoking increases the risk of severe disease and mortality,[17] whereas others have found no significant association between active smoking and severe COVID-19.[18] In our cohort, smoking was less frequent among patients with severe disease, and a statistically significant inverse association was observed between smoking status and disease severity (p=0.009). However, this finding should be interpreted cautiously, as it may be influenced by confounding factors such as age distribution, comorbidity burden, and healthcare access. Overall, the conflicting evidence underscores the need for larger, well-designed prospective studies to clarify this relationship.

Consistent with previous reports,[9,11,15] cough and fever were the most common presenting symptoms in our cohort; however, their frequencies did not differ significantly between severity groups. In contrast, sputum, dyspnea, nausea, and vomiting were significantly associated with disease severity. The median time from symptom onset to hospital admission was 3.0 (2.0–5.0) days, comparable to earlier findings.[10,19] Although the difference was not statistically significant, patients with severe disease presented slightly later than those in the mild–moderate group. This trend may indicate a potential association between delayed presentation and greater disease severity.

CRP and ferritin levels were significantly higher in patients with severe disease, consistent with previous reports demonstrating the association between acute-phase reactants and COVID-19 severity.[20–22] Similarly, fibrinogen, Pro-B type natriuretic peptide, and D-dimer levels were elevated in the severe group, supporting the role of systemic inflammation and coagulopathy in disease progression. Also at initial admission, patients with severe disease exhibited higher absolute neutrophil counts, AST, and LDH,[23] whereas absolute lymphocyte counts and lymphocyte percentages were lower.

While several of these parameters were associated with disease severity in univariate analyses, multivariable modeling identified age and ferritin level as independent predictors of severe disease. These findings suggest that inflammatory and hematological markers may reflect disease severity, although not all retain independent prognostic significance.

Procalcitonin levels were significantly lower in the asymptomatic group (p<0.001). However, the prognostic value of procalcitonin in COVID-19 remains uncertain, and its elevation may reflect secondary bacterial infection rather than direct viral severity.

ICU requirement occurred exclusively among patients in the severe disease group. Among these patients, 31.8% required intensive care support.

Patients transferred to the ICU demonstrated significantly higher CRP, LDH, ferritin, and AST levels at admission, while absolute lymphocyte counts were significantly lower.

Elevated inflammatory markers, particularly CRP, along with reduced absolute lymphocyte counts, were associated with both increased disease severity and ICU requirement. These findings are consistent with previous reports highlighting the role of systemic inflammation and comorbidity burden in identifying high-risk COVID-19 patients, including the study by Aryal et al.[24]

Taken together, selected inflammatory and hematological markers at presentation may reflect a more severe in-hospital clinical trajectory among patients already classified as having severe disease.

Intubation was required in 2.4% of patients in our cohort. Of the 12 intubated patients, 11 belonged to the severe disease group and one to the mild–moderate group. Within the severe subgroup, the intubation rate reached 12.9%.

Among patients with severe disease, the median time from symptom onset to intubation was 4.0 (3.5–7.0) days, suggesting that respiratory deterioration may occur early in the disease course. This observation is consistent with findings reported by Argenziano et al.,[25] who described a bimodal distribution in intubation timing, with peaks at 3–4 days and 9 days after symptom onset.

The concordance of our results with the earlier peak indicates that a subset of patients may experience clinical worsening within the 1st week of illness. These findings underscore the importance of close monitoring during the early phase of hospitalization, particularly in patients with markers of heightened systemic inflammation.

Taken together, our findings indicate that advanced age and heightened systemic inflammatory response are closely associated with greater disease severity and increased likelihood of intensive care requirement. Among laboratory parameters, ferritin remained independently associated with severe disease in multivariable analysis, while other inflammatory markers and reduced absolute lymphocyte counts reflected more advanced clinical presentation.

These routinely available clinical and laboratory parameters may assist in early identification of high-risk hospitalized COVID-19 patients, although their independent prognostic value warrants further investigation.

Limitations

Our study has certain limitations. The COVID-19 Pandemic Guidelines of the Turkish Ministry of Health, which formed the basis for patient management during the study period, were updated frequently in response to rising case numbers and newly emerging information. Consequently, outpatient and inpatient follow-up criteria evolved, and the distribution of cases in our cohort may not fully reflect current clinical practice. In addition, the lack of standardization in reverse transcription-PCR testing during the early phase of the pandemic and limited experience with this novel infection may have influenced diagnostic accuracy.

Furthermore, this was a retrospective, single-center study, which may limit the generalizability of the findings. Although multivariable logistic regression analysis was performed to identify independent associations, residual confounding cannot be excluded. Finally, the relatively small number of ICU patients limits the statistical power of subgroup analyses and may have reduced the ability to detect independent predictors of intensive care requirement.

Conclusion

This retrospective cohort study demonstrates that advanced age and heightened systemic inflammatory response are closely associated with increased COVID-19 severity. Among laboratory parameters, ferritin remained independently associated with severe disease, while elevated inflammatory markers and reduced absolute lymphocyte counts reflected more advanced clinical presentation and greater likelihood of intensive care requirement.

These routinely available clinical and laboratory indicators may assist in the early identification of high-risk hospitalized patients. Although not all markers retained independent prognostic significance, their combined assessment may support clinical decision-making and risk stratification during COVID-19 and future respiratory viral outbreaks.

Ethics Committee Approval: The Dışkapı Yıldırım Beyazıt Training and Research Hospital Clinical Research Ethics Committee granted approval for this study (date: 21.09.2020, number: 96/03).

Informed Consent: Retrospective study.

Conflict of Interest: None declared.

Financial Disclosure: The authors declared that this study has received no financial support.

Use of AI for Writing Assistance: Not declared.

Authorship Contributions: Concept: FAY, AA; Design: FAY, AA; Supervision: FAY, AA; Resource: FAY; Materials: FAY; Data Collection or Processing: FAY; Analysis or Interpretation: FAY, AA; Literature Search: FAY; Writing: FAY, AA; Critical Review: FAY, AA.

Peer-review: Double blind peer-reviewed.

References

1. Budak F, Korkmaz S. A general evaluation of the COVID-19 pandemic process: the example of Türkiye. SAYOD 2020;(1):62-79. [In Turkish] [CrossRef]
2. Vital Surveillances. The epidemiological characteristics of an outbreak of 2019 novel coronavirus disease (COVID-19) - China, 2020. China CDC Wkly 2020;2(8):113-22. [CrossRef]
3. World Health Organization. WHO COVID-19 Dashboard: Deaths. Available at: https://data.who.int/dashboards/covid19/deaths?n=c Accessed Nov 20, 2025.
4. Smail SW, Ismail BA, Maghdid IS, Flaih AH, Janson C. Antioxidant and oxidative enzymes, genetic variants, and cofactors as prognostic biomarkers of COVID-19 severity and mortality: a systematic review. Front Mol Biosci 2025 Oct 23;12:1700263. [CrossRef]
5. Turkish Ministry of Health. COVID-19 Pandemic Management and Working Guideline. Available at: https://www.csgb.gov.tr/Media/4v3dlepr/covid-19-pandemisi-y%C3%B6netimi-ve-eylem-plan%C4%B1-rehberi.pdf Accessed Dec 08, 2020.
6. 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;323(13):1239-42. [CrossRef]
7. Gandhi RT. COVID-19: Clinical features. UpToDate. Available at: https://www.uptodate.com/contents/covid-19-clinical-features Accessed Nov, 20 2025.
8. Sanyaolu A, Okorie C, Marinkovic A, Patidar R, Younis K, Desai P, et al. Comorbidity and its impact on patients with COVID-19. SN Compr Clin Med 2020;2:1069-76. [CrossRef]
9. Guan WJ, Liang WH, Zhao Y, Liang HR, Chen ZS, Li YM, et al. Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis. Eur Respir J 2020;55(5):2000547. [CrossRef]
10. Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382(18):1708-20. [CrossRef]
11. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. Lancet 2020;395(10223):507-13. [CrossRef]
12. Pala SC, Metintas S. Healthcare workers during the COVID-19 pandemic. ESTUDAM J Public Health 2020;5:156-68. [In Turkish]
13. Turkish Statistical Institute (TÜİK). Turkey Health Survey 2022. Available at: https://data.tuik.gov.tr/Bulten/Index?p=Turkiye-Saglik-Arastirmasi-2022-49747. November 18, 2025.
14. Yang J, Zheng YA, Gou X, Pu K, Chen Z, Guo Q, et al. Prevalence of comorbidities and its effects in patients infected with SARS-CoV-2: a systematic review and meta-analysis. Int J Infect Dis 2020;94:91-5. [CrossRef]
15. Tu H, Tu S, Gao S, Shao A, Sheng J. Current epidemiological and clinical features of COVID-19; a global perspective from China. J Infect 2020;81(1):1-9. [CrossRef]
16. Eren-Kutsoylu OÖ, Nazlı-Zeka A, Ömeroğlu-Şimşek G, Appak Ö, Bayram B, Özgen-Alpaydın A, et al. Comparison of clinical characteristics and prognostic laboratory findings of COVID-19 patients by age groups. Infect Dis Clin Microbiol 2021;3(3):120-9. [CrossRef]
17. Sokouti M, Sokouti B, Sokouti M. The effect of smoking on COVID-19 infection: a systematic review and meta-analysis of meta-analyses studies. Discov Appl Sci 2025;7:429. [CrossRef]
18. Lippi G, Henry BM. Active smoking is not associated with severity of coronavirus disease 2019 (COVID-19). Eur J Intern Med 2020;75:107-8. [CrossRef]
19. Park M, Cook AR, Lim JT, Sun Y, Dickens BL. A systematic review of COVID-19 epidemiology based on current evidence. J Clin Med 2020;9(4):967. [CrossRef]
20. Qurat ul Ain S, Rather KU, Sajad S. Statistical analysis of hematological and biochemical parameters in patients with SARS-CoV-2 infection across different populations: a cross-sectional observational study. Discov Appl Sci 2025;7:830. [CrossRef]
21. Fazal M. C-reactive protein: a promising biomarker of COVID-19 severity. Korean J Clin Lab Sci 2021;53:201-7. [CrossRef]
22. Abdel-Ghany MF, El-Karn AFM, Anis MI, Hassan HM, Abdel-Aziz AA, et al. Study of CRP, ferritin, and D-dimer in COVID-19 RICU patients as per HRCT severity in Assiut University Hospitals. Egypt J Bronchol 2024;18:87. [CrossRef]
23. Lippi G, Plebani M. The critical role of laboratory medicine during coronavirus disease 2019 (COVID-19) and other viral outbreaks. Clin Chem Lab Med 2020;58(7):1063-9. [CrossRef]
24. Aryal D, Gurung R, Adhikari D, et al. Predictors to Intensive Care Unit admission among patients with COVID-19. PLOS Glob Public Health. 2024;4(1):e0002516. [CrossRef]
25. Argenziano MG, Bruce SL, Slater CL, Tiao JR, Baldwin MR, Barr RG, et al. Characterization and clinical course of 1000 patients with coronavirus disease 2019 in New York: a retrospective case series. BMJ 2020;369:m1996. [CrossRef]