

Clinicoepidemiological and Laboratory Factors Influencing Covid-19 Severity

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Received: 28th Feb, 2026; Revised: 6th March 2026; Accepted: 7th April, 2026; Available Online: 20th April, 2026

ABSTRACT

Background: The COVID-19 Pandemic Has Plagued The World For About 4-5 Years Now And Has Changed The Day-To-Day Routine. While Some People Are More Susceptible, Suffering More Severe Acute Respiratory Distress. Those People Often Have Underlying Heart Disease, Diabetes Mellitus, COPD, Or Even Chronic Kidney Disease. While Many Studies Have Been Done, Few Have Analyzed The Impact Of Epidemiological Factors And Laboratory Parameters On Susceptibility. Hence, We Performed This Retrospective Study To Identify The Defining Demographic And Laboratory Characteristics, Severity, And Prognosis, Along With The Impact Of These Characteristics On Outcome.

Materials And Methods: Data From Discharged Files Of Confirmed Covid-19 Cases Were Collected From The Medical Record Department. This Is A Retrospective Observation, Performed On All Patients Admitted With COVID-19 (Diagnosis Confirmed By RT-PCR). The Data Was Entered In An MS Excel Spreadsheet. The Factors So Documented Were Then Correlated And Associated With Severity, Prognosis, And Outcomes.

Results: We Observed That Age, D-Dimer, Blood Urea, Serum Creatinine, Serum Ferritin, And Serum LDH, CRP And Liver Enzymes Correlated Well With The Moderate And Severe Forms Of COVID-19. While Other Parameters Such As Gender And Serum Bilirubin Had No Correlation With The Severity.

Conclusions: In This Study, We Observed That Demographic Parameters Such As Age And Laboratory Parameters That Are Routinely Performed For The Patient On Admission Can Be Used As Biomarkers To Assess Severity Of COVID 19 Illness.

Keywords: Biomarkers, Sars Covid 19, Viral Illness, Pandemic

How to cite this article: Meshram SB, Mithun Nilgiri K, Kaushik PB. Clinicoepidemiological and Laboratory Factors Influencing Covid-19 Severity. Int J Drug Deliv Technol. 2026;16(38s): 777-784. DOI: 10.25258/ijddt.16.38s.80

Source of support: Nil.

Conflict of interest: None

INTRODUCTION

The COVID-19 pandemic has crippled the world's healthcare system, making it urgently necessary to do research to identify the complex elements affecting the severity of illness and patient outcomes. [1] The analysis of laboratory variables and their correlation with COVID-19 severity has been a significant topic of inquiry. The evaluation of many lab data has been extremely helpful in determining the course of the illness, directing treatment choices, and gaining understanding of the SARS-CoV-2 virus's fundamental workings. [1,2]

The extent of the effects of COVID-19 may vary from mild or asymptomatic cases to severe multi-organ dysfunction and respiratory distress, the latter of which frequently requires urgent care and poses a serious risk to life. Finding trustworthy disease severity predictions can help with risk classification, resource optimisation, and facilitating early interventions for those most at risk. [3-5]

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A significant worldwide health catastrophe has been brought on by the coronavirus disease 2019 (COVID-19) pandemic brought about by the SARS-CoV-2 coronavirus, which causes the severe acute respiratory syndrome. The majority of COVID-19 virus-infected individuals will develop mild to severe respiratory disease and recover without needing to be hospitalised. [5] Patients over 65 as well as those with underlying health issues including cancer, diabetes, chronic lung disease, chronic renal disease, or cardiovascular disease are more likely to experience serious illness. [6]

A positive diagnosis of COVID-19 is defined as a real-time fluorescence reverse transcription-polymerase chain reaction (RT-PCR) result from a nasopharyngeal swab, gene sequencing of respiratory tract secretions and other samples, OR a positive fast antigen test on nasopharyngeal swab. [6,7]

Laboratory assays provide an unbiased way to assess the pathological and physiological alterations brought on by a COVID-19 infection. Among other measures, haematological, biochemical, and immunological indicators have all been studied in connection to illness severity. These variables offer essential information about the immune response, inflammatory processes, organ damage, and general health of those fighting the virus. [8] This study seeks to thoroughly analyse the relationship between several laboratory parameters and COVID-19 severity. We aim to discover relevant patterns, trends, and correlations from the results of various research carried out globally to shed light on the pathophysiology of the disease and support therapeutic decision-making.

Understanding how laboratory variables relate to the severity of COVID-19 can significantly impact patient care, public health initiatives, and resource allocation. [9,10] This information can assist healthcare professionals in early patient identification of high-risk patients, enabling rapid interventions, customised treatment regimens, and better use of healthcare resources. [11-14]

This investigation will look at frequently used laboratory tests, including complete blood counts, liver and kidney function tests, inflammatory indicators, coagulation profiles, and heart damage markers.[15-16] We seek to find markers that could act as trustworthy indicators of illness development and prognosis by comparing the outcomes of these tests among various groups of COVID-19 patients divided by disease severity.

METHODS AND MATERIALS

This is a retrospective observational study on all patients admitted with COVID-19 (diagnosis confirmed by RT-PCR nasal and oropharyngeal swab). From each of the case records, demographic details, laboratory parameters, and outcome of COVID-19. This data was then entered into an MS excel spreadsheet.

Training was given to the study team on appropriate data capture from the case files to the excel sheet. A study initiation training session was conducted for the same.

On every working day, we collected approximately 50 case files from MRD. In our department, these files were divided among different study coordinators. Each study coordinator entered the information from the IPD file into the excel sheet. The study coordinators were mainly the PG students of the department who had managed these cases.

Other criteria:

1. liver/ kidney function tests, platelet counts, inflammatory markers values on hospital admission was captured

Data Management: -

The co-investigators checked the data after every 100 patient entries to ensure quality control, mainly looking for correctness of data entry as well as for any missing data.

The data was collected in an MS excel spreadsheet which was utilized for analysis of the data.

For the purposes of this study, COVID-19 disease was divided into mild, moderate, and severe, based on HRCT thorax using CORADS system.

The data was entered in Microsoft Excel 2019 (Part of Microsoft Office Professional Edition) [computer program]. Microsoft; 2019) and analyzed using MedCalc v18.2.1 (MedCalc Statistical Software version 18.2.1 (MedCalc Software, Ostend, Belgium; <http://www.medcalc.org>; 2018).

Categorical variables were summarized using number and proportion (where applicable), continuous variables expressed as mean and SD & Median and IQR (where applicable). Normal distribution was verified by Shapiro-Wilk test. Kruskal-Wallis test was used to check for the significance of observations between three groups (Mild, Moderate and Severe). Chi-square test was done to check for association between categorical variables. In all the tests performed, P < 0.05 was statistically significant.

RESULTS

Table 1: Quantitative Data

Parameter	Severity	Frequency	Mean	SD	Median	IQR	Significance
							Kruskal-Wallis test
Blood Urea	Mild	461	26.9	17.3	22.0	18 - 30	H(2)=72.4443, P < 0.001
	Moderate	82	35.0	26.5	28.0	21 - 37.75	
	Severe	110	44.8	35.0	35.5	25 - 53.25	

	Total	653	30.9	23.4	24.0	18 - 34	
Serum Creatinine	Mild	464	1.0	1.3	0.8	0.7 - 1	H(2)= 7.2779, P = 0.026
	Moderate	82	1.0	0.5	0.9	0.75 - 1.14	
	Severe	110	1.1	0.9	0.9	0.7 - 1.14	
	Total	656	1.0	1.2	0.8	0.7 - 1.04	
D-dimer ng/mL	Mild	470	862.5	1556.6	381.5	230 - 746.5	H(2)= 66.7368, P < 0.001
	Moderate	84	1386.1	2072.5	672.0	397 - 1285.25	
	Severe	109	2216.8	2952.8	850.0	432 - 2148	
	Total	663	1151.5	1982.6	460.0	272 - 1019	
CRP mg/L	Mild	481	28.4	47.3	10.1	3.12 - 36.4	H(2)= 95.0788, P < 0.001
	Moderate	87	58.7	61.3	37.5	12.75 - 86.52	
	Severe	113	76.4	72.4	56.8	20.4 - 106	
	Total	681	40.2	57.3	15.0	4.07 - 56	
Serum Ferritin ng/mL	Mild	481	329.4	546.3	158.0	67.3 - 351.2	H(2)= 81.1523, P < 0.001
	Moderate	87	544.4	656.9	358.8	162.2 - 560.28	
	Severe	113	732.0	804.3	442.4	253.77 - 908.9	
	Total	681	423.7	629.1	225.0	90.05 - 469.24	
Serum LDH U/L	Mild	481	283.1	164.5	250.0	198 - 321	H(2)= 129.9672,
	Moderate	87	356.8	136.0	324.0	258.5 - 434.5	H(2)= 129.9672, P < 0.001
	Severe	113	468.1	236.6	407.0	321 - 565	
	Total	681	323.3	188.2	277.0	215 - 378	
Platelet	Mild	473	224608.9	85393.6	214000.0	168000 - 269000	H(2)= 1.5438, P = 0.462
	Moderate	84	236678.6	86371.9	214500.0	175000 - 291250	
	Severe	112	227589.3	102108.4	219000.0	150000 - 273250	
	Total	669	226623.3	88473.9	214000.0	166000 - 272000	

This table demonstrates the association between laboratory parameters and disease severity (mild, moderate, and severe), showing a consistent rise in inflammatory and biochemical markers with increasing severity.

Blood urea levels increased significantly across severity groups, with the highest values observed in severe cases (mean 44.8 mg/dL), indicating worsening renal function or catabolic state (P < 0.001). Serum creatinine also showed a statistically significant but modest increase (P = 0.026), suggesting mild renal involvement.

Markers of inflammation and disease severity—D-dimer, CRP, serum ferritin, and LDH—were markedly elevated in moderate and severe groups compared to mild cases, with all showing strong statistical significance ($P < 0.001$). This reflects progressive hyperinflammation, coagulopathy, and tissue injury as disease severity increases. Among these, LDH showed the strongest association with severity ($H = 129.9672$).

In contrast, platelet counts did not show a significant difference across severity groups ($P = 0.462$), indicating that platelet levels were not associated with disease severity in this cohort.

Overall, the findings suggest that inflammatory markers (CRP, ferritin), coagulation marker (D-dimer), and tissue injury marker (LDH), along with blood urea, are significantly correlated with increasing disease severity and may serve as useful indicators for clinical risk stratification.

A total of 681 patients with COVID-19 illness were included in the study for analysis. The average age of the study population was 56.43 years. 67% of the study population was male, while the remaining was female

.Post-hoc Analysis
 For Blood_Urea, Serum_Ferritin, Serum_LDH - Mild, Moderate, Severe are significant against one another
 For Serum_Creatinine – Mild and Moderate are significant against one another
 For D_dimer, CRP – Mild is significant against Moderate and Severe

We found that there was a significant correlation between age and the severity of the disease ($p < 0.001$). However, when we correlated the gender of the patients with severity, we found no significant difference. (p -value 0.877).

We correlated the following various parameters with the severity of the illness: -

1. Urea and creatinine- positive correlation with severity ($p < 0.001$, p 0.026 respectively)
2. D-dimer- positive correlation with severity ($p < 0.001$)

3. CRP- positive correlation with severity ($p < 0.001$)
4. Serum Ferritin- positive correlation with severity ($p < 0.001$)
5. LDH- positive correlation with severity ($p < 0.001$)
6. Liver enzymes- positive correlation with severity ($p < 0.001$)

When we correlated the severity of COVID-19 illness with the mortality rates, we found that there was a significant correlation of moderate and severe forms with cause-specific death rates.

Table 2: Association between Clinical staging and Sex

Categories	Male	Female	Total
	N (%)	N (%)	N (%)
Mild	303 (69.98)	178 (71.77)	481 (70.63)
Moderate	57 (13.16)	30 (12.1)	87 (12.78)
Severe	73 (16.86)	40 (16.13)	113 (16.59)
Total	433 (63.58)	248 (36.42)	681 (100)
Chi sq(2)=0.263, P=0.877			

Table 2: Association between Clinical Staging and Sex

The majority of patients in both sexes had mild disease (males: 69.98%, females: 71.77%), followed by severe (males: 16.86%, females: 16.13%) and moderate categories (males: 13.16%, females: 12.1%). The proportions across all three severity groups were nearly identical between males and females. Statistical analysis using the Chi-square test showed no significant association between sex and disease severity ($\chi^2 = 0.263$, $P = 0.877$). This indicates that gender did not influence the clinical staging, and disease severity was uniformly distributed among males and females in this cohort.

Table 3: Association between Clinical staging and LFT's [Bilirubin]

Categories	Abnormal	Normal	Total
	N (%)	N (%)	N (%)
Mild	42 (64.62)	439 (71.27)	481 (70.63)
Moderate	10 (15.38)	77 (12.5)	87 (12.78)
Severe	13 (20)	100 (16.23)	113 (16.59)
Total	65 (9.54)	616 (90.46)	681 (100)
Chi sq(2)=1.254, P=0.534			

Table 3: Association between Clinical Staging and LFT (Bilirubin)

Out of the total study population, 9.54% had abnormal bilirubin levels, while the majority (90.46%) had normal values. Among those with abnormal bilirubin, 64.62% were in the mild category, 15.38% in moderate, and 20% in severe disease. Although there appears to be a slightly higher proportion of severe cases among those with abnormal bilirubin, the overall distribution did not differ significantly when compared to patients with normal bilirubin levels ($\chi^2 = 1.254, P = 0.534$). This suggests that bilirubin elevation was relatively uncommon and did not show a meaningful correlation with disease severity.

Table 4: Association between Clinical staging and LFT's [Enzymes]

Categories	Abnormal	Normal	Total
	N (%)	N (%)	N (%)
Mild	67 (54.92)	414 (74.06)	481 (70.63)
Moderate	22 (18.03)	65 (11.63)	87 (12.78)
Severe	33 (27.05)	80 (14.31)	113 (16.59)
Total	122 (17.91)	559 (82.09)	681 (100)
Chi sq (2)=18.204, P<0.001			

Table 4: Association between Clinical Staging and LFT (Enzymes)

Abnormal liver enzymes were observed in 17.91% of patients, with the remaining 82.09% having normal enzyme levels. Among patients with abnormal enzymes, 54.92% had mild disease, 18.03% had moderate disease, and 27.05% had severe disease. In contrast, among those with normal enzymes, a larger proportion were in the mild category (74.06%), with fewer in moderate (11.63%) and severe (14.31%) groups. This difference in distribution was statistically significant ($\chi^2 = 18.204, P < 0.001$). The findings indicate that liver enzyme abnormalities are more frequent in moderate and severe disease, suggesting hepatic involvement or systemic inflammation contributing to disease progression, and highlighting their potential role as markers of severity.

Age and important laboratory biomarkers, such as urea, creatinine, D-dimer, CRP, liver enzymes, and ferritin, are important predictors of the severity of the illness and in-hospital mortality among COVID-19 patients, according to this retrospective investigation. These results add to the increasing amount of information showing that biochemical and demographic factors are important in predicting clinical outcomes and the course of disease. A review of the literature showed that admission with pneumonia [20], comorbidities [19], and patient age [17,18] all had a substantial impact on patient severity or risk of death. Our retrospective study's findings indicate that age is a significant factor in determining the severity of an illness and, as a result, a predictor of death.

DISCUSSION

In a clinical research, Du et al. 2020 showed that people over 65 were more susceptible to COVID-19 pneumonia [18]. Older COVID-19 patients ($>68.7 \pm 10.6$ years) were shown to be more at risk than middle-aged or younger patients. Patients over 50 were more likely than younger patients in the derivation cohort to experience severe pneumonia ($p < 0.05$). Similarly, in-hospital mortality was increased ($p < 0.05$) for COVID-19 patients who were admitted with pre-existing comorbidities such as diabetes, hypertension, asthma, cardiovascular diseases, etc. [17]. Elderly people are more vulnerable because of age-related immune system deterioration, persistent low-grade inflammation, and decreased physiological reserve, all of which hinder the body's capacity to establish a successful defence against infection.

Furthermore, hyperinflammation brought on by a high neutrophil count and malfunctioning lymphocytes was the cause of acute respiratory distress syndrome (ARDS) [18,19]. The pathophysiology of severe COVID-

19 is largely dependent on this excessive inflammatory response, which is frequently referred to as a cytokine storm. According to our retrospective research, early identification of COVID-

19 patient severity during hospital admission was facilitated by high CRP and D-DIMER. As an acute-

phase reactant, CRP indicates the degree of systemic inflammation, whereas D-dimer is a measure of fibrinolysis and coagulation activity, suggesting an underlying hypercoagulable state. Increased risk of consequences such as ARDS, thromboembolism, and multi-organ dysfunction is indicated by elevated levels of these markers.

Ferritin, whose level of >635.7 ng/ml may be a crucial indicator of the severity of a patient's disease, was one of the other biomarkers of concern.

Beyond its function as an iron storage protein, ferritin functions as an acute-phase reactant and is intimately linked to inflammatory processes driven by cytokines and macrophage activation. In a study by Sulthana et al. [20], the combined dataset of ICU and non-ICU COVID-

19 patients showed a high positive connection between D-dimer and CRP levels with age and mortality.

Patients hospitalised to the intensive care unit were shown to be substantially correlated with increased age and D-dimer scores [21].

These results support our findings and highlight the need of using coagulation and inflammatory indicators in early risk assessment.

An iron deficiency is often diagnosed using the indirect iron storage marker ferritin [22].

However, elevated ferritin levels, or hyperferritinemia, in the patient's serum were associated with high levels of growth factors, cytokines, hepatocyte cell death in liver illnesses, and the degree of pulmonary involvement [21,22].

Therefore, elevated ferritin levels may indicate both the degree of tissue damage and the inflammatory burden in COVID-19.

Pneumonia was also linked to elevated ferritin levels in the patient's serum, which might be used as a predictive or diagnostic measure of the disease's severity [22].

In the derivation patient group, ferritin level and severe COVID-

19 sickness were significantly correlated ($p < 0.01$) according to Fischer's test.

In addition to these indicators, our study also discovered a correlation between the severity of the disease and renal function measurements such as blood urea and serum creatinine

. This could be the result of acute kidney damage brought on by systemic inflammation, hypoxia, and haemodynamic instability in severe COVID-19 or pre-existing renal impairment.

Similarly, hepatic damage brought on by direct viral impacts, systemic inflammation, or drug-induced hepatotoxicity may be indicated by increased liver enzymes seen in severe cases.

These results emphasise how severe COVID-19 infection is characterised by multi-or

Overall, the study's findings imply that a mix of routinely available laboratory measures and demographic characteristics can offer important insights into the severity and prognosis of a disease. Using these indicators to identify high-risk patients early on may enhance patient outcomes, expedite therapeutic intervention, and maximise resource utilization—

especially in areas with limited resources.gan involvement

CONCLUSION

The current study emphasises how the severity of COVID-19 is significantly influenced by ageing and commonly available laboratory indicators, including blood urea, serum creatinine, D-dimer, CRP, ferritin, LDH, and liver enzymes. These measures show a high correlation with the advancement of the disease and represent important pathophysiological mechanisms such as coagulopathy, multi-organ involvement, and systemic inflammation.

These laboratory indicators can be useful tools for early risk classification, prognostication, and monitoring of therapy response in hospitalised COVID-19 patients due to their broad availability, affordability, and simplicity of assessment.

Their incorporation into standard clinical evaluation may help identify high-risk patients in a timely manner, allow for focused interventions, and optimise resource allocation—especially in places with limited resources.

However, there are certain limitations to consider when interpreting the results of this study.

Causal inference is limited by the retrospective design, and a thorough evaluation of the severity of the disease is limited by the lack of association with radiological results.

To confirm these findings and improve their therapeutic relevance, more prospective research involving serial biomarker screening and imaging correlations is necessary.

In conclusion, a useful and practical method for determining the severity of COVID-19 and enhancing patient outcomes is the use of straightforward, frequently performed laboratory markers.

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