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D-DIMER A RISK FACTOR ASSOCIATED WITH C-REACTIVE PROTEIN FOR PREDICTING THE SEVERITY OF INFECTION BY COVID-19

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ABSTRACT

Background: COVID-19, caused by SARS-CoV-2, has unresolved mortality risk factors and clinical course, highlighting the need for further research. **Aims**: The study aimed to asses D-dimer and C-Reactive Protein (CRP) as the risk factors for severity covid-19 and who are less capable of surviving. **Methods**: A retrospective study conduct of COVID-19 in adult inpatients aged >20 at Al-sadder and Alamal Hospital in Iraq. Demographics, clinical trials, treatments, and viral RNA samples were analyzed. The study involved 100 patients, with 67 discharged and 33 hospitalized died. The majority of the participants 45% were aged < 40, but 55% were aged >40 years. **Results**: A significant and 57% were male 37(55.2%) Survivor vs. 20 (60.6%) non-survivor, p=0.024), more than 43% were female (30(44.8%) Survivor vs. 13(39.4%) non-survivor, p=0.010. Patients had underlying comorbidities (66%), survivor 37(55%), and non-survivor 29(87%). The most prominent comorbidity in non-survivors more than survivors was diabetic mellitus 85%, asthma 58%, stroke 48%, renal failure 42%, heart strake 33%, and hypertension 18%. The study found significant differences in WBC, lymphocyte count, D-dimer, Ferritin, CRP, and LDH levels in non-survivors compared to survivor patients, with a positive correlation between D- dimer and these parameters. The ROC analysis curve showed CRP with a high AUC of 80.2%, 87.9% sensitivity, and 37.3% specificity, while D-dimer and LDH had AUCs of 0.74.9 and 70%, respectively. **Discussion**: The study found that older age, higher d-dimer, ferritin, CRP, and LDH are associated with disease severity and higher mortality risk in adult COVID-19 patients. **Conclusions**: These biomarkers could aid in early detection of disease progression signs and better patient management

Keywords: *COVID-19, D-dimer, CRP, and LDH*

1. INTRODUCTION

The novel ß-coronavirus Sudden Respiratory Distress Syndrome (SARDS) was established as the cause (ARDS) Coronavirus-2 is a virus that causes Coronavirus Disease in the Year 2019 (COVID-19) (SARS-CoV-2). It was classified as a public health emergency by the World Health Organization (WHO)of worldwide concern in the first month of 2020 (Guo *et al.,* 2020; Zhou *et al.,* 2020).

COVID-19 is categorized into three severity levels. If flu-like symptoms emerge early on, they frequently occur. Viral pneumonia is the result of a viral infection. Patients could be admitted to the hospital for a prolonged stay or placed on a ventilator. Inflammation of the lungs and coagulopathy are two diseases that can occur together. The active phase reaction begins with a combination of physiological and metabolic changes that occur shortly after tissue injury (Sharba & ALsaleh, 2024). Of an inflammatory process. Inflammatory indicators C-reactive protein (CRP), ferritin, IL-6, and IL-1 are all high, and d-dimer has also been related to ARDS, which has poor clinical results. Finally, The third stage of the disease is fibrosis. (Polak *et al.,* 2020). The intracellular reserve ferritin has been intensively researched as an indicator of iron metabolism. (Lino *et al.,* 2021). Ferritin is an acute protein that

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increases in response to a range of inflammatory conditions. Cancer, iron excess, and liver or renal illness are just a few examples. Even if there is a temporary presence of COVID-19, this can be performed by monitoring ferritin levels. Ferritin levels in hospitalized patients have been found to be significantly higher in several investigations. However, there isn't usually a specific marker for hemophagocytic lymphohistiocytosis. (Melo *et al.,* 2021).

D-dimer is a fibrin breakdown product produced by plasma fibrinolytic enzyme, and it's a common thrombotic biomarker (Aljuboory & Sharba, 2024). It's considered typical to have a D-dimer level of less than 0.5 g/mL, and levels increase as people get older and during pregnancy. As the incidence of community-acquired pneumonia increases, so does the severity of the disease, so does the amount of D-dimer. In COVID-19 patients, D-dimer has been recognized as a possible prognostic predictor. The entrance day D-dimer has been shown in multiple studies to predict sickness severity. (Zhou *et al.*, 2020). In this early case series, the assessment of risk factors for severe disease and mortality is not well understood.

The study aimed to look into laboratory biomarkers in COVID-19 individuals to see whether there are any that can distinguish between people who are more likely to develop severe disease and those who aren't, as well as those who are less capable of surviving or are at a high or low risk of dying. Identifying laboratory signs that can distinguish between these patients would also increase clinical situational awareness.

2. MATERIALS AND METHODS

2.1. Materials

All adult inpatients included in the two-center cohort study (≥20 years old) COVID-19 has been confirmed in the lab from Al-sadder and Alamal Hospital in Al-Najaf, Iraq, who had been died or had discharged before and during the time of the study from 1st December 2021 to 31st January 2022. Demographics, Data from clinical trials, treatments, and laboratories, as well as serial samples for detecting viral RNA, were obtained from the hospital database, and survivors as well as non-survivors were compared. The criteria for exclusion are also important. Patients with anemia, thalassemia, and pregnant women who have already been diagnosed, liver disease and cancer were not included in the study.

2.2. Methods

A retrospective cross-sectional study was conducted on all verified all COVID-19 patients have been diagnosed with polymerase chain were included in the polymerase chain reaction (PCR). Severe disease was diagnosed in 100 patients who met any of the following criteria. Dyspnea has a respiratory rate of less than 30 breaths/minute in the resting state, and finger oxygen saturation is 93%. PaO2/FiO2 300 mm Hg. Respiratory failure requiring medical ventilation. The demographic characteristics, as well as comorbidities such as chronic obstructive pulmonary disease (COPD) and asthma, diabetes mellitus, renal failure, hypertension, heart attack, heart failure, stroke, clinical and laboratory findings including white blood cell count (WBC), lymphocyte, D-dimer, Ferritin, C-reactive protein (CRP), and lactic dehydrogenase (LDH), The tests were carried out in the hospital's Clinical Pathology Laboratory and the results were acquired from the hospital's database. Two groups of patients were defined as the subject's survivor and the survivor. All information was entered into a standardized data sheet.

2.3. Statistical Analysis

The Kolmogorov-Smirnov test was used to analyse the distribution of the variables. Qualitative data was provided as median (interquartile range (IQR) 25 percent-75 percent) values. While quantitative data was provided as a mean and standard deviation, qualitative data was presented as a percentage, along with numbers and percentages. The Chi-square test was used to analyze the demographic characteristics. An independent t-test was used to compare the laboratory findings. A receiver operating curve (ROC) was used to determine a cut-off value for potential illness severity predictions, as well as the predictors' sensitivity and specificity. A Pearson correlation test was used to compare the studied parameters. SPSS version 28 is a statistical package for the social sciences (IBM Corp., Armonk, NY, USA) that was used to analyze all of the data. The significance level was set at $p<0.05$ (Sullivan, 2017).

3. RESULTS AND DISCUSSION

3.1. Results

3.1.1. Characteristics of Covid-19 patients

The current study enrolled 100 patients with COVID-19. The characteristics of baseline patients are shown in Table (1). Survivors of COVID-19 were 67%, and 33% were non-survivors. The age range of all the patients was from 22 to 75 years (median (IQR) 43 (32–63.75) years, The average age of non-survivor patients was substantially higher than the average age of

survivors (51.48±15 vs. 44.46±17.74, p=0.042). Patients were divided into groups according to age involved (45%) were aged groups < 40, and (55%) were aged groups >40 years. A significant and 57% were male (37(55.2%) Survivor vs. 20 (60.6%) non-survivor, p=0.024), more than 43% were female (30(44.8%) Survivor vs. 13(39.4%) non-survivor, p=0.010).

Patients had underlying comorbidities (66%), survivor 37(55%), and non-survivor 29(87%). The most prominent comorbidity in non-survivors more than survivors was diabetic mellitus (85% vs. 18%), asthma (58% vs.10%), stroke (48% vs.10%), renal failure (42% vs. 6%), followed by heart strake (33% vs. 10%), and hypertension (18% vs.15%).

3.1.2. Major laboratory parameters and markers were tracked in all patients with COVID-19 in survivors and non-survivors.

3.1.2.1. Hematological parameters

Mean of Hb level 12.79±1.38 in all patients, the results showed no significant differences between survivor and non-survivor of covid-19 patients (12.89±1.49 vs. 12.58±1.13, p=0.294). The median WBC value was (8.7) mg/dl (IQR: 6.1–15.63mg/dl). The mean WBC in non-survivor patients was markedly higher than in survivors(15.49±4.68 vs. 7.74±4.04, p=0.0001), 2(6.1) % of non-survivors had WBC less than <4 mg/dl, but 87.9% with WBC more than >10 mg/dl as compared with survivor patients (17(25.4%), and 14(20.9%) respectively. The baseline lymphocyte count median (IQR) value 57.6 (52.8–61.1) was significantly decreased in survivors than non-survivors (p=0.003).

3.1.2.2. D-dimer, Ferritin, CRP, and LDH.

The average value of D-dimer was (2.35) µg/ml with (IQR: (1.2–4.72) µg/ml, highly significant in non-survivor when compared with the survivor (3.86±2.12 vs. 2.62±2.1, p=0.007). The normal of ferritin (20.0–300.0 lg/mL), also elevated with COVID-19 patients' median value was (775) µg/ml, (IQR: 720.3–866.4) µg/ml. Ferritin levels were significantly elevated in non-survivors mean value was (831.4±146.03) µg/ml, as compared with survivors (766.74±91.21) µg/ml, (p=0.008).

The highest value of CRP was achieved with COVID-19 (4.55) mg/dl, (IQR:1.5–5.3 mg/dl) and CRP (normal value: <0.5 mg/dl). There was a significant increase in the mean value of (5.58±1.43) mg/dl in non-survivors compared to (3.14±2.39) mg/dl in survivors (p=0.0001). Moreover, the median serum LDH level was (341.5) IU/L (IQR: 291.3–427 IU/L). Highly significant in non-survivor when compared with survivor mean value of (403.06±99.06 vs. 332.37±94.06, p=0.0001).

3.1.3. Correlation analysis between laboratory parameters

The association of Inflammatory biomarkers and D-dimer as ferritin, CRP, and LDH, in addition to WBC and lymphocytes, were shown in Table (2) and Figure (2). The results noticed a significant positive correlation between D. dimer and ferritin (r=0.355, p<0.001) weak correlation, but highly correlation with CRP (r=0.646, p<0.001), LDH (r= 0.457, p<0.001), WBC (r=0.437, p<0.001), and weak correlation with lymphocyte (r=0.374, p<0.001). A significant weak correlation between ferritin and CRP (r=0.244, p=0.015), and WBC (r=0.315, p=0.001), but no significance with lymphocyte (r=0.159, p=0.114), also a positive correlation with LDH (r=0.667, p=<0.001). CRP was high significant positive correlation with LDH (r=0.457, p<0.001), WBC (r=0.444, p=0.001), and lymphocyte (r=0.436, p=0.114).

3.1.4. The Area Under the Curve (AUC)

ROC curve analysis showed CRP as a marker of COVID-19 severity in survivors compared with survivors with a cut-off value of 4.45 mg/dl, with 87.9% sensitivity and 37.3% specificity, and high significant AUC= 0.802 (95% CI: 0.717-0.886). In comparison, the AUC for the D-dimer value as a marker of COVID-19 severity was 0.749 (95% CI: 0.652-0.846). And a cut-off for D. dimer of 2.40 µg/ml, with 81.8% sensitivity and 32.8% specificity. The AUC of LDH was 0.70 (95% CI: 0.587-0.813), a cut-off was 353.50 (IU/L) with 72.7% sensitivity and 37.3% specificity. But the ferritin showed the lowest AUC, 0.684 (95% CI: 0.555-0.813), a cut-off was 809.50 (µg/ml) with 69.7% sensitivity and 37.1% specificity. Table (3) and (Figure 3).

3.2. Discussions

3.2.1. Characteristics of the covid-19 patients

The retrospective study determined several risk factors for death in adults in Iraq who were hospitalized with COVID-19. The current study assessed 100 covid-19 positive patients, out of which 67 were survivors and 33 were non-survivor patients. In particular, in older age, d-dimer levels greater than 1 µg/mL were associated with a higher risk of non-survivor hospital death. Additionally, elevated levels of blood ferritin, CRP, LDH, leukocytosis, and lymphocytopenia were more commonly seen in association with disease severity in diagnostic covid-19. Both viral survivors and non-survivors have sustained in throat samples. In SARS and MERS, older age has already been recognized as a substantial independent predictor of mortality. (Hong *et al.,* 2018). Increased age was linked to death in patients with COVID-19, according to the current study. The age-related impairments in T-cell and B-cell activity, as well as the overproduction of type 2 cytokines, could result in a lack of viral replication control and more extended proinflammatory responses, potentially leading to poor outcomes. (Opal *et al.,* 2005).

Diabetes, hypertension, heart attack, asthma, stroke, and renal disease were all found to be comorbid in this study and may play important roles in disease severity and death. An increase in comorbidities with

increasing age could explain the greater death rate in the senior population. (Bozkurt *et al.,* 2021). The prevalence of diabetes mellitus among Covid-19 patients varies according to reports. Research by Li *et al.* (2020) found that diabetes was two times more common in severe cases than in moderate cases and that 9.7% of patients with patients had diabetes. The results of the current study were in agreement with (Li et al. 2020). We found that 85% of non-survivors had diabetes. The immune system is thought to be affected by blood glucose levels, making it more susceptible to SARS-CoV-2 infection and other infectious diseases. (Emami *et al.,* 2020).

When comparing non-survivor covid-19 to survivor covid-19, the current study found a greater rate of asthma, stroke, and heart attack. In severe COVID-19 patients, heart failure and coronary artery disease (CAD) were more common than in moderate COVID-19 individuals, as well as those who are closely linked to the occurrence of diabetes and hypertension. Previous research has shown that cardiovascular disorders worsen the severity of COVID-19, as well as mortality among patients with COVID-19 (Orioli *et al.,* 2020, Bozkurt *et al.,* 2021).

3.2.2. Laboratory Finding:

3.2.2.1. White blood cell and lymphocyte

Between the survivor and non-survivor groups, laboratory and biochemical parameters were found to be significantly different. WBC, lymphocytes, d-dimer, ferritin, CRP, and LDH levels were found to be pathologically increased. The status and degree of multi-organ failure are reflected in sepsis and septic shock. (Singer *et al.,* 2016). Although bacterial infections are the most common cause of sepsis, sepsis can also be caused by viral illnesses. This could also explain why a low lymphocyte count is linked to a poor prognosis and a higher complication rate (Zhang *et al.,* 2020). A rapid increase in neutrophil count may also result in lymphocyte apoptosis. Additionally, lymphocytes have ACE receptors, which may be responsible for the virus's direct cytotoxic action (Xu *et al.*, 2020). In this research, we discovered that more than 87.9% of non-survivor patients had WBC more than 10.0 cells/L. Although bacterial infections are the most common cause of sepsis, sepsis can also be caused by viral infections (Zhou *et al*., 2019).

3.2.3. Serum D. dimer level

The non-survivor group had much higher D dimer values, which was consistent with the findings of other studies that examined D dimer levels (Nizami *et al.,* 2021, Rahman *et al.,* 2021). D-dimer value >2000 mg/L upon hospital admission was a predictor of mortality in COVID-19 patients, according to Zhang et al (2020). When comparing non-surviving COVID-19 patients to survivors, a recent study discovered that higher fibrin-relevant (D-dimer and fibrin degradation product) levels were significantly associated with non-surviving COVID-19 patients, In severe SARS-CoV-2 infected patients with increased d-dimer or sepsis-induced disseminated intravascular coagulation, low molecular heparin was also used. Increased d-dimer values in hospital admissions may be a good predictor of COVID-19 severe and fatal cases (Tang *et al.,* 2020). A similar study found that the d-dimer can distinguish between patients with and without significant COVID-19 forms, although it lacked mortality data(Henry *et al.,* 2020). This could be owing to a hypercoagulable state brought on by cytokine storm and viremia, which leads to fibrin polymerization, thrombus formation (Sharba & ALsaleh, 2024), and, ultimately, a negative consequence (Spiezia *et al.,* 2020). In addition, there was a significant positive connection between D-dimer and CRP (r=0.646; p=0.001) in this study. Siemens et al. (2009) found comparable findings in patients with pulmonary embolisms. In COVID-19 patients, there was also a strong positive connection between D-dimer and CRP. The weak influence connection between D-dimer and serum ferritin (r=0.355; p0.001), on the other hand, was shown to be significant. These data imply that during the immunological response to COVID-19, hyperinflammation stimulates coagulation pathways (Jose and Manuel, 2020).

3.2.4. Serum Ferritin level

The non-survivors of COVID-19 had significantly higher serum ferritin levels. Non-survivors had higher ferritin levels than survivors, according to a previous study (Taneri et al., 2020). Furthermore, ferritin levels were observed to rise in correlation with the severity of the condition (Li *et al.,* 2020). The hospital death rate was higher in patients with serum ferritin levels >300 ng/mL than in patients with serum ferritin levels 300 ng/mL, according to Zhou et al (2020). Ferritin level 809.5 was also shown to predict non-survivors with a sensitivity of 69.7.9% and specificity of 37.1.2% (AUC = 0.684). When all of these observations were combined and analyzed, Hyperferritinemia was found to be an independent risk factor in COVID-19 patients, as well as a predictor of illness severity. There are two possible explanations for ferritin's relevance. According to a recent study, the clinical course of severe COVID-19 patients is similar to that of macrophage-activating syndrome patients, which is characterized by elevated ferritin levels and the presence of a cytokine storm. In patients with COVID-19, the H-chain of ferritin-activating macrophages is responsible for increased inflammatory cytokine output (Shoenfeld *et al.,* 2020). Another possibility is that an increase in ferritin helps the immune system respond to invading bacteria by supporting iron metabolism, including viral infections. For viral replication, host cells must have improved cellular metabolism and optimum iron levels. As a result, restricting iron bioavailability is critical for interfering with virus replication. Despite the underlying etiology, Patients with COVID-19 had higher blood ferritin levels. It would be beneficial to see if serum ferritin can be utilized as a biomarker for the severity of inflammation in COVID-19 patients (Wessling-Resnick, 2018). Nonetheless, ferritin is thought to be a good predictor of bad outcomes.

3.2.5. Serum CRP and LDH level

CRP is a well-known inflammatory biomarker that is observed to be increased in the majority of people with COVID-19. In comparison to non-severe instances, more severe cases showed a more obvious increase in CRP levels (81.5% vs 56.4%, respectively) (Guan *et al.,* 2019). Higher CRP levels have also been connected to the development of acute respiratory distress syndrome, increased troponin-T levels, and myocardial damage in patients with severe COVID-19 (Wu *et al.,* 2020, Shi *et al.,* 2020). This can be interpreted as an indication of severe inflammation. CRP serum levels that are elevated are linked to an increased risk of death. Non-survivors have been shown to have a gradual increase in CRP during their hospital stay (Zhou *et al.,* 2019). We discovered that non-survivors of COVID-19 had higher CRP levels than survivors. Moreover, the analysis of AUC showed a higher CRP of (AUC= 0.802 (95% CI: 0.717-0.886).

4. CONCLUSIONS

The study concluded that older age, higher d-dimer, ferritin, CRP, and LDH were associated with disease severity, and adult patients with COVID-19 have a higher risk of dying. D-dimer and CRP were among the best predictors of disease progression. In addition, These biomarkers could be utilized to separate patients who need intensive care at the time of admission, allowing for risk stratification and, hence, better patient management. This will also aid in the reduction of patient mortality by allowing for the early detection of disease progression signs.

5. DECLARATIONS

5.1. Study Limitations

Due to the pandemic that swept the world and the warning and prevention of the risk of **COVID-19** infection, the most important restrictions were the difficulty of obtaining and recording information from the infected patients directly.Therefore, the laboratory and statistical database kept for the infected in the health centers from which the samples were collected was adopted.

5.2. Acknowledgements

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5.3. Funding source

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5.4. Competing Interests

The authors declare that they have no conflicts of interest regarding the publication of this article.

5.5. Open Access

6. HUMAN AND ANIMAL-RELATED STUDIES

6.1. Ethical Approval

After approval was obtained from Kufa University and the Health Intuition Ethics Committee (November 2021).

6.2. Informed Consent

All COVID-19 patients who had been confirmed by polymerase chain reaction (PCR) tests were included in a retrospective cross-sectional research. One hundred patients who satisfied any of the criteria for infection were diagnosed with severe illness. Hospitalized patients have been permitted to give verbal permission due to the significant risk of infection transmission.

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Table 1. *Demographics and Clinical characteristics in Survivor and non- Survivor of COVID-19 patients.*

Parameters	Total patients of Covid- 19 n= 100	Survivor n=67(67%)	Non- Survivor n=33(33%)	p-value
	Median (IQR)	Mean ± SD	Mean ± SD	
Age (year)	43 (32–63.75)	44.46±17.74	51.48±15	0.042
< 40 n(%)	45 (45%)	37 (55.2%)	8 (24.2%)	0.0001*
> 40 n(%)	55 (55%)	30 (44.8%)	25 (75.8%)	0.500
Male n(%)	57 (57.0%)	37 (55.2%)	20 (60.6%)	0.024 *
Female n(%)	43 (43.0%)	30 (44.8%)	13 (39.4%)	0.010 *
Hb (g/dl)	12.8 (11.8–13.7)	12.89±1.49	12.58±1.13	0.294
WBC (X10/mm3)	8.7 (6.1–15.63)	7.74±4.04	15.49±4.68	0.0001 *
< 4 n(%)	19 (19.0%)	17 (25.4%)	2 (6.1%)	0.0001 *
> 4-10 n(%)	38 (38.0%)	36 (53.7%)	2 (6.1%)	
> 10 n(%)	43 (43.0%)	14 (20.9%)	29 (87.9%)	
Lymphocyte	57.6 (52.8–61.1)	55.56±6.13	59.13±3.5	0.003 *
D. dimer (µg/ml)	2.35 (1.2–4.72)	2.62±2.1	3.86±2.12	0.007 *
Ferritin (µg/ml)	775 (720–866.4)	766.74±91.21	831.4±146.03	0.008 *
CRP (mg/dl)	4.55 (1.5–5.3)	3.14±2.39	5.58±1.43	0.0001 *
LDH (IU/L)	341.5 (291–427)	332.37±94.06	403.06±99.06	<0.001 *

*Significant differences at p-value <0.05. IQR, interquartile range; COVID-19, coronavirus disease 2019; Hb, hemoglobin blood; WBC, white blood cells CRP, C-reactive protein; LDH, lactate dehydrogenase.

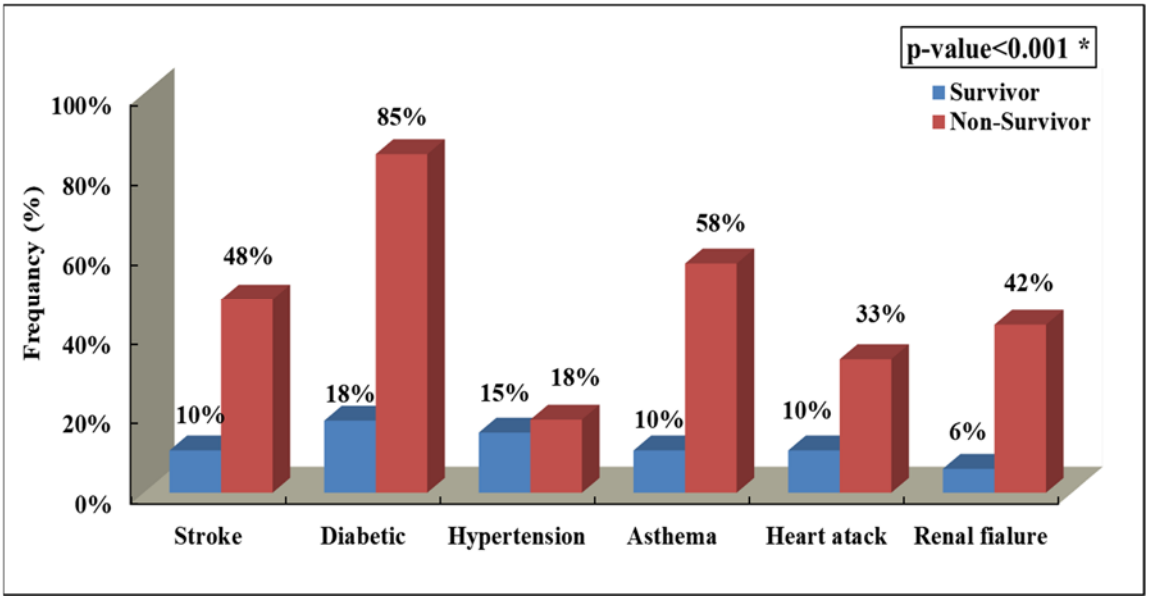

Figure 1*: Prevalence of comorbidities frequency in survivor and non-survivor of covid -19 patients*

Table 2: *Correlation of D-dimer, CRP, and Ferritin levels in COVID-19 patients*

Parameters		D. dimer (µg/ml)	Ferritin (µg/ml)	CRP (mg/dl)	LDH (IU/L)	WBC (X10 mm3)
Ferritin	**R**	0.355**	--			
	P-value	<0.001				
CRP	**R**	0.646**	0.244*	--		
	P-value	<0.001	0.015			
LDH	**R**	0.457**	0.667**	0.457**	--	
	P-value	<0.001	<0.001	<0.001		
WBC	**R**	0.437**	0.315**	0.444**	0.360**	--
	P-value	<0.001	0.001	<0.001	<0.001	
Lymphocyte	**R**	0.374**	0.159	0.436**	0.250*	0.400**
	P-value	<0.001	0.114	<0.001	0.012	<0.001

No. of covid 19= 100 patients; WBC, white blood cells CRP, C-reactive protein; LDH, lactate dehydrogenase. * Correlation is significant at p-value < 0.05; **. at p-value < 0.01.

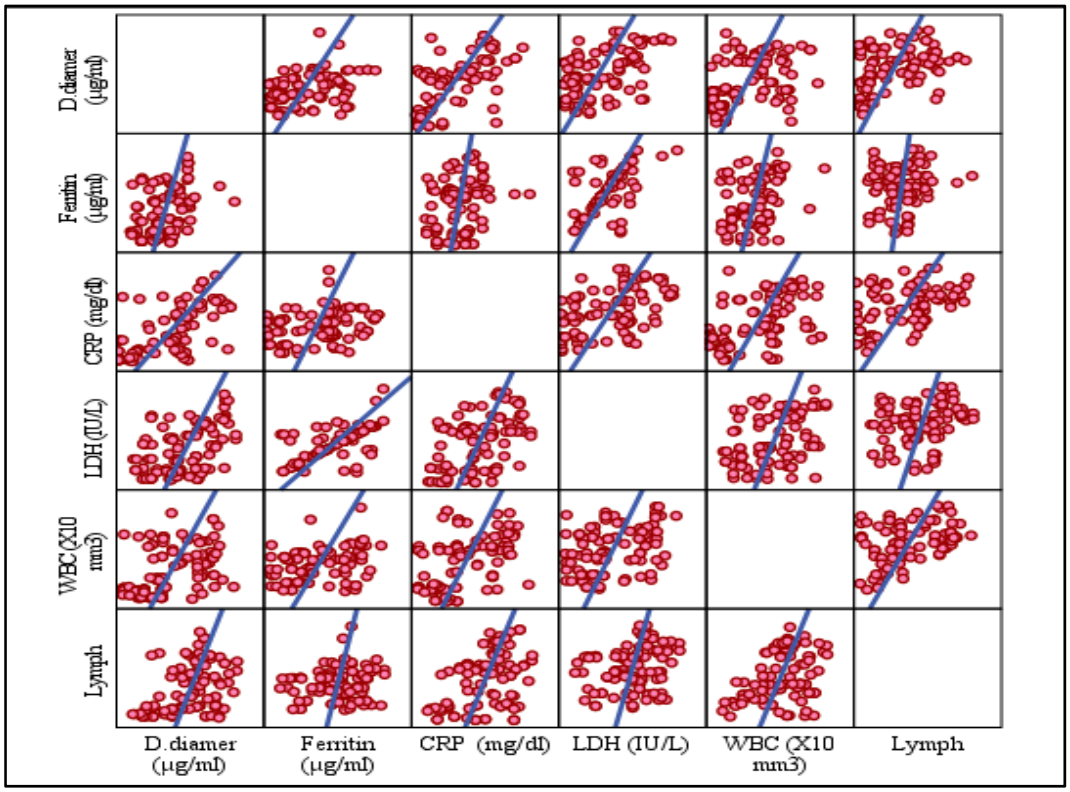

Figure 2: *Multiple scatter plots showed correlations of D. dimer, ferritin, CRP, LDH, WBC, and lymphocytes in patients with COVID-19. WBC stands for white blood cells; CRP is for C-reactive protein; LDH stands for lactate dehydrogenase*

Table 3: *The Area under the curve for study parameters to predict the marker effectiveness for COVID-19 between survivor and non-survivor*

Parameters	AUC	Std. Error	p-value	95% CI	Cut-off	Sensitivity-1 - Specificity
CRP (mg/dl)	0.802	0.043	0.0001	0.717-0.886	4.450	0.879-0.373
D. dimer (µg/ml)	0.749	0.050	0.0001	0.652-0.846	2.40	0.818-0.328
LDH (IU/L)	0.700	0.058	0.001	0.587-0.813	353.50	0.727-0.373
Ferritin (µg/ml)	0.684	0.066	0.003	0.555-0.813	809.50	0.697-0.371

AUC, Area Under the Curve; CI, Confidence Interval. CRP, C-reactive protein; LDH, lactate dehydrogenase.

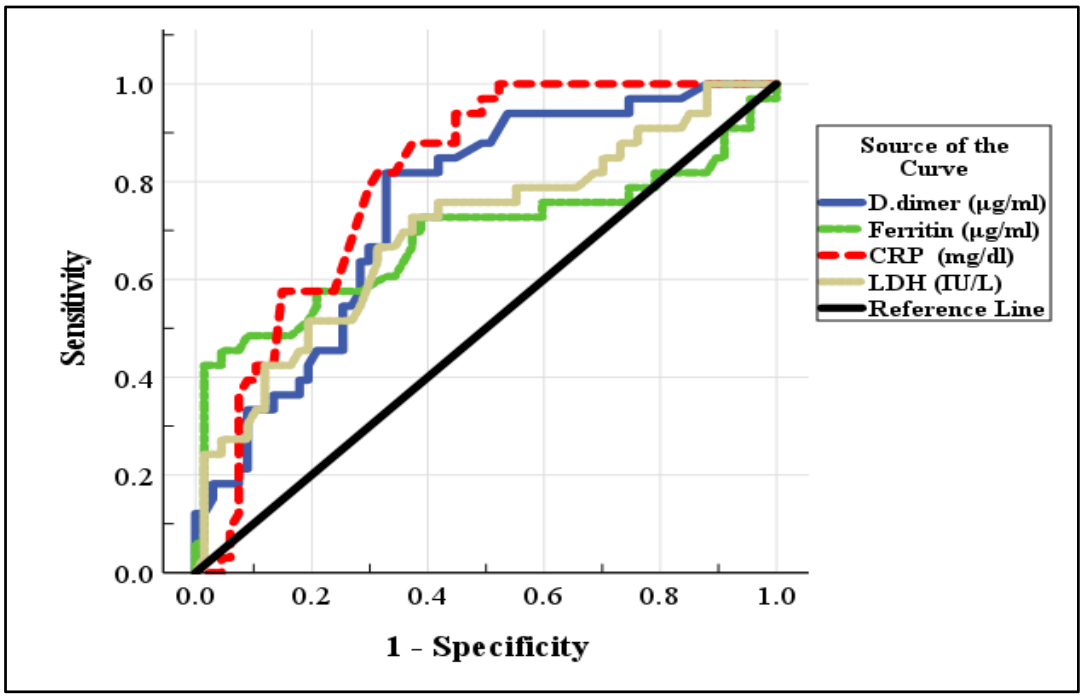

Figure 3. *ROC curve for the D-dimer, Ferritin, CRP, and LDH to predict COVID-19 severity ROC, receiver operating characteristic; CRP, C-reactive protein; COVID-19, coronavirus disease 2019*.