



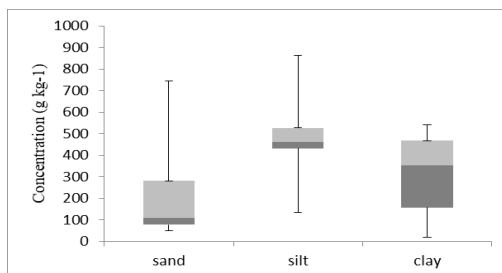
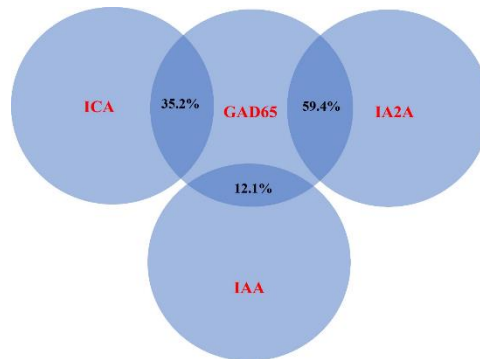
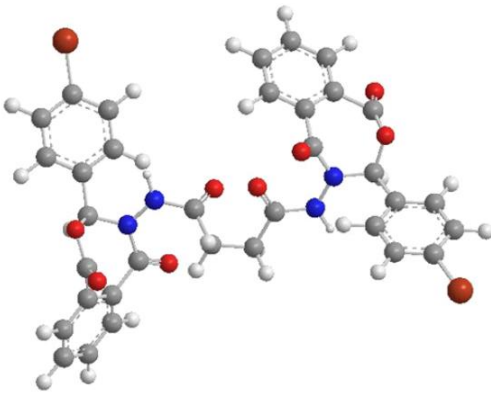
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## Mortality and Survival Analysis in COVID-19 Patients: Hematological and Biochemical Study

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### Abstract

Severe acute respiratory syndrome (SARS-CoV-2) that causes novel coronavirus pneumonia (COVID-19) interacts with the receptor (angiotensin-converting enzyme) on the lung epithelial cells and leads to rapid deterioration of human health if no care is provided, hence risk identification of the case severity is important. The objective of the present study is to analyze the relationship between blood parameters and the severity, survival, and mortality of COVID-19 patients based on the hematological and biochemical abnormalities associated with Iraqi COVID-19 patients. A prospective multicenter observational study has been done on a total of 103 patients admitted to different hospitals between November 1, 2021, and April 1, 2022. Among these 30 (29.1%) patients died, 81% died within two weeks of admission to the hospital, and 73 patients (71.9%) survived. An independent sample t-test revealed a significant difference in the tests including AST, ALT, D-dimer, urea, creatinine, and chloride ion between the dead and survived patients, while there was a non-significant difference when these parameters were compared (age, BMI, CPR, PT, INR, APTT, WBC, LYM, GRA, HGB, RBC, ESR, Creatinine, Na and K ions). Crosstab's study showed that most death (80%) were at ages >60 years, 53.3% of the deaths were having normal BMI and only 10% were obese. Three models for logistic regression were performed to test if the available data set is more effective than the null hypothesis, all three tests yield a similar conclusion that the available data can be used to check the risk factors in COVID-19 patients.

### Introduction

The coronavirus was identified and named for the first time in the 1960s was responsible for upper respiratory tract infections in children. This RNA virus infects both humans and animals and can transmit between them. In animals and birds, this virus can cause respiratory and intestinal infections [1]. Seven coronaviruses can infect humans, including SARS, which emerged in southern China between 2002 and 2003, about 8,000 persons were infected with the SARS coronavirus (SARS-CoV), with a 9.6% mortality rate [2,3]. More attention was focused on the Middle East respiratory syndrome (MERS), which was brought on by the Middle East respiratory

syndrome coronavirus (MERS-CoV), and which appeared in 2012 in the Middle East, Africa, and other nations. Over 2,000 cases were reported, with a fatality rate of about 34.4% [1,4]. Another deadly coronavirus, SARS-CoV-2, emerged in December 2019 and was responsible for a new type of pneumonia [5,6]. Patients with severe disease have trouble breathing and/or not getting enough oxygen one week after their first symptoms show up. In severe cases, they can quickly lead to acute respiratory distress syndrome (ARDS), multiple organ failure, septic shock, metabolic acidosis that is hard to fix, coagulation problems, and septic shock [7]. In December 2019, many pneumonia patients with identical clinical signs and symptoms emerged in Wuhan, Hubei, China. Deep sequencing of lower respiratory tract samples showed a newly identified coronavirus, dubbed 2019 novel coronavirus (2019-nCoV)[5], with a mortality rate of around 3.97%. Outside of China, there has also been a notable rise in confirmed cases. On March 8, 2019, about 24,000 people were diagnosed with the flu. By March 16, 2019, that number had risen to more than 86,000. Additionally, the rate of death increased from 1.96% to 3.92% [8]. The World Health Organization (WHO) estimates that 13.8 % of infected individuals have severe diseases, 6.1% have a critical sickness, and about 80% of infected people have mild to moderate infections (including those with or without pneumonia) [9]. A meta-analysis of more than 50,000 cases found that 18.1% of all infected people had severe infections [10]. Studies have shown that patients who have mild-to-moderate infections, severe infections, and critical infections make up 80.9%, 13.8%, and 4.7% of confirmed cases, respectively [11]. 26.1-32.0% of confirmed cases may develop into severe or critical cases, as reported by the World Health Organization (WHO) [11]. The mortality rate in severe instances has reached a terrifying range which was 61.5% [12]. The mortality rate in those over the age of 80 is 21.9%, showing that the older the infected population, the higher the death toll [8], any cases expeditious develop into severe pneumonia and, eventually, mortality, primarily in people with comorbidities such as cardiovascular disease, obesity, type 2 diabetes [13]. As a result, identifying and diagnosing severe or critical patients is essential. Hematology and Biochemical are the most commonly conducted test in the clinic, and CBC (Complete Blood Count) findings are the first thing clinicians want to see in virtually all laboratories, large and small, outpatient and inpatient.

## **Materials and Methods**

### *Sample Collection*

This multicenter observational study was conducted to detect COVID-19 in several hospitals (Shahid Hemn, Aswda, Shefa 14, Azadi) in Iraq from November 1, 2021 to April 1, 2022. Among these hospitals, Shefa 14 Medical Center reported the highest number of cases. Then, 103 patients, including 61 (52.9%) females and 42 (40.8%) males, whose ages were between 18 to 90 years, were enrolled in this study after taking the historical information of each patient and their family history. By following interim recommendations from the World Health Organization and Polymerase Chain Reaction (PCR), all patients included in this study had verified COVID-19. The clinical standards for the identification of moderate cases were fever, respiratory tract symptoms, and pneumonia imaging meanwhile, in addition to having the symptoms and signs of moderate cases, severe cases also showed respiratory distress (RD) pulse oximetry (%SPO<sub>2</sub>) ≤92 with CPAP; blood pressure (BP) ≤ 130/110 mg Hg; pulse rate beat per minute (PRbpm, 95).

### *Data Collection*

From the admission records, the typical epidemiological data (including recent exposure history, such as contact with patients exhibiting fever or respiratory symptoms at home or another location) and the fundamental data, such as gender, age, clinical symptoms, and signs, were taken. All the laboratory data including complete blood count (CBC Alfa Swelab-Sweden), serum Biochemistry (Cobas Fully Automatic Chemistry Analyzer C311&C111 Roch Germany), and coagulation tests (Cobas Fully Automatic Chemistry Analyzer C311, Catron X, Germany), were collected from the COVID-19 special hospitals. Throughout this investigation, 103 patients were recruited in the hospital, and a total of about 1100 results identified on the Alfa Swelab hematological analyzer, together with biochemistry and coagulation tests, were collected and more than half of the tests were performed in a private laboratory outside hospitals.

### *Ethical Approval*

Ethical clearance was obtained from the Ethics Committee at the Komar University of Science and Technology.

### *Statistical analysis*

In this study, SPSS statistics software (version 19.0) was used for statistical data analysis and GraphPad Prism software (version 8.0.2) was used for mapping. The quantized variables of blood parameters were expressed as mean  $\pm$  standard error. Independent t-test were used to check the significant differences between multiple variables. The differences were regarded as significant at a value of  $p \leq 0.05$ . Crosstab analysis was performed for the Chi-square test was performed. Descriptive statistics were performed for all variables. Linear discriminant analysis (LDA) was employed to conduct a linear combination of each of the two parameters and extract the best data features that could distinguish moderate COVID-19 cases from severe ones. The *Kolmogorov-Smirnov normality test* examines if variables are normally distributed. Logistic regression is used to predict a dichotomous outcome based on a set of independent variables were evaluated as well as multivariate logistic regression analysis was evaluated by taking the severity of COVID-19 as a dependent variable and variables which found significant during univariate analysis were diagnosed as the independent variable. The Hosmer- Lemeshow test is a goodness of fit test for logistic regression.

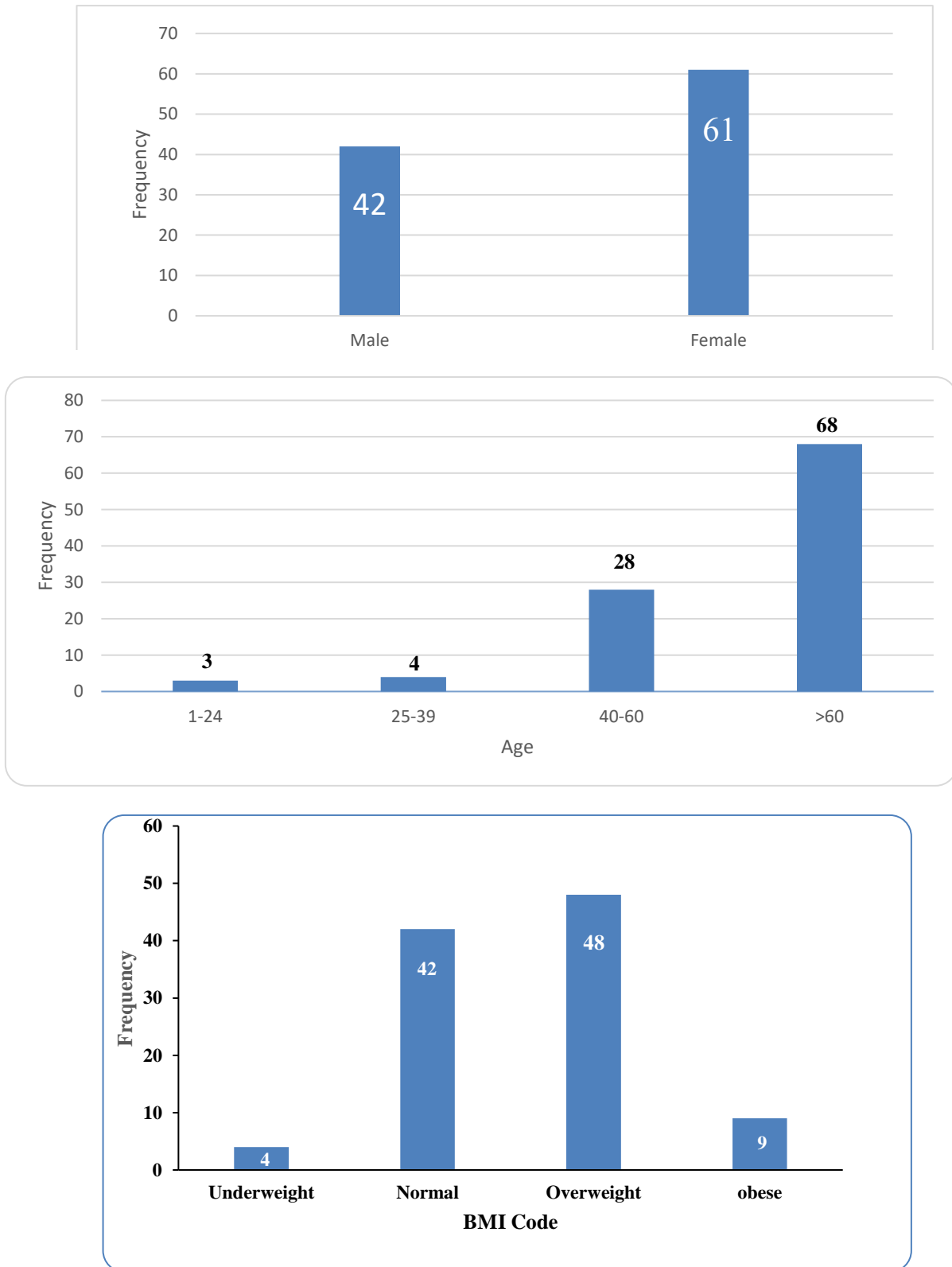
### *Exclusion criteria*

Subjects who had a disease history of liver diseases, kidney diseases, heart diseases, and other autoimmune diseases were excluded.

## **Results**

### *Patients' sociodemographic characteristics*

A total of 103 COVID-19 patients were included in this study, with the mean and standard error of mean (SE) of age being  $65.4272 \pm 15.9439$ . Forty-two cases (40.8%) were males, and 61 (59.2%) were females (Figure 1A).



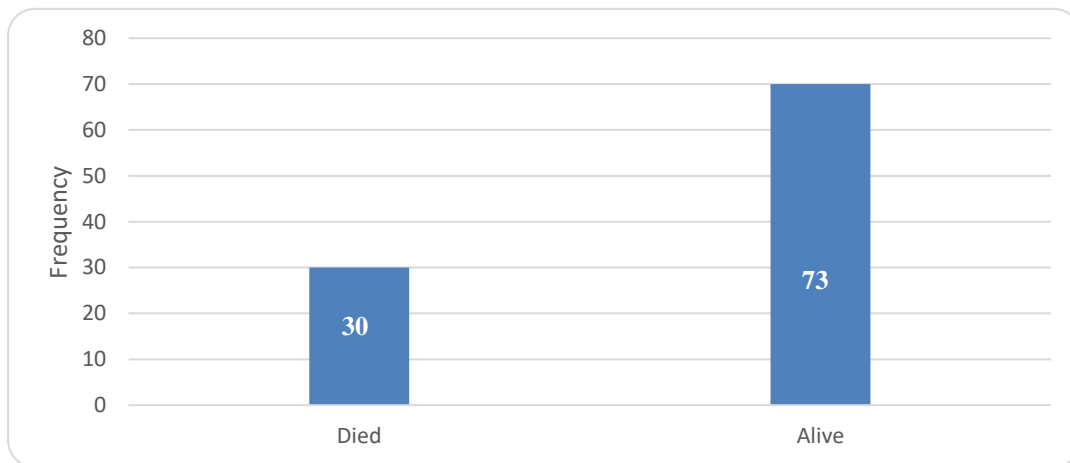
**Figure 1:** The sociodemographic characteristics of the patient groups.

According to BMI, patients were classified into 4 categories (underweight, normal, overweight, and obese). Only 9 subjects (8.7%) were obese, 48 patients (46.6%) were overweight, 42 (40.8%) were normal and the rest (3.9%) were underweight (Figure 1B).

Regarding age, the patients were divided into 4 groups, the frequency of the age group above 60 years old were 68 patients. 28 patients were between 40-60, 4 patients were between 25-39, and only 3 patients were recruited in the hospital were under 25 years old (Figure 1C). The majority of the cases (83%) were living in the city centers.

*Death and survival rates:*

Among 61 female cases, 19 deaths were observed with a death rate of 31.14%, while 11 patients (26.19%) passed away from the total of 42 males admitted to hospitals. Moreover, 22 (73.3%) of the total death were also observed among COVID-19 patients who were residing in the city centers, and 80% of the death was seen among patients older than 60 years (Figure 2),



**Figure 2:** Death and survival rates among COVID-19 patients.

*Severity and non-severity definition and categorization*

COVID-19 patients were grouped depending on the severity of their conditions into 4 categories. Category 1 which had no pneumonia regarded as mild, with 24 patients. Category 2 which they had cough, fever, and pneumonia regarded as moderate, 28 patients. Category 3, had an oxygen saturation of less than 93%, and they had respiratory distress, regarded as severe, 33 patients. The last category was critical as they had respiratory failure they were in the intensive care unit and had one or multiple organ failures, in 18 patients.

*Hematological and biochemical study of the cases*

Complete blood count (CBC) was recorded for all patients on their first admission to the hospitals, Table 1 shows the parameters of blood routine examinations in patients.

According to the results, 46 patients were having normal white blood cell counts (WBC), 7 cases were having lower WBC and 50 cases (48.5%) were having high WBC. The value of mean  $\pm$  SE for WBC count was  $12.56 \pm 5.95 * 10^9/L$  for the death cases, while it was  $10.28 \pm 5.57 * 10^9/L$  for the survival cases, the difference was not significant ( $p=0.068$ ) (Table 2).

**Table 1:** WBC Range in patients categorized into three groups: Low  $<4 \times 10^9/L$ , normal  $4-11 \times 10^9/L$ , and high  $>11 \times 10^9/L$ .

|       | WBC1          | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|---------------|-----------|---------|---------------|--------------------|
| Valid | Low (0-4)     | 7         | 6.8     | 6.8           | 6.8                |
|       | Normal (4-11) | 46        | 44.7    | 44.7          | 51.5               |
|       | High (11-)    | 50        | 48.5    | 48.5          | 100.0              |
|       | Total         | 103       | 100.0   | 100.0         |                    |

**Table 2:** Independent sample t-test for the comparison of different parameters in the dead and alive patients.

| Variable   | State | N  | Mean      | Std. Deviation | Std. Error Mean | T-test | Sig. |
|------------|-------|----|-----------|----------------|-----------------|--------|------|
| Age        | died  | 30 | 69.8000   | 11.54422       | 2.10768         | 1.804  | .074 |
|            | alive | 73 | 63.6301   | 17.18163       | 2.01096         | 2.118  |      |
| BMI        | died  | 30 | 25.426    | 4.6793         | .8543           | -.527  | .599 |
|            | alive | 73 | 26.080    | 6.0825         | .7119           | -.588  | .    |
| AST        | died  | 30 | 51.0953   | 70.70914       | 12.90966        | 2.197  | .030 |
|            | alive | 73 | 31.7464   | 17.31705       | 2.02681         | 1.481  | .    |
| ALT        | died  | 30 | 47.0600   | 49.39700       | 9.01862         | 2.286  | .024 |
|            | alive | 73 | 31.4059   | 20.39738       | 2.38733         | 1.678  | .    |
| CRP        | died  | 30 | 101.9627  | 84.75719       | 15.47448        | .303   | .762 |
|            | alive | 73 | 96.2760   | 87.20932       | 10.20708        | .307   | .    |
| D-dimer    | died  | 30 | 5319.6833 | 5073.93718     | 926.36995       | 3.316  | .001 |
|            | alive | 73 | 2332.4110 | 3720.20031     | 435.41651       | 2.918  | .    |
| PT         | died  | 30 | 14.8667   | 1.71692        | .31347          | -.421  | .675 |
|            | alive | 73 | 15.1192   | 3.08962        | .36161          | -.528  | .    |
| INR        | died  | 30 | 4.4478    | 18.23652       | 3.32952         | 1.294  | .198 |
|            | alive | 73 | 1.5618    | 3.78367        | .44284          | .859   | .    |
| APTT       | died  | 30 | 31.0067   | 2.82024        | .51490          | -1.274 | .205 |
|            | alive | 73 | 32.7173   | 7.10858        | .83200          | -1.748 | .    |
| WBC        | died  | 30 | 12.5600   | 5.95759        | 1.08770         | 1.842  | .068 |
|            | alive | 73 | 10.2890   | 5.57199        | .65215          | 1.791  | .    |
| LYM        | died  | 30 | 1.2633    | 2.21055        | .40359          | -.237  | .813 |
|            | alive | 73 | 1.3507    | 1.44634        | .16928          | -.200  | .    |
| GRA        | died  | 30 | 10.7133   | 5.11143        | .93322          | .723   | .471 |
|            | alive | 73 | 9.3266    | 9.95777        | 1.16547         | .929   | .    |
| HGB        | died  | 30 | 12.2567   | 2.19728        | .40117          | -.224  | .823 |
|            | alive | 73 | 12.3521   | 1.85638        | .21727          | -.209  | .    |
| RBC        | died  | 30 | 4.3110    | .74178         | .13543          | -1.357 | .178 |
|            | alive | 73 | 4.6910    | 1.45526        | .17033          | -1.746 | .    |
| ESR        | died  | 30 | 30.4267   | 20.54571       | 3.75112         | -1.443 | .152 |
|            | alive | 73 | 36.8630   | 20.56920       | 2.40744         | -1.444 | .    |
| Urea       | died  | 30 | 75.2067   | 41.32063       | 7.54408         | 2.878  | .005 |
|            | alive | 73 | 52.4110   | 34.41145       | 4.02756         | 2.666  | .    |
| Creatinine | died  | 30 | 1.2853    | .73020         | .13332          | 1.635  | .105 |
|            | alive | 73 | .9068     | .37483         | .04387          | 1.272  | .    |
| Na         | died  | 30 | 138.1373  | 6.59297        | 1.20371         | 1.569  | .120 |
|            | alive | 73 | 136.3112  | 4.78547        | .56010          | 1.375  | .    |
| K          | died  | 30 | 4.3040    | .86734         | .15835          | -.660  | .511 |
|            | alive | 73 | 4.4247    | .83285         | .09748          | -.649  | .    |
| Cl         | died  | 30 | 105.5700  | 7.11861        | 1.29967         | 2.047  | .043 |
|            | alive | 73 | 101.8996  | 8.69064        | 1.01716         | 2.224  | .    |

The lymphocytes (LYM) were counted revealed that about half of the patients (45.6%) were having lower LYM counts and only 3% had high LYM (Table 3),

**Table 3:** LYM level in patients categorized into three groups: Low ( $<1 \times 10^9/L$ , normal  $1-4.8 \times 10^9/L$ , and high  $>4.8 \times 10^9/L$ .

|       |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|-----------------|-----------|---------|---------------|--------------------|
| Valid | Low ( $<1$ )    | 47        | 45.6    | 45.6          | 45.6               |
|       | Normal (1-4.8)  | 53        | 51.5    | 51.5          | 97.1               |
|       | High ( $>4.8$ ) | 3         | 2.9     | 2.9           | 100.0              |
|       | Total           | 103       | 100.0   | 100.0         |                    |

the value for LYM in the survived cases was  $1.35 \pm 1.44 \times 10^9/L$ , and  $1.26 \pm 2.21 \times 10^9/L$  for the cases who passed away, there were no significant differences between both cases ( $p=0.813$ ) (Table 2).

**Table 4:** GRA level in patients categorized into three groups: Low ( $<1.5 \times 10^9/L$ , normal  $1.5-8.5 \times 10^9/L$ , and high  $>8.5 \times 10^9/L$ .

|       |                  | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|------------------|-----------|---------|---------------|--------------------|
| Valid | Low ( $<1.5$ )   | 1         | 1.0     | 1.0           | 1.0                |
|       | Normal (1.5-8.5) | 44        | 42.7    | 42.7          | 43.7               |
|       | High ( $>8.5$ )  | 58        | 56.3    | 56.3          | 100.0              |
|       | Total            | 103       | 100.0   | 100.0         |                    |

The granulocytes (GRA) count increased drastically in 56.3% of the patients and only 1% of the cases showed a lower level of GRA (Table 4), with  $10.71 \pm 5.11 \times 10^9/L$  for the death cases and  $9.32 \pm 9.95 \times 10^9/L$  for the alive cases, no significant difference was observed between both cases here as well (Table 2). Hemoglobin (Hb) level was normal in 70 patients (68%), while it was low in 30 (29.1%) and high in 3 patients (2.9%) (Table 5),

**Table 5:** HGB level in patients categorized into three groups: Low ( $<13.8$  g/dL) for males and ( $<12.1$ ) for female, normal (13.8-17.2g/dL) for males and (12.1-15.1) for females, and high ( $>17.2$  g/dL) for males and ( $>15.1$ ) for females.

|       |  | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|--|-----------|---------|---------------|--------------------|
| Valid | Low ( $<13.8$ ) for males<br>Low ( $<12.1$ ) for females       | 30        | 29.1    | 29.1          | 29.1               |
|       | Normal (13.8-17.2) for males<br>Normal (12.1-15.1) for females | 70        | 68.0    | 68.0          | 97.1               |
|       | High ( $>17.2$ ) for males<br>High ( $>15.1$ ) for females     | 3         | 2.9     | 2.9           | 100.0              |
|       | Total  | 103       | 100.0   | 100.0         |                    |

the level of Hb in the dead subjects was  $12.25 \pm 2.19$  g/dL, and  $12.35 \pm 1.85$  g/dL for the survived cases, and there was no significant difference ( $p=0.823$ ) (Table 2). Red blood cell (RBC) numbers and morphology were normal in 90 patients (87.4%), while it was low in 8 and high in 5 patients (Table 6),

**Table 6:** RBC level in patients categorized into three groups: Low ( $<4.3 \times 10^{12}$ ) for males & ( $<3.5 \times 10^{12}$ ) for females, Normal ( $4.3-5.9 \times 10^{12}$ ) for males & ( $3.5-5.5 \times 10^{12}$ ) for females, and high ( $>5.9 \times 10^{12}$ ) for males & ( $>5.5 \times 10^{12}$ ) for females.

|       |  | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|--|-----------|---------|---------------|--------------------|
| Valid | Low ( $<4.3$ ) for males<br>Low ( $<3.5$ ) for females             | 8         | 7.8     | 7.8           | 7.8                |
|       | Normal ( $4.3-5.9$ ) for males<br>Normal ( $3.5-5.5$ ) for females | 90        | 87.4    | 87.4          | 95.1               |
|       | High ( $>5.9$ ) for males High<br>( $>5.5$ ) for females           | 5         | 4.9     | 4.9           | 100.0              |
|       | Total  | 103       | 100.0   | 100.0         |                    |

RBC in the dead patients was  $4.31 \pm 0.74 \times 10^{12}/L$ , and  $4.69 \pm 1.45 \times 10^{12}/L$  for the survived patients, no significant difference was found as well ( $p=0.178$ ) (Table 2). Erythrocyte sedimentation rate (ESR) was measured in all patients, with 84 (81.6%) having higher than normal while 19 patients were normal (Table 7).

**Table 7:** ESR value in patients categorized into two groups depending on the age and sex measured in mm/hr.

|       |  | Frequency | Percent | Valid Percent | Cumulative Percent |    |      |      |       |
|-------|--|-----------|---------|---------------|--------------------|----|------|------|-------|
| Valid | Normal ( $\leq 15$ ) for males $<50$<br>years<br>Normal ( $\leq 20$ ) for males $>50$<br>years   | 19        | 18.4    | 18.4          | 18.4               |    |      |      |       |
|       | Normal ( $\leq 20$ ) for females $<50$<br>years<br>Normal ( $\leq 30$ ) for females $>50$<br>years   |           |         |               |                    |    |      |      |       |
|       | High ( $>15$ ) for males $<50$ years<br>High ( $>20$ ) for males $>50$ years<br>High ( $>20$ ) for females $<50$<br>years<br>High ( $>30$ ) for females $>50$<br>years |           |         |               |                    | 84 | 81.6 | 81.6 | 100.0 |
|       | Total  |           |         |               |                    |    |      |      |       |

The ESR level was lower in the dead cases ( $30.42 \pm 20.54$ ) and ( $36.86 \pm 20.56$ ) mm/hr in the survived cases, no significant difference was seen ( $p=0.152$ ) (Table 2). Prothrombin time (PT) and international normalized ratio INR was measured in all patients, PT was normal in 97 patients, high in 5 and low in one patient (Table 8),

**Table 8:** PT value in patients categorized into three groups low ( $<11$ ), normal (11-14), and high ( $>14$ ). measured in seconds.

|       |                | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|----------------|-----------|---------|---------------|--------------------|
| Valid | Low (0-11)     | 1         | 1.0     | 1.0           | 1.0                |
|       | Normal (11-14) | 97        | 94.2    | 94.2          | 95.1               |
|       | High (14-)     | 5         | 4.9     | 4.9           | 100.0              |
| Total |                | 103       | 100.0   | 100.0         |                    |

while INR was normal in 67 patients, high in 32, and lower than normal in 4 patients (Table 9).

**Table 9:** INR value in patients categorized into three groups low (<0.84), normal (0.84-1.1), and high (>1.1) measured in seconds.

|       |                   | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|-------------------|-----------|---------|---------------|--------------------|
| Valid | Low (<0.84)       | 4         | 3.9     | 3.9           | 3.9                |
|       | Normal (0.84-1.1) | 67        | 65.0    | 65.0          | 68.9               |
|       | High (>1.1)       | 32        | 31.1    | 31.1          | 100.0              |
|       | Total             | 103       | 100.0   | 100.0         |                    |

PT in the dead patients was  $14.86 \pm 1.71$  and  $15.11 \pm 3.08$  seconds in the survived subjects, no significant difference was noted ( $p=0.675$ ). INR level was  $4.44 \pm 18.23$  in the dead subjects and  $1.56 \pm 3.78$  seconds in the alive patients, no significant difference was recorded ( $p=0.198$ ) (Table 2). Activated partial thromboplastin time test (aPTT) was normal in 90 patients (Table 10),

**Table 10:** aPTT value in patients categorized into three groups low (<27), normal (27-42), and high (>42) measured in seconds.

|       |                | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|----------------|-----------|---------|---------------|--------------------|
| Valid | Low (<27)      | 9         | 8.7     | 8.7           | 8.7                |
|       | Normal (27-42) | 90        | 87.4    | 87.4          | 96.1               |
|       | High (>42)     | 4         | 3.9     | 3.9           | 100.0              |
|       | Total          | 103       | 100.0   | 100.0         |                    |

low in 9 and high in 4 cases with  $31.00 \pm 2.82$  in the dead subjects and  $32.71 \pm 7.1$  seconds in the alive cases, no significant difference was noted ( $p=0.205$ ) (Table 2). C-reactive protein (CRP) level was high in 101 cases and normal in only two cases (Table 11)

**Table 11:** CRP value in patients categorized into two groups low ( $\leq 5.1$ ), and high ( $\geq 5.1$ ) measured in mg/dL.

|       |                     | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|---------------------|-----------|---------|---------------|--------------------|
| Valid | Normal (<5.1)       | 2         | 1.9     | 1.9           | 1.9                |
|       | High ( $\geq 5.1$ ) | 101       | 98.1    | 98.1          | 100.0              |
|       | Total               | 103       | 100.0   | 100.0         |                    |

with the value of mean  $\pm$  SE was  $101.96 \pm 84.75$  in the death cases and  $96.27 \pm 87.2$  mg/L in the survived cases, no significant difference was available (Table 2). D-dimer was high in 76 patients and normal in 27 cases (Table 12)

**Table 12:** D-Dimer value in patients categorized into two groups normal (<500), and high ( $\geq 500$ ) measured in ng/ml.

|       |                     | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|---------------------|-----------|---------|---------------|--------------------|
| Valid | Normal (<500)       | 27        | 26.2    | 26.2          | 26.2               |
|       | High ( $\geq 500$ ) | 76        | 73.8    | 73.8          | 100.0              |
|       | Total               | 103       | 100.0   | 100.0         |                    |

with  $5319.68 \pm 5073$  in the dead subjects and  $2332.41 \pm 3720.2$  ng/ml in the survived cases, the difference between them was highly significant ( $p=0.001$ ) (Table 2).

According to the results of this study, there were several differences in the factors of blood routine between mild, moderate, and severe patients as the cases categorized in severe groups had lower lymphocyte mean count, higher granulocyte mean count, and higher mean INR, while in the mild and moderate cases, these changes were not observed.

Many biochemical parameters have been studied in all patients such as Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST), Creatinine (Cr), Urea, potassium ion (K), Chloride ion (Cl), and sodium ion (Na). Results have shown that 80 patients were having normal levels of ALT and 23 with a higher than the normal range (Table 13).

**Table 13:** ALT activity in patients categorized into two groups normal (<41), and high (≥41) measured. in U/L.

|       |               | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|---------------|-----------|---------|---------------|--------------------|
| Valid | Normal (2-41) | 80        | 77.7    | 77.7          | 77.7               |
|       | High (>41)    | 23        | 22.3    | 22.3          | 100.0              |
|       | Total         | 103       | 100.0   | 100.0         |                    |

The mean ±SE was 31.4±20.39 for the survived cases and 47.06±49.39 for the patients who passed away later, and there was a significant difference between both cases (p=0.024) (Table 2). AST was normal in 76 patients and high in 27 (Table 14),

**Table 14:** AST activity in patients categorized into two groups normal (<41), and high (≥41) measured in U/L.

|       |                 | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|-----------------|-----------|---------|---------------|--------------------|
| Valid | Normal (2 - 41) | 76        | 73.8    | 73.8          | 73.8               |
|       | High (>41)      | 27        | 26.2    | 26.2          | 100.0              |
|       | Total           | 103       | 100.0   | 100.0         |                    |

with 51.09±70.7 for the dead cases and 31.74±17.31 IU/L for the survival cases, the difference was significant (p=0.03). Creatinine level was normal in 86 patients, high in 16 patients, and low in only one case (Table 15),

**Table 15:** Creatinine value in patients categorized into three groups low (<0.2), normal (0.2-1.2) and high (>1.2) measured in mg/dL.

|       |                  | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|------------------|-----------|---------|---------------|--------------------|
| Valid | Low (0-0.2)      | 1         | 1.0     | 1.0           | 1.0                |
|       | Normal (0.2-1.2) | 86        | 83.5    | 83.5          | 84.5               |
|       | High (1.2<)      | 16        | 15.5    | 15.5          | 100.0              |
|       | Total            | 103       | 100.0   | 100.0         |                    |

being 1.28±0.73 in the dead patients and 0.91±0.37 mg/dl in the alive patients, and there was a significant difference (p=0.05) (Table 2). Urea was normal in 40 patients, high in 61 and low in two subjects (Table 16),

**Table 16:** Urea value in patients categorized into three groups low (<15), normal (15-45) and high (>45) measured in mg/dL.

|       |                | Frequency | Percent | Valid Percent | Cumulative Percent |
|-------|----------------|-----------|---------|---------------|--------------------|
| Valid | Low (0-15)     | 2         | 1.9     | 1.9           | 1.9                |
|       | Normal (15-45) | 40        | 38.8    | 38.8          | 40.8               |
|       | High (45<)     | 61        | 59.2    | 59.2          | 100.0              |
|       | Total          | 103       | 100.0   | 100.0         |                    |

being  $75.2 \pm 41.32$  in the dead patients and  $52.41 \pm 34.41$  mg/dl in the survived ones, a highly significant difference was seen here as well ( $p=0.005$ ) (Table 2). Na and K measurements between the two groups showed no significant difference ( $p=0.12$ , and  $p=0.51$ , respectively), being  $138.13 \pm 6.59$  in the dead subjects and  $136.31 \pm 4.78$  mmol/L in the survived cases for the Na, and  $4.30 \pm 0.86$  for the dead cases,  $4.42 \pm 0.83$  mmol/L for the alive cases for the potassium ion. Cl measurements between both groups showed a significant difference ( $p=0.043$ ) being  $105.57 \pm 7.11$  for the dead cases and  $101.89 \pm 8.69$  mmol/L for the survived cases (Table 17).

**Table 17:** Na, K, and Cl levels in the died and alive patients measured in mmol/L. Frequency

|    |       |    |          |         |
|----|-------|----|----------|---------|
| Na | died  | 30 | 138.1373 | 6.59297 |
|    | alive | 73 | 136.3112 | 4.78547 |
| K  | died  | 30 | 4.3040   | .86734  |
|    | alive | 73 | 4.4247   | .83285  |
| Cl | died  | 30 | 105.5700 | 7.11861 |
|    | alive | 73 | 101.8996 | 8.69064 |

*Correlation analysis was performed between different variables*

Association between categorical variables have been studied against the state of the patients, and according to the crosstab statistical analysis of the gender versus the state, 11 male patients died while 31 survived while

19 female patients died and 42 survived, Pearson Chi-Square test has been applied for the association of the gender and the state of the patients (Tables 18 & 19).

**Table 18:** Associations between categorical variables of gender within state of alive and died patients.

| Crosstab |         |                |        |        |        |
|----------|---------|----------------|--------|--------|--------|
|          |         |                | State  |        | Total  |
|          |         |                | died   | alive  |        |
| Gender   | Males   | Count          | 11     | 31     | 42     |
|          |         | % within State | 36.7%  | 42.5%  | 40.8%  |
|          | Females | Count          | 19     | 42     | 61     |
|          |         | % within State | 63.3%  | 57.5%  | 59.2%  |
| Total    |         | Count          | 30     | 73     | 103    |
|          |         | % within State | 100.0% | 100.0% | 100.0% |

**Table 19:** Chi-Square test for the association of gender and the state of the patients.

| Chi-Square Tests   |                    |    |                                   |                      |                      |
|--|--------------------|----|-----------------------------------|----------------------|----------------------|
|  | Value              | df | Asymptotic Significance (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
| Pearson Chi-Square   | 0.296 <sup>a</sup> | 1  | 0.586                             |                      |                      |
| Continuity Correction <sup>b</sup>   | 0.105              | 1  | 0.746                             |                      |                      |
| Likelihood Ratio   | 0.298              | 1  | 0.585                             |                      |                      |
| Fisher's Exact Test  |                    |    |                                   | 0.662                | 0.375                |
| Linear-by-Linear Association   | 0.293              | 1  | 0.588                             |                      |                      |
| N of Valid Cases   | 103                |    |                                   |                      |                      |
| a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.23. |                    |    |                                   |                      |                      |
| b. Computed only for a 2x2 table   |                    |    |                                   |                      |                      |

Association between age have been studied against the state of the patients, and according to the crosstab statistical analysis of the age versus the state, (20%) of the death cases were recorded at the age between 40-60 years, (80%) of the deaths were recorded at ages above 60 years, while no death cases were recorded at ages less than 40 years old Pearson Chi-Square test has been applied for the association of the age and the state of the patients (Tables 20 & 21).

**Table 20:** Associations between categorical variables of age within state of alive and died patients.

| Crosstab |              |                |        |        |        |
|----------|--------------|----------------|--------|--------|--------|
|          |              |                | State  |        | Total  |
|          |              |                | died   | alive  |        |
| Age1     | 1-24         | Count          | 0      | 3      | 3      |
|          |              | % within State | 0.0%   | 4.1%   | 2.9%   |
|          | 25-39        | Count          | 0      | 4      | 4      |
|          |              | % within State | 0.0%   | 5.5%   | 3.9%   |
|          | 40-60        | Count          | 6      | 22     | 28     |
|          |              | % within State | 20.0%  | 30.1%  | 27.2%  |
|          | more than 60 | Count          | 24     | 44     | 68     |
|          |              | % within State | 80.0%  | 60.3%  | 66.0%  |
| Total    |              | Count          | 30     | 73     | 103    |
|          |              | % within State | 100.0% | 100.0% | 100.0% |

**Table 21:** Chi-Square test for the association of age and the state of the patients.

| Chi-Square Tests             |                    |    |                                   |
|------------------------------|--------------------|----|-----------------------------------|
|                              | Value              | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square           | 4.934 <sup>a</sup> | 3  | 0.177                             |
| Likelihood Ratio             | 6.881              | 3  | 0.076                             |
| Linear-by-Linear Association | 4.719              | 1  | 0.030                             |
| N of Valid Cases             | 103                |    |                                   |

a. 4 cells (50.0%) have expected count less than 5. The minimum expected count is .87.

Association between BMI have been studied against the state of the patients, and according to the crosstab statistical analysis of the BMI versus the state, the highest percentage (53.3%) of the deaths were recorded in normal BMI patients, Pearson Chi-Square test has been applied for the association of the BMI and the state of the patients (Tables 22 & 23).

**Table 22:** Associations between categorical variables of BMI within state of alive and died patients.

| Crosstab |              |                |        |        |        |
|----------|--------------|----------------|--------|--------|--------|
|          |              |                | State  |        | Total  |
|          |              |                | died   | alive  |        |
| BMI code | under weight | Count          | 1      | 3      | 4      |
|          |              | % within State | 3.3%   | 4.1%   | 3.9%   |
|          | Normal       | Count          | 16     | 26     | 42     |
|          |              | % within State | 53.3%  | 35.6%  | 40.8%  |
|          | over weight  | Count          | 10     | 38     | 48     |
|          |              | % within State | 33.3%  | 52.1%  | 46.6%  |
|          | obese        | Count          | 3      | 6      | 9      |
|          |              | % within State | 10.0%  | 8.2%   | 8.7%   |
| Total    |              | Count          | 30     | 73     | 103    |
|          |              | % within State | 100.0% | 100.0% | 100.0% |

**Table 23:** Chi-Square test for the association of BMI and the state of the patients.

| Chi-Square Tests             |                    |    |                                   |
|------------------------------|--------------------|----|-----------------------------------|
|                              | Value              | df | Asymptotic Significance (2-sided) |
| Pearson Chi-Square           | 3.346 <sup>a</sup> | 3  | 0.341                             |
| Likelihood Ratio             | 3.372              | 3  | 0.338                             |
| Linear-by-Linear Association | .885               | 1  | 0.347                             |
| N of Valid Cases             | 103                |    |                                   |

a. 3 cells (37.5%) have expected count less than 5. The minimum expected count is 1.17.

*Application of logistic regression*

In this research binary logistic regression which is typically used when the dependent variable is dichotomous and the independent variables are either continuous or categorical was used. Table 24 presents three inferential statistical tests for overall model evaluation:

**Table 24:** Example Output from Logistic Regression: Overall Model Evaluation and Goodness-of-Fit Statistics.

| Test                                | Categories               | Chi-Square Test | Sig.  |
|-------------------------------------|--------------------------|-----------------|-------|
| Omnibus Tests of Model Coefficients | Step                     | 48.899          | 0.001 |
|                                     | Block                    | 48.899          | 0.001 |
|                                     | Model                    | 48.899          | 0.001 |
| Variables in the Equation           | Wald test                | 16.81           | 0.000 |
| Goodness-of-fit test                | Hosmer and Lemeshow Test | 2.447           | 0.964 |
| Model Summary                       | Cox & Snell R Square     | 0.378           |       |
|                                     | Nagelkerke R Square      | 0.539           |       |

The Omnibus Tests of Model Coefficients and the Wald tests. All three tests yield similar conclusions for the given data set, namely that the given logistic model with independent variables was more effective than the null model. Omnibus Tests of Model Coefficients were used and the results showed that the model is statistically significant. The Hosmer- Lemeshow test was used for the statistical analysis to check if the observed event rates match the expected event rates in population subgroups. As a result, it presents an inferential goodness-of-fit test, the Hosmer-Lemeshow test (2.447) is not statistically significant. Suggesting that the model fit the data well. On the other hand, the results of this study revealed that our data fits the model. The R<sup>2</sup> values that were calculated using (Cox & Snell R2 and Nagelkerke R Square) which suggest that the model explains roughly 37.8% and 53.9% of the variation in the outcome respectively. Table 25 presents a classification table in which explanatory independent variables have been included, the model correctly classifies 85.4% of cases of overall percentage accuracy in classification. Variables in the equation for logistic regression have been studied to check for the joint association between variables.

**Table 25:** Example Output from Logistic Regression: A Classification Table.

| Classification Table |                    |       |           |       |                    |
|----------------------|--------------------|-------|-----------|-------|--------------------|
|                      | Observed           |       | Predicted |       |                    |
|                      |                    |       | Status    |       | Percentage Correct |
|                      |                    |       | Death     | Alive |                    |
| Step 1               | Status             | Death | 19        | 11    | 63.3               |
|                      |                    | Alive | 4         | 69    | 94.5               |
|                      | Overall Percentage |       |           |       | 85.4               |

The parameter estimates (also known as the coefficients of the model) ( $\beta$ ), their standard error (S.E.), the Wald statistic (to test the statistical significance), the degree of freedom, and the important Odds Ratio ( $\text{Exp } \beta$ ) for each variable category has been calculated (Table 26).

**Table 26:** variables in the equation for logistic regression.

| Predictor  | B      | S.E.   | Wald  | df | Sig.  | Exp(B) |
|------------|--------|--------|-------|----|-------|--------|
| Gender     | -1.491 | 0.830  | 3.227 | 1  | 0.072 | .225   |
| Age        | 0.002  | 0.026  | .004  | 1  | 0.947 | 1.002  |
| BMI        | 0.102  | 0.083  | 1.533 | 1  | 0.216 | 1.108  |
| AST        | -0.024 | 0.017  | 2.081 | 1  | 0.149 | .976   |
| ALT        | -0.010 | 0.014  | .495  | 1  | 0.482 | .990   |
| CRP        | 0.004  | 0.004  | 1.160 | 1  | 0.281 | 1.004  |
| D-dimer    | 0.000  | 0.000  | 5.898 | 1  | 0.015 | 1.000  |
| PT         | 0.060  | 0.133  | .201  | 1  | 0.654 | 1.062  |
| INR        | .115   | .068   | 2.904 | 1  | .088  | 1.122  |
| APTT       | .129   | .083   | 2.428 | 1  | .119  | 1.138  |
| WBC        | -.065  | .064   | 1.010 | 1  | .315  | .937   |
| LYM        | -.256  | .199   | 1.660 | 1  | .198  | .774   |
| GRA        | .043   | .050   | .739  | 1  | .390  | 1.044  |
| HGB        | -1.295 | .522   | 6.146 | 1  | .013  | .274   |
| RBC        | 4.455  | 1.564  | 8.112 | 1  | .004  | 86.079 |
| ESR        | .037   | .020   | 3.526 | 1  | .060  | 1.037  |
| Urea       | -.021  | .014   | 2.299 | 1  | .129  | .980   |
| Creatinine | -.159  | .912   | .030  | 1  | .862  | .853   |
| Na         | .017   | .083   | .042  | 1  | .838  | 1.017  |
| K          | .385   | .400   | .928  | 1  | .335  | 1.470  |
| Cl         | -.122  | .053   | 5.223 | 1  | .022  | .886   |
| Constant   | 2.792  | 10.847 | .066  | 1  | .797  | 16.318 |

The variables in the equation provide that

- RBC will be one of the highly significant factors; because it has a greater value in the Wald test column (8.112) with a significant value of  $(0.004 \leq 0.05)$ .
- HGB was the second highly significant factor because it has the second-high value of Wald test value equal (6.146) with a significant value  $(0.013 \leq 0.05)$  it means that this treatment is significant.
- D-dimer and Cl were significant factors because their p-value is less than (0.05).
- Other factors of (dependent variable) were not statistical significance because the p-value for all factors were greater than 0.05.

Application of factor analysis was performed and 9 factors depending on the total variance and rotated component matrix. This study showed that the analysis from the factors are showing 72.929% of the variance (Tables 27 & 28).

The factors are 1<sup>st</sup> Factor that contains three variables (AST, ALT, and INR) with a total variance of 16.022 %.

2<sup>nd</sup> Factor contains three variables (ESR, Urea, and Creatinine) with a total variance of 10.253%. 3<sup>rd</sup> Factor contains three variables (WBC, LYM, and GRA) with a total variance of 8.974%. 4<sup>th</sup> Factor contains two variables (HGB and RBC) with a total variance of 8.098%. 5<sup>th</sup> Factor contains two variables (Na and Cl) with a total variance of 6.881%.

6<sup>th</sup> Factor contains two variables (CRP and D-dimer) with a total variance of 6.236%.

7<sup>th</sup> Factor contains two variables (Age and K) with a total variance of 5.891%.

8<sup>th</sup> Factor contains one variable (gender and BMI) with a total variance of 5.509%.

9<sup>th</sup> Factor contains two variables (PT and APTT) with a total variance of 5.065%.

The Descriptive statistics for scale parameters are shown in table (29).

**Table 27:** Application of Factor analysis.

| Component | Total Variance Explained |               |              |                                     |               |              |                                   |               |              |
|-----------|--------------------------|---------------|--------------|-------------------------------------|---------------|--------------|-----------------------------------|---------------|--------------|
|           | Initial Eigenvalues      |               |              | Extraction Sums of Squared Loadings |               |              | Rotation Sums of Squared Loadings |               |              |
|           | Total                    | % of Variance | Cumulative % | Total                               | % of Variance | Cumulative % | Total                             | % of Variance | Cumulative % |
| 1         | 3.365                    | 16.022        | 16.022       | 3.365                               | 16.022        | 16.022       | 2.652                             | 12.629        | 12.629       |
| 2         | 2.153                    | 10.253        | 26.275       | 2.153                               | 10.253        | 26.275       | 1.893                             | 9.013         | 21.643       |
| 3         | 1.885                    | 8.974         | 35.250       | 1.885                               | 8.974         | 35.250       | 1.701                             | 8.098         | 29.741       |
| 4         | 1.701                    | 8.098         | 43.347       | 1.701                               | 8.098         | 43.347       | 1.647                             | 7.845         | 37.586       |
| 5         | 1.445                    | 6.881         | 50.229       | 1.445                               | 6.881         | 50.229       | 1.645                             | 7.833         | 45.419       |
| 6         | 1.309                    | 6.236         | 56.464       | 1.309                               | 6.236         | 56.464       | 1.577                             | 7.508         | 52.926       |
| 7         | 1.237                    | 5.891         | 62.355       | 1.237                               | 5.891         | 62.355       | 1.435                             | 6.832         | 59.759       |
| 8         | 1.157                    | 5.509         | 67.864       | 1.157                               | 5.509         | 67.864       | 1.389                             | 6.615         | 66.373       |
| 9         | 1.064                    | 5.065         | 72.929       | 1.064                               | 5.065         | 72.929       | 1.377                             | 6.556         | 72.929       |
| 10        | .909                     | 4.328         | 77.257       |                                     |               |              |                                   |               |              |
| 11        | .784                     | 3.736         | 80.993       |                                     |               |              |                                   |               |              |
| 12        | .727                     | 3.460         | 84.453       |                                     |               |              |                                   |               |              |
| 13        | .616                     | 2.933         | 87.386       |                                     |               |              |                                   |               |              |
| 14        | .541                     | 2.575         | 89.961       |                                     |               |              |                                   |               |              |
| 15        | .487                     | 2.317         | 92.278       |                                     |               |              |                                   |               |              |
| 16        | .368                     | 1.753         | 94.031       |                                     |               |              |                                   |               |              |
| 17        | .335                     | 1.597         | 95.628       |                                     |               |              |                                   |               |              |
| 18        | .319                     | 1.519         | 97.147       |                                     |               |              |                                   |               |              |
| 19        | .291                     | 1.385         | 98.532       |                                     |               |              |                                   |               |              |
| 20        | .191                     | .909          | 99.441       |                                     |               |              |                                   |               |              |
| 21        | .117                     | .559          | 100.000      |                                     |               |              |                                   |               |              |

Extraction Method: Principal Component Analysis.

**Table 28:** Rotated component matrix for the 9 factors.

| Rotated Component Matrix <sup>a</sup> |           |       |       |       |       |       |       |       |       |
|---------------------------------------|-----------|-------|-------|-------|-------|-------|-------|-------|-------|
|                                       | Component |       |       |       |       |       |       |       |       |
|                                       | 1         | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     |
| Gender                                | -.209     | -.103 | .129  | -.180 | .131  | -.007 | -.203 | .692  | -.137 |
| Age                                   | -.037     | .381  | .060  | -.338 | .116  | .139  | .583  | .057  | -.114 |
| BMI                                   | .061      | -.063 | -.035 | .066  | -.171 | .064  | .261  | .778  | .133  |
| AST                                   | .922      | .046  | -.013 | .038  | .145  | .017  | -.064 | .028  | -.043 |
| ALT                                   | .831      | -.024 | .000  | -.020 | .112  | .000  | .178  | -.153 | .151  |
| CRP                                   | -.040     | .065  | .033  | .034  | -.081 | .822  | -.133 | -.030 | -.015 |

|  |       |       |       |       |       |       |       |       |       |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| D-dimer  | .128  | .015  | -.063 | -.112 | .140  | .799  | .089  | .072  | .033  |
| PT   | -.064 | .139  | -.008 | -.186 | -.221 | .109  | -.212 | .010  | .696  |
| INR  | .888  | .088  | .005  | .029  | .020  | .065  | -.117 | .030  | -.174 |
| APTT   | -.018 | -.079 | -.002 | .124  | .113  | -.054 | .043  | .011  | .805  |
| WBC  | -.009 | .041  | .476  | .057  | -.050 | .347  | .389  | -.379 | -.022 |
| LYM  | -.019 | -.147 | .779  | .133  | -.133 | -.188 | -.191 | .181  | .038  |
| GRA  | .001  | .038  | .902  | -.013 | .044  | .066  | .092  | -.035 | -.024 |
| HGB  | .154  | -.122 | .110  | .830  | -.015 | .043  | .093  | -.197 | .104  |
| RBC  | -.076 | .130  | .013  | .822  | .152  | -.101 | -.004 | .096  | -.112 |
| ESR  | -.134 | .507  | -.094 | .012  | -.175 | .155  | -.115 | .063  | -.274 |
| Urea   | .250  | .806  | .002  | -.008 | .118  | .053  | .224  | -.145 | .027  |
| Creatinine   | .038  | .842  | -.008 | .027  | .212  | -.070 | .061  | -.078 | .164  |
| Na   | .404  | .168  | -.053 | .130  | .716  | -.004 | -.029 | -.068 | .063  |
| K  | -.003 | .039  | -.033 | .159  | -.001 | -.113 | .762  | .033  | -.041 |
| CI   | .070  | .075  | -.033 | .032  | .889  | .051  | .055  | .008  | -.065 |
| Extraction Method: Principal Component Analysis.<br>Rotation Method: Quartimax with Kaiser Normalization. <sup>a</sup> |       |       |       |       |       |       |       |       |       |
| a. Rotation converged in 7 iterations.   |       |       |       |       |       |       |       |       |       |

|                |         | Age      | BMI    | AST      | ALT      | CRP      | D-dimer             | PT                 |
|----------------|---------|----------|--------|----------|----------|----------|---------------------|--------------------|
| N              | Valid   | 103      | 103    | 103      | 103      | 103      | 103                 | 103                |
|                | Missing | 0        | 0      | 0        | 0        | 0        | 0                   | 0                  |
| Mean           |         | 65.4272  | 25.889 | 37.3820  | 35.9653  | 97.9323  | 3202.4903           | 15.0456            |
| Median         |         | 69.0000  | 25.391 | 30.1000  | 28.3000  | 73.0000  | 1265.0000           | 15.0000            |
| Mode           |         | 70.00    | 22.9   | 45.40    | 31.10    | 30.00    | 500.00 <sup>a</sup> | 12.00 <sup>a</sup> |
| Std. Deviation |         | 15.94390 | 5.6947 | 41.36698 | 32.22591 | 86.12638 | 4353.05999          | 2.75492            |
| Variance       |         | 254.208  | 32.429 | 1711.227 | 1038.510 | 7417.753 | 18949131.260        | 7.590              |
| Range          |         | 78.00    | 52.0   | 404.80   | 231.90   | 388.37   | 23213.00            | 23.20              |
| Minimum        |         | 17.00    | 14.7   | 4.60     | 6.40     | 1.93     | 20.00               | 10.70              |
| Maximum        |         | 95.00    | 66.7   | 409.40   | 238.30   | 390.30   | 23233.00            | 33.90              |
| Percentiles    | 25      | 57.0000  | 22.857 | 21.0000  | 17.8000  | 31.0000  | 500.0000            | 13.1000            |
|                | 50      | 69.0000  | 25.391 | 30.1000  | 28.3000  | 73.0000  | 1265.0000           | 15.0000            |
|                | 75      | 75.0000  | 27.344 | 44.4000  | 38.3000  | 134.5000 | 4745.0000           | 16.3000            |

| Variable       |         | INR      | APTT    | WBC               | LYM     | GRA     | HGB     | RBC     |
|----------------|---------|----------|---------|-------------------|---------|---------|---------|---------|
| N              | Valid   | 103      | 103     | 103               | 103     | 103     | 103     | 103     |
|                | Missing | 0        | 0       | 0                 | 0       | 0       | 0       | 0       |
| Mean           |         | 2.4024   | 32.2191 | 10.9505           | 1.3252  | 9.7305  | 12.3243 | 4.5803  |
| Median         |         | 1.1000   | 31.1000 | 9.9000            | 1.0000  | 8.5000  | 12.3000 | 4.4600  |
| Mode           |         | 1.01     | 31.00   | 7.60 <sup>a</sup> | .40     | 10.10   | 12.40   | 4.69    |
| Std. Deviation |         | 10.31485 | 6.20814 | 5.75167           | 1.69338 | 8.82170 | 1.95119 | 1.29671 |
| Variance       |         | 106.396  | 38.541  | 33.082            | 2.868   | 77.822  | 3.807   | 1.681   |
| Range          |         | 100.28   | 55.18   | 25.20             | 11.90   | 84.40   | 10.60   | 13.06   |

|                |         |            |                    |                   |           |          |           |        |
|----------------|---------|------------|--------------------|-------------------|-----------|----------|-----------|--------|
| Minimum        |         | .72        | 1.02               | 2.20              | .10       | .10      | 7.00      | 2.16   |
| Maximum        |         | 101.00     | 56.20              | 27.40             | 12.00     | 84.50    | 17.60     | 15.22  |
| Percentiles    | 25      | 1.0100     | 29.1000            | 6.7000            | .6000     | 5.3000   | 11.3000   | 4.0400 |
|                | 50      | 1.1000     | 31.1000            | 9.9000            | 1.0000    | 8.5000   | 12.3000   | 4.4600 |
|                | 75      | 1.1800     | 34.7000            | 14.6000           | 1.5000    | 11.7000  | 13.6000   | 4.9500 |
|                |         | <b>ESR</b> | <b>Urea</b>        | <b>Creatinine</b> | <b>Na</b> | <b>K</b> | <b>Cl</b> |        |
| N              | Valid   | 103        | 103                | 103               | 103       | 103      | 103       | 103    |
|                | Missing | 0          | 0                  | 0                 | 0         | 0        | 0         | 0      |
| Mean           |         | 34.9883    | 59.0505            | .9588             | 136.8431  | 4.3895   | 102.9686  |        |
| Median         |         | 30.4000    | 52.0000            | .8700             | 136.3100  | 4.3000   | 101.9000  |        |
| Mode           |         | 30.00      | 52.00 <sup>a</sup> | .67 <sup>a</sup>  | 136.31    | 4.42     | 101.90    |        |
| Std. Deviation |         | 20.67136   | 37.81039           | .50736            | 5.40543   | .84056   | 8.39816   |        |
| Variance       |         | 427.305    | 1429.626           | .257              | 29.219    | .707     | 70.529    |        |
| Range          |         | 108.00     | 185.90             | 3.29              | 48.00     | 7.37     | 85.50     |        |
| Minimum        |         | 2.00       | 9.10               | .10               | 113.80    | 2.01     | 78.00     |        |
| Maximum        |         | 110.00     | 195.00             | 3.39              | 161.80    | 9.38     | 163.50    |        |
| Percentiles    | 25      | 20.0000    | 33.0000            | .6700             | 134.7000  | 4.0300   | 100.1000  |        |
|                | 50      | 30.4000    | 52.0000            | .8700             | 136.3100  | 4.3000   | 101.9000  |        |
|                | 75      | 43.0000    | 75.0000            | 1.1300            | 139.0000  | 4.4200   | 105.4000  |        |

And Pearson correlation studies have been performed between all variables and it was found that age was significantly correlated to HGB, D-Dimer, urea, creatinine, and K. AST was significantly correlated to ALT, INR, urea, Na, and Cl. ALT was significantly correlated to AST, INR, urea, and Na. CRP was significantly correlated to D-Dimer and WBC, and PT to aPTT. INR was significantly correlated to ALT, AST, urea, and Na, WBC to CRP and GRA, and LYM to GRA and urea (Table 30).

**Table 30:** Correlations between multiple variables.

|     |                     | Age   | BMI   | AST    | ALT    | CRP   | D-dimer | PT    | INR    | APTT  | WBC   | LYM   | GRA   | HGB    | RBC   | ESR   | Urea   | Creatinine | Na     | K     | Cl    |
|-----|---------------------|-------|-------|--------|--------|-------|---------|-------|--------|-------|-------|-------|-------|--------|-------|-------|--------|------------|--------|-------|-------|
| Age | Pearson Correlation | 1     | .049  | -.039  | .096   | .028  | .208*   | -.018 | -.029  | -.130 | .180  | -.161 | .117  | -.231* | -.067 | .142  | .380** | .242*      | .023   | .237* | .154  |
|     | Sig. (2-tailed)     |       | .620  | .696   | .335   | .776  | .035    | .859  | .770   | .191  | .069  | .104  | .240  | .019   | .501  | .153  | .000   | .014       | .814   | .016  | .122  |
|     | N                   | 103   | 103   | 103    | 103    | 103   | 103     | 103   | 103    | 103   | 103   | 103   | 103   | 103    | 103   | 103   | 103    | 103        | 103    | 103   | 103   |
| BMI | Pearson Correlation | .049  | 1     | -.019  | -.015  | -.025 | .066    | -.017 | -.038  | .060  | -.103 | .052  | -.006 | -.051  | -.007 | -.012 | -.120  | -.063      | -.076  | .047  | -.106 |
|     | Sig. (2-tailed)     | .620  |       | .851   | .878   | .804  | .508    | .867  | .700   | .544  | .299  | .601  | .953  | .607   | .947  | .903  | .229   | .528       | .446   | .638  | .287  |
|     | N                   | 103   | 103   | 103    | 103    | 103   | 103     | 103   | 103    | 103   | 103   | 103   | 103   | 103    | 103   | 103   | 103    | 103        | 103    | 103   | 103   |
| AST | Pearson Correlation | -.039 | -.019 | 1      | .694** | -.020 | .127    | -.093 | .840** | .015  | -.010 | -.044 | -.021 | .134   | .008  | -.060 | .243*  | .084       | .425** | .001  | .234* |
|     | Sig. (2-tailed)     | .696  | .851  |        | .000   | .839  | .201    | .350  | .000   | .879  | .923  | .660  | .833  | .176   | .938  | .550  | .013   | .399       | .000   | .991  | .017  |
|     | N                   | 103   | 103   | 103    | 103    | 103   | 103     | 103   | 103    | 103   | 103   | 103   | 103   | 103    | 103   | 103   | 103    | 103        | 103    | 103   | 103   |
| ALT | Pearson Correlation | .096  | -.015 | .694** | 1      | -.056 | .123    | -.023 | .572** | .105  | .086  | -.073 | .023  | .159   | -.040 | -.153 | .267** | .048       | .424** | .047  | .146  |
|     | Sig. (2-tailed)     | .335  | .878  | .000   |        | .572  | .215    | .816  | .000   | .292  | .389  | .466  | .819  | .108   | .689  | .123  | .006   | .630       | .000   | .636  | .140  |
|     | N                   | 103   | 103   | 103    | 103    | 103   | 103     | 103   | 103    | 103   | 103   | 103   | 103   | 103    | 103   | 103   | 103    | 103        | 103    | 103   | 103   |
| CRP | Pearson Correlation | .028  | -.025 | -.020  | -.056  | 1     | .405**  | .084  | .052   | -.054 | .209* | -.058 | .037  | .020   | -.113 | .110  | .054   | .023       | -.037  | -.065 | -.031 |
|     | Sig. (2-tailed)     | .776  | .804  | .839   | .572   |       | .000    | .400  | .601   | .587  | .035  | .559  | .713  | .841   | .256  | .269  | .587   | .815       | .711   | .516  | .755  |
|     | N                   | 103   | 103   | 103    | 103    | 103   | 103     | 103   | 103    | 103   | 103   | 103   | 103   | 103    | 103   | 103   | 103    | 103        | 103    | 103   | 103   |

|         |                     |       |       |        |        |        |       |        |       |        |       |       |        |       |       |       |        |       |        |       |       |
|---------|---------------------|-------|-------|--------|--------|--------|-------|--------|-------|--------|-------|-------|--------|-------|-------|-------|--------|-------|--------|-------|-------|
| D-dimer | Pearson Correlation | .208* | .066  | .127   | .123   | .405** | 1     | .057   | .123  | -.031  | .131  | -.177 | .040   | -.041 | -.121 | .068  | .152   | -.002 | .099   | -.055 | .129  |
|         | Sig. (2-tailed)     | .035  | .508  | .201   | .215   | .000   |       | .566   | .216  | .755   | .187  | .074  | .690   | .680  | .223  | .494  | .126   | .983  | .317   | .582  | .196  |
|         | N                   | 103   | 103   | 103    | 103    | 103    | 103   | 103    | 103   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103    | 103   | 103    | 103   | 103   |
| PT      | Pearson Correlation | -.018 | -.017 | -.093  | -.023  | .084   | .057  | 1      | -.082 | .271** | -.043 | .021  | -.060  | -.077 | -.155 | -.046 | -.004  | .078  | -.162  | -.125 | -.141 |
|         | Sig. (2-tailed)     | .859  | .867  | .350   | .816   | .400   | .566  |        | .412  | .006   | .664  | .832  | .547   | .442  | .119  | .646  | .965   | .431  | .103   | .207  | .155  |
|         | N                   | 103   | 103   | 103    | 103    | 103    | 103   | 103    | 103   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103    | 103   | 103    | 103   | 103   |
| INR     | Pearson Correlation | -.029 | -.038 | .840** | .572** | .052   | .123  | -.082  | 1     | -.136  | -.001 | -.041 | .000   | .106  | .008  | -.029 | .234*  | .069  | .352** | -.010 | .122  |
|         | Sig. (2-tailed)     | .770  | .700  | .000   | .000   | .601   | .216  | .412   |       | .169   | .994  | .678  | .998   | .286  | .932  | .774  | .017   | .486  | .000   | .918  | .219  |
|         | N                   | 103   | 103   | 103    | 103    | 103    | 103   | 103    | 103   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103    | 103   | 103    | 103   | 103   |
| APTT    | Pearson Correlation | -.130 | .060  | .015   | .105   | -.054  | -.031 | .271** | -.136 | 1      | -.004 | .043  | -.004  | .097  | .024  | -.070 | -.054  | .033  | .118   | .029  | .002  |
|         | Sig. (2-tailed)     | .191  | .544  | .879   | .292   | .587   | .755  | .006   | .169  |        | .967  | .669  | .965   | .327  | .812  | .484  | .590   | .742  | .233   | .771  | .985  |
|         | N                   | 103   | 103   | 103    | 103    | 103    | 103   | 103    | 103   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103    | 103   | 103    | 103   | 103   |
| WBC     | Pearson Correlation | .180  | -.103 | -.010  | .086   | .209*  | .131  | -.043  | -.001 | -.004  | 1     | .061  | .409** | .154  | .012  | .016  | .159   | .064  | -.012  | .161  | -.011 |
|         | Sig. (2-tailed)     | .069  | .299  | .923   | .389   | .035   | .187  | .664   | .994  | .967   |       | .539  | .000   | .121  | .907  | .875  | .108   | .523  | .901   | .105  | .913  |
|         | N                   | 103   | 103   | 103    | 103    | 103    | 103   | 103    | 103   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103    | 103   | 103    | 103   | 103   |
| LYM     | Pearson Correlation | -.161 | .052  | -.044  | -.073  | -.058  | -.177 | .021   | -.041 | .043   | .061  | 1     | .535** | .142  | .083  | -.082 | -.221* | -.173 | -.138  | -.041 | -.144 |
|         | Sig. (2-tailed)     | .104  | .601  | .660   | .466   | .559   | .074  | .832   | .678  | .669   | .539  |       | .000   | .152  | .405  | .408  | .025   | .080  | .166   | .677  | .148  |
|         | N                   | 103   | 103   | 103    | 103    | 103    | 103   | 103    | 103   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103    | 103   | 103    | 103   | 103   |

|            |                     |        |       |       |        |       |       |       |       |       |        |        |       |        |        |        |        |        |        |      |       |
|------------|---------------------|--------|-------|-------|--------|-------|-------|-------|-------|-------|--------|--------|-------|--------|--------|--------|--------|--------|--------|------|-------|
| GRA        | Pearson Correlation | .117   | -.006 | -.021 | .023   | .037  | .040  | -.060 | .000  | -.004 | .409** | .535** | 1     | .102   | .007   | -.030  | .051   | .018   | -.006  | .013 | .005  |
|            | Sig. (2-tailed)     | .240   | .953  | .833  | .819   | .713  | .690  | .547  | .998  | .965  | .000   | .000   |       | .304   | .947   | .763   | .608   | .858   | .951   | .896 | .958  |
|            | N                   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103   | 103   | 103    | 103    | 103   | 103    | 103    | 103    | 103    | 103    | 103    | 103  | 103   |
| HGB        | Pearson Correlation | -.231* | -.051 | .134  | .159   | .020  | -.041 | -.077 | .106  | .097  | .154   | .142   | .102  | 1      | .499** | -.194* | .026   | -.020  | .125   | .142 | .030  |
|            | Sig. (2-tailed)     | .019   | .607  | .176  | .108   | .841  | .680  | .442  | .286  | .327  | .121   | .152   | .304  |        | .000   | .050   | .794   | .840   | .209   | .152 | .765  |
|            | N                   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103   | 103   | 103    | 103    | 103   | 103    | 103    | 103    | 103    | 103    | 103    | 103  | 103   |
| RBC        | Pearson Correlation | -.067  | -.007 | .008  | -.040  | -.113 | -.121 | -.155 | .008  | .024  | .012   | .083   | .007  | .499** | 1      | .039   | .049   | .067   | .133   | .077 | .152  |
|            | Sig. (2-tailed)     | .501   | .947  | .938  | .689   | .256  | .223  | .119  | .932  | .812  | .907   | .405   | .947  | .000   |        | .699   | .626   | .501   | .181   | .437 | .127  |
|            | N                   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103   | 103   | 103    | 103    | 103   | 103    | 103    | 103    | 103    | 103    | 103    | 103  | 103   |
| ESR        | Pearson Correlation | .142   | -.012 | -.060 | -.153  | .110  | .068  | -.046 | -.029 | -.070 | .016   | -.082  | -.030 | -.194* | .039   | 1      | .154   | .131   | -.004  | .018 | -.029 |
|            | Sig. (2-tailed)     | .153   | .903  | .550  | .123   | .269  | .494  | .646  | .774  | .484  | .875   | .408   | .763  | .050   | .699   |        | .121   | .188   | .972   | .856 | .775  |
|            | N                   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103   | 103   | 103    | 103    | 103   | 103    | 103    | 103    | 103    | 103    | 103    | 103  | 103   |
| Urea       | Pearson Correlation | .380** | -.120 | .243* | .267** | .054  | .152  | -.004 | .234* | -.054 | .159   | -.221* | .051  | .026   | .049   | .154   | 1      | .718** | .263** | .163 | .177  |
|            | Sig. (2-tailed)     | .000   | .229  | .013  | .006   | .587  | .126  | .965  | .017  | .590  | .108   | .025   | .608  | .794   | .626   | .121   |        | .000   | .007   | .100 | .074  |
|            | N                   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103   | 103   | 103    | 103    | 103   | 103    | 103    | 103    | 103    | 103    | 103    | 103  | 103   |
| Creatinine | Pearson Correlation | .242*  | -.063 | .084  | .048   | .023  | -.002 | .078  | .069  | .033  | .064   | -.173  | .018  | -.020  | .067   | .131   | .718** | 1      | .311** | .090 | .208* |
|            | Sig. (2-tailed)     | .014   | .528  | .399  | .630   | .815  | .983  | .431  | .486  | .742  | .523   | .080   | .858  | .840   | .501   | .188   | .000   |        | .001   | .368 | .035  |
|            | N                   | 103    | 103   | 103   | 103    | 103   | 103   | 103   | 103   | 103   | 103    | 103    | 103   | 103    | 103    | 103    | 103    | 103    | 103    | 103  | 103   |

|  |                     |       |       |        |        |       |       |       |        |      |       |       |       |      |      |       |        |        |        |      |        |
|--|---------------------|-------|-------|--------|--------|-------|-------|-------|--------|------|-------|-------|-------|------|------|-------|--------|--------|--------|------|--------|
| Na   | Pearson Correlation | .023  | -.076 | .425** | .424** | -.037 | .099  | -.162 | .352** | .118 | -.012 | -.138 | -.006 | .125 | .133 | -.004 | .263** | .311** | 1      | .023 | .549** |
|  | Sig. (2-tailed)     | .814  | .446  | .000   | .000   | .711  | .317  | .103  | .000   | .233 | .901  | .166  | .951  | .209 | .181 | .972  | .007   | .001   |        | .816 | .000   |
|  | N                   | 103   | 103   | 103    | 103    | 103   | 103   | 103   | 103    | 103  | 103   | 103   | 103   | 103  | 103  | 103   | 103    | 103    | 103    | 103  | 103    |
| K  | Pearson Correlation | .237* | .047  | .001   | .047   | -.065 | -.055 | -.125 | -.010  | .029 | .161  | -.041 | .013  | .142 | .077 | .018  | .163   | .090   | .023   | 1    | .079   |
|  | Sig. (2-tailed)     | .016  | .638  | .991   | .636   | .516  | .582  | .207  | .918   | .771 | .105  | .677  | .896  | .152 | .437 | .856  | .100   | .368   | .816   |      | .427   |
|  | N                   | 103   | 103   | 103    | 103    | 103   | 103   | 103   | 103    | 103  | 103   | 103   | 103   | 103  | 103  | 103   | 103    | 103    | 103    | 103  | 103    |
| CI   | Pearson Correlation | .154  | -.106 | .234*  | .146   | -.031 | .129  | -.141 | .122   | .002 | -.011 | -.144 | .005  | .030 | .152 | -.029 | .177   | .208*  | .549** | .079 | 1      |
|  | Sig. (2-tailed)     | .122  | .287  | .017   | .140   | .755  | .196  | .155  | .219   | .985 | .913  | .148  | .958  | .765 | .127 | .775  | .074   | .035   | .000   | .427 |        |
|  | N                   | 103   | 103   | 103    | 103    | 103   | 103   | 103   | 103    | 103  | 103   | 103   | 103   | 103  | 103  | 103   | 103    | 103    | 103    | 103  | 103    |
| *. Correlation is significant at the 0.05 level (2-tailed).  |                     |       |       |        |        |       |       |       |        |      |       |       |       |      |      |       |        |        |        |      |        |
| **. Correlation is significant at the 0.01 level (2-tailed). |                     |       |       |        |        |       |       |       |        |      |       |       |       |      |      |       |        |        |        |      |        |

## Discussion

After the spread of COVID-19 in all countries around the world, the mortality rate was increasing day by day. Many studies have been conducted to check for the risk factors that cause death. This multivariable research analysis aimed to study different hematological and biochemical parameters in patients and the effect of these parameters on the severity of the disease besides the risk factors that increases the mortality rate among patients diagnosed with positive SARS-COV-2. According to the results of this study, a significant difference was found between the death and survived cases when ALT, AST, D-Dimer, urea, creatinine, and chloride was compared between the two cases, while no significant difference was observed when age, BMI, CRP, PT, INR, aPTT, WBC, LYM, GRA, Hb, RBC, ESR, Na, and K was compared between both cases. This result suggests that AST, ALT, D-dimer, urea, creatinine, and Cl are risk factors for mortality. Changes in the liver function enzymes associated with COVID-19 have been studied by many research groups and our data revealed that in most of the patients recovered from COVID-19, the ratio of the AST to ALT lowers drastically to 1.0 indicating that even with complete recovery patients are suffering from liver dysfunction. In most severe cases, the ratio was higher than 1.22, while in mild/moderate cases this ratio was 1.14. The high ratio of the AST/ALT indicated that these patients were having liver injuries. Our study suggested that liver dysfunction was observed in these patients. The result of this study is consistent with previous research as it demonstrates the high value of the measured liver enzymes [14]. Inconsistent with other results, older age is not the main risk factor for mortality in COVID-19 patients as the difference between both groups was not significant [15]. Comparison of other laboratory parameters such as CRP, D-dimer, PT, INR, aPTT, WBC, LYM, GRA, RBC, Hb, ESR, urea, Cl, Na, Creatinine, and K have been performed. The results showed that most of the hematological analysis and CRP were not associated with a high risk of death this is consistent with a recent research performed in Poland that showed CRP is not a risk factor in predicting mortality but can be used as an inflammatory biomarker for prognosis of the patients [16].

There was a positive correlation between AST and ALT with INR, urea, Na, and Cl and this correlation was significant, while there was no significant correlation between AST, ALT with CRP, D-dimer, PT, aPTT, WBC, LYM, GRA, RBC, Hb, ESR, Creatinine, and K. Many recent publications observed that ALT and AST are not regarded as a risk factor for the mortality in COVID-19 patients [17] while others observed that these two parameters may imply poor prognosis and death in COVID-19 patients. Application of the factor analysis showed that ALT, AST, and INR were factor number one by a total variance of 16.022% as a risk factor for the mortality in the patients, rotated component matrix was used to detect the factors' priority. A High INR value means that the liver is not functioning well, so INR can be regarded as a dependent risk factor for mortality in these patients. The second risk factor for mortality according to the factor analysis are these variables (ESR, urea, and creatinine) by a total variance of 10.253%. Coagulation parameter study was performed by measuring the value of INR, aPTT, and PT. Moreover, prolonged INR was observed in 31% of the patients admitted to the hospital, most of them were severe cases, and elderly people and 74% of these subjects died later suggesting that coagulopathy was one of the risk factors that cause death. Regarding PT and aPTT, most patients (>90%) were normal and few patients were having high prolonged PT or aPTT.

## Conclusions

The results of this study have shown that the dependent variables like AST, ALT, and INR were the highest risk factors contributing to mortality in COVID-19 patients. Followed by urea, creatinine, and ESR were the second risk factors, while gender, BMI, PT and aPTT were the lowest risk factors for mortality in COVID-19 patients. From the result of the study, it can be concluded that the mortality was due to many complications that lead to organ failure such as renal failure, heart failure, and liver damage that may trigger the death of COVID-19 patients.

## Conflict of interest

The authors confirm that they are not affiliated with or involved in any organization or entity with financial interests.

## References

1. Al-Tawfiq JA, Azhar EI, Memish ZA, Zumla A. (2021). Middle East Respiratory Syndrome Coronavirus. In *Seminars in Respiratory and Critical Care Medicine*.;42(6):828–38.
2. Drosten C, Günther S, Preiser W, van der Werf S, Brodt H-R, Becker S, Rabenau H, Panning M, Kolesnikova L, Fouchier RA, Berger A. (2003). Identification of a novel coronavirus in patients with severe acute respiratory syndrome. *New England journal of medicine*.;348(20):1967-76.
3. Huang XJ, Choi YK, Im HS, Yarimaga O, Yoon E, Kim HS. (2006). Aspartate aminotransferase (AST/GOT) and alanine aminotransferase (ALT/GPT) detection techniques. *Sensors*.6(7):756-82.
4. De Groot RJ, Baker SC, Baric RS, Brown CS, Drosten C, Enjuanes L& Fouchier RA, Galiano M, Gorbalenya AE, Memish ZA, Perlman S. (2013). Commentary: Middle east respiratory syndrome coronavirus (mers-cov): announcement of the coronavirus study group. *Journal of virology*. 87(14):7790-2.
5. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y& Zhang L, Fan G, Xu J, Gu X, Cheng Z. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The lancet*.395(10223):497-506.
6. Zhu N, Zhang D, Wang W, Li X, Yang B, Song J and Zhao X, Huang B, Shi W, Lu R, Niu P. (2020). A novel coronavirus from patients with pneumonia in China, 2019. *New England journal of medicine*.;382(8):727-33.
7. Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, Zhang L, Fan G, Xu J, Gu X, Cheng Z. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The lancet*. 15;395(10223):497-506.
8. Wang C, Deng R, Gou L, Fu Z, Zhang X, Shao F, Wang G, Fu W, Xiao J, Ding X, Li T. (2020). Preliminary study to identify severe from moderate cases of COVID-19 using combined hematology parameters. *Annals of translational medicine*.;8(9):593-593.
9. Mallah SI, Ghorab OK, Al-Salmi S, Abdellatif OS, Tharmaratnam T, Iskandar MA, Sefen JA, Sidhu P, Atallah B, El-Lababidi R, Al-Qahtani M. (2021). COVID-19: breaking down a global health crisis. *Annals of clinical microbiology and antimicrobials*. ;20(1):1-36.
10. Fang X, Li S, Yu H, Wang P, Zhang Y, Chen Z, Li Y, Cheng L, Li W, Jia H, Ma X. (2020). Epidemiological, comorbidity factors with severity and prognosis of COVID-19: a systematic review and meta-analysis. *Aging (albany NY)*. 7;12(13): 12493-12503.
11. The Novel Coronavirus Pneumonia Emergency Response Epidemiology Team. (2020). The epidemiological characteristics of an outbreak of 2019 novel coronavirus diseases (COVID-19)—China. *China CDC weekly*. ;2(8):113-122.
12. Yang X, Yu Y, Xu J, Shu H, Liu H, Wu Y, Zhang L, Yu Z, Fang M, Yu T, Wang Y. (2020). Clinical course and outcomes of critically ill patients with SARS-CoV-2 pneumonia in Wuhan, China: a single-centered, retrospective, observational study. *The lancet respiratory medicine*. 1;8(5):475-81.
13. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, Qiu Y, Wang J, Liu Y, Wei Y, Xia J, Yu T, Zhang X, Zhang L. (2020). Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet*. 15;395(10223):507-513.
14. Moon AM, Barritt AS. (2021). Elevated liver enzymes in patients with COVID-19: look, but not too hard. *Digestive Diseases and Sciences*.; 66(6):1767-9.
15. Chinnadurai R, Ogedengbe O, Agarwal P, Money-Coomes S, Abdurrahman AZ, Mohammed S, Kalra PA, Rothwell N, Pradhan S. (2020). Older age and frailty are the chief predictors of mortality in COVID-19 patients admitted to an acute medical unit in a secondary care setting—a cohort study. *BMC geriatrics*. ;20(1):1-1.
16. Kudlinski B, Zgoła D, Stolińska M, Murkos M, Kania J, Nowak P, Noga A, Wojciech M, Zaborniak G, Zembron-Lacny A. (2022). Systemic inflammatory predictors of in-hospital mortality in COVID-19 patients: a retrospective study. *Diagnostics*.12(4):859.
17. Wang Y, Shi L, Wang Y, Yang H. (2021). An updated meta-analysis of AST and ALT levels and the mortality of COVID-19 patients. *The American journal of emergency medicine*. 40:208-209.