A relationship study of coronavirus (COVID-19) infection, blood groups, and some related factors in Iraqi patients

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Abstract

Many studies of the relationship between COVID-19 and different factors have been conducted since the beginning of the corona pandemic. The relationship between COVID-19 and different biomarkers including ABO blood groups, D-dimer, Ferritin and CRP, was examined. Six hundred (600) patients, were included in this trial among them, 324 (56%) females and the rest 276 (46%) were males. The frequencies of blood types A, B, AB, and O were 25.33, 38.00, 31.33, and 5.33%, respectively, in the case group. Association analysis between the ABO blood group and D-dimer, Ferritin and CRP of COVID-19 patients indicated that there was a statistically significant difference for Ferritin (P≤0.01), but no significant differences for both D-dimer and CRP biomarkers. Regarding the age association between COVID-19 patients and biomarkers, D-dimer and Ferritin levels showed a significant difference (P≤0.01), (P≤0.05) in sequence, between ages. Meanwhile CRP level was non-significant. Considering the gender effect on biomarkers on COVID-19 patients, D-dimer and Ferritin males were significant (P≤0.05), (P≤0.01) in sequence from females. But no-significant effect of CRP level. Our results proved that age is an important factor in the COVID-19 infection’s development. The evidence of the association between ABO blood group, D-dimer, CRP and Ferritin with COVID-19 severity, progression and susceptibility, is important and requires more investigation.

Keywords: Blood group, COVID-19, C-reactive protein, D-dimer, Ferritin.

Introduction

6 637 512 deaths worldwide so far4,5. The Corona Virus (Coronaviridae) is RNA virus, it is a family of positive-sense, enveloped and single-stranded virus. It has the largest genome of RNA viruses6. The Coronaviridae is classified, order Nidovirales, family and subfamily the coronavirinae.

Genetically, they are categorized into four important genera: alpha, beta, gamma and delta coronaviruses7. Coronavirus is surrounded by proteins inserted into lipids, because of the club-shaped spike (S) proteins on their surface, they look like a crown6.

On December 2019, Wuhan City in China, became the epicenter of unexplained cases of pneumonia. On January 2020, Chinese scientists identified this as a novel coronavirus, temporarily labelled as, acute severe coronavirus 2, infecting the respiratory system (SARS-CoV-2)1,2.

In February 2020, World Health Organization identified the coronavirus, and named the disease COVID-19, as the disease spread worldwide1. The pandemic had a severe effect on the world economy and health, since COVID-19 has infected over 646 740 524 confirmed cases and killed exceeding
COVID-19 is predisposed to ABO blood group severity. Blood type B, could be a risk factor for prostate and bladder cancer. While blood type O, was reported to have a lower risk of coronary heart disease CHD and gastric cancer. Following a viral invasion, the immune system is reacting in different ways including the activation of the coagulation system. The activation of the coagulation system might cause the elevation of D-dimer levels which is associated with to the mortality increased because of COVID-19 patients.

D-dimer is the product that appears after blood clot destruction as a product of fibrin degradation in the blood.

C-reactive protein (CRP) is a liver production plasma protein, used clinically as an indicator for various inflammatory conditions. There is a relationship between the rising level of CRP and the increase in severity of disease. There is a clear evidence of an association between C-reactive protein (CRP) and COVID-19 patient’s inflammation. The C-reactive protein (CRP) is a plasma protein produced by the liver and it could be induced by inflammatory mediators.

Ferritin is an indirect indicator for the total amount of iron which is stored in the body. It is a protein found in most organs and it is a carrier of iron. The aim of this study was to explore the relationship between ABO blood groups and other biomarkers (Ferritin, D-dimer and CRP) to the COVID-19 disease.

Materials and Methods

Laboratory testing and data collection

Six Hundred patients, 276 males and 324 females were included in this study, which was conducted at a private lab. of Microbiology, Baghdad, Iraq, for one year period (March 2020 to March 2021). All of the trial participants were of Arab nationality (Iraqis) aged >70 years. For patients who had multiple tests, the first positive test for SARS-cov-2, was used, while all other results were excluded.

The blood samples were separated, into their component, immediately after collection. The laboratory testing was done, according to the technical guidelines of laboratory testing, issued by the Central Health Laboratory of the Iraqi Ministry of Health.

It is well known that the most important pathogenic viruses are Severe Acute respiratory syndrome of Coronavirus-2, which is known as SARS Cov. 2, and Severe Acute respiratory syndrome which is known as SARS.

The pandemic of COVID-19 is associated with different factors for mortality patients, including gender, age, race, medical conditions and environmental conditions such as temperature, latitude, humidity, longitude and wind speed. Furthermore, many studies associated ABO blood group with the morbidity and mortality of coronavirus infection.

ABO blood groups have been reported to influence various infectious diseases. Blood Group O has affected by the Norwalk and helicobacter pylori infection virus and is less influenced by SARS.

Blood group A was vulnerable to acute respiratory distress syndrome in sepsis and trauma patients. Many studies have proved that blood group A is more severe COVID-19 disease than blood group O. In A blood group, more severe COVID-19 disease mechanism is proposed and less severe in blood group O. The proposed mechanism is associated with angiotensin-converting enzyme ACE, which is defined as an enzyme which is activating angiotensin; the level of ACE can influence hypertension. A low level of ACE reduces hypertension risk, which is a COVID-19 factor.

COVID-19 IgG/IgM Duo testing

COVID-19 IgG/IgM Duo test is a microfluidic fluorescence immunoassay (FIA). This test is using the FRENIDTM System for IgG/IgM antibodies detection. A sample of 35 μL was transferred to sample dilution tube, mixed 3-5 times, by inverting the sample gently. FRENIDTM System programmed, to begin analysis, once the sample has reacted with the reagents. The reaction and analysis time was approximately 3-4 minutes.
ABO blood type testing

ABO blood type of patients with SARS-cov-2 was determined by standard RBC typing performed for clinical purposes.

D-Dimer testing

D-Dimer test is a quantitative test used to measure fibrinogen degradation product in human plasma by fluorescence immunoassay. 35μl patient’s serum was added to the Frend D-Dimer kit and mixed gently to let D-dimer antibody conjugated fluorescent nanoparticles, the mixture moved via capillary action to the detection region. Where the fluorescent nanoparticles complexes were grabbed. The fluorescent intensities for the complexes were measured and D-Dimer concentration was cacused. D-Dimer concentration was less than 5000 ng/ml (FEU).

Ferritin testing

Ferritin or fluorescence Immunoassay (FIA) is a quantitative technic used for the determination of Ferritin in human serum. The test has been done using a sandwich immune detection method. The sample antigen was binding into antibodies forming complexes of antigen-antibody, then the complex migrated into matrix of nitrocellulose, and was captured by immobilized antibodies on the tested strip. The antibodies detector, could show stronger fluorescence signal, with more antigens in the sample, which led to show ferritin concentration in samples by Instrument for ichromaTM tests processed. The instrument for ichromaTM tests calculated the test results, automatically and displayed Ferritin concentration of the test sample in terms of ng/mL. It is well known ferritin cut-off for women was 20-250 ng/mL and for men 30-350 ng/mL.

CRP testing

The serum samples were thawed once for CRP determination. The levels of CRP were measured using highly sensitive enzyme linked immunosorbent assay kits by laboratory personnel who were unaware of the clinical outcomes of the study participants. The working range was: 2.5 – 300 mg/L. All assays were done three times.

For statistical analyses, the detection effect of different factors in this study, Statistical Analysis System-SAS, we have used (2018) 27. T-test and least significant difference –LSD test (Analysis of Variation-ANOVA) was used to significantly compare between means. For significant comparison between percentages, chi-square test was used (0.05 and 0.01 probability).

\[ \chi^2 = \sum \frac{(O - E)^2}{E} \]

\[ \chi^2: \text{Chi-square, } \Sigma: \text{Summation, } O: \text{Observed No. , } E: \text{Expected No.} \]

Results and Discussion

The present study includes 600 patients, 368 diagnosed with covid-19 and 232 healthy individuals. The results of the test can be printed and displayed on the screen. According to IgM results, there was a significant (P≤0.01) distribution of sample study results in Table1. Meanwhile, no-significant distribution of sample study, was recorded according to IgG results in Table 2.

The concentration of both antibodies (IgM and IgG) was significant (P≤0.01), for Covid-19 patients, from control groups at P-value 0.0001. Covid-19 virus infection had a major impact on both genders. Similarly, in all age groups, D-dimer level (p-value <0.001) raised significantly affected by Covid-19 virus infection Table 3.

The relationship between IgM with D-dimer, Ferritin and CRP showed no-significant results between groups at P-value (0.0577, 0.489 and 0.971) in sequence. Meanwhile, the relationship between IgG with D-dimer, Ferritin and CRP was significant (P≤0.01) at 0.0001, P-value Table 4 and 5.

Regarding the Gender effect on D-dimer, the mean of D-dimer (1.466 ±0.17) for Covid-19 males patients is significant (P≤0.05) for females patients mean (0.997 ±0.12) on the D-dimer level (p-value <0.0220). Similarly, the study found that, a significant effect (P≤0.01) of COVID-19 virus infection, on the Ferritin level (p-value <0.233). Meanwhile, there were no significant differences between both genders on the level of CRP Table 6.
Table 1. Distribution of sample study according to IgM results.

<table>
<thead>
<tr>
<th>IgM results</th>
<th>No</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive (Yes)</td>
<td>60</td>
<td>10.00</td>
</tr>
<tr>
<td>Negative (No)</td>
<td>540</td>
<td>90.00</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100%</td>
</tr>
<tr>
<td>P-value</td>
<td>---</td>
<td>0.0001 **</td>
</tr>
</tbody>
</table>

** (P≤0.01).

Table 2. Distribution of sample study according to IgG results.

<table>
<thead>
<tr>
<th>IgG results</th>
<th>No</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive (Yes)</td>
<td>308</td>
<td>51.33</td>
</tr>
<tr>
<td>Negative (No)</td>
<td>298</td>
<td>48.67</td>
</tr>
<tr>
<td>Total</td>
<td>600</td>
<td>100%</td>
</tr>
<tr>
<td>P-value</td>
<td>---</td>
<td>0.744 NS</td>
</tr>
</tbody>
</table>

NS: Non-Significant.

Table 3. Mean ± SE of IgM and IgG concentration

<table>
<thead>
<tr>
<th>Test</th>
<th>Mean ± SE</th>
<th>IgM conc.</th>
<th>IgG conc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive (Yes)</td>
<td>2.35 ± 0.35</td>
<td>3.65 ± 0.22</td>
<td></td>
</tr>
<tr>
<td>Negative (No)</td>
<td>0.231 ± 0.02</td>
<td>0.101 ± 0.02</td>
<td></td>
</tr>
<tr>
<td>T-test</td>
<td>0.259 **</td>
<td>0.417 **</td>
<td></td>
</tr>
<tr>
<td>P-value</td>
<td>0.0001</td>
<td>0.0001</td>
<td></td>
</tr>
</tbody>
</table>

** (P≤0.01).

Table 4. Relationship between IgM with D-dimer, Ferritin and CRP

<table>
<thead>
<tr>
<th>IgM results</th>
<th>Mean ± SE</th>
<th>D-dimer</th>
<th>Ferritin</th>
<th>CRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient (Yes)</td>
<td>1.702 ±0.32</td>
<td>1.158 ±0.10</td>
<td>149.40 ±39.10</td>
<td>107.68 ±38.99</td>
</tr>
<tr>
<td>Control (No)</td>
<td>0.552 NS</td>
<td>0.0577 NS</td>
<td>68.694 NS</td>
<td>146.72 ±13.98</td>
</tr>
<tr>
<td>T-test</td>
<td>0.259 **</td>
<td>0.0001</td>
<td>81.479 NS</td>
<td>0.971</td>
</tr>
<tr>
<td>P-value</td>
<td>** (P≤0.01)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS: Non-Significant.

Table 5. Relationship between IgG with D-dimer, Ferritin and CRP

<table>
<thead>
<tr>
<th>IgG results</th>
<th>Mean ± SE</th>
<th>D-dimer</th>
<th>Ferritin</th>
<th>CRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient (Yes)</td>
<td>1.816 ±0.14</td>
<td>0.576 ±0.09</td>
<td>232.24 ±16.17</td>
<td>199.42 ±19.67</td>
</tr>
<tr>
<td>Control (No)</td>
<td>0.331 **</td>
<td>0.0001</td>
<td>102.18 ±12.24</td>
<td>83.12 ±14.51</td>
</tr>
<tr>
<td>T-test</td>
<td>0.0001</td>
<td>0.0001</td>
<td>48.905 **</td>
<td>0.971</td>
</tr>
<tr>
<td>P-value</td>
<td>** (P≤0.01)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

** (P≤0.01).

Table 6. Effect of Gender in D-dimer, Ferritin and CRP

<table>
<thead>
<tr>
<th>Gender</th>
<th>Mean ± SE</th>
<th>D-dimer</th>
<th>Ferritin</th>
<th>CRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>1.466 ±0.17</td>
<td>1.997 ±0.12</td>
<td>188.55 ±19.37</td>
<td>153.73 ±20.09</td>
</tr>
<tr>
<td>Female</td>
<td>0.386 *</td>
<td>0.233</td>
<td>152.24 ±13.76</td>
<td>133.52 ±17.43</td>
</tr>
<tr>
<td>T-test</td>
<td>0.0220</td>
<td>0.233</td>
<td>43.617 **</td>
<td>52.078 NS</td>
</tr>
<tr>
<td>P-value</td>
<td>* (P≤0.05) ** (P≤0.01).</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

According to table 7, the results of D-dimer level showed a significant difference (P≤0.01) between ages of confirmed COVID-19 patients. The (20-40) years old groups in comparisons with the group over 40 years or under 20 were higher significant. In addition, our results of Ferritin level showed a significant difference (P≤0.05) between ages of confirmed COVID-19 patients, p-value < 0.0266, (over 40) years were higher significant compared with the group less than 40 years. Meanwhile CRP level was non-significant at p-value 0.462 Table 7.
Age (year) | Mean ± SE | Ferritin | CRP
---|---|---|---
<20 yr. | 0.776 ±0.13 b | 132.43 ±23.27 b | 101.68 ±24.18
20-40 yr. | 1.254 ±0.16 ab | 154.45 ±16.58 b | 150.30 ±20.03
> 40 yr. | 1.511 ±0.20 a | 220.87 ±21.07 a | 165.34 ±24.44
LSD | 0.487 ** | 54.975 * | 65.64 NS
P-value | 0.011 | 0.0266 | 0.462

Means having with the different letters in same column differed significantly. * (P≤0.05), ** (P≤0.01).

The effect of ABO blood group in D-dimer, Ferritin and CRP is shown in table 8. Our results showed significant effect (P≤0.01) of Ferritin level between different blood groups P-value (0.010). Meanwhile D-dimer and CRP level was non-significant at p-value 0.701 and 0.0883 in sequence Table 8.

Table 8. Effect of Blood groups in D-dimer, Ferritin and CRP

<table>
<thead>
<tr>
<th>Blood groups</th>
<th>Mean ± SE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>D-dimer</td>
</tr>
<tr>
<td>A</td>
<td>1.360 ±0.21</td>
</tr>
<tr>
<td>B</td>
<td>1.281 ±0.37</td>
</tr>
<tr>
<td>AB</td>
<td>1.031 ±0.15</td>
</tr>
<tr>
<td>O</td>
<td>1.304 ±0.18</td>
</tr>
<tr>
<td>LSD</td>
<td>0.727 NS</td>
</tr>
<tr>
<td>P-value</td>
<td>0.070</td>
</tr>
</tbody>
</table>

Means having with the different letters in same column differed significantly. ** (P≤0.01).

B type blood was the most common, while Type B was the least common. The blood type distribution of COVID-19 patients (600), showed that, there were 228 patients with type B (38.00%), 188 patients with type O (31.33%), 152 patients with type A blood (25.33%), and 32 patients with type AB (5.33%). This analysis of ABO blood group showed that significant differences (P≤0.01) were recorded between blood groups at P-value 0.0001. The age group differences were significant (P≤0.01) at P-value 0.0053. Meanwhile the differences between genders were not significant at P-value 0.327. Table 9.

Table 9. Distribution results of factors in sample study

<table>
<thead>
<tr>
<th>Factors</th>
<th>No</th>
<th>Percentage (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>276</td>
<td>46.00</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>324</td>
<td>54.00</td>
</tr>
<tr>
<td>Blood groups</td>
<td>A</td>
<td>152</td>
<td>25.33</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>228</td>
<td>38.00</td>
</tr>
<tr>
<td></td>
<td>AB</td>
<td>32</td>
<td>5.33</td>
</tr>
<tr>
<td></td>
<td>O</td>
<td>188</td>
<td>31.33</td>
</tr>
<tr>
<td>Age group (year)</td>
<td>&lt;20</td>
<td>148</td>
<td>24.67</td>
</tr>
<tr>
<td></td>
<td>20-40</td>
<td>272</td>
<td>45.33</td>
</tr>
<tr>
<td></td>
<td>&gt;40</td>
<td>180</td>
<td>30.00</td>
</tr>
</tbody>
</table>

** (P≤0.01), NS: Non-Significant.

For the 600 patients distribution of ABO blood group, COVID-19 showed that, there were 228 patients with type B (38.00%), 188 patients with type O (31.33%), 152 patients with type A blood (25.33%), and 32 patients with type AB (5.33%). B type was the most common, and AB type was the least common, among the blood types.

Only potential confounders were included, in the final model of multivariable, in case of association
between ABO blood type and d-Dimer, Ferritin and CRP outcomes.

**Discussion**

This work has found that individuals of blood type A were more sensitive to COVID-19. Despite that, patient age was a factor in the severity of the disease in our study as reported in previous studies 28, 29.

The results are for the detection of COVID-19 antibodies. IgG and IgM antibodies to COVID-19 are detectable in the blood, after initial infection for several days. Antibodies are not clearly characterized even for a duration of time. Following seroconversion, individuals may have a detectable virus present for several weeks1.

The distribution of IgM and IgG, was not a relevant factor of ABO, Ferritin, D-dimer and CRP in COVID-19 patients. Meanwhile, the concentration of both IgM and IgG was important for COVID-19 diagnosis. Nevertheless, if blood samples were collected during the early stage of the infection, they may produce false negative results. The span time, after disease onset, could affect or reduce the sensitivities of the serum and because of the limitation of serum IgM and IgG for COVID-19 diagnosis 30.

It is well known that, there were several studies that reported a conceivable association between COVID-19 infection and ABO blood group. These studies were worldwide studies included many countries with different populations of patients. Since the pandemic started in 2019, the majority of studies related to the association between ABO blood group and COVID-19 infection proved susceptibility. Meanwhile some of these studies have found a relationship between COVID-19 infection severity and ABO blood group51-38. Nevertheless, in our work we have combined three other biomarkers (D-Dimer, Ferritin and CRP) with ABO blood group. Our finding that, only Ferritin level is associated significantly, with ABO blood group in COVID-19 patients, in comparison to CRP and D-dimer. We believe that these findings are indicative because they probed the relationship between ABO blood groups and D-dimer, Ferritin and CRP as biomarkers, in addition to the gender and age of COVID-19 sufferers51,33,35,39.

Because, COVID-19 is a serious threat to human health worldwide. Global efforts are considered to fight against this dangerous virus infection. Recently, Age and gender, have been observed as an important factor correlated with the severity of COVID-19 infection1. What we found in this study provided some new information from the Ferritin, D-dimer and CRP distribution angle in the mild and critical infection. Our finding was that the level of ferritin and D-dimer was increased. While the CRP level was not increased significantly, the similar findings of previous studies42-43.

Since ABO blood group is not risk factor for COVID-19, this kind of research method also may be useful for evaluating the relation between blood type and other biomarkers, such as Ferritin, CRP and D-dimer. The susceptibility of different ABO blood groups to these biomarkers has also been investigated individually or in combination 44-47, while the progression or prognosis has not been analyzed yet.

Several researchers have studied the association between age and gender, on the vulnerability of COVID-19. We could confirm (according to our current work), that, aging population is susceptible to COVID-19 infection. Therefore, a specific consideration and more susceptible to blood type A. Similar works on West Nile virus infection susceptibility 45, 48. The blood type A has a defendant influence of anti–A antibodies intracellular of COVID-19 uptake Further investigations discovered a protective effect of anti–A antibodies against intracellular uptake of COVID-19 49, 50. Guillion et al and Ritchi et al have discovered that human anti–A antibodies inhibiting the reaction between angiotensin which converts enzyme-2–dependent cellular adhesion to angiotensin 48.

Although the sample in our study was relatively big, the data used in the study were obtained from public medical centers and may better represent this patient group. Furthermore, large-scale investigations are needed to resolve this concern.

It is not clear yet, to determine why COVID-19 virus is more susceptible to blood type A population. Similar to some other diseases occur in specific blood type populations. That could be due to the blood group antigens effective receptors for several infectious microorganisms 51. In addition, the virus entry during infection is supported by spike (S) protein which is binding to specific ABO receptors of glycan antigen.
On the other hand, in previous studies, blood group O population was reported as less susceptible to SARS virus, while our results showed that infection of COVID-19 was more susceptible to blood group A population. The changing of blood concentrations of ABO glycoproteins is affected by inflammation, endothelial function, and microvascular coagulation.

The environmental factors and racial divergence may alter associations. By using multiple-factor model as a logistic model, it is impossible to analyze the association between blood type distribution and COVID-19. This procedure cannot ban the probability that, blood type is the only factor associated with COVID-19 infection and progression.

The evidence of the association between ABO blood group, D-dimer, CRP and Ferritin with COVID-19 severity, progression and susceptibility, requires more investigation. In Addition, our work proved that age is an important factor in COVID-19 infection’s development.

Conclusion

Our results showed that the evidence of the association between ABO blood group, D-dimer, CRP and Ferritin with COVID-19 severity, progression and susceptibility, requires more investigation. In Addition, our work proved that age is an important factor in COVID-19 infection’s development.

Authors’ Declaration

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are ours. Furthermore, any Figures and images, that are not ours, have been included with the necessary permission for republication, which is attached to the manuscript.

Authors’ Contribution Statement

A.Z.; Performed the experiments and contributed to the writing, data analysis of the paper and publishing the paper as correspondence author. A. A. A.; Planned the research work and performed the experiments. F. Th. S.; Contributed to the writing of the paper and data collection. Sh. I. K.; Contributed to the writing of the paper.

References


دراسة العلاقة ما بين المرضى العراقيين المصابين بفايروس كورونا وبعض المؤشرات الحيوية

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تتم إجراء العديد من الدراسات حول العلاقة بين COVID-19 والمؤشرات الحيوية المختلفة منذ بداية جائحة كورونا بما في ذلك فصائل الدم و CRP و Ferritin و D-dimer و ABO. شملت هذه الدراسة سلسلة (600) مريض تم تقسيمهم إلى (324) (نسبة 56٪) من الذكور والتواقي (376) (نسبة 46٪) نسائي. أشارت الدراسة إلى تكرار اختلافات ومعاملات تراكم في فصائل الدم AB و A و B و O و AB و Ferritin و D-dimer و CRP. أشار التحليل الإحصائي على وجود ارتباط بين فصيلة الدم و فصائل الدم CRP و Ferritin و D-dimer و ABO يعملان كمؤشرات حيوية. أما بالنسبة للإرتباط (P<0.05) في تعمل في فيروس كورونا COVID-19، ومزيج مؤشرات CRP و Ferritin و D-dimer و ABO. بين الأمراض. و في الوقت نفسه كان مستوى CRP في الفحص الأول (0.01) P≤0.05 ATH. في الفحص الثاني (0.05) P≤0.01. أشارت الدراسة أن العمر عاملاً مهم لتطور عدوى COVID-19 و يعتبر الارتباط بين فصيلة الدم COVID-19 ك Nguyên framework مهم لنجاح التحقيق. 

الخلاصة

الكلمات المفتاحية: مصابات الدم، كورونا فالوس، بروتين دابير، فيرتن.