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

Alyaa M. Zyara *[1] 🆔✉, Atheer Abdulrazzaq Aldoori [2] 🆔✉, Farah Thamer Samawi[3] 🆔✉, Shaymaa Ismael Kadhim[1] 🆔✉, Zainab Anwar Ali[1] 🆔✉

[1] Department of Biology, College of Science for Women, University of Baghdad, Iraq.
[2] Department of Microbiology, Veterinary Medicine College, University of Baghdad, Iraq.
[3] Biotechnology Research Center, Al-Nahrain University, Baghdad, Iraq.
*Corresponding Author.

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 ($P \leq 0.01$), 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 ($P \leq 0.01$), ($P \leq 0.05$) 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 ($P \leq 0.05$), ($P \leq 0.01$) 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 far[4,5]. 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 viruses[6]. The *Coronaviridae* is classified, order *Nidovirales,* family and subfamily *the* coronavirinae.

Genetically, they are categorized into four important genera: alpha*,* beta*,* gamma *and* delta coronaviruses [7]. Coronavirus is surrounded by proteins inserted into lipids, because of the club-shaped spike (S) proteins on their surface, they look like a crown[6].

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 worldwide[3]. 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 [16-18]. Following a viral invasion, the immune system is reacting in different ways including the activation of the coagulation system[19]. 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 [20].

D-dimer is the product that appears after blood clot destruction as a product of fibrin degradation in the blood[21].

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 [8]. There is a clear evidence of an association between C-reactive protein (CRP) and COVID-19 patient's inflammation[19, 22,23]. The C-reactive protein (CRP) is a plasma protein produced by the liver and it could be induced by inflammatory mediators[24].

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 [25].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[8].

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 [9, 10]. Furthermore, many studies associated ABO blood group with the morbidity and mortality of coronavirus infection [11, 12].

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[13].

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 [14, 15].

COVID-19 IgG/IgM Duo testing

COVID-19 IgG/IgM Duo test is a microfluidic fluorescence immunoassay (FIA). This test is using the FRENDTM 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. FRENDTM System programmed, to begin analysis, once the sample has reacted with the reagents. The reaction and analysis time was approximately 3-4 minutes [26].

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 caucused. 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).

$$\chi^2 = \Sigma \left((O - E)^2 / E \right)$$

χ^2: Chi-square, Σ: Summation, O: Observed No. , E: 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 ($P \le 0.01$) 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 ($P \le 0.01$), 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 ($P \le 0.01$) 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 ($P \le 0.05$) 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 ($P \le 0.01$) 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.

IgM results	No	Percentage (%)
Positive (Yes)	60	10.00
Negative (No)	540	90.00
Total	600	100%
P-value	---	0.0001 **
** (P≤0.01).		

Table 2. Distribution of sample study according to IgG results

IgG results	No	Percentage (%)
Positive (Yes)	308	51.33
Negative (No)	298	48.67
Total	600	100%
P-value	---	0.744 NS

NS: Non-Significant.

Table 3. Mean ± SE of IgM and IgG concentration

Test	Mean ± SE	
	IgM conc.	**IgG conc.**
Positive (Yes)	2.35 ± 0.35	3.65 ± 0.22
Negative (No)	0.231 ± 0.02	0.101 ± 0.02
T-test	0.259 **	0.417 **
P-value	0.0001	0.0001
** (P≤0.01).		

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

IgM results	Mean ± SE		
	D-dimer	**Ferritin**	**CRP**
Patient (Yes)	1.702 ±0.32	149.40 ±39.10	107.68 ±38.99
Control (No)	1.158 ±0.10	171.12 ±12.24	146.72 ±13.98
T-test	0.552 NS	68.694 NS	81.479 NS
P-value	0.0577	0.489	0.971
	NS: Non-Significant.		

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

IgG results	Mean ± SE		
	D-dimer	**Ferritin**	**CRP**
Patient (Yes)	1.816 ±0.14	232.24 ±16.17	199.42 ±19.67
Control (No)	0.576 ±0.09	102.18 ±12.91	83.12 ±14.51
T-test	0.331 **	41.231 **	48.905 **
P-value	0.0001	0.0001	0.0001
	** (P≤0.01).		

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

Gender	Mean ± SE		
	D-dimer	**Ferritin**	**CRP**
Male	1.466 ±0.17	188.55 ±19.37	153.73 ±20.09
Female	0.997 ±0.12	152.24 ±13.76	133.52 ±17.43
T-test	0.386 *	43.617 **	52.078 NS
P-value	0.0220	0.233	0.294
	* (P≤0.05) ** (P≤0.01).		

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
Table 7. Effect of Age in D-dimer, Ferritin and CRP

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		
	D-dimer	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 0.701and 0.0883 in sequence Table 8.

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

Blood groups	Mean ± SE		
	D-dimer	Ferritin	CRP
A	1.360 ±0.21	210.18 ±23.09 a	164.16 ±28.19
B	1.281 ±0.37	243.50 ±45.08 b	126.48 ±51.04
AB	1.031 ±0.15	122.64 ±17.94 a	112.85 ±19.84
O	1.304 ±0.18	179.06 ±20.53 ab	164.69 ±24.20
LSD	0.727 NS	82.090 **	51.893 NS
P-value	0.701	0.010	0.0883
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

Factors		No	Percentage (%)	P-value
Gender	Male	276	46.00	0.327 NS
	Female	324	54.00	
Blood groups	A	152	25.33	0.0001 **
	B	228	38.00	
	AB	32	5.33	
	O	188	31.33	
Age group (year)	<20	148	24.67	0.0053 **
	20-40	272	45.33	
	>40	180	30.00	
**** (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 weeks[1].

The distribution of IgM and IgG, was not a relevant factor of ABO, Ferritin, D-daimer 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 group[31-38] 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 sufferers[31-33,35,39].

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 infection[1]. 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 studies[40-43].

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]. Guillon *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 [52], while our results showed that infection of COVID-19 was more susceptible to blood group A population[53]. The changing of blood concentrations of ABO glycoproteins is affected by inflammation, endothelial function, and microvascular coagulation[54, 55].

The environmental factors and racial divergence may alter associations [56, 57]. 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.

These findings are important because of the correlation among different biomarkers and progression, in addition to susceptibility. And finally, the research conducted, is supporting the fight against COVID-19 worldwide.

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 re-publication, which is attached to the manuscript.
- Authors sign on ethical consideration's approval.
- Ethical Clearance: The project was approved by the local ethical committee in University of Baghdad.

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

1. De Wit E, Van Doremalen N, Falzarano D, Munster VJ. SARS and MERS: recent insights into emerging coronaviruses. Nat Rev Microbiol. 2016 Aug; 14(8): 523-34. https://doi.org/10.1038/nrmicro.2016.81.
2. Hui DS, Chan MC, Wu AK, Ng PC. Severe acute respiratory syndrome (SARS): epidemiology and clinical features. Postgrad Med J. 2004 Jul 1; 80(945): 373-81. https://doi.org/10.1136/pgmj.2004.020263
3. Chen Y, Liu Q, Guo D. Emerging coronaviruses: genome structure, replication, and pathogenesis. J Med Virol. 2020 Apr; 92(4): 418-23. https://doi.org/10.1002/jmv.25681 .
4. World Health Organization. The true death toll of COVID-19: 2021.estimating global excess mortality. https://www.who.int/data/stories/the-true-death-toll-of-covid-19-estimating-global-excess-mortality
5. Salah HA, Ahmed AS. Coronavirus Disease Diagnosis, Care and Prevention (COVID-19) Based on Decision Support System. Baghdad Sci J. 2021; 18(8): 3. https://doi.org/10.21123/bsj.2021.18.3.0593.
6. Weiss SR, Leibowitz JL. Coronavirus pathogenesis. Advances in virus research. 2011 Jan 1; 81: 85-164. https://doi.org/10.1016/B978-0-12-385885-6.00009-2
7. International committee on taxonomy of viruses (ICTV). Taxonomy.2018. https://ictv.global/taxonomy
8. Pormohammad A, Ghorbani S, Khatami A, Farzi R, Baradaran B, Turner DL, et al. Comparison of confirmed COVID-19 with SARS and MERS cases-

Clinical characteristics, laboratory findings, radiographic signs and outcomes: a systematic review and meta-analysis. Rev Med Virol. 2020 Jul; 30(4): e2112. https://doi.org/10.1002/rmv.2112.

9. Covid CD, Team R, Bialek S, Bowen V, Chow N, Curns A, Gierke R, et al. Geographic differences in COVID-19 cases, deaths, and incidence—United States. Morb Mortal Wkly Rep. 2020 Apr 4;69(15):465. https://doi.org/10.15585/mmwr.mm6915e4 .

10. Williamson EJ, Walker AJ, Bhaskaran K, Bacon S, Bates C, Morton CE, et al. OpenSAFELY: factors associated with COVID-19 death in 17 million patients. Nature. 2020 Aug 8; 584(7821): 430. https://doi.org/10.1038/s41586-020-2521-4 .

11. Fan H, Zhang L, Huang B, Zhu M, Zhou Y, Zhang H, et al. Retrospective analysis of clinical features in 101 death cases with COVID-19. MedRxiv. 2020 Mar 12. https://doi.org/10.1101/2020.03.09.20033068 .

12. Zeng X, Fan H, Lu D, Huang F, Meng X, Li Z, et al. Association between ABO blood groups and clinical outcome of coronavirus disease 2019: Evidence from two cohorts. Medrxiv. 2020 Jan 1. https://doi.org/10.1101/2020.04.15.20063107

13. Lindesmith L, Moe C, Marionneau S, Ruvoen N, Jiang XI, Lindblad L, et al. Human susceptibility and resistance to Norwalk virus infection. Nat Med. 2003 May 1; 9(5): 548-53. https://doi.org/10.1038/nm860.

14. Hessami A, Shamshirian A, Heydari K, Pourali F, Alizadeh-Navaei R, Moosazadeh M, et al. Cardiovascular diseases burden in COVID-19: Systematic review and meta-analysis. Am J Emerg Med. 2021 Aug 1; 46: 382-91. https://doi.org/10.1016/j.ajem.2020.10.022

15. Van Vark LC, Bertrand M, Akkerhuis KM, Brugts JJ, Fox K, Mourad JJ, et al. Angiotensin-converting enzyme inhibitors reduce mortality in hypertension: a meta-analysis of randomized clinical trials of renin–angiotensin–aldosterone system inhibitors involving 158 998 patients. Eur Heart J. 2012 Aug 1; 33(16): 2088-97. https://doi.org/10.1093/eurheartj/ehs075.

16. Reilly JP, Meyer NJ, Shashaty MG, Feng R, Lanken PN, Gallop R, et al. ABO blood type A is associated with increased risk of ARDS in whites following both major trauma and severe sepsis. Chest. 2014 Apr 1; 145(4): 753-61. https://doi.org/10.1378/chest.13-1962

17. Wolpin BM, Chan AT, Hartge P, Chanock SJ, Kraft P, Hunter DJ, et al. ABO blood group and the risk of pancreatic cancer. J Nati Cancer Inst. 2009 Mar 18; 101(6): 424-31. https://doi.org/10.1093/jnci/djp020.

18. Etemadi A, Kamangar F, Islami F, Poustchi H, Pourshams A, Brennan P, et al. Mortality and cancer in relation to ABO blood group phenotypes in the Golestan Cohort Study. BMC Med. 2015 Dec; 13(1): 1-7. https://doi.org/10.1186/s12916-014-0237-8 .

19. Antoniak S. The coagulation system in host defense. Res Pract Thromb Haemost. 2018 Jul 1; 2 (3): e12109. https://doi.org/10.1002/rth2.12109 .

20. Lippi G, Favaloro EJ. D-dimer is associated with severity of coronavirus disease 2019: a pooled analysis. Thromb haemost. 2020 May;120 (5): 876-8. https://doi.org/10.1055/s-0040-1709650 .

21. Wilde JT, Kitchen S, Kinsey S, Greaves M, Preston FE. Plasma D-dimer levels and their relationship to serum fibrinogen/fibrin degradation products in hypercoagulable states. Br J Haematol. 1989 Jan; 71(1): 65-70. https://doi.org/10.1111/j.1365-2141.1989.tb06276.x.

22. Levi M, Thachil J. Coronavirus disease 2019 coagulopathy: disseminated intravascular coagulation and thrombotic microangiopathy—either, neither, or both. Semin Thromb hemost 2020 Oct; 46 (7): 781-784. https://doi.org/10.1055/s-0040-1712156.

23. Mohammed SK, Taha MM, Taha E M, Mohammad MNA. Cluster Analysis of Biochemical Markers as Predictor of COVID-19 Severity. Baghdad Sci J 2022, 19(6): 1423-142. https://dx.doi.org/10.21123/bsj.2022.4242

24. Valkanova V, Ebmeier KP, Allan CL. CRP, IL-6 and depression: a systematic review and meta-analysis of longitudinal studies. J Affect Disord. 2013 Sep 25; 150(3):736-44. https://doi.org/10.1016/j.jad.2013.06.004.

25. Seckback J. Ferreting out the secrets of plant ferritin-a review. J Plant Nutr. 1982 Jan 1; 5(4-7): 369-94. https://doi.org/10.1080/01904168209362966 .

26. Fox T, Geppert J, Dinnes J, Scandrett K, Bigio J, Sulis G, et al. Antibody tests for identification of current and past infection with SARS-CoV-2. Cochrane database of Systematic reviews. 2022(11). https://doi.org/10.1002/14651858.CD013652.

27. SAS. Statistical Analysis System, User's Guide. Statistical. 2018. Version 9.6th ed. SAS. Inst. Inc. Cary. N.C. USA.

28. Pranata R, Huang I, Lim M A, Wahjoepramono E J, July J. Impact of cerebrovascular and cardiovascular diseases on mortality and severity of COVID-19–systematic review, meta-analysis, and meta-regression. J stroke cerebrovasc dis. 2020; 29(8): 104949. https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.104949 .

29. World Health Organization. 2020. Report of the WHO-China joint mission on coronavirus disease 2019 (COVID-19). https://www.who.int/docs/defaultsource/coronaviruse/who-china-joint-mission-oncovid-19-final-report.pdf.

30. Woo PC, Lau SK, Wong BH, Tsoi HW, Fung AM, Kao RY, et al. Differential sensitivities of severe acute respiratory syndrome (SARS) coronavirus spike polypeptide enzyme-linked immunosorbent assay (ELISA) and SARS coronavirus nucleocapsid protein ELISA for serodiagnosis of SARS coronavirus pneumonia. J Clin Microbiol 2005 Jul; 43(7): 3054-8. https://doi.org/10.1128/JCM.43.7.3054-3058.2005 .

31. Hoiland R L, Fergusson N A, Mitra A R, Griesdale D E, Devine D V, Stukas S, et al. The association of ABO blood group with indices of disease severity and multiorgan dysfunction in COVID-19. Blood Adv. 2020; 4(20): 4981-4989. https://doi.org/10.1182/bloodadvances.2020002623.

32. Leaf R K, Al-Samkari H, Brenner S K, Gupta S, Leaf D E. ABO phenotype and death in critically ill patients with COVID-19. Br J Haematol. 2020; 190(4): e204. https://doi.org/10.1111/bjh.16984 .

33. Li J, Wang X, Chen J, Cai Y, Deng A, Yang M. Association between ABO blood groups and risk of SARS-CoV-2 pneumonia. Br J Haematol. 2020; 190(1): 24. https://doi.org/10.1111/bjh.16797 .

34. Ray J G, Schull M J, Vermeulen M J, Park A L. Association between ABO and Rh blood groups and SARS-CoV-2 infection or severe COVID-19 illness: a population-based cohort study. Ann Intern Med, 2021; 174(3): 308-315. https://doi.org/10.7326/M20-4511

35. Zhao J, Yang Y, Huang H, Li D, Gu D, Lu X, et al. Relationship between the ABO blood group and the coronavirus disease 2019 (COVID-19) susceptibility. Clin Infect Dis, 2021; 73(2): 328-331. https://doi.org/10.1093/cid/ciaa1150.

36. Zietz M, Zucker J, Tatonetti N P. Associations between blood type and COVID-19 infection, intubation, and death. Nat Commun. 2020; 11(1): 5761. https://doi.org/10.1038/s41467-020-19623-x.

37. Barnkob M B, Pottegård A, Støvring H, Haunstrup T M, Homburg K, Larsen R, et al. Reduced prevalence of SARS-CoV-2 infection in ABO blood group O. Blood Adv. 2020; 4(20): 4990-4993. https://doi.org/10.1182/bloodadvances.2020002657.

38. Boudin L, Janvier F, Bylicki O, Dutasta F. ABO blood groups are not associated with the risk of acquiring SARS-CoV-2 infection in young adults. Haematologica. 2020; 105(12): 2841. https://doi.org/10.3324/haematol.2020.265066

39. Latz C A, DeCarlo C, Boitano L, Png C M, Patell R, Conrad M F, et al. Blood type and outcomes in patients with COVID-19. Ann Hematol. 2020; (99): 2113-2118. https://doi.org/10.1007/s00277-020-04169-1

40. Wu J, Liu J, Zhao X, Liu C, Wang W, Wang D, et al. Clinical characteristics of imported cases of coronavirus disease 2019 (COVID-19) in Jiangsu Province: a multicenter descriptive study. Clin Infect Dis 2020 Jul 28; 71(15): 706-12. https://doi.org/10.1093/cid/ciaa199.

41. Al Meani SA, Abdulkareem AH, Ibrahim MO, Ahmed MM, Mukhlif MY. Assessment the correlation of D-dimer and ferritin level in patients infected with Covid-19 in Anbar Governorate of Iraq. Syst Rev Pharm 2020; 11(9): 1130-3. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Assessment+the+correlation+of+D-dimer+and+ferritin+level+in+patients+infected+with+Covid-19+in+Anbar+Governorate+of+Iraq.+&btnG=

42. Zhou B, She J, Wang Y, Ma X. Utility of ferritin, procalcitonin, and C-reactive protein in severe patients with 2019 novel coronavirus disease. Res Sq. 2020 https://doi.org/10.21203/rs.3.rs-18079/v1

43. AL-Furat AL. study the relationship between CRP and Ferritin in people infection with COVID-19 in AL-Najaf Governorate, Iraq. Al-Kufa Univ J Biol 2020; 12: 20-6. https://www.iasj.net/iasj/download/ac21813023f5339e

44. Tan YJ, Goh PY, Fielding BC, Shen S, Chou CF, Fu JL, et al. Profiles of antibody responses against severe acute respiratory syndrome coronavirus recombinant proteins and their potential use as diagnostic markers. Clin Vaccine Immunol 2004 Mar; 11(2): 362-71.https://doi.org/10.1128/CDLI.11.2.362-371.2004

45. Kim JM, Chung YS, Jo HJ, Lee NJ, Kim MS, Woo SH, et al. Identification of coronavirus isolated from a patient in Korea with COVID-19. Osong Public Health Res Perspect. 2020 Feb; 11(1): 3. https://doi.org/10.24171/j.phrp.2020.11.1.02

46. Tahamtan A, Ardebili A. Real-time RT-PCR in COVID-19 detection: issues affecting the results. Expert Rev Mol Diagn. 2020 May 3; 20(5): 453-4. https://doi.org/10.1080/14737159.2020.1757437 .

47. Salih AM, Salman IN, khudhair Z, abdulwahid R. Study ABO / Rh Systems with IL-18 & IL-33 in Iraqi Patients with Diabetes Mellitus Type II. Baghdad Sci J. 2014 Sep. 7 [cited 2023 Jun. 18]; 11(3): 1136-44. https://bsj.uobaghdad.edu.iq/index.php/BSJ/article/view/2003

48. Diagnostic testing for SARS-CoV-2, (n.d.). https://www.who.int/publications/i/item/diagnostic-testing-for-sars-cov-2 (accessed October 15, 2020).

49. Guillon, P, Clément M, Sébille V, Rivain J G, Chou C F, Ruvoën-Clouet N, et al. Inhibition of the interaction between the SARS-CoV spike protein and its cellular receptor by anti-histo-blood group antibodies. Glycobiology. 2008; 18(12):1085-1093. https://doi.org/10.1093/glycob/cwn093.

50. Ritchie G, Harvey D J, Feldmann F, Stroeher U, Feldmann H, Royle L, et al. Identification of N-linked carbohydrates from severe acute respiratory syndrome (SARS) spike glycoprotein. Virology. 2010; 399(2): 257-269. https://doi.org/10.1016/j.virol.2009.12.020

51. Defeating COVID-19: The Science Behind a New ELISA for COVID-19 Seroconversion Detection, The Scientist Magazine. (n.d.). https://www.the-scientist.com/the-marketplace/defeating-covid-19-the-science-behind-a-new-elisa-for-covid-19-seroconversion-detection-67721(accessed October 15, 2020).

52. Chen N, Zhou M, Dong X, Qu J, Gong F, Han Y, et al. Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. lancet. 2020 Feb 15;

395(10223): 507-13.https://doi.org/10.1016/S0140-6736(20)30211-7.

53. Grant BD, Anderson CE, Williford JR, Alonzo LF, Glukhova VA, Boyle DS, et al. SARS-CoV-2 coronavirus nucleocapsid antigen-detecting half-strip lateral flow assay toward the development of point of care tests using commercially available reagents. Anal Chem. 2020 Jul 1; 92(16): 11305-9. https://doi.org/10.1021/ acs.analchem.0c01975

54. Huang WE, Lim B, Hsu CC, Xiong D, Wu W, Yu Y, et al. RT-LAMP for rapid diagnosis of coronavirus SARS-CoV-2. Microb Biotechnol. 2020 Jul; 13(4): 950-61.https://doi.org/ 10.1111/1751-7915.13586.

55. Nachtigall FM, Pereira A, Trofymchuk OS, Santos LS. Detection of SARS-CoV-2 in nasal swabs using MALDI-MS. Nat Biotechnol. 2020 Oct 1; 38(10): 1168-73. https://doi.org/10.1038/s41587-020-0644-7

56. Jacofsky D, Jacofsky EM, Jacofsky M. Understanding antibody testing for COVID-19. J Arthroplasty. 2020 Jul 1; 35(7): S74-81.https://doi.org/10.1016/j. arth.2020.04.055.

57. Broughton JP, Deng X, Yu G, Fasching CL, Servellita V, Singh J, et al. CRISPR–Cas12-based detection of SARS-CoV-2. Nat Biotechnol. 2020 Jul; 38(7): 870-4. https://doi.org/10.1038/s41587-020-0513-4 .

دراسة العلاقة مـا بين المرضى العراقيين المصابين بفايروس كورونـا وبعض المؤشرات الحيوية

علياء محمد عبد الهادي زيارة[1]، اثير عبد الرزاق الدوري[2] ، فرح ثامر سماوي[3] ، شيماء إسماعيل كاظم[1] ، زينب أنور علي[1]

[1] علوم الحياة، كلية العلوم للبنات، جامعة بغداد، ، العراق.

[2] الاحياء المجهرية، كلية الطب البيطري، جامعة بغداد ، العراق.

[3] مركز بحوث التقانة الحيوية، جامعة النهرين ، العراق.

الخلاصة

تم إجراء العديد من الدراسات حول العلاقة بين COVID-19 والمؤشرات الحيوية المختلفة منذ بداية جائحة كورونا بما في ذلك فصائل الدم ABO و D-dimer و Ferritin و CRP. شملت هذه الدراسة ستمائة (600) مريض تم تقسيمهم الى 324 (56٪) أنثى والباقي 276 (46٪) ذكور. اشارت الدراسة الى تكرار فصائل مجاميع الدم A و B و AB و O 25.33 ; 38.00 ; 31.33 و 5.33٪ على التوالي . كما أشار التحليل الاحصائي بوجود ارتباط بين فصيلة الدم ABO و D-dimer و Ferritin و CRP لمرضى COVID-19 من خلال وجود فروق معنوية بينهم وبين الفيريتين (0.01≥P) ، ولكن لا توجد فروق ذات دلالة إحصائية لكل من D-dimer و CRP. اما بالنسبة للارتباط العمري بين مرضى COVID-19 والمؤشرات الحيوية ، أظهرت مستويات D-dimer و Ferritin فرقًا كبيرًا ((0.01≥P، 0.05≥P)) بين الأعمار. وفي الوقت نفسه كان مستوى CRP غير كبير.و بالنظر إلى تأثير الجنس على المؤشرات الحيوية لمرضى COVID-19 ، كانت ذكور D-dimer و Ferritin معنوية ((0.05≥P، 0.01≥P)) بالتتابع من الإناث. لكن لا يوجد تأثير مهم لمستوى CRP. أثبتت نتائجنا أن العمر عامل مهم لتطور عدوى COVID-19. يعتبر الارتباط بين فصيلة الدم ABO و D-dimer و CRP و Ferritin أيضا عامل خطورة مهم ويحتاج الى المزيد من التحقيق.

الكلمات المفتاحية: مجاميع الدم ، كورونا فايروس، بروتين C الفعال، D دايمر ؛ فرتين.