Journal of Genetic and Environmental Resources Conservation, 2023, 11(1):33-43.
www.gercj.com Print ISSN: 2306-8663, Online ISSN: 2306 – 8280

Relation between some of risk factors and COVID-19 infection

Zahraa J. Jameel[1]*, Hayder Jasim Mohammed[2], Mohammed Abdul Ameer Shawkat[3] and Hadeel J. Ahmed[3]
[1]Dep. of Environment, College of Energy and Environmental Sciences, Al-Karkh University of Sciences, [2]Dep. of Biotechnology, College of Science, Diyala University and [3]Dep. of Biology, College of Science, Diyala University, Iraq.
***Corresponding author: dr.zahraa.j@kus.edu.iq**
Received: October 24th 2022; Accepted: December 6th 2022

Abstract

Several studies have now established that the hyperinflammatory response induced by severe acute respiratory syndrome corona virus-2 (SARS-CoV-2) is a major cause of disease severity and death in infected patients. In relation to the advent of the novel SARS-CoV-2, it has been shown that anti-SARS-CoV-2 IgM antibodies start to manifest one week after infection and last for one month before gradually waning. Contrarily, anti-SARS-CoV-2 IgG antibodies start to manifest 10–21 days after infection and seem to hold steady for as long as 3 months. IgM and IgG antibody levels in patients will be calculated using serologic assays. The enrolled subjects who were expected infect with SARS-CoV-2 were 106 among them, 49 (46.2 %) of the total number were positive for COVID-19, 19(54.3%) were males, 6(8.5%) were pregnant women and 24(33.8%) were non pregnant women while the rest of them 57 (53.8%) were negative by using ELISA. The age group 31-40 years old had the highest number of patients 20(60.6%). 33(67.3 percent) of patients had fever, 26(53.1%) headache, 15(30.69 %) couch, 21(42.8 %) of patients had shortness of breath, 10(20.8 %) diarrhea, 33(67.3 %) Tabification (exhaustion), and 3(6.1 %) O2 Low. high frequency of 17 cases and 12 cases in the A+ and B+ groups, respectively.

Keywords: COVID-19, SARS-CoV-2, IgG, IgM, Blood group.

Introduction

After sever acute respiratory syndrome coronavirus-1 (SARS-CoV-1) and the Middle East respiratory syndrome coronavirus (MERS-CoV), severe acute respiratory syndrome coronavirus-2 (SARS-Cov-2) is the third lethal coronavirus (Huang *et al.,* 2020). According to current evidence, SARS-CoV-2 spreads from person to person via a variety of routes, including respiratory droplets produced by breathing, sneezing, coughing, and other activities, and also direct contact with an infected subject or indirect contact, such as hand-mediated transmission of the virus from contaminated fomites to the mouth, nose, or eyes (Cevik *et al.,* 2020). IgM can be detected after the fourth day of infection, and IgG has been found after the eighth day of disease onset in serologic assays to detect antibodies against SARS-CoV-2. These assays are of great interest because these antibodies can be detected from the second week of the start of COVID-19 symptoms. By minimizing PCR false positive/false negative results, serologic assays offer fast diagnosis. They also provide antibody patterns for estimate of the intensity and duration of humoral immunity (Lu *et al.*, 2020). The importance of the COVID-19 antibody response is significant for both the diagnosis and the prognosis. After viral infection, certain antibodies, such as IgG antibodies and neutralizing antibodies, are crucial for protecting the host against infection by preventing viral entry into host cells (Nie *et al.,* 2020).

The study's goal is to study if there's a link between SARS-COV-2 infection and patient characteristics like gender, age, clinical symptoms, blood types, blood picture, as well as other diseases.

Material and Method

Case control study included 106 expected infect with COVID-19 during period from 17 of December 2020 to the 5 of July 2021. Their ages range between 10 to above 50 years old, 35 were males and 71 were females. The diagnosis of each case was established using clinical diagnosis and confirmed by serologic assays used to estimate IgM and IgG antibodies in expected infect with COVID-19 by ELISA.

Blood samples were obtained from each patient and placed in serum separator tube (SST) with specific gel to easy sorting the serum, then left at room temperature for 20 minutes. Sera were separated using a centrifuge at 4000 rpm for 15 minutes after

coagulation and directly analyzed for IgM and IgG and other tests.

Statistical analyses: Statistical analyses were performed using GraphPad Prism version 3.06. The differences between cases and control were calculated employing Student t test. Whereas, Categorical data are presented as (%), Chi square test ($\chi 2$) was used to calculate P values as appropriate. The data were presented in mean± Standard deviations. The association of the COVID-19 infection with other variables, was determined by using Spearman's correlation coefficient analysis. Correlation coefficients were considered significant at *P-values* less than 0.05. Asterisk (*****) indicates that the correlation or differences was statistically significant in comparison to the patient groups and control group.

Results and Discussion

COVID-19 Rate among Study Population: The enrolled subjects who were expected infect with severe acute respiratory syndrome corona virus-2 were 106 among them, 49 (46.2 %) of the total number were positive for COVID-19 while the rest of them 57 (53.8%) were negative by using ELISA table (1).

In relation to the introduction of the novel SARS-CoV-2, it has been noted that the majority of patients develop strong neutralizing antibody titers 10–14 days after the start of symptoms, while some individuals had undetectable antibody titers in their blood. Within a week of infection, anti-SARS-CoV-2 IgM antibodies emerge, persist for a month, and then gradually decline. Contrarily, anti-SARS-CoV-2 IgG antibodies manifest between 10 and 21 days following infection and seem to be rather persistent for up to 3 months (Zhang *et al.*, 2020).

IgM/IgG assays are critical for determining the duration and source of humorous responses to SARS-CoV-2, as these antibodies can be found as early as a few days following the start of sickness and after infection, can stay in the body for years. IgM and IgG responses to COVID-19 can be seen as early as the second week of the disease (Lee *et al.,*2020).

The duration of protective immunity is critical for avoiding reinfection and for predicting vaccination response in the body. Different humoral immune responses are seen in young and old, males and women, healthy and sick people. investigation of the mechanisms and dynamics of the humoral immune response could aid in the development of the COVID-19 vaccine, as well as other public health measures (Nie *et al.,* 2020).

28 negative controls and 14 confirmed COVID-19 patients were tested by Lee and associates in 2020 for anti-SARS-CoV-2 IgG/IgM antibodies. The antibody response varied depending on the clinical symptoms and severity of the disease.

Table 1: The Comparison of IgM and IgG Levels in Plasma

Ig	Positive no. (%)	Negative no. (%)	Total (%)	*P- Value*
IgM only	18 (17%)	88 (83%)	106(100%)	0.01*
IgG only	20 (18.8%)	86(81.2%)	106(100%)	0.02*
IgM and IgG	11(10.4%)	95(89.6%)	106(100%)	0.01*
	49(46.2%)	57(53.8%)	106(100%)	0.5

***** Statistically significant: n/N (percent) represents categorical data, where N is the total number of patients for whom data are available. Continues data are shown as mean SD, and *P values* were determined using the paired Student t test.

Distribution According to Gender: The total number of the patients who were positive SARA-COV-2 was 49 (46.2 %) of them 19(54.3%) were males, 6(8.5%) were pregnant women and 24(33.8%) were non pregnant women. The result of statistical analysis demonstrated that statistically significant differences were found as shown in Table 2.

The findings of this study matched those of Lee *et al.,* (2020), who discovered that among 632 confirmed SARS-COV-2 cases, 430 infected females accounted for more than half of the total confirmed cases in South Korea. Suleyman *et al.,* (2020) state that in the United States, 463,259 (55.9%) of the population were females. Another report from the United States found that females had a higher rate of infection than males.

Table (2) Gender Distribution in the Study Population

Gender		Patients No. (%)	negative No. (%)	Total
Males		19(54.3%)	16(45.7%)	**35**
Females	pregnant	6(8.5%)	20(28.1%)**	**71**
	Non pregnant	24(33.8%)	21(29.5%)	
Total		49	57	**106**
** (P≤0.01).				

****Statistically significant: Continues data are shown as mean SD, and *P values* were determined using the paired Student t test.

There are a number of studies that show there is no significant difference in the risk of getting SARS-COV-2 infection between males and females, such as the Iranian study by Jalali *et al.,* (2020), which found that among confirmed cases, 50.9 percent were males and 49.1 percent were females, and the Saudi Arabian study by Khan *et al.,* (2020b), which found no significant difference in SARS-COV-2 infection between males and females. Ambrosino *et al.* (2020) found no sex differences in SARS-COV-2 infection in their epidemiology investigation.

Mohammed (2021) investigation, the majority of infection was noted in males 50 (64.10 percent) against females 28 (35.90 percent), which was statistically significant. According to Al-Omari *et al.* (2020), in Saudi Arabia, 80 percent of confirmed cases were males. In Wuhan, China, Shahriarirad *et al.* (2020) discovered that males have a much greater rate of infection than females, with 62.8 percent of infection in males and significantly higher than females in Iran. In Peru, Segovia-Juarez *et al.*, (2020) revealed that males were substantially more likely than females to be infected with SARS-COV-2 (71.12 percent vs. 28.88 percent).

These disparities in infection rates between males and females could be due to one of the following factors: In response to viral infection, females have stronger humeral and cell-mediated immunity than males (Syrett *et al.,* 2019). Females spread infection faster and more effectively than males (Ubeda, 2016). Also, by attaching to specific receptors on immune cells, the sex hormone plays an important role in this process. They can use estrogen to boost their activity or testosterone to make it their home (Schurz *et al.,* 2019). Estrogen boosts antibody production. This could be due to hormones, as estrogen has a favorable influence and promotes IgG and IgM expression on the one hand and inhibits IgG and IgM expression on the other. The testosterone hormone has a suppressive impact (Ruggieri *et al.,* 2016).

Distribution According to Age: Patients were separated into five age groups, with the youngest being 10 years old and the oldest being over 50 years old, with the median age being 35 years old. The age group 31-40 years old had the highest number of patients 20(60.6%) followed by 9 cases in the age group 21-30 years old, 7 instances in each age group 10-20 and more than 50 years old, and a low frequency of 6 cases in the age group 41-50 years old. As demonstrated in Table 3, statistical analysis revealed highly significant differences between them (Table 3).

Table 3: Distribution According to Age.

Age groups Years	Patients No. (%)	Negative No. (%)	Total (N)
10-20	7 (58.3%)	5(41.7%)	12
21-30	9(32.2%)	19(67.8%)	28
31-40	20(60.6%)	13(39.4%)	33
41-50	6(42.8%)	8(57.2%)	14
>50	7(36.8%)	12(63.2%)	19
** P≤0.01			

***** Statistically significant: Categorical data are displayed as n (percent), and the proper P values were calculated using the χ2 test.

This is consistent with the findings of Mohammed (2020) who found that the highest number of patients 34 were in age group 15-35 years old. Sarhan *et al.,* (2020), who found that most cases in Iraq were between the ages of 29 and 50, with those aged 30-39 being the most infected. Goldstein *et al.,* (2021) found that younger adults, particularly those younger than 35 years, have a high incidence of SARS-CoV-2 infection in the community, and the mortality rate in very elderly is significantly higher than elderly using serological tests.

These findings, on the other hand, contradicted the findings of a study conducted by Xue (2020), which found that elderly persons are more susceptible to the disease's more severe manifestations. According to Wu and McGoogan (2020e), the case-fatality rate for patients aged 70 to 79 years was 8.0 percent, compared to 14.8 percent for patients aged 80 years and above.

Reduced adaptive and innate immune activity is linked to aging (Golomb *et al.,* 2015). In the face of adversity, the body is ill-equipped to defend itself against viral and other infections (Van Deursen, 2014). Dendritic cells, which bridge the gap between innate and adaptive immunity, a decline in function as they get older (Gupta, 2014). Indeed, In the elderly population, increased CD5+ B lymphocytes are crucial autoantibody producers, resulting in an imbalance in the immunological response to self-antigens (Bulati *et al.,* 2011). In addition, in elderly patients, a particular CD8+ T cell response to influenza was closely linked to decreased TNF-production and lower DC maturation (Liu *et al.,* 2012). In terms of B and T cell production, the elderly is characterized by a decline in the quantity of these cells (Stervbo *et al.,* 2015). B cell response and antibody production against bacteria and viruses are also harmed (Buffa *et al.,* 2013).

Distribution According to Residence: According to residence of patient with positive SARS-COV-2, the study population divided into two categories, 32(65.3 %) were from Baqubah district and 17(34.7%) around Baqubah district as in Table (4).

Table 4: Distribution According to Residence

Residence	Patients No. (%)	Negative No. (%)	P- Value
Baqubah	32(65.3%)	30(52.6%)	NS
Around Baqubah	17(34.7%)	27(47.4%)	0.02*
Total	49(100%)	57(100%)	NS
* (P≤0.05)			

*****Statistically significant: Categorical data are displayed as n (percent), and the proper P values were calculated using the χ2 test.

This finding is similar to that of Mohammed (2020) the rate of infection 57 (73.08 %) were from Baqubah district and 21(26.92%) around Baqubah district. Moradzadeh *et al.,* (2021), who discovered that infection rates vary by location within Markazi province, with the highest infection rate documented in Delijan at 575.35 per 100,000 people in Iran. According to Aghaali *et al.,* (2020), Qom has a greater rate of infection than other Iranian cities, and Najafi *et al.,* (2020), western Iran has a higher rate of infection than other cities. According to Alamri *et al.,* (2021), the greatest and highest rate of infection was documented in Riyadh, Saudi Arabia's capital. In addition, Wang *et al.,* (2021) discovered a large variation in patient outcomes and description between both the center and surrounding areas of China afflicted by the pandemic, while Guan *et al.,* (2020a) discovered that out of 483, (43.9 percent) were inhabitants of Wuhan.

Air pollution has a direct effect on human health and the spread of diseases, particularly respiratory ailments. Air pollution and poor air quality appear to have a favorable link with the spreading of SARS-COV-2 (Coccia, 2020). According to Rocklöv and Sjödin (2020), high local population density in cities can help spread viruses like SARS-COV-2 by increasing the risk of catching the disease from infected people and altering the dissemination of

infectious diseases. Other considerations include the quantity of tests performed, regional containment measures, and lastly the locations (Napoli and Nioi, 2020). These disparities could be due to variances in distance from the epicenter city, demographic characteristics, restrictive laws, and the state of SARS-COV-2 epidemiology across different cities.

Clinical Feature of Patients with Severe Acute Respiratory Syndrome Coronavirus 2 : According to clinical features of patients with positive SARA-COV-2, 33(67.3 percent) of patients had fever, 26(53.1 percent) headache, 15(30.69 percent) couch, 21(42.8 percent) of patients had shortness of breath, 10(20.8 percent) diarrhea, 33(67.3 percent) Tabification (exhaustion), and 3(6.1 percent) O_2 Low. All of the factors had highly significant differences, according to the statistical analysis.

Table 5: Clinical Characterize of Patients with COVID-19

Clinical signs		Patients No (%)	P- Value
Fever	Yes	33(67.3%)	0.004*
	No	16 (32.7%)	
Headache	Yes	26(53.1%)	0.3
	No	23(46.9%)	
Couch	Yes	15(30.6%)	0.001*
	No	34(69.4%)	
Shortness of breath	Yes	21(42.8%)	0.05*
	No	28(57.2%)	
Diarrhea	Yes	10(20.4%)	0.008*
	No	39(79.6%)	
Loss of smell and tasting	Yes	11(22.4%)	0.001*
	No	38(77.6%)	
Tabification (exhaustion)	Yes	33(67.3%)	0.004*
	No	16(32.7%)	
O_2 Low	Yes	3(6.1%)	0.001*
	No	46(93.9%)	

*****Statistically significant calculating P values by utilizing the paired Student t test.

According to Barry *et al.* (2020), the most prevalent clinical signs among 99 hospitalized patients were fever (67.7%), cough (60.6%), dyspnea (43.4%), upper respiratory symptoms (27.3%), exhaustion (26.3%), diarrhea (19.2%), and loss of smell (9.1%). Nasiri *et al.* (2020) found that among 5,057 confirmed SARS-COV-2 cases in Saudi Arabia. In Tehran, Iran, the most prevalent symptoms were fever (83.0 percent) and cough (65.2 percent). This conclusion also corresponds with Guan *et al.,* (2020a), who reported that fever is the most prevalent symptom (88.7%), cough is the second most common symptom (67.8%), and diarrhea is uncommon (3.8%). According to Chen *et al.* (2020b), patients with SARS-COV-2 had a fever 83 percent of the time, cough 82 percent of the time, shortness of breath 31 percent of the time, and muscle ache 11 percent of the time. In Wuhan, China, Huang *et al.* (2020) found that fever was the most prevalent symptom in 98 percent of patients, followed by dry cough in 76 percent, dyspnea in 55 percent, and diarrhea in 3 percent. In China, according to Du *et al.,* (2020), the majority of patients had fever (78.9%) and dyspnea (60.6%), shortness of breath and fatigue (50.8%), almost half of the patients had anorexia, and 32.6% of the patients had expectoration, while other uncommon symptoms included dry cough, diarrhea, myalgia, headache, vomiting, abdominal pain, chest pain, and pharyngalgia. In a study of 262 cases in China, Tian *et al.* (2020) discovered that the most prevalent symptoms were fever (82.1%), cough 45.8%, exhaustion 26.3 percent, dyspnea 6.9%, and headache 6.5 percent.

Fever was the most common indication in all of these studies across different geographies and severity levels. This could be attributed to a variety of factors, although fever during SARS-COV-2 is mostly induced by the immunological response to the virus. Furthermore, the high prevalence of arterial thrombosis and extra-cerebral organ injuries may lead to an increase in the concentrations of

expression damage-associated molecular patterns (DAMPs). This resulted in the creation of pyrogenic mediators, hypothalamic dysfunction, and fever; this could indicate that fever is a positive prognosis because temperature promotes viral clearance in many viral illnesses. These findings are consistent with a recent study of SARS-COV-2 patients, which found that individuals with a body temperature below 36°C have a higher probability of developing a serious infection (Tharakan *et al.,* 2020). Fever, may boost cellular metabolism as a result of the high temperature, resulting in increased oxygen demand and carbon dioxide production, which can lead to hypoxia and hypercapnia, as well as a poor prognosis (Jeong *et al.,* 2020). Alternatively, clinical sign discrepancies could be attributable to changes in geography, lifestyle, mean age, and epidemiology (Wang et al, 2021).

Distribution According to Type of Blood Groups: In terms of blood groups, patients with positive SARS-COV-2 had a high frequency of 17 cases and 12 cases in the A+ and B+ groups, respectively, followed by patients with blood type O+ 9 cases and low frequency 1 (2%) in patients with blood group type AB+, while in the Rh- group, 4 cases (8.2%) had blood type O- and 3 cases had blood type B-, then 2 cases had blood type AB-, and finally 1 case had blood type AB-. As demonstrated in Table 6, statistical analysis found substantial differences between them.

Table 6: Distribution According to Type of Blood Group

Blood group		Patients No (%)	Negative No (%)	P value
A	Rh+	17(34.6%)	12(21.1%)	0.007*
	Rh-	1(2.0%)	3(5.2%)	0.01*
B	Rh+	12(24.4%)	14(24.5%)	0.5
	Rh-	3(6.1%)	3(5.2%)	0.7
AB	Rh+	1(2.0%)	8(14%)	0.006*
	Rh-	2(4.3%)	1(1.7%)	0.01*
O	Rh+	9(18.4%)	15(26.6%)	0.004*
	Rh-	4(8.2%)	1(1.7%)	0.008*
Total		49(100%)	57(100%)	0.5

***** Statistically significant: Categorical data are displayed as n (percent), and the proper P values were calculated using the χ2 test.

These findings are consistent with the findings of several studies conducted in different countries, such as Li *et al.,* (2020d), who found that Blood group type A patients with SARS-COV-2 showed a greater rate of hospitalization following infection, and Zhao *et al.,* (2020), who discovered that SARS-COV-2 patients In China, blood group A had a greater mortality risk than blood group non-A. According to Zeng *et al.,* (2020) in the United States and Barnkob *et al.,* (2020) in Denmark, people with blood group type A are more susceptible to infection than others, but not to hospitalization. Other studies, reveal some variance, such as Wu *et al.,* (2020d), who found that patients with blood group type O+ had a lower risk of infection than those with blood group type A, which was associated with an increased risk of SARS-COV-2 infection. According to Guillon *et al.,* (2008), Human anti-A antibodies produced naturally can prevent SARS-CoV from interacting with its receptor and provide security. This may help to explain why individuals with blood group A are more vulnerable to contracting SARS-CoV than those with blood group O+.

The recent investigation found that SARS-COV-2 infection and blood group have substantial differences. Unlike some studies from different countries that claim there is no significant difference between patients in terms of disease severity and mortality in relation to the ABO system, such as Goker *et al.,* (2020), who found no link between clinical outcomes such as intubation, intensive care unit stay, and mortality in Turkey. In Iran, Abdollahi *et al.* (2020) found no link between ABO or RHD phenotype and disease severity. Furthermore, as evidenced by the findings of two studies conducted in the United States (Latz *et al.,* 2020; Leaf *et al.,* 2020).

Relationship between COVID-19 Infection with C-reactive protein levels (mg/L)

The systemic inflammatory response to SARS-CoV-2 infection is a hallmark of the 2019 coronavirus disease (COVID-19), and most hospitalized COVID-19

patients exhibit aberrant inflammatory biomarkers. Tillet and Francis were the first to describe C-reactive protein (CRP), a protein in the acute phase, is a commonly available biomarker of inflammation that is produced by the liver in response to interleukin-6 (IL-6) (Liu *et al.*, 2020).

The results of this study showed that CRP is increasing at the beginning of COVID-19 when IgM is high, but CRP is less than the injury where IgG is high as in the Table 7.

Table7: Relationship between COVID-19 Infection with C-reactive protein levels (mg/L)

	CRP	COVID Ab IgM	COVID Ab IgG
CRP	-	**0.01***	**0.02***
COVID Ab IgM	**0.01***	-	0.39
COVID Ab IgG	**(-) 0.01***	(-)0.39	-

***** Statistically significant ;(-) Inverse relationship; Spearman's correlation coefficient analysis was used to calculate P values

Patients with COVID-19 who had elevated CRP levels had a fourfold higher likelihood of unfavorable results, according to a meta-analysis of 20 studies involving 4,843 patients with COVID-19 (Smilowitz, *et al.*, 2021). In a major study of 2,782 COVID-19 patients from a Health care system in New York City, it was discovered that >97% of patients had higher CRP levels at presentation, and high baseline CRP levels were linked to critical illness, acute renal injury, VTE, and all-cause mortality (Krychtiuk, *et al.*, 2020)

Previous research (Stringer *et al.*,2021; Tan *et al.*,2020; Chen *et al.*,2020; Guan *et al.*, 2020) found a positive association between CRP levels, disease severity/mortality, and disease severity/mortality.

Blood picture of the patients with COVID-19: The results of this study showed that there is no significant difference in the enumeration of hematological parameters between the injured and the control except the MCV census there was a significant difference as in the Table 8.

Table 8: The comparison of blood picture of the patients with COVID-19 and control.

	WBC	LYM	RBC	HGB	HCT	MCV	PLT
Control	8.760±3.2	27.17±10.3	5.198±3.6	12.78±2	46.69±25	83.80±9	237.5±70
Cases	7.518±2.5	29.53±13	5.65±	13.40±1.8	41.09±5.1	109.8±20	239.6±49
P –value	**NS**	**NS**	**NS**	**NS**	**NS**	**0.03***	**NS**

Continues data are shown as mean SD, and *P values* are calculated using a paired Student t test.. NS : non-significant correlation, * Statistically significant

In a previous investigation, Alnor *et al.*, (2021) were discovered that Significant changes in platelet indices and white blood cell characteristics. As a result, In COVID-19 patients, platelet count and plateletcrit were decreased, Despite the fact that the average platelet volume, platelet distribution breadth, and platelet big cell ratio were all significantly greater. COVID-19 patients had reduced counts of leukocytes, neutrophils, immature granulocytes, lymphocytes, monocytes, eosinophils, and basophils. For COVID-19 versus non-COVID-19 patients, No discernible variations in mean corpuscular haemoglobin, hemoglobin, haematocrit, or red blood cell count were found. When compared to patients with non-severe COVID-19, Higher amounts of immature granulocytes were seen in individuals with a severe illness history, while lymphocyte and platelet counts were lower. Older age, high WBC counts, high neutrophil counts, low monocyte counts, and low lymphocyte counts were all found to be independent indicators with severe disease in univariate analysis (Lin *et al.*, 2021).

Distribution According to Presence of Other Diseases: In terms of disease, 4 (8.2%) had diabetes mellitus, and 7 (14.2%) had high blood pressure. As seen in Table 9, statistical analysis revealed highly significant differences. The COVID-19 virus appears to make older persons and people with pre-existing medical disorders (such as diabetes, heart disease, and asthma) more susceptible to becoming seriously ill. Due to variations in blood glucose levels and, presumably, the presence of diabetes complications, it can be more difficult to treat a viral infection in people with diabetes (Coccia, 2020)

Two elements appear to be at play. To begin with, the immune system is weakened, making fighting the virus harder and resulting in a longer recovery time. Second, the virus might thrive in a high-glucose blood environment (Gupta *et al.*, 2020).

Table 9: Distribution According to Other Diseases

Variable Factors		COVID-19 **Positive**		**P value**
		Positive No. (%)	**Negative No. (%)**	
Chronic Disease	High Blood Pressure	7**(14.2%)**	42**(85.8%)**	**0.001***
	Diabetes mellitus	4**(8.2%)**	45**(91.8%)**	**0.001***
	Variable Factors	COVID-19 Negative		**P value**
		Positive No. (%)	**Negative No. (%)**	
	High Blood pressure	6**(10.5%)**	51**(89.5%)**	**0.001***
	Diabetes mellitus	8**(14%)**	**49(86%)**	**0.001***

***** Statistically significant: Categorical data are displayed as n (percent), and the proper P values were calculated using the $\chi 2$ test.

Coronavirus infections have been proven to have a major impact on diabetes mellitus management because they enhance inflammation and alter immunological responses, making glycemic control difficult. SARS-CoV-2 infection increases the risk of thromboembolism and is more likely to induce cardiorespiratory failure in people with diabetes mellitus than in people without diabetes. (Lim *et al.*, 2021)

High sympathetic activity, or moments when the sympathetic nervous system is activated, can raise blood pressure in some people for a short period of time. For some people, though, this could be a more long-term issue that leads to high blood pressure. Blood pressure that rises and falls as a result of a stressful situation is not particularly harmful. In the long run, however, elevated blood pressures are problematic (Gupta *et al.*, 2020).

References

Abdollahi, A., Mahmoudi-Aliabadi, M., Mehrtash, V., Jafarzadeh, B., and Salehi, M. (2020). The novel coronavirus SARS-CoV-2 vulnerability association with ABO/Rh blood types, Iran. J. Pathol., 15(3):156.

Aghaali, M., Kolifarhood, G., Nikbakht, R., Saadati, H.M., and Hashemi Nazari, S.S. (2020). Estimation of the serial interval and basic reproduction number of COVID-19 in Qom, Iran, and three other countries: A data-driven analysis in the early phase of the outbreak. Transbound. Emerg. Dis., 67(6): 2860-2868.

Alamri, F., Alsofayan, Y., AlRuthia, Y., Alahmari, A., Almuzaini, Y., Gazalah, F.A., Alradini, F., Alaama, T., and Khan, A. (2021). Predictors of hospitalization among older adults with COVID-19 in Saudi Arabia: A cross-sectional study of a nationally representative sample, Risk Management and Healthcare Policy, 14: 875.

Alnor A, Sandberg MB, Toftanes BE, Vinholt PJ.(2021). Platelet parameters and leukocyte morphology is altered in COVID-19 patients compared to non-COVID-19 patients with similar symptomatology. Scand J Clin Lab Invest ;81(3):213-217.

Al-Omari, A., Alhuqbani, W.N., Zaidi, A.R.Z., Al-Subaie, M.F., AlHindi, A.M., Abogosh, A.K., Alrasheed, A.K., Alsharafi, A.A., Alhuqbani, M.N., Salih, S., and Alhedaithy, M.A. (2020). Clinical characteristics of non-intensive care unit COVID-19 patients in Saudi Arabia: a descriptive cross-sectional study, J. Infect., 13(11): 1639-1644.

Ambrosino, I., Barbagelata, E., Ortona, E., Ruggieri, A., Massiah, G., Giannico, O.V., Politi, C., Moretti, A.M. (2020). Gender differences in patients with COVID-19: a narrative review, Monaldi. Arch. Chest Dis., 90: 2.

Barnkob, M.B., Pottegård, A., Støvring, H., Haunstrup, T.M., Homburg, K., Larsen, R., Hansen, M.B., Titlestad, K., Aagaard, B., Møller, B.K., and Barington, T. (2020). reduced prevalence of SARS-CoV-2 infection in ABO blood group O, Blood Adv., 4(20):4990-4993.

Barry, M., Al-Mohaya, A., AlHijji, A., Akkielah, L., AlRajhi, A., Almajid, F., Alsharidi, A., Al-Shahrani, F.S., Alotaibi, N.H., Alanazi, A., and Ghonem, L. (2020). Clinical characteristics and outcome of hospitalized COVID-19 patients in a MERS-CoV endemic area, J. Epidemiol. Glob. Health., 10(3): 214.

Buffa, S., Pellicanò, M., Bulati, M., Martorana, A., Goldeck, D., Caruso, C., Pawelec, G., and

Colonna-Romano, G. (2013). A novel B cell population revealed by a CD38/CD24 gating strategy: CD38(-) CD24 (-) B cells in centenarian offspring and elderly people, Age, 35(5): 2009-2024.

Bulati, M., Buffa, S., Candore, G., Caruso, C., Dunn-Walters, D.K., Pellicanò, M., Wu, Y.C., and Romano, G.C. (2011). B cells and immunosenescence: a focus on IgG+IgD-CD27-(DN) B cells in aged humans, Ageing Res. Rev., 10(2): 274-284.

Cevik, M., Krutika, K., Jason, K., and Malik, P. (2020). Virology, transmission, and pathogenesis of SARS-COV-2, BMJ., 371:3862.

Chen, N., Zhou, M., Dong, X., Qu, J., Gong, F., Han, Y., Qiu, Y., Wang, J., Liu, Y., Wei, Y., and Yu, T. (2020b). Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study, The lancet, 395(10223):507-513.

Chen, W, Zheng, KI, Liu, S, Yan, Z, Xu, C, Qiao, Z. (2020a). Plasma CRP level is positively associated with the severity of COVID-19. *Ann Clin Microbiol Antimicrob* ;19:18.

Coccia, M. (2020). Factors determining the diffusion of COVID-19 and suggested strategy to prevent future accelerated viral infectivity similar to COVID, Sci. Total Environ., 729, 138474.

Du, Y., Tu, L., Zhu, P., Mu, M., Wang, R., Yang, P., Wang, X., Hu, C., Ping, R., Hu, P., and Li, T. (2020). Clinical features of 85 fatal cases of COVID-19 from Wuhan. A retrospective observational study, Am. J. Respir. Crit. Care. Med., 201(11): 1372-1379.

Göker, H., Karakulak, E.A., Demiroğlu, H., Ceylan, Ç.M.A., Büyükaşik, Y., Inkaya, A.Ç., Aksu, S., Sayinalp, N., Haznedaroğlu, I.C., Uzun, Ö., and Akova, M. (2020). The effects of blood group types on the risk of COVID-19 infection and its clinical outcome, Turk. J. Med. Sci., 50(4):679-683.

Goldstein, E., Lipsitch, M., and Cevik, M. (2021). On the effect of age on the transmission of SARS-CoV-2 in households-schools, and the community, J. Infect. Dis., 223(3):362-369.

Golomb, L., Sagiv, A., Pateras, I.S., Maly, A., Krizhanovsky, V., Gorgoulis, V.G., Oren, M., and Ben-Yehuda, A. (2015). Age-associated inflammation connects RAS-induced senescence to stem cell dysfunction and epidermal malignancy, Cell Death Differ., 22(11): 1764-1774.

Guan, W.J., Ni, Z.Y., Hu, Y., Liang, W.H., Ou, C.Q., He, J.X., Liu, L., Shan, H., Lei, C.L., Hui, D.S., and Du, B. (2020). Clinical characteristics of coronavirus disease 2019 in China, N. Engl. J. Med. 382(18):1708-1720.

Guillon, P., Clément, M., Sébille, V., Rivain, J.G., Chou, C.F., Ruvoën-Clouet, N., and Le Pendu, J. (2008). Inhibition of the interaction between the SARS-CoV spike protein and its cellular receptor by anti-histo-blood group antibodies, Glycobiology, 18(12):1085-1093.

Gupta R, Ghosh A, Singh AK, Misra A. (2020). Clinical considerations for patients with diabetes in times of COVID-19 epidemic. Diabetes Metab Syndr;14(3):211-212.

Gupta, S. (2014). Role of dendritic cells in innate and adaptive immune response in human aging. Exp. Gerontol. 54(1): 47-52.

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., and Cheng, Z. (2020). Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China, Lancet, 395(10223): 497-506.

Jalali, S.F., Ghassemzadeh, M., Mouodi, S., Javanian, M., Kani, M.A., Ghadimi, R., and Bijani, A. (2020). Epidemiologic comparison of the first and second waves of coronavirus disease in Babol, North of Iran, Caspian J. Intern, Med., 11: 544.

Jeong, H.G., Lee, Y., Song, K.H., Hwang, I.C., Kim, E.S., Cho, Y.J. (2020). Therapeutic temperature modulation for a critically ill patient with COVID-19, J. Korean Med. Sci., 35: e210.

Khan, A.A., AlRuthia, Y., Balkhi, B., Alghadeer, S.M., Temsah, M.H., Althunayyan, S.M., and Alsofayan, Y.M., (2020). Survival and estimation of direct medical costs of hospitalized COVID-19 patients in the kingdom of Saudi Arabia (Short Title: COVID-19 survival and cost in Saudi Arabia, Int. J. Environ. Res. Public Health., 17(20):7458.

Krychtiuk, K. A. *et al.* (2020). Biomarkers of coagulation and fibrinolysis in acute myocardial infarction: a joint position paper of the Association for Acute CardioVascular Care and the European Society of Cardiology Working Group on Thrombosis. *Eur. Heart J. Acute Cardiovasc. Care* **10**, 343–355.

Latz, C.A., DeCarlo, C., Boitano, L., Png, C.M., Patell, R., Conrad, M.F., Eagleton, M. and Dua, A. (2020). Blood type and outcomes in patients with COVID-19, Ann. Hematol., 99(9):2113-2118.

Leaf, R.K., Al-Samkari, H., Brenner, S.K., Gupta, S., and Leaf, D.E., 2020. ABO phenotype and death

in critically ill patients with COVID-19, Br. J. Haemato, 190(4): e204-e208.

Lee YL, Liao CH, Liu PY, Cheng CY, Chung MY, Liu CE, Chang SY, Hsueh PR.(2020). Dynamics of anti-SARS-Cov-2 IgM and IgG antibodies among COVID-19 patients. J Infect. Aug;81(2):e55-e58.

Li, J., Wang, X., Chen, J., Cai, Y., Deng, A., and Yang, M. (2020d). association between ABO blood groups and risk of SARS-CoV-2 pneumonia, Br. J. Haematol., 190(1):24-27.

Lim, S., Bae, J.H., Kwon, HS. *et al.* (2021). COVID-19 and diabetes mellitus: from pathophysiology to clinical management. *Nat Rev Endocrinol* **17,** 11–30.

Lin S, Mao W, Zou Q, Lu S, Zheng S.(2021). Associations between hematological parameters and disease severity in patients with SARS-CoV-2 infection. J Clin Lab Anal. 35(1):e23604.

Liu F, Li L, Xu M, Wu J, Luo D, Zhu Y, Li B, Song X, Zhou X.. Prognostic value of interleukin-6, C-reactive protein, and procalcitonin in patients with COVID-19. J Clin Virol 2020;127:10437

Liu, W.M., Nahar, T.E., Jacobi, R.H., Gijzen, K., van Beek, J., Hak, E., Jonges, M., Boog, C.J., van der Zeijst, B.A., and Soethout, E.C. (2012). Impaired production of TNF-alpha by dendritic cells of older adults leads to a lower CD8+ T cell response against influenza, Vaccine, 30(9): 1659-1666.

Lu, M., Liu, Q., Wang, X., Zhang, J., Zhang, X., Shi, D., Liu, J., Shi, H., Chen, J., and Feng, L. (2020). Development of an indirect ELISA for detecting porcine delta coronavirus IgA antibodies, Arch. Virol., 165: 845-851.

Mohammed, A. H. (2021). Sequencing of SARS-COV-2 and Assessment the Level of Pro Inflammatory Cytokine during COVID-19 Infection in Diyala Governorate, thesis, College of Medicine - University of Diyala, p.127.

Moradzadeh, R., Zamanian, M., Amini, S., Kalantari, M., and Nazari, J., (2021). Clinical characteristics and reproduction number of coronavirus disease (COVID-19) cases in Markazi province in Iran, IJCBNM, 9(1): 18-29.

Najafi, F., Izadi, N., Hashemi-Nazari, S.S., Khosravi-Shadmani, F., Nikbakht, R., and Shakiba, E. (2020). Serial interval and time-varying reproduction number estimation for COVID-19 in western Iran, New Microbes New Infect., 36: 100715.

Napoli, P.E., and Nioi, M. (2020). Global spread of coronavirus disease 2019 and malaria: an epidemiological paradoxin the early stage of a pandemic, J. Clin. Med. 9:1138.

Nasiri, M.J., Haddadi, S., Tahvildari, A., Farsi, Y., Arbabi, M., Hasanzadeh, S., Jamshidi, P., Murthi, M., and Mirsaeidi, M. (2020). COVID-19 clinical characteristics, and sex-specific risk of mortality systematic review and meta-analysis, Front. Med., 7 :459.

Nie Y, Wang G, Shi X, Zhang H, Qiu Y, He Z, *et al.* Neutralizing antibodies in patients with severe acute respiratory syndrome-associated coronavirus infection. J Infect Dis 2020;190:1119–26.

Rocklöv, J. and Sjödin, H. (2020). High population densities catalyse the spread of COVID-19, J. Travel Med. 27, taaa038.

Ruggieri, A., Anticoli, S., D'Ambrosio, A., Giordani, L., and Viora, M. (2016). The influence of sex and gender on immunity, infection, and vaccination. Ann 1st Super Sanita., 52:198-204.

Sarhan, A.R., Flaih, M.H., Hussein, T.A., and Hussein, K.R. (2020). Novel coronavirus (COVID-19) Outbreak in Iraq: the first wave and future scenario, Lancet, 69(12): 343-346

Schurz, H., Salie, M., Tromp, G., Hoal, E.G., Kinnear, C.J., and Moller, M. (2019). The X chromosome and sex-specific effects in infectious disease susceptibility. Hum. Genom., 13: 2.

Segovia-Juarez, J., Castagnetto, J.M. and Gonzales, G.F. (2020). high altitude reduces infection rate of COVID-19 but not case-fatality rate, Respir. Physiol. Neurobiol., 281:103494.

Shahriarirad, R., Khodamoradi, Z., Erfani, A., Hosseinpour, H., Ranjbar, K., Emami, Y., Mirahmadizadeh, A., Lotfi, M., Yeganeh, B.S., Nejad, A.D. and Hemmati, A. (2020). Epidemiological and clinical features of 2019 novel coronavirus diseases (COVID-19) in the South of Iran. BMC Infec. Dis., 20(1): 1-12.

Smilowitz, N. R. *et al.* (2021).C-reactive protein and clinical outcomes in patients with COVID-19. *Eur. Heart J.* **42**, 2270–2279.

Stervbo, U., Bozzetti, C., Baron, U., Jürchott, K., Meier, S., Mälzer, J.N., Nienen, M., Olek, S., Rachwalik, D., Schulz, A.R. and Neumann, A. (2015). Effects of aging on human leukocytes (part II): immunophenotyping of adaptive immune B and T cell subsets, Age, 37(5): 93.

Stringer, D, Braude, P, Myint, PK, Evans, L, Collins, JT, Verduri, A, *et al.*. (2021).The role of C-reactive protein as a prognostic marker in COVID-19. *Int J Epidemiol*;50:420–9.

Suleyman, G., Fadel, R.A., Malette, K.M., Hammond, C., Abdulla, H., Entz, A., Demertzis, Z., Hanna, Z., Failla, A., Dagher, C., and Chaudhry, Z. (2020). Clinical characteristics and morbidity associated with coronavirus disease 2019 in a series of patients in metropolitan Detroit, JAMA, 3(6): e2012270-e2012270.

Syrett, C.M., and Anguera, M.C. (2019). When the balance is broken: X-linked gene dosage from two X chromosomesand female-biased autoimmunity. J. Leukoc. Biol., 106, 919-932.

Tan, C, Huang, Y, Shi, F, Tan, K, Ma, Q, Chen, Y, *et al.*. (2020). C-reactive protein correlates with computed tomographic findings and predicts severe COVID-19 early. *J Med Virol* 2020;92:856 62.

Tharakan, S., Nomoto, K., Miyashita, S., and Ishikawa, K. (2020). Body temperature correlates with mortality in COVID-19 patients, Crit. Care, 24:298.

Tian, H., Liu, Y., Li, Y., Wu, C.H., Chen, B., Kraemer, M.U., Li, B., Cai, J., Xu, B., Yang, Q., and Wang, B. (2020). an investigation of transmission control measures during the first 50 days of the COVID-19 epidemic in China, Science, 368(6491): 638-642.

Ubeda, F.; Jansen, V.A. (2016) The evolution of sex-specific virulence in infectious diseases. Nat. Commun., 7:13849.

Van Deursen, J.M. (2014). The role of senescent cells in ageing, Nature 509(7501): 439-446.

Wang, G., Luo, F.M., Liu, D., Liu, J.S., Wang, Y., Chen, H., Tian, P.W., Fan, T., Tang, L., Yu, H., and Wang, L. (2021). Differences in the clinical characteristics and outcomes of COVID-19 patients in the epicenter and peripheral areas of the pandemic from China: a retrospective, large-sample, comparative analysis, BMC Infect., 21(1): 1-15.

Wu, Y., Feng, Z., Li, P., and Yu, Q. (2020d). Relationship between ABO blood group distribution and clinical characteristics in patients with COVID-19, Clin. Chim. Acta., 509: 220-223.

Wu, Z., and McGoogan, J.M. (2020). Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China - summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention, JAMA, 323(13):1239-42.

Xue, Q.L. (2020). Frailty as an integrative marker of physiological vulnerability in the era of COVID-19, BMC Med., 18(1):333.

Zeng, X., Fan, H., Lu, D., Huang, F., Meng, X., Li, Z., Tang, M., Zhang, J., Liu, N., Liu, Z., and Zhao, J. (2020). Association between ABO blood groups and clinical outcome of coronavirus disease 2019: Evidence from two cohorts, Infect. Genet. Evol., 84(1567-1348):104485.

Zhang, G., Shuke, N., Zhaohui, Z., and Zhentao, Z. (2020). Longitudinal change of severe acute respiratory syndrome coronavirus 2 antibodies in patients with coronavirus disease 2019, J. Infect. Dis., 222: 183-188.

Zhao, J., Yang, Y., Huang, H., Li, D., Gu, D., Lu, X., Zhang, Z., Liu, L., Liu, T., Liu, Y., and He, Y. (2020). relationship between the ABO Blood Group and the COVID-19 Susceptibility. Clin. Infect. Dis., ciaa1150.