# ABO Blood Grouping Association to Risk and Severity of Symptoms Among Post COVID-19 Infection Patients

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## Abstract

**Background:** Since the COVID-19 outbreak the researches have been focused only on the infection spread prevention and treatment. Right now, there is no biomarker available that can expect people who are at high risk of susceptibility and symptoms severity of COVID-19 infection. Recent studies indicate that a persons' vulnerability and severity of COVID-19 infection may be significantly influenced by their ABO blood group. **Aim:** To explore the association between ABO blood grouping and both risk and severity of symptoms among post COVID-19 infection patients. **Methods:** A retrospective observational research design was used. A convenient 500 post COVID-19 infection individuals from Beni-Suef University hospital were participated in the study. Tool I patient characteristics and tool II COVID-19 related data were used for data collection. **Results:** The findings illustrated that 16.2% exposed to severe COVID-19 symptoms, blood group A represents the highest frequency 34.8% among other blood groups while blood group O depicts the lowest frequency 17.2%. Moreover, severity risk for blood group B individuals was significantly higher than blood group A individuals (OR= 1.795, 95% C.I = 1.027– 3.137). In addition, a statistically significant correlation was found between increased age and severity of symptoms "moderate and severe" ($\chi^2 = 41.626$, $p < 0.001$). **Conclusion and recommendations:** As blood group A showed the highest frequency, following safety precautions is critical for those people, and in the event of a COVID-19 infection, strict treatment, thorough observation, and monitoring are required. Further researches about adding further doses of vaccination for blood group A individuals.

**Keywords:** ABO blood grouping; risk; symptoms severity; COVID-19

## Introduction:

The coronavirus disease 2019 (COVID-19) pandemic has been arisen at the end of 2019 and rapidly spread worldwide as a global health crisis with serious consequences at health, social, and economy level. The pandemic leads to severe illness and death among millions of people globally. According to the World Health Organization (WHO), since December 30, 2019 till January 1, 2022 about 301 707 970 COVID-19 cases have been confirmed, including 5 476 003 deaths **(WHO, 2022).**

The virus of COVID-19 becoming a global health threat with a wide range of symptoms among the infected individuals from asymptomatic infection to severe and critical manifestations leading to mortality. These new SARS-CoV-2 variants may have a higher rate of transmission or increased risk of infection outbreak resulting in severe burden on the healthcare system which provoked efforts to identify the susceptible individuals and investigate the potential mechanisms of the different clinical manifestations among the infected population **(Singanayagam et al., 2022).**

It was found that elderly people have a higher risk for COVID-19 infection and poor prognosis. Furthermore, patients who have associated comorbidities like diabetes, malignancy, chronic heart disease, chronic liver disease, chronic obstructive pulmonary disease, chronic kidney disease, obesity, and smoking have been correlated to severe COVID-19 symptoms. In addition to acute respiratory distress syndrome, shock, and acute kidney injury. So, identifying individuals who are vulnerable to COVID-19 is crucial in dealing with the pandemic **(Pijls et al., 2021).**

Blood group also might be associated with increased susceptibility of infection and with the risk of developing severe COVID-19. The association between

the ABO blood group and the COVID-19 susceptibility was first reported in China in confirmed COVID-19 cases at three different hospitals. It was found that 37% of total COVID-19 patients with blood group A, while only 26% of patients with blood group O in a region where the prevalence of blood groups A and O among the population is 31% and 34%, respectively **(Zhao et al, 2021).**

Blood group antigens can influence infections directly, acting as receptors or co-receptors for microorganisms and toxins; or indirectly, through the anti-blood group antibodies, which can be prompted by bacteria and enveloped viruses bearing blood group-like antigens. As with SARS-CoV-1, preliminary evidence suggests a potential correlation between blood group antigens and increased susceptibility to or increase severity of COVID-19 disease **(Jawdat et al., 2022).**

Analyzing the association between ABO blood group and COVID-19 infection is very important, as ABO blood group of the patients may be an additional factor that could influence the preventive and therapeutic management. For example, the identification of a blood group as a risk factor may guide individual or collective decisions on vaccination (especially when prioritization is required due to resource constraints) or the use of preventive measures or treatments at an early stage, and it also may suggest new treatment and enhance the design of new studies **(Gutiérrez-Valencia, 2022).**

**Significance of the Study:**

According to the World Health Organization (WHO) in Egypt, from January 3, 2020 to January 31, 2022, there have been 423,688 confirmed cases of COVID-19 with 22,604 deaths reported to the WHO **(WHO, 2022).** There is extraordinary variability in viral susceptibility and disease severity caused by SARS CoV-2 infection, while certain individuals show no symptoms; others experience acute respiratory distress syndrome, septic shock, and even death. This situation explodes an extraordinary effort from scientists, clinicians, and all health workers to rapidly detect the pathogenesis of disease and the effective preventive measures **(Jawdat et al, 2022).**

Many studies have been investigating a possible association between the ABO blood group and SARS-CoV-2 infection, with conflicting findings. Some authors pointed to the ABO blood type as an influencing factor for SARS-CoV-2 infection or even its severity and mortality **(Booth et al., 2021)**. So, it is very important to analyze the association between the ABO blood group and both susceptibility and severity of COVID-19 infections which can help in prevention and treatment of COVID-19 disease.

## Aim of the study

To explore the association between ABO blood grouping and both risk and severity of symptoms among post COVID-19 infection patients.

### Research questions:

**Q1**: What are the characteristics of patients who infected with COVID-19?

**Q2:** What is the blood group type most infected with COVID-19?

**Q3:** What is the blood group type associated with the most severe symptoms of COVID-19?

## Subjects and Methods

**Research design:** A retrospective observational research design was conducted.

**Setting:** Data were collected from Beni-Suef University hospital, Beni-Suef, Egypt. The hospital chest department consisted of two units "14 bed in one unit and 8 beds in the other unit".

**Study subjects:** A convenient sample of 500 post COVID-19 infection individuals selected from health care providers, workers, and patients in the chest ward were participated in the study.

**Sample size calculation:**

Based on a previous a study by **Kabrah et al., (2021)a** where chi-square value of symptom variation between blood groups was (10.689), the effect size was calculated as (0.19). Using the following formula $n = [(Z\alpha/2 + Z\beta)^2 \times 2/ (d)^2$. Where $Z\alpha/2$: depends on level of significance, for 5% this is 1.96, $Z\beta$: depends on power, for 80% this is 0.84 and (d) is effect size. Therefore, $n= [(1.96 + 0.84)^2 \times 2 / (0.19)^2=434$. By adding 10% for dropout rate, final sample size equal 434+43=477. Increased to 500 by the researchers.

**Tools of the study:** Questionnaire sheet was developed and translated into Arabic by the researchers based upon the relevant literature **Wu, Feng, Li, & Yu (2020); Muñiz-Diaz et al., (2021); Almadhi, et al., (2021)a.** Which consists of two tools.

**Tool I: Patient characteristics which composed of two parts.**

- **Part one:** It includes patient's demographic data (age, gender, residence, level of education and occupation).
- **Part two:** Health related data comprised of presence of comorbidities and usual

medications taken before COVID-19 infections.

**Tool II: COVID-19 related data: It consisted of two main parts:**

- **Part one:** It composed of compliance to protective precautions, life style, smoking status and ABO blood group. (4 items)
- **Part two:** It comprised signs and symptoms, severity of COVID-19 infection, treatment options and the need for oxygen therapy during infection episodes. (4 items)

**Validity and Reliability:**

A jury of three experts in Medical-Surgical nursing, Community Health Nursing, and Medical Statistics assessed the content validity. The tools were revised for clarity, relevancy, simplicity, and applicability; minor changes were made, and the final form was created.

**Pilot Study**

A pilot study was carried out on 10% (50) of the participants to test the applicability and feasibility of the tools and make necessary modifications. Patients who participated in the pilot study were not included in the study sample.

**Ethical Considerations**

A written permission obtained from dean of faculty of nursing, Beni-Suef University and directed to hospital manager to facilitate data collection. After an explanation of the purpose of the study, informed consent was obtained from all the participants before starting the data collection procedure. After clarification of the nature & purpose of the study, the researchers emphasized that participation is voluntary and the participants had the right to withdraw at any time. Furthermore, they were assured that confidentiality of information was protected.

**Data collection**

Data were collected in the following phases from December 2021 to April 2022:

**Preparatory phase:**

The researchers assessed participants to identify previous positive cases of COVID-19 among health care providers and workers in the hospital.

**Implementation phase:**

The researchers designed an electronic tool on google form and sent it to the participants to find out their previous experiences about the symptoms of COVID-19 infection. The researchers involved positive COVID-19 patients at the chest department of the hospital to the study and their data were filled by the researchers from hospital records.

**Statistical analysis of the data**

IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) was used to analyze data. Qualitative data were described using number and percent. The Kolmogorov-Smirnov test was used to verify the normality of distribution. Quantitative data were described using range (minimum and maximum), mean, standard deviation, median. Significance of the obtained results was judged at the 5% level. The used tests were Chi-square test for categorical variables to compare between different groups and odd ratio (OR) that was used to calculate the ratio of the odds and 95% confidence interval of an event occurring in one risk group to the odds of it occurring in the non-risk group.

**Results:**

**Table (1)** illustrated that about two thirds of the participants were female (69.2%). Additionally, two thirds between 18-30 years and graduated from university (63.4%, 63.0%) respectively and only 9.8% were pregnant. Half of them 51.0% were from medical field and 52.4% were from rural.

**Table (2)** displayed that the majority of patients were free from comorbidities (84.6%) and only 15.4% had associated comorbidities. The high associated chronic diseases were cardiovascular diseases (5.0%). Also, more than two thirds of patients (77.8%) not used to take medications before COVID-19 infection while the highest medications used were antibiotics (9.4%).

**Table (3)** showed that only one fifth of patients (23.6%) didn't follow a balanced diet, and more than one third didn't exercise regularly (41.0%). Only 13.2% don't get plenty of rest. Furthermore, the majority of patients (85.8%) were non-smokers.

**Figure (1)** revealed that the majority of patients were committed with protective precautions (83.2% wear mask regularly, 77.8 wash hands thoroughly, 73.2% committed to personal tools, and 68.8 % maintain one meter distance with others.

**Table (4)** revealed that fever represents more than half of patients (53.4%) followed by sore throat and G.I.T were equal (46.8%). About one third of patients showed loss of taste and shortness of breath (37.4%, 34.4%) respectively. Then (29.0%, and 28.4%) for upper respiratory infection and dry cough. The lowest frequencies for hypotension and loss of voice that were the same (0.2%). The majority of patients treated at home (91.6%) and only (11.4%) needed oxygen.

**Figure (2)** illustrated that 50.0% of symptoms were moderate while, about one third (33.8%) were mild and the lowest (16.2%) were severe.

Blood group A represents the highest prevalence 34.8% followed by blood group AB 30.4%. The lowest prevalence was among blood group O (17.2%) **figure (3) displayed.**

**Table (5)** illustrated that severity risk in blood group B individuals was significantly higher than in group A individuals (OR= 1.795, 95% C.I = 1.027– 3.137).

**Table (6)** showed that there was a statistically significant correlation between increased age and severity of symptoms "moderate and severe" ( $\chi^2$ = 41.626, $p < 0.001$). While, there were no statistically significant correlation between gender & smoking and symptoms severity ($\chi^2 = 0.319$, $p = 0.853$), ($\chi^2 = 4.515$, $p = 0.341$) respectively.

**Table (1): Distribution of the participants according to demographic characteristics (n = 500)**

| Demographic characteristics | No. | % |
|---|---|---|
| **Gender** | | |
| Male | 154 | 30.8 |
| Female | 346 | 69.2 |
| **Age (years)** | | |
| 18<30 | 317 | 63.4 |
| 30<40 | 100 | 20.0 |
| 40<60 | 71 | 14.2 |
| > 60 | 12 | 2.4 |
| Min. – Max. | 18.0 – 99.0 | |
| Mean ± SD. | 28.99 ± 11.76 | |
| Median | 24.0 | |
| **Level of education** | | |
| Illiterate | 3 | 0.6 |
| Secondary | 81 | 16.2 |
| University | 315 | 63.0 |
| Post graduate | 101 | 20.2 |
| **Pregnancy** | **(n = 346)** | |
| Yes | 34 | 9.8 |
| No | 312 | 90.2 |
| **Occupation** | | |
| Medical field | 255 | 51.0 |
| Non- Medical field | 245 | 49.0 |
| **Residence** | | |
| Rural | 262 | 52.4 |
| Urban | 238 | 47.6 |

SD: **Standard deviation**

**Table (2): Participants' distribution concerning health-related data (n = 500).**

| Health related data | No. | % |
|---|---|---|
| **Comorbidities**[#] | | |
| No | 423 | 84.6 |
| Cardiovascular diseases | 25 | 5 |
| Diabetes | 21 | 4.2 |
| Liver disease | 10 | 2 |
| Obesity | 18 | 3.6 |
| Chronic renal failure | 1 | 0.2 |
| Rheumatoid arthritis | 3 | 0.6 |
| Hypothyroidism | 6 | 1.2 |
| Musculoskeletal diseases | 4 | 0.8 |
| Bronchial asthma | 7 | 1.4 |
| Esophageal regurgitation | 2 | 0.4 |
| **Medications**[#] | | |
| No | 389 | 77.8 |
| Antibiotics | 47 | 9.4 |
| Corticosteroids | 10 | 2 |
| Diabetic medications | 21 | 4.2 |
| Hypertensive medications | 16 | 3.2 |
| Analgesics | 10 | 2 |
| Bronchodilator | 7 | 1.4 |
| Hypothyroidism medications | 6 | 1.2 |

[#]: More than one answer

**Table (3): Distribution of the participants according to adherence to healthy life style (n = 500).**

| Healthy life style | No. | % |
|---|---|---|
| **Follow a balanced diet** | | |
| Yes | 165 | 33.0 |
| No | 118 | 23.6 |
| Sometimes | 217 | 43.4 |
| **Do regular exercise** | | |
| Yes | 103 | 20.6 |
| No | 205 | 41.0 |
| Sometimes | 192 | 38.4 |
| **Get plenty of rest (6-8 hours a day)** | | |
| Yes | 288 | 57.6 |
| No | 66 | 13.2 |
| Sometimes | 146 | 29.2 |
| **Smoking** | | |
| Non smoker | 429 | 85.8 |
| Ex-smoker | 22 | 4.4 |
| Smoker | 49 | 9.8 |

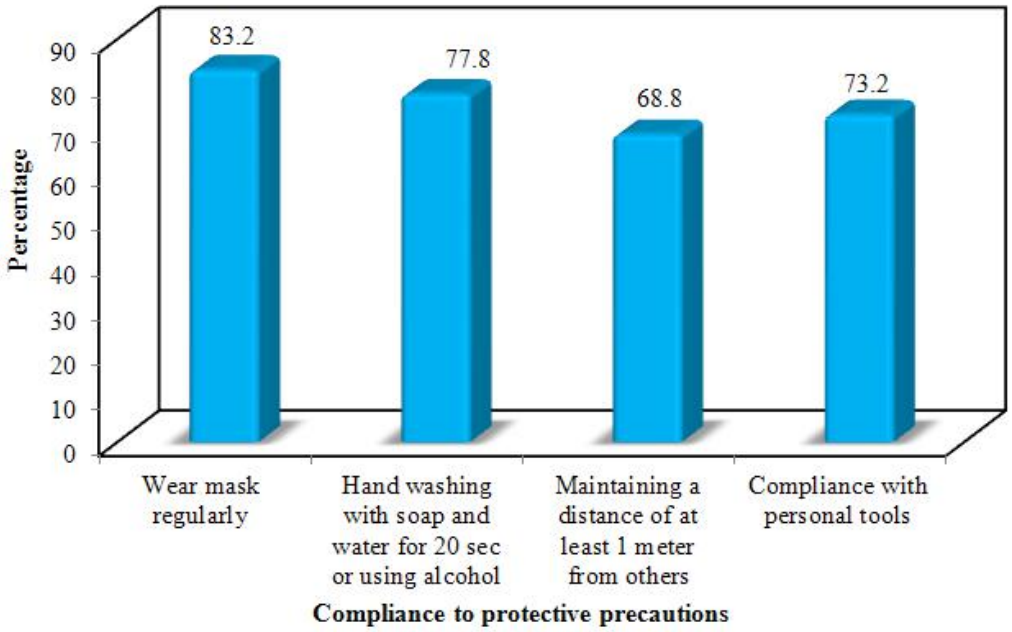


**Figure (1): Participants' distribution according to compliance to protective precautions (n = 500)**

**Table (4): Distribution of the participants according to COVID-19 characteristics (n = 500).**

| COVID-19 characteristics | No. | % |
|---|---|---|
| **COVID-19 Associated Symptoms[#]** | | |
| Upper respiratory tract infection | 145 | 29 |
| Fever | 267 | 53.4 |
| Shortness of breath | 172 | 34.4 |
| Sore throat | 234 | 46.8 |
| Chest pain | 130 | 26 |
| Fatigue | 137 | 27.4 |
| Pharyngeal exudate | 45 | 9 |
| Dry cough | 142 | 28.4 |
| Productive cough | 101 | 20.2 |
| Loss of taste | 187 | 37.4 |
| Gastrointestinal (G.I.T) symptoms | 234 | 46.8 |
| Loss of smell | 19 | 3.8 |
| Body cracking/ pain "back, bone, and joint" | 21 | 4.2 |
| Persistent headache | 6 | 1.2 |
| Diarrhea | 2 | 0.4 |
| Hypotension | 1 | 0.2 |
| Loss of voice | 1 | 0.2 |
| **Treatment** | | |
| At home | 458 | 91.6 |
| At hospital | 42 | 8.4 |
| **Oxygen needed** | | |
| Yes | 57 | 11.4 |
| No | 443 | 88.6 |

[#]: More than one answer

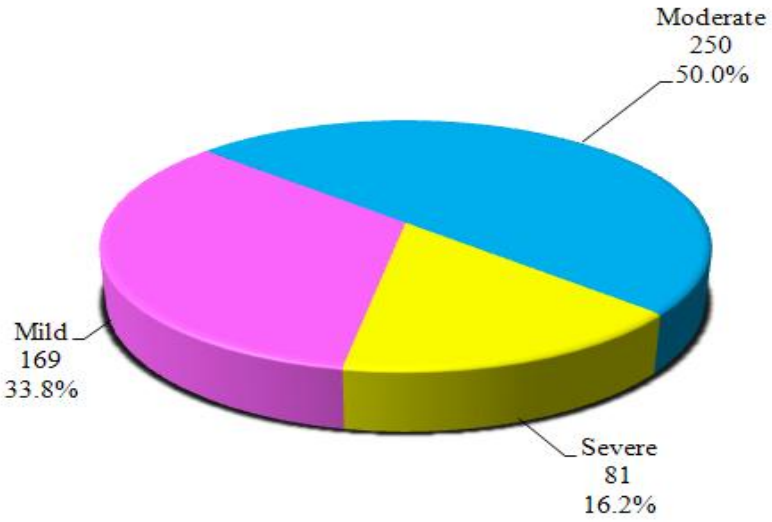


**Figure (2): Participants' distribution regarding severity of symptoms (n = 500)**

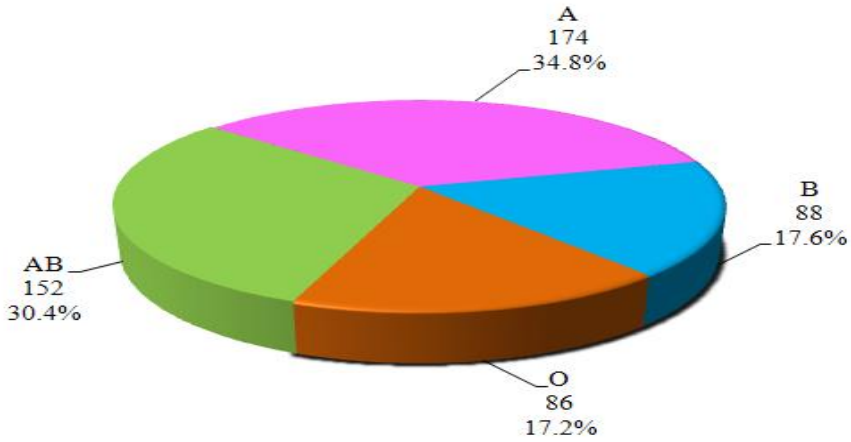


**Figure (3): Distribution of the studied cases according to ABO blood group (n = 500)**

**Table (5): Relation between severity of symptoms and ABO blood group (n = 500).**

| Blood group | Severity of symptoms | | | | $\chi^2$ | p | OR (95% C.I) | p |
|---|---|---|---|---|---|---|---|---|
| | Mild (n =169) | | Moderate +Severe (n =331) | | | | | |
| | No. | % | No. | % | | | | |
| A® | 70 | 41.4 | 104 | 31.4 | 5.513 | 0.138 | 1.00 | |
| B | 24 | 14.2 | 64 | 19.3 | | | 1.795(1.027– 3.137) | 0.040* |
| O | 28 | 16.6 | 58 | 17.5 | | | 1.394 (0.810– 2.401) | 0.231 |
| AB | 47 | 27.8 | 105 | 31.7 | | | 1.504(0.951– 2.378) | 0.081 |

$\chi^2$: **Chi square test**
OR: Odds ratio CI: Confidence interval LL: Lower limit UL: Upper Limit
p: p value for comparison between the studied categories
*: Statistically significant at $p \leq 0.05$

**Table (6): Relation between severity of symptoms and different parameters (n = 500)**

| | Severity of symptoms | | | | | | $\chi^2$ | p |
|---|---|---|---|---|---|---|---|---|
| | Mild (n =169) | | Moderate (n = 250) | | Severe (n = 81) | | | |
| | No. | % | No. | % | No. | % | | |
| **Gender** | | | | | | | | |
| Male | 52 | 30.8 | 75 | 30.0 | 27 | 33.3 | 0.319 | 0.853 |
| Female | 117 | 69.2 | 175 | 70.0 | 54 | 66.7 | | |
| **Age (years)** | | | | | | | | |
| 18<30 | 129 | 76.3 | 150 | 60.0 | 38 | 46.9 | 41.626* | <0.001* |
| 30<40 | 20 | 11.8 | 58 | 23.2 | 22 | 27.2 | | |
| 40<60 | 19 | 11.2 | 39 | 15.6 | 13 | 16.0 | | |
| > 60 | 1 | 0.6 | 3 | 1.2 | 8 | 9.9 | | |
| **Smoking** | | | | | | | | |
| Non smoker | 142 | 84.0 | 213 | 85.2 | 74 | 91.4 | 4.515 | 0.341 |
| Ex-smoker | 6 | 3.6 | 14 | 5.6 | 2 | 2.5 | | |
| Smoker | 21 | 12.4 | 23 | 9.2 | 5 | 6.2 | | |

$\chi^2$: **Chi square test**
p: p value for comparison between the studied categories
*: Statistically significant at $p \leq 0.05$

## Discussion:

From the beginning of the pandemic, the researches have been focused only on the infection spread prevention and treatment. Because, there is currently no biomarker that can predict who is especially susceptible to the infection and the severity of COVID-19 infection symptoms, we have used a retrospective observational research design to explore the association between the ABO blood group and both susceptibility and severity of COVID-19 infections which can help in prevention and treatment of COVID-19 disease.

The current study illustrated that about two thirds of the participants were females and two thirds between 18-30 years graduated from university half of them from the medical field and live in rural. These results disagreed with **Sansone et al., (2022)** who found that about two thirds of the participants were males between 25 and 60 years old, had completed high school and the majority live in urban. This may be because women are responsible for all family members and went out more than men for groceries and markets also for shopping so she is more liable for infection.

Concerning comorbidities, the majority of participants were free from comorbidities and more than two thirds of participants not used to take medications. This result is in the same line with **Hafez et al., (2022)** who found that none of the comorbidities were common among all included participants. This result may be due to the young age of the participants which is between 18-30 years old, and most of the comorbidities appear with old age. Also, half of them from the medical field and they know how to protect themselves from the common health problems and diseases.

The result of the current study clarified that the majority of participants were non-smokers, more than one third didn't exercise regularly, and only one fifth of patients didn't follow a balanced diet. This result consistent with **Tavakol et al., (2021)** who found that the majority of the participants were nonsmokers and clarified that physical inactivity or lower levels of physical activity was significantly associated with the severity of COVID-19. Also, clarified that patients with a healthier dietary pattern had lower severity of the disease. This result may be due to the higher level of education of the participants and half of them from the medical field who recognize the importance of the healthy life style on health.

Concerning protective precautions, the majority of participants were committed with protective precautions. This result supported by **Baumkötter et al., (2022)** who found that the majority using face masks and wash hands thoroughly, and near half of participants maintain physical distancing. This result also may be due to the higher number of participants from medical field, the higher level of education, and increasing the awareness among people regarding COVID-19 prevention. Additionally, these findings revealed that another factor may increase the infection.

Regarding symptoms of infection, fever represents more than half of patients followed by sore throat and G.I.T that were equal. About one third of patients showed loss of taste and shortness of breath. Then upper respiratory infection and dry cough. This result is

supported by **Huang et al., (2020)** who illustrated that common symptoms at onset of the COVID-19 disease were fever, cough, and fatigue; and the less common symptoms were sputum production, headache, hemoptysis, and dyspnea. Also, this result supported by **Almadhi et al., (2021)b** who mentioned that the disease has a wide range of presentations, from asymptomatic infection to fever, cough, shortness of breath and the loss of taste and smell.

Moreover, the present study findings showed that half of participant symptoms were moderate while, about one third were mild and the lowest were severe. This result is in the same line with **Samra et al., (2021)** who found that most of the COVID-19 patients were mild to moderate cases and critical patients were only 36 (7.1%). while, the present study result disagreed with **Huang et al., (2020)** who mentioned that one third of patients were admitted to the ICU because they required high-flow nasal cannula or higher-level oxygen support measures to correct hypoxemia. This result is due to the majority of participants were committed with protective precautions.

The present study also showed that the majority of patients treated at home. This result supported by **Bshaena et al., (2022)** who found that two thirds of patients with COVID-19 had mild to moderate symptoms and were self-isolated at home. This result may be due to the high level of education of the participants, about half of them working in the medical field, and they are aware and familiar with the therapeutic protocol and the steps of isolation and home treatment.

The current study clarified that blood group A represents the highest prevalence followed by blood group AB. The lowest prevalence was among blood group O. Similarly, **Shibeeb, & Khan, (2022)** who illustrated that blood group A is higher risk for Covid-19 infection whereas blood group O is thought to be more protective against it. Also, this is similar to results of **Kabrah et al. (2021)b** who found that blood group A represents the highest prevalence. But it is in contrast with **Bhardwaj et al., (2022)** who showed that the highest frequency between blood group B individuals while blood group AB individuals represents the lowest frequency. Additionally, it is contradicted with **Jawdat et al., (2022)** who found that the highest blood group is O and the lowest is AB blood group individuals.

Although blood group A showed the higher frequency, the present study illustrated that severity risk in blood group B individuals was significantly higher than in group A individuals. This result agreed with **Bhardwaj et al., (2022)** who indicated that blood group B associated with an increased risk of COVID-19 infection and severity. while; this result in contrary to **Jawdat et al, (2022)** who found no significant associations between blood group phenotype and COVID-19 severity. However, he found evidence for associations between blood group phenotype and risk of infection.

Moreover, the study findings revealed a statistically significant correlation between elderly patients and severe symptoms. This is consistent with **Hafez et al., (2022)** who illustrated that an increased age is associated with increased the risk for pneumonia, severe illness, and mortality in patients of all types of blood group.

## Conclusions:

The study findings concluded that the highest prevalence of COVID-19 infection among blood group A individuals and lowest frequency among blood group O. Furthermore, blood group B represented severe symptom higher than blood group A.

## Recommendations:

- Adherence to protective precautions is essential especially for blood group A individuals and in case of COVID-19 infection, strict treatment, close observation and monitoring are crucial from nurses.
- Further studies to compare health outcomes of COVID-19 infection between different blood groups.
- Add ABO blood group to COVID-19 risk factors.
- Further studies on adding further doses of vaccination for blood group A individuals.

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