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Effects of ABO Blood Groups on Psychological and Physical Activity Outcomes with COVID-19: A Comparative Study on Women*

ABO Kan Gruplarının COVID-19 ile Psikolojik ve Fiziksel Aktivite Sonuçları Üzerindeki Etkileri: Kadınlar Üzerinde Karşılaştırmalı Bir Çalışma

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ABSTRACT

Background and Aim: This study compared the effects of ABO blood groups on COVID-19 and its psychological and physical activity outcomes in infected and non-infected women.
Methods: This cross-sectional comparative study was conducted using a web-based online survey on social media platforms (such as WhatsApp, Facebook Messenger, and Instagram). The sample included 409 women (206 COVID-19(+); 203 COVID-19(-)).
Results: While that 65% of the participants with the blood group A were infected with COVID-19, having the blood group A increased the risk of infection 3.929 times. Conversely, the participants with the blood group O had the lowest rate of infection at 33.6% as well as the lowest risk. Considering the Rh factor, 66% of the participants with the Rh factor (Rh(+)) were infected with COVID-19, and Rh(+) increased the risk of infection 2.506 times. Those infected with COVID-19 had more psychological symptoms than those who were not, where those infected with COVID-19 had a 1.241-fold increase in somatization and a 1.354-fold increase in obsessive-compulsive symptoms. Those infected with COVID-19 had lower moderate physical activity scores than those who were not. Among only the COVID-19-infected participants, psychological symptoms were more prevalent among those with the blood group A than others. There was no difference between the physical activity levels of the infected participants according to their blood groups.
Conclusions: It was concluded that the blood group A and Rh(+) increased the risk of COVID-19 infection, and psychological symptoms were more prevalent among women infected with COVID-19 and having the blood group A.

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ÖZET

Giriş ve Amaç: Bu araştırma, COVID-19 enfekte olan ve olmayan kadınlarda ABO kan gruplarının COVID-19 ve bunun psikolojik ve fiziksel aktivite sonuçları üzerindeki etkilerini karşılaştırmalı olarak belirlemek amacıyla yapıldı.
Yöntem: Bu kesitsel karşılaştırmalı çalışma, sosyal medya platformlarında (WhatsApp, Facebook Messenger ve Instagram gibi) web tabanlı bir çevrimiçi anket kullanılarak gerçekleştirilmiştir. Örneklem 409 kadını (206 COVID-19(+); 203 COVID-19(-)) içermektedir.
Bulgular: Kan grubu A olan katılımcıların %65'i COVID-19 ile enfekte olurken, kan grubu A olan katılımcıların enfeksiyon riskini 3.929 kat artırdığı görüldü. Tersine, kan grubu O olan katılımcılar %33.6 ile en düşük enfeksiyon oranına ve aynı zamanda en düşük riske sahipti. Rh faktörü dikkate alındığında Rh faktörü (Rh(+)) olan katılımcıların %66'sı COVID-19 ile enfekte olmuş ve Rh(+) enfeksiyon riskini 2.506 kat artırmıştır. COVID-19 ile enfekte olanlar, olmayanlara göre daha fazla psikolojik semptomlara sahipti, burada COVID-19 ile enfekte olanlarda somatizasyonda 1.241 kat ve obsesif-kompulsif semptomlarda 1.354 kat artış vardı. COVID-19 ile enfekte olanlar, olmayanlara göre daha düşük orta düzeyde fiziksel aktivite puanlarına sahipti. Sadece COVID-19 ile enfekte olan katılımcılar arasında, A kan grubuna sahip olanlar arasında psikolojik semptomlar diğerlerine göre daha yaygındı. Enfekte katılımcıların kan gruplarına göre fiziksel aktivite düzeyleri arasında fark yoktu.
Sonuç: Kan grubu A ve Rh(+) olanların COVID-19 enfeksiyon riskini artırdığı, psikolojik semptomların COVID-19 ile enfekte olan ve kan grubu A olan kadınlarda daha yaygın olduğu sonucuna varıldı.

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1. Introduction

The vast majority of the world's population has been exposed to a number of adversities such as infection risk and social isolation due to the COVID-19 pandemic (1). Age, sex, smoking, and chronic diseases affect the course of the disease in COVID-19 patients (2,3). However, there is no definite biological marker of susceptibility to the disease yet. Studies have shown a relationship between the ABO blood group system and the risk of COVID-19, as in several other viral and bacterial infections such as P. falciparum, H. pylori, Norwalk virus, hepatitis B, and N. gonorrhoeae (2). Studies on the relationship between the ABO blood group system and COVID-19 susceptibility have found that compared to other blood groups, the blood group A increases an individual's susceptibility to COVID-19 infection, whereas the blood group O reduces this susceptibility (4,5). Studies on healthcare workers exposed to similar conditions have also reported that those with the blood group O have a lower risk of COVID-19 infection (6). Similar to the ABO blood group system, the Rh factor (Rh(+) and Rh(-)) is important for immune response. Studies have determined that Rh(-) is significantly protective against COVID-19 infection, whereas Rh(+) is significantly predisposed to it (2,7).

Epidemics or pandemics are not only biological or medical events, but they also affect people's psychology negatively. The rapid spread of COVID-19 and the precautions of governments to reduce its transmission (e.g., quarantine, social distancing, curfews) have produced negative psychological effects on the mental health of populations across the world (8). Nevertheless, studies have reported that women have a higher risk of psychological distress associated with COVID-19 due to their lower social status and more difficult access to healthcare services than men in many societies (9,10).

Although the COVID-19 pandemic is a critical and stressful period in our lives, individuals who have had the disease experience more psychological distress than those who have not (11). In addition, according to studies in the literature, it is believed that there is a genetic link between blood types and mental status because susceptibility to psychiatric disorders can be determined by enzymes and genes. There is also a widely accepted theory about the influence of blood type on personality and mental state (a particular blood type determines personality, temperament and compatibility with others), especially in Japan, as well as in neighboring Asian countries such as South Korea and Taiwan. The findings of the study conducted by Pisk et al. to determine whether there is a significant relationship between psychiatric syndromes and ABO blood groups indicate that there is a relationship between ABO blood group and psychological symptoms (12-15). Studies have found that the risk of conditions involving psychological distress such as depression and anxiety is two times higher in individuals who have had COVID-19, even after treatment, than in those who have not had it. Additionally, psychological symptoms such as post-traumatic stress and sleep disorders are more common in these individuals (16). The quality of life of individuals who have had COVID-19 is negatively affected whereby more than half of these individuals suffer from permanent fatigue (17). COVID-19 is associated with panic reactions, causing fear and anxiety (11). Even if these individuals have recovered, they are afraid of the potential unpredictable complications of the disease, getting sick again, and even dying (18).

The physiological function of the ABO blood group in humans is still a mystery. There is no conclusive evidence of a putative biological role although some hypotheses have been made. After more than a century of research, it is now clear that having a certain blood type can have significant consequences for health and well-being. It is also stated that diseases such as diabetes, venous thrombosis, and especially cardiovascular diseases are associated with the ABO blood group (19). Lippi et al., in their study to determine the effect of ABO blood group on running and athletic endurance, stated that blood groups have a relationship with physical activity (20). It is thought that these conditions will significantly affect the physical activity levels of individuals with ABO blood groups.

Hence, knowing the effects of ABO on mental health, physical activity and COVID-19 in women can allow researchers and clinicians to make early psychological interventions and plan relevant initiatives to increase these women's physical activity levels. Therefore, it is important to know the factors that increase susceptibility to COVID-19. Although the effects of sociodemographic characteristics and blood groups on susceptibility to COVID-19 has been evaluated in separate in the literature (6), there is no study which handles the pandemic period as a whole and simultaneously evaluates psychological symptoms and physical activities after COVID-19 infection. In the light of this information, this study will make an important contribution to the field in order to provide information about the deficiency in the literature and to determine the risk factors for physical, psychological and infectious diseases of health professionals. This study was conducted to compare the effects of the ABO blood group system on COVID-19 and its psychological and physical activity outcomes in women with COVID-19(+) and COVID-19(-) test results.

2. Materials and Methods

2.1. Study Design and Setting

This is an internet-based cross-sectional comparative study. It was conducted using a web-based questionnaire via social media platforms (such as Facebook Messenger, Instagram). The link to the questionnaire, which was prepared on the Google Forms platform (https://docs.google.com/forms), was shared with women's groups and COVID-19 survivor groups on social media. Online data collection has many advantages like convenience, low cost, comprehensiveness, and a shorter time for collecting data. On the other hand, online data collection also raises questions regarding reliability. 'Indifference' has been proposed as the factor with the largest effect in this inadequacy of reliability. Different recommendations have been offered to avoid this problem, including methods such as the 'Self-report, Bogus Item, Instructed Response Item, and LongString Index' methods. In this study, for increasing reliability, the 'LongString Index' and 'Instructed Response Item' methods, which are two of the most prevalently preferred methods, were used (21). The study was conducted with a total of 409 women who were over 18 years old, agreed to fill out the online questionnaire, had no history of physical and/or psychological illness, and did not use any psychiatric medication during the data collection phase. After collecting the data, the participants were divided into two groups as COVID-19(+) and COVID-19(-) according to their history of COVID-19 positivity, including 206 women in the COVID-19(+) group and 203 women in the COVID-19(-) group. Then, the data obtained from these two groups were compared. Before collecting the data, ethical approval was obtained from the Health Sciences Non-Invasive Clinical Research and Publication Ethics Committee (Decision No: 2020/1132).

2.2. Data Collection Tools

The data were collected between November 2021 and January 2022 using a personal information form, the Brief Symptom Inventory (BSI), and the International Physical Activity Questionnaire (IPAQ). Permission was obtained from the authors for the use of scales.

Personal Information Form: The form was created by the researchers to determine some individual characteristics. The form also included questions about blood groups and whether the participants had COVID-19 during the pandemic. Blood groups are classified in two different ways (A, B, AB, and O according to the ABO system and Rh(+) and Rh(-) according to the Rh factor) (5,22).

Brief Symptom Inventory: The scale was developed to screen various psychological symptoms, and its validity and reliability in Turkish were tested by Şahin and Durak. The scale consists of 53 items and nine subscales (obsessive-compulsive disorder, phobic anxiety, hostility, anxiety disorder, psychoticism, interpersonal sensitivity, depression, somatization, and paranoid thoughts). This is a five-point Likert-type scale, where each item is scored from 0=none to 4= too much. A higher subscale score indicates a severe symptom relevant to that subscale. The Cronbach's alpha internal consistency coefficients of the subscales varied between 0.66 and 0.81 in the Turkish validity and reliability study of the scale (23) and between 0.68 and 0.89 in this study.

International Physical Activity Questionnaire: IPAQ was developed to determine the physical activity levels of individuals. Its Turkish validity and reliability study was performed by Öztürk. The scale evaluates an individual's physical activity levels in the last week. To determine physical activity levels, a MET score (minutes/week) is obtained by multiplying the minutes, days, and Metabolic Equivalent of Tasks (METs) for each type of physical activity.

A classification is made at three activity levels according to the score obtained from the sum of the results of these calculations:

- Light =<600 METs-min/week,
- Moderate = 600–3000 METs-min/week,
- Vigorous =>3000 METs-min/week (24).

2.3. Statistical Analysis

The data were analyzed using the SPSS 25.0 for Windows software (SPSS, Chicago, IL, USA). In reporting the results, the participants were divided into two groups: (1) women diagnosed with COVID-19 and (2) healthy women who had not been diagnosed with COVID-19. Blood group data were compared as blood group A and others, blood group B and others, blood group AB and others, blood group O and others, and Rh(+) and Rh(-). Descriptive statistics are presented in frequencies and percentages. The Chi-squared test was used to compare the differences between the groups, and independent-samples t-tests were used to compare the groups in terms of the variables meeting parametric test conditions. A logistic regression analysis was performed to examine the effects of blood groups, psychological symptoms, and physical activity on COVID-19. The level of statistical significance was set at $p<0.05$.

3. Results

3.1. Participant characteristics

Among the participants in the COVID-19(+) group, 56.8% were in the 21-34 age group, 71.8% had university or higher degrees, 64.6% were unemployed, 61.1% were public servants, 61.7% were single, and 87.9% had chronic diseases. Among the participants in the COVID-19(-) group, 47.7% were in the 21-34 age group, 59.6% had university or higher degrees, 83.7% were unemployed, 65%

were public servants, 70% were single, and 86.2% had chronic diseases. Accordingly, there was a statistically significant difference between the groups of women with and without a COVID-19 diagnosis in terms of age, educational status, employment status, and ABO groups ($p<0.05$). On the other hand, there was no statistically significant difference between the groups in terms of their occupation, marital status, and presence of chronic diseases ($p>0.05$).

3.2. Effects of the ABO blood group system on COVID-19 infection status

Table 1 presents the distribution of blood groups between the participants with and without COVID-19-positive test results. Accordingly, 65% of those with blood group A, 50.8% of those with blood group B, 37.5% of those with blood group AB, 33.6% of those with blood group O, and 66% of those with Rh(+) had been diagnosed with COVID-19. Those with blood group A, those who did not have the O blood group, and those with Rh(+) had higher rates of being infected with COVID-19 ($p<0.05$) (Table 1).

Table 1. Comparisons of blood groups, psychological symptoms, physical activity, and COVID-19 infection status

	COVID-19(+) (n=206)		COVID-19(-) (n=203)			
	n	%	n	%	Test	p-value[a]
Blood Group[#]						
A	117	65.0	63	35.0	χ^2=27.538	p<0.001
B	31	50.8	30	49.2	χ^2=0.006	p=0.939
AB	15	37.5	25	62.5	χ^2=2.936	p=0.087
O	43	33.6	85	66.4	χ^2=20.967	p<0.001
Rh(+)	31	66.0	16	34.0	χ^2=5.163	p=0.023
Rh(-)	175	48.3	187	51.7		
	Mean±SD		**Mean±SD**		**Test**	**p-value[b]**
Psychological Symptoms[¥] (BSI subscale scores)						
Somatization	5.89±6.12		3.08±3.55		t=5.694	p<0.001
Obsessive-compulsive symptom	5.39±5.22		4.37±4.51		t=2.102	p=0.036
Interpersonal sensitivity	3.20±3.56		2.45±2.92		t=2.315	p=0.021
Depression	6.57±5.14		4.05±4.48		t=5.279	p<0.001
Anxiety	6.61±5.36		3.22±3.48		t=7.588	p<0.001
Hostility	3.89±4.65		3.07±3.42		t=2.028	p=0.043
Phobic anxiety	3.61±4.16		2.68±3.20		t=2.525	p=0.012
Paranoid thought	4.60±3.85		3.45±3.56		t=3.132	p=0.002
Psychoticism	2.86±3.69		2.13±3.11		t=2.163	p=0.031
Physical Activity (IPAQ scores)[¥]						
Vigorous physical activity	472.62±418.5		1193.85±3423.8		t= -1.306	p=0.199
Moderate physical activity	216.47±191.4		331.43±517.6		t= -1.988	p=0.049
Walking physical activity	555.84±750.9		596.94±840.0		t= -0.479	p=0.133
IPAQ total	637.49±856.4		891.22±2245.7		t= -1.514	p=0.131

Data are expressed as mean ± Standard Deviation
¥ Data are expressed as frequencies and percentages
[a] p <0.05 as determined by Independent-samples t-test
[b] p <0.05 as determined by Pearson's chi-squared test
χ^2: Pearson's chi-squared test; t: Independent-samples t-test; SD: Standard Deviation; BSI: Brief Symptom Inventory; IPAQ: International Physical Activity Questionnaire

The logistic regression analysis results showed that having the blood group A (OR: 3.929) and having Rh(+) (OR:2.506) were associated with an increased risk of COVID-19 infection, while having the blood group O (OR:0.470) was associated with a decreased risk of COVID-19 infection (Table 2).

Tablo 2. Logistic regression analysis on the effects of blood groups, psychological symptoms, and physical activity on COVID-19

	B	SE	df	P[a]	OR	95% CI	
						Lower	Upper
Blood Group							
A Non-A	(Reference) 1.368	0.249	1	<0.001	3.929	2.414	6.394
B Non-B	(Reference) 0.565	0.420	1	0.178	1.760	0.773	4.894
AB Non-AB	(Reference) 0.190	0.381	1	0.617	1.210	0.573	2.554
O Non-O	(Reference) -0.756	0.321	1	0.019	0.470	0.250	0.882
Rh(+) Rh(-)	(Reference) 0.919	0.341	1	0.007	2.506	1.283	4.894
Psychological Symptoms (BSI subscale scores)							
Somatization	0.216	0.047	1	<0.001	1.241	1.132	1.361
Obsessive-compulsive symptom	0.303	0.105	1	0.004	1.354	1.101	1.664
Interpersonal sensitivity	0.143	0.127	1	0.259	1.154	0.900	1.480
Depression	0.050	0.093	1	0.590	1.052	0.876	1.263
Anxiety	-0.105	0.102	1	0.305	0.901	0.738	1.100
Hostility	-0.049	0.111	1	0.661	0.952	0.766	1.184
Phobic anxiety	-0.105	0.099	1	0.286	0.900	0.742	1.092
Paranoid thought	0.023	0.099	1	0.812	1.024	0.844	1.242
Psychoticism	-0.089	0.155	1	0.566	0.915	0.675	1.240
Physical Activity (IPAQ scores)							
Vigorous physical activity	0.000	0.000	1	0.796	1.000	0.998	1.000
Moderate physical activity	-0.001	0.002	1	0.607	0.999	0.995	1.000
Walking physical activity	0.000	0.000	1	0.373	1.000	0.999	1.000

B: Regression Coefficient; SE: Standard Error; df: degrees of freedom; OR: Odds Ratio; CI: Confidence Interval; BSI: Brief Symptom Inventory; IPAQ: International Physical Activity Questionnaire; [a] p <0.05 as determined by logistic regression analysis

3.3. Psychological and physical activity outcomes of the COVID-19 pandemic

All mean psychological symptom scores were significantly higher in those who had been positive for COVID-19 ($p<0.05$). The moderate-intensity physical activity scores were found to be significantly lower in the participants who had tested positive for COVID-19 ($p<0.05$) (Table 1). The logistic regression analysis showed that somatization (OR: 1.241) and obsessive-compulsive symptoms (OR: 1.354) were associated with an increased risk of COVID-19 infection (Table 2).

The results of the comparisons of the mean BSI subscale scores by blood groups of only the COVID-infected participants are given in Figure 1 (Panel A). Accordingly, the mean obsessive-compulsive symptom, interpersonal sensitivity, depression, anxiety, hostility, and paranoid thoughts scores of those who had been positive for COVID-19 and had the blood group A were higher than the mean scores of those who did not have the blood group A ($p<0.05$). Those with the blood group B had lower mean scores of interpersonal sensitivity, depression, anxiety, hostility, paranoid thought, and psychoticism than those in other blood group categories ($p<0.05$). Those with the blood groups AB and O had lower mean scores of depression, anxiety, and paranoid thoughts than those in other blood group categories ($p<0.05$). Those with Rh(+) had a higher mean score of psychoticism than those with Rh(-) ($p<0.05$) (Figure 1–Panel A). There was no statistically significant difference among the mean physical activity scores of those in different blood group categories (A, B, AB, O, Rh(+) and Rh(-)) ($p>0.05$) (Figure 1–Panel B).

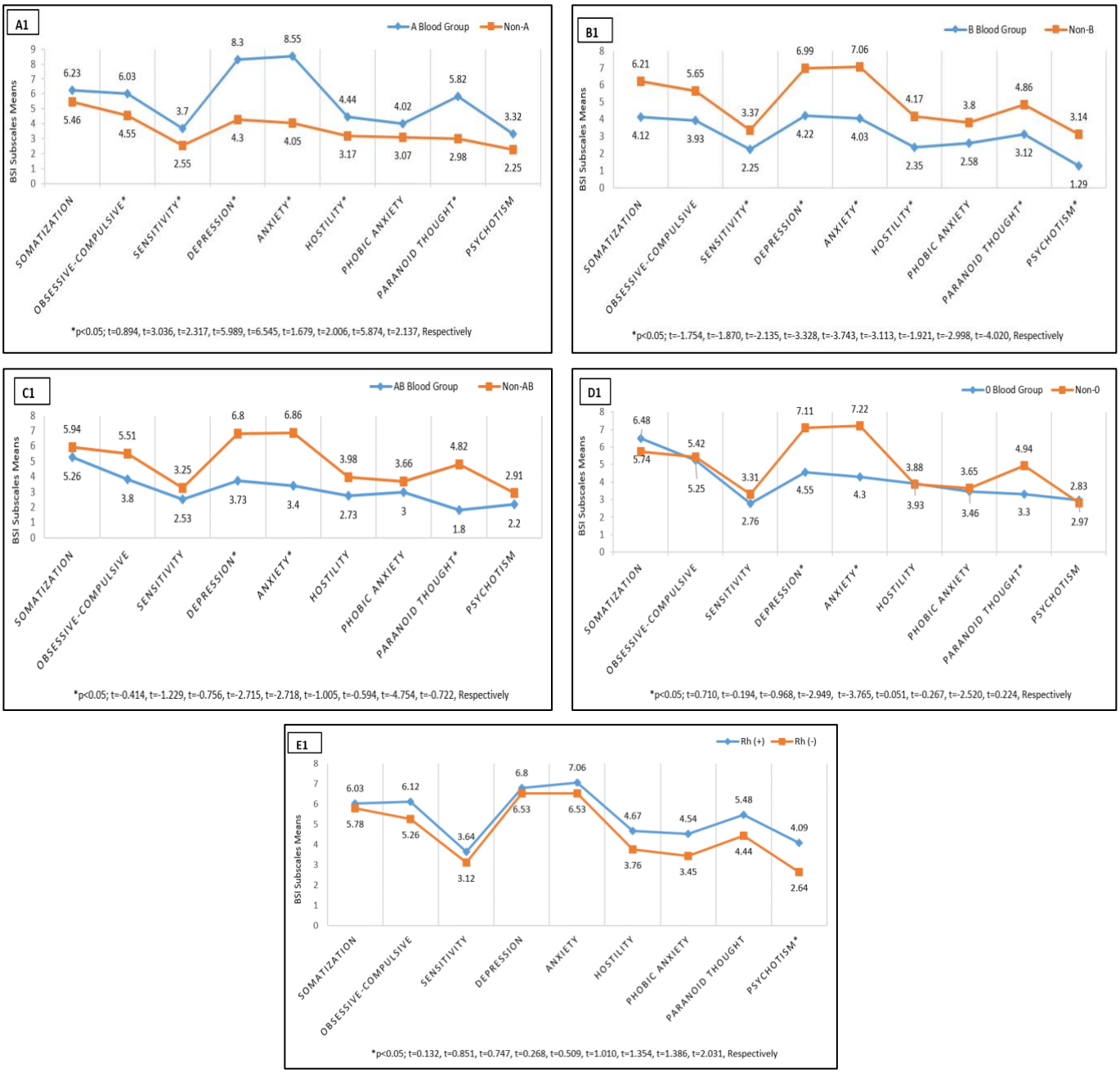

Figure 1. Panel A

*Data of only COVID-infected women, t: Independent-samples t-test, BSI: Brief Symptom Inventory

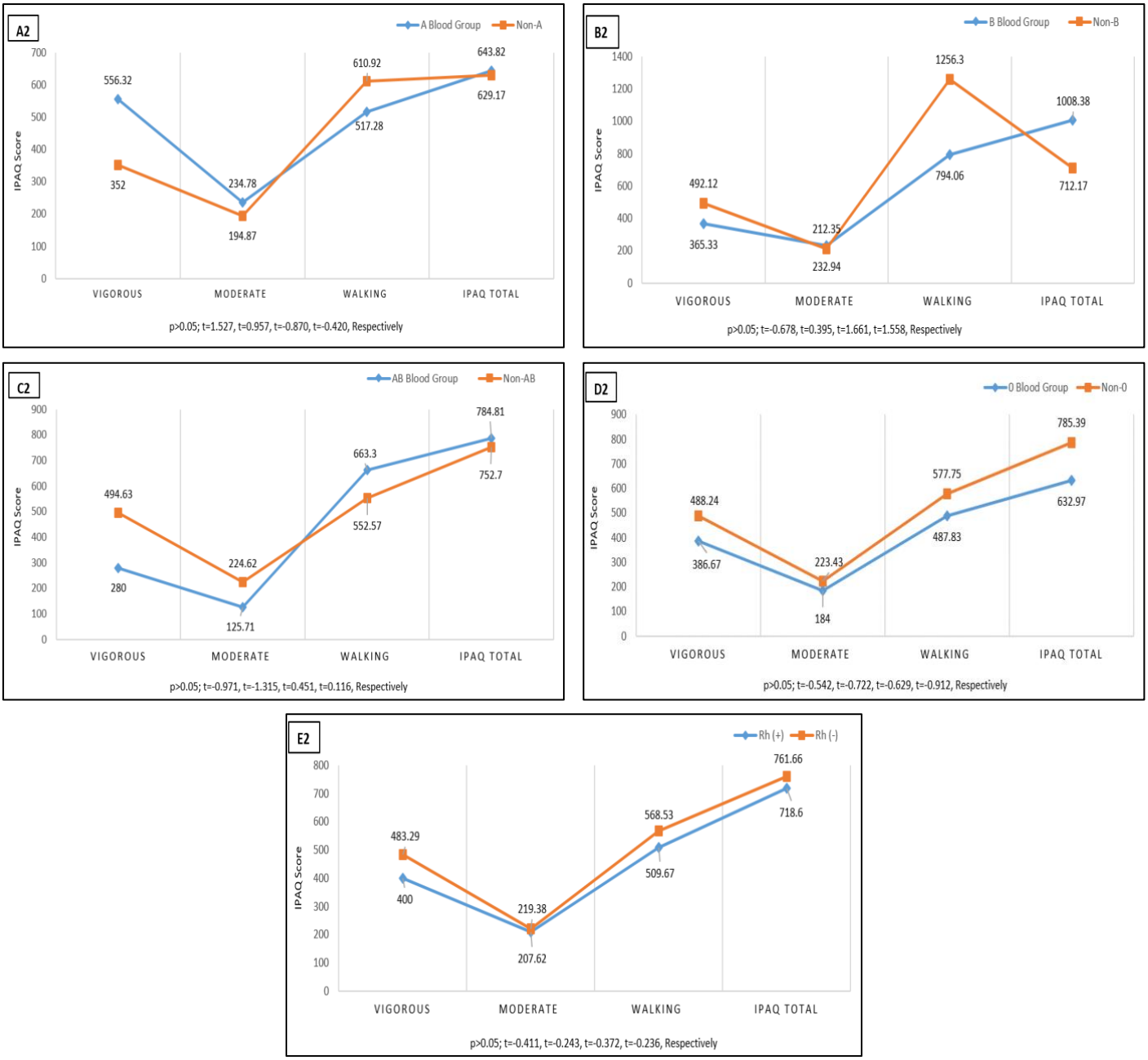

Figure 1. Panel B

*Data of only COVID-infected women, t: Independent-samples t-test, IPAQ: International Physical Activity Questionnaire

Figure 1. Panel A- The mean BSI subscale scores by blood group among only COVID-infected participants (n=206). Data are expressed as means. *p<0.05 as determined by Independent-samples t-test. Panel B- Total activity, vigorous activity, moderate-intensity activity, and walking scores calculated in units of MET-minutes/week by the blood groups of only COVID-infected participants (n=206). Data are expressed as means. There was no statistically significant difference between the groups as determined by Independent-samples t-test. A1) Comparison of BSI subscale and B1) physical activity scores of participants with and without the A blood group. A2) Comparison of BSI subscale and B2) physical activity scores of participants with and without the B blood group. C1) Comparison of BSI subscale and C2) physical activity scores of participants with and without the AB blood group. D1) Comparison of BSI subscale and D2) physical activity scores of participants with and without the O blood group. E1) Comparison of BSI subscale and E2) physical activity scores of participants with and without the Rh factor.

4. Discussion

4.1. Effects of the ABO blood group system on COVID-19

This study was conducted to determine the effects of the ABO blood group system on COVID-19 in women. In the study, it was determined that those with blood group A, those who did not have the O blood group, and those with Rh(+) had higher rates of being infected with COVID-19. Several studies have reported an association between ABO blood groups and susceptibility to COVID-19, suggesting an increased rate of COVID-19(+) in individuals with the blood group A and a decreased rate in those with the blood group O (4,5). Studies have also found that the risk of COVID-19 infection is significantly higher in individuals with Rh(+) (2,7). These findings showed that Anti-D antibodies in terms of the Rh factor increase the risk of COVID-19 infection. Additionally, a lower infection rate in the blood group O can be interpreted as that Anti-A and Anti-B antibodies can prevent target cell infection while a higher infection rate in the blood group A can be interpreted as that individuals carrying the A-antigen are more prone to COVID-19 infection (25). Accordingly, it may be stated that Anti-A and Anti-B antibody transfusion can prevent COVID-19 infection or provide partial protection against infection. These findings showed that individuals with the blood group A and Rh(+) should take more protective measures against COVID-19 infection. Considering that the number of individuals with the blood group A and the Rh factor is high worldwide (26), these findings are thought to be important in the prevention and treatment phases.

4.2. Psychological and physical activity outcomes of the COVID-19 pandemic

This study contributes to evidence on the effects of a diagnosis of COVID-19 on psychological symptoms in women. The results of this study demonstrated that psychological symptoms were more abundant in those with a history of COVID-19, somatization was associated with a 1.241-fold increased risk of COVID-19 infection, and obsessive-compulsive symptoms were associated with a 1.354-fold increased risk of COVID-19 infection. Similarly, several studies have reported that COVID-19 negatively affects individuals, increasing their psychological symptoms (27, 28). Pérez-Fuentes et al. conducted a study with 1,014 Spanish people and showed that perceived threat due to COVID-19 was positively associated with negative emotions and emotional symptoms, namely sadness-depression, anxiety, and anger-hostility (29). One study about the effects of COVID-19 on psychotic symptoms, namely paranoia and hallucinations, found a significant relationship between the presence of paranoid thoughts and hallucinations and compulsive buying during the COVID-19 pandemic (30). This result revealed that women infected with COVID-19 are vulnerable to changes in psychological status and deserve special care to cope with the high level of psychological problems created by a period of uncertainty and stress. These studies show parallelism with our findings.

Although studies examining blood groups and physical activity levels have not been found in the literature, we think that this study will shed light on this clarification in the literature. Quarantine interventions mainly reduce people's physical activity levels (19). This study demonstrated that moderate physical activity levels were lower in those who had been COVID-19 positive. One study conducted with 2,524 people in Italy determined a statistically significant difference in total physical activity levels measured before and during the COVID-19 pandemic period, whereby individuals diagnosed with COVID-19 had significantly lower physical activity levels during the quarantine process (31). Spending a long time at home increases sedentary behaviors and decreases energy expenditure, leading to the formation and/or progression of chronic diseases, loss of muscle strength and mass, causing immune loss, and increasing viral potential risks (32).These studies are similar to our findings.

As another important result, this study determined higher levels of psychological symptoms in women infected with COVID-19 who had the blood group A. Still, since the 1950s, there have been several studies suggesting a relationship between the blood group A and depression (22,33). Apart from these studies, in a study conducted with 226 medical students to examine the relationship between blood groups and depression, a significant relationship was reported between the blood group A and post-traumatic stress disorders (22). In the literature, the higher frequency of psychological problems in individuals with the blood group A has been attributed to the fact that the stress hormone cortisol is higher in individuals with the blood group A than those with other blood groups. The overproduction of cortisol causes fatigue and depression (34). This information explains that the women who had been infected with COVID-19 and had the blood group A among the participants of this study had more psychological symptoms. Therefore, it may be argued that those with the blood group A among women with a history of COVID-19 may need more psychological support.

5. Conclusion

According to the results of this study, the ABO blood group system plays an active role in COVID-19 infection. It was determined that the risk of infection increased in the participants with the blood

group A and the Rh factor, and the risk of infection decreased in those with the blood group O. Besides, COVID-19 was found to cause an increase in psychological symptoms and a decrease in moderate physical activity levels. The participants who had been positive for COVID-19 and had the blood group A had more psychological symptoms. There was no significant relationship between blood groups and physical activity levels in the participants who had been infected with COVID-19. In addition, risk prevention support programs should be developed in order to protect both the physical and psychological health of individuals with risky blood groups. All health personnel, especially in family health centers providing primary care preventive health services, should be informed about this issue.

Healthcare professionals should know how and in what way the ABO blood group can affect the process of an infectious disease such as COVID-19, and thus, the physical and psychological health of individuals and necessary training should be provided. It may also be helpful to introduce the ABO blood type and the risk of COVID-19 to midwives, healthcare professionals and non-healthcare workers as a routine part of the COVID-19 pandemic process. It may also be useful to inform healthcare professionals and non-healthcare workers about the ABO blood group system and their risks of having COVID-19 as a routine part of measures implemented during the COVID-19 pandemic period.

Limitations of the study

This study has some limitations. First, this is a cross-sectional study, therefore, it could not determine a causality in the results. A prospective cohort study can be more reliable in determining causes and effects. Second, as this is a single-centered study that does not have a large sample group, its results cannot be generalized to all population. It may be suggested to cover a wider area and have a larger sample in future studies.

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Authorship Contribution:

EKO: Research design, literature review, manuscript writing and final checks.

ESB: Research design, literature review, manuscript writing and final checks.

TU: Literature review, manuscript writing and final checks.

EG: Literature review, manuscript writing and final checks.

SÖC: Literature review, data collection and analysis.

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