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Change of complete blood count parameters according to blood type and smoking

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Abstract

In this study, it was aimed to investigate the change in the parameters of complete blood count depending on blood type and smoking status. The individuals were grouped according to their blood group type and status of cigarette use, and the statistical differences in their levels of Neutrophil/Lymphocyte ratio (NLR), Platelet/Lymphocyte ratio (PLR), and Mean Platelet Volume/Lymphocyte ratio (MPVLR) were evaluated.3119 individuals participated in the study. 26.67% of them were smokers. According to the ABO blood group system, 44.47% of the participants had type A, 32.48% had type O, 16.09% had type B, and 6.96% had type AB. 88.81% of the participants were Rh(+) and 11.19% of them were Rh(-). The NLR, PLR, and MPVLR of the smokers were higher than those of the non-smokers. The participants' NLR, PLR, and MPVLR levels showed statistically significant differences depending on ABO and Rh blood groups. This difference was seen to arise from ARh (+) individuals. The NLR, PLR, and MPVLR levels were the highest in ARh (+) individuals and the lowest in the ABRh (-) individuals. The NLR, PLR, and MPVLR values were the highest in the ARh (+) smokers and the lowest in ABRh (-) non-smokers. It was found that there were significant differences in the participants' blood count parameters depending on blood type and smoking status. This may imply that ARh (+) individuals who smoke have higher parameters than those who have other blood groups and do not smoke, which may be beneficial in predicting the risk of chronic inflammation-related diseases.

Keywords: ABO blood group, healthy individuals, Rh factor, smoking

1. Introduction

Various blood group systems have been identified based on different blood group antigens. Clinically valid system is ABO and Rhesus (Rh). The ABO blood group system consists of four basic groups, that is, A, B, AB, and O, which change depending on the presence of A and B antigens. These antigens are controlled by three alleles (A, B, and O genes) on the long arm of chromosome 9 (1).The Rh blood group system plays an important role in blood transfusion. In Rh system, blood groups are classified as Rh (-) and Rh (+) (2). Population studies have shown that the frequencies of ABO group phenotypes vary widely between ethnicities (3). While the distribution of ABO blood groups is O> A> B> AB across the world; in Turkey, it is A> O> B> AB and Rh (+)> Rh (-) (4).Although ABO blood group antigens are mainly expressed by erythrocytes, they are also expressed by different cells in various human tissues, including epithelial cells, vascular endothelial cells, and neurons. Therefore, studies have focused on the role of ABO antigens in the pathogenesis of various systemic diseases (5).Studies have shown that ABO and Rh blood groups are associated with cancer, cardiovascular diseases, infections, thyroid diseases, diabetes mellitus, chronic kidney failure, postpartum depression, and rheumatological diseases (6-8).

Exposure to tobacco smoke has been linked to the development of chronic diseases, including pulmonary diseases, heart infections, and cancer (9). Smoking causes many pathological processes to start and progress. Negative effects of smoking on the hematopoietic system have been shown in previous studies. Smoking causes an increase in the number of leukocytes and platelets in the blood (10). It has been reported that smoking increases systemic inflammation (11).

Neutrophils and leukocytes play an important role in inflammatory processes. Neutrophil/Lymphocyte ratio (NLR), which is calculated by dividing the absolute neutrophil count by the absolute lymphocyte count, is considered as a new marker that can be used to evaluate the systemic inflammatory response (12).

While high platelet counts are associated with poor cardiovascular outcomes, low lymphocyte counts are associated with increased cardiovascular morbidity and mortality. The increase of Platelet/Lymphocyte ratio (PLR), which is a combination of both parameters, is a predictor of poor prognosis in cardiovascular diseases and malignant conditions (13). The increased NLR, PLR, and Mean platelet volume/Lymphocyte ratio (MPVLR) levels were found to be associated with inflammation and poor prognosis (14,15). PLR is seen as a predictor of mortality in heart, lung diseases and some malignant diseases (16).

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Although high MPV values pose an increased risk of cardiovascular disease, they have been considered as one of the markers of systemic inflammatory response in recent years (17). MPVLR, a marker that can be easily detected with complete blood count (CBC), has been shown to increase in the presence of inflammation (14,15). NLR, PLR, and MPVLR levels can be evaluated quickly, cheaply, and easily by clinicians. Shown to be the new markers in the evaluation of systemic inflammatory response; NLR, PLR, and MPVLR have been being used to monitor the prognosis, morbidity, and mortality of many diseases (10).

There are many studies in the literature investigating the effects of ABO and Rh blood groups on chronic diseases (6-8).However, we could not find any study in the literature investigating how CBC parameters and NLR, PLR and MPVLR levels are related to blood types and smoking status.

The purpose of our study was to investigate the effects of ABO and Rh blood groups and smoking status on CBC parameters and NLR, PLR and MPVLR levels.

2. Materials and Methods

The individuals who applied to local University Faculty of Medicine Family Medicine outpatient clinic between January 2018 and January 2020 were included in the cross-sectional study. Sociodemographic data such as age, gender, smoking, and blood group, and complete blood count (CBC) test results were scanned from the hospital automation system. In our hospital, blood samples taken for CBC are collected in K3EDTA tubes and analyzed with the automated hematology analyzer Mindray BC-6000. NLR, PLR, and MPVLR levels were calculated. It was evaluated whether there was any change in the CBC parameters depending on blood groups. Again, it was evaluated whether there was a difference in the CBC parameters between the smokers and non-smokers depending on blood type.

The individuals without any disease were included in the study. These people applied to the polyclinic for reasons such as student registration, check-up, driver's license report, etc. The individuals with acute or chronic diseases, any systemic disease that will affect the results of CBC (cardiovascular diseases, diabetes mellitus, hypertension, cancer, digestive system diseases, respiratory system diseases, psychosis, musculoskeletal system problems, hormonal diseases, kidney failure, obesity, vitamin and mineral deficiencies), drug users, individuals under 18 and over 65, and pregnant individuals were excluded from the study. In addition, subjects with abnormally high and low complete blood counts and other laboratory values (anaemia, leukocytosis, leukopenia, or other hematological, biochemical, or serological abnormalities) were excluded from the study (Fig. 1).

This study was approved by the clinical studies ethics committee of local University (Decision Number: 2020/240).

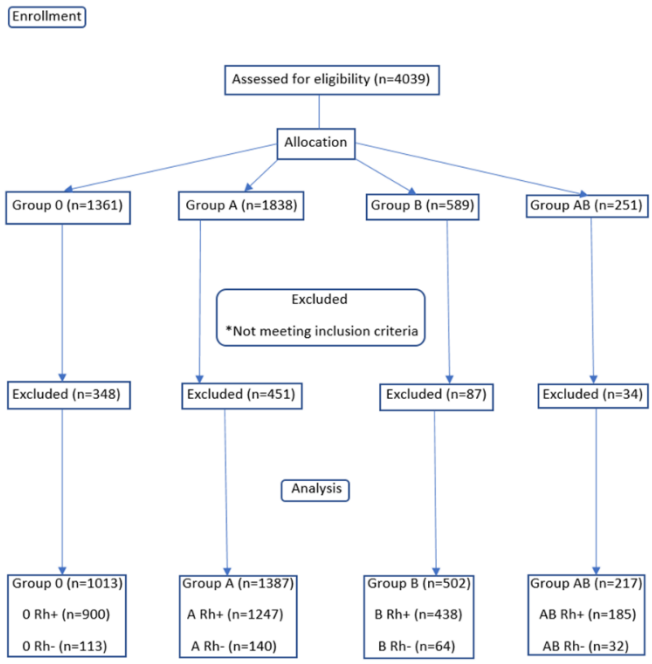

Fig. 1. Flow diagram of the study

2.1. Statistical Analyses

IBM SPSS software package (v.22.0) was used in the statistical data analysis. Descriptive statistics were expressed in number, percentage, and mean ± standard deviation. One Way ANOVA test was used for the parametric data and Kruskal-Wallis test for the non-parametric data. The categorical data were compared with chi-square test. The statistical significance was set at $p<0.05$.

3. Results

Data of 4039 people were scanned for the study, but 920 people who did not meet the inclusion criteria were excluded (Figure 1). Of the 3119 individuals included in the study, 1542 (49.43%) were male and 1577 (50.57%) were female. The average age of the individuals was 34.07±12.52. The rate of smoking in the women was 13.63% (n = 215), and this rate was 40.01% (n = 617) in men. 832 (26.67%) individuals were smokers in the whole group (Table 1).

Table 1. Sociodemographic data of patients

Variables	Smoker	Non-smoker	Total
Age, mean±SD	36.26±11.44	33.08±13.15	34.07±12.52
Male, n (%)	617 (40.01)	925 (59.99)	1542 (49.43)
Female, n (%)	215 (13.63)	1362 (86.37)	1577 (50.57)
Total, n (%)	832 (26.67)	2287 (73.33)	3119 (100)

Table 2. Blood group distributions of patients

Blood Group	Rh (+), n (%)	Rh (-), n (%)	Total, n (%)
O	900 (28.93)	113 (3.55)	1013 (32.48)
A	1247 (40.07)	140 (4.40)	1387 (44.47)
B	438 (14.06)	64 (2.03)	502 (16.09)
AB	185 (5.94)	32 (1.02)	217 (6.96)
Total	2770 (88.81)	349 (11.19)	3119 (100)

The population consisted of 1387 (44.47%) individuals with blood group A, 1013 (32.48%) with blood group O, 502 (16.09%) with blood group B, and 217 (6.96%) with blood group AB. The number of the A Rh (+) individuals, the most crowded group, was 1247 (40.07%), while the number of the AB Rh (-) individuals, the least crowded group, was 32 (1.02%) (Table 2).

The NLR ($p<0.001$), PLR ($p<0.001$), and MPVLR ($p<0.001$) levels of the smokers were statistically significantly higher than those of the non-smokers (Table 3).

Table 3. Changes in hemogram test results and systemic inflammatory parameters according to smoking

Parameters	n(%)	Neutrophil (10^3 /mm^3) mean±SD	Lymphocyte (10^3 /mm^3) mean±SD	Platelets (10^3 /mm^3) mean±SD	MPV (fl) mean±SD	NLR mean±SD	PLR mean±SD	MPVLR mean±SD
Smoker	832 (26.67)	4.56±1.45	2.28±0.69	255.37±58.02	9.99±1.14	2.14±0.91	119.77±39.55	4.74±1.50
Nonsmoker	2287 (73.23	4.29±1.34	2.46±0.89	258.41±62.55	9.98±1.14	1.87±0.62	116.34±41.48	4.50±1.54
Total	3119 (100)	4.36±1.37	2.41±0.85	257.60±61.38	9.98±1.14	1.94±0.71	116.34±41.48	4.56±1.53
p		<0.001	<0.001	0.222	0.926	<0.001	0.005	<0.001

p value, ANOVA test; n, number; SD, Standard Deviation; MPV, Mean Platelet Volume; NLR, Neutrophil / Lymphocyte ratio; PLR, Platelet / Lymphocyte ratio; MPVLR, MPV / Lymphocyte ratio.

There were significant differences between ABO and Rh blood groups in terms of NLR ($p<0.001$), PLR ($p<0.001$), and MPVLR ($p<0.001$) levels. The NLR, PLR, and MPVLR levels were found to be the lowest in the AB Rh (-) patients (Table 4).

Table 4. Changes in hemogram test results and systemic inflammatory parameters according to ABO and Rh blood groups

Blood Groups	n(%)	MPV(fl) mean±sd	NLR mean±sd	PLR mean±sd	MPVLR mean±sd
AB Rh (-)	32 (1.02)	9.80±2.00	0.57±0.34	69.12±34.03	2.69±1.19
AB Rh (+)	185 (5.88)	9.86±1.13	0.85±0.14	74.23±25.52	2.87±0.75
A Rh (-)	140 (4.48)	9.89±1.24	2.01±0.02	116.96±43.97	4.76±1.85
A Rh (+)	1247 (39.82)	10.00±1.17	2.61±0.58	136.35±42.68	5.38±1.48
B Rh (-)	64 (2.05)	9.68±1.56	1.43±0.01	89.09±22.12	3.23±0.74
B Rh (+)	438 (14.05)	9.99±1.06	1.59±0.08	106.58±32.41	4.15±1.21
O Rh (-)	113 (3.62)	9.90±1.07	1.38±0.31	99.17±32.24	3.65±1.13
O Rh (+)	900 (28.78)	10.04±1.05	1.54±0.29	107.70±32.95	4.22±1.20
Total	3119 (100)	9.98±1.14	1.94±0.71	116.34±41.48	4.56±1.53
p	-	0.126	<0.001	<0.001	<0.001

p value, ANOVA test; Rh, Rhesus; n, number; SD, Standard Deviation; MPV, Mean Platelet Volume; NLR, Neutrophil / Lymphocyte ratio; PLR, Platelet / Lymphocyte ratio; MPVLR, MPV / Lymphocyte ratio.

In the statistical analysis carried out considering the ABO and Rh blood groups and smoking status, a significant difference was found in terms of NLR ($p<0.001$), PLR ($p<0.001$), and MPVLR ($p<0.001$) levels. The NLR, PLR, and MPVLR levels were found to be the lowest in the non-smoker AB Rh (-) individuals (Table 5).

Table 5. Changes in hemogram test results and systemic inflammatory parameters according to ABO and Rh blood groups and smoking

Parameters		n (%)	MPV(fl) mean±sd	NLR mean±sd	PLR mean±sd	MPVLR mean±sd
AB Rh (-)	Smoker	12 (0.38)	10.03±0.98	0.92±0.22	76.74±39.75	1.32±0.24
	Non-smoker	20 (0.52)	9.66±2.43	0.36±0.19	64.55±30.27	2.50±1.09
AB Rh (+)	Smoker	30 (0.94)	9.67±0.67	0.92±0.16	83.91±25.14	3.09±0.86
	Non-smoker	155 (4.86)	9.90±1.17	0.85±0.13	73.43±25.98	2.87±0.75
A Rh (-)	Smoker	42 (1.34)	10.14±1.11	2.02±0.02	113.65±35.71	5.12±2.21
	Non-smoker	98 (3.14)	9.79±1.29	2.00±0.01	118.37±47.17	4.60±1.67
A Rh (+)	Smoker	339 (10.86)	10.00±1.29	2.96±0.87	136.00±41.86	5.43±1.41
	Non-smoker	908 (29.16)	9.99±1.12	2.48±0.34	136.49±43.01	5.37±1.50
B Rh (-)	Smoker	18 (0.51)	9.95±0.59	1.43±0.01	93.88±17.26	3.48±0.33
	Non-smoker	46 (1.36)	9.57±1.80	1.43±0.01	87.22±23.66	3.13±0.83
B Rh (+)	Smoker	98 (3.14)	9.98±1.12	1.65±0.07	107.71±31.82	4.26±1.27
	Non-smoker	340 (10.87)	9.99±1.04	1.57±0.07	106.26±32.62	4.12±1.19
O Rh (-)	Smoker	35 (1.15)	10.03±0.97	1.54±0.28	106.07±29.59	3.76±0.88
	Non-smoker	78 (2.57)	9.85±1.11	1.31±0.30	96.07±33.07	3.60±1.22
O Rh (+)	Smoker	258 (8.24)	9.98±1.03	1.59±0.27	113.85±33.76	4.46±1.24
	Non-smoker	642 (20.58)	10.07±1.06	1.53±0.29	105.23±32.32	4.13±1.18
Total		3119 (100)	9.98±1.14	1.94±0.71	116.34±41.48	4.56±1.53
p		-	0.220	<0.001	<0.001	<0.001

p value, ANOVA test; Rh, Rhesus; n, number; SD, Standard Deviation; MPV, Mean Platelet Volume; NLR, Neutrophil / Lymphocyte ratio; PLR, Platelet / Lymphocyte ratio; MPVLR, MPV / Lymphocyte ratio

4. Discussion

In our study, we examined the future health risks as a result of the reflection of blood Type and smoking on hematological parameters. We investigated the effects of blood types and smoking on NLR, PLR and MPVLR values in healthy individuals. In our study, we found that complete blood count parameters changed depending on blood type and smoking status.

In our study, 832 (26.67%) of the individuals included in the study were smokers. The rate of smoking in women was 13.63% (n = 215), and this rate was 40.01% (n = 617) in men. According to the 2012 data of Government Statistical Institute, the rate of smoking in adults was 27% in Turkey. This rate was 41.4% for men and 13.1% for women (18), which is in line with the data in our study. In our study, the frequency of blood groups was as follows: A> O> B> AB. These data were in line with the data in Turkey.

In our study, the NLR, PLR, and MPVLR levels of the smokers were found to be higher than those of the non-smokers. The analysis carried out considering the ABO, Rh blood groups and smoking status showed statistical differences in terms of NLR, PLR, and MPVLR levels. In the post hoc analysis, this difference was observed to be caused by the A Rh (+) individuals. The NLR, PLR, and MPVLR levels were found to be the highest in the A Rh (+) individuals and the lowest in the AB Rh (-) individuals. The NLR, PLR, and MPVLR levels were found to be the highest in the A Rh (+) smokers and the lowest in the non-AB Rh (-) smokers.

Behçet's disease, spondyloarthropathy, vasculitis, and rheumatoid arthritis were reported to be more common in the patients with group A blood. Familial Mediterranean fever, systemic lupus erythematosus, systemic sclerosis, and Sjögren's syndrome have been reported to be more common in the patients with group O blood. inflammatory diseases were found to be the lowest in people with group AB blood (4). In another study, blood type A was found to be a risk factor for myocardial infarction. It was reported that there was a link between the distribution of ABO blood group antigens and the risk of developing specific types of cancer (5). Cancer can cause pathological conditions in many different systems in patients (19). Various studies have suggested that there is a relationship between ABO blood group and tumor behavior and later clinical outcome in patients with various malignancies in lung, kidney, ovary, colorectum, and pancreas. Observational studies have recently shown a relationship between the blood group O and the low risk of exocrine pancreatic tumors (20). In another study, it was shown that while the blood group A increased the risk in gastric cancers, the blood group O was protective (3). Another study reported that individuals with group A had a higher risk of developing glioblastoma, while individuals with group O had a lower risk (5). In their study, Franchini et al. found a positive relationship between A blood group and plasma lipid levels and clinically observed increased susceptibility to cardiovascular disease in individuals with non-O blood types (21).

In a meta-analysis, the frequencies of the blood groups A, B, O, and AB in the individuals infected with COVID-19 were reported as 36.22%, 24.99%, 29.67%, and 9.29%, respectively. The frequencies of the blood groups A, B, O, and AB in cases of death due to COVID-19 infection were calculated as 40%, 23%, 29%, and 8%, respectively. It was shown that the individuals with blood group A were at a higher risk for COVID-19 infection, while those with blood group O were at a lower risk (22). COVID-19 can cause diseases in many systems (23).

In the literature, it has been reported that the individuals with blood group O have a lower risk of cardiovascular disease, high total cholesterol levels, and type 2 diabetes (2). In another study, the probability of developing type 2 diabetes was found to be higher in the individuals with blood group A than in those with other blood groups. It was suggested that blood type A be considered as a risk factor for type 2 diabetes screening (24).

Lung cancer has been reported to be more common in Rh (+) people in the literatüre (25). In another study, Rh factor positivity was found to be higher in rheumatologic patient groups (4). In the study of Tulgar et al., white blood cell, neutrophil, basophil and eosinophil counts; mean corpuscular volume, red cell distribution width and NLR were significantly higher in smokers when compared to non-smokers ($p<0.05$) (26). In our study, the NLR, PLR, and MPVLR levels were found to be high in the A Rh (+) individuals and the smokers. When the groups were combined, the NLR, PLR, and MPVLR levels were found to be at the highest level in the A Rh (+) smoker patients. It may be thought that A Rh (+) individuals have a higher risk for inflammatory diseases, and smoking increases this risk.

The limitation of our study is that it is single-centered and retrospective. Examination of people's smoking addiction level and pack/year status is one of the limitations of the study. One of the limitations of the study is that other laboratory values of the patients (such as white blood cell, hemoglobin, B12, lipid profile, liver function tests, urea and creatinine for kidney function) were not examined. Multicenter studies are needed in which the relationship between the prospective and other systemic inflammatory markers and the parameters such as C-Reactive Protein and sedimentation is examined.

Although there are many studies in the literature on blood groups and chronic diseases, there is no study investigating the effect of blood groups and smoking on NLR, PLR, and MPVLR values in healthy individuals. In this regard, we think that our study will contribute to future studies.

In this study, we found that the parameters of complete blood count changed depending on blood group and smoking status. It was observed that the A Rh (+) individuals who smoke had higher levels of total blood count parameters. This

result may be helpful in predicting the possibility of developing chronic inflammation-related diseases based on blood groups and smoking status.

Ethical Statement

This study was approved by the clinical studies ethics committee of local University (Decision Number: 2020/240).

Conflict of interest

The authors declare no conflicts of interest.

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None to declare.

Authors' contributions

Concept: H.I., Design: H.I., Data Collection or Processing: H.I., Analysis or Interpretation: H.I., Literature Search: H.I., Writing: H.I.

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