



**Full Length Research Article**

**METABOLIC SYNDROME AND ITS COMPONENTS ARE NOT ASSOCIATED WITH ABO BLOOD GROUPS**

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**ARTICLE INFO**

**Article History:**

Received 20<sup>th</sup> December, 2013  
Received in revised form  
03<sup>rd</sup> January, 2014  
Accepted 22<sup>nd</sup> February, 2014  
Published online 05<sup>th</sup> March, 2014

**Key words:**

ABO blood groups,  
Metabolic syndrome,  
Metabolic syndrome components

**ABSTRACT**

**Objective:** There are certain diseases which show strong association with ABO blood groups. No study has been performed for the association between ABO blood groups and metabolic syndrome. The aim of this study was to investigate the association between ABO blood groups and metabolic syndrome.

**Patients and methods:** A total of 300 subjects were enrolled to this cross-sectional study in two groups; 150 patients (according to the NCEP ATP III criteria) in metabolic syndrome group and 150 subjects in control group. All samples were examined for ABO blood groups by trypsin-polybren-citrate (TPC) technique. Frequency of ABO blood groups were determined in both groups. Waist circumference, systolic and diastolic blood pressure of all patients were recorded. Fasting glucose and serum lipid levels were measured. MedCalc 12.7 software program was used for statistical analyses.

**Results:** Chi square test results showed that frequency of blood groups were comparable in study and control groups ( $p>0.05$ ). There was no association between ABO blood groups and metabolic syndrome ( $p>0.05$ ). The frequencies of components of metabolic syndrome were comparable in all ABO blood groups ( $p>0.05$ ).

**Conclusion:** In this case-control study, metabolic syndrome and its components are not associated with ABO blood groups.

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**INTRODUCTION**

Metabolic Syndrome (MS) is a common chronic metabolic diseases complex that affects several people worldwide. It is a cluster of metabolic abnormalities that includes abdominal obesity, hypertriglyceridemia, low levels of high-density lipoprotein cholesterol, hypertension and hyperglycemia. Metabolic syndrome and its components are major risk factors for development of atherosclerosis. Insulin resistance, physical inactivity and hormonal imbalance were common underlying risk factors but clustering of the syndrome in families suggests a genetic component (Church, 2009; Grundy, 2005; Groop, 2000). The blood group antigens are the preponderant human genetic markers. The first blood group antigen system is ABO. A and B antigens are saccharide groups of glycoproteins present on RBC membrane. The alleles which determine the presence of these antigens are located on chromosome 9p (Dziczkowski and Anderson, 2012). Numerous studies have been performed for the relationship between ABO blood

groups and diseases. There are many diseases which were reported in these studies. For example, non O blood group is associated with lung cancer and coronary heart disease, A blood group is associated with oral cancer and carcinoma of stomach, O blood group is associated with prevalence of hemoglobinopathy, duodenal ulcer and also with coagulation defect (Urun *et al.*, 2013; He *et al.*, 2012; Jaleel and Nagarajappa, 2012; Macafee, 1964; Mondal *et al.*, 2012; Issitt and Anstee, 1999). In addition to these studies, relationship between ABO blood groups and diabetes or hypertension or dyslipidemia was investigated in many studies. The results were not clear and mostly conflicting or no relation was found (Kamil *et al.*, 2010; Jassim, 2012; Rahman, 1976; Koley, 2008; Craig and Wang, 1955; Maxwell and Maxwell, 1955). Furthermore, there is no any study about the association between ABO blood groups and metabolic syndrome. In this study we aimed to investigate the association between ABO blood groups and metabolic syndrome.

**MATERIALS AND METHODS**

This case-control study was carried out in the internal medicine outpatient clinics of Adana Numune Training and

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Research Hospital from February 1, 2012 to August 1, 2012. The institutional review board of the hospital approved this experiment (IRB no 16/2012; 09.02.2012), and informed consent was obtained from all subjects. All procedures were followed in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. A total of 300 subjects from both genders, with a minimum age of 18 years old, were included. The study group was comprised of 150 patients with metabolic syndrome and the control group was comprised of 150 healthy subjects. Patients with a diagnosis of a disease other than metabolic syndrome and/or malignancy were excluded. Collection of the data in this study included the following tests: Blood chemistry, waist circumference and blood pressure. Blood pressure of patients was measured after 10 minute of rest with periodically calibrated sphygmomanometers (Erka, Germany) at least two times in two distinct days. One reading was taken for the patients with hypertension. The waist circumference was measured at the plane between the anterior superior iliac spines and between the lower costal margins at the narrowest part of the waistline. A venous blood sample was collected in the morning of overnight fasting.

All samples were examined for ABO blood groups by trypsin-polybren-citrate technique. We measured fasting glucose and serum lipids. Fasting glucose, triglyceride, high-density lipoprotein cholesterol (HDL-C) were analysed with an automatic analyser (Roche C-501, Tokyo, Japan) by using hexokinase method (glucose) and homogeneous colorimetric enzyme test (triglyceride and HDL-C). The metabolic syndrome was defined according to the National Cholesterol Education Program Third Adult Treatment Panel Guidelines (NCEP ATP III) (NCEP, 2001). The components of metabolic syndrome were noted as waist circumference > 102 cm in men or >88 cm in women, triglycerides  $\geq$  150 mg per 100 ml, HDL-C < 40 mg per 100 ml in men or < 50 mg per 100 ml in women, blood pressure  $\geq$  130/85 mmHg, and fasting glucose  $\geq$  100 mg per 100 ml. The metabolic syndrome was defined as having at least three of the five components (NCEP, 2001). MedCalc 12.7 software program (MedCalc Turkey, www.medcalcturkey.com) was used for statistical analysis. Categorical measurements were reported as number and percentage. Quantitative measurements were reported as the mean  $\pm$  SD. Kolmogorov-Smirnov test was used to show the normal distribution of quantitative measurements. Chi square test was used to compare categorical measures and frequency of blood groups between the groups.

**Table 1. The properties of the study and control group**

	Metabolic syndrome group N=150	Healthy group N=150	p	Reference values
Age (years)	46.9 $\pm$ 9.9	44.7 $\pm$ 10.5	0.067	
Female sex N(%)	99 (66%)	83 (55.3%)	0.399	
Waist circumference (cm)	114.8 $\pm$ 12.8	83.5 $\pm$ 8.1	<0.001	Male<102 Female<88
Systolic blood pressure (mmHg)	154.3 $\pm$ 18.8	105.3 $\pm$ 11.8	<0.001	<130
Diastolic blood pressure (mmHg)	89.5 $\pm$ 9.4	66.6 $\pm$ 9.9	<0.001	$\leq$ 85
Fasting glucose (mg/dl)	164.4 $\pm$ 80.2	91.0 $\pm$ 9.7	<0.001	<110
HDL-C (mg/dl)	43.5 $\pm$ 11.0	54.8 $\pm$ 12.5	<0.001	Male>40 Female > 50
Triglycerides (mg/dl)	221.6 $\pm$ 114.3	104.7 $\pm$ 48.0	<0.001	< 150

**Table 2. Frequency of blood groups in the study and control groups**

ABO blood groups	Metabolic syndrome group N=150	Healthy group N=150	p
A	60 (40%)	60 (40%)	0.849
B	20 (13.3%)	24 (16%)	
AB	6 (4%)	9 (6%)	
O	64 (42.7%)	57 (38%)	

**Table 3. Comparison of metabolic syndrome components according to the blood groups in patients with metabolic syndrome**

	A (N=60)	B (N=20)	AB (N=6)	O (N=64)	p
Age (years)	45.6 $\pm$ 9.5	45.2 $\pm$ 12.0	47.8 $\pm$ 7.5	48.5 $\pm$ 9.7	0.159
Female N (%)	42 (70%)	11 (55%)	4 (66.7%)	42 (65.6%)	0.130
Waist circumference (cm)	113.5 $\pm$ 14.4	120.6 $\pm$ 11.1	110.1 $\pm$ 13.8	114.7 $\pm$ 11.1	0.681
Systolic blood pressure (mmHg)	154.8 $\pm$ 17.9	145.5 $\pm$ 15.9	146.8 $\pm$ 18.8	157.2 $\pm$ 19.8	0.741
Diastolic blood pressure (mmHg)	89.6 $\pm$ 9.3	85.6 $\pm$ 11.0	87.1 $\pm$ 9.1	90.8 $\pm$ 8.8	0.508
Fasting glucose (mg/dl)	164.4 $\pm$ 84.6	144.8 $\pm$ 55.3	132.0 $\pm$ 29.8	171.7 $\pm$ 85.2	0.056
HDL-C (mg/dl)	43.8 $\pm$ 10.5	44.8 $\pm$ 9.6	36.4 $\pm$ 10.3	43.5 $\pm$ 11.9	0.703
Triglycerides (mg/dl)	236.8 $\pm$ 146.0	205.3 $\pm$ 89.3	205.4 $\pm$ 133.2	214.0 $\pm$ 81.9	0.062

**Table 4. Comparison of metabolic syndrome components according to the blood groups in healthy subjects**

	A (N=60)	B (N=24)	AB (N=9)	O (N=57)	p
Age (years)	44.5 $\pm$ 10.3	47.8 $\pm$ 12.9	46.1 $\pm$ 11.6	43.4 $\pm$ 9.4	0.161
Female N (%)	31 (51.7%)	16 (66.7%)	5 (55.6%)	31 (54.4%)	0.138
Waist circumference (cm)	81.9 $\pm$ 8.1	83.6 $\pm$ 9.0	84.5 $\pm$ 6.3	85.0 $\pm$ 7.8	0.304
Systolic blood pressure (mmHg)	104.6 $\pm$ 12.2	108.1 $\pm$ 11.5	99.4 $\pm$ 11.3	105.9 $\pm$ 11.5	0.948
Diastolic blood pressure (mmHg)	66.6 $\pm$ 10.7	67.3 $\pm$ 9.7	64.4 $\pm$ 4.6	66.6 $\pm$ 10.0	0.154
Fasting glucose (mg/dl)	91.1 $\pm$ 9.5	96.5 $\pm$ 10.6	86.0 $\pm$ 4.5	89.4 $\pm$ 9.2	0.127
HDL-C (mg/dl)	54.1 $\pm$ 12.7	55.4 $\pm$ 11.5	54.0 $\pm$ 17.3	55.5 $\pm$ 12.1	0.149
Triglycerides (mg/dl)	103.9 $\pm$ 45.0	102.7 $\pm$ 59.1	113.5 $\pm$ 49.8	105.1 $\pm$ 46.9	0.645

ANOVA or Kruskal Wallis tests were used for comparison of quantitative measurements between the groups. Student-Newman-Keuls test used for pairwise comparison. Odds ratio was used for to analyse the degree of association between blood groups and metabolic syndrome. A p-value of less than 0.05 was considered to be statistically significant.

**Table 5. Association of blood groups with metabolic syndrome**

ABO blood groups	OR	95% CI	p
A	1	0.63-1.58	1
B	0.807	0.42-1.53	0.514
AB	0.652	0.22-1.88	0.429
O	1.21	0.76-1.92	0.410

OR=Odds ratio

## RESULTS

The characteristics of the study subjects are summarized in Table 1. The mean age was  $46.9 \pm 9.9$  years for metabolic syndrome group, and  $44.7 \pm 10.5$  years for control group. There were 99 women and 51 men in the metabolic syndrome group, 83 women and 67 men in control group. There was no statistical difference in the age and the gender distribution of the two groups ( $p=0.067$  and  $0.399$ , respectively). The frequency of A, B, AB and O blood groups were 60 (40%), 20 (13.3%), 6 (4%), 64 (42.7%), respectively in patients with metabolic syndrome and 60 (40%), 24 (16%), 9 (6%), 57 (38%) in those without the metabolic syndrome. There was no statistical significant difference between the frequency of blood groups according to the study and control groups ( $p=0.849$ ) (Table 2). Mean level of waist circumference, systolic blood pressure, diastolic blood pressure, fasting glucose, HDL-C and triglycerides were comparable according to the ABO blood groups in both study and control groups ( $p>0.05$  for each one) (Table 3,4). There was no association between blood groups and metabolic syndrome ( $p>0.05$ , for each group) (Table 5).

## DISCUSSION

Distribution of ABO blood groups vary according to populations (Mourant *et al.*, 1978). In our country, most common blood group is A and it is followed by O, B and AB blood groups (Büyükyüksel, 1973). The frequency distribution of ABO blood groups in healthy subjects in present study was similar with the frequency distribution of our country according to Büyükyüksel study (Büyükyüksel, 1973). Although O blood group is higher than A blood group in metabolic syndrome group the difference is not significant. Metabolic syndrome is common in our country and it is also common in female sex. The prevalence of the metabolic syndrome in a Turkish adult population was found 33.4 % (39.1% for women and 23.7 % for men) in Adana, a southern province of Turkey (Özsahin *et al.*, 2004). In accordance with this study female sex was preponderant in the present study. Genetic factors related to distribution of blood groups may play a role in the development of some diseases. A number of studies have been performed for to show the association of ABO blood groups with certain diseases (Urun *et al.*, 2013; He *et al.*, 2012; Jaleel and Nagarajappa, 2012; Macafee, 1964; Mondal *et al.*, 2012; Issitt and Anstee, 1999). In this study we investigated the association of ABO blood groups in patients with metabolic syndrome. The findings suggested that there was no association between the ABO blood groups and metabolic syndrome.

To our knowledge this is the first study that investigates the association between ABO blood groups and metabolic syndrome. Additionally, we investigated the association between ABO blood groups and each of metabolic syndrome components. We did not find any association between ABO blood groups and each of metabolic syndrome components. There are many studies about the association between ABO blood groups and diabetes and/or hypertension and/or dyslipidemia and/or obesity (Kamil *et al.*, 2010; Jassim, 2012; Rahman, 1976; Koley, 2008; Craig and Wang, 1955; Maxwell and Maxwell, 1955; Chandra and Gupta, 2012). There is no any study about the association between waist circumference and ABO blood groups. In Chandra *et al* study, they have shown an association between B blood group and obesity. In that study they did not measure waist circumference they measured and compared body mass index of subjects (Chandra and Gupta, 2012). Systolic and diastolic blood pressures of both metabolic syndrome patients and healthy subjects were comparable according to the blood groups in our study. We have not found any association between ABO blood groups and systolic and/or diastolic blood pressure. In accordance with this link in Maxwell *et al* study, they have not found any association between ABO blood groups and hypertension.

Similarly, Nemesure *et al* have not found any association in African population (Nemesure *et al.*, 2006). There are several studies about the relation between ABO blood group and diabetes. There are inconsistent results in these studies (Macafee, 1964; Mondal *et al.*, 2012; Kamil *et al.*, 2010; Jassim, 2012; Rahman, 1976). Kamil *et al* have found negative association between blood groups A,O and diabetes (Kamil *et al.*, 2010). Whereas Jassim reported in a study from Iraq with a sample size of 920 diabetic patients and 200 controls that there was an association between O blood group and diabetes (Jassim, 2012). On the other hand, Macafee reported in a study with a sample size of 865 diabetic patients and 11327 controls that there was no association between ABO blood groups and diabetes (Macafee, 1964). Similarly, in Rahman study from Bangladesh and in Koley study from India they reported that there was no association (Rahman, 1976; Koley, 2008). Our results in present study is supported with the studies of Macafee, Rahman and Koley. The result of studies about the association between ABO bloods and dyslipidemia or hypercholesterolemia are also inconsistent. A blood group was reported as an associated blood group with hyperlipidemia in Mehta *et al* study from Bombay and in Gillum study from Maryland (Mehta *et al.*, 1984; Gillum, 1991). In another study, Jassim reported that O blood group is associated with hyperlipidemia in Iraq (Jassim, 2012). On the other hand, Orchard *et al* have shown that there is no association between ABO blood groups and cholesterol levels (Orchard *et al.*, 1981). Our results are in accordance with Orchard *et al* study.

This study did have also some limitations. First, it would have been beneficial if the sample size had been larger. Second, the association between Rhesus (Rh) blood groups and metabolic syndrome could have been investigated. Third, further genetic and population investigations are needed to support this study.

In conclusion, we have shown that metabolic syndrome and its each component are not associated with ABO blood groups. Metabolic syndrome can be affected from different genetic

factors other than ABO blood groups. The result of our study is supported by certain studies in literature.

### Acknowledgements

The authors declare that there is no conflict of interests regarding the publication of this article.

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