

Relation between ABO/Rh blood groups and metabolic syndrome

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Abstract

Metabolic Syndrome (MetS) 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. There are certain diseases which show strong association with ABO/Rh blood groups. Few studies have been performed for the association between ABO/Rh blood groups and metabolic syndrome.

Aim of the work: The aim of this study was to investigate the association between ABO/Rh blood groups and metabolic syndrome and its components.

Subjects and methods: A total of 400 subjects were enrolled to this case-control study in two groups; 200 patients with the diagnosis of metabolic syndrome (according to the NCEP ATP III criteria) in the MetS patient group and 200 healthy subjects as control group. Waist circumference, systolic and diastolic blood pressure, fasting blood glucose, Triglycerides and HDL levels were measured for all subjects. ABO blood groups were determined for all subjects by slide

haeagglutination test using anti-A, anti-B, and anti-D monoclonal antibodies.

Results: There was no statistically significant difference with p -value > 0.05 between patients and controls as regards ABO blood groups. On the other hand, positive Rh blood group was significantly higher with p -value <0.05 in patients compared to controls. As regards MetS components, there was no significant difference with p -value > 0.05 between different ABO and Rh blood groups as regards waist circumference, blood pressure, fasting blood glucose and triglycerides. However, BMI was significantly higher in blood group O and lower in blood group AB (p -value <0.05). HDL was significantly lower with p -value <0.05 in Rh positive patients compared to Rh negative patients while there was no significant difference between different ABO blood (p -value > 0.05).

Conclusion: Metabolic syndrome was not associated with ABO blood groups in this study. However, BMI was significantly higher in blood group O and lower in blood group AB. Positive Rh blood group was

associated with metabolic syndrome and lower HDL. Further studies on larger samples are needed to confirm the results of this study.

Keywords:

Metabolic syndrome - ABO blood group – Rhesus blood group

Introduction:

Obesity and the metabolic syndrome (MetS) are two of the pressing healthcare problems of our time. The MetS is defined as increased abdominal obesity in concert with elevated fasting glucose levels, insulin resistance, elevated blood pressure, and plasma lipids. It is a key risk factor for type 2 diabetes mellitus (T2DM) and for cardiovascular complications and mortality. (1)

Researchers have proposed several mechanisms for the development of insulin resistance and the metabolic syndrome. These include: Genetic defects in proteins involved in the insulin action cascade, increased levels of visceral adiposity, free

fatty acid levels (FFA), and chronic inflammation. (2)

ABO blood group was first described by Karl Landsteiner in 1900, based on the presence or absence of specific antigens on the human red blood cell (RBC) membrane.

Blood type is classified as group A, B, O, or AB depending on whether the RBC membranes contain antigen A, antigen B, neither antigen, or both antigens, respectively. Rhesus blood group is the second most important blood group system after ABO. RBC surface of an individual may or may not have immunogenic D-antigen. Accordingly, the status is indicated as either Rh-positive (D-antigen present) or Rh-negative (D-antigen absent). (3)

Recently, a great interest has been provoked among the studies related to the association between ABO and Rhesus blood groups and others diseases. (4) Blood group A has been associated with increased risks of gallstones, colitis, and certain tumor types, Whereas non-O blood groups have been associated with cardiovascular diseases, including

ischemic heart disease and atherosclerosis.(5) Rh positive blood type was found to be a risk factor for gestational diabetes. (6) While other studies reported that Rh negative blood type was more common in the diabetic group. (7).

However there are few published studies as regards the association of blood groups with metabolic syndrome. Moreover, the results of the relationship between ABO blood groups and metabolic syndrome components such as diabetes, hypertension and dyslipidemia are conflicting in different studies. (6)

Identification of risk factors for metabolic syndrome is crucial for prevention, early diagnosis and management by effectively employing lifestyle and modifiable risk factor changes.

The aim of this study was to investigate the association between ABO/Rh blood groups and metabolic syndrome and its components.

Subjects and Methods

This case-control study was conducted in Fayoum University Hospitals during the period from June 2018 to February 2019 and included 200 patients diagnosed as having metabolic syndrome and 200 age and sex matched healthy subjects as a control group.

The study was reviewed and approved by the Faculty of Medicine, Fayoum University ethics committee and written informed consent was obtained from all study participants.

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.

Thorough medical history and full clinical examination were done with emphasis on height, weight, BMI, waist circumference and measurement of BP.

Blood samples were collected for routine laboratory tests and measurement of metabolic syndrome work up including FBS, lipid profile including total cholesterol, LDL, HDL. ABO and Rh blood group determination was done by direct haemagglutination slide method using Vitro Scient anti -A, anti -B and anti -D monoclonal blood grouping antibodies.

Data analysis was performed using Statistical Package of Social Science (SPSS) software version 18 in windows 7. Independent student t-Test was used to compare measures of two independent groups of quantitative data. One way ANOVA test was used in comparing more than two independent groups of quantitative data. For qualitative data, Chi square test was used to compare two or more qualitative

groups. The $p\text{-value} \leq 0.05$ was considered the cut-off value for significance.

Results

The demographic data of the study subjects are summarized in Table 1. The mean age was 32.5 ± 4.9 years for the metabolic syndrome (MetS) group and 31.3 ± 4.2 years for the control group. The metabolic syndrome group included 99 males and 110 females and the control group included 103 males and 97 females. There was no statistical difference in the age and the gender distribution of the two groups ($p=0.5$ and 0.1 respectively).

Anthropometric and metabolic data in different study groups are shown in Table 2. The values of waist circumference, BMI, systolic blood pressure, diastolic blood pressure, fasting blood glucose, triglyceride and HDL were significantly higher in patients with MetS than in controls.

Comparison of ABO/Rh blood groups in different study groups are shown in table 3 and Figures 1 and 2. The blood group O was the most common while the AB blood group was the least frequent in both patient and control groups. There was no statistically significant difference with $p\text{-value} > 0.05$ between cases and controls as regards ABO blood groups. On the other hand, there was statistically significant difference with $p\text{-value} < 0.05$ between cases and controls as regards Rhesus blood group, with high percentage of Rh positive among cases.

Comparison of each of the metabolic syndrome components between different ABO and Rh blood groups is shown in (Table 4 and 5). There was no statistically significant difference between different ABO and Rh blood groups as regards waist circumference, blood pressure, fasting blood glucose and triglycerides. However, there was statistically significant difference with $p\text{-value} < 0.05$ between different ABO blood groups as regards BMI of patients with higher mean BMI among patients with group O and lower mean BMI among patients with AB group (Figure 3). While, there was no statistically significant difference between Rh positive and Rh negative patients as regards BMI. there is statistically significant difference with $p\text{-value} < 0.05$

between different Rhesus factor as regards HDL level of patients, with high mean among patients with negative Rh factor (Figure 4).

Table (1): Demographic data of different study groups.

Variables	MetS group (n=200)	Control group (n=200)	p-value
Age (years)			
Mean \pm SD	32.5 \pm 4.9	31.3 \pm 4.2	0.5
Gender			
Male (%)	90 (45%)	103 (51%)	0.1
Female (%)	110 (55%)	97 (49%)	

Table (2): Anthropometric and metabolic data in different study groups.

Variables	MetS group	Control group	p-value
Waist circumference (cm)	108.1 \pm 10.9		
BMI (kg/m ²)	32.4 \pm 4.9		
Systolic blood pressure	135.1 \pm 16.2		
Diastolic blood pressure	87.3 \pm 11.5		
Fasting blood glucose (mg/dl)	174.5 \pm 55.5		
Triglycerides (mg/dl)	184.4 \pm 60.6		
HDL (mg/dl)	30.9 \pm 9.6		

Table (3): Comparisons of ABO/Rh blood groups in different study groups.

Variables	MetS group		Control group		p-value
	No.	%	No.	%	
Blood grouping					
Group A	82	40.8%	74	37%	0.6

Group B	51	25.4%	49	24.5%	
Group O	48	23.9%	60	30%	
Group AB	20	10%	17	8.5%	
Rhesus factor					
Positive	193	96.5%	183	91.5%	0.03*
Negative	7	3.5%	17	8.5%	

Table (4): Comparisons of metabolic syndrome components in different ABO blood groups among patient group.

Variables	Group A	Group B	Group O	Group AB	p-value
Waist circumference (cm)	106.9±13.9	108.9±10.7	109.7±12.4	102.1±11.2	0.1
BMI (kg/m ²)	32.3 ± 4.1	32.4±4.5	33.6±6.5	29.8±3.2	0.03*
Systolic blood pressure	137.2±16.7	132.2±14.3	134.8±16.2	135±18.2	0.4
Diastolic blood pressure	87.8±12.3	86.5±9.8	87.9±12.4	86±10.5	0.8
Fasting blood glucose (mg/dl)	181.9±53.5	166.6±64.1	168.7±51.9	178.7±47.4	0.4
Triglycerides (mg/dl)	179.5±53.9	193.7±56.5	181.9±62.9	187±88	0.6
HDL (mg/dl)	32.5±8.7	29±10.3	31.3±10.2	28.7±9.4	0.2

Table (5): Comparisons of metabolic syndrome components in different Rh blood groups among patient group.

Variables	Rh positive	Rh negative	p-value
Waist circumference (cm)	107.6±12.8	108.9±10.7	0.9
BMI (kg/m ²)	32.5±4.9	31.3±4.2	0.5
Systolic blood pressure	134.9±16.1	141.4±18.6	0.3
Diastolic blood pressure	87.2±11.4	91.4±13.5	0.3

Fasting blood glucose (mg/dl)	174.2±55.5	183.1±58.8	0.7
Triglycerides (mg/dl)	184.3±60.2	188.9±75	0.8
HDL (mg/dl)	30.7±9.3	38.1±16.4	0.04*

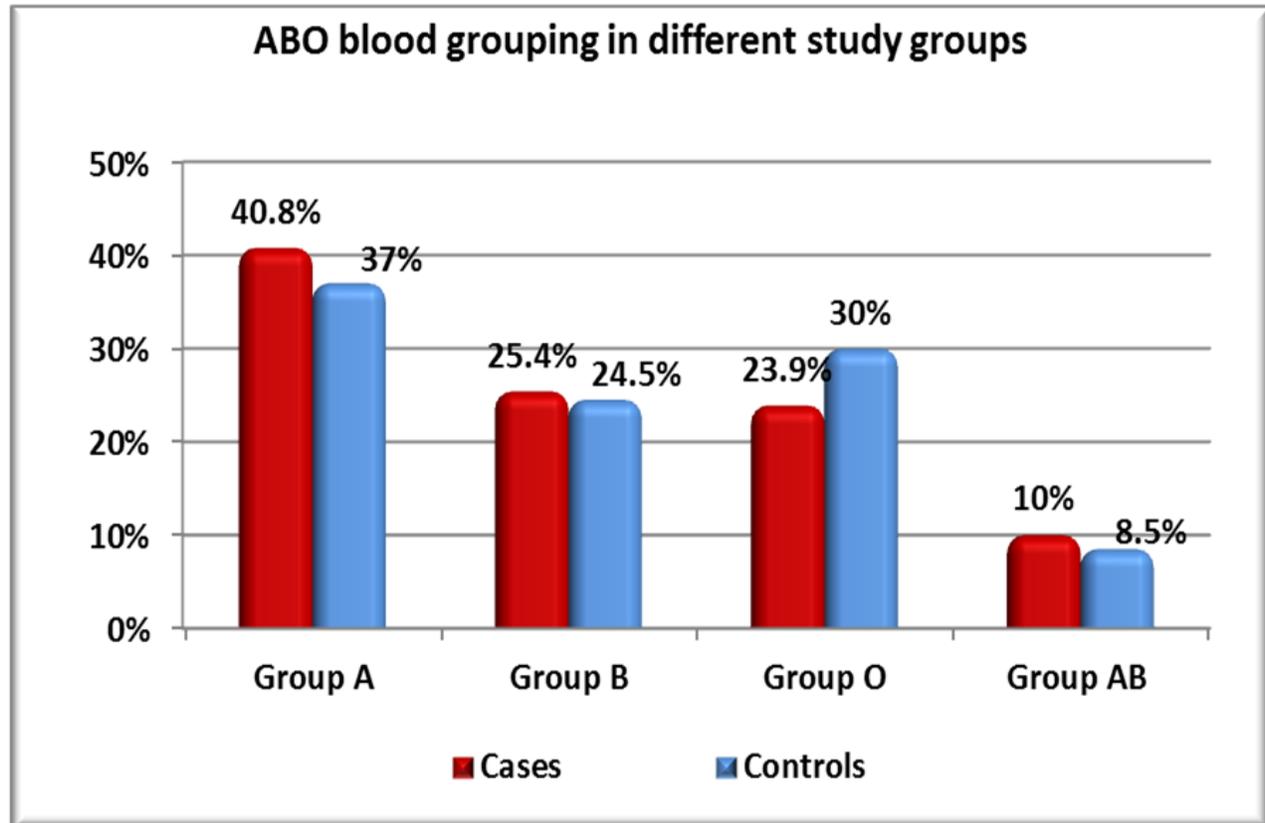


Figure (1): Comparison of ABO blood groups in different study groups.

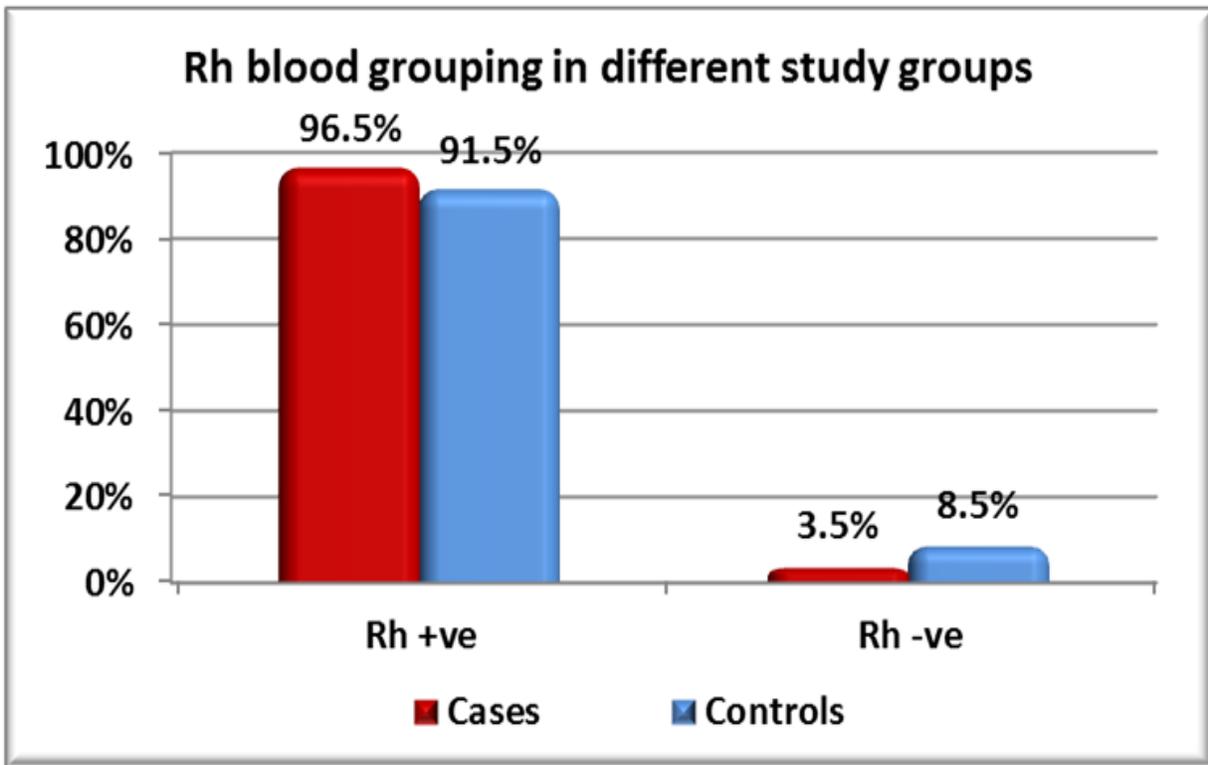


Figure (2): Comparison of Rhesus blood groups in different study groups.

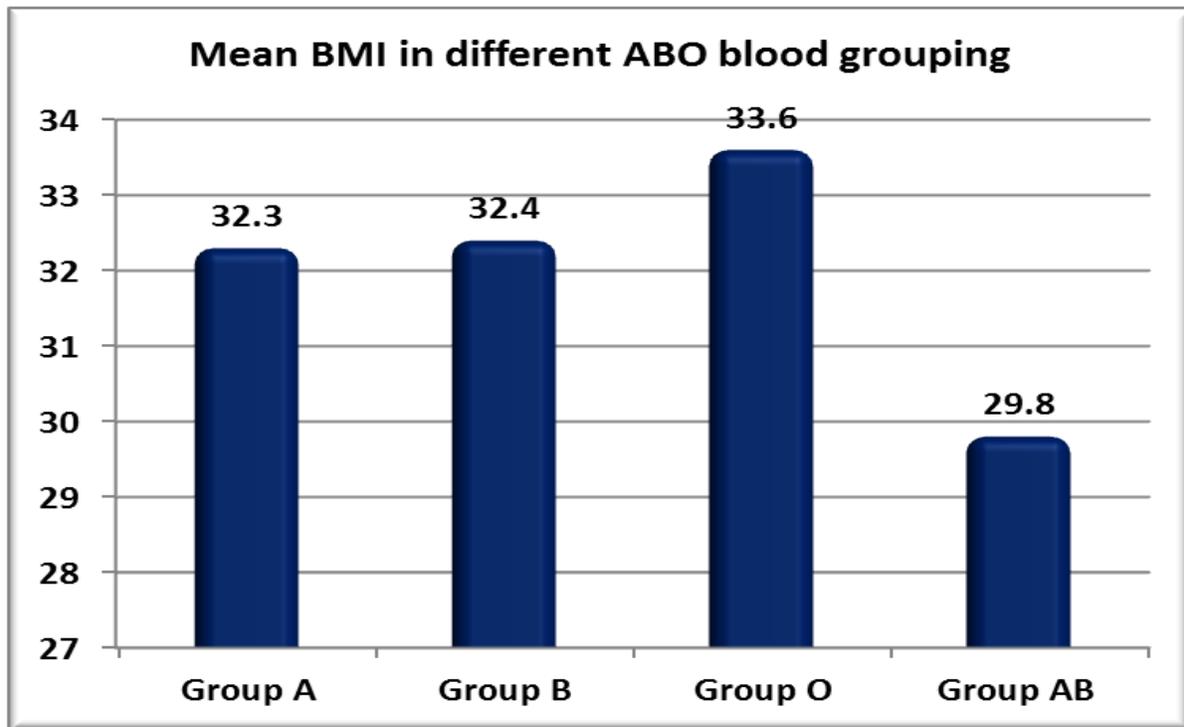


Figure (3): Comparisons of BMI in different ABO blood groups among patient group.

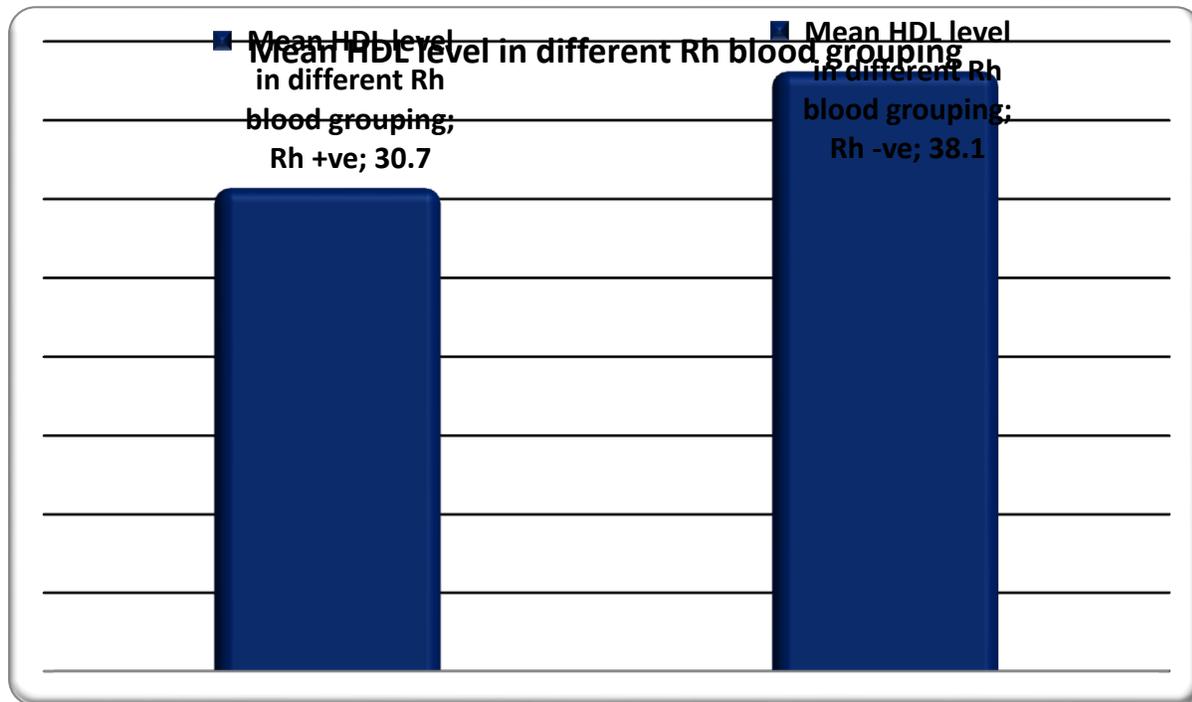


Figure (4): Comparisons of mean HDL level in different Rh blood groups among patient group.

Discussion

Metabolic syndrome has become increasingly relevant in recent times due to the exponential increase in obesity worldwide. Identification of risk factors is important in order to effectively employ lifestyle and modifiable risk factors changes.

(8) There is a strong relationship between the ABO blood groups and many diseases.

(9) However, few studies are published as regards the association of ABO blood groups with metabolic syndrome. (5) The aim of this study was to investigate the association

between ABO/Rh blood groups and metabolic syndrome and its components.

There was no statistically significant difference with p-value >0.05 between cases and controls as regards ABO blood groups in this study. On the other hand, there was statistically significant difference with p-value <0.05 between cases and controls as regards Rhesus factor, with high percentage of positive Rh factor noted among cases.

These results agrees with a previous cohort study performed on 150 patients with metabolic syndrome and 150 healthy

subjects as a control group which reported that there was no statistically significant difference with p-value >0.05 between cases and controls as regards ABO blood grouping and concluded that metabolic syndrome is not associated with ABO blood groups. (5)

Another case-control study in Morocco which included 119 patients suffering of MetS and 119 normal healthy subjects reported that there was no association between the ABO/Rh blood groups and MetS in the studied population. (10)

Several studies have investigated the association between ABO or ABO/Rhesus and the components of the metabolic syndrome but the results were inconsistent. (10) The association between ABO/Rh blood groups and each of the metabolic syndrome components was also investigated in this study.

As regards waist circumference, there was no statistically significant difference between different ABO and Rh blood groups which indicated no association between

ABO/Rh blood groups and patients waist circumference.

This agrees with previous cohort study which reported that there was no statistically significant difference with p-value >0.05 between blood groups and waist circumference of patients. (5)

Body mass index (BMI), which is widely used as marker of obesity, has been studied with ABO system to find out the potential risk of a particular blood group. (12)

In this study, there was statistically significant difference between ABO blood groups as regards BMI of patients with high mean BMI among patients with O group and low mean BMI among patients with AB group. On the other hand there was no statistically significant difference between different Rh groups which indicated no association between Rhesus blood group and BMI in the studied patients.

Similar results were reported by Papanna and Bettegowda, 2019 (13) and Jawed et al.,

2018 (14) where blood group O showed significant positive association with obesity.

In contrast to this study, Nas and Fişkın, 2015, reported that AB Rh (-) group was associated the highest mean BMI value. (15) While Chandra and Gupta, 2012 reported an association between B blood group and obesity. (11)

However, Smith et al, 2018 (16) did not observe any significant association between ABO/Rh blood groups and BMI in Ghanaian population. Also, Other studies by Jafari et al. 2012 (17) in Iran, Aboel-Fetoh et al. 2016 (18) in Saudi Arabia, Chuemere et al. 2015 (19) in Nigeria, and Sukalingam et al. 2015 (20) in Malaysia failed to link BMI with either ABO or Rh phenotype.

As regards blood pressure, the results of this study showed that there was no statistical significant difference in mean systolic and diastolic blood pressure in between different ABO/Rh blood groups, which indicates no association between blood pressure and ABO/Rh blood groups among studied patients.

In accordance to these results, many studies reported no statistically significant association between hypertension and ABO/Rh blood groups (10, 21, 22, 23). However, other previous studies have shown significant association of Hypertension with blood group B (24, 25) and blood group O (26).

As regards FBS level, there was no statistically significant difference between different ABO/Rh blood groups in this study, which indicates no association between blood grouping and FBS level among patients.

This is in agreement with previous studies which reported no relation between ABO blood group and diabetes (10, 26, 27) .

On the other hand, Kamil et al. 2010 (4) have found negative association between blood groups A,O and diabetes. While Waseem et al. 2012 (28) reported that blood group AB was more common in diabetics as compared to controls. Also Mandal et al. , 2018 (29) found that persons with O+ve blood group has least chance of developing

Type 2 DM whereas subject with AB+ve blood group are more vulnerable to develop Type 2 DM. Fagherazzi et al. 2015 (30) concluded that people with the O blood type have a lower risk of developing type 2 DM.

As regards lipid profile, there was no statistically significant difference between different ABO blood groups as regards triglycerides, which indicates no association between triglycerides / HDL and ABO blood groups among studied patients.

There was no statistically significant difference between different Rhesus blood groups as regards triglycerides. On the other hand there was statistically significant difference between different Rhesus blood groups as regards HDL level, with higher mean among patients with negative Rh blood group.

The result of different studies about the association between ABO bloods and dyslipidemia are inconsistent. Ghazaei et al. 2014 (31) reported that there was no significant differences in terms of lipid profile between the different types of

ABO/Rhesus blood groups. Keşkek et al. 2014(5) found no association between ABO blood groups and either triglycerides or HDL. Kanbay et al., 2006 (32) reported that Rh-negative patients had higher levels of high-density lipoprotein cholesterol (HDL) compared to Rh-positive patients. While another study by El-Sayed and Amin, 2015 (25) illustrated high triglycerides and lower HDL in blood groups A and B.

In conclusion, the results of the present study showed no association between ABO blood groups and metabolic syndrome. There was statistically significant difference between cases and controls as regards Rhesus blood group, with higher percentage of Rh positive noted among cases compared to controls. As regards metabolic syndrome separate components; there was no significant difference between ABO/Rh blood groups as regards waist circumference, blood pressure, fasting blood glucose and triglycerides. However, BMI was significantly higher in blood group O and lower in blood group AB. Statistically significant lower mean HDL level was found

in Rh positive patients while there was no significant difference between ABO blood groups. Further studies on large sample size are needed to confirm the results of this study.

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