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Metabolic syndrome and its components are not associated with ABO or ABO/Rhesus blood groups in the adult Moroccan population

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Abstract— **Metabolic syndrome is a constellation of risk factors for diabetes mellitus and cardiovascular diseases. The genetic component is an integral part of its pathophysiology. The aim of this study was to investigate the association between ABO/Rhesus blood groups and MetS in a population of Moroccan adults.**

A total of 238 patients was included in this case control study. The metabolic syndrome was identified by the new harmonized definition. The ABO and Rh (D) blood groups are determined by a conventional slide agglutination test using anti-A, anti-B, and anti-D serum.

The blood group O was the most common (50.84%), traced by blood group A (32.35%) and B (13.87%) while the AB blood group was less frequent (2.94%). Our study population was mostly Rh (+) (91.18%). There was no association between blood groups (ABO and ABO/Rhesus) and the metabolic syndrome or its components.

An independence was shown between Metabolic syndrome and blood groups ABO and Rhesus. The genetic factors underlying the etiology of the metabolic syndrome seem not to include the ubiquitous blood groups ABO and Rhesus.

Index Terms—**Blood groups, cardiovascular diseases, Diabetes mellitus Metabolic syndrome, Morocco.**

I. Introduction

Metabolic syndrome (MetS) is a constellation of various risk factors for diabetes mellitus and cardiovascular diseases. It combines android obesity, atherogenic dyslipidemia, hypertension and hyperglycemia [1]. In the diverse hypotheses that try to explain the pathophysiology of this syndrome, the genetic component has been remarked as an integral part [2, 3]. Several studies have been conducted on the association of MetS and its components with a number of candidate genes [3, 4]. Accumulating evidences suggest that ABO and Rhesus blood antigens play a role in various human diseases [5]. The connection between these blood systems and MetS risk factors have been reported [6]-[10]. The association between MetS and ABO blood system was studied in only one study [11]. Moreover, on that point is, no study about the connection between the Rhesus system and MetS neither between ABO / Rhesus polymorphism and the syndrome.

The objective of this study aimed to investigate the association between ABO/Rhesus blood groups and MetS in a population of Moroccan adults.

II. Material and Methods

This case-control study was carried out in consultant patients in the diagnostic center of Rabat – Morocco. your manuscript electronically for review. A total of 238 subjects from both genders, with a minimum age of 20 years old, was included. Patients with a diagnosis of a disease other than MetS were excluded.

After obtaining informed oral consent for each patient, the study population was split into two groups:

- Control group: includes males and females, and consisted of 119 normal healthy subjects.
- Study group: includes males and females, and consisted of 119 patients suffering of MetS.

Collection of the data in this study included: 1) anthropometric parameters (the age and the waist

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circumference, which allows the evaluation of the abdominal obesity of the patient); and 2) the measurement of blood pressure and the dosage of biochemical parameters (glycemia, triglyceridemia, total cholesterol, and HDL cholesterol).

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The ABO and Rh (D) blood groups are determined by a conventional slide agglutination test using anti-A, anti-B, and anti-D serum.

Definition of MetS

We used the recently published joint interim statement endorsed by the International Diabetes Federation Task Force and several other international and national organizations to define MetS [1]. The consensus criteria define MetS as the presence of three or more of the following metabolic risk factors:

- Elevated waist circumference (population- and country-specific cutoffs: ≥94 cm for men and ≥80 cm for women).
- Elevated triglycerides ≥150 mg/dL (1.69 mmol/L).
- Reduced HDL cholesterol <40 mg/dL (1.04 mmol/L) in men, and <50 mg/dL (1.29 mmol/L) in women.
- Elevated blood pressure (systolic ≥130 mmHg and/or diastolic ≥85 mmHg).
- Elevated fasting glucose ≥100 mg/dL (5.56 mmol/L). Individuals who report using drug treatments for any of the above medical conditions are considered to meet the criteria for the specific component.

Statistical analysis

The analyses reported in this study were performed using the Statistical Analysis System (SAS Institute Inc., Cary, NC, USA). Categorical measurements were reported as number and percent. Quantitative measurements were reported as the mean ± SD. Chi square test ($\chi 2$) was used to assess the frequency distribution of blood groups among syndromes and healthy subjects. *P*-values of less than 0.05 were considered statistically significant.

III. RESULTS

Metabolic and anthropometric characteristics of the study population are summarized in the table I. The average age of the study population is 53.11±12.58 years. The values of SBP, DBP, WC, GLY and TG were significantly higher in patients with MetS than those without MetS.

TABLE I: Metabolic and anthropometric characteristics of the study population.

	Entire population		Healthy group		MetS group		P value (Groups)
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	
SBP(mmHg)	133.39	15.924	125.52	7.447	141.25	18.141	<0.0001***
DBP(mmHg)	74.39	8.615	70.97	4.396	77.81	10.303	<0.0001***
WC (cm)	83.87	7.775	79.83	4.267	87.91	8.385	<0.0001***
GLY (g/l)	1.0894	0.45440	0.8692	0.13736	1.3097	0.54589	<0.0001***
TG (g/l)	1.2507	0.72569	0.8029	0.27157	1.6986	0.76118	<0.0001***
TCH (g/l)	1.9177	0.40208	1.8008	0.37211	2.0347	0.39830	0.780
HDL (g/l)	0.5486	0.18088	0.6271	0.15765	0.4702	0.16865	0.824
LDL (g/l)	1.1187	0.37777	1.0129	0.35015	1.2245	0.37609	0.619
Age (years)	53.44	12.835	52.53	13.364	54.35	12.271	0.124

Note: ***P<0.001.

Abbreviations: DBP, diastolic blood pressure; GLY, glycemia; HDL, high-density lipoprotein; LDL, low-density lipoprotein; SBP, systolic blood pressure; SD, standard deviation; TCH, total cholesterol; TG, triglyceridemia; WC, waist circumference.

We examined the distribution of ABO and ABO/Rhesus blood groups in our sample (Table II and Table III). The blood group O was the most common, representing half of our sample (50.84%), traced by blood group A (32.35%) and B (13.87%) while the AB blood group was less frequent representing only 2.94% of our patients.

On the other hand, just 8.82% of our study population had been Rh (-) blood group (Table II). There was no statistical difference between blood groups (ABO and ABO/Rhesus) and the syndrome status in patients with and without MetS (Table III). We also assessed the association between these two blood systems and different MetS abnormalities (Table IV and Table V). Our results indicate that the dispersion of these disorders is independent of the ABO/Rhesus profile of patient with MetS.

I. DISCUSSION

In this study, the frequencies of ABO blood groups were O (50.84%), A (32.35%), B (13.87%) and AB (2.94%). Similar ABO dispersion results were found by other studies in Morocco [12, 13]. The higher prevalence of O blood group appears to follow a more global gene flow from the sub-Saharan populations, where the O blood group is at a

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higher frequency compared to other ABO blood groups [14, 15]. In the Rhesus system, the distribution of our study population was Rh+ (91.18 %) and Rh– (8.82 %). These outcomes do not differ from those of Benahadi et al who found Rh+ (91 %) and Rh– (9 %) [13]. This result highlights the difficulties that may be encountered by patients Rh (-) in the Moroccan blood transfusion system.

TABLE II: The distribution of ABO blood groups in the entire population, MetS group and healthy group.

	Entire Population (238)		Healthy group (119)		Syndrome group (119)		P Value
	Size	%	Size	%	Size	%	(groups)
A	77	32.35	37	31.09	40	33.61	0.6778
AB	7	2.94	4	3.36	3	2.52	0.7013
B	33	13.87	19	15.97	14	11.77	0.3486
O	121	50.84	59	49.58	62	52.10	0.6974
Rh (+)	217	91.18	108	90.76	109	91.60	0.8193
Rh (-)	21	8.82	11	9.24	10	8.40	0.8193

TABLE III: The distribution of ABO/Rhesus blood groups in the entire population, MetS group and healthy group.

ABO/Rhesus		Entire Population		Healthy group		Syndrome group		P Value
ABO	Rhesus	Size	%	Size	%	Size	%	(groups)
A	+	64	26.89	31	26.05	33	27.73	0.7688
	-	13	5.46	6	5.04	7	5.88	0.7755
AB	+	7	2.94	4	3.36	3	2.52	0.7013
	-	0	0	0	0	0	0	-
B	+	25	10.50	14	11.77	11	9.24	0.5245
	-	8	3.36	5	4.20	3	2.52	0.472
O	+	121	50.84	59	49.58	62	52.10	0.6974
	-	0	0	0	0	0	0	-
Total		238	100	119	100	119	100	

TABLE IV: The distribution of ABO blood groups in the syndrome group, according to MetS abnormalities.

Abnormalities	Syndrome group								P Value
	A (40)		AB (3)		B (14)		O (62)		(ABO)
	Size	%	Size	%	Size	%	Size	%	
Abdominal obesity	27	67.5	2	66.67	12	85.71	50	80.65	0.360
High blood pressure	13	32.5	1	33.33	7	50	25	40.32	0.681
Low HDL-c	28	70	0	0	8	57.14	43	69.36	-
Hypertriglyceridemia	26	65	3	100	5	35.71	33	53.23	0.102
Hyperglycemia	10	25	1	33.33	6	42.86	14	22.58	0.467

To our knowledge this is the first study that evaluates the association between two blood systems (ABO/Rhesus) and MetS. Our results indicate that there is no association between the ABO or ABO/Rhesus blood groups and MetS in our study population. The sole study of that subject has reported the same result in ABO blood system [11]. This suggests that the future research on a genetic predisposition to MetS should not target the ubiquitous blood systems ABO and Rhesus. This is also borne out by the outcomes of the Pooja et al study that did not find a correlation between the different blood groups and cardiovascular diseases, the main consequences of MetS [16]. Furthermore, we look into a potential link between these two systems and MetS components in syndrome group. Our results show that there is no association between ABO or ABO/Rhesus blood groups and each of MetS disorders. Several studies have investigated the association between ABO or ABO/Rhesus and the abnormalities defining the MetS and the results were inconsistent. In these studies, some are in accordance with our results and they report no association between hypertension and ABO and Rhesus blood systems [6, 9]. However, Jassmin WE et al have reported that O blood group has a significantly higher prevalence of hypertension than other blood groups [8]. A high prevalence has also been found in B blood group patients by Tulika Chandra et al [7]. The same author reported no association between obesity and the ABO blood groups [7]. Similar results were found by Kumar Ganesan [17]. Inversely, obesity was significantly higher in A blood group patients by Elham Jafari et al [18]. In that study, the obesity is measured by body mass index and not by waist circumference [18]. Likewise,

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patients with O blood group and B rhesus + blood group had a higher prevalence of hyperglycemia than other blood groups in the study of Jassim WE and Kumar Ganesan simultaneously [8, 17]. This is in disagreement with our results in which no association has been observed between ABO blood groups and hyperglycemia. For the lipid profile, the results of the contiero et al study show that there is no association between CHT, HDL-c or LDL-c and ABO blood groups, but triglycerides were higher in individuals with antigen B (B + AB) [19]. In other studies, CHT was higher in persons with blood group A [20] and O [8]. These results reflect a great disparity which suggests an independence between the MetS components and ABO/Rhesus blood groups in different populations.

TABLE V: The distribution of ABO/Rhesus blood groups in syndrome group, according to MetS abnormalities.

Abnormalities	Syndrome Rhesus positive								
	A (33)		AB (3)		B (11)		O (62)		P Value
	Size	%	Size	%	Size	%	Size	%	
Abdominal obesity	22	66.67	2	66.67	9	81.82	50	80.65	0.446
High blood pressure	12	36.36	1	33.33	5	45.46	25	40.32	0.947
Low HDL-c	23	69.70	0	0	8	72.73	43	69.36	-
Hypertriglyceridemia	22	66.67	3	100	4	36.36	33	53.23	0.122
Hyperglycemia	9	27.27	1	33.33	6	54.55	14	22.58	0.184
	Syndrome Rhesus negative								
	A (7)		AB (0)		B (3)		O (0)		P Value
	Size	%	Size	%	Size	%	Size	%	
Abdominal obesity	5	71.43	0	0	3	100	0	0	-
High blood pressure	1	14.29	0	0	2	66.67	0	0	-
Low HDL-c	5	71.43	0	0	0	0	0	0	-
Hypertriglyceridemia	4	57.14	0	0	1	33.33	0	0	-
Hyperglycemia	1	14.29	0	0	0	0	0	0	-

I. CONCLUSION

In conclusion, we did not see any association between the ABO or ABO/Rhesus and the MetS or its components in Moroccan adult population. Future research along the genetic factors of MetS should not be focused on ABO and Rhesus blood systems.

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