

# Correlation between ABO/Rh Blood Groups and Obesity in Young Medical Students at Um-Alqura University Makkah Al-Mukaramah, Saudi Arabia

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## Abstract

**Background:** Obesity is considered as one of the most important health problems universally. Identification of the risks for obesity is important for its control. The ABO/Rhesus (Rh) factor blood group is considered as fundamental genetic factor that can give valuable information for those at risk.

**Objective:** To find out any potential association between ABO blood group and Rhesus (Rh) antigen with obesity among Saudi medical students.

**Subjects and Methods:** This cross-sectional study conducted on 241 second year MBBS student in order to find any associations between of ABO blood group and Rhesus (Rh) antigen with obesity. BMI was calculated using formula  $BMI = \text{weight in kg} / \text{height in m}^2$ . Blood groups were determined by classic (antigen-antibody slide agglutination test). The data was analyzed through SPSS 24.

**Results:** The majority of participants were female 51.9%. Obese individuals constituted 8.7%. Blood group "O" was found to be the most prevalent blood group (46.1%) among the students. Most of the students' Rhesus-D group was positive (85.9%). Our results revealed that there was significant positive relationship between obesity and blood group O positive ( $P=0.000^*$ ) indicating that blood group O positive had a direct relationship to obesity.

**Conclusion:** Our study finds that O Rh positive blood group may be predisposed to obesity due to the higher mean of weight, and BMI found in this group. It is suggested that Saudi student with O Rh positive blood group, who have the highest mean BMI value, should pay special attention to their weight.

**Keywords:** Obesity; Body mass index; ABO/Rhesus factor blood-group system

## Introduction

Obesity is widespread globally in all age groups at a frightening rate [1]. A considerable increase in obesity with it is adverse public health problems is realized worldwide both in developed and developing countries. The Arabian Gulf region is not an exception for this globosity [2]. Obesity in the Kingdom of Saudi Arabia (KSA) is increasing at a disturbing rate. Both growth and wealth have brought noticeable changes in the people's lifestyle. Most eating habits are not healthful and the level of physical activity is very little [3,4]. Surveys done in numerous different areas and provinces of KSA have reported a high prevalence of both overweight and obesity in Saudi children in all age groups [2]. Since the late 1980s to mid-1990s the prevalence of obesity in the KSA averaging around 20% fluctuating from as low as 13.1% amongst men to as high as 26.6% amongst women [4]. Body Mass Index (BMI; in  $\text{kg}/\text{m}^2$ ) is widely used for the classification of overweight ( $BMI \geq 25$ ) and obesity ( $BMI \geq 30$ ) in men and women. BMI correlates reasonably well with laboratory-based measures of obesity for population studies and is extremely practical in most clinical settings [5].

Recently, a possible association of obesity with the ABO blood group have been evaluated [6]. Blood group system is well-defined based on presence or absence of antigens existing on the surface of Red Blood Cells (RBCs). Two types of blood group system are present ABO and Rh [7]. ABO blood group antigens are glycoproteins expressed on the RBCs surface. Their expression is partly dependent on racial origin [8,9]. The ABO blood group system was the first human blood group system discovered by Karl Landsteiner in 1900. In spite of the presence of more than 400 blood group antigens, the ABO and Rh have been documented as the major clinically significant blood group antigens and the main human blood type system with principal importance in transfusion medicine [9-11]. "ABO" blood type system comprises of four major "ABO" phenotypes "A", "B", "O", and "AB" depending on the presence or absence of gene "A" and "B" positioned on short arm of chromosome 9 (9q34) [9,12]. Concerning the Rhesus blood group system, there are only two Rh

phenotype Rh positive and Rh negative, depending on the presence or absence of the Rh antigen on the RBC [10].

It is found that ABO blood group was associated with height and weight and one of the risk factors of obesity may be ABO and Rhesus blood groups [13]. This means carrying a particular ABO blood antigen possibly predisposes one to higher Body Mass Index (BMI) [14]. ABO and Rhesus blood groups vary largely across races and geographical boundaries in spite of the fact that the antigens involved are stable throughout life [10,15]. The ABO blood groups are inherited traits of an individual that will provide much valuable information for early detection of susceptible groups [15,16]. ABO system has been identified as a genetic marker for obesity [17]. It has been discovered that ABO and Rhesus blood types are associated with some obesity comorbidities like type 2 diabetes mellitus, hypercholesterolemia, hypertension, cardiovascular diseases and specific types of cancers like salivary gland tumors, Pancreatic Cancer (PC), gastric cancer, colorectal cancer, ovarian tumors, upper urinary tract tumors, small cell carcinoma of lung and breast cancer [8,9,12,13,18-21].

More recently, several studies have analyzed a possible association of obesity with the ABO blood group [10,14,22,23]. However, the results obtained have been divergent. Some studies reported no association [14,22] while others identified an association between different blood groups and being overweight [1,10,15]. In addition, some studies evaluated only specific population groups or only reported descriptive analyses [1,10,15,22-24]. The phenotypic diversity of the ABO blood group in the world population requires that supposed associations must be evaluated in different countries or regions. Body Mass Index (BMI) is an internationally accepted index for assessing obesity. It is the most accepted among the other anthropometric indices [25]. Relationship between Lewis blood grouping and obesity was extensively studied; however the association between ABO blood group system and obesity is yet to be put forward [1].

The aim of the present study was to determine the frequency of obesity and its association with ABO/Rhesus blood groups among medical university students. Poor eating habits, use of snacks and fast-food consumption are heading to obesity in this age group.

## Materials and Methods

This cross-sectional study was conducted at Umm Al-Qura University, Faculty of Medicine, Makkah Al-Mukaramah, Saudi Arabia during the period March to June 2022 among second year medical students. Ethical approval for the study was obtained from the Scientific Medical Ethics Committee, on Human Research and Publication at the College of Medicine, Umm Al-Qura University (UQU). Using a simple random sampling, a total of 241 students from the second academic year were recruited for the study which included 116 males and 125

females of ages 18-20 years. Students with fever, swelling, and having age <18 years were excluded from the study. After explaining the study procedure to the students, all the students gave their informed consent for participation. Structured questionnaires with questions to suit the population of study needs were in use for the study. The participant was asked to stand barefoot so that foot is evenly placed on measurement platform Stadiometer. Stadiometer, Detecto scale (Webb City, MO, USA) was used to check bodyweight in kilograms, with subjects not wearing shoes and in light clothing in the upright position (measured to the nearest 0.1 kg). Height was measured by the same instrument to the nearest 0.1 cm. Obesity is properly measured by using the Body Mass Index (BMI).  $BMI = \text{weight (Kg)} / \text{Height}^2 \text{ (m)}$ . BMI was classified according to the proposed criteria of the WHO. Where BMI of the following values: <18.5 kg/m<sup>2</sup>, 18.5-24.9 kg/m<sup>2</sup>, 25-29.9 kg/m<sup>2</sup>, and  $\geq 30$  kg/m<sup>2</sup>, is categorized as underweight, normal weight, overweight and obese, respectively.

Aseptic measures were ensured and blood samples were taken by finger pricking with sterile lancet. ABO blood group and Rhesus (Rh) antigen blood typing was done by classic (antigen-antibody agglutination test) method by slide method using Anti sera-A, Anti sera- B and Anti sera- D marketed by Diagnostics Ltd (Crescent Company) KSA.

## Statistical analysis

The data obtained were analyzed statistically to determine any association between obesity and different ABO/Rhesus blood groups. The data were analyzed by the Statistical Package of Social Science (SPSS) software version 24.0 in windows 10 using descriptive statistics and cross-tabulations. Demographic data of the study population was evaluated by descriptive statistics. Categorical variables were reported as number and percentages, whereas continuous variables like age, weight, height, height square and BMI were expressed as Mean (M)  $\pm$  Standard Deviations (SD). Proportions of the studied groups were expressed in percentages (%) and absolute number (n) of frequencies. Linear regression was applied to see the association between ABO/Rhesus bloods groups and obesity. The confidence limit was kept at 95%, hence a P-value<0.05 was considered to be statistically significant.

## Results

As shown in **Table 1**, out of 241 medical students participated in the study, 116 (48.1%) of the participants were male and 125 (51.9%) were female. The mean age was  $18.50 \pm 0.64$ . The ages of the subjects were between 18 and 20 years old (**Table 1**). The mean Body Mass Index (BMI) of participants was  $23.06 \pm 6.02$ . The classification of participants according to BMI were 42 (17.4%) underweight, 139 (57.7%) normal weight, 39 (16.2%) overweight and 21 (8.7%) obese (**Table 1**).

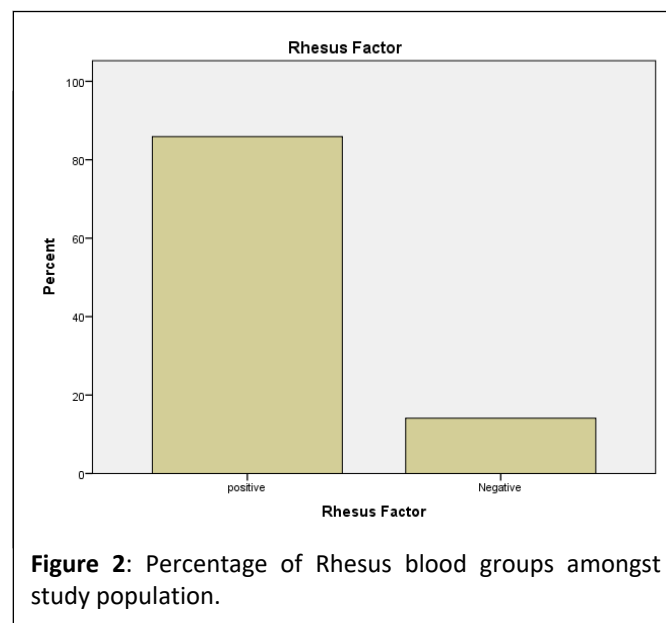
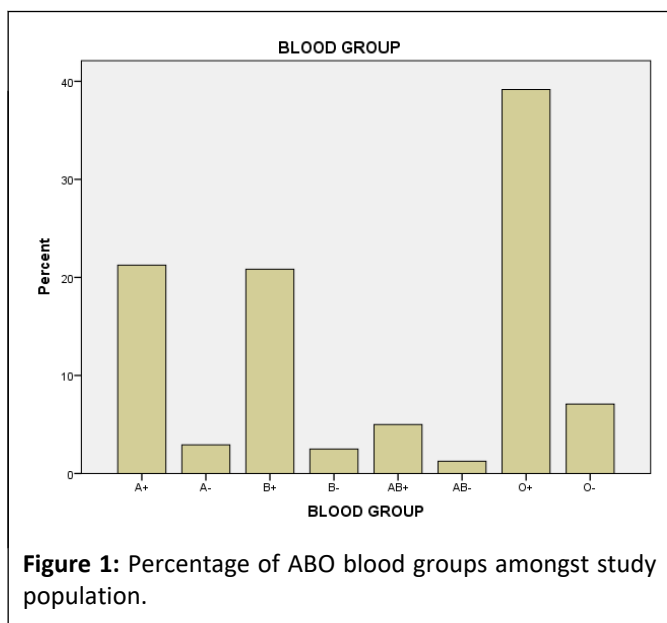
**Table 1:** Descriptive statistics of study participants (n=241).

Age(years)	18.50 ± 0.64	
Height (m)	1.59 ± 0.15	
Height square (m <sup>2</sup> )	2.46 ± 0.24	
Weight (kg)	56.67 ± 11.85	
BMI (kg/m <sup>2</sup> )	23.06 ± 6.19	
<b>Frequency</b>		
<b>Gender</b>		
Male	116	48.1
Female	125	51.9
<b>ABO blood groups</b>		
A	60	24.9
B	55	22.8
AB	15	6.2
O	111	46.1
<b>Rhesus (±)</b>		
Negative	34	14.1
Positive	207	85.9
<b>BMI categories</b>		
Underweight	42	17.4
Normal weight	139	57.7
Overweight	39	16.2
Obese	21	8.7
<b>Note:</b> SD: Standard Deviation; n: number of participants.		

From our study, we observed that; Overweight and obesity were found to be more prevalent in female students than male students, in total 59% of females and 41% of males were overweight, the same trend was found in obesity 52.4% of females and 47.6% of males were obese.

The frequencies of ABO blood groups among all students

were: Blood group "O" was found to be the most prevalent blood group in students (46.1%), followed by blood group A (24.9%), blood group B (22.8%) and blood group AB (6.2%) (**Figure 1**). On the other hand, most of the students' Rhesus-D blood group was positive (85.9%) and the Rhesus-D negative prevalence was (14.1%) (**Figure 2**). Gender \*ABO/Rhesus blood group cross-tabulation is shown in **Table 2**.



**Figure 1:** Percentage of ABO blood groups amongst study population.

**Figure 2:** Percentage of Rhesus blood groups amongst study population.

**Table 2:** Gender \*ABO/Rhesus blood group cross-tabulation.

Count		Blood group								
		A+	A-	B+	B-	AB+	AB-	O+	O-	Total
Gender	Male	28	6	23	4	2	1	45	6	115
	Female	23	1	27	2	10	2	49	11	125
Total		51	7	50	6	12	3	94	17	240

48% of obese individuals had blood group “O”, 38.1% of obese had blood group “A”, 9.5% of obese had blood group B%, and the least percentage (4.7%) of obese had blood group AB. Additionally, 76% of obese individuals had Rhesus-D positive blood group.

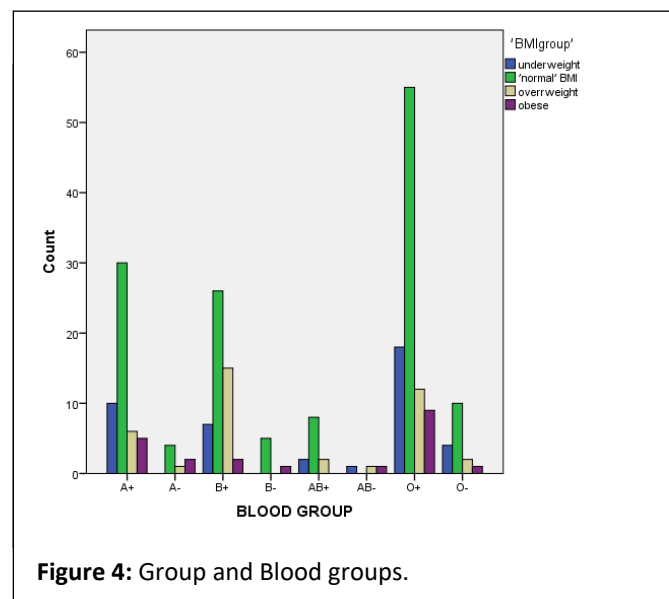
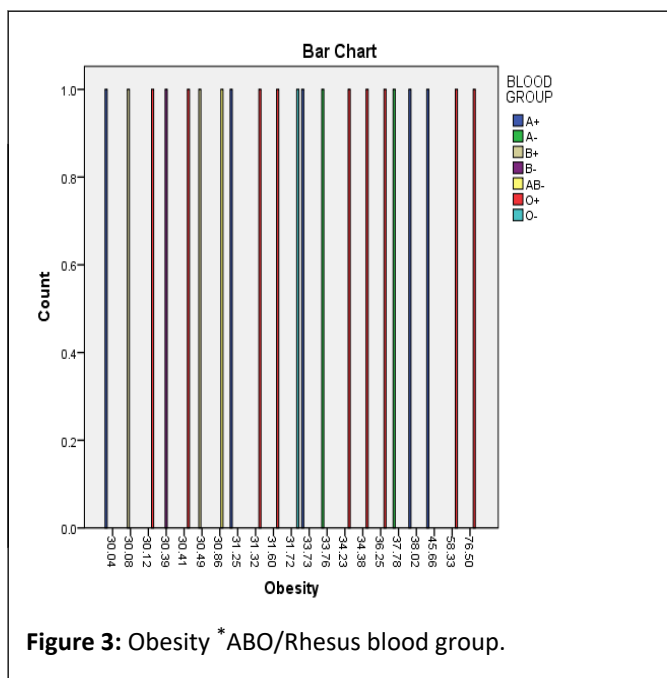
between obesity and ABO blood groups ( $\beta=851, P=0.000^*$ ). Results of linear regression for relationship between obesity and Rhesus blood groups, showed significant positive relation between obesity and Rhesus blood groups ( $\beta=888, P=0.000^*$ ) as shown in **Table 3 and Figure 3**.

Results of linear regression for relationship between obesity and ABO blood groups, showed significant positive relation

**Table 3:** Obesity \*ABO/Rhesus blood group cross-tabulation.

Count		Blood group								
		A+	A-	B+	B-	AB-	O+	O-	Total	
Obesity	30.04	1	0	0	0	0	0	0	1	
	30.08	0	0	1	0	0	0	0	1	
	30.12	0	0	0	0	0	1	0	1	
	30.39	0	0	0	1	0	0	0	1	
	30.41	0	0	0	0	0	1	0	1	
	30.49	0	0	1	0	0	0	0	1	
	30.86	0	0	0	0	1	0	0	1	
	31.25	1	0	0	0	0	0	0	1	
	31.32	0	0	0	0	0	1	0	1	

	31.6	0	0	0	0	0	1	0	1
	31.72	0	0	0	0	0	0	1	1
	33.73	1	0	0	0	0	0	0	1
	33.76	0	1	0	0	0	0	0	1
	34.23	0	0	0	0	0	1	0	1
	34.38	0	0	0	0	0	1	0	1
	36.25	0	0	0	0	0	1	0	1
	37.78	0	1	0	0	0	0	0	1
	38.02	1	0	0	0	0	0	0	1
	45.66	1	0	0	0	0	0	0	1
	58.33	0	0	0	0	0	1	0	1
	76.5	0	0	0	0	0	1	0	1
<b>Total</b>		<b>5</b>	<b>2</b>	<b>2</b>	<b>1</b>	<b>1</b>	<b>9</b>	<b>1</b>	<b>21</b>



Results of linear regression for relationship between ABO/Rhesus bloods groups and obesity are presented in **Table 2**, showing significant positive relationship between obesity and blood group O positive ( $\beta = .921, P = 0.000^*$ ) indicating that blood group O positive had a direct relationship to obesity (**Table 4**).

**Table 4:** BMI GROUP and ABO/Rhesus Blood Group as shown in **Figure 4.**

**Table 4:** Linear regression between ABO/Rhesus bloods groups and obesity.

Blood groups	Beta	P value	95% Confidence interval
A Positive	0.972	0.001	21.229-24.522
B Positive	1	0.004	9.227-10.963
O Positive	0.921	0	3.966-7.672

## Discussion

The present cross-sectional study showed the prevalence of overweight and obesity among medical students at Um-Alqura University, Makkah Al-Mukaramah KSA. Overweight found to be more prevalent in female students than male students, in total 16.2% participants were overweight with BMI  $\geq 25$  kg/m<sup>2</sup> (18.4% in females and 13.8% in males) the same trend was found in obesity 8.7% of total participants were obese (BMI  $\geq 30$  kg/m<sup>2</sup>) females were having a prevalence of 8.8% while males had 8.6%.

In 2007, according to Forbes report, Saudi Arabia ranks 29 on a list of the fattest countries with a percentage of 63.5% of its citizens being overweight [3]. About 50% of Saudi children have a BMI above the 85% percentile [2]. Prevalence of obesity was higher among Saudi females compared to Saudi males [4,22,26-31].

There is great genetic diversity within all human populations, the simplest example is ABO group system. ABO and Rhesus (Rh) genes and phenotypes vary widely between ethnic groups and both within and between geographical areas [15]. In our study, we found that the blood group "O" was found to be the most prevalent blood group in students (46.1%) followed by the A group (24.9%), B group (22.8%) and AB group (6.2%). Most of this study's participants (85.9%), were RhD-positive. These results are comparable to previous results of other studies from other regions of KSA. Most of the students' Rhesus-D group was positive (85.9%) and the Rhesus-D negative prevalence was (14.1%). Many studies conducted in Saudi Arabian population found this same distribution [22,32]. Also this distribution reported in Nigeria and India [16,17,33,34].

Many researchers have tried to identify a possible association between ABO and Rh blood groups with obesity. The results have been inconsistent, variable, and varied from one region to another. Some researchers have recognized an association between ABO and Rh blood groups and obesity, while others could not find such association [35].

Results of this study found a relationship between obesity or high BMI and ABO/Rhesus blood groups especially O and Rh positive blood group was associated with the highest number of obese subjects. Conversely, many studies did not find a relationship between ABO blood groups and obesity. Two studies from KSA showed no association between obesity and ABO and Rh blood types, the first study from Arar, Northern area of KSA and the second a study from Almadinah Almunawwarah, KSA [22]. Our results were also in disagreement with other findings worldwide. The findings as no association between obesity and ABO blood types were published in Iran. In a population-based study consisting of 50,045 men and women, aged 40-75 years, who resided in urban and rural areas of Iran [13]. Likewise in a study conducted in a sample of 14000 mothers and their children in England, Scotland and Wales [36]. Additionally, in Nigeria the same results were found in a study comprising 1620 subjects (males 773 or 47.7% and females 847 or 52.3%) ranging in age from 7 to 21 years in Obio/Akpo local government area, Port Harcourt, Rivers State, Nigeria [16]. Our findings as there was an association between obesity and Rh

blood types were opposed by two studies, one done in Lithuania including 207 of Klaipeda University students and the second study done in UK on 14000 participants by Mascie-Taylor and Lasker et al. [36].

Our results were in agreement with other findings worldwide. Many studies found a relationship between ABO blood groups and obesity. In a study conducted by Behera et al. [23] included 100 healthy MBBS students at Amalapuram, Andhra Pradesh, India found that the blood group AB and Rh negative was associated with the highest number of obese subjects. In another study conducted by Nas and Fiskin in Turkey including 298,247 Turkish seafarers. It is ended up that seafarers with AB Rh negative blood group, have the highest mean BMI value [24]. In a Lithuanian study conducted by Idzeliene and Razbadauskas (2010) included 207 students concluded that the obesity was greatest among blood group A subjects. In a study conducted in inhabiting Punjabi population at Selangor, Malaysia including 990 subjects a significant association was found between obesity and blood group B and Rh-positive groups [37]. In a study including 151 staff and students from Advanced Medical and Dental Institute, Universiti Sains Malaysia, a high incidence of obesity (mild and moderate) was found in type "B" blood group [38]. In a retrospective study carried out on 23,320 blood donors at Lucknow, Uttar Pradesh, India during a period of one year. Obesity was found to be more prevalent in those with blood group B [10]. In a study conducted in Sargodha, Pakistan including 149 male and female children, Ainee et al. found higher incidence of obesity among the children with blood group O as compared to children with the other blood groups [39].

In another study in India a total of 143 school children from two school of Andhra Pradesh were enrolled in study. Obesity was found more prevalent in O blood group children [40]. In Iranian study on 5000 healthy persons of Golestan Province, Northern Iran, the prevalence of obesity was found to be more in O blood group [41]. In a cross-sectional study covered randomly selected 201 postmenopausal women, from Port Harcourt, Rivers State, Nigeria, revealed that the participants with O blood types are at high risk of obesity and overweight [42]. A prospective randomized study including 885 overweight or obese, in Hatwan Private Hospital and Sulaimani Teaching Hospital in Sulaimani Governorate, Kurdistan Region/Iraq they were consulting for advice, diet and or drugs and various bariatric operations. This was conducted in the period of 6 years from February 1<sup>st</sup>, 2012 to March 1<sup>st</sup>, 2018. The results of this study revealed that (Group O) is the most common blood group, while the least common ABO blood group was (Group AB). Regarding Rhesus antigen, D blood group positive in the dominant [15].

## Conclusion

Our study finds that O Rh positive blood group may be predisposed to obesity due to the higher mean of weight, and BMI found in this group. It is suggested that Saudi student with O Rh positive blood group, who have the highest mean BMI value, should pay special attention to their weight.

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