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Correlation Between Abo/Rhesus Blood Groups With Waist Circumference (Wc) And Waist-Hip Ratio (Whr) Among Medical Students At Um-Alqura University Makkah Al-Mukaramah Saudi Arabia

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Keywords: ABO Blood Group; Rh Blood Group; abdominal obesity; Waist circumference; Waist-hip ratio, Saudi Arabia

Abstract

Background: The amount of body fat determines the health condition of an individual. Current discoveries suggest that waist circumference is a more convincing marker of health risk than BMI. Therefore, the measurement of modern obesity parameters, such as visceral fat, waist circumference, or waist-hip ratio (WHR), must be taken into consideration.

Aims and Objective: This study was conducted to find out the relationship between ABO and Rhesus (Rh) blood group with waist circumference (WC) and waist-hip ratio (WHR) among Saudi medical students.
Subjects and Methods: WHR was calculated after measuring waist and hip circumference using a body tape measure. Blood groups were determined by classic (antigen-antibody slide agglutination test). The data was analyzed through SPSS 24.

Result: This cross-sectional study was conducted on 241 medical students at Um-Alqura University, Makkah Al-Mukaramah, Saudi Arabia. Females constitute 51.9%.In males, blood group O+ has the highest waist circumference(WC) of > 102 cm. In females, blood group B+ has the highest waist circumference(WC) of > 88 cm. In males, blood group A++ + has the highest WHR (>0.9). In females, blood group A+ has the highest WHR (>0.85). There was a statistically significant relationship observed between female ABO blood group and Rhesus antigen with WHR (P 0.004). There was no statistically significant relationship between male ABO blood group and Rhesus antigen with WHR (P 0.415).

Conclusion: Males with blood group O+ + and females with blood group B+ may be predisposed to obesity due to the higher waist circumference (WC), and they should pay special attention to their weight.

Introduction

Obesity has become a great global health problem over the last decades[1]. Obesity has become a pandemic that is increasing rapidly because of changing food habits and a sedentary lifestyle [2]. There is a substantial increase in obese children and adolescents in the last twenty years [1].Obesity remains a cause of public distress

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worldwide. The health impact of obesity is huge, as made known by an increased risk for multiple chronic diseases and conditions, including hypertension (HTN), diabetes mellitus (DM), hypercholesterolemia, coronary heart disease, asthma, arthritis, cancers, and many others. Furthermore, obesity, particularly abdominal obesity, is associated with increased all-cause, cardiovascular, or cancer mortality [3]. Obesity is widespread globally in all age groups at a frightening rate [4]. Still, all the reasons for obesity are yet to be found out[5]. Obesity is defined as an excess of body fat. A surrogate marker for body fat content is the body mass index (BMI = body weight/height in metres2). However, BMI has a limitation of not distinguishing between fat and muscle mass [2]. Abdominal fat deposition is a fundamental component of obesity[6]. Body mass index (BMI; in kg/m2) is widely used for the classification of obesity (BMI ≥ 30) in males and females. It correlates reasonably well with laboratory-based measures of obesity for population studies. However, BMI does not account for the wide variation in body fat distribution, the nature of obesity across different individuals and populations, and the joint relation of body composition and body size to health outcomes [7]. Increased visceral or abdominal adipose tissue, in particular, has been shown to be more strongly associated with metabolic and cardiovascular disease risk and a diversity of chronic diseases. So, measurements that are more sensitive to individual differences in abdominal fat might be more useful than BMI for identifying obesity associated risk factors [7]. Waist circumference (WC) has been shown to be a better predictor for the risk of myocardial infarction, type 2 diabetes T2DM, metabolic syndrome MS, medical care costs, and all-cause mortality than BMI [6]. Waist circumference is a simple and convenient way of measuring abdominal or central obesity [6]. It has been recognized that abdominal obesity, assessed by waist circumference (WC), forecasts obesity-related health risk, and the weighted evidence indicates that WC coupled with BMI predicts health risk better compared to BMI only [8, 9]. Waist circumference (WC) is a reliable measure of abdominal obesity and is unconnected to height, correlates closely with BMI and total body fat, and is associated with cardiovascular disease (CVD)risk factors independent of BMI. Hence, WC may be an effective clinical tool for the assessment of cardiovascular diseases. The identification of WC cutoffs to discriminate individuals at significantly elevated risk for obesity-associated risk factors would be a valuable tool for clinical care and public health research [7]. Waist circumference (WC) could be a promising index of abdominal fat distribution. Experience accumulated in adult studies suggests that waist circumference predicts health risks beyond that predicted by BMI alone [9]. It has been shown that WC and hip circumference have self-regulating and opposite influences on metabolic health risk. While WC is positively associated with health risk, hip circumference is negatively associated with health risk. This indicates a protective effect of a large hip circumference, which could be because of a greater lean mass in the non-abdominal regions [8]. Several studies suggest a potential relationship between ABO, Rh blood groups, and various metabolic, malignant diseases, thyroid disorders, coronary heart disease, hypercholesterolemia, and diabetes mellitus (DM) [2]. The ABO and Rhesus (Rh) blood group systems are the most important amongst the 36 identified systems. In the early 1900s, 3 types of blood groups, A, B, and C (later re-named O), were known, and later the fourth group, AB, was discovered. The second most important blood group system is Rh, which was discovered in 1941 and contains 2 phenotypes only, Rh-positive and Rh- negative blood groups [10]. These correlations have led to the assumption that there is some definite correlation of various metabolic disorders with the ABO blood group. These correlations help to recognize the vulnerability of the diseases and support possible preventive actions and diminish the incidence [2]. The ABO system has been identified as a genetic marker for obesity [11]. It has been discovered that ABO and Rhesus blood types are associated with some obesity co- morbidities like type 2 diabetes mellitus, hypercholesteremia, 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 [12-18]. More recently, several studies have analyzed a possible association of obesity with the ABO blood group [2], [19, 20]. However, the results obtained have been different. Some studies reported no association [21], [20], while others identified an association between different blood groups and being overweight [21], [4]. In addition, some studies evaluated only specific population groups or only reported descriptive analyses[21-24]. The phenotypic diversity of the ABO blood group in the world population [25], requires that supposed associations must be evaluated in different countries or regions. The distribution of the ABO blood groups varies worldwide depending on different factors, such as genetics, race, and ethnicity. The possible explanation of conflicting results concerning the association between ABO and Rh blood groups and obesity could be racial and geographical variations playing a role in the genetic expression of the disease [26]. Many studies have been conducted to establish the relationship between ABO blood group, rhesus (Rh) antigen, and obesity. However, none have taken body fat percentage (BFP), visceral fat, or waist-hip ratio (WHR) into consideration [2]. Therefore, the objective of this study was to find out the relationship between blood group and Rh antigen with obesity parameters, for example, waist circumference and waist-hip ratio (WHR), among Saudi medical students.

Methodology

This cross-sectional study was conducted at Umm Al-Qura University, Faculty of Medicine, Makkah Al-Mukaramah, Saudi Arabia, during the period March-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 aged 18–20 years. Students with fever, swelling, who were highly trained athletes, and those aged <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 needs of the study were used. Measurement was conducted between 9 am and 12 noon. Measurement was done before lunch and about 2 hours after b

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reakfast. Measurement was avoided immediately after a meal, bath, or rigorous exercise. Abdominal obesity was defined as a waist circumference of > 102 cm for men and > 88 cm for women who were either overweight or obese with a BMI of ≥ 25.0 kg/m2 [3]. Waist and hip circumferences were measured using a measuring body tape measure to the nearest 0.1 cm. Keeping the measuring tape parallel to the floor, the waist circumference was measured at the level of the umbilicus at the high point of the iliac crest on the midaxillary line at minimal respiration. Hip circumference measurement was taken around the widest portion of the buttocks. Waist-hip ratio (WHR) was calculated after measuring waist and hip circumference. WHR = Waist circumference/hip circumference [7]. WHR >0.9 in males and >0.85 in females is considered to be obese [2]. Aseptic measures were ensured, and blood samples were taken by finger pricking with a sterile lancet. ABO/Rhesus 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 were evaluated by descriptive statistics. Categorical variables were reported as numbers and percentages, whereas continuous variables like age, weight, height, height square, and BMI were expressed as mean (M) ± standard deviation (SD). Proportions of the studied groups were expressed in percentages (%) and absolute numbers (n) of frequencies. The Pearson chi-square correlation analysis was used to determine the relationship between ABO blood group and Rhesus (Rh) factor blood with the waist-hip ratio. The confidence limit was kept at 95%, hence a P-value<0.05 was considered to be statistically significant.

Result

Out of 241 medical students who participated in the study, 116(48.1%) were male and 125 (51.9%) were female. The mean age was 18.50 ±0.64. The ages of the subjects were between 18 and 20 years old. According to the definition of abdominal obesity as a waist circumference of > 102 cm for men and > 88 cm for women who were either overweight or obese with a BMI of ≥ 25.0 kg/m2 [3]. The mean waist circumference among participants was 71cm ± 12.30 cm. The mean hip circumference among participants was 94.4cm ± 15.65cm. The mean W/H ratio among participants was 0.76 ± 0.08. [Table1]. 91% of the obese females had waist circumference of > 88 cm. 20% of the obese males had waist circumference of > 102 cm. 43% of the overweight females had waist circumference of > 88 cm. 50% of the overweight males had waist circumference of > 102 cm. 13.6% of females had increased WHR (>0.85). 3% of male participants had increased WHR (>0.9).

Increased WHR (>0.9) incidence is seen in 30% of obese males. Blood group "O" was found to be the most prevalent, 46.1% followed by blood group A (24.9%), blood group B (22.8%), and blood group AB (6.2%). Most of the students' Rhesus-D –D group was positive (85.9 %), and the Rhesus-D –D negative prevalence was (14.1 %) [Table1].

Variables	**Mean±SD**	**Percentage**
Age(years)	18.50±0.64	
Waist circumference	71cm ± 12.30	
Hip circumference	94.4cm ± 15.65	
Waist/Hip ratio	0.76 ± 0.08	
Gender	**Frequency**	
Male	116	48.1
Female	125	51.9
ABO blood groups		
A	60	24.9
B	55	22.8
AB	15	6.2
O	111	46.1
Rhesus (−/+)		
Negative	34	14.1
Positive	207	85.9
SD : standard deviation; n : number of participants		

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

Distribution of males according to ABO blood group and Rhesus (Rh) [Figure 1]. Distribution of females according to ABO blood group and Rhesus (Rh) [Figure 2].

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Distribution of various body composition parameters according to the blood groups in males is shown in [Table 2]. Distribution of various body composition parameters according to the blood groups in females is shown in [Table 3]. Rhesus (Rh) antigen and waist circumference [Figure 3]. Rhesus (Rh) antigen and waist-hip ratio [Figure 4]. In our study, we have divided the study results into two groups based on gender (males and females). From our study, we observed that, in males, only 1 participant with blood group A and Rh-positive participants had the highest WHR (>0.9). In males, only 1 participant with blood group O and Rh- positive phenotype has the highest percentage of participants having a higher waist circumference of > 102 cm. Increased WHR >0.85 is seen in blood group A and Rh-positive females. In females, blood group AB and Rh-positive phenotype have the highest percentage of participants having a higher waist circumference of > 88 cm. Visceral obesity measured by Waist circumference above 102 cm (>102 cm) was seen in only 1 participant (4%) of blood group O positive. Increased WHR (>0.9) incidence is seen in 1 participant (4%) of blood group A positive. Rh-positive males have a higher chance of having higher visceral fat and increased WC than Rh- negative males. Visceral obesity measured by Waist circumference above 88 cm (>88 cm) was seen in all ABO/Rhesus blood groups except A-negative and B-negative blood groups. Visceral obesity measured by Waist circumference above 88 cm (>88 cm) was seen in females with blood group AB and Rh-positive. Increased WHR (>0.85) incidence is seen in all ABO/Rhesus blood groups except A- negative and B-negative blood groups. The highest percent of increased WHR (>0.85) is seen in females with blood group A positive (30%). Therefore, Rh-positive females have more chances of having higher visceral fat, waist circumference, and waist-hip ratio than Rh-negative females.

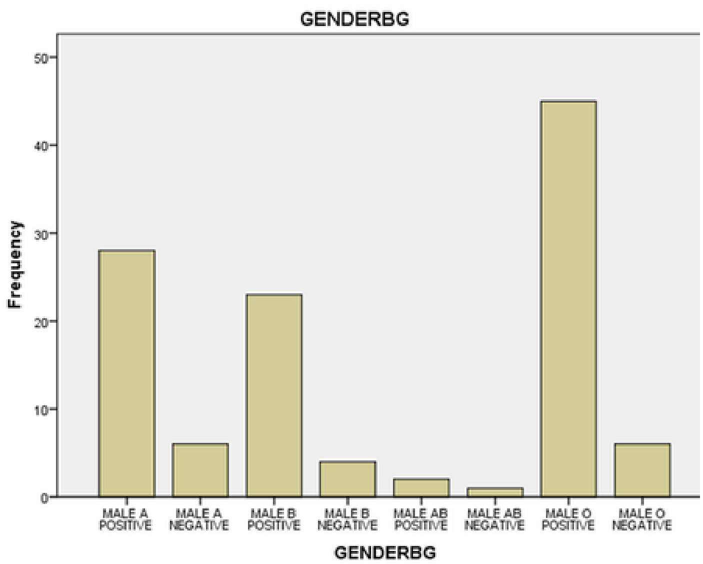

Figure 1: Distribution of males according to ABO/Rhesus blood group

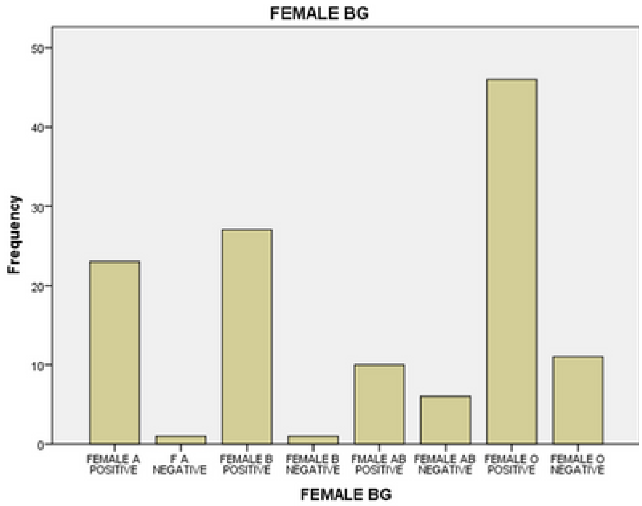

Figure 2: Distribution of females according to ABO Rhesus blood group

Blood Group	Number of	Percent	% of increased WC > 102 cm	Number of	% of increased WHR
	participants			participants with	
A Positiv	28	11.5	0%	1	4%
A Negati	6	2.5	0%	0	0%
B Positiv	23	9.5	0%	0	0%
B Negati	4	1.6	0%	0	0%
AB Positiv	2	0.8	0%	0	0%
AB Negati	1	0.4	0%	0	0%
O Positiv	45	18.5	4%	0	0%
O Negati	6	2.5	0%	0	0%

Table 2: Distribution of various body composition parameters in accordance to the blood groups in males

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Blood Group	Number of participants	Percent	% of increased WC > 88 cm	Number of participants with	% of increased WHR
A Positive	23	9.5	4%	7	30%
A Negativ	1	0.4	0%	0	0%
B Positive	27	11.1	15%	4	15%
B Negativ	1	0.4	0%	0	0%
AB Positive	10	4.1	17%	1	10%
AB Negativ	6	2.5	10%	1	17%
O Positive	46	18.9	4%	3	6%
O Negativ	11	4.5	9%	1	9%

Table 3: Distribution of various body composition parameters in accordance to the blood groups in females

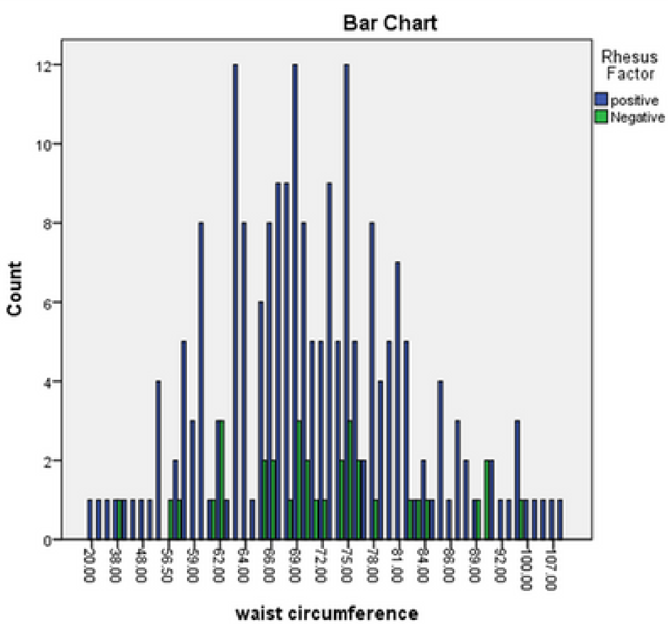

Figure 3: Rhesus(Rh)antigen and waist circumference

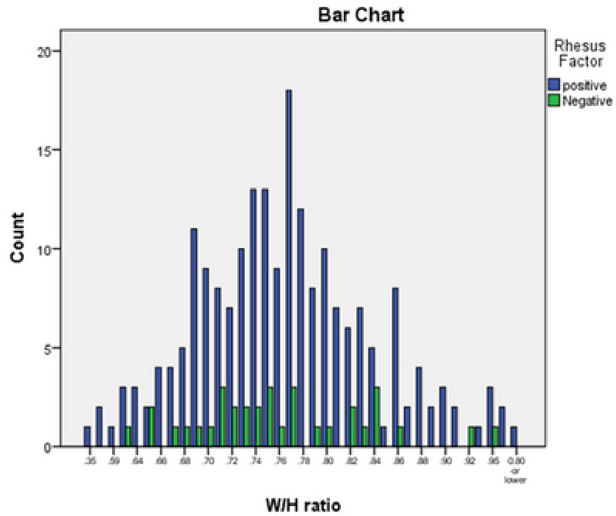

Figure 4: Rhesus (Rh)antigen and waist -hip ratio

The Pearson chi-square correlation analysis revealed that there is a statistically significant relationship observed between female ABO blood group and Rhesus antigen with WHR (P 0.004) [Table 4]. There was no statistically significant relationship between male ABO blood group and Rhesus antigen with WHR (P 0.415) [Table 5].

Correlations			
		Female BG	**W/H ratio**
Female BG	Pearson Correlation	1	-.256**
	Sig. (2-tailed)		0.004
	N	125	125
W/H ratio	Pearson Correlation	-.256**	1
	Sig. (2-tailed)	0.004	
	N	125	241
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 4: Correlation test between female ABO blood group and Rhesus antigen and WHR

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Correlations			
		W/H ratio	Gender BG
W/H ratio	Pearson Correlation	1	-0.077
	Sig. (2-tailed)		0.415
	N	241	115
Gender BG	Pearson Correlation	-0.077	1
	Sig. (2-tailed)	0.415	
	N	115	115

Table 5: Correlation test between male ABO blood group and Rhesus antigen and WHR

Discussion

Many researchers have tried to identify a possible association between ABO and Rh blood groups with obesity. The results have been inconsistent, variable, and have differed 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 an association [26]. There is great genetic diversity within all human populations; the simplest example is the ABO group system. ABO and rhesus (Rh) genes and phenotypes vary widely between ethnic groups and both within and between geographical areas [27].

Numerous studies have evidenced that Body Mass Index (BMI) is not the correct measurement of health or obesity and that the amount of body fat determines the health condition of the person. So, many studies used anthropometric measurements such as waist circumference (WC) waist- hip ratio (WHR) [2]. Therefore, this cross-sectional study was conducted to find out the relation between the ABO blood group and Rhesus (Rh) with the waist circumference (WC)and waist-hip ratio (WHR).

Results of this study show that in males, blood group A and Rh-positive participants have the highest WHR (>0.9). In males, blood group O and Rh-positive phenotype have the highest percentage of participants having a higher waist circumference of > 102 cm. Increased WHR >0.85 is seen in blood group A and Rh-positive blood group AB and Rh-positive phenotype have the highest percentage of participants having a higher waist circumference of > 88 cm. Rh-positive females have a higher chance of having a higher visceral fat percentage than Rh-negative females. The Pearson chi-square correlation analysis revealed that there is a statistically significant relationship observed between female ABO blood group and Rhesus antigen with WHR (P 0.004). There was no statistically significant relationship between male ABO blood group and Rhesus antigen and WHR (P 0.415). According to my best knowledge, only one published study was conducted to assess the relation between obesity and blood group using body composition and not the BMI. In agreement with our findings that there is a relationship of ABO blood group and Rhesus antigen with visceral fat, and waist-hip ratio, is a study conducted by Behera et al which included 100 healthy, first year MBBS students (54 - females, 46 - males) aged 18-20 years of Konaseema Institute of Medical Sciences and Research Foundation, Amalapuram, in the year 2015-2016 [2].

In comparison with our findings, in their study, Behera et al. found that in males, increased WHR (>0.9) incidence is seen more in blood group AB and Rh-negative males. Rh-negative males have shown a higher percentage of body fat. Visceral fat percentage above the normal range of 10% was seen in 1 participant each in all ABO blood groups except "AB." Rh-positive males have a higher chance of having a higher visceral fat percentage than Rh-negative males. Blood group AB has shown the highest number of students having body fat percentage (BFP) above 21%, while in females, blood group O has the highest number of participants having body fat percentage>30%. Rh-positive females show an increased tendency toward increased BFP. Visceral fat percentage is 1% each for blood group A, B, and O. In females, none of the members of blood group AB have increased visceral fat percentage (>10%). Rh-positive females are more prone to having increased visceral fat percentage. Increased WHR >0.85 is seen in blood group O and Rh-negative females [2].

Many studies have found a relationship between ABO blood groups and obesity. However, all of them have used BMI to assess obesity and not the body composition. In a study conducted by Nas and Fiskin in Turkey, including 298,247 Turkish seafarers. It has been noted that seafarers with AB Rh (–) blood group have the highest mean BMI value [24]. A Lithuanian study conducted by Idzeliene and Razbadauskas (2010) included 207 students and concluded that obesity was greatest among blood group A subjects. In a study conducted in the Punjabi population at Selangor, Malaysia, including 990 subjects, a significant association was found between obesity and blood group B and Rh-positive groups [29]. In a study including

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151 staff and students from Advanced Medical & Dental Institute, Universiti Sains Malaysia, a high incidence of obesity (mild and moderate) was found in type "B" blood group [29]. 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 [22]. In a study conducted in Sargodha, Pakistan, including 149 male and female children, Ainee et al found a higher incidence of obesity among the children with blood group O as compared to children with the other blood groups (Ammara Ainee, Sarfraz Hussain, Tusneem Kauser, Tahir Mahmood Qureshi, 2014). In another study in India, a total of 143 school children from two schools in Andhra Pradesh were enrolled in the study. Obesity was found to be more prevalent in O blood group children [31]. In an Iranian study on 5000 healthy persons of Golestan Province, northern Iran, the prevalence of obesity was found to be higher in the O blood group [32]. A cross-sectional study that 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 [33-35]. A prospective randomized study including 885 overweight or obese individuals, in Hatwan private hospital, and Sulaimani Teaching Hospital in Sulaimani governorate, Kurdistan Region/Iraq, who were consulting for advice, diet, and or drugs, and various bariatric operations. This was conducted in the period of 6 years from February 1st, 2012, to March 1st, 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 the Rhesus antigen, D blood group positive individuals are dominant [27].

On the other hand, 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 [21], and the second study from Almadinah Almunawwarah, KSA [21]. Our results were also in disagreement with other findings worldwide. The findings of 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. Additionally, in Nigeria, the same results were found in a study comprising 1650 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 [33].

Conclusions

Our study finds that the Relation with body composition parameters such as waist circumference (WC) and waist–hip ratio (WHR) may be useful to assess the disease incidence and risk assessment according to ABO and Rh blood groups. Our study finds that A Rh (+) blood group may be predisposed to obesity due to the higher waist circumference (WC) and waist–hip ratio (WHR). It is suggested that Saudi student with A Rh (+) blood group, who have the highest waist circumference (WC) and waist–hip ratio (WHR) value, should pay special attention to their weight.

Limitation

This study is an experimental or trial project to concentrate on the problem of obesity in society and to identify the relation of obesity to the ABO blood group and Rhesus antigen using modern obesity measurements such as waist circumference (WC),- hip ratio (WHR. However, because of the small sample size and age group limitation, it is difficult to deal with the problem in a large community. A bigger sample size about the present prevalence may provide the exact problem statement and its relation to different blood groups. Future studies with a bigger sample size than ours will prove or refute such findings.

Strength of this study

The major strength of this study is that the samples came from a homogeneous population of relatively similar behavioral, environmental, and socio-economic layers.

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