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A Comprehensive Study of Distribution and Relation of ABO and RH Blood Group Antigens with Body Mass Index Among Medical Students

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ABSTRACT

Background: Obesity predisposing factors have been raised as a major concern of researchers due to the consequences of obesity on health such as diabetes, hypertension, and depression, ABO blood groups linked to many diseases, so may affect directly or indirectly on the incidence of obesity.
Aims and Objective: Objective of this research was to study the distribution and relation of ABO and Rh blood group antigens with body mass index among medical students.
Materials and Methods: This study was conducted on 468 healthy MBBS students. ABO blood group typing was done by slide agglutination method. Height and weight were recorded in centimeters and kilograms respectively. Then BMI was calculated as weight in kilogram divided by square of height in meters.
Result: In our study blood group B was the most frequent blood group type with B positive comprising of the maximum cases (31.8%). Out of 468 participants, 91.02% were rhesus positive and 8.97% cases were found to be rhesus negative. Most participants (70.1%) were classified under normal weight category and only 4.1% were obese. Blood group O had maximum number of students in Pre obesity (5.55%) and obese category (1.49%).
Conclusion: The revelation of relation between obesity and ABO blood group type emphasizes the fact that there may be significant physiological difference among individuals of various blood types. This knowledge can be utilized to initiate healthy life style in the risk population and aid towards developing a healthy lifestyle.

Keywords: *ABO Blood Group; Rh Blood Group; BMI, Obesity, pre-obese.*

INTRODUCTION

ABO antigens are glycoproteins present on the surface of red blood cells (RBCs) and their genes are located on chromosome 9q34.[1,2] These antigens help in maintaining RBCs integrity, cytoskeleton, as well as membrane transport and have important role in cellular physiology and pathology.[3] The ABO Blood Group System was first discovered by Karl Landsteiner, an Australian scientist, in 1900.[2] The presence or absence of antigens lead to specific blood types which indirectly play role in susceptibility to many diseases including cognitive and cardiovascular disease, and metabolic disorders such as diabetes mellitus, hypertension and obesity.[4]

Obesity is a condition with excessive fat deposition that can have deleterious effect on human health. WHO considers adults with body mass index (BMI) between 25 to 29.9 as overweight and those with BMI more than equal to 30 as obese.[5] It is emerging as a major global health problem in recent times.[6] According to WHO, in 2022, approximately 890 million adults were living with obesity.[5] This is a cause of concern as it itself is related to many serious health issues including cardiovascular, type 2 diabetes, renal and skeletal diseases as well as certain malignancies.[7,8,9] Although many researches have reported association between obesity and ABO blood groups, this relationship is still under investigation due to conflicting results.[10] Thus, immense workup is needed to validate relationship between BMI and blood groups , since if

there is an association, and even though blood group is a nonmodifiable risk factor, the at risk individual can implement life style changes early in life, to prevent development of obesity and its complications.[11]

The goal of our study is to determine the frequency of obesity and find out any potential relation between ABO blood group and BMI among Medical students.

MATERIAL AND METHOD

This is a descriptive cross – sectional study conducted from August 2025 to November 2025 in the Pathology Department of Veer Chandra Singh Garhwali Government Institute of Medical Science & Research, Srinagar, Uttarakhand. It includes 468 medical students (boys and girls) of MBBS batches 2021-2022, 2022- 2023 & 2024-25. The study was well described to the students and written consent was taken.

Inclusion criteria - Students between the age group of 18 to 23 years without any obvious illness.
Exclusion criteria - Students with:

- any cardiovascular, respiratory, neurological or gastrointestinal diseases
- treatment for any active illness
- history of hospitalization in the last six months

ABO blood group typing was done by slide agglutination method under aseptic conditions.
The height and weight were recorded by the same person to prevent inter- observer bias. The height was measured in centimeters in upright position without shoes by Stadiometer and later converted to meters for calculating BMI and weight was measured bare foot with light clothes on analog weighing machine. BMI was calculated as weight in kilogram divided by square of height in meters. The BMI classification according to WHO, used to categorize students is given in **Table 1**.

Table 1: Classification of body mass according to body mass index (BMI)

Classification	BMI (kg/m^2)
Underweight	<18.5
Normal	18.5 – 24.9
Pre obesity	25.0 – 29.9
Obese	>= 30

The data was analysed using statistical software SPSS (Statistical Package for the Social Sciences, IBM Corporation, Armonk, Network) version 20 to determine any association between obesity and different blood groups.

RESULT

In our study we are reporting a comparative distribution pattern of ABO and Rhesus (Rh) blood group antigen along with BMI groups in medical students. Out of 468 participants, 246 were females and 222 males. The median age was found to be 21.5 years and the mean BMI for the patients was 23.8 kg/m^2.

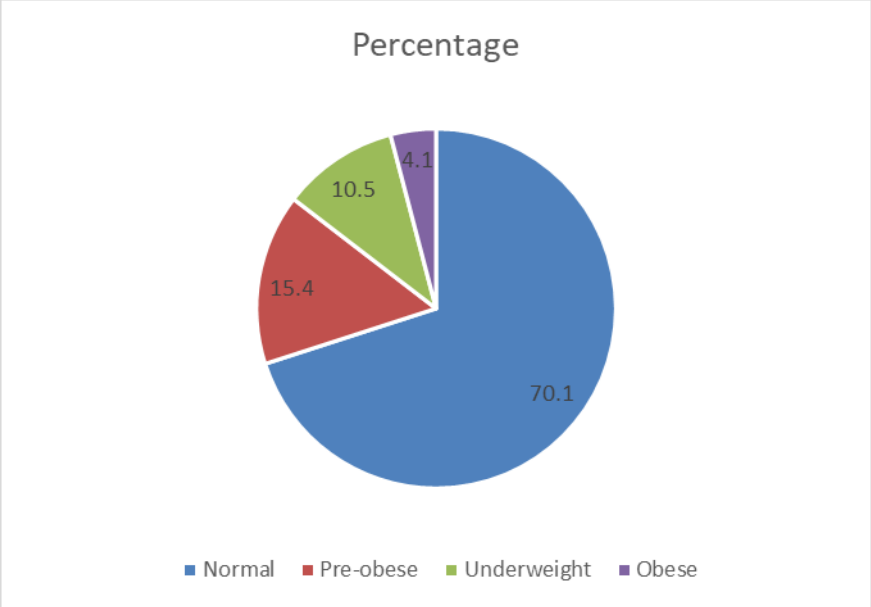

Figure 1: Distribution of BMI among participants

In our study blood group B was the most frequent blood group type with B positive comprising of the maximum cases (31.8%), while B negative & AB negative (1.1%) both were equally the least common blood group reported. Out of 468 participants, 91.02% were rhesus positive and 8.97% cases were found to be rhesus negative.

Table 2: Distribution of medical students based on ABO blood group and Rhesus (n= 468)

Blood groups	**A (= 125)**		**B (= 154)**		**AB (=55)**		**O (= 134)**	
Rhesus	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
Frequency	112	13	149	05	50	05	115	19
Percentage	23.9 %	2.7 %	31.8 %	1.1 %	10.7 %	1.1 %	24.6 %	4.1 %

The relationship of ABO blood group with BMI category is shown in Table 3.

Table 3: Distribution of various BMI in accordance to the blood groups (n= 468)

Blood Groups	**A**			**B**			**AB**			**O**		
Rhesus	**+**	**-**	**Total**	**+**	**-**	**Total**	**+**	**-**	**Total**	**+**	**-**	**Total**
Under weight	11	05	**16 (3.41%)**	13	00	**13 (2.77%)**	06	00	**06 (1.28%)**	13	01	**14 (2.99%)**
Normal	83	03	**86 (18.37%)**	112	04	**116 (24.78%)**	35	04	**39 (8.33%)**	74	13	**87 (18.58%)**
Pre obese	16	03	**19 (4.05%)**	19	01	**20 (4.27%)**	06	01	**07 (1.49%)**	22	04	**26 (5.55%)**
Obese	02	02	**04 (0.85%)**	05	00	**05 (1.06%)**	03	00	**03 (0.64%)**	06	01	**07 (1.49%)**

Maximum number of cases in normal weight category were seen in blood group B (24.78%) and minimum cases were seen in AB blood group (8.33%)

Blood group A had maximum underweight students (3.41%), while blood group AB had the minimum (1.28%). Blood group O had maximum number of students in Pre obesity (5.55%) and obese category (1.49%).

DISCUSSION

The distribution of ABO blood groups varies worldwide depending on different factors such as genetics, race and ethnicity. Our study results showed that majority of participants belonged to the blood group type B (40.8%) while AB (11.8%) was the least frequent blood group. These results were concordant with studies done by Shireen et al (10), Behra et al[12] and Shehin et al[13] where also the B blood group was the most commonly found blood group. However, our results didn't match with Papanna J et al[14], who reported O blood group type as the most prevalent blood group type in the population. **[Table 4]**

Table 4: Comparison of the prevalence of ABO blood group types in different studies with our study

Blood group	**Present study N = 468**	**Shireen et al[10] N= 200**	**Behra et al[12] N = 100**	**Shehin et al[13] N = 150**	**Papanna J et al[14] N = 1514**
A	26%	24.40%	22%	18.70%	26.61 %
B	32.9%	42.7%	37%	42%	24.90 %
AB	11.8%	5.2%	13%	11.30%	6.99%
O	28.7%	27.6%	28%	28%	41.47%

In addition, in our research the positive rhesus records the highest distribution (86.6%) in comparison to negative rhesus (13.4%) which is congruent with the studies done by Shireen et al [10], Shehin et al[13], Papanna J[14], Shrivastava A et al[15] and Kar k et al[16] respectively.

Recent studies have shown that obesity is increasing globally. In our study, frequency of overweight and obese individuals were 15.40% and 4.10% respectively. Maximum obesity was the least common category reported. Our results were similar to most of the studies done by, Shehin et al[13], Shrivastava A et al[15], Kar K et al[16] and Kidwai et al[17] where also pre obesity was the second most common category reported after normal BMI. However, obesity wasn't the least common category reported in studies done by Shehin et al[13] and Kidwai et al[17] where underweight was the least common category reported**. [Table 5]**

Table 5: Comparison between the BMI categories of different studies with our study

	Present Study N = 468	**Shehin et al[13] N = 150**	**Kar K et al[16] N = 720**	**Shrivastava A et al[15] N = 745**	**Kidwai et al[17] N = 384**
Under weight	10.50 %	3.30 %	10.69 %	8.30 %	8.85 %
Normal	70.10 %	60.70 %	56.11 %	59.20 %	53.12 %
Pre obese	15.40 %	20.70 %	24.72 %	25.20 %	22.39 %
Obese	4.10 %	15.30 %	8.47 %	7.20 %	15.62 %

Several studies have been done to establish a relation between ABO blood group and obesity. According to our study, maximum number of obese and pre obese subjects belonged to blood group O (19.01%) followed by blood group B (5.54%), blood group A (3.29%) and blood group AB (1.38%) respectively. Similar results were observed in study conducted by Shireen et al[10] and Papanna J et al[14] where also blood group O takes the highest frequency of obese individuals.

However, our results weren't congruent with studies done by Shrivastava A et al[15] and Kar K et al[16] where blood group B showed susceptibility towards obesity. Whereas, study done by Shehin et al[13] and Kidwai et al[17] revealed that individuals with blood group AB were more prone to developing obesity. Some studies like Kelso et al[18] did not show any relation between blood groups and obesity.

Rh-positive was more susceptible to get obesity as compared to people that have negative rhesus. This finding was similar to all the other studies conducted.

CONCLUSION

The investigation identified B as the most prevalent ABO blood group among the study's subjects. Notably, obese and overweight participants predominantly belonged to blood group O, with blood group AB being the least frequent. This observed relationship between obesity and ABO blood group type suggests the presence of significant physiological differences between individuals of varying blood types. Such knowledge can be leveraged to target health promotion initiatives within at-risk populations and facilitate the development of personalized healthy lifestyle recommendations. Limitations included a small sample size and the absence of data on Rhesus-negative blood groups due to donor rarity. Future research necessitates larger, population-based studies to address these constraints.

Conflict of interest declaration

The authors declare that there is no conflict of interest**.**

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