

Association of Body Mass Index with Frequency of Different Blood Groups among Medical Students

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Abstract

ABO blood group and Rh typing has been given high priority because of their medical importance. ABO antigen type has been proved as a risk factor for obesity, cardiovascular diseases, cancers, and infectious diseases. A cross-sectional study was conducted in the Department of Physiology, Bashundhara Ad-din Medical College, Keraniganj, Dhaka, Bangladesh, between January and June of 2024 among 100 undergraduate medical students, to determine the association between ABO blood groups and body mass index. Individuals with physical deformities that influenced height such as short or amputated lower limbs, kyphosis, and scoliosis, a genetic disorder linked with obesity, conditions including hypothyroidism, polycystic ovary syndrome or Cushing syndrome linked with obesity were excluded. Weight of the students was measured in the upright position to the nearest 0.5kg and height was measured without shoes to the nearest 0.1cm. Then, BMI was calculated. Blood samples were collected for ABO blood grouping and Rh typing. The mean age of the medical students was 21.36±1.23 years. 34% were male and 66% were female; male-female ratio was 1:1.94. Based on BMI, 39% of students were obese, while 16% were overweight, 43% had normal BMI and 11% were underweight. The mean BMI was 23.74±3.98 kg/m². Most of the participants belonged to the B blood group (42%), followed by blood group O (29%), blood group A (21%) and blood group AB (8%). 97% of the participants had Rhesus-positive and 3% were Rhesus negative. Among the overweight, obese and underweight students, blood group B was predominant (62.5%, 40% and 36.4% respectively); while among the students having normal BMI blood group AB was predominant (39.5%). The differences were not statistically significant (p=0.499). In all BMI categories, i.e., underweight, normal, overweight and obese, Rh positive was predominant (100%, 95.3%, 93.8% and 100% respectively). The differences were not statistically significant (p=0.589). Blood group B is the most common blood group and there is no relationship between BMI and blood group among the medical students.

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Introduction

Overweight and obesity designate a state of excessive body weight, mostly due to an increase in fat mass. While overweight comes from extra muscle, bone, fat and water, obese persons always have a high proportion of extra body fat. The most frequently used indicator of overweight and obesity is the body

mass index (BMI).¹ In 2022, 2.5 billion adults aged 18 years and older were overweight, including over 890 million adults who were living with obesity worldwide.² This shows that obesity and overweight has become a big problem in the world. Understanding the risks for obesity is important for its control. Thus, finding

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predisposing factors of obesity is a major concern of the researchers.³

Since the beginning of the 19th century, numerous blood group systems have been identified, but the ABO and Rhesus (Rh) blood groups remain clinically the most important. Karl Landsteiner in 1901 discovered the first human blood group, which was the ABO group.⁴ Later, Rh blood group was defined by Landsteiner and Wiener in 1941.⁵ The plasma membrane of red blood cell contains many antigens, the most important and best known of these are the A and B antigens. The A and B antigens are inherited as Mendelian dominants, and on the basis of these individuals are categorized into four major blood groups: A, B, AB, and O. The ABO antigens are complex oligosaccharides present in the form of glycoprotein and glycolipids.⁴ The presence of Rh antigens adds to further variability and on the basis of presence or absence of Rh antigens, each blood group is classified into two groups – Rh-positive and Rh-negative.⁶ Some reports have shown evidence of potential association between ABO blood and some diseases. However, it has yet to be fully established the validity of this associations, evidence suggests that blood group antigens may play a biological role in some disease pathogenesis.⁷ There have been several studies to determine an association between ABO, Rh blood groups, and obesity co-morbidities such as coronary heart disease,⁸ hypercholesterolemia,⁹ hypertension,¹⁰ and diabetes mellitus.^{9,10} These correlations have directed to the assumption that there is some definite correlation of various metabolic disorders with ABO blood group. These correlations help to recognize the vulnerability of the diseases and support possible preventive actions and diminish the incidence.¹¹ Several studies analyzed a possible association of obesity with the ABO blood group.¹¹⁻¹⁵

However, the results obtained have been inconsistent. Some studies found no association.^{12,13,15} while others observed an association between different blood groups and overweight.^{14,16,17} In addition, some studies evaluated only specific population groups or only reported descriptive analyses.^{11-13,16,17} The phenotypic difference of the ABO blood group in the world population necessitates evaluating these associations in different countries or regions.¹⁸ The present study was design to determine the association between the ABO blood group and BMI among medical students of Bangladesh.

Methods

This cross-sectional study conducted in In the Department of Physiology, Bashundhara Ad-din Medical College, Keraniganj, Dhaka, Bangladesh, between January and June of 2024 among 100 undergraduate medical students from MBBS first and second year. Individuals with physical deformities that influenced height such as short or amputated lower limbs, kyphosis, and scoliosis, a genetic disorder linked with obesity, conditions including hypothyroidism, polycystic ovary syndrome or Cushing syndrome linked with obesity were excluded from the study.

Anthropometric measurement like weight of the medical students was measured in the upright position to the nearest 0.5kg using a weight measuring scale and height was measured without shoes to the nearest 0.1cm with a with a balanced beam scale and portable stadiometer. Then, body mass index (BMI) was calculated based as weight in kilograms divided by the square of the height in metres (kg/m^2). BMI was classified according to the proposed criteria for South and Southeast Asian

countries including Bangladesh,¹⁹ where BMI of the following values: $<18.5\text{kg/m}^2$, $18.5\text{--}22.9\text{kg/m}^2$, $23\text{--}24.9\text{kg/m}^2$, and $\geq 25\text{kg/m}^2$, was categorized as underweight, normal weight, overweight, and obese, respectively.

Blood samples were collected for ABO blood group analysis. For blood grouping and Rh typing, two glass slides were taken for each student. One slide was divided and marked as A and B. Other slide was marked as D. Blood drop was placed on the slides; one drop in each areas of A, B and D. Appropriate anti-serum was placed on respective areas on the slides. Blood and anti-serum were mixed properly by stirrer. Observation was done by naked eye, then under microscope, for presence or absence of agglutination.

Descriptive statistics of the frequency, percentage, mean and standard deviation were used to examine the data. ANOVA-test was used to compare the difference of means BMI among blood groups. Fisher's Exact test was used to determine the association between BMI categories and ABO blood group and Rh system. Statistical analysis was done using SPSS version 25.0 statistical software package was used to carry out statistical analysis. A p-value <0.05 was considered statistically significant.

The study was approved by the Ethical Review Committee of Bashundhara Ad-din Medical College, Keraniganj, Dhaka, Bangladesh

Results

In this study, the mean age of the medical students was 21.36 ± 1.23 years. 34% were male and 66% were female; male-female ratio was 1:1.94. Based on BMI, 39% of students were obese, while 16% were overweight, 43% had normal BMI and 11% were

underweight. The mean BMI was $23.74\pm 3.98\text{ kg/m}^2$ (Table-I). Most of the participants belonged to the B blood group (42%), followed by blood group O (29%), blood group A (21%) and blood group AB (8%). 97% of the participants had Rhesus-positive and 3% were Rhesus negative (Table-II). Among the overweight, obese and underweight students, blood group B was predominant (62.5%, 40% and 36.4% respectively); while among the students having normal BMI blood group AB was predominant (39.5%). The differences were not statistically significant ($p=0.499$) (Table-III). In all BMI categories i.e., underweight, normal, overweight and obese, Rh positive was predominant (100%, 95.3%, 93.8% and 100% respectively. The differences were not statistically significant ($p=0.589$) (Table-IV).

Table-I: Distribution of the medical students based on gender and BMI (n=100)

Variables	Frequency	Percentage
Gender		
Male	34	34.0
Female	66	66.0
BMI category		
Underweight	11	11.0
Normal	43	43.0
Overweight	16	16.0
Obese	30	30.0

Table-II: Distribution of the medical students based on blood grouping and Rh typing (n=100)

Blood groups	Frequency	Percentage
ABO blood grouping		
A	21	21.0
AB	8	8.0
B	42	42.0
O	29	29.0
Rhesus typing		
Negative	3	3.0
Positive	97	97.0

Table-III: Association between BMI category and ABO blood groups

ABO blood groups	BMI categories				p-value
	Underweight (n=11)	Normal (n=43)	Overweight (n=16)	Obese (n=30)	
A	3 (27.3%)	6 (14.0%)	3 (18.8%)	9 (30.0%)	0.499 ^{NS}
B	4 (36.4%)	16 (37.2%)	10 (62.5%)	12 (40.0%)	
O	1 (9.1%)	4 (9.3%)	1 (6.2%)	2 (6.7%)	
AB	3 (27.3%)	17 (39.5%)	2 (12.5%)	7 (23.3%)	

Fisher's Exact test was applied; NS=not significant.

Table-IV: Association between BMI category and Rh factors

BMI categories	Rh factor		p-value
	Positive	Negative	
Underweight	11 (100%)	-	p=0.589
Normal	41 (95.3%)	2 (4.7%)	
Overweight	15 (93.8%)	1 (6.2%)	
Obese	30 (100%)	0 (0.0%)	

Fisher's Exact test was applied; NS=not significant.

Discussion

ABO and Rh blood group distribution studies are important as they play a major role in blood transfusion, transplantation of organs, and research in the field of genetics, human evolution and forensic pathology.²⁰ Among the different blood groups, ABO system was the first to be professed and characterized as a genetic marker for obesity.²¹ Several studies showed association between ABO blood group and obesity or obesity related comorbidities like coronary heart disease, hypercholesterolemia, hypertension, and diabetes mellitus.⁸⁻¹⁰ In contrast, inconsistent relationship between ABO blood group and BMI were reported in several studies – as some studies observed the association of increased BMI with the presence of particular ABO antigens,^{14,16,17} while others found no association between those factors.^{12,13,15} In this study, the frequency distribution of blood group B was the highest with percentage frequency followed by

blood group O, blood group A, and the least percentage frequency being AB. This result was in line with a study in Bangladesh.²² This was also in agreement with several studies done in India and Pakistan.^{14,20,23,24} The distribution of ABO blood groups differs greatly by area and ethnicity. Predominant O blood group was found in previous studies done in Bangladesh and Nepal,^{25,26} while predominant A blood group was observed in Japanese people (40%).²⁷ Therefore, marked variance of blood group across various ethnic groups and races varies worldwide suggesting racial variations, as based on ethnic and genetic differences.²⁸

In this study, there was no statistically significant relation detected between ABO blood groups (p=0.499) and no statistically significant relation was detected between among ABO blood groups and an increase of BMI (p=0.959). Several studies supported our results of no association between ABO and

BMI.^{12,13,15,29-31} In contrast, significant association was found between ABO blood group and BMI among sample populations of different countries.^{11,14,16,17} Our data also suggests that there was no statistically significant association between Rh factor and BMI categories ($p=0.589$). This result correlated with the result of the study done in the UK that failed to link BMI with either ABO or Rh phenotype.³²

One of the limitations of the our study was in its cross-sectional design, which hardly establish causal relationship. Apart from that, our study period was short and sample size was small, due to the budget constraint. Hence, the results of the study may not be generalized and does not necessarily reflect the overall picture of the country. Further studies with larger samples involving multiple medical colleges from different regions of the country are recommended.

Conclusion

A female predominance was observed among medical students. Blood group B and Rh-positive were identified as the most common blood group types among medical students. There is no relationship between BMI and blood groups as well as Rh factors among the medical students.

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