ORIGINAL ARTICLE

Frequency of different blood groups and its association with BMI and blood pressure among the female medical students of Faisalabad

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Abstract

Objective: To determine the frequency of different blood groups among female medical students and to find the association of blood groups and body mass index with blood pressure.

Methods: This cross-sectional study was performed at the University Medical and Dental College, Faisalabad, Pakistan, from March to April 2016, and comprised female medical students. Participants were divided into groups on the basis of their ABO blood groups and on body mass index criteria. Blood groups were determined by simple conventional slide method. Blood pressure was estimated by manual auscultatory technique with a mercury sphygmomanometer. Data was analysed usingSPSS20.

Results: There were 145 students with an overall mean age of18.4±0.75 years (range: 17-23 years). Blood group B was the predominant group 65(44.8%). Besides, 130(89.6%) subjects were rhesus positive, and 23(53%) subjects of blood group O were pre-hypertensive. Multiple regression analysis indicated significant positive association of blood group O with both systolic and diastolic blood pressure (p=0.002, 0.001). However, subsequent logistic regression showed significant association only with diastolic blood pressure (p=0.001). Relative risk of pre-hypertension for obese (p=0.001) was greater than non-obese subjects. Body mass index was significantly associated with both systolic and diastolic blood pressure (p=0.004, 0.042)

Conclusion: Blood group B was the most common blood group. Blood group O was associated with diastolic pre-hypertension, while body mass index was associated with both systolic and diastolic pre-hypertension.

Keywords: Pre-hypertension, BMI, Diastolic blood pressure, Blood groups. (JPMA 67: 1132; 2017)

Introduction

Hypertension, termed a "silent killer", is a common health problem globally.[1] Its complications imply a large burden on health care system. Its prevalence is increasing in adolescents because of sedentary and unhealthy lifestyle and increasing trends towards obesity in children and teenagers.[2] Previous researches have shown that high blood pressure is associated with many genetic markers and familial patterns.[1] There are empirical evidences suggesting its linkage with blood groups.[1] The International Society of Blood Transfusion has identified thirty-three various blood group systems.[3] Clinically, the most important system is ABO system[4] which was discovered by Karl Landsteiner in 1901. Later on, another system rhesus (Rh) blood group was identified by Weiner and Karl Landsteiner in 1940[5] The major blood groups of ABO system are A, AB, B and O. The A and B antigens are oligosaccharide, expressed on erythrocytes, platelets, vascular endothelium and tissue cells.[6] Major determinant of Rh group is D antigen.[6] The regulation of ABO blood group system is under the control of ABO gene expression.[7] Genes for ABO antigens and Rh antigen are located on chromosome no. 9 and 1, respectively.[4,8] Several epidemiological studies have reported that the distribution of different ABO blood groups vary markedly among the populations of different geographical areas reflecting racial differences.[9] The studies performed at different areas of Punjab reveal the predominance of blood group B.[9,10] Since the discovery of the ABO system, its significance regarding evolution, paternity, finger printing, inheritance pattern, legal medicine, blood transfusion and genetic study, as predictor of national suicide rate, are all well documented by past researches.[5,10] The blood group systems are of interest to recent researchers of modern medicine due to its linkage with various diseases.[11] Evidences are available on the association of various diseases and malignancies with blood groups, although more extensive researches are still required in this aspect.[11] Several studies have also reported the association of blood group A with cervical cancer.[10] Population with blood group B is genetically more prone to diabetes type-2.[12] The association of hypertension and obesity with blood group B was reported by many past researchers.[13] It is important to identify the susceptible population and need to evaluate the association of blood group with blood pressure and body mass index (BMI). Recognition of a positive relation with blood groups might reflect increased susceptibility

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to hypertension which is still required to be explored by new researches. Young population at high risk of hypertension should be screened earlier than other population and possible preventive measures should be adopted to reduce the prevalence of hypertension and its harmful consequences.

The current study was designed to determine the frequency of different blood groups among the female medical students and to find out the association of blood groups and BMI with blood pressure.

Subjects and Methods

This cross-sectional study was conducted at the University Medical and Dental College, Faisalabad, Pakistan, from March to April 2016, and comprised female medical students. The sample size was calculated with the prevalence (P) of pre-hypertension of 3.6%,[2,12] error (e) of 5% and confidence interval (CI) of 95% by the formula N= (Za)^2[p(1-p)] /e^2. (N = sample size; Z = standard normal Z value at 95% CI =1.96).[14] The participants were selected using multistage sampling technique. First, the total number of students enrolled in the University of Faisalabad was identified based on various disciplines. A list of these students was collected from students' record after ethical approval from the institutional research and ethics committee. The total number of students in all the five disciplines was 2,021. Of the five disciplines, medicine was selected randomly; it had 971 students, including 750 of Bachelor of Medicine, Bachelor of Surgery (MBBS) and 221 of Bachelor of Dental Surgery (BDS). A list of these students was entered on Microsoft Excel 2007. Random numbers were generated and sorted in ascending order. The first 200 students were selected from the sorted list. Relevant information including race, ethnicity, place of residence, age, medical history and family history was documented on a pre-designed proforma. Subjects with history of rheumatic fever, cardiovascular diseases, and diabetes and thyroid disorders were excluded. All participants were divided into four groups based on their ABO blood groups. For further analysis on the basis of BMI, subjects were also categorised into sub-groups: underweight (BMI<18.5 kg/m^2), normal weight (BMI 18.5-22.9 kg/m^2), overweight (23-24.9 kg/m^2) and obese (BMI $\geq$25kg/m^2). Standard cut-off point for obese was taken as $\geq$25kg/m^2 as recommended by the International Obesity Task Force (IOTF) and the World Health Organisation (WHO) for Asians.[15]

Subjects were briefed about the rationale of the study and written informed consent was taken. For the assurance of confidentiality, the subjects were assured that information provided by them — including name, identity and data — would not be disclosed at any time and only the principal investigator would have access to it. Anthropometric parameters, including height in centimetres and weight in kg, were taken by stadiometer, and then BMI was calculated by Quetelet index: BMI= weight in kg/ height in m^2.[2]

Blood groups were determined by simple conventional slide method. After aseptic measures, blood was obtained by figure pricking with sterile lancet. Blood drops were placed on three dry and clean glass slides labelled as 'A', 'B' and 'D', followed by adding a drop of the anti-sera including anti-A, anti-B and anti-D on each slide. Blood was mixed with anti-sera with the help of three separate toothpicks. Blood groups were determined on the basis of agglutination reaction.[3,10]

Blood pressure was measured by manual auscultator technique with a mercury sphygmomanometer as recommended by the American Heart Association (AHA).[16] The subject were made to sit relaxed in a comfortable position with back and arm supported for a few minutes. After proper exposure, the cuff was placed 2cm above the cubital fossa. Brachial artery was palpated and the chest piece of stethoscope was placed over it. Radial artery was palpated while inflating the cuff. It was inflated 20-30 mmHg above the point at which the radial pulse disappears. Then, cuff was deflated slowly and Korotkoff sounds were noticed. Systolic blood pressure (SBP) was recorded with the onset of clear Korotkoff sound and diastolic blood pressure (DBP) reading was noted with the disappearance of these sounds. Manometer was properly observed in a direct line to avoid parallax error. Zero error was checked prior to measurement of blood pressure. Three readings were taken at intervals of at least 1 minute, and the average value was recorded in order to acquire an accurate blood pressure reading as recommended by the AHA.[16]

Hypertension was classified on the basis of Joint National Committee (JNC) guidelines:[8] low (<90/60 mmHg), normal (91/61 to120/80 mmHg) pre-hypertension (121/81 to 139/89 mmHg), and hypertension (?140 mm Hg SBP and/or ?90 mm Hg DBP).[17]

SPSS 20 was used for data analysis. Demographic data of study population was evaluated by descriptive statistics. Continuous variables like age, BMI, and systolic and diastolic blood pressure were expressed as mean ± standard deviation (SD). Categorical variable (pre-hypertension) was presented by frequency and percentages. Shapiro-Wilk test was used to test for normality. After the assumptions were satisfied, parametric test (analysis of variance, or ANOVA) for the

comparison of means was used.

Pre-hypertension was analysed as a dichotomous outcome (absence versus presence). Chi-square test was used to assess the frequency and percentages of pre-hypertension among the various blood groups and different categories of BMI (underweight BMI <18.5 kg/m^2, normal weight 18.5 - 22.9 kg/m^2, over weight 23-24.9 kg/m^2 and obese BMI > 25 kg/m^2. Mantel-Haenszel (MH) age-adjusted odd ratios (ORs) and 95% CI were used for the estimation of relative risk for pre-hypertension among the various study groups. Multiple regression analysis was applied to assess the significant association between the dependant variables (SBP and DBP) and independent variables (age, BMI and blood groups). The significant associations were again tested by logistic regression analysis by using systolic and diastolic pressure as dichotomous variables to confirm the results. Results of logistic regression were presented as OR. P<0.05 was considered statistically significant.

Results

A total of 145 students were enrolled in the study. The overall mean age was 18.4±0.75 years (range: 17-23 years). The distribution of phenotype frequencies and percentages for the A, B, AB, O, were 27(18.6%), 65(44.8%), 10(6.9%) and 43(29.7%), respectively. The frequency of Rh-positive subjects was 130(89.6%) and Rh-negative was 15(10.4%).

The overall mean values for weight, height and BMI were 58±16.3kg, 1.69±1.20 metres and 22±7.62kg/m^2. The mean SBP, DBP, mean blood pressure and pulse pressure were 113±12.6, 77±9.06, 69±19.5, and 36.2±8.94, respectively. ANOVA revealed significant differences in mean age (p=0.045) of the study groups. There were no significant differences in height, weight and BMI of the participants.

Significant differences were observed in the mean SBP (p=0.007) and DBP (p=0.003) among the ABO study groups. SBP and DBP were significantly higher in patients with blood group O, i.e. 118.9±13.5and 81.3±8.20 respectively, than other blood groups. Significant difference was noted in percentages of pre-hypertensive subjects among the ABO blood groups (p=0.001) (Table-1).

Moreover, 32(24.6%) and 1(6.6%) subjects were pre-hypertensive among the Rh +ve and Rh -ve blood groups, respectively; however, the difference was not statistically significant (p=0.36).

Besides, 31(21.4%) subjects were underweight, 69(47.4%) were normal weight, 20(14%) were overweight and 25(17.2%) were obese. Mean SBP values were 106.75±10.3, 112±11.2 and 122±15.2 (p=0.0001), and mean DBP values were 74.89±8.92, 75.93±8.44 and 84±8.71 (p=0.002) in the three groups, respectively (Table-2).

The subjects having blood group O (OR= 5.91, p=0.001) and BMI ≥25kg/m^2 (OR=4.5, p=0.001) had greater relative risk for pre-hypertension than other groups. This result was confirmed by logistic regression analysis which indicated the same odd ratio and significant difference (p=0.001) (Table-3).

There was significant positive association of blood group O and BMI with SBP and DBP. The β regression coefficient of O blood group for SBP and DBP were 7.01 and 5.407 (p= 0.002, 0.001), which shows that systolic and diastolic blood pressure increased by 7 and 5 units respectively due to the presence of blood group O. β regression coefficient of BMI for SBP was 0.27 (p=0.044) and for DBP was 0.19 (p=0.042). It indicates that SBP and DBP were elevated by 0.27 and 0.19 units, respectively by1 kg/m^2 increase in BMI. Age and other blood groups were not significantly associated with blood pressure (Table-4). The effect of age on univariate stage was also insignificant (systolic p=0.724, diastolic p=0.874).

Table-1: Comparison of Study variables among the ABO study groups.

Study groups (n= 145)	SBP (mm Hg) Mean ±SD	DBP (mmHg) Mean ±SD	Normotensive 100-120 / 60-80 mmHg n(%)	Pre-hypertensive 121-140 / 81-90 mmHg n(%)
A (n=27)	110.0 ± 10.6	75.7 ± 9.16	22 (81.5%)	5 (18.5%)
B (n= 65)	111.3 ±12.4	75.2 ±9.14	57 (87.7%)	8 (12.3%)
AB (n= 10)	110.7 ± 8.05	74.6 ± 6.18	9 (90%)	1 (10%)
O (n= 43)	118.9 ± 13.5	81.3 ± 8.20	20 (46.5%)	23 (53.5%)
P value	0.007*	0.003*	0.000*	

SBP: Systolic blood pressure
DBP: Diastolic blood pressure
Analysis of variance (ANOVA) for comparisons of means
χ^2 test for comparisons of percentages
Statistically significant value at p≤ 0.05.

Table-2: Comparison of study variables among BMI subgroup.

Study groups (n= 145)	SBP (mm Hg) Mean ±SD	DBP (mmHg) Mean ±SD	Normotensive 100-120 / 60-80 mmHg n(%)	Pre-hypertensive 121-140 / 81-90 mmHg n(%)
Underweight n= 31(21.4%) (BMI<18.5 kg/m^2)	107± 10.11	74.5± 8.70	27 (87%)	4 (13%)
Normal weight n= 69 (47.4%) (BMI=18.5-22.9 kg/m^2)	112 ± 9.90	75.6 ± 8.13	57 (82.6%)	12 (17.4%)
Overweight n= 20 (14%) (BMI=23-24.9 kg/m^2)	113± 14.7	76.7 ±9.48	15 (75%)	5 (25%)
Obese n = 25 (17.2%) (BMI ? 25 kg/m2)	125± 14.9	84.0 ±8.60	13 (52 %)	12 (48%)
P value	0. 0001*	0.002*	0.009*	

BMI: Body mass index
SBP: Systolic blood pressure
DBP: Diastolic blood pressure
Analysis of variance (ANOVA) for comparison of means
χ^2 test for comparison of percentages
Statistically significant value at p≤0.05.

Table-3: Mantel-Haenszel odds ratios for relative risk of pre-hypertension among the study groups.

Blood groups	Odds Ratio	P Value	95% Confidence Interval
A / non A	1.15	0.83	0.29 - 4.49
B / non B	2.20	0.17	0.68 - 7.11
AB / non AB	1.11	0.06	1.04 - 1 .04
O / non O	5.91	0.000 *	0.07 - 0.39
BMI			
Obese / non obese	4.51	0.001*	0.18 - 0.65

BMI: Body mass index, BMI ≥25 kg/m^2 are consider as obese and less than 25 kg/m^2 as non obese.
Statistically significant value at p≤0.05.

Table-4: Regression analysis.

Variables	Systolic blood pressure (SBP)				Diastolic blood pressure (DBP)			
	β	S.E.	P value	C.I	β	S.E.	P value	C.I
Age	0.62	1.39	0.65	- 3.37 -1.13	0.87	0.99	0.38	2.13 - 0.09
BMI	0.27	0.13	0.044*	0.013 - 0.54	0.19	0.09	0.042*	0.01 - 0.40
Blood group O	7.01	2.27	0.002*	2.52 -11.49	5.40	1.61	0.001*	2.20 - 8.60
Blood group A	0.67	0.60	0.26	- 0.51 - 1.86	0.23	0.43	0.59	- 0.619 - 1.084
Blood group B	-1.01	2.55	0.69	- 6.05 - 4.03	- 0.10	1.82	0.95	-3.710- 3.51

Dependant variables: SBP and DBP, Independent variables: age, BMI, ABO blood groups.
β = beta coefficient resulting from regression, SE= standard error, CI = Confidence interval, Statistically significant value at p≤ 0.05.
BMI: Body Mass Index.

To further strengthen the significant associations, binary logistic regression was performed which revealed a significant positive association of blood group O with DBP only (OR= 5.05, p= 0.001); however, association with SBP was not found (OR= 2.018, p=0.06). A significant positive association of BMI with SBP (OR=1.02, p=0.002) and DBP (OR= 1.3, p=0.003) were also found on logistic regression.

Discussion

ABO and Rh blood group systems are genetically determinant and their genes are located on chromosomes 9 and 1, respectively.[4] Strong evidences from various studies suggested that the diversity of ABO blood group distribution across the population of whole world, including Pakistan.[4] This diversity may reflect the difference in ethnicity and races.[5] Knowledge about the distribution of blood groups may aid in planning and management of various emerging health challenges, as the association of ABO blood groups with various diseases was documented by several previous studies.[10] Etemadi A, et al. studies showed the association of several vascular disorders like atherosclerosis and venous thromboembolism to non-O blood group and the most probable cause of this linkage was hypercholesterolaemia observed in these individuals.[18] They also reported that 8.9% of total deaths in non-O blood groups individuals were due to cardiovascular diseases.[18] The relationship between ABO blood groups and the prevalence of pre-hypertension and hypertension was well studied in the past but still is not well-established and remained to be hypothesised because of conflicting results reported by past researchers. The prevalence of pre-hypertension and hypertension in people aged 3 to 18 years was 3.4% and 3.6% as documented previously.[12]

Additional researches are required to clarify the association of blood groups and risk factors like age and BMI in respect to pre-hypertension and hypertension. The current study was conducted to determine the frequency of various blood groups and their impact on blood pressure. The association of risk factor for hypertension like age and BMI with blood pressure was also evaluated in this study to identify the individuals at risk.

Common blood group among the participants of the current study population was B, followed by blood group O, A and AB. Similar findings were also reported by Khan MU et al,[19] who conducted a research in Lahore on a large sample of 3,000 healthy adult donors.[19] Similar pattern of distribution of blood group was documented by many past studies conducted at different regions of Punjab and Khyber Pakhtoonkhwa (KPK).[7,10,20] In contrast to the present study, blood group O is most prevalent in Sindh, Balochistan and some cities of Punjab[20] and blood group A in northern areas of Pakistan.[5,9] Least common blood group as evident by all these studies is blood group AB;[1,3,5,20] the finding is similar to the present study. In the current study, significant differences in DBP and SBP were noticed among the various ABO blood groups of study population (p= 0.003, 0.007). The subjects having blood group O have higher levels of DBP and SBP than other blood groups; similar results were reported by Jassim WE et al.[21] In the present study, MH odd ratios indicated that subjects having blood group O have 5 times more risk for getting pre-hypertension as compared to other blood groups (OR=5.91, p=0.001). Controversial reports from several other researchers, including Supratik B.[13] and Chandra T et al,[22] suggested that the individuals with blood group B have increased risk for developing hypertension.[13] A recent study conducted by Varghese A. has also reported the significant positive association between DBP and blood group B in the pre-hypertensive group.[1]

Results of regression analysis of this study showed significant positive associations of blood group 'O' with both DBP (p=0.001) and SBP (p= 0.002); however, subsequent binary logistic regression indicates the significant positive association only with DBP (P value =0.001) but not with SBP (P value =0.06). In contrast to the current findings, a previous research by Nemesure B. indicated the positive association of blood groups A and AB with diastolic blood pressure, but the study did not find any significant association with SBP.[23] Controversial results have been reported by Tabatabaie AH et al, who did not find significant association between ABO blood groups and hypertension.[24]

Many studies have suggested that the Rh factor is also a determinant of cardiovascular diseases.[2] The present study reported higher percentage of pre-hypertension among the Rh positive blood group than Rh negative individuals (24.6% vs 6.6%). Similar findings have been reported by Nemesure B, et al.[23] Conflicting results have been documented by Kondam A, which reported 6% higher risk of hypertension in Rh -ve individuals.[25] The reason of disparity between the previous and recent documentations may be due to the small number of Rh -ve individuals in the present study. However, confirmatory studies on broader base are required to elucidate this association.

There are strong evidences showing that the gender, BMI, age, smoking, and hypercholesterolaemia are multiple risk factors for pre-hypertension and hypertension. Moreover, 9-12% of pre-hypertensive and 7.7% adolescent hypertensive subjects are overweight as documented by previous studies.[12] Most probable cause of elevated blood pressure in obese subjects is abnormal renal haemodynamics.[2] Increase proximal tubular sodium reabsorption due to glomerular hyperfiltration results in expansion of extracellular fluid and blood volume which subsequently elevates the blood pressure. Excessive activation of renal sympathetic and renin-angiotensin-aldosterone system is also a contributing factor for sodium retention and hypertension in obese subjects.[2] The current study indicates that individuals having BMI $\geq$25kg/m^2 are at the risk of getting pre-hypertension and subsequent hypertension later on. The current study observed that 48% of obese population was pre-hypertensive. MH odd ratio for O / non-O blood groups was 4.5, which indicates that obese subjects had 4 times higher risk for pre-hypertension than non-obese ones (p=0.001).

Regression analysis of the present data indicated positive association of BMI with SBP (p=0.044) and DBP (p=0.042). Similar findings have been reported by a recent study conducted by Kaur M.[2] Many investigators including Chuemere AN et al. and Supratik B, et al. have reported statistically significant association of BMI with pre-hypertension and hypertension.[12,13] These studies have reported that subjects with BMI $\geq$25-kg/m^2 have higher incidence of pre-hypertension and hypertension as compared to normal weight subjects.[12] This finding is in accordance with results of the current study. Association of elevated blood pressure with advancing age was also well documented by numerous large-scale studies conducted previously.[2,26] In contrast to these researches, the current study did not find any significant association of blood pressure with age. Information about the distribution of blood groups and their association with hypertension and various other diseases need to be elucidated on a broader scale to get advance opportunities for understanding and managing of

emerging health challenges.

The small sample size was a limitation of the current study and its findings may not represent the whole population.

We recommend that health awareness programmes should be arranged to make society aware about blood group-related diseases and to develop effective approaches to identify the population at high risk of hypertension and make proper planning for cure and management to reduce its risk and related complications in the future.

Conclusion

Blood group B was most predominant while blood group O had a positive impact on diastolic blood pressure and it was associated with diastolic pre-hypertension. BMI ≥25-kg/m^2 significantly contributed to increased risk of elevated blood pressure and was associated with pre-hypertension. Further studies are required to clarify the potential mechanism underlying the elevation of diastolic pressure among blood group O individuals who are most susceptible to this condition.

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