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Original Research Article

Correlation Between ABO Blood Groups and Hypertension in Different Age Groups: A Retrospective Analysis

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Abstract:

Background: Hypertension is a leading global health concern with multifactorial etiology, including genetic and environmental influences. ABO "blood groups have been implicated in disease susceptibility, including hypertension. This study investigates the correlation between ABO blood groups and hypertension across different age groups.

Methods: A retrospective study was conducted in the Department of Physiology, Anugrah Narayan Magadh Medical College, Gaya, Bihar. Data from 98 participants (51 males, 47 females) were collected over nine months. Blood pressure was measured using a mercury sphygmomanometer, and ABO and Rh blood groups were determined using the slide agglutination method. Body mass index (BMI) was calculated using standard WHO classifications. Statistical analysis was performed using SPSS version 27, with a significance threshold of $p < 0.05$.

Results: Blood group B was the most prevalent (34.69%), followed by O (28.57%), A (27.55%), and AB (9.18%). Rh-positive individuals constituted 92.86% of the sample. Blood group B exhibited the highest prevalence of pre-hypertension and Stage I hypertension. Additionally, obesity (BMI ≥30) was most common in blood group B, while blood group AB had no obese individuals. Pre-hypertension was more frequent across all blood groups than Stage I hypertension.

Conclusion: This study suggests a potential association between blood group B and increased susceptibility to hypertension and obesity. The findings highlight the need for further" large-scale studies to validate these associations and explore underlying genetic and physiological mechanisms.

Keywords: ABO blood groups, Hypertension, Blood pressure, Obesity, Epidemiology.

Introduction

High blood pressure, or "hypertension, is a widespread health concern affecting people of all ages worldwide. Often dubbed the "silent killer," it typically progresses without noticeable symptoms, leading to undetected cases until serious complications develop. As per the Joint National Committee (JNC) guidelines, normal blood pressure falls within a systolic range of 90–119 mmHg and a diastolic range of 60–79 mmHg. Hypertension is diagnosed when blood pressure consistently exceeds these values, with systolic readings above 120 mmHg and diastolic readings over 80 mmHg [1]. It is further classified into distinct categories: prehypertension (120–139 mmHg systolic, 80–89 mmHg diastolic), stage 1 hypertension (140–159 mmHg systolic, 90–99 mmHg diastolic), stage 2 hypertension (160–179 mmHg systolic, 100–109 mmHg diastolic), and hypertensive emergency (systolic ≥180 mmHg, diastolic ≥110 mmHg). Additionally, isolated systolic hypertension is identified when systolic pressure is 140 mmHg or higher while diastolic pressure remains within the normal range [2].

Hypertension arises from a combination of genetic, lifestyle, and environmental influences. Key contributing factors include being overweight, consuming high-fat and low-fiber diets, increased cholesterol levels, physical inactivity, high salt consumption, and prolonged stress. Recent studies have investigated possible links between blood group antigens and different health conditions, including hypertension.

In 1900, Karl Landsteiner introduced the ABO blood group system—a breakthrough that remains vital in both hematology and transfusion practices [3]. This system categorizes blood into four main types (A, B, AB, and O) depending on whether red blood cells display the A and/or B antigens. Because these markers are inherited according to Mendelian

genetics, an individual's blood type stays consistent over their lifetime. Moreover, people naturally produce antibodies against the antigens that do not appear on their cells, a factor that is crucial for ensuring compatibility in blood transfusions and organ transplants.

Beyond the ABO classification, the Rhesus (Rh) blood group system is also essential in transfusion medicine. This system is primarily determined by the presence (Rh-positive) or absence (Rh-negative) of the D antigen in red blood cells. The prevalence of ABO and Rh blood groups differs across populations and ethnic groups, which may play a role in predisposition to certain conditions, such as hypertension [4].

Numerous studies have explored the association between ABO blood groups and hypertension, producing mixed findings. For example, research by Lutfullah et al. reported a higher incidence of hypertension in individuals with blood group B, followed by O, A, and AB. In contrast, a study by Kaur et al. suggested that non-O blood groups, particularly A and B, were linked to a greater risk of thromboembolic events but a lower likelihood of hypertension compared to blood group O [5]. These conflicting results emphasize the complexity of this relationship and highlight the necessity for further research.

Examining the potential link between ABO blood groups and hypertension across different age groups could provide valuable insights for personalized medicine and risk assessment. This retrospective study aims to explore the relationship between ABO blood types and hypertension prevalence across various age cohorts. By analyzing the distribution of blood groups among hypertensive and normotensive individuals, the study seeks to identify whether certain blood types are associated with a higher or lower risk of developing hypertension. The findings could contribute to targeted prevention strategies" and deepen our understanding of the underlying pathophysiological mechanisms of hypertension.

Material and Methods

Study Design and Setting: This retrospective study was conducted in the Department of Physiology, Anugrah Narayan Magadh Medical College, Gaya, Bihar. The study aimed to evaluate the correlation between ABO blood groups and hypertension across different age groups.

Sample Size and Duration: A total of 98 subjects "were included in the study. Data collection was carried out over nine months

Inclusion and Exclusion Criteria: Adults aged 18 years and above included in the study, whose blood pressure and blood group were recorded in the institute's medical records. Individuals with secondary hypertension, chronic kidney disease, endocrine disorders, or incomplete medical records were excluded.

Blood Pressure Measurement: Blood pressure (BP) was measured using a mercury sphygmomanometer. The BP was recorded in a sitting position after the subject had rested for at least 5 minutes. Two separate BP measurements were taken at intervals of at least 3 minutes, on the left arm, using a mercury sphygmomanometer. The first Korotkoff sound indicated the systolic blood pressure (SBP), while the disappearance of the sound indicated the diastolic blood pressure (DBP). The average of the two readings was recorded as the final BP value.

Blood Group Determination: Blood grouping was determined using the slide agglutination method with anti-sera. A blood sample was obtained via a finger prick under aseptic conditions, and the ABO and Rhesus (Rh) blood groups were classified accordingly.

Anthropometric Measurements: Height and weight of participants were measured to calculate BMI. Height was recorded in" meters, and weight was measured in kilograms. BMI was calculated using the formula:

$$BMI = \text{Weight (kg)} / \text{Height (m}^2\text{)}$$

BMI classifications were based on the World Health Organization (WHO) Asian criteria:

BMI (kg/m²)	Classification
<18.5	Underweight
18.5-22.9	Normal weight
23-24.9	Overweight
25-29.9	Pre-obese
≥30	Obese ▪ Type 1 Obese ▪ Type 2 Obese ▪ Type 3 or Super Obese

Statistical Analysis: The gathered data was "organized and input into a Microsoft Excel 2007 spreadsheet. Subsequently, it was transferred to SPSS software (version 27, SPSS Inc., Chicago, Illinois, USA) for statistical analysis. Both descriptive and inferential statistical methods were employed to examine the relationship between ABO blood groups and hypertension. A 95% confidence level was maintained, with statistical significance determined at a p-value of less than 0.05.

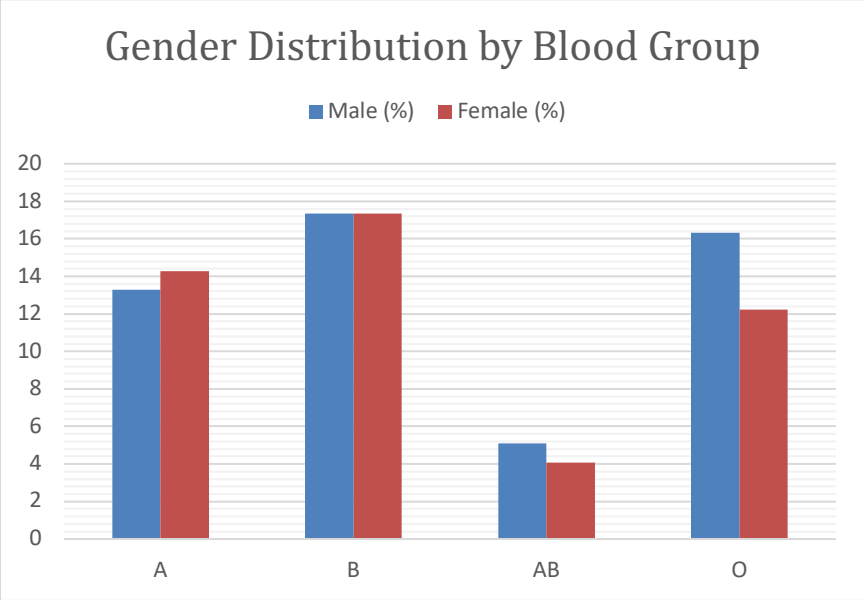
Results

The data of 98 participants were collected and analyzed using the chi-square test. The mean age of participants was 22.50 years. Of the total, 51 (52.04%) were male, and 47 (47.96%) were female. The most common blood group was B, found in 34 (34.69%) participants, while the least common was AB, observed in 9 (9.18%) participants. The most common blood group among both sexes was B. Among the participants, 91 (92.86%) had Rh-positive blood, while 7 (7.14%) had Rh-negative blood.

Regarding BMI distribution, 3 (3.06%) participants with blood group B were classified as obese (≥30 kg/m²). No participants with blood group AB were obese. The highest number of underweight individuals (5, 5.10%) were found in blood group O. The highest proportion of overweight individuals (23-24.9 kg/m²) was found in blood group A, while pre-obese individuals (5.10%) were most common in blood group B. This suggests that the tendency for obesity was highest in blood group B and lowest in blood group" AB.

Table 1: Gender Distribution by Blood Group

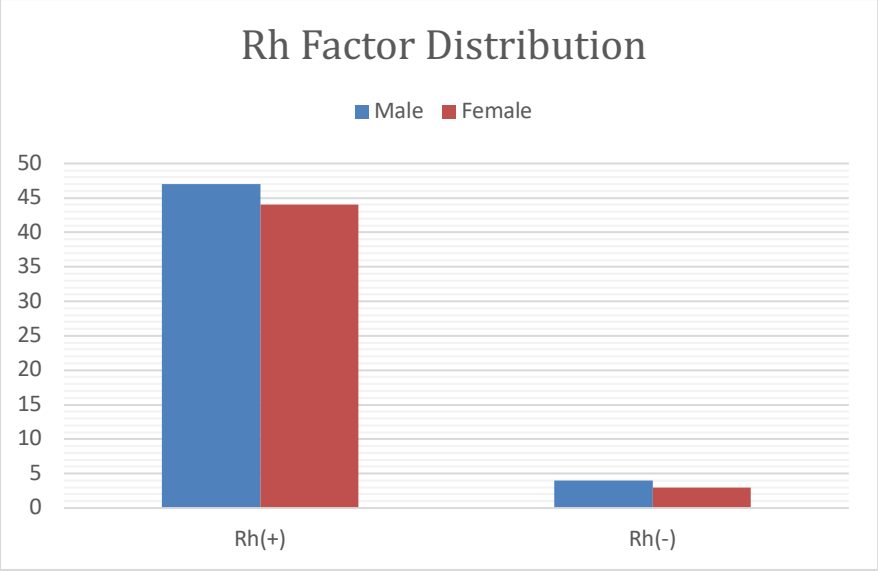
Blood Group	Male (%)	Female (%)	Total (%)
A	13 (13.27)	14 (14.29)	27 (27.55)
B	17 (17.35)	17 (17.35)	34 (34.69)
AB	5 (5.10)	4 (4.08)	9 (9.18)
O	16 (16.33)	12 (12.24)	28 (28.57)
Total	**51 (52.04)**	**47 (47.96)**	**98 (100)**



The distribution of Rh factors among the study population shows that Rh-positive blood type is predominant, with 91 individuals (47 males and 44 females) testing Rh(+), while only 7 individuals (4 males and 3 females) were Rh-negative. This indicates a higher prevalence of Rh positivity in both genders.

Table 2: Rh Factor Distribution

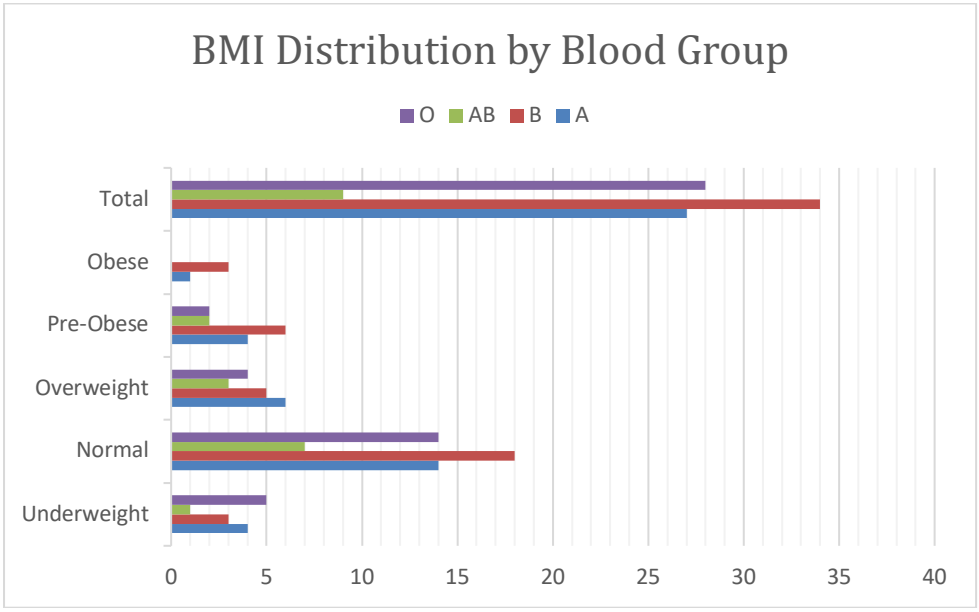
Rh Factor	Male	Female	Total
Rh(+)	47	44	91
Rh(-)	4	3	7



The BMI distribution across different blood groups shows that the majority of individuals fall within the normal BMI range (53 out of 98), followed by overweight (18), pre-obese (14), and obese (4). Among blood groups, type B has the highest representation (34 individuals), with most in the normal BMI category (18), while type AB has the lowest count (9 individuals), with no cases of obesity. Blood group A has 27 individuals, with a relatively even distribution across BMI categories, whereas blood group O (28 individuals) has no obese cases but a notable proportion in the underweight (5) and normal (14) categories.

Table 3: BMI Distribution by Blood Group

Blood Group	Underweight	Normal	Overweight	Pre-Obese	Obese	Total
A	4	14	6	4	1	27
B	3	18	5	6	3	34
AB	1	7	3	2	0	9
O	5	14	4	2	0	28
Total	**13**	**53**	**18**	**14**	**4**	**98**

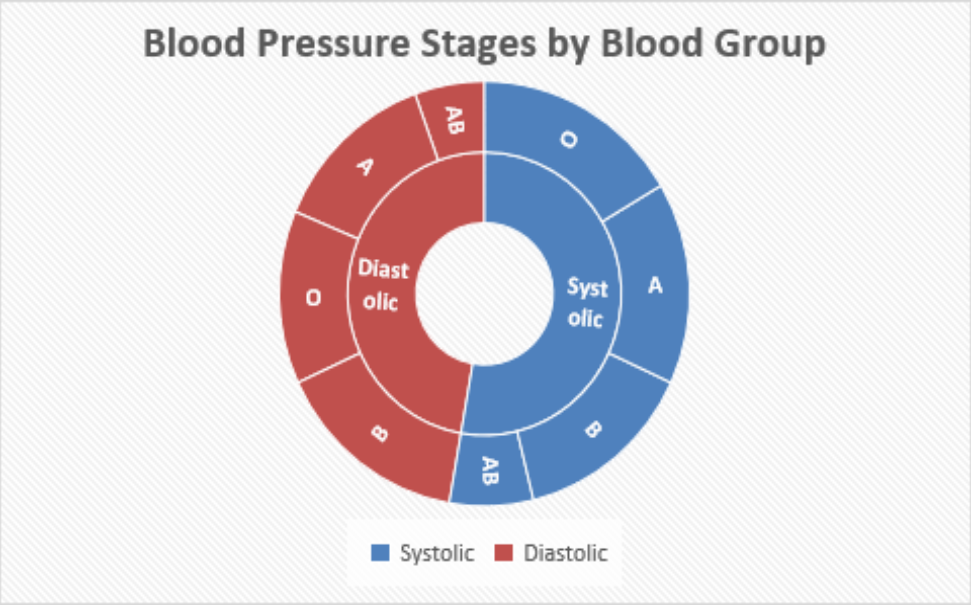


The distribution of blood pressure stages across different blood groups shows that most individuals fall within the normal or pre-hypertension categories, with very few cases of Stage I hypertension. For systolic blood pressure, blood group B has the highest number of individuals in the pre-hypertension stage (18), while blood group A has no cases of Stage I hypertension. Similarly, for

diastolic blood pressure, blood group B again has the highest count in pre-hypertension (19) and two cases in Stage I hypertension. Blood groups AB and O have no individuals with Stage I hypertension for systolic readings, while O has a few cases (2) for diastolic readings. Overall, pre-hypertension is more common across all blood groups compared to Stage I hypertension.

Table 4: Blood Pressure Stages by Blood Group

Blood Group	Normal	Pre-Hypertension	Stage I Hypertension
Systolic			
A	14	11	0
B	13	18	2
AB	6	3	0
O	15	9	0
Diastolic			
A	12	11	2
B	14	19	2
AB	5	4	0
O	12	11	2



The results suggest that individuals with blood group B had the highest prevalence of pre-hypertension and Stage I hypertension in both systolic and diastolic categories. Blood group AB had the lowest prevalence of hypertension.

Discussion

The present study aimed to analyze the "distribution of ABO and Rh blood groups among a sample of 98 individuals and examine the associations between blood groups, body mass index (BMI), and blood pressure. The results indicated that blood group B was the most prevalent (34.69%), followed by blood group O (28.57%), blood group A (27.55%), and the least common, blood group AB (9.18%). The predominance of blood group B is consistent with previous studies conducted in South Asian populations, which have reported a higher prevalence of this blood group [6,7]. Additionally, Rh-positive blood types were observed in 92.86% of the participants, which aligns with global trends indicating a higher frequency of Rh positivity in various populations [8].

The analysis of BMI distribution among different blood groups revealed noteworthy trends. Blood group B had the highest proportion of obese individuals (3.06%), whereas blood group AB had no reported cases of obesity. The highest proportion of overweight individuals (BMI: 23-24.9 kg/m²) was observed in blood group A, while pre-obese individuals (BMI: 25-29.9 kg/m²) were most commonly found in blood group B. These findings suggest that individuals with blood group B may have a higher predisposition to obesity. Previous research has also indicated a potential association between ABO blood groups and metabolic disorders, including obesity and diabetes, with blood group B being more frequently linked to higher BMI values and metabolic syndrome [9,10]. However, other studies have reported no significant correlation between ABO blood groups and BMI, suggesting

that genetic, environmental, and lifestyle factors play a crucial role in influencing body weight [11,12].

Furthermore, our study examined the distribution of blood pressure categories across different blood groups. The results indicated that pre-hypertension and Stage I hypertension were more prevalent among individuals with blood group B, whereas blood group AB had the lowest prevalence of hypertension. Specifically, for systolic blood pressure, blood group B had the highest number of individuals in the pre-hypertension category (18 individuals), and for diastolic blood pressure, blood group B also had the highest number of pre-hypertensive individuals (19 individuals) and two cases of Stage I hypertension. These findings are consistent with studies that have reported a higher risk of hypertension in individuals with blood group B [13,14]. The underlying mechanisms for this association remain unclear; however, some researchers suggest that ABO blood group antigens may influence vascular function and blood pressure regulation through their impact on endothelial function and plasma viscosity [15].

Gender distribution across blood groups in this study did not show significant variation, with males (52.04%) and females (47.96%) being evenly distributed across the different blood groups. This is consistent with previous studies that have reported no significant gender-based differences in blood group distribution [16]. However, some studies have suggested that males may be at a higher risk for hypertension and cardiovascular diseases irrespective of blood group, which could be attributed to differences in hormonal regulation and lifestyle factors such as smoking and alcohol consumption [17,18].

The predominance of Rh-positive individuals in this study (92.86%) is in agreement with global data indicating that Rh-negative blood types are less common in most populations. The distribution of Rh positivity was relatively equal among both genders, with 47 males and 44 females having Rh-positive blood, while Rh-negative individuals accounted for a small fraction (7.14%). This trend has been consistently observed in other studies conducted in different geographical regions [19,20].

Although our study provides valuable insights into the associations between blood groups, BMI, and blood pressure, it has certain limitations. Firstly, the sample size of 98 participants is relatively small, which may limit the generalizability of the findings. Additionally, the study did not consider other contributing factors such as dietary habits, physical activity, genetic predisposition, and socioeconomic status, all of which can significantly" impact BMI and blood pressure outcomes. Future studies with larger sample sizes and a more comprehensive approach to data collection are warranted to confirm and expand upon these findings.

Conclusion

This study highlights a potential association between blood group B and a higher prevalence of obesity and hypertension. These findings suggest that individuals with blood group B may have an increased risk of developing metabolic and cardiovascular disorders. However, due to inconsistencies in existing literature and potential confounding factors, further research is required to establish a definitive link between ABO blood groups, BMI, and hypertension. Understanding these associations may provide valuable insights into personalized medicine and targeted prevention strategies for metabolic and cardiovascular diseases.

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