# A study of Association of Blood Groups with Anemia in healthy Young Adults

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**Abstract**

**Background:** Blood is a specialised connective tissue that gives each individual their identity by determining their blood group and type. In transfusion medicine, the blood group has clinical significance. Malnutrition is one of the world's significant health issues, with anaemia accounting for a significant proportion of the problem, particularly in underdeveloped nations. Reduced haemoglobin levels have an unfavourable effect on the functioning of other human bodily systems. The association between blood groups and disorders including stomach cancer and pernicious anaemia has been established. Previously, several research examining the relationship between anaemia and different blood types yielded mixed results. As a result, the current study was conducted in order to shed light on blood groups and haemoglobin (Hb) levels.

**Objectives:** To determine if there is a relationship between blood group distribution and the prevalence of anaemia among young medical students based on the variations of haemoglobin concentration of individuals.

**Materials& Methods:** First-year MBBS and BDS students enrolled to GMC Jammu in the academic year 2020-21 were used as subjects, and blood grouping was performed using the conventional antisera slide agglutination method. With the use of Sahli's hemoglobinometer, the participants' haemoglobin content was calculated. Hb less than 13 g/dl for males and less than 12 g/dl for females was deemed anaemia.

**Results:** The blood group distribution was B (39.6%), O (34 %), A(21.2 %), & AB (5.2 %). The overall distribution of anemia in subjects was blood group B with 13.2%, O with 10%, A with 5.6%, and AB with 2.4%.172 (68.8%) subjects were having normal hemoglobin concentrations and 78 (31.2%) were found to be anemic. 5 (4%) males were anemic and 73 (58.4%) females had low Hb content.The prevalence of anemia in relation to blood groups was highest in AB (46.15%) followed by B (33.33%), O (29.41%), and A (24.41%). The Chi-square value was 2.466 with a p-value of 0.4814 which is insignificant (> 0.05) in all blood groups, showing a non-significant association between anemia and blood groups.

**Conclusion:** In terms of frequency, anaemia was found to be more common in those with the B blood group and less common in those with the AB blood group. The blood types followed the North Indian pattern (B> O > A > AB), and anaemia followed the same pattern. However, when it came to the distribution of participants with anaemia by blood

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group, the AB blood group was found to be more vulnerable. Females were found to be more anaemic, which might be attributed to a decrease in red cell mass caused by increased oestrogen levels. Although not statistically significant, this study suggests an association between blood types and anaemia.

**Keywords:**Anemia, Blood groups, Hemoglobin, Estrogen

## Introduction

Blood is a specialised connective tissue that gives each individual their identity by determining their blood group and type. In transfusion medicine, the blood group has clinical significance. Malnutrition is one of the world's significant health issues, with anaemia accounting for a substantial chunk of the problem, particularly in underdeveloped nations. Anemia is a condition in which the oxygen-carrying capacity of the blood is diminished, either owing to a reduction in red blood cells or a decrease in the amount of haemoglobin in the blood.[1]Anemia can be caused by a variety of factors, including blood loss, reduced red cell synthesis, or accelerated red cell destruction.[2] Anemia is defined by the World Health Organization (WHO) as Hb less than 13 g/dl in men over the age of 15, and less than 12 g/dl in non-pregnant women over the age of 15.[3]

Anemia is a major worldwide health issue that affects both underdeveloped and developed countries, having significant implications for human health as well as socio - economic development.[4]According to WHO Anemia affects 1.62 billion individuals worldwide, approximately 24.8 % of the total population, It is also thought to be responsible for approximately 20% of maternal and perinatal deaths in underdeveloped countries.[5] Anemia has a well-known negative influence on mother and child health. A higher risk of maternal and infant mortality has been associated to severe anaemia.[6]

Anemia has also been attributed to population-wide impairments in physical and psychological development, behaviour, and occupational performance.[7] Due to diminished oxygen delivery and cellular oxidative capacity, anaemia can even impair physical performance. As a result, it would be ideal to combat anaemia by providing treatment to those who are prone to it.[8] It would be easier to provide precise dietary recommendations to prevent the incidence of anaemia in such a group if the specific population prone or resistant to anaemia could be identified. The fact that the A blood type is linked to a higher risk of stomach cancer is well-known.[9]Similarly, females with non-O blood types have a 40-60% increased risk of ovarian cancer.[10] It is also essential to obtain information on the distribution of these blood types in a population group and to determine whether there is any association between blood group and anaemia, which can help to prescribe suitable preventative interventions in avoiding anaemia in a certain population.

## Materials and Methods

**Type of Study:** Cross-sectional study

**Study setting:** Department of Physiology, GMC Jammu, Bakshinager,

**Duration of study:** September 2021 and November 2021.

**Sample size:** 250 Medical students(males and females) pursuing first phase MBBS and BDS in the academic year 2020-2021 were selected as subjects.

The individuals were given a brief overview of the study and protocol, and signed informed consent was obtained from them. This study was approved by the institution's Ethical Committee (IEC).

### Inclusion Criteria

- Males and females between the age group of 17 and 20 who are healthy.

### Exclusion Criteria

- Subjects with known hemolytic disorders, hereditary anemia, abnormal hemoglobin, anemic subjects under treatment, bleeding disorders, malignancies, acute and chronic infection.

**Thetechnique of blood grouping & typing:** The antisera slide agglutination method was used to group and type the blood. Antisera A, B, and D were used. Students were given a sterile finger prick on one of their middle three fingers on their left hand, and a few drops of blood were placed in a test tube with 0.9 percent normal saline. The antisera were mixed individually with the saline suspension of blood on a slide and evaluated for agglutination; the presence or absence of clumping determined the blood type.

Agglutination was collected on a glass slide and focussed using a compound microscope's low-power objective for confirmation.[11]

**The techniqueof Hemoglobin Estimation:** Hemoglobin was estimated using Sahli's hemoglobinometer test, which is based on the principle of acid hematin production and colorimetric matching with the apparatus's standard comparators. The first of three measurements corresponded to the hue of the fluid when it was somewhat darker than the comparator. When the fluid colour matched the comparator perfectly, the second reading was taken. The fluid colour was somewhat lighter than the usual colour in the third reading. All three measurements were recorded in g/dl, with the scale set to the lower meniscus values. The final haemoglobin measurement in g/dl was calculated as the average of the three values.[11]Furthermore, the frequency of anaemia was determined for the ABO blood group and Rh factor. The WHO standards for identifying anaemia were used to get the diagnosis. Hb <13 g/dl for males and Hb <12 g/dl for females was deemed anaemia. The study used WHO cut-offs for mild, moderate, and severe anaemia, which were defined as Hb less than 13 g/dl, <11 g/dl, and <8 g/dl for males and less than <12 g/dl, <11g/dl, and <8g/dl for females.

**Statistical Analysis:** The result was represented as a percentage, which is the frequency distribution of each ABO blood group and Rh factor, as per the normal technique. The unpaired t-test was used to analyse the demographic data. The frequency distribution (observed frequency) of the blood group among the overall anaemic population (N= 78) was compared to those of the general nonanemic population (N= 172) using the Chi-Square test to establish the association between the blood group and anaemia.

## Observation and Results

**Table 1: Comparison of Demographic and Hb Parameters between male and female subjects studied.**

| Parameter | Gender | Number | Mean | SD | Significance | |
|---|---|---|---|---|---|---|
| | | | | | t-value | p-value |
| Age (years) | Males | 125 | 17.8320 | 0.63164 | -4.137 | 0.097 |
| | Females | 125 | 18.1040 | 0.71147 | | |
| Weight (Kg) | Males | 125 | 60.8320 | 4.50580 | 22.341 | < 0.0001 |
| | Females | 125 | 50.7040 | 2.32110 | | |
| Height (cm) | Males | 125 | 167.0000 | 4.24644 | 38.110 | < 0.0001 |
| | Females | 125 | 155.1680 | 3.97723 | | |
| BMI (kg/m2) | Males | 125 | 19.8568 | 1.77529 | -5.927 | < 0.0001 |
| | Females | 125 | 21.0417 | 1.35779 | | |
| Hb | Males | 125 | 13.82 | 0.76 | 22.18 | < 0.001 |
| | Females | 125 | 10.94 | 1.57 | | |

**Table 2: Blood group-wise and gender-wise distribution of subjects studied.**

| Blood group | Males | | Females | | Total | |
|---|---|---|---|---|---|---|
| | Frequency | Percentage | Frequency | Percentage | Frequency | Percentage |
| A | 26 | 20.8 | 27 | 21.6 | 53 | 21.2 |
| AB | 06 | 4.8 | 07 | 5.6 | 13 | 5.2 |
| B | 50 | 40.0 | 49 | 39.2 | 99 | 39.6 |
| O | 43 | 34.4 | 42 | 33.6 | 85 | 34.0 |
| Rh-positive | 118 | 94.4 | 120 | 96 | 238 | 95.2 |
| Rh-negative | 7 | 5.6 | 5 | 4 | 12 | 4.8 |

**Table 3: Distribution of subjects studied concerning anemia in males and females.**

| Blood groups | Males Anemia< 13 g/dl | | | | |
|---|---|---|---|---|---|
| | N (125) | Normal | Mild | Moderate | Severe |
| A | 26 | 25 | 1 | 0 | 0 |
| AB | 6 | 5 | 1 | 0 | 0 |
| B | 50 | 48 | 2 | 0 | 0 |
| O | 43 | 42 | 1 | 0 | 0 |
| Rh-positive | 118 | 114 | 4 | 0 | 0 |
| Rh-negative | 7 | 6 | 1 | 0 | 0 |
| Blood groups | Females Anemia | | | | |
| | N (125) | Normal | Mild < 8g/dl | Moderate < 11g/dl | Severe < 12 g/dl |
| A | 27 | 14 | 2 | 11 | 0 |
| AB | 7 | 2 | 2 | 3 | 0 |
| B | 49 | 18 | 9 | 22 | 0 |
| O | 42 | 18 | 7 | 17 | 0 |
| Rh-positive | 120 | 49 | 19 | 52 | 0 |
| Rh-negative | 5 | 3 | 1 | 1 | 0 |

**Table 4: Association of blood groups with anemia among the subjects studied.**

| **Blood groups** | **Non-Anemic (a) N (%)** | **Mild N (%)** | **Moderate N (%)** | **(b) Anemic (%)** | **Grand Total(c)=a + b (%)** | **Prevalence of Anemia according toblood groups=b/c (95% confidence interval)** | **Chi sq. value** | **p-value** |
|---|---|---|---|---|---|---|---|---|
| A | 39 (15.6) | 3(1.2) | 11(4.4) | 14 (5.6) | 53 (21.2) | 24.41(14.93-37.57) | 2.466 | 0.4814 |
| AB | 7(2.8) | 3(1.2) | 3(1.2) | 6 (2.4) | 13 (5.2) | 46.15(23.21-70.86) | | |
| B | 66 (26.4) | 11(4.4) | 22 (8.8) | 33 (13.2) | 99 (39.6) | 33.33(23.02-41.0) | | |
| O | 60 (24) | 8(3.2) | 17(6.8) | 25 (10) | 85 (34) | 29.41(20.79-39.82) | | |
| Total | 172 (68.8) | 25(10) | 53(21.2) | 78(31.2) | 250(100) | - | | |
| Rh-positive | 163 (65.2) | 23 (9.2) | 52 (20.8) | 75 (30) | 238 (95.2) | 31.51(25.16-36.8) | 0.504 | 0.4788 |
| Rh-negative | 9 (3.6) | 2 (0.8) | 1 (0.4) | 3 (1.2) | 12 (4.8) | 25(4.69-49.12) | | |
| Total | 172 (68.8) | 25 (10) | 53 (21.2) | 78 (31.2) | 250 (100) | - | | |

(Note: For Calculation of associationwe have considered anemia in two categories i.e. males and females).

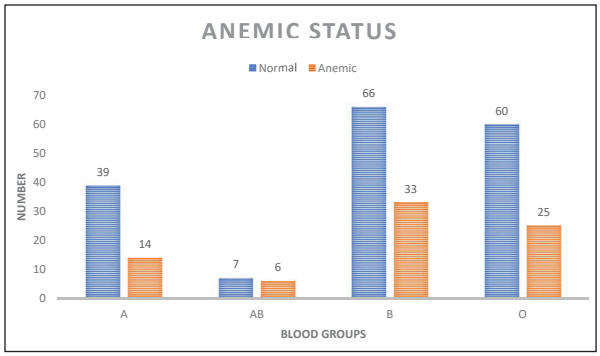


**Fig 1: Association of Blood groups with Anemia.**

There were 250 participants in the research, with 125 males and 125 females. The comparison of socio-demographic factors and Hb of participants is shown in Table 1. The prevalence of different blood types in boys and females is shown in Table 2 in decreasing order (B > O >A > AB). The B blood group was the most frequent among the participants (39.6 %).Table 3 demonstrates that 172 (68.8%) of the individuals had normal haemoglobin values, whereas 78 (31.2%) were anaemic. 5 (4%) of males were anaemic, whereas 73 (58.4%) of females had low Hb levels. Table 4 shows the typical distribution of anaemia in blood groups: B group has 13.2 %, O group has 10%, A group has 5.6 %, and AB group has 2.4 %.Anemia was shown to be prevalent in blood types AB (46.15 percent), B (33.33 %), O (29.41 %), and A (29.41 %) (24.41% ). In all blood groups, the Chi-square value was 2.466 with a p-value of 0.4814, which is negligible (> 0.05), indicating that there is no link between anaemia and blood types. Overall, 75 Rh-positive participants (30%) and 3 Rh-negative subjects (1.2%) were confirmed to be anaemic. Anemia was found to be prevalent in 31.51 % of Rh-positive people and 25 % of Rh-negative people. The Chi-square value was 0.504, with a p-value of 0.478, which is not statistically significant.

## Discussion

Blood grouping and type is a commonly performed inquiry prior to blood donation, identification card documentation, and is beneficial in the event of an emergency blood transfusion. Hemoglobin estimation is a standard test performed in outpatient departments in almost all medical disciplines. Both examinations are frequently performed as part of the MBBS, BDS, and BSc paramedical curriculum.[12]The current study comprised 250 first-year medical students, including males (125) and girls (125). The B blood group was the most common, accounting for 39.6% of all cases, followed by the O blood group (34%), A blood group (21.2%), and AB blood group (5.2%). The predominance of the ABO blood group was the same in our study as in the North Indian trend. According to several studies, the ABO blood categories B > O > A > AB were the most common. Anemia was shown to be most common in blood group B (13.2%), followed by O (10%), A (5.6%), and AB (5.6%) in our study (2.4%).In studies by Kaur M, Basak Asim Kumar, and Maji Kaushik et al, the similar pattern of anaemia distribution within the B blood type was observed.[13,14] The prevalence of anaemia was found to be higher in blood group AB (46.15 %), followed by blood group B (33.33 %), O (29.41 %), and least in blood group A (24.41 %), however this was not statistically significant (p=0.4814).

Tebit EK and Tayong DBK observed that the AB group was more likely to be anaemic, which is consistent with the findings of this study.[15]There have been very few studies comparing haemoglobin levels in different ABO blood types in a small population. ABO blood type frequencies differ from one population to the next. Similarly, blood haemoglobin levels range from person to person. Age, sex, ethnicity, region, occupation, socioeconomic level, and numerous medical conditions all contribute to these disparities. When compared to age-matched men, women had 12% lower Hb levels.[16]Hemoglobin concentrations can also be influenced by genes that encode for RBC enzymes and membranes.[17]Anemia is a worldwide public health issue that is exacerbated in underdeveloped countries. From childhood to old age, anaemia has affected many organ systems in the human body. Low haemoglobin levels have been associated with poor academic performance in students.[18]Mild anaemia can diminish immunological competence and have a negative impact on productivity. According to numerous studies across the Indian subcontinent, t he average prevalence of anaemia was 25-80 %. In a study conducted by the Indian Council of Medical Research (ICMR) in sixteen districts across eleven states, the prevalence rate of anaemia was 90.1 % among adolescent girls aged 11 to 18. Anemia was observed in 35% of the 300 students evaluated in their research.[19]The average prevalence of anaemia in different blood types was found to be 31.2 % in this study. Further analysis revealed that anaemia was more prevalent in female medical students (58.4%) than male medical students (4%) at GMC Jammu. In Telangana, girls (84.66%) had a similar greater prevalence of anaemia than boys (12.72 %).[20] This study revealed a correlation between blood

group type and anaemia, albeit it was not statistically significant, possibly due to the small sample size. If a correlation between anaemia and blood group is identified, it will be much easier to forecast which populations are more susceptible or resistant to anaemia, and thus to prescribe preventative actions to these populations so that the negative effects of low Hb levels may be prevented.According to Karl LandsteinerThe relevant agglutinins should be absent in the plasma if the specific agglutinogen is present on the RBC surface. According to this rule, a blood type possesses agglutinogen-alpha on the RBC surface and agglutinin-beta in its plasma; blood group O's plasma contains both alpha and beta agglutinins. Individuals with blood type antigens alpha and beta are more likely to be anaemic due to a higher risk of hemolysis, whereas those without these antigens are less susceptible to anaemia. Individuals with blood types B, AB, and A can avert anaemia by eating a vitamin- and iron-rich diet on a regular basis.Due to the limited sample size, the study's limitations include the inability to compare males and females independently and the inability to determine which form of anaemia each blood group is prone to.

## Conclusion

B > O > A > AB were the blood groups observed in decreasing order in the study. The B blood group is the most prevalent subgroup with low Hb levels (13.2 %). When it came to the distribution of individuals by blood types and their association to anaemia, blood group AB (46.15 %) was the most common. In the study, the anaemia found with decreasing prevalence was AB >B > O > A, and there was no significant association between anaemia and any blood group. Females were more prone to anaemia than males, which might be attributable to a reduction in red blood cell mass caused by high oestrogen levels. We can counsel those who are more vulnerable to anaemia to consume a diet rich in iron and vitamins, as well as their supplements, based on their blood types. Future research should be done on a larger population to corroborate the findings and to determine what sort of anaemia each blood group is prone to.

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**Ethical Clearance:** Mandatory ethical clearance was obtainedbefore the study from IEC, GMC Jammu.

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