A Comparative Study Of Red Blood Cell Count And Haemoglobin Values In ABO Blood Groups Of Medical Students

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Abstract:

Background:On comparison, red blood cell count and haemoglobin concentrations in four distinct ABO blood groups produced inconsistent findings. The goal of the current study was to examine potential variations in haemoglobin content and red blood cell counts among undergraduate medical students of the four ABO blood groups.

Materials and Methods:A total of 97 students were recruited for this study. The study group consisted of 39 males and 58 females. A red blood cell count was done using Neubauer's hemocytometer, and Sahli's method was used to estimate haemoglobin levels. The blood groups of the subjects were determined using the slide method. Statistical analysis was done using SPSS software version 22.

Results:O-positive was the most common blood group, followed by B-positive. The mean haemoglobin value and the mean red blood cell count were comparatively higher in the AB blood group.

Conclusion: The mean haemoglobin levels and red blood cell counts among the four ABO blood categories did not differ significantly.

Key words: ABO blood groups, Haemoglobin, Red blood cells

I. INTRODUCTION

"Blood group" refers to the overall blood group system, which includes red blood cell (RBC) antigens whose specificity is determined by a number of genes that can be allelic or extremely closely spaced on the same chromosome. There are 33 blood groups recognised by the International Society of Blood Transfusion. [1] The ABO blood group system was reportedly discovered in 1900 by Karl Landsteiner. Based on the inherited properties of red blood cells (erythrocytes), which are identified by the presence or absence of antigens A and B that are carried on their surface, the ABO blood group system groups all individuals into one of eight blood types. As a result, blood types A, B, O, and AB can exist in individuals. While blood group O lacks the A/B antigen but does contain both of their antibodies in serum, blood group A contains an antibody against blood group B in serum, and vice versa. [1] The antibodies known as agglutinins target these red cell antigens.

The Rhesus (Rh) system is the second-most important blood group system after ABO. [2] Rh factor and immunogenic D-antigen may or may not be present on a person's RBC surface. Either Rh-positive (D-antigen present) or Rh-negative (D-antigen lacking) status is therefore indicated. The Rh blood group system is among the most immunogenic and polymorphic in humans. Over the past ten years, this system's molecular foundations have been thoroughly investigated and are now well understood.

Haemoglobin (Hb), a protein that delivers oxygen to the body's tissues, is found in red blood cells (RBC), which are created in the bone marrow. To determine the quantity of RBCs in the blood, an RBC count is performed. The normal RBC count is 4.3-5.9 million/mm^3 in males and 3.5–5.5 million/mm^3 in females. [3] The amount of haemoglobin in whole blood is expressed in grams per deciliter (g/dl). Males should have a Hb level of 14 to 18 g/dl, while females should have 12 to 16 g/dl. When the haemoglobin level is low, the patient has anaemia.[4]

Studies on the levels of total haemoglobin and total red blood cells in the individual blood groups have been conducted all around the world with varying degrees of success. Hirschfeld and Hirschfeld showed that the frequencies of blood groups A and B differ between populations. [5] A few older investigations have noted that specific blood groups had a higher incidence of hemolytic anaemia. In a study done among the Bengali families in Calcutta, low haemoglobin levels were observed in the A1 and O blood groups. [6] The goal of the current study was to examine potential variations in the levels of total red blood cells and haemoglobin in healthy subjects who belonged to four ABO blood types.

II. MATERIALS AND METHODS

Selection of subjects

This prospective observational study was carried out in the Department of Physiology, SreeMookambika Institute of Medical Sciences, Kulasekharam, India. The research was done from October 2022 to April 2023. The study participants were undergraduate medical students between the ages of 18 and 22. Students with chronic diseases and drug intake were excluded from the study. Non-consenting students were also not allowed to participate.

Blood sample collection

The finger-prick method was used to obtain the blood under aseptic precautions. The first drop of blood was discarded since it might contain tissue fluid.

Total RBC count determination

The Neubauer hemocytometer slide method is used to calculate the red blood cell count with freshly prepared Hayem's fluid.

Estimation of haemoglobin concentration

The haemoglobin content of the study participants was measured by Sahli's method. [7] N/10 HCl was taken in the Hb tube up to the lowest mark of "2." 20 µl of the blood sample was collected with a single-marking pipette. After 10 minutes of waiting for it to convert to acid hematin, distilled water was poured into it until the colour of the solution in the Hb tube coincided with the glass plates of the comparator. The percentage of Hb was calculated from the reading.

Blood group determination

The blood groups of the subjects were determined using the slide method and the antisera A, B, and D. In a test tube, a few drops of blood were combined with sodium chloride (NaCl). Three slides with the names A, B, and D each received a drop of each antisera: A, B, and D. Then, three different plastic sticks were used to thoroughly mix a drop of blood that had been combined with NaCl into each of the three slides. To rule out any self-agglutination, a control slide containing a drop of blood and NaCl is also retained. For 10 minutes, the slides were kept covered with a Petri dish to stop any antisera from evaporating. The blood groups were identified, and the slides were examined for agglutination after 10 minutes.

Statistical evaluation

Data were moved to an Excel sheet created by Microsoft. Tables were created for each blood group's RBC count and haemoglobin levels.

Non-parametric tests were used in the statistical analysis, which was carried out using SPSS version 22. Using the SPSS program, p-values were tested to see if there were any statistically significant differences in the RBC count and haemoglobin values between each blood group. Statistics were deemed significant at a p-value of 0.05 or lower.

III.   RESULTS

The study included 97 healthy students. The age of the students is between 18 and 21 years old. There were 39 males and 58 females. The age differences between the male and female students were not statistically significant.($p > 0.05$).

97 healthy students who underwent ABO blood group testing revealed 6 males (37.5%) and 10 females (62.5%) with the A blood group, 15 males (44.1%) and 19 females (55.9%) with the B blood group, 14 males (35.9%) and 25 females (64.1%) with the O blood group, and 4 males (50.0%) and 4 females (50.0%) with the AB blood group. The O blood group was the most common, followed by the B blood group. The distribution of ABO blood groups among male and female students is shown in Table 1.

Table 1. Distribution of ABO Blood group among male and female students (n = 97)

Gender		Frequency	Percentage
Overall	Male	39	40.2
	Female	58	59.8
A	Male	6	37.5
	Female	10	62.5
B	Male	15	44.1
	Female	19	55.9
O	Male	14	35.9
	Female	25	64.1
AB	Male	4	50.0
	Female	4	50.0

In addition, 85 of the 97 healthy students tested positive for RhD, whereas the remaining 12 tested negative. O-positive was the most common blood group, followed by B-positive, and there were no AB-negative students in our study. Table 2 shows the distribution of students according to their Rh blood group and ABO blood group type.

Table 2. Distribution of students according to their Rh and ABO blood group types

Rh		Frequency	Percentage
Overall	Positive	85	87.6
	Negative	12	12.4
A	Positive	13	81.3
	Negative	3	18.7
B	Positive	28	82.4
	Negative	6	17.6
O	Positive	36	92.3
	Negative	3	7.7
AB	Positive	8	100.0
	Negative	0	0.0

The total haemoglobin content in different blood groups was 11.40±1.46 g/dL, 11.35±1.82 g/dL, 11.41±2.08 g/dL, and 11.67±1.21 g/dL in A, B, O, and AB blood groups, respectively (p = 0.978). Blood group B had the lowest mean haemoglobin value, followed by blood group A. Similarly, the total red blood cell count in different blood groups was 5.07±0.63 ($\times10^6$/L), 4.92±0.66 ($\times10^6$/L), 4.69±0.0.90 ($\times10^6$/L), and 5.13±0.72 ($\times10^6$/L) in A, B, O, and AB blood groups, respectively (p = 0.241). The O blood group had the lowest RBC count, followed by the B blood group. Table 3 and Figures 1 and 2 show the comparison of total RBC count and total haemoglobin levels in the four blood groups.

Table 3. Comparison of total RBC count and total haemoglobin levels in the ABO blood groups

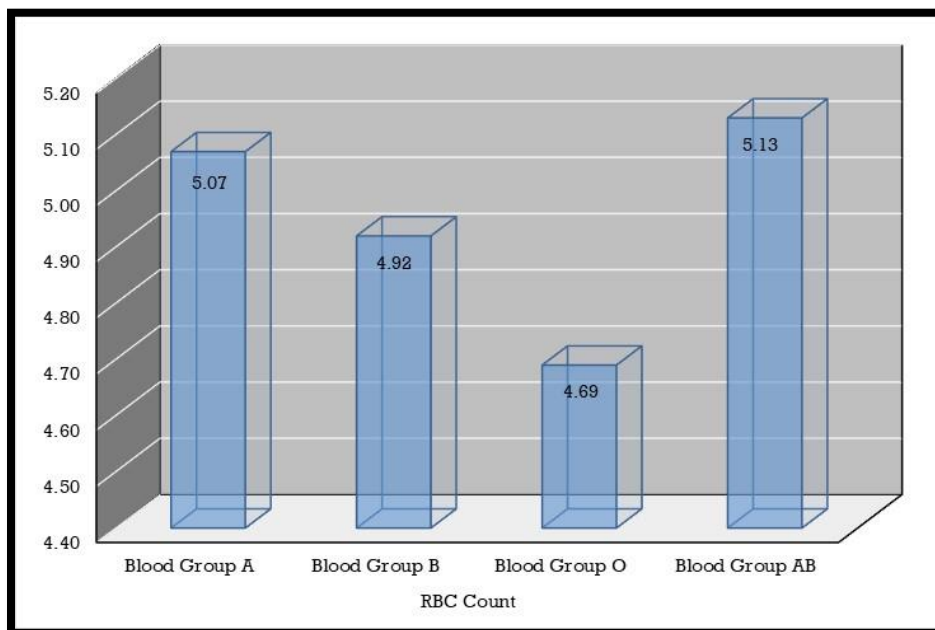|		n	Mean	Standard Deviation	p-value
RBC count	Blood Group A	16	5.07	0.63	0.241
	Blood Group B	34	4.92	0.66	
	Blood Group O	39	4.69	0.90	
	Blood Group AB	8	5.13	0.72	
Hb value	Blood Group A	16	11.40	1.46	0.978
	Blood Group B	34	11.35	1.82	
	Blood Group O	39	11.41	2.08	
	Blood Group AB	8	11.67	1.21	
p-value based on Analysis of Variance (ANOVA) Test * = Statistically Significant (p < 0.05)					

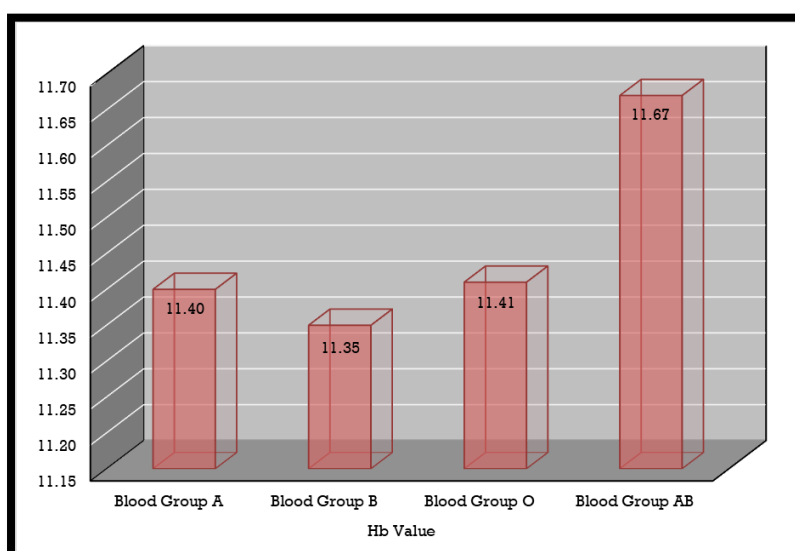**Figure 1. Comparison of total RBC counts in the ABO blood groups**

Figure 2. Comparison of haemoglobin values in the ABO blood groups

IV.   DISCUSSION

The study had 97 pupils in all. The majority of the students—59.8%—were female and ranged in age from 18 to 21. The age difference between the male and female pupils was one year. The blood group O positive was the most prevalent, followed by B positive and A positive. This is in accordance with the study done by P. K. Das et al., in a tertiary care centre in South India, which also showed a higher incidence of blood group O, followed by blood group B. [8] Our study showed a higher mean haemoglobin value in the AB blood group (11.67±1.21 g/dL), followed by the O blood group (11.41±2.08 g/dL), though there were no significant differences in the haemoglobin values between the groups. The mean RBC count was higher in the AB blood group (5.13±0.72 x 10^6/μL) followed by the A blood group (5.07±0.63 x 10^6/μL). A study done by Pratima et al., revealed that haemoglobin values were lower in the B and O blood groups. [9] A study done by Mahapatra et al., also showed that there were comparable differences in RBC count and haemoglobin values among the four ABO blood groups. [10] A study done among the rural population of Kanchipuram district in Tamil Nadu by Ramalingam et al., revealed that there were significantly higher haemoglobin values in the O blood group than in the A and B blood groups. [11]

A few of the study's limitations are due to the fact that the comparison between men and women was not done separately, which would have required an even larger sample size. The results could not be applied to blood groups like AB-negative because they were not present in our study group.

V.   CONCLUSION

The average values and variances in blood haemoglobin levels and red blood cell counts among the ABO blood groups were quantified in this study. Future research can be conducted on a larger population while taking into account variables like gender and anthropometric measurements, allowing for the planning of dietary adjustments and lifestyle changes to raise haemoglobin levels and the RBC count.

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