RESEARCH ARTICLE

Blood group and gender-wise hemoglobin level among blood donors

Hemlata Chourasia1, Smita Rani Pradhan2,Joshil Kumar Behera3, Pawan Kumar Jha3

1Department of Physiology, N.S.C.B Medical College, Jabalpur, Madhya Pradesh, India, 2Department of Physiology, Raipur Institute of Medical Sciences, Raipur, Chattisgarh, India, 3Department of Physiology, ESI Medical College and Hospital, Bihta, Bihar, India

Correspondence to: Pawan Kumar Jha, E-mail: pavankumarjha84@gmail.com

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ABSTRACT

Background: After collection of blood from a blood donor, it undergoes certain tests for its suitability for transfusion to a recipient. According to the Red Cross, women should have at least a hemoglobin level of 12.5 g/dL and men should have 13 g/dL. Aim and Objectives: The aim of the study was to observe the hemoglobin level of donated blood according to the sex and according to the blood groups – A, AB, B, and O. Materials and Methods: This cross-sectional data audit was conducted with the data of males and females from a blood bank of a tertiary care hospital in India. A total of 4 years of data from 2013 to 2016 were analyzed. The hemoglobin levels were tested by the Shapiro–Wilk normality test. The distribution was not normal. Hence, data were presented as median (first quartile–third quartile) and tested by non-parametric tests – Mann–Whitney test and Kruskal–Wallis test. Results: Total data of 7026 blood donors (6658 [94.76%] males and 368 [5.24%] females) were analyzed in this study. The level is above the cutoff suggested by Red Cross. The overall hemoglobin level was 13.8 (13.2−14.1) g/dL. Male had higher hemoglobin 13.8 (13.2−14.2) g/dL than females 13 (13−13.5) g/dL, \( P < 0.0001 \). There was no difference in hemoglobin in A, AB, B, and O blood group in overall, males, and females. Conclusion: There were more male blood donors than female donors. Males have higher hemoglobin levels than females in all types of blood groups in the ABO system. There was no difference in hemoglobin concentration in different blood groups.

KEY WORDS: Blood Donors; Blood Banks; Blood Group; Hemoglobins; India

INTRODUCTION

When a donor arrives at any blood donation center or camp, her/his history and physical examination are conducted to find suitability for the donation.1 Donors’ hemoglobin status should be screened for two purposes – to protect the donor from being more anemic and to get blood that has an optimum level of hemoglobin.2 If the hemoglobin is adequate, the blood is collected. The donated blood and sample for various tests are then transported to the blood bank and attached laboratory and tested for various blood transfusion-related disease risks.3

Although the determination of packed cell volume can determine the presence of anemia, screening for hemoglobin status provides further insight into the actual content of hemoglobin that is linked to the oxygen-carrying capacity of the blood.4 The cutoff value of hemoglobin level for detection of anemia according to the World Health Organization is 13 g/dL in males (≥15 years) and 12 g/dL in non-pregnant females (≥15 years).5 The Red Cross suggests an almost similar range (male >13 g/dL and females > 12.5 g/dL) above that hemoglobin level a person can donate blood.6

A study by Ramalingam et al. showed that people with the O blood group have higher hemoglobin levels than A. This study was conducted in the Kanchipuram district of Tamil Nadu.7
Chourasia et al. found that the A1 blood group has a low level of hemoglobin among men and the O group has a lower level of hemoglobin among women.\[8\]

With this background, in this study, we evaluated the hemoglobin levels of male and female blood donors over 4-year and compare the level according to the gender and groups of the ABO blood grouping system.

**MATERIALS AND METHODS**

This cross-sectional data audit was conducted from the attached blood bank of a tertiary care hospital situated in the Northern part of India. The study involves only analysis of the anonymous data from the blood bank where no patients' identifiers were stored. The Institutional Ethics Committee approved the study vide reference number IEC-21/FAC/01.

The datasheet contained the sex, blood group, and hemoglobin level of the donors. The data from 2013 to 2016 were collected for further analysis.

**Statistical Analysis**

Apache OpenOffice 4.1.11 Calc spreadsheet software was used for sorting data and GraphPad Prism 6.01 (GraphPad Software, USA) was used for statistical analysis. The data were tested for normality by the Shapiro–Wilk test and further analysis was decided accordingly. As there was a “not-normal” distribution, we decided to present the data in the median (first quartile [Q1]–third quartile [Q3]) format. The Mann–Whitney U test was performed to find the difference between the median of males and females and the Kruskal–Wallis test was performed to find differences among various blood groups. Further, the distribution of donors according to the sex and blood groups was expressed in numbers and percentages and tested by the Chi-square test. $P < 0.05$ was considered statistically significant.

**RESULTS**

Data of 7026 blood donors were analyzed in this study. Total 6658 males comprised 94.76% of the donors and 368 females comprised 5.24% of the total donors. According to the blood group, in male, there was 2092 (31.42%) in group A, 742 (11.14%) in AB, 2096 (31.48%) in B, and 1727 (16.93%) in the O group. Among females, there were 95 (28.82%) in group A, 42 (11.41%) in AB, 111 (30.16%) in B, and 127 (34.51%) in the O group. The distribution is shown in Figure 1. The distribution of males and females according to the blood group showed statistically significant difference ($\chi^2 = 9.61$ and $P = 0.02$).

The data were checked for normality according to the Shapiro–Wilk test and the data were not distributed normally.

The overall hemoglobin level was 13.8 (13.2–14.1) g/dL. In the overall sample, there was no difference in hemoglobin level among different blood groups [Figure 3]. There was no sex-wise difference in hemoglobin level among different blood groups [Table 1].

Males have a higher level of hemoglobin 13.8 (13.2–14.2) g/dL than females 13 (13–13.5) g/dL, $P < 0.0001$. A similar result is also shown in different blood groups as shown in Table 1.

**DISCUSSION**

We found that among the blood donors, the majority are male who contributed 94.76% of the total donors. However, there were no data regarding the third gender in this database.
Among the donors, blood group A and B groups show a higher number and together make approximately 63% of the male donors. Among female donors, AB showed the lowest number like males. However, O group donors were higher in number, unlike men. The overall hemoglobin level was above the cutoff defined by Red Cross. The hemoglobin levels of male donors were higher than female donors. We found no difference in hemoglobin levels among different blood groups.

In Spain, 52.3% of blood donors are female.[9] In Portugal, 43%, Belgium 45.4%, Netherlands, Denmark, and France have 50% female donors with Finland having 55% female donors.[10] Our study shows a lower percentage than these countries. Hence, further information, education, and communication strategies should be planned for more inclusion of female donors. The males have higher hemoglobin levels and it is a fact. Furthermore, a similar pattern of hemoglobin levels is seen among other mammals, birds, and reptiles. The underlying cause is the difference in the level of sex hormones and the effect of those hormones on erythropoiesis.[11,12] Our study supports this sex difference in hemoglobin. However, our study does not support the difference in hemoglobin to blood groups reported by Ramalingam et al. and Mukherjee et al.[7,8] We found no difference in hemoglobin according to the blood groups. This discordant finding may be attributed to the difference in sample size and geographical difference of the sample.[13]

In this study, we analyzed a large dataset of 4 years. This makes the result credible and generalizable. However, the data were collected from a particular state and not from the samples all over India. Hence, a further study with a sample from different states may be conducted for a national standard.

CONCLUSION

In our sample from a particular state in India, we found that there were more male blood donors than females. All have minimum levels of hemoglobin level required for donating blood. Males have higher hemoglobin levels than females in all types of blood groups in the ABO system. There was no difference in hemoglobin concentration in different blood groups (A, AB, B, and O). This result may help to get an insight into the hemoglobin concentration in donated blood according to the sex and ABO blood groups.

REFERENCES

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