

# Distribution of ABO and Rhesus Blood Group Phenotypes Among Blood Donors at Bahir Dar Blood Bank, Amhara, Northwest Ethiopia: A Retrospective Cross-Sectional Study

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**Background:** Among the blood group antigens identified, ABO and Rhesus are the most important in transfusion medicine. ABO blood group antigens are the most immunogenic followed by Rhesus (D antigen). These blood groups' frequency distribution varies among different regions and races of the world. This study aimed to identifying the frequency distribution of ABO blood group and rhesus factors among blood donors in Ethiopia.

**Methods and Materials:** Aretrospective cross-sectional study was conducted from September 12/2019 to March 18/2021 at Bahir Dar blood bank service. After getting a permission letter from the blood bank, data were collected from the blood bank donor data registration system, and descriptive statistical results were presented in number (frequency) and percentage. A Chi-square test was used to show the difference in the frequency distribution of ABO and Rh blood groups among sex and blood donation site.

**Results:** From 40,053 blood donors, 67.7% were males and younger donors (within the age range of 18–24 years) account for 63.7%. All donations were from voluntary non-remunerated blood donors. The most common blood group was blood group O (41.5%) followed by A (29.8), B (23.2%), and AB (5.5%). Considering ABO and Rh blood group altogether blood group O positive with 37.9% was the predominant blood group followed by A positive (27.2%), B positive (21.4%), AB positive (5%), O negative (3.6%), A negative (2.6%), B negative (1.8%), and AB negative (0.4%). The majority of study participants were 91.5% Rh (D) positive.

**Conclusion:** This study showed that blood group O was the predominant followed by A, B, and AB and most of the blood donors' blood groups were Rh-positive (91.5%). About 68.9% of the total donations were from the first time donor.

**Keywords:** ABO blood group, rhesus factor, frequency distribution

## Introduction

Blood donation is a crucial part of worldwide healthcare. It includes blood collection, testing, storage, and transfusion to the patient. Among tests performed on collected blood for transfusion includes blood grouping and screening for transfusion transmissible infectious diseases. The term blood group refers to the entire blood group system comprising red blood cell (RBC) antigens and a series of genes controlled the specificity of the blood group, which can be allelic or linked closely on the same chromosome. Blood type refers to a particular pattern of reaction to

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testing antisera within a given system. About 38 blood group system genes have been recognized and all known alleles sequenced.<sup>1,2</sup>

Among blood group systems identified, ABO (with blood types A, B, AB, and O) and Rhesus (with Rh D-positive or Rh D-negative blood types) are the most important in transfusion medicine. ABO blood group antigens are the most immunogenic of all the blood group antigens followed by Rh (D antigen).<sup>3</sup> The most common cause of death from a blood transfusion is transfusion of incompatible ABO blood type due to a clerical error. These antigens are expressed on the RBC surface and determine an individual's blood group.<sup>4</sup> The Austrian scientist Karl Landsteiner discovered A, B, and O blood types in 1900, and Alfred Von Decastello and Adriano Sturli discovered the fourth type AB, in 1902. Karl Landsteiner and Alexander S. Wiener discovered Rh blood group in the late 1930s.<sup>5</sup>

ABO and Rh blood group frequency distribution varies among different regions and races of the world. Blood group A was the most frequent in Japan, while blood group O was the predominant blood group among Chinese and Americans.<sup>6,7</sup> A study by Liu et al in China showed that the frequency distribution of blood groups O, A, B, and AB was 35.54%, 31.90%, 24.14%, and 8.42%, respectively. The distribution of the Rh (D) negative group was found to be 0.55% among Chinese blood donors.<sup>7,8</sup> A systematic review study in India revealed that O blood group (34.56%) was the predominant followed by B (34.10%), A (23.16%), and AB (8.1%). Based on Rh type, Rh(D) positive and Rh(D) negative population were 94.13% and 5.87%, respectively.<sup>9</sup> In the United States of America, the frequency distribution of blood group O varies from 39.8% in Asian donors to 56.5% in Hispanic donors, and the proportion of Rh (D) negative varies from 1.7% in Asian donors to 17.3% in White non-Hispanic donors.<sup>6</sup> Blood group A (43.8%) was the most frequent and AB the least frequent, and Rh positivity rate was 85% in Turkey.<sup>10</sup>

In Tanzania, the most common blood type was blood group O (52%), followed by blood group A (26%), blood group B (19%) and blood group AB (3%), and 98% (n = 1773) of participants were Rh-positive.<sup>11</sup> Studies in Nigeria and Uganda also revealed blood group O as the most frequent blood group followed by blood group A, B, and AB was the least frequent blood group.<sup>12,13</sup> Studies in Ethiopia showed that blood group O was the dominant blood group followed by A, B, and AB, and the Rh-

positive blood group account for the highest percentage.<sup>14–16</sup>

The objective of this study was to determine the distribution of ABO and Rh blood groups among blood donors at Bahir Dar blood bank. This data is valuable to manage blood availability by blood type since this study showed the ABO and Rh blood distribution by donation site.

## Methods and Materials

A retrospective cross-sectional study was conducted on 40,053 blood donor data collected from September 12/2019 to March 18/2021 at Bahir Dar blood bank service. The blood bank is located in the capital city of Amhara regional state, Bahir Dar, Ethiopia. The city is situated in northwest Ethiopia 565 kilometers far from Addis Ababa the capital city of Ethiopia. The blood bank serves more than 28 governmental and private health facilities. It has developed its own blood donor data management system which can store data, perform statistical analysis, send a different text to the blood donor like: “thank you for donating blood”, “donor blood type”, “reminder for next donation, and post-donation counseling”.

Blood was collected from voluntary non-remunerated blood donors, through a mobile campaign and at the blood bank, transported to the blood bank by maintaining the cold chain at 2–10°C with a cold box. After arrival at the blood bank, blood was arranged by blood unit number and stored in a blood bank refrigerator (2–6°C). Forward ABO blood grouping was performed by slid method with known antisera (anti-A and anti B). Rh group was determined by test tube method by using anti-D reagents and Coombs test was performed to detect weak D antigen (Mediclone, Mediclone Biotech, India) and reverse blood grouping was performed with known 5% A and B cell suspension prepared in the laboratory. ABO and Rh blood type of the blood donors were registered into the computerized blood donor data management system. The data were collected after getting a seal of approval from Bahir Dar blood bank. The data registered on an excel sheet on the blood bank blood donor data registration system were checked for completeness and transferred into SPSS version 23 for further analysis.

Descriptive statistical analysis was performed to show the frequency distribution, in number and percentage, of ABO and Rh blood group among blood donors, and a chi-square test was employed to test the absence of ABO and Rh blood group distribution difference by sex, blood

**Table 1** Age and Sex Distribution of Voluntary Non-Remunerated Blood Donors from September 12/2019 to March 18/2021 at Bahir Dar Blood Bank

		Age						Total
		18–24	25–29	30–34	35–39	40–44	>45	
Sex	Female	10,767	1115	453	270	168	167	12,940 (32.3)
	Male	14,737	4765	3755	1890	1009	957	27,113 (67.7%)
Total		25,504 (63.7%)	5880(14.7%)	4208(10.5%)	2160 (5.4%)	1177 (2.9%)	1124 (2.8%)	40,053 (100%)

donation site, and p-value less than 0.05 were considered as statistically significant. Bonferroni post hoc test was performed to detect which cells from the contingency table are significantly different. The data were collected after getting acquiescence from the blood bank and we used only donor ABO and Rh blood group, age, sex, and site of blood donation based on the code given at the blood bank. Other than these we did not use other voluntary blood donor data like name and phone number. All the data were secured, protected, and accessed only by the investigators.

## Result

In this study, which includes 40,053 voluntary non-remunerated blood donors, the majority of blood donors were males (67.7%), and most of them (63.7%) were within the age range of 18–24 years (mean age 24.4 years) (Table 1). Students, from universities and high school, account for 56.6% of the total (Table 2). As to this investigation, most blood donors (60.2%) were from the Bahir Dar city administration and 68.9% of donations were from the first-time donor. A total of 80,567 units of blood were collected from 40,053 blood donors. The most frequent blood group was blood group O (41.5%) followed by A (29.8), B (23.2%), and AB (5.5%). Considering ABO and Rh blood group altogether blood group O positive

**Table 2** Occupational Distribution of Blood Donors from September 12/2019 to March 18/2021 at Bahir Dar Blood Bank

Occupation	Frequency	Percent
Civil Servant	7272	18.2
Driver	421	1.1
Private worker	6012	15.0
Student	22,676	56.6
Teacher	459	1.1
Unemploy	2421	6.0
Others	792	2.0
Total	40,053	100.0

**Table 3** ABO and Rh Blood Group Distribution of Blood Donors from September 12/2019 to March 18/2021 at Bahir Dar Blood Bank

		Rh blood Group of Blood Donors		Total
		Negative (%)	Positive (%)	
ABO	A	1036 (8.7%)	10,897 (91.3%)	11,933 (100.0%)
	AB	179 (8.2%)	2009 (91.8%)	2188 (100.0%)
	B	726 (7.8%)	8570 (92.2%)	9296 (100.0%)
	O	1451 (8.7%)	15,185 (91.3%)	16,636 (100.0%)
Total		3392 (8.5%)	36,661 (91.5%)	40,053 (100.0%)

(37.9%) was the most predominant blood group followed by A positive (27.2%), B positive (21.4%), (91.5%), AB positive (5%), O negative (3.6%), A negative (2.6%), B negative (1.8%), and AB negative (0.4%). About 91.5% of the blood donors were Rh (D) positive and 8.5% were Rh (D) negative (Table 3).

## Distribution of ABO and Rh Blood Groups with Sex and Blood Donation Site

ABO and Rh frequency were not significantly different ( $P = 0.64$ ) between males and females. The proportions of the B, O, and AB blood groups were significantly different across blood donation sites ( $P = 0.012$ ). As compared with others, Meshenti donation site had a significantly higher (46.9%) and Motta lower (40.4%) proportion of the blood group O, while Merawi (27.0%) and Sekela (7.0%) had a higher proportion of B and AB blood group respectively. Rh-positive blood groups were significantly less frequent among donors around Gimjabet (86.3%) and Durbete (89.6%) as compared to other donation sites ( $<0.0001$ ) (Table 4).

## Discussion

In Ethiopia, even though there are 40 blood banks, blood and blood component supply is in short supply to meet the

**Table 4** ABO and Rh Blood Group of Blood Group Distribution by Donation Site

site of Donation	ABO				Rh	
	A (%)	AB (%)	B (%)	O (%)	Negative (%)	Positive (%)
Adet	296 (30.5%)	54 (5.6%)	224 (23.0%)	398(40.9%)	68 (7.0%)	904 (93.0%)
Bahirdar	7150 (29.6%)	1390 (5.8%)	5630 (23.3%)	9953 (41.3%)	1935 (8.0%)	22,188 (92.0%)
Bicolo	42 (26.1%)	9 (5.6%)	38 (23.6%)	72 (44.7%)	7 (4.3%)	154 (95.7%)
Chagni	381 (30.1%)	62 (4.9%)	287 (22.7%)	537 (42.4%)	107 (8.4%)	1160 (91.6%)
Dangila	689 (30.5%)	102 (4.5%)	504 (22.3%)	962 (42.6%)	206 (9.1%)	2051 (90.9%)
Durbete	476 (32.5%)	74 (5.0%)	315 (21.5%)	601(41.0%)	152 (10.4%)	1314 (89.6%)*
Gemejabet	98 (30.5%)	18 (5.6%)	68 (21.2%)	137 (42.7%)	44 (13.7%)	277 (86.3%)*
GendaMoy	382 (29.3%)	61 (4.7%)	325 (24.9%)	536 (41.1%)	114 (8.7%)	1190 (91.3%)
Kosober	975 (28.9%)	163 (4.8%)	786 <sub>a</sub> (23.3%)	1448 (42.9%)	321 (9.5%)	3051 (90.5%)
Merawi	227 (26.7%)	35 (4.1%)*	230 (27.0%)*	359 (42.2%)	79 (9.3%)	772 (90.7%)
Meshenti	80 (25.6%)	15 (4.8%)	71 (22.8%)	146(46.8%)*	31 (9.9%)	281 (90.1%)
Mota	1060 (31.9%)	182 (5.5%)	735 (22.2%)	1341 (40.4%)*	300 (9.0%)	3018 (91.0%)
Sekela	77 (23.4%)	23 (7.0%)*	83 (25.2%)	146 (44.4%)	28 (8.5%)	301 (91.5%)
Total	11,933 (29.8%)	2188 (5.5%)	9296 (23.2%)	16,636 (41.5%)	3392 (8.5%)	36,661 (91.5%)

**Notes:** \*Donation sites with, significantly, higher or lower proportions of B, AB, O, and Rh-positive blood group (P=0.012, and <0.0001 respectively).

national demand. Bahir Dar blood bank is the outstanding blood bank in the country, which satisfies the need for blood and blood component supply for its catchment health facilities. The need for the determination of the distribution of ABO and Rh blood groups arises to maintain the adequacy of safe blood supply.

In this study, which involved 40,053 blood donors at Bahir Dar blood bank, male blood donors accounted for 67.7%, while 32.3% were females. In line with our finding studies done in Ethiopia (Arba Minch Jima and Debre Tabor) and Tanzania indicated that males were more involved in blood donation than females.<sup>11,14,16</sup> This might be due to female donors are more likely to be different than male donors due to medical grounds, such as low hemoglobin levels, low body weight, pregnancy, and breastfeeding. Of the total blood donors in our investigation, the younger population (18–24 years) and students were the most common blood donors. The reason behind might be due to this portion of the population are dynamic and easily convinced.

In this investigation, the most common blood group was O (41.5%) followed by A (29.8), B (23.2%), and AB (5.5%) which was in line with other findings showed that blood group O as the most common followed by A, B and AB.<sup>13,14,17,18</sup> However, a research conducted in Turkey and Pakistan indicated that blood group A was the predominant,<sup>19,20</sup> while others revealed B was the most common blood group.<sup>21,22</sup> This difference in the frequency distribution of ABO blood group might be due to genetic variations of the study participant.

As to our finding Rh-positive blood group was the most predominant which covered 91.5% and the rest (8.5%) was Rh-negative. Similarly, a study in Debre Tabor, Ethiopia indicated that Rh positive blood group was the most frequent with 92.7% and the remaining 7.3% was Rh-negative.<sup>14</sup> However, a study in Gambela, Ethiopia reported a higher (19.37%) proportion of Rh-negative.<sup>23</sup> Considering ABO and Rh blood group altogether, blood group O positive (37.9%) was the most predominant blood group whereas AB negative (0.4%) was the rarest. Similarly, a study in Ethiopia and Uganda showed O positive as the most frequent and AB negative the least blood group,<sup>13,14</sup> but a study by Jahanpour et al in Tanzania showed A negative (3%) followed by B negative and O negative 2% each.<sup>11</sup> This study also showed that ABO and Rh blood group distribution varies among different blood donation sites so that the local blood bank will make use of this finding to adjust bloodstock by blood type.

## Conclusion

In this study, blood group O was the most common followed by A, B, AB. Most of (91.5%) of the blood donors' blood group were Rh-positive. About 68.9% of the total donations were from the first-time donor. To make these donors regular non remunerated blood donors strong promotion activities are required. Our study also showed that the distribution of ABO and Rh blood groups varies among blood donation sites and it will be help full for the blood bank to adjust bloodstock by blood type.

## Abbreviations

°C, Degree Celsius; RBC, Red Blood Cells; RH, rhesus factor.

## Data Sharing Statement

All relevant data are included in this document.

## Ethical Considerations

We obtained a permission letter from Bahir Dar blood bank management bodies. Since we used secondary data, written informed consent was not obtained from each study participant.

## Consent for Publication

Consent for publication of this work was found from Bahir Dar blood bank.

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted, agree to be accountable for all aspects of the work.

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## Disclosure

The authors have declared that no competing interests exist.

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