

# ABO and Rhesus blood groups in blood donors: A study from Mosul Central Blood Bank at Nineveh, Iraq

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## ABSTRACT

**INTRODUCTION:** ABO and Rh blood groups are the major blood group systems. These two systems are very important in blood transfusion and blood banking.

**OBJECTIVE:** to measure the frequencies of ABO and Rhesus blood groups in blood donors at the Mosul Central Blood Bank at Nineveh, Iraq.

**METHODS:** A retrospective, record-based study conducted on data of voluntary and replacement blood donors, of both sexes, who donated blood at the Mosul Central Blood Bank in Nineveh from January 2019 to June 2020. ABO and Rh forward typing were done via tube agglutination method with ABO and Rh antisera, while reverse typing with known pooled A and B cells. The frequency of ABO and Rh blood groups, percentage of male and female donors, percentage of voluntary and replacement donation, all were counted and stated in simple percentages.

**RESULTS:** Out of 49647 blood donors, male donors were 49380 (99.46%). Replacement donors are more predominant 28250 (56.90%). The most common blood group was O 18245 (36.75%). The least common is AB 4041 (8.14%). Blood group A 15128 (30.47%) has higher frequency than B 12233 (24.64%). The frequency of Rhesus positive and negative was 44506 (89.64%) and 5141 (10.36%) respectively.

**CONCLUSION:** Donor population is predominantly male, replacement donation, O positive blood grouped. Order of frequency of blood groups in rhesus positive donors is O>A>B >AB; while in Rhesus negative donors, it is O>A=B>AB. The awareness of frequencies of the different blood groups is very critical for the management of blood bank stores and blood transfusion service policies.

**Keywords:** ABO and Rhesus blood groups, blood donors, blood bank, Mosul.

## INTRODUCTION

Blood groups are classified according to many systems. The major systems are the ABO system that classifies blood groups into A, B, AB and O, and Rh system, by which blood groups are classified into Rh-positive and Rh-negative. These classifications depend on the presence or absence of an inherited antigenic substance on the surface of red blood cells (RBCs).<sup>1</sup> Karl Landsteiner was the first to discover ABO blood group system in 1901,<sup>2</sup> then he and Wiener explored the Rh blood group in 1941.<sup>3</sup>

In ABO system, the antibodies are steadily and predictably present in the serum of a normal person where his RBCs lack the antigens.

In contrast, in Rh-system, the D antibodies are not readily present in the serum of a person whose RBCs lacking D antigen unless being sensitized like what happens in haemolytic disease of the new born.<sup>2</sup> Types of blood groups have an enormous significance for the individual health and medical diagnosis, genetic information, counselling, forensic medicine, and general wellbeing.<sup>4,5</sup>

The International Society of Blood Transfusion counted over 33 blood group systems containing about 300 antigens; ABO system is the most important in transfusion and transplantation. On development of the human body, all will have clinically significant anti-A and/or anti-B antibodies in their serum by the age of six months of life. Blood group A has antibodies

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against blood group B in serum and vice-versa; meanwhile, blood group O has no A/ B antigens but has both antibodies in serum. The precursor of the ABO blood group antigen is the H-antigen. The rare Bombay blood group neither have H antigen nor A or B antigens. The Rhesus system contains 50 blood group antigens.<sup>6</sup> But only five Rh antigens are important; D, C, c, E, e. Among them the D antigen is the most common and the most immunogenic.<sup>7</sup> The surface of RBC may or may not carry an immunogenic D-antigen or Rh factor. The D-negative RBCs usually do not contain anti-Rh antibodies unless these subjects were exposed to D-positive RBCs in the past. Since these immune antibodies are immunoglobulin G (IgG) in nature, they can cross the placenta and harm the baby.<sup>6</sup>

Researchers found a relationship between blood groups with specific diseases. Subjects with blood group B are susceptible to type 2 diabetes mellitus.<sup>8</sup> A study on British men suggests that ABO blood groups and related factors have an impact, though small, on individual risk for ischaemic heart disease,<sup>9</sup> making its pathogenesis on cardiovascular disorders a captivating issue.<sup>10</sup> Literature has shown a link between blood group O with stomach cancer, myasthenia, and bladder cancer; blood group B with brain neoplasm, gingivitis, periodontal disease; blood group A with chronic heart diseases, bronchial asthma, breast cancer, tuberculosis, atherosclerosis with complication, pancreatic cancer, gastroesophageal reflux disease; and blood group AB with sore throat, sinusitis, nasopharynx cancer.<sup>11</sup> Kaur et al. concluded that these studies might be of benefit in case of expectation of future diseases.<sup>12</sup>

In 2004, researchers in the US carried out a study to measure the frequency of ABO and Rh blood group systems in blood donors from different blood centres, and they found that blood group O Rh+, B Rh+/AB Rh+, Rh- were highest in Hispanic, Asian, and white non-Hispanic donors, respectively.<sup>13</sup> In 1988 Toy et al. found slight ethnic differences in the prevalence of positive direct antiglobulin test in group A infants born to group O mothers; however, most haemolytic disease of new born

that need exchange transfusion does not differ significantly among infants of Asian, Black, Hispanic, or Caucasian populations.<sup>14</sup>

Rajshree and Raj concluded that knowing the distribution of the blood groups is a significant issue in blood banks for patient health.<sup>15</sup> Information about the population's blood group that is essential in managing blood banks and transfusion services, especially in emergencies is scarce in Iraq. The objective of this study was to determine the frequency of blood groups among the population of the Nineveh Governorate by defining blood groups in blood donors at Mosul Central Blood Bank. To help the blood banks to know how much they may need of each blood group, to avoid shortages of such blood group at the expense of wastages of others.

## METHODS

**Setting and study design:** A retrospective record-based study was carried out at the Mosul Central Blood Bank in Nineveh, Iraq, on data registered from January 2019 to June 2020.

**Ethical consideration:** The research ethics committee of the Nineveh Health Directorate approved the protocol of this study. The Mosul Central Blood Bank administration in Nineveh has agreed to use the bank's data to achieve this study's objectives.

**Definition of the case, inclusion and exclusion criteria:** We included data of all voluntarily and replacement donors who were registered at the bank records during the targeted period. Replacement's donors were those who donated to their related patients, and they were either family members, close relatives or friends of the patients. The voluntary donors were those who donated their blood at an in-house blood bank or in outdoor campaigns for unrelated patients.

**The protocol of donation at the blood bank:** The blood bank protocol is to accept the donation from only medically fit persons. The donors were first allowed to fill up a registration form

**Table 1** | Distribution of donors according to genders:

Gender	No. of donors	%
Male	49380	99.462
Female	267	0.538
Total	49647	100

**Table 2** | Distribution of donors according to type of donation

Type of donation	No of donors	Percentage (%)
Voluntary	21397	43.098%
Replacement	28250	56.902 %
Total	49647	100 %

containing all personal, demographic, occupation, medical, and surgical details. After the blood vessel venesection, ABO and Rh typing were done by antigen-antibody agglutination test using commercially available and validated antisera anti-A, anti-B, and anti-D (Tulip diagnostic Ltd) and reversed grouping using known pooled A and B cells. Blood groups were done using the tube method. All weak D groups donors were considered as Rh-positive.

Haemoglobin (Hb) concentration and packed cell volume (PCV) level were measured for each donor. Male donors with Hb of less than 13.5 g/dL or more than 17.5 g/dL, PCV of less than 42 % or more than 52 % were not allowed to donate. Female donors whose Hb is less than 12.5 g/dL or more than 16.5 g/dL, PCV of less than 40 % or more than 48 % were not allowed to donate and were not selected. Medical officers screen the donors according to blood donor selection criteria and guidelines. Individuals in good health, mentally alert, physically fit were assigned as blood donors and asked to sign the donor questionnaire and informed consent form.

**Sampling:** based on the record, we enrolled 49647 blood donors. We carefully checked the records of the donor to avoid duplication of the data.

**Procedure and statistical analysis:** We retrieved data regarding the gender, types of donations, replacement or voluntary, ABO and Rh blood groups.

The data were recorded, entered, tabulated in the Statistical Package for Social Science (SPSS), and analysed by calculating the percentages of blood groups.

## RESULTS

We included 49647 persons in our analysis ABO. The donor population was predominantly male, the ratio being 185:1, as in **table 1**. Donation is mainly replacement, as in **table 2**. The most common ABO blood group was O 18245 (36.75%), and the least common was AB 4041 (8.14%). We also found that Rh-positive donors 44506 (89.64%) were much more than Rh-negative donors 5141 (10.36%).

The order of frequency of blood groups regarding ABO and in Rhesus positive donors was found to be presented by the formula O>A>B >AB; while the order of frequency of blood group regarding ABO and Rh negative was found to be depicted by the formula O>A and B>AB. Where A negative and B negative had the same frequency, as shown in **table 3**.

## DISCUSSION

In our study, the donor population is predominantly male, replacement, blood group O Rh-positive.

The current study showed a higher number of male donors (99.462) compared to female donors. This result is compatible with other previous studies throughout the world; as in Uttarakhand's study, 2014 (99.71%)<sup>16</sup> and in Andhra Pradesh, Tirupati, 2019 (97.88%),<sup>17</sup> and

**Table 3** | Distribution of ABO and Rhesus blood group among study population (n=49647)

Blood group	A (%)	B (%)	AB (%)	O (%)	Total (%)
Rh positive	13771 (27.74)	11007 (22.17)	3602 (7.26)	16126 (32.48)	44506 (89.64)
Rh negative	1357 (2.47)	1226 (2.47)	439 (0.88)	2119 (4.27)	5141 (10.36)
Total	15128 (30.47)	12233 (24.64)	4041 (8.14)	18245 (36.75)	49647 (100)

in Punjab, Pakistan, 2004 (93.1%).<sup>3</sup> Also compatible, but higher than study done in Swat, Pakistan, 2008 (74.86%),<sup>18</sup> rural south western Uganda, 2016 (73%).<sup>19</sup> All find that the male donors are the predominant one.

Paramount male predominance in developing countries like Iraq and India might be due to social and cultural barriers.<sup>16</sup> lack of motivation and fear of blood donation. Many females were timely menstruating, pale or low body weight, and lactating on screening before blood donation. That is why deferred temporary from blood donation. This put the light on the importance of improving women's wellbeing and nutritional status and ensuring adequate awareness, and assures the women to be motivated to donate blood next time. European blood donors found that the gender has an important role in the motivation to donate blood, and that the adverse reactions prevent females from being a regular donor. They indicate that the distribution of female and male donors is the same in many countries, except Italy in having female counting for only 30% from total donors.<sup>20</sup>

Voluntary blood donors (43.098%) in the current study were less than the replacements donors (56.902%); Garg et al.<sup>16</sup> in their study has found that 99.71% were voluntary. Voluntary blood donation has to be encouraged and promoted through media and talk shows. It is the vital source of healthier blood donation due to less risk of acquiring transfusion-transmitted

diseases.<sup>21</sup> By voluntary donation, blood can be provided to all patients in emergency wards rapidly without the need for replacement donors.

Regarding the frequency and distribution of ABO and Rh blood groups, the current study was done on the blood donors in the Central Blood Bank in Mosul city in Iraq. The frequencies were compared with many similar studies carried out throughout the world, as in Saudi Arabia,<sup>22</sup> in Punjab, Lucknow, Rajasthan, Uttarakhnd in northern India,<sup>3, 4, 15, 16</sup> Tirupati, Andhra Pradesh in southern India,<sup>17</sup> in Uganda,<sup>19</sup> Uganda and Tanzania in East Africa and Nigeria in the west of Africa.<sup>5</sup> In Pakistan,<sup>23</sup> In Nepalese.<sup>24</sup> See **table 4**

In our study, the most common ABO blood group was being O positive, and The least one is AB-positive; results that are similar to that reported from Saudi Arabia,<sup>22</sup> Tirupati in southern India,<sup>17</sup> Uganda and Tanzania in East Africa,<sup>19, 25</sup> west Africa,<sup>5</sup> and in U.S.A.<sup>26</sup> Studies from northern India,<sup>3, 4, 15, 16</sup> also Pakistan,<sup>23</sup> has found that B positive is the most common blood group, and AB positive is the least one. While, in Nepalese study A positive is the most common blood group, and AB positive is the least one.<sup>24</sup>

Regarding Rh blood group, the commonest one is Rh positive, which is compatible with all the above mentioned studies.<sup>3-5,15-17,19, 22-26</sup>

**Table 4** | Comparison of frequency percentage of ABO and Rhesus blood groups in different countries

Population of study	A	B	AB	O	Rh positive	Rh negative
Present study	30.47	24.64	8.14	36.75	89.64	10.36
Saudi Arabia [22]	24.0	17.0	4.0	52.0	93.0	7.0
Northern India/ Punjab [3]	23.93	34.30	8.65	33.43	93.00	7.00
Northern India/ Lucknow [4]	21.38	39.92	9.43	29.27	95.71	4.29
Northern India/ Rajasthan [15]	22.2	36.4	9.4	31.7	91.75	8.25
Northern India/ Uttarakhand [16]	28.70	32.07	10.53	28.70	94.49	5.51
Southern India/ Tirupati, Andhra Pradesh [17]	20.4	31.3	5.9	42.2	94.07	5.93
East Africa/ Uganda [19]	25.00	20.39	4.25	50.36	97.97	2.03
East Africa/ Tanzania [25]	26.00	19.00	3.00	52.00	98.00	2.00
West Africa/ Nigeria [5]	23.3	14.6	2.6	53.3	94	6.0
Pakistan [23]	23.8	38.00	10.00	28.2	89.1	10.9
Nepalese [24]	34.0	29.0	4.0	33.0	96.7	3.3
USA [26]	41.0	9.0	4.0	46.0	85.0	15.0

## CONCLUSION

The current study concludes that O is the most common blood group, and AB is the least common blood group among blood donors, followed by blood group A and B blood group. Concerning Rh blood group, Rh positive is more common than Rh negative. Females donate blood very rarely compared to male and replacement donation is slightly higher than voluntary donation.

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**Abbreviations list:** Haemoglobin (Hb), Red blood cells (RBCs), Packed cell volume (PCV) .

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