Section: Pathology & Blood Bank

Original Research Article

# RH ANTIGENS (D, C,c, E, e) FREQUENCY DISTRIBUTION IN VOLUNTARY BLOOD DONORS AT A TERTIARY CARE MEDICAL INSTITUTE IN WESTERN UTTAR PRADESH, INDIA

**Jeetu Raj Singh[1], Ajit Singh[2], Sonia Singh[3], Ravinder Pali[4]**

[1]Assistant Professor, Department of Blood Bank, Autonomous state Medical College, Shahjahanpur, Uttar Pradesh, India
[2]Assistant Professor, Department of Pathology, Kalpana Chawla Government Medical College, Karnal, Haryana, India
[3]Assistant Professor, Kalpana Chawla Government Medical College, Karnal, Haryana, India
[4]Medical Officer, PHC, Jatusana Rewari

*Received* : 12/11/2023
*Received in revised form* : 15/12/2023
*Accepted* : 25/12 /2023

*Keywords:*
*Blood group, rhesus antigen, alloimmunization, D antigen, e antigen, C antigen, c antigen, E antigen.*

Corresponding Author:
**Dr. Sonia Singh,**
Email: dr.soniagulia@gmail.com

DOI: 10.47009/jamp.2023.5.6.277

Source of Support: Nil,
Conflict of Interest: None declared

*Int J Acad Med Pharm*
2023; 5 (6); 1346-1349

## Abstract

**Background:** The Rh blood group system, a critical component of blood typing, plays a pivotal role in transfusion medicine and prenatal care. Alloimmunization remains a risk for transfused individuals lacking Rh antigens on the red cells. Therefore it is paramount to be aware of extended red cell Rh antigen frequency in their local and regional blood donor population. The present study was undertaken to observe the frequency distribution of common Rh antigens D, C, c, E, and e in the local blood donor population and concerning gender. **Materials and Methods:** This study was carried out in the blood bank of a tertiary care teaching medical institute in western Uttar Pradesh, India from November 2022 to Oct 2023 on all voluntary healthy blood donors. The conventional tube technique method was used for detecting blood groups of the ABO and common Rh antigens D, C, c E, e using monoclonal antisera (biorad). Frequency distribution of Rh antigens (D, C,c, E,e) in the blood donor population, and distribution to independent variables such as gender. **Result:** The samples were analyzed for five different Rh antigens. Irrespective of gender, e was the commonest antigen observed in the current study, comprising 98.79% followed by D (94.50%) > C (85.02%) > c (55.04%) > E (18.01%). **Conclusion:** A different frequency of Rh antigens in blood donors is paramount for judicious blood transfusion with prudent antigen-matched blood, to prevent alloimmunization, and delayed hemolytic transfusion reactions thus enhancing blood safety.

## INTRODUCTION

The Rh blood group, also known as the Rhesus system, is crucial for blood transfusion and pregnancy-related issues, was discovered by K. Landsteiner and A.S Wiener in 1939-1940.[1] Clinical observations of P. Levine and R.E. Stetson in 1939, were recognized as a complex system with almost more than 54 independent antigens. In addition to the main Rh factor (D antigen), the Rh system has several other antigens known as extended antigens like C,c, E,e, etc.[2]

The RHD and RHCE are genes encoding the proteins situated on the short arm of chromosome.[1] The RHD protein is responsible for the expression of RhD antigen and the RHCE protein expresses the antigens C or c and E or e.[3] The D antigen is the second most immunogenic after the ABO system. Rh antigen-deficient recipients when exposed to non-self-red cell antigens are prone to alloimmunization via transfusion, transplantation, and feto-maternal hemorrhage during pregnancy; as a result, this leads to delayed hemolytic transfusion reactions and hemolytic disease of the fetus and newborn, a principal culprit of perinatal morbidity and mortality in India.[4,5] These adverse outcomes were not only reported by anti-D antibodies but alloantibodies against C,c, E, and e have also been involved.[6] Therefore it is imperative for transfusion medicine services to be aware of the characteristics and pattern of Rh antigen expression due to variation at the genetic level, on the red cell surface among their local blood donor population. This will help them formulate and maintain a database for supplying suitable crossmatched antigen-negative blood to manage and prevent alloimmunization in multiple transfused like thalassemia, sickle cell anemic, and chronic anemic patients, thus enhancing blood safety and preventing delayed hemolytic


ISSN (O): 2687-5365; ISSN (P): 2753-6556

transfusion reactions and perinatal obstetrics adverse events.

## MATERIALS AND METHODS

The prospective observational study was undertaken at the blood bank of a tertiary care medical institute in western Uttar Pradesh, India over one year from November 2022 to October 2023. The study population included voluntary healthy blood donors, who were selected for blood donation after qualifying the inclusion and exclusion criteria, as per Guidelines for Blood donor selection and Blood donor deferral, NBTC, NACO, Ministry of Health and Family Welfare, Govt. of India, 2017.[7]

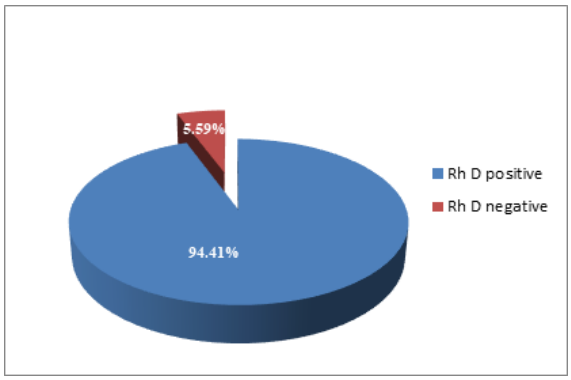
All voluntary blood donors who have given their consent to blood donation were selected after a donor questionnaire and medical examination for blood pressure, hemoglobin, weight, pulse, and respiratory rate. The blood was withdrawn in a 350 ml bag with samples collected through the tubing of the blood bag, labeled plain and EDTA vial. If the test was not performed on the same day then samples were stored at 2-4 degrees C immediately. Non-reactive transfusion-transmitted infection screening samples were subjected to antigen typing, finally registering 955 blood donors in our study

For ABO and RH system antigens donor antigen typing, the conventional tube technique was used, the test is based on the hemagglutination method using monoclonal antisera (biorad, India). Monoclonal antisera-Anti-A, Anti-B, and Anti-AB were used for ABO typing, and merisera Anti-D (IgM) Monoclonal and Anti-D (Monoclonal Blend) were used for Rh-D typing. The Rh antigens like C,c, E, and e were typed using Monoclonal Anti-C, Anti-E, Anti-c, and Anti-e.

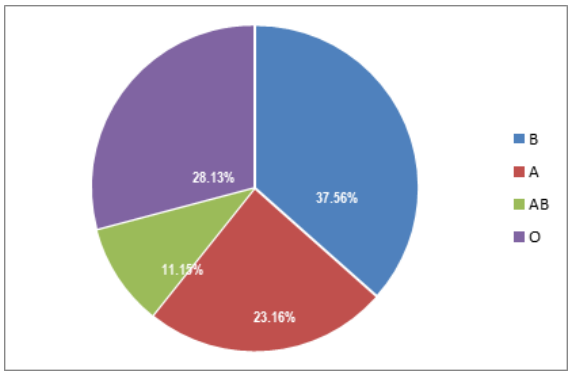
Data were tabulated in a Microsoft Excel spreadsheet and analyzed for statistics in terms of frequency and percentage of donor's gender, ABO type, and Rh-D status, Rh (C,c, E,e). Antigen frequency was calculated by the total sum of the number of antigen-positive donors and dividing it by the total number of donors.

## RESULTS

The current study enrolled 955 voluntary blood donors, of which 850 (89%) were males and 105 (11%) were females, the ratio being 8:1(Table 1). Rh-D positive and Rh-D negative blood donors comprised 94.41% (n=898) and 5.59% (n=57), respectively [Pie chart 1]. Group B was the predominant blood group with 349 (37.56%) donors followed by O (n=278, n=28.13%), A (n=231, 23.16%), and AB (n=97, 11.15%) [Pie chart 2].




**Pie chart 1: Percentage of Rh D positive and negative in voluntary blood donors**




**Pie chart 2: Percentage of ABO blood grouping in voluntary blood donor population.**

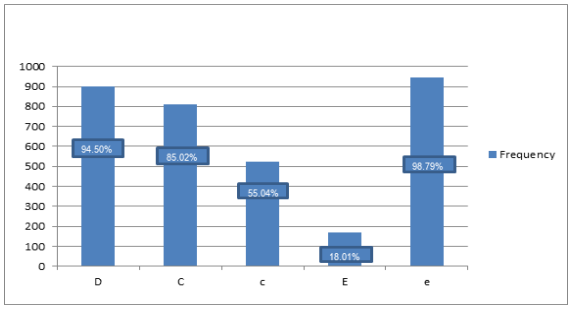



**Figure 1: Frequency distribution of Rh antigens among blood donors.**

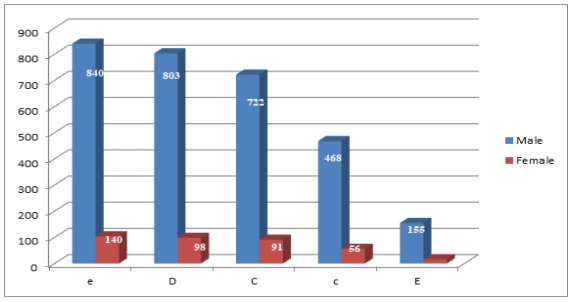



**Figure 2: Gender distribution of Rh antigens**

**Table 1: Total number of voluntary blood donors.**

| Total no. voluntary blood donors (%) | Males (%) | Females(%) |
|---|---|---|
| 955 (100) | 850 (89) | 105 (11) |


ISSN (O): 2687-5365; ISSN (P): 2753-6556

The distribution of various Rh antigens in the total study population and for gender was shown in Figures 1 and 2 respectively. Irrespective of gender, e was the commonest antigen observed in the current study, comprising 98.79% followed by D (94.50%) > C (85.02%) > c (55.04%) > E (18.01%). Prevalence of Rh antigens e, D, C, c, E in males and females was 98.79% vs 98.19%, 94.50% vs 92.18%, 85.02% vs 87.15%, 55.04% vs 53.16% and 18.01% vs 14.99%.

## DISCUSSION

The variation in the expression of red cell antigens in different races is attributed to genetic variability in different populations.8 The phenotyping of different blood group antigens is necessary to avoid adverse events like red cell alloimmunization in multiply transfused thalassemia, sickle cell anemia, and hemolytic disease of the newborn (HDFN) especially in perinatal obstetric female patients. The present study edifies the frequency distribution of Rh antigen amongst blood donors in western Uttar Pradesh. The knowledge of the frequency distribution of red cell antigens is vital in preventing red cell alloimmunization, where an individual's immune system produces antibodies against transfused red blood cells like in pregnant females, and multiply transfused patients. By identifying and matching antigens, healthcare providers can minimize the risk of immune reaction, ensuring more successful and safer blood transfusion.[9]

In the present study, the male-to-female ratio was 8:1. Khattak et al. reported a male-to-female ratio of 3.02:1 from Pakistan.[10,11] The variation is attributed to the fact that the samples are from voluntary blood donors, excluding replacement and family donors at the blood bank.

In the present study Rh-D, positive and Rh-D negative blood donors percentages are 94.41% (n=898) and 5.59% (n=57), which is concordant with the findings of Khattak et al, Kumar et al (2002), Roy et al (2004), Chitra et al and Thakral et al(2010).[10,11] The prevalence of the D-negative population in India ranges from 4.76% to 7.02% which is concordant with the present study.[12,13]

In the present study blood group B was the predominant blood group with 349 (37.56%) donors followed by O (n=278, n=28.13%), A (n=231, 23.16%), and AB (n=97, 11.14%). A similar trend was observed by Agarwal et al. (2013) in New Delhi and Basu et al. (2018) in West Bengal. However, our study is discordant with Chitra M et al. (2016) in Chennai reported blood group O (46%) as the most prevalent group.[10]

In the current study regardless of gender ‘e’ was the most common antigen observed comprising 98.79% followed by D (94.50%) > C (85.02%) > c (55.04%) > E (18.01%). The present study results are concordant with Lamba et al. (2013) Keshav et al Chitra et al, and Makrooet al.[14-17] The frequency of all Rh antigens was found higher in males as compared with females except for C antigen. The present study supports ethnic and regional differences in Rh antigens frequency exist, contributing to variation in blood types among populations.[18]

## CONCLUSION

Understanding extended Rh antigens is essential for comprehensive blood typing and compatibility assessment. This knowledge enables healthcare providers to identify rare Rh variants, minimizing the risk of transfusion reactions and alloimmunization. Additionally, in prenatal care, knowing the full spectrum of Rh antigens is crucial for managing pregnancies and preventing Rh-related complications contributing to better health care.

## REFERENCES


1. Chudley AE. Genetic landmarks through philately – Karl Landsteiner: the father of blood grouping. Clin Genet 2000; 57:267-9
2. Avent ND, Reid ME. The Rh blood group system: a review. Blood. 2000 Jan 15;95(2):375-87.
3. Cherif-Zahar B, Mattei MG, Le Van Kim C, Bailly P, Cartron J-P, Colin Y. Localization of the human Rh blood group gene structure to chromosome 1p34.3-1p36.1 region by in situ hybridization. Hum Genet 1991;86:398–400
4. Rudman SV. Textbook of Blood Banking and Transfusion Medicine. 2nd ed. Elsevier Saunders; 2005.
5. Reid ME, Lomas-Francis C, Olsson ML. RH - Rh Blood Group System, in the Blood Group Antigen FactsBook. 3rd. Boston: Academic Press; 2012:147–262.
6. Gardner K, Hoppe C, Mijovic A, Thein SL. How we treat delayed hemolytic transfusion reactions in patients with sickle cell disease. Br J Haematol. 2015;170(6):745-756.
7. Nbtc.naco.gov.in. New Delhi. National Blood Transfusion Council. http://nbtc.naco.gov.in/assets/resources/policy/Letter-reg-%20guidelines-for-blood-donor-selection&referral-2017.pdf.Accessed 15 Nov 2018
8. Wagner FF, Flegal WA. Review: The molecular basis of the Rh blood group phenotypes. Immunohaematology. 2004;20:23–36.
9. Singer ST, Wu V, Mignacca R, Kuypers FA, Morel P, Vichinsky EP. Alloimmunization and erythrocyte autoimmunization in transfusion-dependent thalassemia patients of predominantly Asian descent. Blood. 2000;96:3369–73.
10. Chitra M et al. Prevalence of Rh Antigens among voluntary blood donors in Chennai, Tamil Nadu, India. Int J Res Med Sci. 2016 Dec;4(12):5360-5363.
11. Khattak ID, Khan TM, Khan P, Shah SM, Khattak ST, Ali A. Frequency of ABO and rhesus blood groups in district Swat, Pakistan. J Ayub Med Coll Abbottabad. 2008;20:127–9.
12. Latoo JA, Masoodi NA, Bhat NA, Khan GQ, Kadla SA. The ABO and Rh blood groups in the Kashmiri population. Indian J for the Practicing Doctor. 2005;3(2) 2006-5-2006-6.
13. Periyavan S, Sangeetha SK, Marimuthu P, Manjunath BK, Seema DM. Distribution of ABO and Rhesus-D blood groups in and around Bangalore. Asian J Transfus Sci. 2010;4:41.
14. Agrawal, et al.: ABO and Rh (D) group distribution and gene frequency; the first multicentric study in India. Asian Journal of Transfusion Science - Vol 8, Issue 2, July - December 2014.
15. Basu et al.ABO, Rhesus, and Kell Antigens, Alleles, and Haplotypes in West Bengal, India. Transfus Med Hemother2018;45:62–66.




ISSN (O): 2687-5365; ISSN (P): 2753-6556

16. Divjot Singh Lamba, Ravneet Kaur, Sabita Basu.Clinically Significant Minor Blood Group Antigens amongst North Indian Donor Population Adv Hematol. 2013:2013:215454. doi: 10.1155/2013/215454. Epub 2013 Dec 9.
17. R N Makroo, Aakanksha Bhatia, Richa Gupta, Jessy Phillip. Prevalence of Rh, Duffy, Kell, Kidd & MNSs blood group antigens in the Indian blood donor population. Indian J Med Res. 2013 Mar;137(3):521-6.
18. Ruqaiya Hussain, Mohd Fareed, Ahsana Shah, Mohammad Afzal. Prevalence and gene frequencies of A1A2BO and Rh(D) blood group alleles among some Muslim populations of North India. Egyptian Journal of Medical Human Genetics.Volume 14, Issue 1, January 2013, Pages 69-76


ISSN (O): 2687-5365; ISSN (P): 2753-6556