



Research Article

Erythrocyte Phenotype Profiling in Repeat Blood Donors: A Cross-sectional Study in the Gbêkê Region, Côte d'Ivoire

M'boh Epi Reine Elisabeth N'gou^{1,*} , Konan Eugène Kouame¹,
Natacha Fleur Nenelou¹, Liliane Siransy^{1,2} , Saydou Kabore¹ ,
Bamory Dembele^{1,3} , Mamadou Yassongui Sekongo¹

¹National Blood Transfusion Center, Abidjan, Côte d'Ivoire

²Faculty of Medicine and Biomedical Sciences, Félix Houphouët-Boigny University (UFHB), Abidjan, Côte d'Ivoire

³Faculty of Pharmaceutical and Biological Sciences, Félix Houphouët-Boigny University (UFHB), Abidjan, Côte d'Ivoire

Abstract

The objective of this study was to catalogue clinically significant antigens of the Rh and Kell blood group systems among regular donors at the Regional Blood Transfusion Center (RBTC) of Bouaké. A total of 129 donors were included. ABO, Rh, and Kell typing were performed on samples collected from these donors using both slide and gel card methods. Among the donors, 120 (93.02%) were male and 9 (6.98%) female, aged between 19 and 58 years, with a mean age of 32.75 ± 7.9 years. The distribution of ABO phenotypes was as follows: O (49.6%, n = 64), A (17.1%, n = 22), B (27.1%, n = 35), and AB (6.2%, n = 8). Regarding the Rhesus (Rh) system, out of the 120 donors typed, 66 (51.2%) were RhD positive and 63 (48.8%) RhD negative. The most prevalent Rh antigens were c and e, each present in 99.2% of donors, followed by D (51.2%), C (17.1%), and E (10.3%). The observed Rh phenotypes were predominantly: ddccee (37.2%), Dccee (35.7%), ddCcee (11.6%), DccEe (8.5%), DCccee (4.6%), DccEE (1.6%), and DCCee (0.8%). The frequency of the Kell antigen (K) among these donors was 1.6%. The associated erythrocyte phenotypes were mainly O- cc dd ee K+ and O+ cc D Ee K+. The establishment of this erythrocyte phenotype database represents a valuable tool to enhance transfusion safety and reduce the risk of post-transfusion complications.

Keywords

Phenotype, ABO, Rh, Kell, Blood Donor

1. Introduction

The primary goal of transfusion therapy is to ensure the quality of blood products and transfusion safety by minimizing post-transfusion reactions and the transmission of infectious diseases [1].

The International Society of Blood Transfusion recognizes 47 blood group systems, comprising a total of 366 antigens [2]. Among these, the ABO system is the most clinically significant.

*Correspondence: M'boh Epi Reine Elisabeth N'gou (reinemboh@hotmail.com)

Received: 3 February 2026; Accepted: 12 February 2026; Published: 26 February 2026



Copyright: © The Author(s), 2026. Published by Science Publishing Group. This is an **Open Access** article, distributed under the terms of the Creative Commons Attribution 4.0 License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

cant, as it is responsible for acute hemolytic transfusion reactions in cases of ABO incompatibility.

The Rh system includes 55 protein antigens, five of which are of major clinical importance in transfusion medicine: D (RH1), C (RH2), E (RH3), c (RH4), and e (RH5) [3, 4]. The Kell system comprises 36 antigens; the k antigen is highly prevalent (98%) but can cause transfusion reactions in individuals who lack it, whereas the K antigen, although less common, is highly immunogenic [3, 5].

Antibodies against Rh (D, E, C, c, e) and Kell (K, k) antigens are the leading cause of alloimmunization related to blood transfusions and female reproduction. In Côte d'Ivoire, as in many other countries, most blood transfusions are performed based solely on ABO and RhD compatibility [6].

While this practice is approved, transfusions without full erythrocyte phenotyping carry an increased risk of alloimmunization, potentially leading to clinical complications, particularly in polytransfused patients whose survival depends on transfusion therapy [7].

In 2002, Daniels et al. estimated the overall incidence of transfusion-related alloimmunization between 2% and 10%, reaching up to 60% in polytransfused patients [8].

According to other authors, alloimmunization rates range from 1.4% to 4.24% in patients who have previously received blood transfusions [9]. These rates may reach 18.7% in patients with sickle cell disease [10], approximately 20% in thalassemic patients [11], and up to 44% in patients with malignant hematologic disorders [12].

Chou et al. reported even higher rates (8% to 76%) in polytransfused patients with sickle cell disease or thalassemia, resulting in ineffective transfusions [13].

Prevention of alloimmunization necessarily involves phenotyping both recipients and donors to ensure the broadest possible immunological compatibility for ABO, Rh, and Kell systems, thereby reducing alloimmunization incidence to 1 in 4,000 to 12,000 transfusions [14]. This also facilitates more efficient use of blood products, especially those with rare phenotypes.

In countries where phenotyping is mandatory, such as France since 2002, post-transfusion alloimmunization has become a rare complication [15].

Given the importance of establishing a database of erythrocyte phenotypes among regular donors, this study aims to catalogue clinically significant Rh and Kell antigens in donors attending the Regional Blood Transfusion Center (RBTC) of Bouaké

2. Materials and Methods

The study involved a population of 129 blood donors registered at the RBTC of Bouaké located in the North-Central region of Côte d'Ivoire, between June and July 2025. All included donors tested negative for Hepatitis B and C markers, Human Immunodeficiency Virus (HIV), and syphilis. This

population comprised both first-time donors and regular donors, defined as those who had donated at least twice within the past six months.

Blood samples were collected at the RBTC of Bouaké as well as during mobile blood drives in the surrounding region. Samples were drawn into tubes containing ethylenediaminetetraacetic acid (EDTA).

ABO and RhD grouping (Beth-Vincent and Simonin methods) was performed using the conventional slide technique. All analyses were carried out in duplicate to ensure result accuracy. In accordance with the standard operating procedure, monoclonal reagents were used: anti-A (lot: 867000), anti-B (lot: 867000), anti-A, B (lot: 852000), and anti-D IgM (lot: 856000). For donors initially typed as RhD negative, weak D antigen screening was performed using a gel card containing antiglobulin and monoclonal anti-D IgG antibodies (lot: 463000). Test red cells A1 and B (lot: 25502.01) were supplied by GRIFOLS.

Phenotyping of Rh and Kell system antigens was performed manually using gel cards (lot: 24008.01.1) following the manufacturer's instructions (GRIFOLS). Red blood cells from each donor sample were prepared as a 2% suspension. Gel card readings were carried out using the GRIFOLS gel card reader, following the manufacturer's instructions.

3. Results

The study included 129 blood donors, of whom 15 (11.63%) were first-time donors. Among these first-time donors, 12 (80%) were RhD negative. The remaining 114 donors (88.37%) were regular donors who had donated at least twice in the previous six months. Among these regular donors, 51 (44.7%) were RhD negative (Table 1).

Donors' ages ranged from 19 to 58 years, with a mean age of 32.75 ± 7.9 years. The majority of donors were male (120, representing 93.02%), while females constituted a minority (9, or 6.98%). The most represented age groups among donors were 25–34 years, followed by 35–44 years and 19–24 years (Table 2). All donors were of Black ethnicity.

The frequencies of erythrocyte phenotypes O, A, B, and AB were 49.6% ($n = 64$), 17.1% ($n = 22$), 27.1% ($n = 35$), and 6.2% ($n = 8$), respectively. The RhD antigen was present in 51.2% of donors ($n = 66$) and absent in 48.8% ($n = 63$). It was more prevalent among blood groups O and B, accounting for 23.3% and 17% of all RhD-positive (RH-1) donors, respectively. Only one donor (0.8%) exhibited a weak RhD antigen. The distribution of blood groups among the 129 donors is shown in Figure 1.

Among the five major Rh system antigens (D-RH1, C-RH2, c-RH4, E-RH3, e-RH5), the c and e antigens were the most frequent, each with a prevalence of 99.2%, followed by the D antigen at 51.2%. The E antigen was the least common, with a frequency of 10.3%. No donors expressed the C^w antigen (see Figure 2 and Table 3).

Overall, the most common Rh phenotype in the population

was ddccee (37.2%), followed by Dccee (35.7%) and ddCcee (11.6%). Among RhD-positive donors, the Dccee phenotype predominated (35.7%), while DCCee was the rarest (0.8%). In RhD-negative donors, only two phenotypes were observed, with ddccee being the most frequent (37.2%) (Table 4).

Regarding the Kell antigen, its frequency among 120 donors is presented in Figure 3. Only two donors (1.6%) expressed the K antigen on their erythrocytes. Their erythrocyte phenotypes were O- cc dd ee K⁺ and O+ cc D Ee K⁺, respectively.

The phenotypes cc Dee K-, cc DEe K-, Cc dd ee K-, and cc dd ee K- were found across blood groups A, B, AB, and O. The most common phenotype was cc dd ee K- (47 donors, 36.43%), followed by cc Dee K- (46 donors, 35.66%). The Cc Dee K- phenotype was present in groups B, AB, and O but absent in group A. The cc DEE K- phenotype was observed only in groups B and AB. Additionally, the phenotypes CCD ee K-, cc DEe K⁺, and cc dd ee K⁺ were exclusively found in blood group O (Table 5).

Table 1. Distribution of the number of blood donations according to Rhesus factor.

Number of blood donations	Rh D- n (%)	Rh D+ n (%)	Total n (%)
= 1	3 (2.33)	12 (9.30)	15 (11.63)
[2-3]	20 (15.5)	27 (20.93)	47 (36.43)
[4-8]	40 (31)	27 (20.93)	67 (51.94)
Total	63 (48.8)	66 (51.2)	129 (100)

Table 2. Distribution of blood donors: Age and gender.

Age (Years)	Sex		Total n (%)
	Male n (%)	Feminine n (%)	
[19-25]	27 (20.93)	4 (3.10)	31 (24.03)
[25-35]	46 (35.66)	2 (1.55)	48 (37.21)
[35-45]	36 (27.91)	1(0.77)	37 (28.68)
[45-55]	10 (7.75)	1(0.77)	11 (8.53)
[55-65]	1 (0.77)	1(0.77)	2 (1.55)

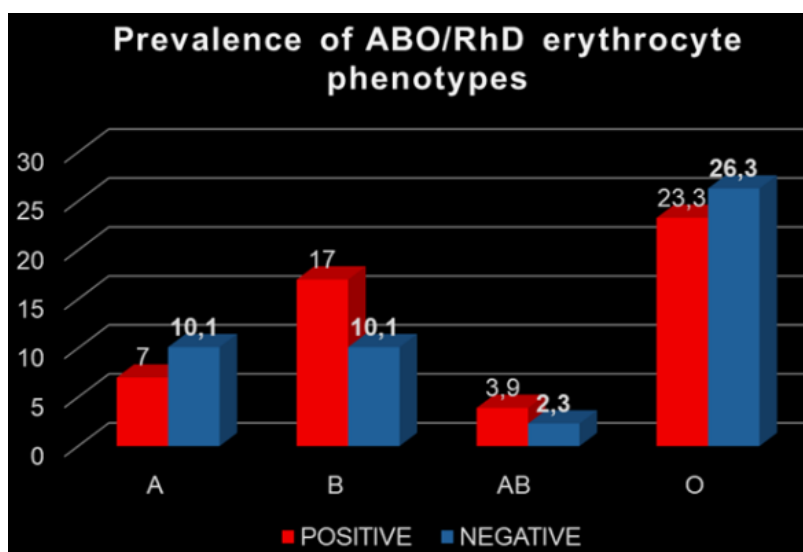


Figure 1. Frequency of ABO/RhD erythrocyte phenotypes.

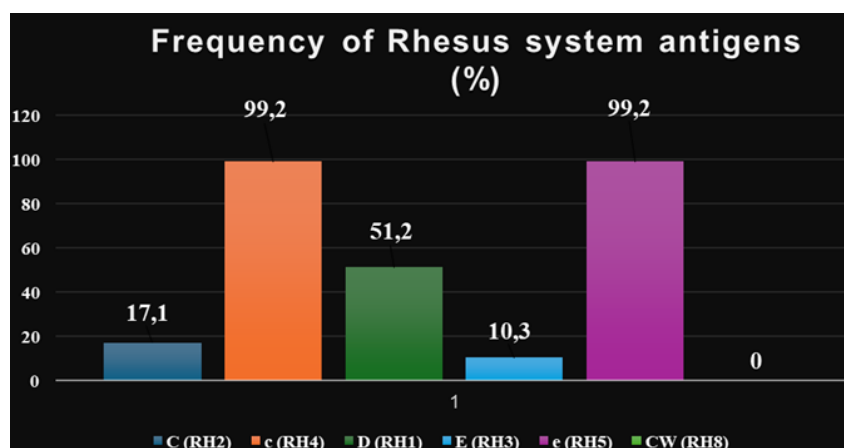


Figure 2. Frequency of Rh system antigens (%).

Table 3. Rh blood group antigen and Kell antigen prevalence in ABO blood groups (%).

ABO RH	A	B	AB	O
C	1.6	4.7	1.6	9.3
c	17.1	27.1	6.2	48.8
D	7	17.1	3.9	23.3
E	0.8	3.1	2.3	3.9
e	17.1	26.4	5.4	49.6
C ^w	0	0	0	0
K ⁺	0	0	0	1.6

Phenotype	Frequency (%)
DccEE	1.6
DccEe	8.5
ddCcee	11.6
ddccee	37.2

Table 4. Rh phenotype frequency.

Phenotype	Frequency (%)
DCCee	0.8
DCcee	4.6
Dccee	35.7

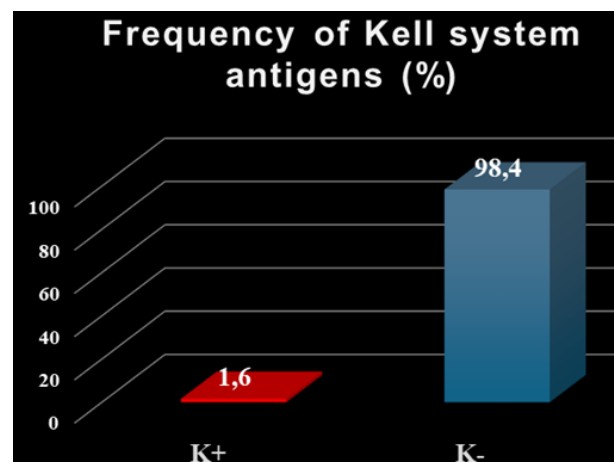


Figure 3. Frequency of Kell system antigens (%).

Table 5. Distribution of erythrocyte phenotypes in blood groups.

Phenotype	Blood groups				Total
	A n (%)	B n (%)	AB n (%)	O n (%)	
CC D ee K-	0	0	0	1 (0.77)	1 (0.77)
Cc D ee K-	0	3 (2.32)	1 (0.77)	2 (1.55)	6 (4.65)
cc D ee K-	8 (6.20)	15 (11.63)	1 (0.77)	22 (17.05)	46 (35.66)

Phenotype	Blood groups				Total
	A n (%)	B n (%)	AB n (%)	O n (%)	
cc D EE K-	0	1 (0.77)	1 (0.77)	0	2 (1.55)
cc D Ee K-	1 (0.77)	3 (2.32)	2 (1.55)	4 (3.10)	10 (7.75)
cc D Ee K+	0	0	0	1 (0.77)	1 (0.77)
cc dd ee K+	0	0	0	1 (0.77)	1 (0.77)
Cc dd ee K-	2 (1.55)	3 (2.32)	1 (0.77)	9 (6.98)	15 (11.63)
cc dd ee K-	11 (8.53)	10 (7.75)	2 (1.55)	24 (18.60)	47 (36.43)
Total	22 (17.05)	35 (27.13)	8 (6.20)	64 (49.61)	129 (100)

4. Discussion

Many studies have reported significant differences in the distribution of erythrocyte antigens across various populations. In our study, blood groups O and B were the most common, followed by A and AB. Similar predominance of groups O and B has been found in Guinea, Madagascar, and India in the studies by Loua et al., Randriamanantany *et al.*, and Chandra & Gupta, respectively [16-18]. However, some other studies report that groups O and A are the most common [19-23]. Generally in Black populations, the estimated frequency of blood groups is O (50 %), A (26 %), B (20 %), and AB (4 %) [24]. This discrepancy with our findings may be explained by the application of selection criteria, including negativity for hepatitis B and C markers, HIV, and syphilis, and regular blood donation.

In our study, the frequencies of the Rh system antigens D, C, c, E, and e are similar to those reported in other African studies, particularly in Côte d'Ivoire: Bogui et al. reported frequencies of e (99.8 %), c (99.8 %), D (92.9 %), C (21.9 %), and E (13.8 %) [25]. Comparable results were observed in Sudan, except for antigen D, with a reported frequency of 93 % [26].

In an India-based study, Baruah et al. [27] reported that the D antigen was the most prevalent (99.05 %), followed by e (97.14 %), C (92.38 %), c (51.43 %), and E (20.95 %).

The lower D frequency in our study may be due to a greater proportion of RhD-negative individuals among our donors. Indeed, the frequency of RhD negativity is typically estimated at about 5 % for Black Africans, 12-18 % for Caucasians, and under 3 % in Asian populations [28].

In Black populations in general, antigens c and e are almost universally present, with frequencies around 99 % and 98 % respectively; similar trends hold in White populations, though with somewhat lower c frequency (~80 %) [29, 30]. The D antigen is estimated at ~92 % in Blacks and ~85 % in Whites.

The antigen C is much less frequent in Blacks (~32 %) compared to Whites (~78 %) and Asians (~93 %). For E, frequencies are much lower in Blacks (~2 %), higher in Whites (~29 %), and higher still in Asians (~39 %) [29, 30].

Based on Rh antigen expression, the phenotypes observed in our study were: ddccee, Dccee, ddCcee, DccEe, DCcee, DccEE, DCCee,

In general Black populations, corresponding phenotype frequencies have been estimated at 7 %, 22.9 %, 1 %, 5.7 %, 8.8 %, 1.3 % and 2.9 % respectively. In White populations, these are quite different: approximately 15 %, 3 %, 1 %, 10.4 %, 31.1 %, 2 %, and 17.6 % [31].

The most common phenotypes reported in the study by Baruah et al. [27] were DCCee – 45.71 %, DCcee – 30.48 %, DCCeE – 11.43 %, DccEe – 4.76 %, DCCEE – 1.90 %, DCCee – 1.90 %, Dccee – 1.90 %, DCCee – 0.95 %, and ddccee – 0.95 %.

Notably, the phenotype ddccee, most common in our sample (37.2 %), was found in only 0.07 % of donors in a study in Northern India (26). Conversely, DCCee, which was very rare in our cohort (0.8 %), is among the most frequent Rh phenotypes in India (40.87 %) (27) [32].

For the Kell system, the antigen K was found in 1.6 % of donors, a rate similar to that reported by Garg et al. [31]. In Côte d'Ivoire, it had been previously estimated at 0.8 % [25]. In Black populations globally, the frequency of K is around 2 %, compared with about 8.8 % in White populations and up to 25 % in Arab populations [33]. The Kell phenotype K- k+ is most frequent: ~98 % in Africans, 91 % in Caucasians, and 100 % in Chinese populations [34].

We observed two cases combining RhD and Kell positivity in donors from blood group O (i.e., O RhD- K+ and O RhD+ K+). Given the immunogenicity of the K antigen, such donors are not suitable for K- recipients because the probability of anti-K antibody production is high, potentially causing post-transfusion reactions.

5. Conclusion

This study showed that among donors at the RBTC of Bouaké the prevalence order of ABO phenotypes is $O > B > A > AB$. Within the Rh system, antigens c and e were almost universally present, while antigen E was the least frequent. Among Rh phenotypes identified, ddcce was the most common and DCCee the rarest. The K antigen appeared on erythrocytes at a prevalence of 1.6 %, detected primarily among group O donors.

These findings emphasize the importance of erythrocyte antigen typing of blood donors, particularly for Rh and Kell systems, to ensure better matching of blood products according to clinical demand, and to prevent the immune system from producing alloantibodies when exposed to incompatible red cells.

Abbreviations

RBTC	Regional Blood Transfusion Center
Rh	Rhesus
HIV	Human Immunodeficiency Virus
EDTA	Ethylenediaminetetraacetic Acid

Author Contributions

M'boh Epi Reine Elisabeth N'gou: Conceptualization, Data curation, Formal analysis, Investigation, Writing – review & editing, Resources

Konan Eugène Kouame: Data curation, Methodology, Writing – review & editing

Natacha Fleur Nenelou: Data curation, Validation, Supervision

Liliane Siransy: Methodology, Supervision, Validation, Project administration

Saydou Kabore: Supervision, Project administration

Bamory Dembele: Supervision, Project administration

Mamadou Yassongui Sekongo: Resources, Supervision

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Booth C., Allard S., Robinson S. Blood transfusion. *Medecine*. 2025, 25(4), 246-252.
<https://doi.org/10.1016/j.mpm.2025.01.012>
- [2] Hyland A. C., Castilho L., Chen Q., Clausen B. F., Denomme A. G., Fichou Y., Flegel A. W., Floch A., Gleadall S. N., Hellberg A., Ji Y., Karamatic V. É., Keller M. A., Lane J. W., Lighthart C. P., Lomas-Francis C., Lopez H. G., Montemayor C., Nogués N., Ochoa G., Olsson L. M., Peyrard T., Srivastava K., Storry R. J., Tani Y., Thornton N., van der Schoot E., Végarienne S., Veldhuisen B., Wagner F. F., Weinstock C., Wendel S., Westhoff M. C., Yahalom V., Gassner C. International Society of Blood Transfusion Working Party on Red Cell Immunogenetics and Blood Group Terminology Report of Gothenburg, Barcelona and four virtual business meetings: Update on blood group systems. *Vox Sang.* 2026, 121(2), 202-212.
<https://doi.org/10.1111/vox.70148>
- [3] International Society of Blood Transfusion. Working Party for Red Cell Immunogenetics and Blood Group Terminology.
- [4] Cartron, J. P. and Agre, P. Rh Blood Group Antigens: Protein and Gene Structure. *Seminars in Hematology.*, (1993), 30, 193-208.
- [5] Kathryn E., Webert James W., Smith Donald M. Red Cell, Platelet, and White Cell Antigens Wintrobe's Clinical Hematology. (12th edtn.). Lippincott Williams & Wilkins, (2009) 22: 631-638.
- [6] Kulkarni S., Choudhary B., Harita Gogri H., Jayashree Sharma J., Madkaikar M. Red cell antigen phenotypes in blood donors & thalassaemia patients for creation of red cell antigen-matched inventory. *Indian J Med Res.* (2020), 152(3), 273-9.
https://doi.org/10.4103/ijmr.IJMR_1199_18
- [7] Yonli Y. D., N'fié K., Yacouba S., Kiba A., Sawadogo S., Sawadogo S. M., Traore Y. Alloimmunisation in polytransfused patients with non-phenotyped red blood cells at the University Hospital Sourou Sanou of Bobo Dioulasso (Burkina Faso). *Pan Afr Med J.* 2022, 24(41), 244.
<https://doi.org/10.11604/pamj.2022.41.244.30952>
- [8] Daniels G., Poole J., de Silva M. Callaghan T., MacLennan S., Smith N. The clinical significance of blood group antibodies. *Transfusion Med.* (2002) 12, 287-295.
<https://doi.org/10.1046/j.1365-3148.2002.00399.x>
- [9] Sood R., Makroo R. N., Riana V., Rosamma N. L. Detection of alloimmunization to ensure safer transfusion practice. *Asian J Transfus Sci.* 2013, 2(2), 135-9.
<https://doi.org/10.4103/0973-6247.115577>
- [10] Kangiwa U., Ibegbulam O., Ocheni S., Madu A., Mohammed N. Pattern and prevalence of alloimmunization in multiply transfused patients with sickle cell disease in Nigeria. *Biomark Res.* 2015, 3, 26 <http://dx.doi.org/10.1186/s40364-015-0050-3>
- [11] Chao Y. H., Wu K. H., Lu J. J., Shih M. C., Peng C. T., Chang C. W. Red blood cell alloimmunization among Chinese patients with β -thalassaemia major in Taiwan. *Blood Transfus.* 2013, 11, 71-74 <http://dx.doi.org/10.2450/2012.0153-11>
- [12] Guelsin G. A., Rodrigues C., Visentainer J. E., De Melo Campos P., Traina F., Gilli S. C. O., Saad O. T. S., Castilho L. Molecular matching for Rh and K reduces red blood cell alloimmunization in patients with myelodysplastic syndrome. *Blood Transfus.* 2015, 13, 53-58.
<http://dx.doi.org/10.2450/2014.0332-13>
- [13] Chou S. T., Liem R. I., Thompson A. A. Challenges of alloimmunization in patients with haemoglobinopathies. *Br J Haematol.* (2012) 159(4), 394-404.
<https://doi.org/10.1111/bjh.12061>

- [14] Klein H. G., Anstee D. J. Mollison's Blood Transfusion in Clinical Medicine. (2005) 11th edn. Oxford: Blackwell Science. <https://doi.org/10.1002/9780470986868>
- [15] Pachaury R., Arya D. R., Lai Mahawar N., Bharti A., Kumar Das P. Frequency of Rh Phenotypes in voluntary Blood Donors. *JMSCR* (2017), 05(07), 25083-8. <https://dx.doi.org/10.18535/jmscr/v5i7.129>
- [16] Loua, A., Lamah, M. R., Haba, N. Y. and Camara, M. Frequency of Blood Groups ABO and Rhesus D in the Guinean Population. *Transfusion Clinique et Biologique.*, (2007), 14, 435-439. <https://doi.org/10.1016/j.traccli.2007.12.008>
- [17] Randriamanantany Z. A., Rajaonatahina D. H., Razafimanantsoa F. E., Rasamindrakotroka M. T., Andriamahenina R., Rasoarilalamanarivo F. B. Hanitriniala S. P., Herisoa F. R., Rasamindrakotroka A., Rakoto Alson O. A. Phenotypic and Allelic Profile of ABO and Rhesus D Blood Group System among Blood Donor in Antananarivo. *International Journal of Immunogenetics* (2012), 39, 477-479. <https://doi.org/10.1111/j.1744-313x.2012.01120.x>
- [18] Chandra, T. and Gupta, A. Frequency of ABO and Rhesus Blood Groups in Blood Donors. *Asian Journal of Transfusion Science*. (2012) 6, 52-53. <https://doi.org/10.4103/0973-6247.95057>
- [19] Apecu, R. O., Mulogo, E. M., Bagenda, F. and Byamungu, A. ABO and Rhesus (D) Blood Group Distribution among Blood Donors in Rural South-Western Uganda: A Retrospective Study. *BMC Research Notes*. (2016), 9, 513. <https://doi.org/10.1186/s13104-016-2299-5>
- [20] Tesfaye, K., Petros, Y. and Andargie, M. Frequency Distribution of ABO and Rh (D) Blood Group Alleles in Silte Zone, Ethiopia. *Egyptian Journal of Medical Human Genetics.*, (2015) 16, (1), 71-76. <https://doi.org/10.1016/j.ejmhg.2014.09.002>
- [21] Ndoula, S. T., Noubiap, J. J. N., Nansseu, J. R. N. and Wonkam, A. Phenotypic and Allelic Distribution of the ABO and Rhesus (D) Blood Groups in the Cameroonian Population. *International Journal of Immunogenetics*. (2014), 41, 206-210. <https://doi.org/10.1111/iji.12114>
- [22] Said, N., Ben Ahmed, F., Doghri, A., Ghazouani, E., Layouni, S., Gritli, N. The ABO System Polymorphism in Tunisian Blood. *Transfusion Clinique et Biologique*. 2003, 10, 331-334. [https://doi.org/10.1016/s1246-7820\(03\)00100-9](https://doi.org/10.1016/s1246-7820(03)00100-9)
- [23] Bukasa H. K., Kabobo I. K., Tchoni S. M., Mposhi D. N., Nsomue G. K., Tshinkobo C. K., Kabiswe J. P., Ebondo P. K. Frequency of Erythrocyte Phenotypes in Blood Group Systems ABO and Rhesus at Moba, Province of Tanganyika, Democratic Republic of Congo. *Library Journal*. 2017, 4, e3421. <https://doi.org/10.4236/oalib.1103421>
- [24] Ristovska E., Bojadjeva T. M., Velkova E., Dimceva A. H., Todorovski B., Tashkovska M., Rastvorceva R. G. & Bosevski M. Rare blood groups in ABO, Rh, Kell systems –biological and clinical significance. *Sec. of Med. Sci.* 2022, 2, 1857-9345. <https://doi.org/10.2478/prilozi-2022-0021>
- [25] Bogui L. S., Dembele B., Sekongo Y., Abisse S., Konat éS., & Sombo M. Phenotypic Profile of Rh and Kell Blood Group Systems among Blood Donors in Cote d'Ivoire, West Africa. *Journal of Blood Transfusion*, 2014, 309817 <https://doi.org/10.1155/2014/309817>
- [26] Shahata W. M., Khalil H. B., Abass A-E., Adam I., Hussien S. M. Blood group and Rhesus antigens among blood donors attending central blood bank in Sudan. *Sudan JMS*. (2012), 7(4), 245–8. <https://doi.org/10.4314/sjms.v7i4>
- [27] Dipankar Baruah Gitali Devi, Jabin Musfique, Abhijit Bharali, Umesh Chandra Dutta. Distribution and frequency of principal Rh blood group antigens (D, C, c, E, and e) and their phenotypes in the blood donors attending blood bank in a tertiary care hospital in Barpeta district of Assam. *Asian J Transfus Sci*. 2022, 16(2), 167-174. https://doi.org/10.4103/ajts.AJTS_64_20
- [28] Daniels G. Human Blood Groups. Second ed. Blackwell Science. (2002) 295-324.
- [29] Dean L. Blood Groups and Red Cell Antigens. National Center for Biotechnology Information (US). (2005) Chapter 7 and Chapter 10.
- [30] Harmening Denise M. Modern blood banking and transfusion practices. 5th ed. Philadelphia: FA Davis Company. (2005) p. 163-90.
- [31] Garg N, Singh DK, Tomar R, Singh B. Phenotype Prevalence of Blood Group Systems (ABO, Rh, Kell) in Voluntary, Healthy Donors-Experience of a Tertiary Care Hospital in Delhi, North India. *J Blood Disord Transfus*. (2015), 6, 297. <https://doi.org/10.4172/2155-9864.1000297>
- [32] Kahar M. A. & Patel R. D. Phenotype frequencies of blood group systems (Rh, Kell, Kidd, Duffy, MNS, P, Lewis, and Lutheran) in blood donors of south Gujarat, India. *Asian J Transfus Sci*. (2014), 8(1), 51–55. <https://doi.org/10.4103/0973-6247.126693>
- [33] Reid M. E., Lomas-Francis C. The Blood Group Antigen Facts Book. Second ed. New York: Elsevier Academic Press. (2004). <https://doi.org/10.1016/B978-0-12-586585-2.X5000-8>
- [34] Makroo R. N., Bahtia A., Gupta R., Philip J. Prevalence of Rh, Duffy, Kell, Kidd & MNSs blood group antigens in the Indian blood donor population. *Indian J Med Res*. (2013), 137(3), 521–526.