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Assessing Abo and Kell Blood Group Phenotypes and Antigens in Donated Blood Units at University College Hospital, Ibadan, Nigeria

Yusuf Olawale Nurudeen [a], Christopher Igbeneghu [a*], Kikelomo Oluyemi Oyeleke [a] and Suleiman Adebayo Nassir [a]

[a] Department of Medical Laboratory Science, Facility of Basic Medical Science, College of Health Sciences, Ladoke Akintola University of Technology (LAUTECH), Ogbomoso, Nigeria.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The ABO blood group system is the most clinically recognized and routinely investigated blood group system in donated blood used for transfusions in Sub-Saharan Africa, due to its immunogenicity and the potential for antibodies against ABO antigens to cause the destruction of transfused red blood cells. However, research has shown that the unrecognized Kell antigen and its associated phenotypes also have potent immunogenic potential that could contribute to transfusion reactions. Therefore, this study aims to investigate the prevalence of ABO and Kell

**Corresponding author: E-mail: ciigbeneghu@lautech.edu.ng;*

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blood group antigens in 287 donated blood units at the University College Hospital in Ibadan, Nigeria.

Methods: A total of 287 blood units donated between February and November 2022 at the University College Hospital, Ibadan, were analyzed using standard serological techniques. Positive and negative controls for red blood cell antigens were included with each batch of samples to ensure accuracy. For each blood unit, 2 mL of blood was drawn into a plain container, and ABO and Kell blood grouping was carried out using the slide technique for direct agglutination of antigens with their corresponding antibodies and the tube method for the indirect antiglobulin test.

Results: Out of the 287 donated blood units, the distribution of ABO blood groups was as follows: A 62 (21.6%), B 46 (16.0%), AB 17 (5.9%), and O 162 (56.5%). The frequency of identified Kell blood group antigens was: K+ 17 (6.0%), K- 270 (94.0%); k+ 22 (7.7%), k- 265 (92.3%); Kpa+ 34 (11.9%), Kpa- 253 (88.1%); and Kpb+ 21 (7.3%), Kpb- 266 (92.7%). Distribution of Kell phenotypes was as follows: K+k- 80 (27.9%), K-k+ 95 (33.1%), K+k+ 77 (26.8%), K-k- 35 (12.2%); Kp (a+b+) 66 (23.0%), Kp (a+b-) 15 (5.2%), Kp (a-b+) 206 (72.0%), and Kp (a-b-) 0 (0%).

Conclusion: This study provides valuable data on the prevalence of Kell phenotypes and its blood group antigens in donated blood units at the University College Hospital, Ibadan. The findings call attention to the importance of considering these antigens, alongside the ABO system, as they may influence transfusion outcomes, in terms of immunogenicity and the risk of transfusion reactions.

Keywords: ABO blood group; kell blood group; kell phenotype; blood donation; hematology.

1. INTRODUCTION

A donation occurs when a healthy person voluntarily has blood drawn for transfusion or preparation of medication by fractionation (American Red Cross Biomedical Services, 2009). There is increasing awareness about the relationship between diseases (particularly transfusion transmissible infections) blood donation and transfusion. Blood can be obtained from many categories of individuals, which encompass compensated donors, family substitute donors, autologous donors, and volunteer donors. It is widely acknowledged that the most secure blood units are obtained from voluntary non-remunerated donors. This is achieved by ongoing efforts in raising awareness and educates communities, as well as organization of both indoor and outdoor blood donation campaigns. Many developed countries of the world have since relied on individuals who willingly and without any form of coercion or remuneration choose to donate their blood for medical purposes to meet the transfusion requirement of their health services (Bloch *et al.,* 2020). The central goal of blood banks is to guarantee timely provision of safe and suitable units of blood or blood components to patients. However, the attainment of this goal may provide challenges in situations where individuals have been identified with alloantibodies, yet there is a lack of available donor within the immediate vicinity (Khojah *et al*., 2021). Storry *et al*. (2019) reported that the International Society of Blood Transfusion has officially acknowledged a comprehensive count of 346 blood group antigens. A total of 308 antigens have been classified and assigned to 36 separate blood group systems. The remaining 38 antigens have been categorised to three groups: high-frequency series (901), low-frequency series (700), and collection series (200).

Blood transfusion reaction refers to an undesirable, unintended, unfavourable response that arises subsequent to the infusion of blood and blood products, leading to substantial patient discomfort and imposing additional financial burden on the healthcare system (Jones *et al*., 2020). The discovery and characterization of the A and B blood group antigens was a notable achievement in the discipline of blood group serology, which underwent tremendous advancements and progress during the 20th century. As a result, International Society of Blood Transfusion currently acknowledges a total of 302 blood group antigens, the majority of which are categorised within one of 29 distinct blood group systems (Elizabeth and Beryl 2018). According to Obeta *et al.* (2020), there is a possibility for the clinical significance of antibodies targeting a considerable number of these 302 antigens. The determination of ABO blood types is facilitated by the existence of glycosyltransferase on chromosome 9 (9q34.1), which is located on red blood cells surface and is bound to a protein backbone referred to as H antigen. The assortment of alleles that is passed down from parents is responsible for determining the specific glycoproteins, also known as antigens, present on an individual's blood cells. The aforementioned research done by Romanos-Siraki *et al*. (2022) demonstrates that a straightforward examination can be employed to ascertain the existence or nonexistence of antigen A or antigen B in bloodstream, hence enabling the determination of a person's ABO blood type. The Rhesus blood group system incorporates a total of 54 antigens, with the D antigen being recognised as the most significant in clinical settings within this system (Etim *et al*., 2017). The involvement of Rh antigens (C, c, E, e) in the alloimmunization of recipient red cells has been observed, with a particular emphasis on the impact of RhC and E antigens (Etura *et al*., 2020). The research by Adewoyin *et al*. (2018) provides insights into the immunogenicity and clinical importance of Rh antigens. It highlights the elevated risk of alloantibody production and the potential of these antibodies to induce significant in vivo hemolysis of the recipient's erythrocytes.

The Kell blood group system bears considerable significance within the realm of transfusion medicine, being second in importance only to the Rh system. The high immunogenicity of specific Kell antigens is responsible for the occurrence of severe transfusion reactions in instances of mismatched blood transfusions. Moreover, the presence of Kell antibodies in feto-maternal incompatible pregnancies might give rise to foetal anaemia (Swelem *et al*., 2018).The Kell blood group system has a comprehensive collection of 35 antigens, encompassing six discrete groups of antigens, namely K, k, Kpa, Kpb, Jsa, and Jsb. These sets of antigens exhibit antithetical interactions, as documented by Alghamdi, (2021) The ABO and Rhesus blood type systems are of great clinical importance in the context of both haemolytic sickness of the foetus and new born (HDFN) and haemolytic transfusion reactions (HTR). The mortality rate associated with blood transfusion was significantly elevated prior to the identification of ABO and other rare blood groups, as there was a lack of understanding regarding the variations in blood composition among the human population. Prevalence of ABO blood and Rh D antigen has been well documented among the donors in several places. Despite the potential for transfusion reactions arising from mismatched ABO and Kell antigens, there is a lack of reported data on the prevalence of these antigens in Nigeria. This gap in knowledge highlights the need for research on the prevalence of ABO and Kell blood group antigens at the University College Hospital, Ibadan, Oyo State, Nigeria.

2. MATERIALS AND METHODS

2.1 Study Sample and Sample Techniques

A total of 287 units of donated blood, obtained from the University College Hospital, Ibadan, Nigeria from February to November, 2022, were recruited for this study. Inclusion criteria included all donated blood units which passed prescreening and transfusion transmissible infection test. The sample size was calculated based on the lowest nonzero prevalence of a phenotype in a geographically close region and at a 95% confidence level and margin of error of 1.25%. In total, 287 blood samples from blood donors were used in the study, which was adequate to draw conclusions on distribution of Kell antigens.

A convenient sampling technique was adopted for this study. The units of donated blood were analyzed for the presence of Kell, and ABO antigens.

2.2 Sample Collection

From each donated blood unit, 2ml of blood were collected into a plain container. Direct agglutination of the antigens was performed using the slide technique, while the indirect antiglobulin test was conducted by the tube method for both the ABO and Kell blood group antigens. Additionally, the Kell phenotypes were determined based on the antigenic profile.

2.3 Chemicals

Anti-A, -B, -AB, and -D monoclonal antisera from Atlas Medical, UK, Anti –Kell, – kell, – kpa, –kpb, Rapid Labs Limited, UK. Standard cell-A and –B freshly prepared, Normal saline.

2.4 Equipment

Hand gloves, plain sample bottle, water bath, centrifuge, pipette, Cotton wool, glass slide, toilet roll, test tube, tile, detergent and disinfectant.

2.5 Laboratory Procedures

2.5.1 Tile agglutination technique

A 5% cell suspension of the sample (donated blood unit) was prepared in isotonic solution (normal saline) by adding 5ml of blood into 95ml of normal saline. 0.2mL of Rapid Labs Monoclonal Typing reagent was placed on a clean white tile. 0.1mL of suspended sample (donated blood unit) was placed next to the reagent on the tile. The reagent and sample were mixed over an area of approximately 20mm in diameter, with gentle and continuous rocking. The resulting reaction was read macroscopically and microscopically for detection of agglutination. All results were read after 2 minutes (Makroo *et al*., 2018).

2.5.2 Tube agglutination technique

For tube agglutination technique, 0.1mL of sample (donated blood unit) was introduced into a labeled khan tube. A 3% cell suspension of the sample was prepared in isotonic solution (normal saline) by adding 3ml of blood into 97ml of normal saline. Also, 0.1mL of Rapid Labs Monoclonal Typing reagent and 0.1mL of sample suspension were introduced into a clean labeled khan tube. The contents were mixed well and centrifuged at 1000 revolution for 20 seconds. Thereafter, the tube was agitated gently to dislodge the sample and examined macroscopically and microscopically for detection of agglutination. All tubes which showed weakly positive reaction were incubated at 37^{o}C for 5 minutes, mixed properly and centrifuged at 1000 revolution for another 20 seconds and re-examined macroscopically as well as microscopically for signs of agglutination to rule out false negatives (Etura *et al.,* 2020)

ABO and K antigen typing was carried out using the conventional tube agglutination method and commercially sourced antisera according to the manufacturer's instructions (Lorne Laboratories, Reading, UK). Each batch of tests was accompanied with control samples. Positive control cells were RBCs with single-dose antigen expression (i.e., C+c+ or E+e+). Negative control cells were RBCs that lacked the target antigens. All serologic reactions were carried out at optimal temperature (the temperature of the water bath was quality controlled with an external, calibrated thermometer)

2.6 Statistical Analysis

All the data was analysed using the statistical package for Social Science (SPSS) version 28 and the results were presented in percentages.

3. RESULTS

Between February and November, 2022, 287 healthy individuals were recruited from the University College Hospital, Ibadan, Nigeria for the study of ABO, Kell and Kell Blood Phenotype among donated blood units at University College Hospital, Ibadan Nigeria.

Table 1 shows the frequency of Kell antigens, which there were K- 186 (64.8%) male donors, as majority of Kell antigens according to gender, followed by Kp^{b-} 171 (59.6%), k− 169 (58.9%), Kp^{a+} 20 (7.0%), k+ 17 (5.9%), Kp^{b+} 15 (5.2%), and K+ 12 (4.2%) donors. For the female donors who participated in this study, k- had 96 (33.5%), Kp^{b-} 95 (33.1%), Kp^{a-} 87(30.3%), K-84(29.3), Kp^{a+} 14(4.9%), Kp^{b+} 6(2.1%) with K+ and k+ both having 5(1.74%).

This study found that there were high-frequency antigens for the Kell blood group including K− 270(94.0%), Kp^{b-} 266(92.7%), k− 265(92.3%), and Kp^{a-} 253(88.1%). It also showed that the antigens with the lowest frequency were K+ 17(6.0%), Kp^{b+} 21(7.3%), k+22(7.7%) and Kp^{a+} 34(11.9%) (Table 1).

As shown in Table 1, six Kell phenotypes were found to be present in participated donors. This study indicates that the most common Kell phenotype among donors being $Kp^{(a-b+)}$ 221(77.0%), followed by K− K+95(33.1%), K+K-80(27.9%), K+K+77(26.8%), $Kp^{(a+b+)}$ 66(23.0%), and K-K-35(12.2%) was the rarest phenotype observed. Two phenotypes, $Kp^{(a+b-)}$ and $Kp^{(a-b-)}$ were not observed among blood donors. Furthermore, Table 1 shows $Kp^{(a-b+)}$ 138 (48.1%) for the males, to be the most common Kell phenotype according to the gender among blood donors participating in this study. The least common phenotypes were K+K+63 (22.0%), K-K+60(20.9%), K+K -50(17.4%), $Kp^{(a+b+)}$ 48(16.7%), and K-K-35(12.2%). For the female donors, $Kp^{(a-b+)}$ 83(28.9%) was the most prominent, followed by K-K+35(12.2%), K+K-30(10,5%), $Kp^{(a+b+)}$ 18(6.3%) and. K+K+14 (4.9%).

Table 2 revealed that the k- antigen was the most common among individuals with the O blood group 158(55.1%), followed by K-154(53.7%), Kp^{b-} 152(52.9%), and Kp^{a-} 142(49.4%). The A blood group also had a relatively high frequency of K- 88(30.7%), k-61(21.3%), Kp^{b-} 57 (19.9%), Kp^{a-} 54(18.8%), k+ and Kp^{a+} 8(2.8%), K+ 6(2.1%), and Kp^{b+}5(1.7%), while the B and AB blood groups had lower frequencies of these antigens. The Kp^{a+} and Kp^{b+} antigens were generally less frequent across all blood groups.

Additionally, the frequency of Kell blood group antigens differed between males and females. Among males, the most common phenotype was $Kp^{(a-b+)}$ 138(48.1%), followed by K+K+ 63(22%), K-K+ 60(20.9%), K+K-50(17.4%), K $p^{(a+b+)}$ 48(16.7%), and K- K - 35(12.5%). In females, the most common phenotype was $Kp^{(a-b+)}$ 83(28.9%), followed by K-K+ 35(12.2%), K+ K- 30(10.5%), $Kp^{(a+b+)}$ 18(6.3%), and K+k+ 14(4.9%). The $Kp^{(a+b-)}$ and $Kp^{(a-b-)}$ phenotypes were not observed in all gender.

Table 1. Frequency of Kell antigens and phenotypes among donors

	Frequency	GENDER Male, n(%)	Female n(%)
Antigens			
K+	17(6.0)	12(4.2)	5(1.7)
K-	270(94.0)	186(64.8)	84(29.3)
k+	22(7.7)	17(5.9)	5(1.7)
k-	265(92.3)	169(58.9)	96(33.5)
Kp^{a+}	34(11.9)	20(7.0)	14(4.9)
Kp^{a-}	253(88.1)	166(57.8)	87(30.3)
Kp^{b+}	21(7.3)	15(5.2)	6(2.1)
Kp^{b-}	266(92.7)	171(59.6)	95(33.1)
Phenotypes			
K+ k-	80(27.9)	50(17.4)	30(10.5)
K- k+	95(33.1)	60(20.9)	35(12.2)
K+ K+	77(26.8)	63(22.0)	14(4.9)
K- K-	35(12.2)	35(12.2)	0
$Kp^{(a+b+)}$	66(23.0)	48(16.7)	18(6.3)
$Kp^{(a+b-)}$	0	0	0
$Kp^{(a-b+)}$	221(77.0) `	138(48.1)	83(28.9)
$Kp^{(a-b-)}$	0	0	0

Table 2. Frequency of kell blood group antigens in different blood groups

	Frequency	ABO A (%)	B (%)	AB (%)	O (%)
Antigens					
K+	17(6.0)	6(2.1)	2(0.9)	1(0.4)	8(2.8)
K-	270(94.0)	88(30.7)	24(8.4)	4(1.3)	154(53.7)
k+	22(7.7)	8(2.8)	0.0	0.0	14(4.9)
k-	265(92.3)	61(21.3)	29(10.1)	17(5.9)	158(55.1)
Kp^{a+}	34(11.9)	8(2.8)	5(1.7)	1(0.4)	20(6.9)
Kp^{a-}	253(88.1)	54(18.8)	41(14.3)	16(5.6)	142(49.5)
Kp^{b+}	21(7.3)	5(1.7)	6(2.1)	0(0.0)	10(3.5)
Kp^{b-}	266(92.7)	57(19.9)	40(13.9)	17(5.9)	152(52.9)
Phenotypes					
K+K-	80(27.9)	4(1.4)	1(0.4)	0	75(26.1)
K-K+	95 (33.1)	25(8.7)	26(9.1)	0	44(15.3)
K+K+	77 (26.8)	8(2.8)	8(2.8)	15(5.2)	46(16.0)
K-K-	35(12.2)	3(1.0)	0	2(0.7)	30(10.5)
$Kp^{(a+b+)}$	66 (23.0)	20(7.0)	12(4.2)	0	34(11.9)
$Kp^{(a+b-)15}$	15(5.2)	7(2.4)	0	0	8(2.8)
$Kp^{(a-b+)}$	206 (72.0) `	48(16.7)	34(11.8)	17(5.9)	107(37.3)
$Kp^{(a-b-)}$	0	0	0	0	0

Furthermore, there were variations in antigen frequencies among different ABO blood groups. In the A blood group, the most common phenotype was $Kp^{(a-b+)}$ 48(16.7%), follow by K- K + 25(8.7%), $Kp^{(a+b+)}$ 20(7.0%), K+K+ 8(2.8%), $Kp^{(a+b-)}$ 7(2.4%), K+K- 4(1.4%), and K-K- 3(1.0%). In the B blood group, the most common phenotype was $Kp^{(a-b+)}$ 34(11.8%), followed by K-K+ 26(9.1%), $Kp^{(a+b+)}$ 12(4.2%), K+K+ 8(2.8%) and K+K- 1(0.4%). In the AB blood group, the most common phenotype was $Kp^{(a-b+)}$ 17(5.9%) followed by K+K+15(5.2%), and K-K- 2(0.7%). In the O blood group, the most common phenotype was $Kp^{(a-b+)}$ 107(37.3%), followed by K+K- 75(26.1%), K+K+ 46(16%), K-K+ 44(15.3%), $Kp^{(a+b+)}$ 34(11.9%) and K-K-30(10.5%).

4. DISCUSSION

This study contributes significantly to the knowledge of the prevalence of ABO and Kell blood group antigens in a cohort of healthy blood donors at the University College Hospital, Ibadan, Nigeria. The results have shown a high predominance of Kell antigens: K− 94.0%, Kpb− 92.7%, k− 92.3%, and Kpa− 88.1%. The detected frequencies are meaningful and in agreement with previous studies conducted on diverse populations; this again highlights the importance of regional studies to extend the knowledge of blood group distribution. In comparison, our results resemble the work of Gopal *et al.,* (2022), who reported a high prevalence of negativity of the Kell antigen in population of Pondicherry India, reflecting the geographical and ethnic factors that may influence antigen frequencies. This further emphasizes the need for localized information since practices of blood transfusion and the management of hemolytic disease of the newborn are greatly affected by these frequencies. Moreover, gender-associated differences in antigen frequencies were observed, and the most common antigens were K− (64.8%) and Kpb− (59.6%) among the male donors. Such a balance of gender has also been identified in the work by Mahapatra *et al.,* (2023), where it was established that men have higher prevalence in certain blood group antigens compared to females. This observation necessitates additional exploration into the biological or sociocultural elements that may account for these disparities. Notably, our research also revealed a considerably reduced prevalence of positive Kell antigens, including K+ (6.0%) and Kpa+ (11.9%). This result aligns with earlier findings from African populations, which frequently display lower rates of Kell positive phenotypes (Osaro *et al.,* 2015). The ramifications of these results hold significant importance for the field of transfusion medicine, especially regarding compatibility and the potential for alloimmunization, which poses a concern for both patients and blood banks. The high frequency of K− antigens in our population would mean a relatively lower risk of anti-Kell alloimmunization in patients who are potential candidates for blood transfusions, thus supporting the assertion made by Davis *et al.* (2012) that local knowledge of antigen prevalence remains a key issue in the prevention of transfusion complications. However, the presence of other rare blood phenotypes calls for comprehensive screening and genotyping of blood donors to ensure compatibility with recipients and avoid adverse transfusion reactions.

The prevalence of Kp(a-b+) phenotype, which is 72.0% among the donors, shows a high trend-a finding that is in agreement with the results from previous studies. Indeed, past studies by (Anstee, 2010), and (Kahar and Patel, 2014) have also reported relatively high frequencies of Kp(a-b+) among various populations, indicating its wide prevalence. Gender variation of the Kell phenotype may further our understanding of the distribution of antigens. From the samples collected, male donors had a higher percentage of Kp(a-b+) 42.9% compared to the female gender, which was 28.9%. This agrees with previous work done by Wapukha *et al.* (2023), who suggested that antigens may vary depending on gender due to various biological determinants or different immunological reactions, and this difference might be important when assessing transfusion policies as this may affect the likelihood of alloimmunization. The investigation also identified the rare phenotype K- K- at 12.2%, as well as the absence of the Kp(a+b-) and Kp(a-b-) phenotypes in the sample population. The rarity of some phenotypes in our group confirms observations by Osaro *et al.,* (2015), who identified that some combinations of Kell antigens are relatively rare in African populations. This therefore brings to light important implications for practices surrounding blood banking since the poor diversity of some of the phenotypes may bring about difficulties in achieving compatibility between donors and recipients, particularly in patients requiring multiple transfusions or who are at risk of hemolytic disease. Furthermore, our results point out that among the donors tested, the phenotypes K+ K+ (26.8%) and K+ K- (27.9%) are relatively frequent in this population. The results obtained are supported by the work of Pahuja *et al.* (2020), who identified comparable frequencies within a varied cohort, implying that particular combinations of Kell antigens may have a higher occurrence in distinct geographical areas. This information is essential for healthcare professionals and blood transfusion services as it aids in forecasting the probability of facing specific antigen profiles throughout transfusion procedures. Furthermore, the consequences of our results are pertinent to transfusion medicine, wherein comprehending the frequencies of local blood group antigens is essential for mitigating the risks linked to blood transfusions. As emphasized by (Aneke and Okocha, 2017), awareness of the distribution of local antigens can facilitate the formulation of effective transfusion protocols, thus diminishing the likelihood of negative reactions.

The findings presented in Table 2 explain the distribution of Kell blood group antigens among different ABO blood groups and by gender, revealing interesting trends that enhance our understanding of blood group antigen variation. The prevalence of the k- antigen among those classified as having O blood group status (55.1%) corroborates previous findings from Daniels and Bromilowo, (2011) indicating a high prevalence of k- antigens across populations. This suggests a potential evolutionary advantage or selective pressure in the favor of this antigen in O blood types, often considered universal donors. More significantly, the low prevalence rates of Kpa+ and Kpb+ antigens in all blood groups are consistent with the findings of Felimban and Sumeda, (2021), who reported similarly small prevalence rates in their study. This might indicate a consistent trend across demographic groups and, therefore, further research on the genetic and environmental determinants of such distributions of antigens is of utmost importance. The noted sexual dimorphism in antigen prevalence is indeed a big opening that beckons an in-depth inquiry. The increased occurrence of the K+K- phenotype in males (17.4%) relative to females, where Kp(a-b+) is more prevalent (28.9%), reflects the results from Akiyama *et al.* (2018), which proposed that biological differences between sexes might affect immune responses and, as a result, the expression of antigens. This variance may indicate potential hormonal influences or genetic components that deserve further investigation. Additionally, differences in antigen frequencies within each ABO blood group illustrate the complexity of blood grouping and transfusion medicine. K- K+ phenotype in the B blood group at a frequency of 9.1% and Kp(a-b+) occurred at a rate of 37.3% in the O blood group. This agreed with observations by Zimring *et al.* (2017). They added that the mentioned antigen distribution is crucial to be known since this would ensure transfusion compatibility and, consequently, minimize the risks of hemolytic transfusion reactions.

5. CONCLUSION

This study significantly enhances our understanding of the distribution of ABO and Kell blood group antigens in a population of healthy blood donors at the University College Hospital, Ibadan, Nigeria. The high frequency of Kell antigens, particularly K−, Kpb−, k−, and Kpa−, aligns with previous research, emphasizing the importance of regional studies in assessing blood group variations. Notably, the observed gender differences, such as the higher incidence of K− and Kpb− among male donors, warrant further investigation into potential biological or sociocultural factors. The rarity of certain phenotypes, such as K− K− and the absence of Kp(a+b-) and Kp(a-b-) phenotypes, raises important considerations for blood banking practices and transfusion strategies. Furthermore, the high frequency of Kp(a-b+) underscores the need for population-specific data to inform transfusion protocols and reduce the risk of alloimmunization. These findings highlight the importance of comprehensive screening for Kell phenotypes and blood group antigens alongside the ABO system in blood donation processes as they may influence transfusion outcomes, in terms of immunogenicity and the risk of transfusion reactions.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

CONSENT

As per international standards or university standards, respondents' written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

Ethical clearance was obtained from the Joint Ethical committee of the College of Medicine, University of Ibadan and the University College Hospital, Ibadan prior to the commencement of the study and it was assigned the number UI/EC/21/0630.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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