

Original Research Article

DUFFY BLOOD GROUP DISTRIBUTION AMONG PATIENTS IN A MALARIA ENDEMIC REGION.

Abstract:

Background: It was noted since in the 1920s that Black Africans had some intrinsic resistance to infection with malaria. Duffy negative status is suggested to play a role in resistance to malaria infection and has been reported with higher frequencies in countries where there is a high incidence of *Plasmodium vivax* malaria. We carried out this study to find out the distribution of Duffy blood group among patients in a tertiary hospital.

Study design: two hundred and twenty nine hospitalized patients requiring a red cell transfusion with age range of between 1 year and 75 years and mean age of 27.3 years, were recruited for the study.

Materials and Method: Three milliliters of whole blood was collected from each subject into an EDTA anticoagulated tubes. The red cell was typed for Duffy antigen using potent antisera from Lorne Laboratory UK

Results: This study reported that 19.2% were Duffy positive (Fya+b-, Fya-b+ and Fya+b+ with respective prevalence of 7.4%, 4.4% and 7.4%) while 80.8% (61.1% Females and 19.7% Males) of the patients were Duffy negative (Fy a-b-). The prevalence of Duffy negative was highest among age group 21-30 with 26.2%, followed by age group 31-40 with 17.5% and the least was age group 41 – 50 years with 3.5%. The prevalence of Duffy negative among the three ethnic groups of Hausa, Igbo and Yoruba was 78.6%, 0.9% and 1.3% respectively.

Conclusion: The study concluded that the distribution of Duffy negative (Fya-b-) in the study area was high.

25 **Key words:** Duffy, Blood group, Distribution, Malaria, Sokoto, Nigeria.

26 **Introduction:**

27 The Duffy antigen is located on the surface of red blood cells and is named after the patient in
 28 which it was discovered. The protein encoded by this gene is a glycosylated membrane
 29 protein and a non-specific receptor for several chemokines. The Duffy antigen receptor gene
 30 (gp-Fy; CD234) is located on the long arm of chromosome 1 (1.q22-1.q23) and was cloned in
 31 1993.⁽¹⁾ The protein is also the receptor for the human malarial parasites *Plasmodium vivax*
 32 and *Plasmodium knowlesi*.⁽²⁾ In areas of West Africa, there is a high frequency of the Fy (a-
 33 b-) phenotype. This has prevented *P. vivax* malaria from becoming endemic in West Africa.⁽³⁾
 34 It was noted in the 1920s that Black Africans had some intrinsic resistance to infection with
 35 malaria but the basis for this was then unknown, however, Duffy negative status is suggested
 36 to play a role in resistance to malaria infection⁽⁴⁾ and has been reported with higher
 37 frequencies in countries where there is a high incidence of *Plasmodium vivax* malaria.⁽⁵⁾ On
 38 erythrocytes, the Duffy antigen acts as a receptor for invasion by the human malaria parasites
 39 *P. vivax* and *P. knowlesi*. Duffy negative individuals whose erythrocytes do not express the
 40 receptor are believed to be resistant to merozoite invasion, although *P. vivax* infection has
 41 been reported in Duffy negative children in Kenya, Madagascan people, Angola and
 42 Equatorial Guinea, suggesting a role in resistance to disease, not infection.^(6,4,5) The Duffy
 43 antigen gene was the fourth gene associated with the resistance after the genes responsible for
 44 sickle cell anaemia, thalassemia and glucose-6-phosphate dehydrogenase.⁽⁷⁾ In 1950 the
 45 Duffy antigen was discovered in a multiply transfused haemophiliac whose serum contained
 46 the first example of anti-Fya antibody.⁽⁷⁾ In 1951 the antibody to a second antigen, Fyb, was
 47 discovered in serum. Using these two antibodies three common phenotypes were defined: Fy
 48 (a+b+), Fy (a+b-), and Fy (a-b+).⁽⁷⁾

There exist differences in the racial distribution of the Duffy antigens, it was found that the overwhelming majority of Blacks had the erythrocyte phenotype Fy(a-b-), 68% in African Americans⁽⁴⁾ and 88-100% in African Blacks (including more than 90% of West African Blacks). This phenotype is exceedingly rare in whites. The presence of this antigen has been used to detect genetic admixture. Overall the frequencies of Fya and Fyb antigens in Caucasians are 66% and 83% respectively, in Asians 99% and 18.5% respectively and in Blacks 10% and 23% respectively. The frequency of Fy3 is 100% Caucasians, 99.9% Asians and 32% Blacks. Phenotype frequencies are: Fy(a+b+): 49% Caucasians, 1% Blacks, 9% Chinese; Fy(a-b+): 34% Caucasians, 22% Blacks, <1% Chinese; Fy (a+b-): 17% Caucasians, 9% Blacks, 91% Chinese.^(4,5,6) A Duffy negative blood recipient may have a transfusion reaction if the donor is Duffy positive. Since most Duffy-negative people are of African descent, blood donations from people of Black African origin are important to transfusion banks. There is no information regarding the distribution of Duffy blood group in most of the African countries including Nigeria especially in Sokoto, Northwestern Nigeria. We intend to find the distribution of the Duffy antigens among hospitalized patients requiring a red cell transfusion in a tertiary hospital in malaria endemic region.

Study design and study site:

The study was a cross-sectional descriptive study to find the effect of transfusion on the development of alloantibodies among 229 consecutively- recruited patients from a tertiary hospital in Sokoto Nigeria. Sokoto is the capital city of Sokoto state. Sokoto State is located in the extreme Northwest of Nigeria, near to the confluence of the Sokoto River and the Rima River. With an annual average temperature of 28.3 °C (82.9 °F), Sokoto is, on the whole, a very hot area. Report from the 2007 National Population Commission indicated that the state had a population of 3.6 million.⁽⁸⁾ The two major languages in the state is Hausa and Fulfulde

73 which is spoken among the Fulani. The main occupation of the people is grain production and
74 animal husbandry.

75 **Materials and Method:**

76 Three milliliters of whole blood was collected from each subject into an EDTA
77 anticoagulated tubes. The red cell was collected and typed for Duffy antigen using potent
78 antisera from Lorne Laboratory UK.

79 **Selection criteria:**

80 Ethical clearance was obtained from the ethical committee of the Specialist hospitals, Sokoto.
81 While written informed consent was sought from all participants in this study. All consenting
82 patients in whom a red cell transfusion was indicated were eligible for recruitment into the
83 study. All non- consenting patients were all excluded in this study.

84 **Data analysis:**

85 The sociodemographic information was collected using a pre-validated structured
86 questionnaire administered to the patients. The data obtained were presented in tabular forms
87 and was analyzed using statistical software (SPSS version 20).

88 **Result:**

89 Table 1 below showed that 19.2% were Duffy positive (Fya+b-, Fya-b+ and Fya+b+ with
90 respective prevalence of 7.4%, 4.4% and 7.4%) while 80.8% (61.1% Females and 19.7%
91 Males) of the patients studied were Duffy negative (Fy a-b-). In table 2, the prevalence of
92 Duffy negative was found to be highest among ages 21-30 with 26.2%, followed by ages 31-
93 40 with 17.5%. Table 3 showed the prevalence of Duffy negative among three ethnic groups
94 of Hausa, Igbo and Yoruba as 78.6%, 0.9% and 1.3% respectively. The proportions of Duffy
95 positive and negative within the various ethnic groups was calculated as; 19.3% Duffy
96 positive and 80.7% Duffy negative among the Hausa/Fulani ethnic group , 0.0% Duffy

97 positive and 100% Duffy negative among the Igbo ethnic group and 23.5% Duffy positive
98 and 76.5% Duffy negative among the Yoruba ethnic group.

99 **Table 1. Distribution of Duffy phenotype of the patients based on gender.**

Gender	Duffy phenotype				Total
	Fya-b-	Fya+b-	Fya-b+	Fya+b+	
Male	19.7%	1.7%	0.9%	1.7%	24.0%
Female	61.1%	5.7%	3.5%	5.7%	76.0%
Total	80.8%	7.4%	4.4%	7.4%	100.0%

100 The above table showed that 80.8% (61.1% Females and 19.7% Males) of the patients
101 studied were Duffy negative (Fy a-b-), while 19.2% were Duffy positive (Fya+b-, Fya-b+ and
102 Fya+b+ with respective prevalence of 7.4%, 4.4% and 7.4%).

104 **Table 2. Distribution of Duffy phenotype among the patients based on age groups.**

Age groups	Duffy phenotype				Total
	Fy (a-b-)	Fy (a+b-)	Fy (a-b+)	Fy (a+b+)	
< 10	13.5%	0.4%	0.4%	0.9%	15.3%
11 - 20	13.5%	1.3%	0.4%	2.2%	17.5%
21 - 30	26.2%	3.1%	2.2%	2.6%	34.1%
31 - 40	17.5%	1.3%	0.9%	0.9%	20.5%
41 - 50	3.5%	0.4%	0.4%	0.4%	4.8%
≥ 51	6.6%	0.9%	0.0%	0.4%	7.9%
Total	80.8%	7.4%	4.4%	7.4%	100.0%

105 Table 2 above showed the prevalence of Duffy negative to be highest among ages 21-30 with
106 26.2%, followed by ages 31-40 with 17.5%.

108 **Table 3. Distribution of Duffy phenotype among the patients based on ethnicity.**

Ethnicity	Duffy phenotype				Total
	Fy (a-b-)	Fy (a+b-)	Fy (a-b+)	Fy (a+b+)	
Igbo	0.9%	0.0%	0.0%	0.0%	0.9%
Hausa	78.6%	7.4%	3.9%	7.4%	97.4%
Yoruba	1.3%	0.0%	0.4%	0.0%	1.7%
Total	80.8%	7.4%	4.4%	7.4%	100.0%

109 Table 3 above showed that the prevalence of Duffy negative among three ethnic groups of
 110 Hausa, Igbo and Yoruba as 78.6%, 0.9% and 1.3% respectively. The proportions of Duffy
 111 positive and negative within the various ethnic groups was 19.3% Duffy positive and 80.7%
 112 Duffy negative for among the Hausa/Fulani ethnic group, 0.0% Duffy positive and 100%
 113 Duffy negative among the Igbo ethnic group and 23.5% Duffy positive and 76.5% Duffy
 114 negative for among the Yoruba ethnic group.

115 **Discussion:**

116 In this present study, we observed Fya and Fyb prevalence of 14.8% and 11.8% respectively
 117 with 85.2% and 88.2% of the study population lacking the respective antigens. Erhabor *et al.*,
 118 reported a much lower prevalence among pregnant women in the same study area. The reason
 119 for the difference was attributed to the difference in the methods used and the type of study
 120 population.⁽⁹⁾ In their study, a less sensitive tube method was used while in this study, we
 121 applied the gel microtubules method which is more sensitive. Our finding is also higher than
 122 previously reported which observed Duffy antigens among 2.38% of Sudanese subjects.⁽¹⁰⁾
 123 Our finding is however very lower than reported values among the whites which indicated
 124 that Fya and Fyb antigens were relatively frequently in Caucasians, (66% and 83%) and
 125 Asians (99% and 18.5%) but far less commonly in Blacks (10% and 23%) respectively.⁽⁷⁾

The distribution of the Duffy phenotype in this our present study was 19.2% Duffy positive (Fya+b-, Fya-b+ and Fya+b+ with respective prevalence of 7.4%, 4.4% and 7.4%) and 80.8% (61.1% Females and 19.7% Males) Duffy negative (Fy a-b-). These values are in agreement with the values suggested for Black population of 68.0%, 1.0%, 9.0% and 22.0 respectively, but it varies from the values obtain for Indians, white and the Chinese in which high prevalence of Fya⁺b⁻, Fya⁺b⁺, and Fya⁺b⁻ was reported. Fya⁻b⁻ prevalence was reported as 0.0% or very rare in these ethnic groups,⁽¹¹⁾ this invariably meant that it is difficult to source for Duffy negative blood for Blacks resident among the Whites who required blood transfusion. It also showed that Duffy negative blood are in great supply among the Black population.

The prevalence of Duffy negative was observed to be highest among ages 21-30 with 26.2%, followed by ages 31-40 with 17.5%. These age groups are considered to be in the blood donor age bracket and can provide the general population with the much needed Duffy negative blood especially to transfusion dependant patients and pregnant women. Duffy antigens are clinically significant antigens and when transfused to an individual that lacks it, can cause the production of clinically significant alloantibodies against this antigens in the individual. These alloantibodies can complicate blood transfusion among blood transfusion dependent patients and also complicates pregnancy out come in women.

Duffy negative status is suggested to play a role in resistance to malaria infection.⁽⁴⁾ Duffy negative has been reported with higher frequencies in countries where there is a high incidence of *Plasmodium vivax* malaria.⁽⁵⁾ Blood groups antigens are the product of genes. Evolutionary pressure from various environmental pathogens is thought to be responsible for the generation of genetic variants, resulting in survival advantage. A well-known example are individuals whose phenotype is Fy (a-b-) and lack glycol protein-Fy on their erythrocytes, preventing the invasion of malaria *Plasmodium vivax* parasite.⁽¹²⁾ Nigeria generally is

considered a malaria endemic region, although *P. falciparum* is considered the most dominant species, the high prevalence of Duffy negative obtained in our study for all the ethnic groups studied may not be unrelated to the good love of nature providing resistance against double infection by other species of malaria. The prevalence of Duffy negative among three ethnic groups of Hausa, Igbo and Yoruba was 80.7%, 100% and 76.5% respectively.

Conclusion:

The study concluded that the distribution of Duffy negative (Fya-b-) in the study area is high providing the necessary protection against *P. vivax* and *P. knowlesi* infections.

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