International Journal of Blood Transfusion

Duffy Red Cell Antigen Phenotype among Indigenous Pregnant Women attending Antenatal Clinic at Federal Teaching Hospital Gombe, Gombe State, North Eastern Nigeria.

Ahmed M. Gaji[1], Ann Ogbenna[2], Ahmed I. Girei[3], Kasim M. Pindiga[4], Sani Adamu[5], Saleh Yuguda[4], Ademola Adewoyin[2], Davies Nosimot Omotola[2]

[1]Department of Haematology and Blood Transfusion, College of Medicine, University of Lagos.

[2]Department of Haematology and Blood Transfusion, College of Medicine, University of Lagos, Lagos State, Nigeria.

[3]Department of Haematology and Blood Transfusion Federal Teaching Hospital Gombe, Gombe State, Nigeria.

[4]Department of Haematology and Blood Transfusion, Federal Teaching Hospital Gombe, Gombe State, Nigeria.

[5]Department of Chemical Pathology, Federal Teaching Hospital Gombe, Gombe State, Nigeria.

Research Article

Open Access &

Peer-Reviewed Article

Corresponding author:
Ahmed M. Gaji, Department of Haematology and Blood Transfusion, College of Medicine, University of Lagos, Lagos State, Nigeria.

Keywords:
Duffy phenotype, Haemolytic disease of foetus and newborn, plasmodiasis.

Received: August 15, 2023

Accepted: October 30, 2023

Published: December 27, 2023

Academic Editor:
Anubha Bajaj, MD. (Pathology) Panjab University, Department of Histopathology, A.B. Diagnostics, A-1, Ring Road , Rajouri Garden, New Delhi, 110027, India.

Citation:
Ahmed M. Gaji, Ann Ogbenna, Ahmed I. Girei, Kasim M. Pindiga, Sani Adamu et al. (2023) Duffy Red Cell Antigen Phenotype among Indigenous Pregnant Women attending Antenatal Clinic at Federal Teaching Hospital Gombe, Gombe State, North Eastern Nigeria.. International Journal of Blood Transfusion - 1(1):9-17.

Abstract

Background and Objectives: Duffy (FY) blood group system is implicated in transfusion incompatibilities and haemolytic disease of the foetus and newborn (HDFN). The primary objective was to determine the Duffy phenotype among indigenous pregnant women in Gombe, Gombe State, Nigeria.

Materials and Methods: This was a Cross sectional study where simple random sampling was employed on consented participants. Two hundred and fifty nine pregnant women attending antenatal clinic at Federal Teaching Hospital Gombe were randomly recruited into the study. About 3mls of blood was taken, and Duffy antigen typed by standard tube technique (LORNE LABORATORY UK).

Results: Among the Indigenous tribe, the percentage of Fy(a+b+) was seen in 2.2% of Fulani and 3.4% of Tangale, Fy(a+b-) phenotype was seen in 4.3% of Tangale, 6.8% of Fulani,9.5% of Tera, 10.3% of Hausa and 10.5% of Waja. Fy(a-b+) phenotype was seen in 5.3% of Waja, 7.6% of Fulani,8.7% of Tangale, 9.5% of Tera and 12.5% of Bolawa. Fy(a-b-) phenotype was seen in 2.4% of Tula,6.4% of Bolawa,7.3% of Waja, 7.8% of Tera, 17.8% of Tangale, 11.8% of Hausa and 46.5% of Fulani. About 84.6% of the study population had the null Duffy phenotype.

Conclusion: The research showed the phenotypic distribution of Duffy blood group among the study participants with relatively high percentage of null Duffy phenotype hence possible risk of alloimmunisation.

Background of the Study

The Duffy (Fy) blood group system is important in clinical medicine due to transfusion incompatibilities and haemolytic disease of the foetus and newborn (HDFN).[1] However, many causes of acute and delayed haemolytc transfusion reaction and haemolytic disease of the foetus and neonate are underreported due to poor obstetric and neonatal screening of clinically important rare blood group system.[2] The Duffy (Fy) antigen is a glycoprotein found on red cell membrane, endothelium, and epithelial cells of alveoli and collecting tubules of the kidneys.[2] The antigen act as receptor for chemokines and plasmodium vivax.[2] Globally, Haemolytic disease of the foetus and newborn affects an estimated 80 in 100,000 patients annually. [3] It could lead to bilirubin encephalopathy & late anaemia of infancy.[4] Though more commonly associated with Rhesus and ABO blood group. Severe haemolytic disease of foetus and newborn has been reported with minor blood groups like the Duffy and Kell blood group system.[4]Approximately 4% of pregnant women with anti-Fya have been reported to have foetus with severe anaemia, some requiring intrauterine transfusion.[4]Knowing the distribution of blood group antigens in a specific population, helps to determine the risk of alloimmunization, and among women, the risk of haemolytic disease of foetus and newborn. The distribution of Duffy phenotype among pregnant women in Gombe state is not known, hence the need to determine the primary data.

Materials and Methods

The study took place at Federal Teaching Hospital Gombe (F.T.H.G). This was a cross sectional study. Gombe state is located in northeastern part of Nigeria. It lies in the wooded savanna lands of the Gongola River basin. It is mainly inhabited by the Fulani, Bolewa, Tera (Terawa), Tangale, Hausa, Kanuri, Waja (Wajawa), and Tula peoples.[5] A total of 259 pregnant women attending the antenatal clinic at the Federal Teaching Hospital Gombe, who consented, were recruited. A simple random sampling (balloting) technique was used to recruit indigenous pregnant women. Those who picked "yes" were included, whereas those who picked "no" were excluded. Socio-demographic information such as age, religion; tribe, marital status, educational level, occupation and previous obstetric history were obtained from consented participants. Three 3ml of venous blood was aseptically collected into EDTA sample bottle from each participants and transported to the lab for processing. Samples were analysed in batches for Duffy antigen using standard tube technique (LORNE LABORATORY UK), [6] ABO, Rhesus blood grouping [7] and screening for Plasmodium species using thin and thick blood film by WHO MM-SOP-08.[8] Data was compiled into an excel spread sheet and analysed using IBM SPSS Version 25.[9] Analyzed variables were presented inform of frequency and percentage. Level of significance was set at $p< 0.05$. Ethical approval (NHREC/25/10/2013) was obtained from Research and Ethics Committee of F.T.H.G.

Result

All the women were married, 96.5% had secondary school education and above. Majority (91.5%) were between the ages of 18 and 35 years, with a mean age of 26.71 $\pm$ 4.58years. Two- hundred and forty-eight (95.7%) where rhesus positive and 114(44.1%) were blood group O positive.

The major indigenous tribes in this study were Fulani's (45.6%), Tangale's (17.8%), and Hausa's (11.2%). Tera's, Waja's, Bolewa's and Tula's make up the rest (23.5%) of the population. Tula's were only 5 out of 259 (1.9%) participants.

The most predominant Duffy phenotype among the study population was Fy(a-b-). This was observed in 84.6% of the women (Table 3). The Fy(a-b-) was seen in 82.2% of Fulani's, 89.7% of Hausa's and 84.8% of Tangale's, 81.0% of Tera's. 84.2% of Waja's. The least proportion (68.75%) was seen among the Bolewa's (Table 4). The Fy (a+b+) was the least common phenotype seen in only 1.9% of the study

Table 1. Socio-demographic data of the study population.

Variable	Frequency (n=259)	Percent (%)
Age group		
18-25 years	110	42.5
26-35 years	127	49.0
36-45 years	22	8.5
Religion		
Islam	193	74.5
Christianity	66	25.5
Marital status		
Married	259	100
Unmarried	0	0
Ethnicity		
Fulani	118	45.6
Tangale	46	17.8
Hausa	29	11.2
Tera	21	8.1
Waja	19	7.3
Bolewa	16	6.2
Tula	5	1.9
Others	5	1.9
Educational level		
Tertiary	152	58.7
Secondary	98	37.8
Primary	6	2.3
None	3	1.2
Occupation		
Full time house wife	138	53.3
Civil servant	58	22.8
Student	24	9.3
Entrepreneur	23	8.9
Applicant	15	5.8

Note: Mean age of the participants = 26.71 $\pm$ 4.58years, Median age = 26 years (IQR: 20-30), Others; Yoruba and Igbo, Shuwa.

Table 2. Distribution of ABO, Rhesus blood group system and Obstetric History.

Variable	Frequency (=259)	Percent (%)
ABO group		
A	78	30.1
B	56	21.6
AB	11	4.2
O	114	44.1
Rh group		
Positive	248	95.7
Negative	11	4.3
Miscarriages		
Yes	88	34
No	171	66
Still births		
Yes	21	8.1
No	238	91.9
History of neonatal Jaundice		
Yes	61	23.6
No	198	76.4

Note. N=Sample size, Rh=Rhesus blood group

Table 3. Distribution of Duffy blood group phenotype among participants

	Frequency (n=259)	Percent (%)
Duffy phenotypes		
Fy (a+b-)	17	6.6
Fy (a-b+)	18	6.9
Fy (a+b+)	5	1.9
Fy (a-b-)	219	84.6
Total	259	100

Fy; Duffy antigen, n; sample size.

Table 4. Distribution of Duffy blood group amongst the ethnic groups

Ethnic groups	Frequency (n=259)	Percent (%)
Fulani		
Fy (a+b-)	8	6.8
Fy (a-b+)	9	7.6
Fy (a+b+)	4	3.4
Fy (a-b-)	97	82.2
Hausa		
Fy (a+b-)	3	10.3
Fy (a-b-)	26	89.7
Tangale		
Fy (a+b-)	2	4.3
Fy (a-b+)	4	8.7
Fy (a+b+)	1	2.2
Fy (a-b-)	39	84.8
Tera		
Fy (a+b-)	2	9.5
Fy (a-b+)	2	9.5
Fy (a-b-)	17	81.0
Waja		
Fy (a+b-)	2	10.5
Fy (a-b+)	1	5.3
Fy (a-b-)	16	84.2
Bolewa		
Fy (a+b-)	2	12.5
Fy (a-b+)	1	6.25
Fy (a+b+)	2	12.5
Fy (a-b-)	11	68.75
Tula		
Fy (a-b-)	5	100
Others		
Fy (a-b-)	5	100
Total n (%)	259	100

Note: Others; Yoruba, Igbo, Shuwa

Table 5. Distribution of Duffy phenotype and negative obstetric history

	Fy(a+b-) n (%)	Fy(a-b+) n (%)	Fy(a+b+) n (%)	Fy(a-b-) n (%)	Total n (%)	P value
Miscarriages						
Yes	3 (17.65)	8 (44.44)	0 (0.00)	77 (34.16)	88 (33.98)	0.52
No	14 (82.35)	10 (55.56)	5 (100.00)	142 (64.64)	171 (66.02)	
Still birth						
Yes	0 (0.00)	2 (11.11)	0 (0.00)	19 (8.68)	21 (8.11)	0.07
No	17 (100.00)	16 (88.89)	5 (100.00)	200 (91.32)	238 (91.89)	
Neonatal jaundice						
Yes	8 (7.06)	5 (27.78)	1 (20.00)	47 (21.26)	61 (23.55)	0.52
No	9 (52.94)	13 (72.22)	4 (80.00)	172 (78.54)	198 (76.45)	

Table 6. Prevalence of malaria parasitaemia among participants and type of plasmodium species.

	Frequency	Percent (%)
Malaria parasiteamia (n=259)		
Not seen	124	47.9
Seen	135	51.1
Plasmodium species (n=135)		
P. falciparum	88	65.2
P. vivax	17	12.6
P. malariae	15	11.1
P. ovale	15	11.1

Table 7. Distribution of plasmodium species based on Duffy antigen status of participants.

	Fy(a+b-) n (%)	Fy(a-b+) n (%)	Fy(a+b+) n (%)	Fy(a-b-) n (%)	*P value
P.falciparum	6 (60.00)	2 (14.29)	1 (20.00)	79 (74.53)	0.001
P.malariae	0 (0.00)	2 (14.29)	0 (0.00)	13 (12.26)	
P.vivax	3 (30.00)	10 (71.43)	4 (80.00)	0 (0.00)	
P.ovale	1 (10.00)	0 (0.00)	0 (0.00)	14 (13.21)	
Total	10 (100.00)	14 (100.00)	5 (100.00)	106 (100.00)	

*Pearson's chi square

population. It was not seen in the Hausas', Tera's and the Waja's. The highest proportion for the Fy(a+ b+) was seen among the Bolewa's. (Table 4). Thirty-four percent (34%) had a history of miscarriage, 23.6% had history of neonatal jaundice and 8.1% had a history of still births. However the proportion with this bad obstetric history did not vary across the different Duffy phenotypes (Table 5). A hundred and thirty-five (51.1%) pregnant women had malaria parasite by microscopy; 65.2% had P. falciparum infestation, 12.6% had P.vivax, 11.2% had P.malariae and P.ovale (Table 6). P falciparum was the predominant malaria specie seen among participant with Fy (a-b-) (74.52%) and Fy(a+b-) phenotypes (60%), while P.vivax was the predominant specie among those with the Fy(a-b+) (71.43%) and Fy(a+b+) (80%) phenotypes. None of the participants with the null Duffy phenotype has P vivax infestation.

Discussion

The Duffy blood group antibodies are IgG antibodies and have the ability to cross the placental barrier and hence are associated with risk of haemolytic disease of foetus and new born. We investigated the prevalence and distribution of the Duffy blood group antigen among pregnant women in Gombe State, North - East Nigeria.

In this study, the null phenotype was the most prevalent phenotype seen in 80- 86% of pregnant women from all the major ethnic groups in Gombe, except among the Bolewa, where it accounted for 69% of the pregnant women. This agrees with previous study among blacks in sub Saharan Africa.[10] In a related study in Sokoto, a state in North West Nigeria, all the pregnant Fulani's women (20/162) in the study lacked both the Fya and Fyb antigen, implying they also had a null phenotype. Kulkarni et al., [11] Erhabor et al., [12] also reported 98.8% of Duffy negativity among Hausa's in North West Nigeria. The prevalence rate of Fy (a+b-), Fy (a-b+) and Fy (a+b+) phenotype disagree with the research carried out in north western Nigeria[12], where prevalence rate of 4.3%, 5.6% and 0.61% were reported respectively.

In another research carried out at donor clinic of Aminu Kano teaching hospital, using potent antisera, Duffy antigens were not detected among the blood donors. [13]

The Duffy antibody is an immune antibody produced in response to previous exposure and has the ability to cause immediate and delayed transfusion reaction and haemolytic disease of the foetus and newborn. In this study, out of 259 participants, 88 (33.98%) had history of miscarriage, 21 (8.11%) still births and 61 (23.55%) had neonatal jaundice. Contrary to expectations, the proportion of pregnant women with bad obstetric history was higher among the pregnant women with null Fy(a-b-) than those with Fy(a-b+). Table 5. The pregnant women with null Fy (a-b-) phenotype had the highest history of miscarriages, still births, and neonatal jaundice. The antibody against the Fya antigen (anti-Fya) is 20 times more potent than the anti-Fyb and is associated with mild-to-severe HDFN, than the anti-Fyb. The anti-Fyb is rarely associated with mild HDFN.[14] Moreover, studies have shown that blacks with the F (a-b-) phenotype who develop Duffy antibodies, do not produce anti-Fyb but usually produce anti-Fya and anti Fya3 or Fy5.[15] This is because the Fy(a–b–) phenotype in blacks is associated with a mutation (a single amino acid substitution at position 46) which impairs the erythroid promoter, GATA-1 binding motif. The mutation prevents the transcription of the FY gene in the RBCs only while the Duffy Fyb antigen is expressed on the other tissues.[16]

These and the dosage effect observed in the Duffy blood group though not statistically significant, may explain the differences observed in the obstetric history across the various phenotypes.

The Duffy antigens serve as receptor for diverse group of chemokines and P. vivax. The Duffy antigen receptor plays a vital role as an immune regulator where it served as a chemokine sink during inflammatory processes. In this study, out of 259 participants, 135 had plasmodiasis, out of which 11.1%

were infested with P. malariae and P. ovale respectively, 12.6% P. vivax, and 65.2% P. falciparum. The prevalence rates of plasmodiasis among participants with null Duffy phenotype Fy (a-b-) was 0.0% for P. vivax, 12.26 % P. malaria, 74.53 % P. falciparum and 13.21 % P. ovale. These findings supported previous studies which stated that red cells of null Duffy phenotype individuals resist invasion by P. vivax which was due to non-expression of Duffy antigen on the red cell surface, hence the resistivity.[17] This study did not screen for allo-antibodies among the pregnant women with the null phenotype. Doing this will have provided more data on the risk of alloimmunization among pregnant women with the null phenotype.

Conclusions

The prevalence of the null Duffy phenotype is high among pregnant women in Gombe and hence there may be a high risk of alloimmunization and obstetric complications. The least seen phenotype is the F (a+b+) phenotype.

References

1. Mollison PL, Engelfried CP, Contreras M. Blood transfusion in clinical medicine, British journal of haematology, 1997: (2): 324-356.
2. Rosenfield RE, Vogel P, Race RR. A new case of ant-Fya in human serum. Revised Journal of Heamatology. 1950: (5):315-317.
3. Delaney M, Matthews DC. Haemolytic disease of the foetus and newborn: managing the mother, foetus and newborn. Journal of American society of Haematology. 2015. (1):146-51.
4. Hughes LH, Rossi KQ, Krugh DW, O' Shaughnessy RW. Management of pregnancies complicated by anti-Fya (a) alloimmunization. Transfusion. 2007; 47: 1858-61.
5. National population commission: 2006 PHC Priority tables.poipulation.gov.ng.2018
6. Lorne laboratories ltd. Anti-Fya monoclonal, Anti-Fyb polyclonal, email:info@lornelabs.com
7. BIO-RAD. Seraclone ABO Blood Group and Rh Reagents. Bio-Rad Laboratories. Contactemeacustomerservice@bio-rad.com
8. WHO. Bench for Malaria diagnosis. Geneva. 2009; 1-5
9. Darren George, Paul Mallery. IBM SPSS Statistics 25 step by step: simple guide and reference. ACM Journal. 2018; 404
10. Le Pennec PY, Rouger P, Klein MT, Robert N, Salmon C. Study of anti-Fya in five black Fy(a−b−) patients. Vox Sang 1987; 52:246–9.
11. Akunwata C. Duffy Antigens and Malaria: The African Experience. Blood Groups - More than Inheritance of Antigenic Substances [Internet]. 2022 Aug 17; Available from: http://dx.doi.org/10.5772/intechopen.102014
12. Erhabor O, Shehu CE, Alhaji YB, Yakubu A. Duffy red cells phenotypes among pregnant women in Sokoto, North Western Nigeria.Journal of Blood disorders and Transfusion. 2014; (5): 223-228
13. Fatima A. Aldarweesh. The Duffy blood group system. Journal of Intech Open. 2019; (3):1-4
14. Vengelen-Tyler V. Anti-Fya preceding anti-Fy3 or -Fy5: a study of five cases (abstract). Transfusion 1985; 25:482.
15. Le Pennec PY, Rouger P, Klein MT, Robert N, Salmon C. Study of anti-Fya in five black Fy(a−b−)

patients. Vox Sang 1987;52:246–9

16. A. Aldarweesh F.The Duffy Blood Group System [Internet]. Human Blood Group Systems and Haemoglobinopathies. IntechOpen; 2021. Available from: http://dx.doi.org/10.5772/intechopen.89952
17. Moise KJ. Fetal anaemia due to non-Rhesus-D red cell alloimmunization.Semin fetal neonatal Medicine. 2008. 13(4): 207-14.