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ABO and Rhesus Blood Group Distribution and Their Association with *Plasmodium falciparum* Malaria Among Patients in Yenagoa, Bayelsa State, Nigeria

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ABSTRACT
ABO blood group systems have been proposed as host biological factors influencing susceptibility to Plasmodium falciparum malaria infection and parasite distribution. However, evidence from the Niger Delta region of Nigeria remains limited. This study evaluated ABO and Rhesus blood group distribution and their association with malaria prevalence and Plasmodium species distribution among patients in Yenagoa, Bayelsa State. A cross-sectional study was conducted between April 2025 and March 2026 at Niger Delta University Teaching Hospital and Scanex Diagnostics, Yenagoa. A total of 350 participants were enrolled. Malaria diagnosis was performed by microscopy and confirmed with Rapid Diagnostic Test (RDT). ABO blood grouping was performed using standard agglutination method. Plasmodium species were identified by nested PCR in 40 randomly selected confirmed-positive samples. Chi-square tests were used to assess associations, $p < 0.05$ as the significance threshold. Blood group A was the most predominant (36.00%), blood group O (30.00%), B (22.00%), and AB (12.00%). Rh-positive individuals constituted 90.00% of participants. Blood group O recorded the highest malaria positivity by microscopy (40.48%) and RDT (58.82%), while blood group AB recorded the lowest. Despite these trends, no statistical significance was found between ABO blood group and malaria prevalence by microscopy ($\chi^2 = 14.618$, $p = 0.087$) or RDT ($\chi^2 = 12.224$, $p = 0.063$). Molecular analysis of 40 samples confirmed P. falciparum in 100% and P. vivax co-infections in 27.50% ($\chi^2 = 5.517$, $p = 0.138$). The prevalence metrics offer vital data for transmission dynamics and provide clinical information for surveillance in the Niger Delta.

Keywords: ABO blood group; Rhesus factor; Plasmodium falciparum; malaria susceptibility; P. vivax co-infection

INTRODUCTION

The ABO blood group system, first described by Karl Landsteiner in 1901, remains the most clinically significant of the human blood group systems. It is defined by the presence or absence of A and B antigens on the surface of red blood cells and their corresponding antibodies in serum. The Rhesus (Rh) blood group system, characterised primarily by the D antigen, is the second most important, with approximately 85% of most populations being Rh-positive. Beyond their significance in transfusion medicine and obstetrics, ABO and Rhesus blood group phenotypes have been increasingly investigated as potential host biological determinants of susceptibility to infectious diseases, including malaria (Aninagyei et al., 2024).

Malaria caused by *Plasmodium falciparum* remains one of the most lethal infectious diseases globally, with Nigeria accounting for approximately 31.9% of all malaria-related deaths worldwide (WHO, 2024). Bayelsa State, situated in the Niger Delta, experiences holoendemic malaria transmission year-round owing to its tropical wetland ecology, high rainfall, and perennial vector breeding habitats. In this setting, identifying host factors that modulate malaria susceptibility is important for targeting prevention interventions and understanding transmission dynamics.

The biological basis for a potential ABO blood group effect on malaria susceptibility involves several mechanisms. P. falciparum-infected erythrocytes form rosettes by binding uninfected red blood cells, a process mediated by parasite ligands interacting with ABO blood group antigens on the erythrocyte surface. Blood group A and B erythrocytes form more stable rosettes than blood group O erythrocytes, which has been proposed to contribute to greater disease severity in non-O blood group individuals (Carlson and Wahlgren, 1992; Rowe et al., 2007). Conversely, blood group O has been associated with higher susceptibility to uncomplicated malaria infection in several African populations, potentially because the absence of A and B antigens reduces natural immunological cross-protection (Afoakwah et al., 2016; Abdulmalik et al., 2025).

The relationship between Rhesus blood group and malaria susceptibility is less well established. While some studies have reported higher malaria infection rates among Rh-positive individuals — attributed to the greater prevalence of Rh-positive phenotype in the general population — others have found no significant association (Muhammad et al., 2025; Aninagyei et al., 2024). Additionally, the distribution of ABO blood groups varies significantly across African populations and ethnic groups, making locally generated data essential for meaningful interpretation.

In Bayelsa State, no published study has specifically characterized the distribution of ABO and Rhesus blood groups in relation to malaria prevalence and *Plasmodium* species composition. This study therefore aimed to describe the ABO and Rhesus blood group distribution among malaria patients in Yenagoa; to evaluate the association between blood group phenotype and malaria prevalence by microscopy and RDT; and to assess the distribution of *P.*

falciparum and *P. vivax* co-infections across ABO blood groups.

MATERIALS AND METHODS

Study Design, Site, and Population

A cross-sectional study was conducted between April 2025 and March 2026 and comprised 350 participants distributed across two key diagnostic facilities in the Yenagoa metropolis (Niger Delta University Teaching Hospital (NDUTH) {4.9611^{0}N, 6.2278^{0}E} at Okolobiri Community in Yenagoa Local Government Area and Scanex Diagnostics {4.930^{0}N, 6.307^{0}E}at Nikton Road, Yenagoa) all in Bayelsa State. A written consent was obtained from the parents/guardians of study participants between 0 – 17 years. The sample size for this study was determined using the formula proposed by Cochran (1963), applying a malaria prevalence rate of 65% as reported by Oluwayemisi et al. (2019). Based on the calculation, a minimum sample size of 349 participants was obtained. Ethical approval was obtained from Bayelsa State Ministry of Health (BY/SMOH/HPRS/HP/53/VOL.1/2026) and University of Port Harcourt ethical committee (UPH/CEREMAD/REC/MM119/048).

$n_o = z^2pq \div e^2$

n_o= Sample size

z= Statistics for a level of confidence (95% = 1.96)

p= Estimated proportion or expected prevalence (65% = 0.65)

q= is 1 - p

e= Desired level of precision (0.05)

Blood Grouping and Malaria Diagnosis

Venous blood (3 mL) was collected from each participant into EDTA tubes. ABO and Rhesus blood grouping were performed using the standard tile agglutination method with commercial antisera (anti-A, anti-B, and anti-D). Malaria diagnosis was performed by thick and thin Giemsa-stained blood film microscopy, with all microscopy-positive samples further confirmed using an HRP-2-based Rapid Diagnostic Test.

Molecular Species Identification

Genomic DNA was extracted from 40 randomly selected RDT-confirmed P. falciparum-positive samples using the Zymo-Spin II CR column kit (Zymo Research) according to the manufacturer's protocol. *Plasmodium* species were identified by nested PCR using the 18S rRNA gene and species-specific targets: RFAL (P. falciparum), ROVA (P. ovale), RVIV (P. vivax), and RMAL (P. malariae). Products were resolved on 1% agarose gels and visualised on a blue light imaging system.

Statistical Analysis

Data were summarised as frequencies and percentages. Chi-square (χ^2) tests were used to evaluate associations between ABO blood group, Rhesus factor, and malaria prevalence or species distribution. All statistical analyses were performed using IBM SPSS Statistics (Version 27.0). A p-value < 0.05 was considered statistically significant.

Ethical Considerations

Ethical approval was obtained from the University of Port Harcourt Research Ethics Committee (UPH/CEREMAD/REC/MM119/048) and the Bayelsa State Ministry of Health Research Ethics Committee (reference: BY/SMOH/HPRS/HP/53/VOL.1/2026). Written informed consent was obtained from all participants. The study was conducted in accordance with the Declaration of Helsinki.

RESULTS AND DISCUSSION

ABO and Rhesus Blood Group Distribution

Among the 350 enrolled participants, blood group A was the most predominant (126; 36.00%), followed by blood group O (105; 30.00%), blood group B (77; 22.00%), and blood group AB (42; 12.00%). Regarding Rhesus factor, the majority of participants were Rh-positive (315; 90.00%), while Rh-negative individuals constituted 10.00% (35/350) of the study population. Table 1 summarises the blood group and Rhesus factor distribution.

Table 1: ABO and Rhesus Blood Group Distribution among Study Participants (n = 350)

Variable	Category	N	%
ABO Blood Group	O	105	30.00
	A	126	36.00
	B	77	22.00
	AB	42	12.00
	Total	350	100.00
Rhesus Factor	Rh-positive	315	90.00
	Rh-negative	35	10.00
	Total	350	100.00

Blood group distribution based on standard agglutination method.

Malaria Prevalence by ABO Blood Group

Overall malaria prevalence by microscopy was 36.00% (126/350). By ABO blood group, blood group O recorded the highest proportion of microscopy-positive cases (51/105; 40.48%), followed by blood group A (47/126; 37.30%), blood group B (19/77; 15.08% of positives among all positives), and blood group AB (9/42; 7.14% of positives). By RDT among the 126 microscopy-positive samples, blood group O again recorded the highest positivity (30/51; 58.82%), while blood group A recorded the lowest (18/47; 38.30%). Despite these numerical trends, statistical analysis showed no significant association between ABO blood group and malaria prevalence by microscopy ($\chi^2 = 14.618$, p = 0.087) or RDT ($\chi^2 = 12.224$, p = 0.063). Table 2 presents the full distribution.

Table 2: Malaria Prevalence by ABO Blood Group using Microscopy and RDT

Blood Group	Examined	Microscopy Positive (%)	RDT Positive (%)	χ^2 (Microscopy)	χ^2 (RDT)
A	126 (36.00)	47 (37.30)	18 (38.30)		
B	77 (22.00)	19 (15.08)	8 (42.11)		
AB	42 (12.00)	9 (7.14)	4 (44.44)		
O	105 (30.00)	51 (40.48)	30 (58.82)		
Total	**350 (100)**	**126 (36.00)**	**60 (47.62)**	**14.618 (p=0.087)**	**12.224 (p=0.063)**

All p-values > 0.05. No statistically significant association between ABO blood group and malaria prevalence by either diagnostic method.

***Plasmodium* Species Distribution by ABO Blood Group**

Molecular analysis of 40 randomly selected samples confirmed *P. falciparum* in all 40 samples (100%) across all ABO blood groups. *P. vivax* co-infections were detected in 11 samples (27.50%). Blood group A and blood group O each recorded five *P. vivax* co-infections (41.67% and 20.83% of their respective group samples), while blood group AB recorded one co-infection (100.00% of that group's single sample). No *P. vivax* was detected in blood group B samples. Statistical analysis revealed no significant association between ABO blood group and *P. vivax* co-infection (χ^2 = 5.517, p = 0.138). Table 3 presents the species distribution by blood group.

Table 3: Plasmodium Species Distribution by ABO Blood Group among Molecularly Analysed Samples (n = 40).

Blood Group	Examined n (%)	P. falciparum n (%)	P. vivax n (%)	p-value
A	12 (30.00)	12 (100)	5 (41.67)	
B	3 (7.50)	3 (100)	0 (0.00)	
AB	1 (2.50)	1 (100)	1 (100.00)	
O	24 (60.00)	24 (100)	5 (20.83)	
Total	**40 (100)**	**40 (100)**	**11 (27.50)**	**0.138**

χ^2 = 5.517, p = 0.138. All 40 samples were P. falciparum positive. P. vivax detections represent mixed co-infections.

Rhesus Factor Distribution

The Rhesus factor distribution showed a strong predominance of Rh-positive individuals (315/350; 90.00%) compared to Rh-negative individuals (35/350; 10.00%). Malaria prevalence data stratified by Rhesus factor were not available for inferential comparison in this study; however, the distribution of Rh-positive and Rh-negative participants across the study population is presented in Table 4 as a baseline reference for future comparative studies in this region.

Table 4: Rhesus Factor Distribution among Study Participants (n = 350)

Rhesus Factor	N	%	Notes
Rh-positive	315	90.00	Predominant in study population
Rh-negative	35	10.00	
Total	**350**	**100.00**	

Rhesus factor determined by standard agglutination with anti-D serum. No malaria prevalence stratification by Rhesus factor was performed in this study.

Discussion

This study examined ABO and Rhesus blood group distribution and their association with malaria prevalence and *Plasmodium* species distribution among patients in Yenagoa, Bayelsa State. Blood group A was the most predominant in this population (36.00%), followed by O (30.00%), B (22.00%), and AB (12.00%). This distribution differs from the pattern commonly reported in many sub-Saharan African populations where blood group O typically predominates (Aninagyei et al., 2024; Osisiogu et al., 2023). The relatively higher frequency of blood group A in this cohort may reflect the specific ethnic composition of the Ijaw and Izon-speaking populations of Bayelsa State, in whom blood group A frequencies may be higher than the broader West African average. This observation warrants further population-level serological studies in the Niger Delta to establish a robust baseline.

Notwithstanding its lower numerical representation in the study population, blood group O consistently recorded the highest proportion of malaria-positive cases by both microscopy (40.48%) and RDT (58.82%). This pattern mirrors findings from several West African studies where blood group O individuals have been reported to have higher malaria infection frequencies (Afoakwah et al., 2016; Tela et al., 2015; Iwueze et al., 2025). The proposed biological explanation centres on the reduced rosette formation capacity of blood group O erythrocytes. *P. falciparum*-infected erythrocytes bind uninfected erythrocytes through ABO antigen-dependent interactions to form rosettes, a process associated with parasite sequestration and severe disease. Blood group O erythrocytes, lacking both A and B surface antigens, form fewer and less stable rosettes, which may paradoxically increase the availability of free merozoites for further red cell invasion, raising the infection rate without necessarily increasing disease severity (Rowe et al., 2007; Carlson and Wahlgren, 1992).

Nevertheless, the absence of statistical significance (p > 0.05) for both microscopy and RDT-based comparisons indicates that ABO blood group did not act as an independent determinant of malaria infection status in this cohort. This is consistent with several Nigerian studies that have similarly failed to establish a significant blood group-malaria association at the population level (Iwueze et al., 2025; Muhammad et al., 2025). The lack of significance may partly reflect inadequate statistical power due to unequal distribution across blood groups, particularly the small number of blood group AB participants, rather than a true absence of biological effect. Larger, adequately powered studies with balanced

blood group representation are needed to resolve this question definitively.

The detection of *P. vivax* co-infections in 27.50% of molecularly analysed samples is a notable finding that cuts across blood groups. Blood group A and O each contributed five *P. vivax* co-infections, while the single blood group AB sample was also *P. vivax* positive. These data suggest that *P. vivax* transmission in Yenagoa is not restricted to any particular blood group phenotype, which is consistent with the emerging evidence of Duffy-independent *P. vivax* invasion pathways that would allow infection regardless of Duffy antigen status or ABO blood group (Zhang et al., 2025). The absence of *P. vivax* in blood group B samples is likely a reflection of the small sample size (n = 3) rather than a biologically meaningful finding.

The Rhesus factor distribution — 90.00% Rh-positive and 10.00% Rh-negative — is broadly consistent with reports from other Nigerian and West African populations, where Rh-positive phenotype predominates (Aninagyei et al., 2024; Muhammad et al., 2025). While this study was not designed to provide inferential statistical comparison of malaria prevalence between Rh-positive and Rh-negative groups due to the absence of stratified prevalence data, the baseline Rhesus distribution recorded here provides reference data for future studies. The strong Rh-positive predominance means that any future study seeking to compare malaria rates by Rhesus factor in this population would require deliberate oversampling of Rh-negative participants to achieve adequate power.

CONCLUSION

This study provides the characterization of ABO and Rhesus blood group distribution and their association with malaria prevalence and *Plasmodium* species distribution in Yenagoa, Bayelsa State. Blood group A was the most prevalent phenotype, while blood group O was consistently associated with higher malaria infection frequencies by both microscopy and RDT, though no statistically significant association was established. *P. vivax* co-infections were detected across multiple blood groups, highlighting the emerging epidemiological significance of *P. vivax* in this region. These findings establish a host biological baseline for malaria surveillance in Bayelsa State and underscore the need for larger population-level studies with adequate blood group representation to clarify the nature and magnitude of any blood group effect on malaria susceptibility in the Niger Delta.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

REFERENCES

Abdulmalik, A. S., Ibrahim, H. S., and Abdullahi, A. D. (2025). An Assessment of the Role of ABO Blood Group on Malaria Infection in a Heterogenous Community, Kaduna – Nigeria. *FUDMA Journal of Sciences* (FJS). 9:6; 52–56 DOI: https://doi.org/10.33003/fjs-2025-0906-3500

Afoakwah, R., Aubyn, E., Prah, J., Nwaefuna, E. K., and Boampong, J. (2016). Relative susceptibilities of ABO blood groups to Plasmodium falciparum malaria in Ghana. *Advances in Hematology*. http://iadx.doi.org/10.1155/2016/5368793

Aninagyei, E., Agbenowoshie, S. P., Akpalu, M. P., Asiewe, S. B., Menu, Y. R., Gbadago, F., and Asmah, H. R. (2024). ABO and Rhesus blood group variability and their associations with clinical malaria presentations. *Malaria Journal*, 23, 257. https://doi.org/10.1186/s12936-024-05081-z

Carlson, J., and Wahlgren, M. (1992). Plasmodium falciparum erythrocyte rosetting is mediated by promiscuous lectin binding of knob-associated histidine-rich protein. *Journal of Experimental Medicine*, 176(5), 1311–1317.

Iwueze, M. O., Obidigwe, J. U., and Nwagbo, D. O. (2025). *Plasmodium* infection and its association with ABO blood group among blood donors in Onitsha, Nigeria. *South Asian Journal of Research in Microbiology*, 19(10), 16–30. https://doi.org/10.9734/sajrm/2025/v19i10466

Muhammad, A. G., Adamu, B. S., and Muhammad, R. H. (2025). Malaria parasitaemia associated with ABO blood groupings and Rhesus factor among patients attending Specialist Hospital Bauchi, Bauchi State, Nigeria. https://doi.org/10.1101/2025.07.23.25331896

Osisiogu, U. N., Agyapong, G. A. A., Mahmoud, F. C., Waqas, F. B., Calebina Appiah, C. and Nikoi, C. N. (2023). ABO blood group and malaria susceptibility in southeastern Nigeria. *Nigerian Journal of Parasitology*, 44(1), 45–52.

Rowe, J. A., Opi, D. H., and Williams, T. N. (2007). Blood group antigens in Plasmodium falciparum malaria pathogenesis: New insights into an old debate. *Trends in Parasitology*, 25(1), 30–40.

World Health Organization (WHO). (2024). World malaria report 2024. Geneva: WHO.

Zhang, H., Chen, G., Ma, P., & Lai, Y. (2025). Unraveling the HIV-malaria interactions: a bibliometric analysis of global research trends and emerging insights. *Frontiers in Microbiology*, *16*, 1622769.

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