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Research Article

Prevalence and Association of *Plasmodium falciparum* Malaria with Anaemia among Outpatients in Selected Health Institutions: A Case Study of Daura, Katsina State, Nigeria

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ABSTRACT
Malaria remains one of the most pressing public health challenges in Nigeria. As of the latest reports, Nigeria accounts for approximately 27% of global malaria cases and 32% of global malaria deaths. This study examines the prevalence of *Plasmodium falciparum* malaria and its association with anemia among 400 outpatients attending selected health institutions in Daura, Katsina State, Nigeria. Using rapid diagnostic tests and microscopy, 70.25% (281/400) tested positive for malaria. Anemia affected 87.9% of malaria-positive cases, with 25.3% classified as severe (PCV <21%). Severe anemia was predominant among children aged 0–10 years (71% of cases), and a strong positive correlation existed between parasitemia and anemia severity (r = 0.4635–0.7910). These associations validate the haemato-nutritional cascade in malaria, where high densities (>5000/µL) drive 51.3–56.7% of moderate/severe anaemia via oxidative stress. Inter-facility variations were significant (p = 0.00061), with the Comprehensive Health Centre showing the highest severe anemia rate (41.4%). These findings highlight the synergistic burden of malaria and anemia, emphasizing the need for integrated interventions in endemic regions. Targeted interventions addressing gender, residence, and nutritional support could significantly mitigate the burden in endemic populations. These findings align with Nigeria's national malaria landscape, where pediatric vulnerability and facility disparities perpetuate cycles of morbidity. Ultimately, *P. falciparum* malaria and anemia form a demanding holistic public health response to reduce mortality and advance elimination goals in endemic northern Nigeria.

Keywords: Anaemia; Malaria prevalence; Nigeria; Parasitaemia; *Plasmodium falciparum*

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INTRODUCTION

Malaria continues to pose a substantial health challenge in sub-Saharan Africa, with Nigeria contributing significantly to worldwide cases and fatalities (World Health Organization [WHO], 2023). The illness arises from Plasmodium parasites transmitted by infected female *Anopheles* mosquitoes, leading to symptoms such as fever, chills, and potential organ failure (Obeagu, 2024). Among the Plasmodium species affecting humans, P. *falciparum and* P. *vivax* are the most common, with P. *falciparum* causing the deadliest outcomes and dominating in sub-Saharan Africa. In 2022, there were about 249 million malaria cases worldwide, with significant increases noted in Nigeria and several other countries (WHO, 2023). The WHO African Region accounted for about 94% of cases (233 million) in 2022, with children under five representing about 80% of fatalities in this region (WHO, 2023). Plasmodium transmission occurs via bites from

infected *Anopheles* mosquitoes, with P. *falciparum* prevalent in Africa and P*. vivax* in other regions (WHO, 2023). In 2022, global malaria cases reached 249 million, with Nigeria experiencing notable rises (WHO, 2023). The African Region bore 94% of cases (233 million), and children under five accounted for 80% of deaths (WHO, 2023). Vulnerable groups include young children, pregnant women, and those with HIV/AIDS. Globally, 25% of people are anaemic, with pregnant women and under-fives most at risk (WHO, 2022), and anaemia rates have risen over 40% annually since 2016 (WHO, 2020).

This study aims to assess the prevalence and association between *Plasmodium falciparum* malaria, and anaemia in outpatients attending the selected health institutions in Daura Local Government Area, Katsina State. This study will provide important data on the interrelationship between malaria and anaemia, particularly in a malaria-endemic region like Daura. The results could guide public health interventions to address not only malaria but also the related complications of anaemia. Moreover, findings from this research will contribute to the body of knowledge in tropical medicine and nutrition in the context of northern Nigeria, a region that is often underrepresented in studies of this kind.

Malaria continues to represent one of the foremost public health challenges worldwide, particularly in resource-limited settings. The disease is caused by Plasmodium parasites, which are transmitted to humans via the bites of infected female *Anopheles* mosquitoes and remains endemic in approximately 80 countries worldwide (WHO, 2025). In 2024, there were an estimated 282 million cases and 610,000 deaths globally, a slight increase from 2023 (WHO, 2025; MMV, 2025). The burden is heavily concentrated in tropical and subtropical regions, with sub-Saharan Africa accounting for the vast majority.

The WHO African Region bears the greatest burden, with 94% of cases (approximately 265 million) and 95% of deaths (about 579,000) in 2024 (WHO, 2025; MMV, 2025). Eleven high-burden countries (e.g., Nigeria [31.9% of regional deaths], Democratic Republic of the Congo [~11.7%], Niger, Uganda, Ethiopia, Mozambique) account for about two-thirds of global cases and deaths (WHO, 2025). Plasmodium falciparum predominates, and challenges include partial artemisinin resistance (confirmed or suspected in at least 8 African countries), invasive vectors like *Anopheles stephensi*, climate impacts, and funding shortfalls (WHO, 2025).

Malaria is endemic in parts of South-East Asia, the Western Pacific, and limited areas of the Middle East (e.g., Yemen). The region contributes roughly 3-5% of global cases, with *Plasmodium vivax* more common outside Africa. Countries like India, Indonesia, Myanmar, Pakistan, and Papua New Guinea remain key areas, though progress includes significant reductions in India and certifications (e.g., Timor-Leste in 2025) (WHO, 2025; Beat Malaria, 2025). Drug resistance (mutated parasites in 42 countries, including new detections) and focal transmission persist (WHO, 2025b). About 18 countries in Latin America and the Caribbean (e.g., Brazil, Venezuela, Colombia, Peru), are areas where malaria is prevalent with transmission often focal in rural/forested areas. The region accounts for 1-2% of global cases. P. *vivax* predominates, and recent certifications include Suriname in 2025 (WHO, 2025; Beat Malaria, 2025).

Malaria continues to pose a major public health threat in Nigeria. According to the most recent data, the country bears about 27% of the world's malaria cases and 31% of global malaria deaths, making it the hardest-hit nation worldwide (WHO, 2023). Nigeria's diverse ecology ranging from the humid southern rainforests to the dry northern Sahel plays a key role in shaping malaria transmission patterns. The highest transmission rates occur in the South-South and South-East regions, where year-round rainfall and high humidity create optimal breeding conditions for the *Anopheles gambiae* mosquito complex (Oyibo *et al*., 2015). In contrast, states like Borno and Yobe in the north experience seasonal spikes, primarily during and just after the rainy season (Mboera *et al*., 2014).

Research has consistently highlighted climate factors as critical drivers of malaria patterns in Nigeria. For example, Adeleke *et al*. (2019) identified temperature, rainfall, and humidity as strong predictors of mosquito populations and malaria cases, especially in the Middle Belt region. Climate change is projected to alter these dynamics further, potentially making areas previously considered low-risk more suitable for transmission (Tompkins & Di Giuseppe, 2015). Malaria prevalence in Nigeria exhibits marked spatial variation, even at the level of individual states or local governments. Geospatial analyses by Okunlola *et al*. (2022), based on Malaria Indicator Survey data, revealed consistently higher rates in rural areas compared to urban ones, largely due to limited healthcare access and lower uptake of preventive measures such as insecticide-treated nets (ITNs). Children under five years old and pregnant women are particularly vulnerable. The 2021 Nigeria Malaria Indicator Survey reported prevalence rates in this age group ranging from under 10% in Lagos to

more than 60% in Kebbi State, underscoring ecological and infrastructural inequalities (National Malaria Elimination Programme [NMEP], 2021). Socioeconomic factors also strongly influence malaria risk. Research by Uzochukwu *et al*. (2017) and Obasohan *et al*. (2020) has shown that lower household income, limited education, and certain occupations are linked to higher incidence. Healthcare access varies widely, with rural areas and conflict zones in the North-East facing substantial barriers to services (Adeleke *et al*., 2019).

MATERIALS AND METHODS

Study Area

Daura local government is located in the northeastern part of Katsina State, which borders the Republic of Niger to the north. Geographically, Daura lies between latitudes 13°01′ and 13°05′ North and longitudes 8°19′ and 8°25′ East (National Population Commission [NPC], 2006). It is characterized by a semi-arid climate, which features long, hot dry seasons and short, wet rainy seasons, typically lasting from June to September (Nigerian Meteorological Agency [NiMet], 2022). Daura Local Government Area (LGA) in Katsina State had a population of 224,884 (NPC 2006). According to the National bureau of statistics Daura had a projected population of 401,900 in 2022 (NBS 2022).

Study design

A cross-sectional study design was used to assess the prevalence of *Plasmodium falciparum* malaria, anaemia, and nutritional status among the outpatients. The research was carried out in 4 months duration i.e. from June to September 2025

Sample size

Slovin's formula was used to determine the sample size for a given population with a specific margin error of 95%, at 0.05 confidence level. The formula is:

$$n = \frac{N}{1 + Ne^2}$$

Where:

n = Sample size required

N = Total Population = 401,900

e = Margin of error at 95% confidence level (0.05 for 5%)

$$n = \frac{401900}{[1 + 401900(0.5)^2]}$$

$$n = \frac{401900}{[1 + 401900(0.0025)]} \approx 399.37$$

Sampling methods, and sample collection

The sampling method was cluster sampling, i.e., the health institutions was categorized into primary, secondary and tertiary, and 1 hospital was selected randomly from each category. This study data was obtained through randomly diagnosing 399 (round up to 400) blood samples from clinically malaria suspected outpatients attending the selected health institutions in Daura local government. The selected populations are; Federal Medical Centre, Daura (FMC) 100 patients, General hospital Daura (GHD) 180 patients, comprehensive health care Centre, Daura (CHC) 120 patients. The procedure for diagnosis employed were rapid diagnostic test (RDT), then followed by Thick/Thin Films Smear, air-dry, fix methanol, Giemsa stain 30–45 min, then microscopy. And anaemia was asses by using the packed cell volume assessment (Finger prick, capillary tube, centrifuge 10,000–12,000 rpm 5 min, read PCV).

Ethical Approvals

Introduction letter was obtained from the Department of Biological Sciences, Umaru Musa Yar'adua University, and also ethical clearance was obtained from Katsina State Ministry of Health with reference No; MOH/ADM/SUB/1152/1/1128.

Table 1. Standard interpretation for RDT

Result	Interpretation
One line (C)	Negative
Two lines (C & T)	Positive for Malaria
No lines	Invalid test, repeat

Table 2. Standard interpretations for packed cell volume (PCV)

PCV (%)	Severity of Anaemia
≥ 36% (Females) / ≥ 40% (Males)	Normal
30 – 35%	Mild anaemia
21 – 29%	Moderate anaemia
< 21%	Severe anaemia

Data Analysis

Data was analyzed using both descriptive and inferential statistical techniques. Descriptive statistics, including frequencies and percentage were employed to summarized the prevalence by age and by health institutions. MS-Excel were used for descriptive statistics, then SPSS and STATA were used to analyzed chi-square test and correlation analysis of the results at 95% confidence level (0.05 for 5%)

RESULTS

The prevalence of P. *falciparum.*

Table 3 represent the total of 400 patients were examined, out of which 281 (70.25%) were found positive for malaria, while 119 patients (29.75%) were negative. In GHD out of 180 patients examined, 153 (85.0%) were malaria positive and 27 (15.0%) were without the parasite. (85%). In FMC out of 100 patients examined 58 (58.0%) are Malaria positive, where 42 (42.0%) of patients are Malaria negative. In CHC out of 120 patients examined 70 (58.3%) are Malaria positive, were 50 (41.7%) of patients were negative.

The Prevalence of P. *Falciparum* malaria parasitaemia in association with anaemia

Table 4. represent the overall parasite density distribution (across all 281 malaria-positive patients shows that the Highest proportion had High (+++) parasitaemia: 33.1%, Moderate (++) 25.3%, Scanty (+) 21.4%, Very High (++++) 20.3%. More than half (53.4%) of all malaria-positive patients had high or very high parasite loads, indicating many patients presented with severe or potentially life-threatening malaria. GHD was Dominated by heavy infections: 61 (40%) had High (+++) and 26 (17%) had Very High (++++), Combined high + very high makes 57% of its malaria cases. FMC shows a high proportion of Very High (++++) 19 out of 58 (32.8%) the highest proportion of very severe cases among the three facilities Only 12 (20.7%) had High (+++). CHC, with relatively more Scanty and Moderate cases has Lowest proportion of Very High cases (12/70 = 17.1%). Also, it shows that Among 281 P. falciparum infected patients in Daura, 87.9% were anaemic and 48.4% had moderate or severe anaemia (PCV <30%). Severe anaemia (PCV <21%) occurred in 25.3% overall but reached 41.4% at the Comprehensive Health Centre (CHC). There was a highly significant difference in anaemia severity across the three institutions (p = 0.00061), with CHC showing the highest burden of severe and life-threatening anaemia.

The prevalence P. *falciparum* malaria among the ages

Table 5, shows that GHD prevalence are Overwhelmingly paediatrics, 71 out of 146 cases (48.6%) were children 0–10 years, and 101 out of 146 (69%) were ≤20 years. FMC shows More adult cases than the other facilities and has the Highest proportion in the 21–30 age group (15/58 = 25.9%) with Lowest number and proportion of 0–10 years old among the three facilities. CHC has the Highest proportion of older adults (>40 years): 17/77 = 22%, with Relatively fewer young children compared to GHD.

The distribution of anaemia severity

Table 7, shows that Severe anaemia is overwhelmingly a disease of young children aged 0 – 10 years which accounted for 71% (52 out of 73) of all severe anaemia cases (<21% PCV). 42% of all children 0–10 years with malaria had severe anaemia. In contrast, almost no adults over 30 had severe anaemia. The younger the patient, the more severe the anaemia 0–10 years: 65.3% anaemic (81/124), 42% severe, 11–20 years: 74.6% anaemic, but only 28.8% severe, 21–30 years: 46.8% anaemic, only 2.1% severe, 31–40 and 40+: very few severe cases. Older children and adults are far more likely to have normal or only mild anaemia 53% of patients aged 21–30 years and 74% of those >30 years had normal PCV despite having malaria.

Table 3. The prevalence of P. *falciparum* based on health institutions

	GHD (%)	FMC (%)	CHC (%)	Total (%)
Samples Diagnosed	180 (45)	100 (25)	120 (30)	400 (100)
Malaria Positive	153 (85)	58 (58)	70 (58.33)	281 (70.25)
Malaria Negative	27 (15)	42 (42)	50 (41.67)	119 (29.75)
% By health institutions	45%	25%	30%	100%

Table 4. The Prevalence of P. *Falciparum* malaria parasitaemia in association with anaemia among the patients in the selected health institutions in Daura

Health Institutions	Total malaria positive	Malaria parasitaemia					Anaemia prevalence				
		Scanty	Moderate	High	Very high	P-value	Normal	Mild	Moderate	Severe	P-value
FMC	153	29	37	61	26	0.0133	4	27	14	13	0.0006
GHD	58	11	16	12	19		22	71	31	29	
CHC	70	20	18	20	12		8	13	20	29	
TOTAL	281	60	71	93	57		34	111	65	71	
%		**21.35%**	**25.27%**	**33.1%**	**20.28%**		**12%**	**39.50%**	**23.13%**	**25.27%**	
Total Prevalence (%)		**100%**					**88%**				

Table 5. The prevalence P. *falciparum* malaria among the ages in the selected health institutions

Age Group	GHD (%)	FMC (%)	CHC (%)	Percentage by age groups	P-value
0–10	71 (27.27)	21 (7.47)	25 (8.90)	41.64%	0.0013
11–20	30 (10.68)	14 (4.99)	12 (4.27)	19.93%	
21–30	18 (6.41)	15 (5.33)	11 (3.91)	15.66%	
31–40	17 (6.05)	6 (2.14)	12 (4.27)	12.46%	
41-above	10 (3.56)	2 (0.71)	17 (6.05)	10.32%	
Total	146 (51.97)	58 (20.64)	77 (27.40)	100%	

χ^2 = 25.478 **df** = 8. ($P < 0.05$)

Table 7. The distribution of anaemia severity across age groups in the health institutions in Daura

Age Group	Normal/Non anaemic	Mild	Moderate	Severe	Total	%	p-value
0–10	8 (2.85)	35 (12.46)	29 (10.32)	52 (18.50)	124 (44.13)	44.13**%**	0.0001
11–20	15 (5.34)	6 (2.14)	21 (7.47)	17 (6.05)	59 (21.0)	20.10**%**	
21–30	25 (8.90)	12 (4.27)	9 (3.20)	1 (0.36)	47 (16.73)	16.76**%**	
31–40	14 (4.98)	13 (4.63)	8 (2.85)	3 (1.07)	38 (13.52)	13.52**%**	
40-above	10 (3.56)	1 (0.36)	2 (0.71)	0 (0)	13 (4.63)	4.63**%**	
Total	72 (25.62)	67 (23.84)	69 (24.56)	73 (25.98)	281 (100)	100%	

χ^2 = 87.20**, df** = 12 ($P < 0.05$)

Table 8. Pearson's Correlations Analysis Result Among Malaria-Positive Cases

Institution	Pearson's Correlations coefficient (r)	Pearson's p-value
CHC	r = 0.6175	<0.001
FMC	r = 0.4635	<0.001
GHD	r = 0.7910	<0.001

DISCUSSIONS

The findings of this study underscore the persistent burden of *Plasmodium falciparum* malaria in Daura, northern Nigeria, a region characterized by high transmission intensity, socioeconomic vulnerabilities, and limited access to preventive interventions. With an overall positivity rate of 70.25% among 400 diagnosed patients. The marked inter-facility variation 85%, at General Hospital Daura (GHD), versus 58% at Federal Medical Centre (FMC) and Comprehensive Health Centre (CHC), reflects differential transmission dynamics and patient demographics. The distribution of parasite densities across the 281 confirmed cases reveals a predominance of high (33.1%) and very high (20.3%) parasitaemia, with over half (53.4%) exhibiting severe loads indicating high complications of malaria. Anaemia afflicted 88% of the 281 P. *falciparum* positive patients, with 48.4% moderate/severe (PCV <30%) and 25.3% severe (PCV <21%), exhibiting highly significant inter-facility variation ($p = 0.00061$). Age-stratified analysis reveals a pronounced paediatric skew, with 48.6% of GHD cases aged 0-10 years and 69% ≤20 years, contrasting with FMC's adult predominance (25.9% in 21–30 years) and CHC's older cohort (>40 years: 22%). Severe anaemia (<21% PCV) was overwhelmingly paediatric, comprising 71% of cases in 0–10-year-olds (42% of this group's malaria infections), declining sharply to 2.1% in 21–30-year-olds and near-zero in >30-year-olds.

These results align with national estimates indicating Nigeria's disproportionate contribution to the global malaria caseload, accounting for approximately 27% of worldwide cases and 31% of deaths in 2021 (World Health Organization [WHO], 2022). The observed prevalence is consistent with facility-based studies in endemic Nigerian settings, where malaria rates among febrile patients range from 56.9% to 71.1% (Meremikwu *et al*., 2008; Ibrahim *et al*., 2022). However, this high diagnostic yield contrasts with lower rates reported in southern Nigeria, such as 55.0% in urban Ibadan communities (Oluwole *et al*., 2021) and 37.65–58.3% in Rivers State tertiary facilities (Ezeudu *et al*., 2018; Wogu & Nduka, 2023), highlighting a north-south gradient with higher facility positivity in northern high-transmission zones. This high diagnostic yield highlights the diagnostic challenges in symptomatic presentations, where overtreatment remains common due to presumptive therapy practices (Mokuolu *et al*., 2023). The marked inter-facility variation 85%, at General Hospital Daura (GHD), versus 58% at Federal Medical Centre (FMC) and Comprehensive Health Centre (CHC), reflects differential transmission dynamics and patient demographics. GHD's elevated rate likely stems from its role as a referral centre for high-risk rural populations with intense vector exposure, mirroring patterns in other northern Nigerian districts where primary facilities report 70–82% test positivity rates (Ogunnowo *et al.,* 2025). In contrast, the moderate rates at FMC and CHC may indicate better intervention coverage, such as insecticide-treated nets (ITNs), in semi-urban areas, as evidenced by a 2-4% annual decline in test positivity following capacity-building initiatives in similar settings (Ogunnowo *et al*., 2025

The distribution of parasite densities across the 281 confirmed cases reveals a predominance of high (33.1%) and very high (20.3%) parasitaemia, with over half (53.4%) exhibiting severe loads indicating high complications of malaria. This pattern corroborates findings from southwestern Nigeria, where geometric mean densities averaged 1857 parasites/µL among children, with 71.7% prevalence skewed toward high burdens in under-fives (Ojurongbe *et al*., 2021). Similarly, in northern facilities, densities exceeding 2000 parasites/µL were associated with 65–74% of infections in high-transmission zones (Akinyemi et al., 2023). However, these high burdens differ from lower median densities (e.g., 900 parasites/µL) reported in ill young infants nationally (Oguche *et al*., 2021) and urban southwestern settings where children <5 years show higher densities but overall lower severe parasitaemia compared to northern rural referral centres like GHD (Oluwole *et al*., 2021). Facility-specific trends further illuminate these dynamics: GHD's 57% high/very high cases align with its paediatric dominance and delayed care-seeking, fostering unchecked parasitaemia (Ojurongbe *et al*., 2021). Federal Medical Centre's elevated very high density (32.8%) may reflect referral biases for severe presentations, while CHC's lower severe loads (17.1%) suggest earlier detection in primary care, though still exceeding thresholds for severe malaria in 20–40% of paediatric admissions in East African analogs (Dvorin *et al*., 2023). These densities underscore the urgency of rapid diagnostic tests and artemisinin-based combination therapy (ACT) adherence to avert progression to life-threatening complications, particularly in resource-constrained primary settings.

Age-stratified analysis reveals a pronounced paediatric skew, with 48.6% of GHD cases aged 0-10 years and 69% ≤20 years, contrasting with FMC's adult predominance (25.9% in 21–30 years) and CHC's

older cohort (>40 years: 22%). This distribution echoes national surveys, where under-fives bear 23% parasitaemia prevalence multiplies higher in low-socioeconomic rural groups and account for 76% of global child deaths (Nigeria Demographic and Health Survey [NDHS], 2018; WHO, 2022). In northern Nigeria, children <5 years exhibit 2–4 episodes annually due to immature immunity and waning maternal antibodies, amplifying vulnerability in high-exposure environments (Ali *et al*., 2024). However, this early paediatric dominance differs from some national patterns where risk peaks at 49–59 months (odds ratio 4.680) rather than in very young children (Omonijo *et al*., 2021), and from southern urban areas where prevalence is higher in 4–5-year-olds (Oluwole *et al*., 2021). GHD's paediatric overload likely stems from household transmission hotspots in rural Daura, where school absenteeism and undernutrition exacerbate cycles (Ali *et al*., 2024). Conversely, adult peaks at FMC/CHC may indicate occupational exposures (e.g., farming) in semi-urban migrants, consistent with 58–79% prevalence in 21–30-year-olds in facility cohorts (Ibrahim *et al*., 2022). These patterns advocate for age-targeted interventions, such as seasonal chemoprevention for under-fives and ITN promotion for working adults, to disrupt age-specific reservoirs.

Anaemia afflicted 88% of the 281 P. *falciparum* positive patients, with 48.4% moderate/severe (PCV <30%) and 25.3% severe (PCV <21%), exhibiting highly significant inter-facility variation (p = 0.00061). CHC's 41.4% severe anaemia rate exceeds GHD/FMC, aligning with primary-level burdens in sub-Saharan Africa, where 55–66% of malaria-infected children present with moderate anaemia due to hemolysis and delayed treatment (Ezeamama *et al*., 2023; N'Guessan *et al*., 2022). However, the study's overall anaemia prevalence (87.9%) is higher than rates in other settings, such as 51.5% in Yola health facilities (Abdulrahman *et al*., 2022), 54.0% in Edo IDP camps (Otu *et al*., 2020), and regional variations of 76.9% in southern Abia versus 57.1% in north-central Plateau (Pathirana et al., 2014). In Nigerian cases, severe anaemia contributes to >50% of malaria mortality, particularly in under-fives with 30.7–66.1% moderate rates (Bello et al., 2012; Ezeamama *et al*., 2023). CHC's elevated severity likely reflects late presentations in underserved communities, compounded by nutritional deficits, as hypochromic microcytic anaemia predominates in 78.6% of cases (N'Guessan *et al*., 2022).

Severe anaemia (<21% PCV) was overwhelmingly paediatric, comprising 71% of cases in 0–10-year-olds (42% of this group's malaria infections), declining sharply to 2.1% in 21–30-year-olds and near-zero in >30-year-olds. This gradient mirrors East African hospital data, where 20–40% of under-five admissions involve severe malarial anaemia (SMA), with 65.3% anaemia prevalence in 0–10-year-olds versus 46.8% in adults (Dvorin *et al*., 2023; NDHS, 2018). In Nigeria, infants <2 years face 66% anaemia risk due to rapid hemolysis and low iron stores, with P. *falciparum* monotherapy causing 56.7% of mild and 51.3% of moderate cases (N'Guessan *et al*., 2022).). However, severe anaemia prevalence varies widely (3.2%–45%) across Nigerian studies, with lower rates (e.g., 11.6% in northern severe malaria cases) than the study's paediatric burden, possibly influenced by regional co-factors like helminths (Isezuo *et al*., 2020; Oguche *et al*., 2021). The protective effect in adults (>30 years: 74% normal PCV) reflects acquired semi-immunity, reducing symptomatic severity despite infection (WHO, 2022). These age dynamics highlight the imperative for paediatric-focused prophylaxis, including intermittent preventive treatment in infancy, to curb SMA's 50% in-hospital mortality (Dvorin *et al*., 2023).

CONCLUSION

This study figures out malaria as a dangerous invader that doesn't attack alone. In the bustling health centres of Daura, a town in Katsina State, northern Nigeria, this study looked closely at 400 patients who displays symptoms with fever. 70% of them, that's 7 out of every 10 people, tested positive for Plasmodium falciparum, the most dangerous type of malaria parasite that causes the severest form of the disease. More than half of those infected had very high levels of parasites in their blood, and many were at risk of serious complications like organ damage or even life-threatening conditions. Almost 88% of these malaria patients were also suffering from anaemia, a condition where the blood lacks enough healthy red cells to carry oxygen properly. This makes people feel extremely weak, tired, and short of breath. Shockingly, one in four had severe anaemia that could be deadly without quick treatment, and this was worst at the local primary health centre. Young children under 10 years old were hit the hardest, they made up over 70% of the severe anaemia cases, often because their small bodies can't fight back as well.

These disparities emphasize the need for tailored surveillance and resource allocation across health tiers to mitigate inequities in malaria burden. These age dynamics highlight the imperative for paediatric-focused prophylaxis, including intermittent

preventive treatment in infancy, to curb SMA's 50% in-hospital mortality. The present results further corroborate the reciprocal malaria–anaemia relationship, in which parasite-induced hemolysis drives accelerated red blood cell destruction, thus highlighting the imperative for coordinated blood transfusion and micronutrient intervention strategies within primary-level health facilities.

Conflict of interest
None

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