Investigation of Malaria by Microscopy among Febrile Outpatients of a Semi-Rural Nigerian Medical Center: What Happened to Malaria Control Programs?

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Abstract

Background: Older reports estimate that malaria accounts for 60% of outpatient clinic encounters in Nigeria. However, current estimates suggest that malaria control programs have considerably reduced malaria-related morbidity and mortality on a global scale. The extent to which these programs impacted malaria prevalence in endemic countries such as Nigeria after the Millennium-Development Goals era may not have been fully appreciated. This study, therefore, assessed how common malaria was among febrile patients attending a semi-rural medical center in Nigeria. **Materials and Methods:** This was a cross-sectional study involving 290 randomly selected general and pediatric outpatients (who fulfilled inclusion criteria) attending the Federal Medical Centre, Birnin Kudu in August 2016. It assessed participants' clinical features, insecticide-treated net usage and presence of malaria parasitemia (confirmed by microscopy). **Results:** Participants' overall mean age was 18.4 ± 16.3 years (ranging from 0.25–62.0 years); 146 (50.3%) were females; 73.4% used insecticide-treated-net the previous night. Their mean overall temperature was 37.7°C ± 1.1°C. Overall malaria prevalence was 65.5%; however, the incidence was highest in ≥15 years age-group (30.3%) followed by ≤4 years age group (20.7%). Clinical features predicting malaria parasitemia were pallor (odds ratio [OR] = 5.03, 95% confidence interval [CI] = 1.96–14.42) and history of convulsion (OR = 4.06, 95% CI = 1.53–10.78). Their median parasite density was 1 ± 1.3. Clinical features poorly predicted malaria parasite density among participants. **Conclusion:** The malaria prevalence in this study was worryingly high. There is a need to review or modify current malaria control programs using more comprehensive strategies if reduction in the malaria-related morbidity and mortality in this and similar settings is desired.

Keywords: Febrile patients, malaria prevalence, Northern Nigeria, rural

Introduction

Malaria is a preventable and curable infectious disease caused by *Plasmodium* species. The infected female anopheline mosquito bite is responsible for the parasite's transmission. *Plasmodium falciparum* causes most morbidity and mortality from malaria. Nearly 97% of the Nigerian population is at risk of malaria infection.[1] Malaria accounts for 50%–60% of outpatient visits in Nigeria with about 132 billion naira (≈$471.4 million as at 2016) lost as cost of treatment and lost person-hours.[1-3] In 2015, malaria accounted for an estimated 438,000 deaths globally with 90% of these deaths occurring in Africa, and under-5 children and pregnant women the predominant victims.[4] Combating HIV/AIDS, malaria, and other infectious diseases was the 6th goal of the Mellinium-Development-Goals (MDGs) and had a target of halting and beginning the reversal of malaria incidence by 2015.[5] This global partnership resulted in improved vector control, prompt treatment of cases with Artemisinin Combination Therapies (ACTs), chemophylaxis in pregnant women, infants, nonimmune travelers, and people living with HIV/AIDs and tuberculosis in many affected countries.[6] Consequently, there have been gains in malaria control globally as evidenced by a 60% reduction in malaria

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death rates from 2000 to 2015.[4] However, some scholars have criticized the implementation of the MDGs in Nigeria and have associated implementation deficiencies to poor resource management in the healthcare system, bureaucratic bottlenecks, frequent healthcare worker industrial action, and Boko Haram insurgency in northern Nigeria.[7] The extent to which global malaria control programs impacted the incidence of malaria in many rural settings in northern Nigeria with poor documentation and reportage of malaria cases has not been fully evaluated.

Evaluation of measurable indicators is an important management tool for improvement in public health programs;[8] hence, assessing the success of malaria control programs will require among other indicators, the regular evaluation of malaria morbidity and mortality. We, therefore, assessed how common malaria was among febrile patients attending the general and pediatric outpatient clinics (GOPC and POPC) of Federal Medical Centre, Birnin Kudu. We hope that the study findings may help malaria control program managers reassess the magnitude of the disease and the control strategies towards reducing the malaria burden. With the prevailing presumptive malaria treatment of febrile patients observed in many resource-limited settings like ours,[9] the study outcome may also help to improve the rational use of ACTs in the treatment of febrile patients.

Materials and Methods

Study setting

This descriptive cross-sectional study was conducted at the GOPC and POPC of Federal Medical Centre Birnin Kudu, northwest Nigeria. Birnin Kudu is about 120 km southeast of Kano and lies between latitude 11.45°N and 9.475°E. It has a similar climate with Kano and located in the Sahel savanna with a hot, semi-arid climate. It has an average rainfall of about 690 mm (27.2'') annually, most of which occurs from June to September.[10] It is typically hot but is cooler from December to February.[10] Nigeria is endemic for malaria with moderate-to-high transmission in the whole country.[3]

The study population were patients with history of fever in the preceding 72 h or an axillary temperature of ≥37.5°C[11] who were accessing healthcare services at the GOPC and POPC during the study, from August 2 to 30, 2016 (a period of high malarial transmission in the area).[6] This period also coincides with the period of peak utilization of the clinics in the preceding year.

Sample size estimation

Using a malaria parasitemia prevalence of 35.7% reported in Makarfi, Northwest Nigeria[12] and Leslie Fisher's formula [$n = Z_{\alpha}^2 pq/d^2$], a sample size (n) of 353 was obtained. Since an average of 40% of 450 adults (180) seen at the GOPC weekly and the 80% of 200 children (160) seen weekly at the POPC had febrile illnesses, our target population was 1360 (340 × 4, estimated number of febrile patients in the 4-week study period). Then, using the formula ($n_f = n/1+n/N$) for estimating the sample size for populations <10,000, the desired minimum sample size (n_f) of 272 was obtained.

Sampling technique

A systematic random sampling technique was used to select every 5th febrile adult and child (sampling frame/sample size = 1360/272 = 5) proportionately from patients attending the GOPC and POPC. An average of six and five patients was recruited daily from the GOPC and POPC respectively until the sample sizes of 144 GOPC and 128 POPC were reached.

Selection criteria

All children (aged ≤14 years) with fever (≥37.5°C) or history of fever within the preceding 72 h at the POPC and those ≥15 years with fever or similar history at the GOPC were included in the study. Participants or caregivers who had ingested or given ACT to their children before presentation or who declined consent were excluded from the study.

Data collection

A pretested, semi-structured, investigator-administered questionnaire was used for data collection after a written informed consent or accent had been obtained. The questionnaire assessed the participants' sociodemographics, use of insecticide-treated nets (ITNs) the previous night, and clinical history and signs. Participants' household monthly income was an estimate of all incomes into the family reported by the participants or their caregivers. A household monthly income of <₦16 800 ($60 at $2/day as at 2016) was defined as low-household income.[13] In addition, thick and thin smears were prepared from blood collected by pinprick from each participant. Samples were stained with Giemsa stain for 45–60 min (in 3% dilution), washed in buffered solution (pH 7.2), dried and examined under oil immersion for malaria parasites using light microscopy at ×100 by a trained microscopist. Thin blood smear was used for parasite species identification. In the thick blood smear, if no parasite was found in 100 oil-immersion microscopic fields, it was considered malaria parasite negative. Malaria was defined as the presence of malaria parasites on microscopy. The plus sign grading system was used to estimate the parasite density by counting the number of parasites per high-power field (HPF) of the microscope.[14] A count of 1–10 parasites per 100 HPF was defined as (+), 11–100 parasites per 100 HPF (++), 1–10 in every HPF (+++), and ≥10 in every HPF (++++).[14] A second microscopist who was unaware of the results of the first microscopist, checked the entire thick smears for quality assessment. For participants who were pale on physical examination, blood was also collected for packed cell volume (PCV). Axillary temperature was measured using the digital thermometer (Tro-digitherm [water resistant], LOT: 12639-01, Troge Medical GMBH, Hamburg Germany, 2016). Participants were subsequently managed according to the hospital's treatment protocols.

Ethical approval

Ethical approval was obtained from the Federal Medical Centre, Birnin Kudu, Ethics and Research Committee. Written informed consent was obtained from all adult

participants (≥18 years) and cargivers of children; however, assent was also obtained from children who were ≥7 years of age in addition to their caregiver's consent.

Data management

Data were entered and analyzed using Epi Info Version 7.1.1.14 (2012) (CDC, Atlanta GA, USA). Continuous variables were summarized using measures of central tendencies (means, median and standard deviations) whereas categorical variables were presented in frequency tables. Student's *t*-test was used to compare malaria prevalence among age groups whereas Mann–Whitney test was used to compare continuous variables with skewed distribution such as malaria parasite density. Chi-square test was used to determine the relationship between selected sociodemographic variables, clinical characteristics of participants, and malaria parasitemia as well as parasite density. Logistic regression was used to examine independent effects of significant variables on malaria parasitemia and parasite density to find the predictors of malaria parasitemia and parasite density. In building the covariates for the regression model, clinical characteristics were classified as presence or absence of variables (Yes/No), whereas age was grouped into participants <15 years (pediatric clinic) and ≥15 years (general outpatients clinic). The secondary outcome variable, malaria parasite density consisted of those with lower density (1+ and 2+) and those with higher density (≥+3). $P < 0.05$ was considered statistically significant.

Results

Sociodemographic characteristics of participants

A total of 290 participants were proportionately recruited from both clinics and were used for analysis. Their overall mean age was 18.4 ± 16.3 years; however, the mean age for the 0–4, 5–14 and ≥15 years age-groups were 2.1 ± 1.1 years (range: 0.25–4.0 years), 8.7 ± 2.9 years (range: 5–14 years), and 30.6 ± 13.2 years (range: 15–62 years), respectively. There were 146 (50.3%) females [Table 1]. Most participants were residents of Birnin Kudu local government area (212, 73.1%) of Jigawa state (239, 82.4%). Most participants (196, 67.5%) were either unemployed or reported a monthly household income of <₦16800 (<$60). Majority (213, 73.4%) reported sleeping under ITN the previous night.

All *Plasmodium* species identified in this study were *P. falciparum*.

Participants' clinical features and malaria prevalence

Majority of participants (175, 60.3%) had fever (temperature of ≥37.5°C) at recruitment. Their overall mean temperature was 37.7°C ± 1.1°C (range = 33.7°C–40.7°C). However, the mean temperatures were higher among participants ≤14 years (i.e., 0–4 years, 38.3°C ± 1.0°C) and (5–14 years, 38.3°C ± 1.1°C) than those ≥15 years (37.2°C ± 0.9°C) ($P < 0.001$). A majority had nonspecific symptoms, namely general body weakness (73.4%), headache (58.3%), and body aches (56.9%) [Table 2]. However, fewer number of participants (55, 19%) had symptoms suggestive of other causes of fever, namely respiratory tract infection, urinary tract infection, sickle-cell vasoocclusive crisis, otitis media, and meningitis. Physical examination findings included pallor (21%), abdominal organ enlargement (spleen or/and liver, 13.8%), and jaundice (4.5%). Nearly Sixty-one (21%) participants had PCV test; their mean PCV was 17.7 ± 5.9% (range = 17.0%–29.0%). The overall prevalence of malaria was 65.5% [Table 2]. The ≥15 years age group had the highest prevalence of 30.3% whereas 5–14 year age had the least (14.5%).

Table 1: Sociodemographic characteristics of participants

Variables	*n* (%)
Age (years)	
≤4	83 (28.6)
5-14	54 (18.6)
≥15	153 (52.8)
Sex	
Male	144 (49.7)
Female	146 (50.3)
LGA of residence	
Birnin Kudu	212 (73.1)
Takai	30 (10.3)
Ningi	18 (6.2)
Gwaram	13 (4.5)
Others	17 (5.9)
State of residence	
Jigawa	239 (82.4)
Kano	33 (11.4)
Bauchi	18 (6.2)
Reported household monthly income (Naira*)	
Unemployed	99 (34.1)
<16,800	97 (33.4)
16,800-40,000	35 (12.1)
40,001-60,000	36 (12.4)
60,001-100,000	17 (5.9)
≥100,000	6 (2.1)
Use of ITN	
No	77 (26.6)
Yes	213 (73.4)

*₦280 naira=$1 in 2016. LGA: Local government area, ITN: Insecticide-treated net

Malaria parasite density among participants

Of the 190 (65.5%) participants with malaria parasitemia, 75 (39.4%) participants had 1+ parasite density whereas 115 (60.6%) had 2+ and above [Table 3]. The median malaria parasite density was 1 ± 1.3; however, the median parasite density among all participants was higher among the 0–14 year age group (2 + 1.4) compared to those ≥15 years (Mann–Whitney test $P = <0.001$).

Relationship between participants' sociodemographics and malaria parasitemia

Similarly, there was higher proportion of participants with malaria among ≥15 years old (46.3%), followed by ≤4 year (31.6%) and by 5– 14-year group (22.1%) ($P = 0.008$) [Table 4]. There were no significant associations between sex, state, or local

Table 2: Participants' clinical features and malaria prevalence

Variable	*n* (%)
Temperature (°C) (mean=37.7±1.1)	
<37.5	115 (39.7)
≥37.5	175 (60.3)
Headache	
No	121 (41.7)
Yes	169 (58.3)
Body aches	
No	125 (43.1)
Yes	165 (56.9)
General body weakness	
No	77 (26.6)
Yes	213 (73.4)
Joint aches	
No	148 (51.0)
Yes	142 (49.0)
Vomiting	
No	217 (74.8)
Yes	73 (25.2)
Convulsion history	
No	241 (83.1)
Yes	49 (16.9)
Diarrhea	
No	244 (84.1)
Yes	46 (15.9)
Bitter taste	
No	198 (68.3)
Yes	92 (31.7)
Loss of appetite	
No	130 (44.8)
Yes	160 (55.2)
Symptoms suggesting other causes of fever	
Absent	235 (81.0)
Present	55 (19.0)
Prostration	
No	281 (96.9)
Yes	9 (3.1)
Jaundice	
No	277 (95.5)
Yes	13 (4.5)
Pallor (conjunctivae, palms)	
No	229 (79.0)
Yes	61 (21.0)
Abdominal organ enlargement (spleen, liver)	
No	250 (86.2)
Yes	40 (13.8)
Overall malaria prevalence	
Absent	100 (34.5)
Present	190 (65.5)
Malaria prevalence in age group	
0-4	60 (20.7)
5-14	42 (14.5)
≥15	88 (30.3)

government area of residence, household monthly income, sleeping under ITN, and malaria parasitemia.

Relationship between participants' clinical features and malaria parasitemia/parasite density

Fever ($\chi^2 = 6.83$, $P = 0.009$), headache ($\chi^2 = 4.78$, $P = 0.03$), body aches ($\chi^2 = 4.09$, $P = 0.04$), joint aches ($\chi^2 = 4.99$, $P = 0.03$), history of convulsion ($\chi^2 = 10.64$, $P = 0.001$), jaundice ($\chi^2 = 4.32$, $P = 0.04$), pallor ($\chi^2 = 18.10$, $P = 0.00002$), and abdominal organ enlargement ($\chi^2 = 5.92$, $P = 0.02$) were found to be associated with malaria parasitemia [Table 5].

Similarly, significant associations were observed between fever ($\chi^2 = 4.4$, $P = 0.04$), headache ($\chi^2 = 5.92$, $P = 0.02$), general body weakness ($\chi^2 = 8.67$, $P = 0.003$), history of convulsion ($\chi^2 = 7.93$, $P = 0.005$) joint aches ($\chi^2 = 14.43$, $P = 0.0002$), bitter taste ($\chi^2 = 12.59$, $P = 0.0004$), other fever causes ($P = 0.003$), and malaria parasite density [Table 5].

Participants' characteristics predicting malaria and malaria parasite density

Logistic regression of variables significantly associated with malaria parasitemia showed that a history of convulsion (odd ratio [OR] = 4.06, 95% confidence interval [CI] = 1.53–10.78, $P = 0.005$) and presence of anemia (OR = 5.32, 95% CI = 1.96–14.42, $P = 0.001$) were the greatest predictors of malaria parasitemia among the study participants [Table 6]. However, there was no participants' characteristic that predicted malaria parasite density [Table 6].

Discussion

This was a hospital-based study in a semi-rural setting of Northwest Nigeria, where malaria is known to be stably transmitted all year round.[15] We found that about two-thirds (65.5%) of the participants had malaria. This overall prevalence of malaria was higher than the 35.7% found in Makarfi (Northwest, Nigeria) in 2015,[12] the 36.6% in Plateau State (northcentral, Nigeria) in 2014,[16] and the 36.1% in Abia state (southeast Nigeria) in 2014.[16] It was also higher than 22% of febrile outpatients in Nairobi, Kenya in 2016.[17] However, our study prevalence was lower than the 71.4% reported in Calabar, South-South Nigeria in 2013.[18] Differences in study geographical location, study population, and their adherence to malaria control measures may explain the differing malaria prevalences. For instance, poor adherence to the use of ITN and other malaria preventive measures by the population at risk was cited in a study in Kano, Nigeria in 2015.[19]

An interesting finding in our study was the highest prevalence of malaria (30.3%) observed in participants ≥15 years. This result differed from similar facility-based studies in Makarfi, Nigeria and Nairobi, Kenya, where the 5–15 and 5–14 years age-groups, respectively accounted for the highest prevalence of malaria.[12,17] This variation could be due to differences in study design (prospective versus retrospective), sampling technique (convenience versus systematic sampling), and unique differences in study population (including larger sample sizes in the previous studies and behavior toward malaria prevention). While a shift in attention to children

Table 3: Malaria parasite density among the participants

Variable	*n* (%)	Median	Range
Density			
1+	75 (39.4)	-	-
2+	46 (24.2)		
3+	44 (23.2)		
4+ and above	25 (13.2)		
All parasite positive	190 (65.5)	1±1.3	1-4
Age			
0-4	83 (28.6)	2±1.4†	0-4
5-14	54 (18.6)	2±1.4†	0-4
≥15	153 (52.8)	1±1.4†	0-4

†Mann-Whitney test $P \leq 0001$

Table 4: Relationship between sociodemographics and malaria parasitemia

Variable	Malaria		Test statistic
	Absent, *n* (%)	Present, *n* (%)	
Age (years)			
0-4	23 (23.0)	60 (31.6)	χ^2=9.60
5-14	12 (12.0)	42 (22.1)	P=0.008*
≥15	65 (65.0)	88 (46.3)	
Sex			
Male	43 (43.0)	101 (53.2)	χ^2=2.70
Female	57 (57.0)	89 (46.8)	P=0.10
LGA of residence			
Birnin Kudu	70 (70.0)	142 (74.7)	χ^2=0.75
Others**	30 (30.0)	48 (25.3)	P=0.39
State of residence			
Jigawa	80 (80.0)	159 (83.7)	χ^2=0.61
Others***	20 (20.0)	31 (16.3)	P=0.43
Household monthly income (Naira)			
Lower income†	62 (62.0)	134 (70.5)	χ^2=2.17
Higher income††	38 (38.0)	56 (29.5)	P=0.14
Slept under ITN previous night			
No	23 (23.0)	54 (28.4)	χ^2=0.99
Yes	77 (77.0)	136 (71.6)	P=0.32

*Significant; **Albasu, Buji, Dutse, Gwaram, Hadejia, Ningi, Ringim, Sara, Takai, and Tarauni; ***Kano and Bauchi States; †Unemployed and income <₦16,800 (<$60), ††Income ≥16,800

under 5 years of age, and children of 5–15 years leaving home for boarding school and other purposes, thereby losing parental control and supervision have been cited as the reason for higher prevalences in 5–15 years age group,[12] this age group had the least malaria prevalence in our study. The reason for this difference may need further investigation. However, our study's malaria parasitemia prevalence (30.3%) in those ≥15 years was similar to the 28.1% reported among adults in an endemic area of Kenya,[20] but was <4.8% found in Makarfi, Nigeria.[12] This result may not be surprising as 97% of the Nigerian population is at risk of malaria[1] but incidences can be modified by malaria control behaviors of individuals and communities.

Furthermore, the prevalence of malaria in the children under 5 years in this study was 20.7%. The result was higher than the 11.7% found in Makarfi, Nigeria, in 2015,[12] but was similar to the 23% reported in Nairobi, Kenya in 2016,[17] and the 27.7% reported in Maiduguri, Northeast Nigeria in 2015.[11] This variance may be due to differences in study location. Birnin Kudu is a border town with an express road linking the northwest with the northeast region of Nigeria. The insurgency in the northeast region has led to population migration to neighboring states and towns that are relatively safe. This migratory population who often abandon some or all malaria preventive behaviors may have been receiving care at our study site. This may partly explain the similarity observed in the under-5 malaria prevalence in a facility that serves a migratory population in Nairobi Kenya,[17] University of Maiduguri Teaching Hospital in Maiduguri (one of the cities affected by Boko Haram insurgency),[11] and our study result.

In addition, some reports have identified three major challenges to reduction of malaria burden in endemic countries such as Nigeria that may explain our study findings.[21] Sustaining national and international fundings of effective malaria reduction strategies such as the provision of ITNs, rapid malaria diagnostic tests, and ACTs have been limited by global economic recession affecting donor countries. This is worsened by poor health system resource management, corruption and frequent health workers strikes in some countries such as Nigeria. Second is the threat and potential emergence and spread of artemisinin-resistant *Plasmodium. falciparum* parasite in sub-Saharan Africa.[21] This has resulted in poor parasite clearance in those treated with ACTs, thus increasing malaria transmission. Finally, the established resistance of malaria vector to pyrethroid-insecticides in ITNs.[22] This render the ITNs largely ineffective in some countries in Sub-saharan Africa.

We also observed that all the *Plasmodium* species identified in this study were *P. falciparum*. This was consistent with findings from other studies.[15,16,23] However, we found no significant association between ITN use and malaria parasitemia despite a majority having used ITN the previous night. This finding was also consistent with another study in Maiduguri, Nigeria.[11] Since the prevention of malaria requires a multi-pronged approach, this finding suggest that the study participants may have poorly adhered to other preventive measures that our study did not assess.

We also found that though age (<15 years), fever, headache, body ache, joint aches, history of convulsion, jaundice, pallor, and splenic/hepatic enlargement were associated with malaria, only history of convulsion and pallor predicted malaria. This is at variance with the result from a study in Sokoto, Nigeria were myalgia, throat pain, absence of lung crepitations, fever, vomiting and body weakness were good predictors of malaria.[24] This may be due to differences in the study population. While the Sokoto study was

Table 5: Relationship between participants' clinical features and malaria parasitemia/parasite density

Variable	Malaria		Test statistic	Parasite density		Test statistic
	Absent, *n* (%)	Present, *n* (%)		<+3	≥3+	
Age (years)						
<15	35 (35.0)	102 (53.7)	χ^2=9.18	52 (43.0)	50 (72.5)	χ^2=15.37
≥15	65 (65.0)	88 (46.3)	*P*=0.003*	69 (57.0)	19 (27.5)	*P*=0.00009*
Temperature (°C)						
<37.5	50 (50.0)	65 (34.2)	χ^2=6.83	48 (39.7)	17 (24.6)	χ^2=4.41
≥37.5	50 (50.0)	125 (65.8)	*P*=0.009*	73 (60.3)	52 (75.4)	*P*=0.04*
Headache						
No	33 (33.0)	88 (46.3)	χ^2=4.78	48 (39.7)	40 (58.0)	χ^2=5.92
Yes	67 (67.0)	102 (53.7)	*P*=0.03*	73 (60.3)	29 (42.0)	*P*=0.02*
Body aches						
No	35 (35.0)	90 (47.4)	χ^2=4.09	51 (42.2)	39 (56.5)	χ^2=3.64
Yes	65 (65.0)	100 (52.6)	*P*=0.04*	70 (57.8)	30 (43.5)	*P*=0.06
General body weakness						
No	24 (24.0)	53 (27.9)	χ^2=0.51	25 (20.7)	28 (40.6)	χ^2=8.67
Yes	76 (76.0)	137 (72.1)	*P*=0.48	96 (79.3)	41 (59.4)	*P*=0.003*
Joint aches						
No	42 (42.0)	106 (55.8)	χ^2=4.99	55 (45.4)	51 (73.9)	χ^2=14.43
Yes	58 (58.0)	84 (44.2)	*P*=0.03*	66 (54.6)	18 (26.1)	*P*=0.0002*
Vomiting						
No	73 (73.0)	144 (75.8)	χ^2=0.27	95 (78.5)	49 (71.0)	χ^2=1.35
Yes	27 (27.0)	46 (24.2)	*P*=0.60	26 (21.5)	20 (29.0)	*P*=0.25
Convulsion history						
No	93 (93.0)	148 (77.9)	χ^2=10.64	102 (84.3)	46 (66.7)	χ^2=7.93
Yes	7 (7.0)	42 (22.1)	*P*=0.001*	19 (15.7)	23 (33.3)	*P*=0.005*
Diarrhea						
No	82 (82.0)	162 (85.3)	χ^2=0.52	103 (85.1)	59 (85.5)	χ^2=0.005
Yes	18 (18.0)	28 (14.7)	*P*=0.47	18 (14.9)	10 (14.5)	*P*=0.94
Bitter taste						
No	62 (62.0)	136 (71.6)	χ^2=2.78	76 (62.8)	60 (87.0)	χ^2=12.59
Yes	38 (38.0)	54 (28.4)	*P*=0.10	45 (37.2)	9 (13.0)	*P*=0.0004*
Loss of appetite						
No	45 (45.0)	85 (44.7)	χ^2=0.002	54 (44.6)	31 (44.9)	χ^2=0.003
Yes	55 (55.0)	105 (55.3)	*P*=0.97	67 (55.4)	38 (55.1)	*P*=0.91
Other fever causes						
Absent	75 (75.0)	160 (84.2)	χ^2=3.60	95 (78.5)	65 (94.2)	*P*=0.003†,*
Present	25 (25.0)	30 (15.8)	*P*=0.06	26 (21.5)	4 (5.8)	
Prostration						
No	99 (99.0)	182 (95.8)	*P*=0.13†	116 (95.9)	66 (95.7)	*P*=0.94†
Yes	1 (1.0)	8 (4.2)		5 (4.1)	3 (4.3)	
Jaundice						
No	99 (99.0)	178 (93.7)	*P*=0.04*	112 (92.6)	66 (95.7)	χ^2=0.71
Yes	1 (1.0)	12 (6.3)		9 (7.4)	3 (4.3)	*P*=0.40
Pallor						
No	93 (93.0)	136 (71.6)	χ^2=18.10	90 (74.4)	46 (66.7)	χ^2=1.29
Yes	7 (7.0)	54 (28.4)	*P*=0.00002*	31 (25.6)	23 (33.3)	*P*=0.33
Organ enlargement						
No	93 (93.0)	157 (82.6)	χ^2=5.92	100 (82.6)	57 (82.6)	χ^2=0.00
Yes	7 (7.0)	33 (17.4)	*P*=0.02*	21 (17.4)	12 (17.4)	*P*=0.99

*Significant; †Fishers exact test

carried out in children, our study population included both children and adults. Furthermore, our clinical predictors for malaria were symptoms and signs that could be attributed to severe malaria, making their use in outpatient clinics of poor-resourced settings less appealing as such patients would mandatorily require laboratory diagnosis and treatment while on admission. However, a febrile child with convulsion and pallor should raise the index of suspicion for malaria in

Table 6: Participants' characteristics predicting malaria and malaria parasite density

Variable	OR	95% CI	Coefficient	*P*
Malaria parasitemia				
Age (≥15/<15) years	0.70	0.22-2.21	−0.36	0.54
Temperature (≥37.7/<37.5) °C	1.52	0.83-2.77	0.42	0.17
Headache (yes/no)	1.54	0.58-4.12	0.43	0.39
Body ache (yes/no)	1.68	0.61-4.64	0.52	0.32
Joint ache (yes/no)	0.97	0.40-2.32	−0.03	0.94
Convulsion (yes/no)	4.06	1.53-10.78	1.40	0.005*
Jaundice (yes/no)	2.93	0.31-27.39	1.07	0.35
Pallor (yes/no)	5.32	1.96-14.42	1.67	0.001*
Organ enlargement (yes/no)	0.99	0.33-2.88	−0.01	0.98
Constant	-	-	−0.43	0.31
Malaria parasite density				
Age (≥15/<15) years	0.54	0.18-1.63	−0.61	0.27
Fever (yes/no)	1.09	0.50-2.38	0.09	0.83
Headache (yes/no)	1.70	0.69-4.22	0.53	0.25
General body weakness (yes/no)	0.67	0.31-1.43	−0.41	0.30
Joint aches (yes/no)	0.55	0.21-1.47	−0.60	0.23
Bitter taste (yes/no)	0.43	0.17-1.09	−0.84	0.08
Constant	-	-	0.08	0.85

*Significant. CI: Confidence interval, OR: Odd ratio

endemic areas such as our study site with a need to commence antimalarial therapy when laboratory tests are absent or laboratory results are delayed. Similarly, the clinical features of our study participants were not good predictors of parasite density and may not be useful in assessing the severity of parasitemia; this is consistent with the result from a previous study.[12]

Policy implication

The prevalence of malaria parasitemia in this study was worryingly high; suggesting that global gains in malaria control have not rubbed-off in our study population. Hence, the need to review or modify current malaria control programs. New strategies that include improved national security, sustained funding for malaria control programs and proper health resource management may be required to reduce the current malaria-related morbidity and mortality. Clinicians in malaria-endemic poor-resourced settings may use the presence of pallor and history of convulsion (especially in children) in making clinical decision to diagnose and to treat malaria.

Limitations of the study

This was a hospital-based study, and the true prevalence of malaria may have been underestimated as many patients may have been treated at primary healthcare posts within the community. We did not exclude participants who could not confirm the use of antimalarial drugs at home as this could influence malaria parasitemia if indeed medicines ingested at home included antimalarials.

Conclusion

Malaria prevalence is still worryingly high among the study's participants. The need to review or modify malaria control programs using more comprehensive strategies is required if reduction in the malaria-related morbidity and mortality in this and similar settings is desired.

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Conflicts of interest

There are no conflicts of interest.

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