Prevalence and Determinants of Malaria Infection Among Children of local farmers in Central Malawi

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Abstract

Background: Malaria is a leading cause of morbidity and mortality among children under five in Malawi, and especially among those from rural areas of central Malawi. The goal of this study was to examine the prevalence and determinants of malaria infection among children in rural areas of the Dowa district in central Malawi.

Methods: A multistage cross-sectional study design was used to systematically sample 523 child-mother dyads from postnatal clinics. A survey was administered to mothers and a rapid malaria infection diagnostic test was administered to children. The main outcome was positive malaria diagnostic tests in children. Logistic regressions were used to determine risk factors associated with malaria among children aged 2 to 59 months.

Results: The prevalence of malaria among children under five years was 35.4%. Results suggest that children of mothers who experienced recent intimate partner violence were more likely to be diagnosed with malaria (*AOR*: 1.88, 95% *CI*: 1.19–2.97; *P* = 0.007) than children of mothers who did not. Children of mothers who had no formal education were more likely to be diagnosed with malaria (*AOR*: 2.77, 95% *CI*: 1.24–6.19; *P* = 0.013) than children of mothers who had received secondary education. Children aged 2 to 5 months and 6 to 11 months were less likely to be diagnosed with malaria (*AOR*: 0.21, 95% *CI*: 0.10–0.46; *P* = 0.000 and *AOR*: 0.43; 95% *CI*: 0.22–0.85; *P* = 0.016, respectively) than children aged 24 to 59 months.

Conclusion: We found that the prevalence of malaria infection among children in the study area was comparable to the national level. In addition to available malaria control programs, further attention should be paid to children whose mothers have no formal education, children aged 24 to 59 months and children of mothers that are exposed to IPV in the area.

Background

Malaria is a mosquito-borne disease that kills a significant number of people in Africa every year (1). The pathology is mainly caused by the *Plasmodium falciparum* parasite and is transmitted to human beings through female anopheles mosquito bites (2). In 2017, 61% of cases of malaria worldwide were in children under the age of five. Geographically, approximately 92% (200 million) of malaria cases in the world were diagnosed in Africa, claiming about 404,550 lives (1).

In Malawi, malaria is among the top three most significant public health issues. Nearly 4 million people are diagnosed with the infection every year (3). Malawi accounts for 2% of malaria cases worldwide and is among the top 15 countries with a high malaria burden (WHO, 2018). Children under five and pregnant women are at a high risk for malaria morbidity compared to other groups in Malawi (4). Since 2005, the Malawi government has been implementing comprehensive malaria control programs that target more than 85% of its population. The two main strategies have been preventing the malaria vector mosquitoes from biting people and case management. Prevention efforts include promoting the use of insecticide-treated nets (ITNs) and indoor spraying of insecticide. Case management includes diagnostic testing and prescribing antimalarial drugs to children with positive malaria tests (5). These strategies are combined with messages about social behavioural changes in order to increase community uptake and utilization (6).

Despite these investments, little progress has been made so far to reduce the burden of malaria in children under five in Malawi. Studies have shown that the prevalence of malaria among children detected by a gold standard microscopy technique was at 28% in 2012; it increased to 33% in 2014 and slightly dropped to 24% in 2017 (7). Malaria morbidity among children is not evenly distributed across Malawi. According to the national data collected through malaria rapid diagnostic tests (RDTs) and microscopy in 2017, the prevalence of child malaria is significantly higher in rural areas (40.6% and 27.5%) compared to urban areas (6% and 4%). In addition, the prevalence of malaria among children in central Malawi was higher (39.7%) compared to children in southern (36.4%) and northern (19.4%) regions (8). These studies suggest that geographical space plays a significant role in malaria prevalence among children. Therefore, there is a need to broaden the scope of studies that consider social and environmental risk factors for malaria to inform local policies and programs.

We chose to conduct this study in rural areas of the Dowa district in Malawi for two reasons. First, the Dowa district is one of the highest-risk areas for child malaria in Malawi. Despite this, there is no literature to date that specifically focuses on this region apart from the national aggregated studies (8). Second, we wanted to contribute to the study by Sassi (9) who assessed the risk factors of child undernutrition in the Dowa district. In her study, she used household access to mosquito nets as a proxy variable for malaria control among children. Her assumption was that children from households without mosquito nets would be more likely to suffer from malaria as there are synergistic interactions between the two child morbidities. Our study specifically used cross-sectional quantitative data to examine individual and household risk factors for child malaria infection in order to understand the phenomenon in the Dowa district.

Methods

Study setting

The study was implemented in six postnatal clinics in the Dowa district of central Malawi in southern Africa (Figure 1). Malawi has a population of about 17,563,749 people (8). In 2017, about 71% of the population was living in extreme poverty according to United Nations indicators (10). Malaria is an endemic disease in Dowa and the surrounding districts, but higher numbers of cases are recorded during and after the rainy season (December to July) due to increased potential breeding environments (9,11). We conducted this study between May and September in 2018 because this period would allow us to capture average malaria cases in the study areas.

Study sample

A multistage descriptive cross-sectional study design was employed to select a representative sample of children aged 2 to 59 months and their mothers in the Dowa district. We randomly selected six out of eight outreach clinics that were part of the Mvera mission hospital. The selected clinics were located in Gogo, Ching'amba, Mkhalanjoka, Kalinyengo, Mvera and Mphande, within approximately five to ten kilometres of the Mvera mission hospital. During the study, the Mvera mission hospital served a population of 27,719 people, of whom 5,240 were mothers with a child under five years old. A total population of 4,527 mothers with children between 2 and 59 months were identified in postnatal registers in the six randomly selected postnatal clinics. Our sample size was determined by a Raosoft sample size calculator (12). A margin of error of 5% with a 95% confidence level and 50% response distribution was set.We used a systematic sampling strategy to select a sample of 523 children and their mothers from the postnatal registers.[1] We randomly picked a name for the first child-mother dyad and subsequently picked every ninth child-mother dyad.

Participant recruitment

We contacted the selected mothers and their children in the six postnatal clinics during the regular monthly health screening for children. The screening program is an initiative of the Malawi government to promote maternal and child health through a framework of a continuum of care for mothers, newborns and children (13). Community health workers who were assigned as research assistants sought informed consent from mothers to take part in the study. All interviews took place in the consultation room at each outreach postnatal clinic using a pre-tested questionnaire. The questionnaire contained questions on household sociodemographic characteristics, household food security, house structure type, use of mosquito nets and maternal exposure to Intimate Partner Violence (IPV). The child's and the mother's anthropometric and health status data from their health passports was recorded in the questionnaire after their health screening program was completed (14).

Measures

Outcome variable

The main outcome variable of our study was malaria infection in children 2 to 59 months old. The term child malaria infection was operationalized as the presence of the malaria parasite in children's red blood cells as recorded in the child's health passport (15). In all the postnatal clinics, RDTs were used to assess the malaria parasitaemia in children. If the diagnostic test was positive, the child was coded as 1 = malaria infection, and 0 = otherwise.

Explanatory variables

We selected potential covariates of child malaria infection in our model based on current literature in Malawi and other countries in SSA (16–21). These were characteristics of the children, who were our study population, characteristics of the parents that influence childcare practices and characteristics of the household. Our covariate variables were child gender, age and weight at birth. We also included variables capturing the child's history of other morbidities in the past 30 days as reported by the mother. These included diarrheal episodes and acute respiratory infection (ARI); child deworming in the past 12 months was also considered. Child nutrition status was determined through height-for-age, weight-for-height, and weight-for-age Z-score values. Child stunting, underweight and wasting were categorized as those that were ≤ -2 standard deviations of height-for-age, weight-for-age and weight-for-height Z-scores (22).

Other independent variables that were considered as risk factors for child malaria include the mother's age, level of education, pregnancy planning and exposure to Intimate Partner Violence (IPV) perpetrated by their current or recent husband. We assessed cases of IPV using a WHO multi-country study questionnaire on women's health and life experiences that was validated and used in Malawi (23,24). The questionnaire contains 18 items that make up four sub-scales measuring different forms of IPV: physical abuse, emotional abuse, controlling behaviour and sexual abuse. Maternal exposure to IPV was operationalized as any mother who reported that they experienced any form of IPV.

The fathers' characteristics were also considered as risk factors. These include level of education, age and health risk behaviours such as alcohol consumption and smoking. Household malaria predisposing and enabling factors in Malawi such as the use of an Insecticide-treated bed nets (ITN), household poverty, type of dwelling, and presence of animals in the house were included. We asked mothers if the child had an ITN, and whether the child slept under the net the night before the survey. Household poverty was defined based on the international poverty measure of US$1.90 a day (25). The presence of animal kraals/sheds within one to ten metres of the dwelling house was considered a risk factor (26). We also asked the mothers if their houses had been sprayed with insecticides and how many people were sleeping in the house.

Survey enumerators administered the survey on Android tablets using an Open Data Kit (ODK). We used a WHO protocol for conducting research on sensitive topics because some of the questions in our study focused on domestic violence (27,28). Enumerator orientation and questionnaire pre-testing was conducted for five days. A PhD candidate in social work, a clinical officer and an environmental health officer were responsible for training the enumerators. The research team, including the enumerators, had professional training in community health, nutrition and primary health care.

Research Ethics Review

Ethics approval to conduct this study was obtained from the University of Livingstonia research ethics committee in Malawi (protocol number: UNILIA-REC-4/18) and the Research Ethics Board of McGill University in Canada (protocol number: REB File #: 503-0518). Written permission was also sought from the Dowa district commissioner's office, the Dowa district health office and the Mvera mission hospital management. We obtained oral consent from local health leaders and research participants in the study areas.

Data analysis

The Kolmogorov–Smirnov test was used to test the normality of the distribution of numerical variables. These include age, number of children, number of household members and household food security. We constructed categorical variables from our numerical data because we found that our data was not normally distributed (29). Bivariate logistic regressions were performed to examine significant predictors of child malaria. Significant predictors of child malaria at the bivariate level of (p 0.05) were included in the final multivariable logistic regression model using the forward enter method.

We tested the multicollinearity of explanatory variables and obtained a variance inflation factor (VIF) of 5,143, which indicated independence among the explanatory variables both at the individual and the cluster level. Consequently, a fixed effects model was used to account for the clustering effect in our analysis. The results of the multivariable analysis have been reported as crude and adjusted odds ratios with a 95% confidence interval (*CI*). A *p* value of less than 0.05 was considered statistically significant in our study. The data was analyzed using an IBM Statistical Package of Social Sciences (SPSS) for Windows version 23.0 (IBM Corp., Armonk, NY, USA).

[1] We determined that a sample size of 355 was adequate but increased our sample size because we had resources to do so. The larger sample size increased the accuracy and precision of the estimates.

Results

Sociodemographic characteristics of study population

Sociodemographic and malaria infection data for all 523 selected children aged 2 to 59 months was obtained over four months (see Table 1). In terms of gender, 49.1% of the children were girls and 50.9% were boys. In terms of age, 13.4% of the sample was aged 2 to 5 months, 17.2% was aged 6 to 11 months, 29.6% was aged 12 to 23 months, and 41.9% was aged 24 to 59 months. We observed that 14.3% of the selected children were born with a low birth weight (birth weight of less than 2.5 kg). 27.2% of the mothers reported that their children did not sleep under mosquito nets the night before the survey. 67.1% of mothers reported that their children had signs of fever 30 days preceding the survey. We found that 42.0% of the children were stunted, and 11.3% were underweight.

In terms of parental characteristics, we found that 15.3% of the mothers had no formal education, 68.1% had a primary education and 16.6% had a secondary education. 75% (n = 392) of the mothers reported that they experienced IPV perpetrated by their current or most recent partner in the past 12 months. Regarding age, 7.5% of the mothers were 15 to 19 years old, 57.3% were 30 to 39 years old, 29.6% were 30 to 39 years old, and 5.5% were 40 to 49 years old. We observed that 88.7% (n = 464) of the mothers reported that they had received childcare counselling during their pregnancy. With respect to the fathers, the study found that 14.5% (n = 76) had no formal education, 56.2% (n = 296) had a primary education, and 28.7% (n = 150) had a secondary education. Slightly less than half of the husbands (43%) were beer drinkers and a quarter (26%) were tobacco smokers.

The study found that 11.3% (n = 59) of the households had pigs and 22.4% (n = 117) had goats in kraals/sheds close to their dwelling. Regarding house construction materials, 25.8% (n = 135) of the children lived in brick-walled houses, and only 12.8% (n = 67) lived in iron-roofed houses.

Table 1: Characteristics of children, mothers and fathers, and the environment

Mothers' characteristics	**Age (years)**	**N = 523**	**%**
	15–19	39	7.5
	20–29	299	57.3
	30–39	155	29.6
	40–49	29	5.5
	Education		
	No education	80	15.3
	Primary	356	68.1
	Secondary	87	16.6
	Received childcare education		
	Yes	464	88.7
	No	59	11.3
	Exposed to IPV		
	Yes	392	75.0
	No	131	25
	Confidant		
	Yes	382	73.0
	No	141	27.0
Children's characteristics	**Nutrition status**		
	Stunted	219	42.0
	Not stunted	304	58.0
	Underweight	59	11.3
	Normal weight	57	10.6
	Fever		
	No	172	32.9
	Yes	351	67.1
	Malaria		
	No	338	62.6
	Yes	185	35.4
	Cough		
	Yes	213	40.7
	No	308	58.9
	Child birth weight		
	Normal	447	85.6
	Low birth weight	75	14.3
	Dewormed		
	Yes	240	45.9
	No	283	54.1
	Sleep under mosquito net		
	Yes	380	72.8
	No	142	27.2
	Sex		
	Female	257	49.1
	Male	275	50.9
	Age		
	2–5	59	13.4
	6–11	90	17.2
	12–23	155	29.6
	24–59	219	41.9
Husbands' characteristics	**Age category**		

	15–24	85	16.3
	25–34	239	45.7
	35–49	199	38.0
	Educational level		
	No education	76	14.5
	Primary	296	56.2
	Secondary	150	28.7
Household characteristics	**Poverty level (US$1.90/day)**		
	Below poverty line	500	95.6
	Above poverty line	23	4.4
	Keep pigs around		
	Yes	59	11.3
	No	464	88.7
	Keep goats around		
	Yes	117	22.4
	No	406	77.6
	Number of children		
	1–2	283	54.4
	3–4	162	31.0
	5 and more	75	14.4
	Walls of house		
	Mud/sticks	387	74.1
	Bricks	135	25.8
	Roof of house		
	Grass thatched	455	87.0
	Iron sheets	67	12.8
	Indoor residual spraying (IRS)	0	0

Prevalence and factors associated with child malaria in bivariate and multivariate analyses

The study found that 35% of children (n = 185) were diagnosed with the malaria parasite within 48 hours prior to the research interview. There was no gender difference in malaria cases among the sampled children ($\chi2$ = 0.00, *df* = 1, *p* = .987). Unadjusted logistic regressions (Table 2) indicate that children of mothers who had no formal education were more likely to be diagnosed with the malaria parasite than children of mothers with a secondary school education (crude odds ratio [*COR*]: 2.92, 95% *CI*: 1.44–5.91, *P* = 0.003). Children who were in the age range of 2 to 5 and 6 to 11 months were less likely to be diagnosed with malaria compared to children who were in the age range of 24 to 59 months (*COR*: 0.14, 95% *CI*: 0.07–0.26, *P* = 0.000 and *COR*: 0.26, 95% *CI*: 0.16–0.44, *P* = 0.000, respectively). Children whose mothers experienced IPV in the form of controlling behaviour in the past 12 months were more likely to be diagnosed with the malaria parasite than children whose mother did not (*COR*: 2.92, 95% *CI*: 1.44–5.91, *P* = 0.003). Children who were consistently sleeping under mosquito nets were less likely to be diagnosed with the malaria parasite than children who were not regularly sleeping under the net (*COR*: 0.45, 95% *CI*: 0.30–0.75, *P* = 0.001). Children who did not receive deworming drugs were more likely to be diagnosed with the malaria parasite than children who were dewormed (*COR*: 2.61, 95% *CI*: 1.79–3.82, *P* = 0.000). Children whose mothers had female confidants were less likely to be diagnosed with the malaria parasite than children whose mothers had no confidant (*COR*: 0.64, 95% *CI*: 0.43−0.99, *P* = 0.048). Children whose fathers were in the age range of 15 to 24 years old were less likely to suffer from malaria than children whose fathers were in the age range of 35 to 49 (*COR*: 0.55, 95% *CI*: 0.33−0.91, *P* = 0.021). Finally, children whose mothers were in the age range of 30 to 39 years old were less likely to suffer from malaria than children whose mothers were 40 to 49 years old (*COR*: 0.14, 95% *CI*: 0.07−0.26, *P* = 0.000).

Table 2: Crude and adjusted odds ratios (95% *CI*) for factors associated with child malaria in the Dowa district

Variables		Crude *OR*	(95% *CI*)	*P-value*	Adjusted *OR*	(95% *CI*)	*P-value*
Mother's education	No education	2.92	1.44–5.91	0.003	2.77	1.24–6.19	0.013
	Primary	1.12	0.69–1.80	0.656	1.07	0.62–1.87	0.806
	Secondary	1			1		
Child's age (months)	2–5	0.14	0.07–0.26	0.000	0.21	0.10–0.46	0.000
	6–11	0.26	0.16–0.44	0.000	0.43	0.22–0.85	0.016
	12–23	0.64	0.40–1.02	0.063	0.91	0.52–1.57	0.136
	24–59	1			1		
Child dewormed	No	2.61	1.79–3.82	0.000	1.42	0.84–2.39	0.191
	Yes	1			1		
Child ITN use	Yes	0.47	0.30–0.75	0.001	0.72	0.43–1.20	0.200
	No	1			1		
Husband's age	15–24	0.55	0.33–0.91	0.021	0.83	0.47–1.54	0.588
	25–34	1.09	0.73–1.63	0.678	1.24	0.78–1.96	0.362
	35–49	1			1		
IPVAM (control)	Yes	1.83	1.22–2.74	0.003	1.88	1.19–2.97	0.007
	No						
Confidant	Yes	0.64	0.43–0.99	0.48	0.70	0.43–1.12	0.136
	No	1					
Mother's age	15–19	0.37	0.12–1.19	0.096	0.39	0.11–1.48	0.168
	20–29	0.40	0.13–1.07	0.068	0.45	0.15–1.34	0.152
	30–39	0.31	0.11–0.86	0.025	0.29	0.10–0.90	0.032
	40–49	1					
Note: 1 is a reference category							

In multivariable analysis (Table 2), the odds of children being diagnosed with malaria was higher among children whose mothers had no formal education than among children whose mothers had a secondary education (*AOR*: 2.77, 95% *CI*: 1.24−6.19, *P* = 0.013). It was also found that children whose mothers had experienced IPV in the form of controlling behaviour in the past 12 months had higher odds of being diagnosed with the malaria parasite compared to children whose mothers did not experience IPV in the past year (*AOR*: 1.88, 95% *CI*: 1.19−2.97, *P* = 0.007). Children who were 2 to 5 and 6 to 11 months old were less likely to suffer from malaria than children who were 24 to 59 months old (*AOR*: 0.21, 95% *CI*: 0.10−0.46, *P* = 0.000 and *AOR*: 0.43, 95% *CI*: 0.22−0.85, *P* = 0.016, respectively). Finally, children of mothers who were 30 to 39 years old were less likely to be diagnosed with the malaria parasite than children whose mothers were 40 to 49 years old (*AOR*: 0.29, 95% *CI*: 0.10−0.90, *P* = 0.032).

Discussion And Implication

This study examined the prevalence of and risk factors for malaria infection among children 2 to 59 months old in order to contribute to the understanding of various sociodemographic determinants associated with poor child health in rural areas of the Dowa district in Malawi. The prevalence of child malaria in this study area was 35.4%, which was equivalent to the national malaria prevalence in 2017 (36%) (NMCP and ICF. 2018) and just slightly lower than malaria prevalence in central and rural Malawi, at 39.7% and 40.6%, respectively. This finding raises concerns regarding whether the long-lasting insecticidal nets (LLINs), and Sulfadoxine Pyrimethamine preventive treatment programs that were introduced in the study area in 2007 and 2006, respectively, and were still running in 2019, are associated with the reduction in malaria prevalence. But a study by (30) observed that malaria reduction programs in Malawi are facing various challenges, including the failure to understand the social cultural context in the uptake of the malaria control programs. Another study in Malawi suggested that a limited number of health workers and poor prescription of antimalarial drugs were some of the challenges that constrain malaria prevention in Malawi (31). In the preceding paragraphs, our study identified risk factors that were significantly associated with child malaria infection in the study areas.

This study found that mothers' exposure to IPV in the form of controlling behaviour was a significant determinant of malaria infection in children under five years of age. Our study supports the findings of a study in South Asia where they found that IPV against women was a predisposing factor for child cough, malaria and diarrhea (32). In Tanzania, a nationally representative study also found that children of mothers who were exposed to any form of IPV were at high risk of suffering from fever, cough and diarrhea (33). Two explanations can be offered for the observed association between controlling behaviour IPV and child malaria. First, we anticipate that the husbands' controlling behaviour constrained the mothers' capacity to implement the preventative measures suggested by childcare counsellors, including regularly sleeping under the mosquito net. We also posit that mothers who were experiencing IPV were more likely to be depressed, which may have compromised their capacity to take care of children (34).

In addition, this study found that children of mothers who had no formal education were more likely to suffer from malaria compared to children whose mothers had a secondary education. This reflects findings from a regional study in SSA, which found that households where children of mothers with a sixth-grade education or higher had lower odds of suffering from malaria (OR = 0.73) compared to children of mothers with lower levels of education (35). Our finding can be explained by a study in Malawi, which found that mothers with higher levels of education were more knowledgeable about malaria prevention and signs, and were therefore more proactive and reactive with regard to prevention than mothers with lower levels of education (36).

Furthermore, this study found that children who were over two years old had higher odds of being diagnosed with malaria infection than younger children. This is consistent with other studies which reported that malaria prevalence increases with child age (37,38). This may be because younger children in Malawi share a bed with their mothers and are more likely to be covered properly with a blanket or mosquito net than older children. This suggestion is supported by studies in Uganda and other parts of

Africa where children who were sharing their mother's bed were more likely to sleep under a mosquito net compared to children who were not sharing a bed with their mother (39,40). Another explanation is that the majority of children in Malawi are weaned from breastfeeding at the age of two, after which they receive less caregiver attention and have an increased risk of exposure to malaria vectors (41).

Finally, our study found that children of mothers between 30 to 39 years old were less likely to be diagnosed with malaria than children of mothers between 40 to 49 years old. This finding was surprising, as we originally assumed that children born from adolescent mothers (16-19 years) would be at higher risk of malaria diagnosis than children born of mothers 40 to 49 years. This suggests that children of both adolescent mothers and older mothers may be at risk of poor health outcomes. This support findings from earlier studies. A longitudinal study in South Africa observed similar prevalence of low birthweight among children of adolescent and adult mothers (aged 42), and a study in Kenya found that the survival rate of children of adolescent mothers was similar to that of children of older mothers (aged 43). Therefore, we suggest that child malaria mitigation programs in Dowa district should also pay attention to the needs of older mothers.

Implications for practice

The results of our study demonstrate that malaria infection among children under five is an important public health problem in rural areas of the Dowa district. To address the problem, we suggest that in addition to the available interventions such as LLINs and Sulfadoxine Pyrimethamine preventive treatment programs, health planners should also consider developing malaria control programs that accommodate mothers without formal education. For example, the community-based peer-to-peer malaria education model has been an effective tool for behavioural changes in selected rural areas of southern Malawi, and may be applicable (44,45).

We also suggest that malaria control programs in the study areas should incorporate interventions that address IPV against mothers of young children. The current malaria proactive programs in the Dowa district are gendered as they mainly target mothers by providing them with insecticide-treated mosquito nets and by administering antimalarial drugs during pregnancy. There is a need to involve fathers in all programs that address child malaria. One such intervention could be a community-based participatory child malaria program that involves both men and women, as this has been found to improve fathers' participation in childcare activities in similar contexts (46).

Finally, health professionals should consider engaging parents to find health promotion strategies that can reduce the risk of malaria among children 2 to 5 years old. The interventions should consider the developmental stages of children, geographical space, and the times of day and night that predispose these children to malarial vectors. For example, application of mosquito repellents can protect children from mosquito bites both indoors and outdoors. However, because current evidence on the effectiveness of repellents in the prevention of malaria in developing contexts is inconclusive, more research is needed before this intervention is adopted (47–49).

Strengths and limitations of the study

The main strength of this study is that it is based on a systematic sampling technique and therefore, the findings can be generalized to all children 2 to 59 months old who accessed primary health care services in the studied clinics. Nevertheless, this study has some limitations. First, we conducted the study during the dry season, a period with significantly fewer mosquito-breeding sites compared to the wet season. Therefore, the findings do not represent seasonal variations in malaria prevalence. We suggest that a longitudinal study should be conducted in order to provide a broader picture of malaria infection prevalence and risk factors in the study area. This study also used a cross-sectional design and as such, no causal inference can be made regarding the identified determinants and child malaria infection. Despite these limitations, our study has identified potential risk factors for malaria infection among children under five in rural areas of the Dowa district that can inform local programs.

Conclusion

The current study shows that the prevalence of malaria infection among children aged 2 to 59 months in rural areas of Dowa District was at 35.4%, which is equivalent to the prevalence of the phenomenon at the national level in 2017. Apart from well-known risk factors of child malaria infection such as child age range (24 to 59 months) and lack of maternal formal education, we have identified that maternal exposure to IPV is also a risk factor. Therefore, we suggest that apart from increasing the distribution of treated mosquito nets and malaria screening, child malaria programs in the Dowa district should also consider the negative impact of IPV against mothers in malaria morbidity.

List Of Abbreviations

AOR: Adjusted odds ratios

COR: Crude odds ratios

CI: Confidence interval

IPV: Intimate partner violence

ITN: Insecticide-treated bed nets

NMCP: National Malaria Control Programme

NSO: National Statistics Office

RDT: Rapid diagnostic test

SRQ: Self-reporting questionnaire

SSA: Sub-Sahara Africa

US$: United States dollar

WHO: World Health Organization

Declarations

Ethics approval and consent to participate

We received research ethics approval from the Non-Medical Research Ethics Board at University of Livingstonia in Malawi (UNILIA-REC-4/18), and at McGill University, Canada (REB File #: 503-0518). The study also received written consent from the Dowa district health office. Informed consent was obtained from all participants before each interview.

Consent for publication

We informed the participants that the study will be published to partially fulfill the requirement for a PhD. With full understanding of the research and its intended purpose, all participants gave full consent for us to publish the findings.

Availability of data and materials

The study involved gathering sensitive data according to WHO standards. We documented mothers' disclosures of violence by their current husbands. Due to the sensitivity of the study, the two ethics boards did not recommend sharing the law data publicly.

Competing interests

We declare no competing interests.

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Authors' contributions

EC designed the study, collected and analyzed the data, and wrote the first draft of the manuscript. DCV, HM and CM supervised the study design, data analysis and writing. KC supported the writing of the draft manuscript. All authors read and approved the final manuscript.

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Figures

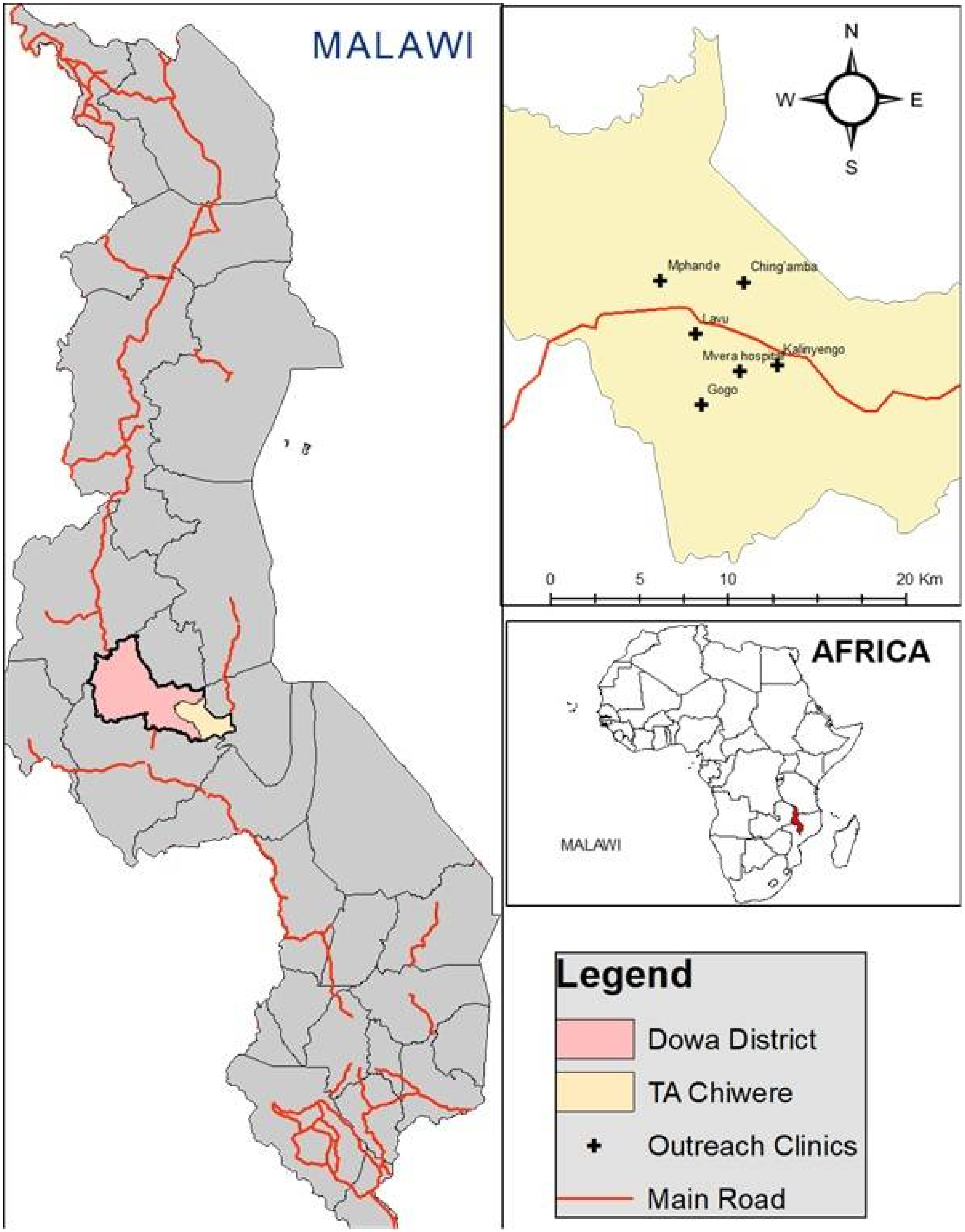

Figure 1

The research setting