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. Children from rural areas of central Malawi have high burden of malaria morbidity compared to other regions. The goals of this study were to examine the prevalence and determinants of malaria infection among children in rural areas of Dowa district in central Malawi.

Methods

A multistage cross-sectional study design was used to systematically sample 523 child-mother dyads from postnatal clinics. The main outcome was child positive malaria diagnostic test during postnatal clinic health assessment. Logistic regressions were used to determine risk factors associated with malaria among children aged 2 to 59 months.

Results

The prevalence of malaria amongst children under five years was 35.4%. The results of multivariable analyses show that children of mothers who experienced recent intimate partner violence (IPV) 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 attained secondary education. In addition, children in the age range of 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 in the age range of 24 to 59 months.

Conclusion

The study found that the prevalence of malaria infection among children in the study area was comparable to that of national level. We propose that malaria control programs among children should also take into account mothers without formal education, mothers with children aged 24 to 59 months, and mothers that are experiencing IPV in the area.

1. Background

Malaria is a mosquito-borne disease that kills a significant number of people in Africa every year (World Health Organization, 2018). The pathology is mainly caused by Plasmodium falciparum parasite and is transmitted to human beings through female anopheles mosquito bites (Acharya, Garg, Kumar, Munjal, & Raja, 2017). 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 that claimed about 404,550 lives (WHO, 2018).

In Malawi, malaria is amongst the top three most significant public health problems. Nearly 4 million people are diagnosed with the infection every year (National Malaria Control Programme (NMCP) and ICF, 2018). Malawi contributes 2% of global malaria cases and is among the top 15 countries with a high malaria burden (WHO, 2018). Children under five years and pregnant women are at high risk of malaria morbidity as compared to other groups in Malawi (Zgambo, Mbakaya, & Kalembo, 2017). Since 2005, the Malawi government has been implementing comprehensive malaria control programs that target more than 85% of its population. The main strategy has been obstructing the malaria vector mosquitoes from biting people. This include promoting the use of insecticide treated nets (ITN), and indoor spraying of insecticides. These strategies are blended with social behavioral change messages in order to increase community uptake and utilization (Nkoka, Chipeta, Chuang, Fergus, & Chuang, 2019).

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 (Mahende et al., 2016; National Malaria Control Programme (NMCP) and ICF, 2018). Malaria morbidity among children is not evenly distributed across Malawi. According to the national data collected through malaria Rapid Diagnostic Tests (RDTs) in 2017, the burden of child malaria is significantly higher in rural areas (40.6%) compared to urban areas (6%). In addition, the prevalence of malaria amongst children in Central Malawi was higher (39.7%) compared to children in Southern (36.4%) and Northern (19.4%) regions (NMCP & ICF, 2018). These studies suggest that geographical space plays a significant role in malaria prevalence among children. Therefore, there is a need to increase the scope of these studies that consider social and environmental risk factors of malaria to inform local policies and programs.

2. Study Objectives And Conceptual Framework

The objectives of our study were to examine the prevalence and significant social and environmental risk factors associated with malaria infection among children 2 to 59 months old in rural central Malawi. The assumption was that apart from virulent malaria pathogen (plasmodium), there are some predisposing and enabling factors that operate at the host (children), and in the environment in order to cause the disease. Therefore, we chose the Triangle of Human Ecology model as a guiding conceptual framework to assess the risk factors of child malaria infection in rural areas of central Malawi (Scholthof, 2007; Garchitorena A. et al., 2017).

The concept of Triangle of Human Ecology, also called the disease triangle - originates from the disease ecology framework. It provides a guiding principle for studying the environment in which the disease agents emerge (Meade & Emch, 2010). Some scholars in Sub Saharan Africa (SSA) have applied the model to study the drivers of malaria pathology in different spatial contexts. For example, Messina et al., (2011) studied the risk factors of malaria in DRC Congo by examining the nexus of population, behaviour, and habitat. In Rwanda, the triangle of human ecology model was used to identify significant conditions that exacerbate malaria during community based malaria eradication program development (Ingabire et

al., 2016). Therefore, we were compelled to apply the triangle of Human Ecology model as it provides a holistic conceptual lens to comprehend malaria predisposing and enabling factors in rural areas of Malawi.

3. Methods

Study setting

The study was implemented in six postnatal clinics in Dowa district of central Malawi, in Southern Africa, between the months of June and September of 2018 (Figure 1). Malawi has a population of about 17,563,749 people (NSO, 2018). In 2017, about 71% of the population were living in extreme poverty according to United Nations indicators (Phiri, 2017).

Study sample

A multi-stage descriptive cross-sectional study design was employed to select a representative sample of children aged 2 to 59 months and their mothers in Dowa district. We randomly selected six out of eight outreach clinics that were part of Mvera mission hospital. The selected clinics were Gogo, Ching'amba, Mkhalanjoka, Kalinyengo, Mvera, and Mphande which are approximately 5 to 10 kilometers from the Mvera mission hospital. During the study, Mvera mission hospital served a population of 27,719 people of which 5240 were mothers with a child under five years old. A total population of 4,527 mothers with children between 2 to 59 months was identified in postnatal registers in the six randomly selected postnatal clinics. Our sample size was determined by a Raosoft sample size calculator (McCrum-Gardner, 2010). A margin error of 5% with 95% confidence level and 50% response distribution was set.

A minimum sample size of 355 was determined but we increased it to 523 in order to strengthen the study reliability by decreasing the margin of error to 4% from 5%. We used a systematic sampling strategy to select a sample of 523 children and their mothers from the postnatal registers. We randomly picked a name of first child-mother dyad and subsequently picked every ninth child-mother dyad.

Participant recruitment

We contacted selected mothers and their children in the six postnatal clinics during the regular monthly child health-screening program. The screening program is an initiative of the Malawi government to promote maternal and child health through a framework of continuum of care for mothers, newborns and children (Kerber et al., 2007). Community health workers who were assigned as research assistants were seeking informed consent from mothers to take part in the study. All interviews took place in the consultation room at each outreach postnatal clinic. Sociodemographic data was collected through a questionnaire that was administered orally. Child and mother's anthropometric and health status data

were recorded from child and mother's health passports to the questionnaire after completing their health screening program (Tsega et al., 2016).

Measures

Outcome variable

The main outcome variable of our study was malarial infection in children two to 59 months old. The term child malaria infection was operationalized as presence of malaria parasite in children's red blood cells as recorded in the child health passport (Koram & Molyneux, 2007). In all the postnatal clinics, Rapid Diagnostic Tests (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 (Bassey & Izah, 2017; Carlucci et al., 2017; Hajison, Feresu, & Mwakikunga, 2018; Kateera et al., 2015; Kazembe & Mathanga, 2016; Zgambo, Mbakaya, & Kalembo, 2017). Informed by triangle of human ecology model (Figure 2), we grouped independent variables into three categories. These were the characteristics of children which was our study population, characteristics of parents that influence child care practices, and the characteristics of the household that represent child habitat.

Each covariant variable was coded as follows. Child gender was coded as 0 = female, and 1 = male. Age of children was coded as 1 = 2-5 months, 2 = 6-11 months, 3 = 12-23 months, and 4 = 24- 59 months. Childbirth weight was coded as 0 = normal birth weight (≥ 2.5Kgs), and 1 = low birth weight (□ 2.5Kgs). We included variables capturing child history of other morbidities in the past 30 days as reported by the mother. These included: diarrheal episodes (coded as 0 = no, and 1 = yes), and Acute Respiratory Infection (ARI) (coded as 0 = no, and 1 = yes). 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 (Malawi Ministry of Health, 2017). Children who received deworming drugs in the past year were coded = 1, and those that did not receive the treatment was coded = 0.

We coded at least sixteen independent variables that were considered risk factors of child malaria in the behavioral apex of triangle of human ecology model. The age of the mother was coded as 1 = 15- 19, 2 = 20- 29, 3 = 30-39, 4 = 40- 49. Mother's education was categorized as 0 = no education, 1= primary school, and 2 = secondary school. We also asked mothers to explain whether the pregnancy of the studied child was planned = 0, or unplanned = 1. We assessed whether a mother was a victim of IPV perpetrated by the current or recent husband which was coded as 1 = yes, and 0 = no. We assessed cases of IPV by

using a WHO multi-country study questionnaire on women's health and life experiences that was validated and used in Malawi (Fan et al., 2016; VanderEnde et al., 2016). The questionnaire contains 18 items that make up four sub-scales measuring different forms of IPV which are physical, emotional, controlling behavior, and sexual abuse. Maternal exposure to IPV was operationalized as any mother who reported that they experienced any form of IPV. Maternal depression was assessed by a Chichewa version of the WHO 20-item Self-Reporting Questionnaire (SRQ) which was validated in previous studies in Malawi (Stewart et al., 2009; Stewart, Umar, Tomenson, & Creed, 2013). A woman was considered positive to depression if she affirmed ten or more of the questions (1 = Yes), and negative if it was less than ten (0 = no).

Fathers' characteristics were also included in the behavioural component of the THE model. Education was coded as 0 = no formal education, 1 = primary, and 2 = secondary. Age was categorized as 1= 15-24, 2 = 25-34, and 3 = 35-49 years old. Fathers' health risk behaviours included alcohol consumption and smoking. Both were coded 0 = no, and 1 = yes. Household malaria predisposing and enabling factors in Malawi such use of ITN, household poverty, type of dwelling house, and availability of animals within the house were included. We asked mothers if the child had an ITN and whether the child slept under the net a night before the survey. The variable was coded as 1 = no, and 0 = yes. We also asked if the child used mosquito repellants or antimalarial drugs in the past two weeks which were coded as 1= no, and 0 = yes. Household poverty was defined based on the international poverty measure of US$ 1.90 a day (Prydz, 2016). Households that had less than US$ 1.90 a day per person were regarded as poor (1 = yes), and those above US$ 1.90 a day were considered not poor (0 = no). Availability of animal kraals/sheds within one to ten meters from the dwelling house was considered a risk factor and was coded as (1 = yes) and (0 = otherwise) (Mayagaya et al., 2015). Grass/temporary thatched, and mud/temporary wall houses were categorised (1 = yes, and 0 = no) for permanent dwelling structures. We also consider the number of people who usually sleep in the house. This was coded as 1 = two to three, 2 = four to six, 3 = seven or more. We also asked mothers if their houses were sprayed with insecticides (1 = no, and 0 = yes). We did not include toilet type in our analysis because 99% of the mothers reported that they use an open pit latrine.

Survey enumerators were administering the survey on Android tablets using an Open Data Kit (ODK). We used a WHO protocol for conducting sensitive topic research because some of the questions in our study were focusing on domestic violence (Ellsberg & Heise, 2002; Ellsberg, Heise, Pena, Agurto, & Winkvist, 2001). Enumerator orientation and pretesting of the questionnaire was conducted for five days. A PhD candidate in Social Work, clinical officer, and an environmental health officer were responsible for training the enumerators. The research team including enumerators had professional training in community health, nutrition, and primary health care.

Research Ethics Review

Ethics approval to conduct this study was obtained from 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, 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 (Berger & Zhou, 2014). Risk factors for child malaria were calculated based on covariates included in the triangle of human ecology model. Bivariate logistic regressions were performed to examine significant predictors of child malaria. Significant predictors of child malaria at the bivariate level were included in the final multivariable logistic regression model using 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. 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).

4. Results

Sociodemographic characteristics of study population

Sociodemographic and malaria infection data for all 523 selected children aged two to 59 months was obtained over four months (see Table 1). In terms of gender, 49.1% and 50.9% of the children were girls and boys respectively. In terms of age, 13.4% of the sample was aged 2-5 months, 17.2% was aged 6-11 months, 29.6% was aged 12-23 months, and 41.9% was aged 24- 59 months. We observed that 14.3% of the selected children were born with low birth weight (birth weight of less than 2.5 Kgs). 27.2% of the mothers reported that their children did not sleep under mosquito nets a night before the survey. 67.1% of mothers reported that their children had signs of fever 30 days preceding the survey. We found that 62.1% of the children were stunted, and 11.3% were underweight.

In terms of parental characteristics, we found that 15.3% of mothers had no formal education, 68.1% had primary education, and 16.6% had a secondary education. We found that 75% (n = 392) of mothers reported that they experienced IPV perpetrated by their current or recent partner in the past 12

months. Regarding age, 7.5% of mothers were between 15 -19, 57.3% were between 30 - 39, 29.6% were between 30 - 39, and 5.5% were between 40 - 49 years old respectively. We observed that 88.7% (n = 464) of mothers reported that they had received child care counselling during their pregnancy. About the attributes of fathers, the study found that 14.5% (n = 76) had no formal education, 56.2% (n = 296) had 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 kraals/sheds close to their dwelling. Regarding house construction materials, 25.8% (n = 135) of the children were dwelling in brick walled houses, and only 12.8% (n = 67) were living in iron roofed houses.

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 ($\chi 2$ = 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 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 2-5 and 6-11 months were less likely to be diagnosed with malaria as compared to children who were in the age range of 24- 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 behavior 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 that 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 malaria parasite than children whose mothers had no confidants (*COR*: 0.64, 95% *CI*: 0.43-0.99, *P* = 0.048). Children whose fathers were in the age range of 15-24 were less likely to suffer from malaria than children whose fathers were in the age range of 35-49 years (*COR*: 0.55, 95% *CI*: 0.33-0.91, *P* = 0.021). Finally, children whose mothers were in the age range of 30-39 years we less likely to suffer from malaria than children whose mothers were 40-49 years old (*COR*: 0.14, 95% *CI*: 0.07-0.26, *P* = 0.000).

In multivariable analysis (Table 2), the odds of children being diagnosed with malaria was higher amongst children whose mothers had no formal education than 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 of mothers that experienced IPV in the form of controlling behavior 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 2-5 and 6 -11 months old were less likely to suffer from malaria than children who were 24-59 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 30-39 years old were less likely to be diagnosed with the malaria parasite than children whose mothers were 40-49 years old (*AOR*: 0.29, 95% *CI*: 0.10-0.90, *P* = 0.032).

5. Discussion And Implication

This study examined the prevalence of, and risk factors for, malaria infection among children 2–59 months old in order to contribute to the understanding of various social and environmental determinants associated with poor child health in rural areas of Dowa district in Malawi. The prevalence of child malaria in this study area was 35.4% that was equivalent to national malaria prevalence in 2017 (36%) (NMCP & ICF. 2018) but were slightly lower than malaria prevalence in central and rural Malawi 39.7% and 40.6% respectively. This difference may arise because of the different time of year that the two studies took place. Our study was conducted from June to September 2018, while the national study was conducted from April to June 2017. In Malawi, because of seasonal rainfall patterns, stagnant water bodies are more common in the months of April and May as compared to June and September (Nicholson, Klotter, & Chavula, 2014). We anticipate that malaria vector mosquitoes had high favorable breeding environment in the earlier study, as compared to our study. A study in Kasungu district of Malawi supports our hypothesis. In 2013, the study found that monthly severe malaria admissions at Kasungu hospital pediatric wards ranged from 300 in January, to 165 in April, and 90 in June, and was lowest in August with 50 cases (Chung et al., 2016).

This study found that mothers' exposure to IPV controlling behavior was a significant determinant of malaria infection in children under five years of age. Our study support 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 (Ferdousy & Matin, 2015). 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 (Bintabara & Kibusi, 2018). Two explanations can be offered for the observed association between IPV controlling behavior and child malaria. Firstly, we anticipate that husbands' controlling behavior constrained mothers' capacity to implement preventative measures suggested by childcare counselors, 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 (Engle, Bentley, & Pelto, 2000).

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 who had

attained a sixth grade education or higher had lower odds of suffering from malaria (OR = 0.73), as compared to children from mothers with lower educational attainment (Siri, 2014). Our finding can be explained by a study in Malawi which found that mothers with higher education achievement were more knowledgeable about malaria prevention and signs, and were therefore more proactive and reactive with regard to prevention than mothers with low education (Oyekale, 2015).

Finally, this study found that children who were more than two years old had high 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 (Roberts & Matthews, 2016; Zgambo et al., 2017). This may be because younger children in Malawi share the same 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 the same bed with the mother were more likely to sleep under a mosquito net compared to children who were not sharing the bed with the mother (Eisele, Keating, Littrell, Larsen, & Macintyre, 2009; Mugisha & Arinaitwe, 2003). Another explanation is that majority of children in Malawi are weaned from breastfeeding at the age of two. Consequently, they have less caregiver attention and increased risk of exposure to malaria vectors (Milali, Sikulu-Lord, & Govella, 2017).

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 Dowa district. To address the problem, we suggest that in addition to the available interventions, 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 behavior change in selected rural areas of Southern Malawi, and may be applicable (Malenga et al., 2017; van den Berg et al., 2018).

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 Dowa district are gendered as they mainly target mothers by providing them with insecticide treated mosquito nets and administration of antimalarial drugs during pregnancy. There is a need to involve fathers in all programs that address child malaria. One such intervention may 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 context (Kerr et al., 2016).

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. The interventions should consider the developmental stage of children, geographical space, and time of the day and night that predisposes 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 (Mittal, Sreehari, Razdan, Dash, & Ansari, 2011; Wilson, Chen-Hussey, Logan, & Lindsay, 2014; Win Han Oo et al., 2018).

Strength and limitations of the study

The main strength of this study is that it is based on a systematic sampling technique with a 100% response rate. Therefore, the findings can be generalized to all children 2 to 59 months old who accessed primary health care services in the eight postnatal clinics in Mvera hospital network in Dowa district of Malawi. Nevertheless, this study has some limitations. First, we conducted the study during the dry season, a period that mosquito-breeding sites are significantly reduced compared to wet season. Therefore, our findings did not take into consideration seasonal variation of malaria prevalence. We suggest that a longitudinal study should be done 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 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 of malaria infection among children under five years in rural areas of Dowa district that can inform local programs.

Conclusion

The current study shows that the prevalence of malaria infection among children aged 2- 59 months in rural areas of Dowa district was at 35.4% which was equivalent to the prevalence of the phenomenon at the national level in 2017. Informed by the triangle of human ecology model, the two significant predictors of child malaria infection at the child population apex were failure to deworm the children, and age range between 24 to 59 months. In the behavior apex, the risk factors of child malaria were maternal exposure to IPV and lack of formal education of the parents. In the multivariate analysis, there were no significant covariates of child malaria associated with habitat. The results of our study suggest that apart from intensifying the distribution of treated mosquito nets, child malaria programs in central Malawi should also invest in interventions that address IPV against mothers of children less than five years old.

List Of Abbreviations

AOR: Adjusted odds ratios

COR: Crude odds ratios

CCAP: Presbyterianism

CI: Confidence interval

IPV: Intimate partner violence

NMCP: National Malaria Control Programme

NSO: National Statistics Office

RDTs: Rapid diagnostic tests

SRQ: Self reporting questionnaire

SSA: Sub Sahara Africa

US$: United States dollar

WHO: World Health Organization

Declarations

Nothing to declare

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 Dowa district health office. Informed consent were 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 the 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 capturing of sensitive data according to WHO standards. We documented mothers' disclosure 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, analyzed the data, and wrote the first draft of the manuscript. DCV, HM, CM provided supervision roles towards the study design, data analysis, and writing. KC supported in writing the draft manuscript. All authors read and approved the final manuscript.

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Tables

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 child care 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	325	62.1
	Not stunted	198	37.9
	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 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
	Wall of house		
	Mud/sticks	387	74.1
	Bricks	135	25.8
	Roof of a house		
	Grass thatched	455	87.0
	Iron sheets	67	12.8

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

Figures

Variables		Crude *OR*	(95% *CI*)	*P-value*	Adjusted *OR*	(95% *CI*)	*P-value*
Education mother	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		
Children 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		
Age husband	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					
Age Mother	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							

Figure 1

The research setting

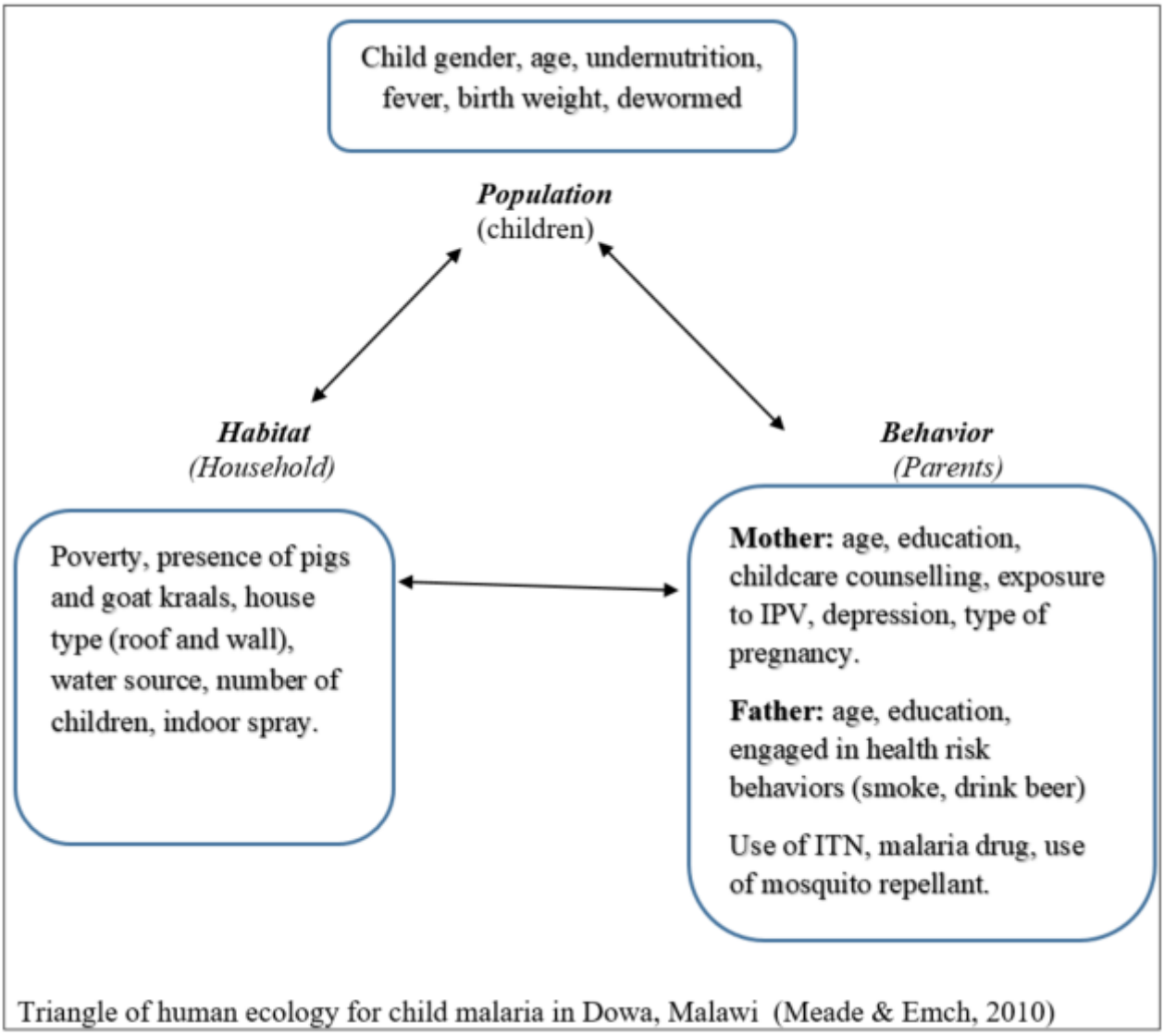

Figure 2

Selected covariates of child malaria