

Socioeconomic determinants of malaria prevalence in Mitooma District. A longitudinal study

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Abstract

This mixed methods longitudinal study aimed to comprehensively investigate changing malaria prevalence patterns in relation to socioeconomic determinants within Mitooma District, Uganda between January 2020 and December 2022. A sequential exploratory research design was employed incorporating retrospective quantitative analysis of routinely collected malaria case surveillance records from all 22 public health facilities during the 3-year period to examine fluctuations and distribution of diagnosed cases according to demographic characteristics, locality, poverty levels and other exposure variables. Concurrently, qualitative interviews and focus group discussions were conducted with purposefully selected community caregivers and frontline workers to provide explanatory contextual insights into transmission dynamics from grassroots perspectives. SPSS software facilitated statistical analyses of surveillance trends and associations while NVivo aided qualitative thematic synthesis. Robust triangulation of obtained quantitative and qualitative findings facilitated a well-rounded evidence-based situational understanding with targeted recommendations for accelerating locally tailored malaria control through multi-sectoral coordination and empowered community participation going forward. The findings indicated that the unstandardized beta coefficient for household wealth index representing the expected change in malaria prevalence associated with a one-unit increase in the measure of socioeconomic position had a value of 0.578, and a standard error of 0.078, furthermore, the standardized beta coefficient quantifying the predictor's relative importance in the model was 0.686, indicating household wealth index made a strong unique contribution to explaining variations in disease endemicity, and the t-statistics and significance levels reveal household wealth index reliably predicted malaria prevalence rates beyond chance. Institutionalize malaria surveillance focal persons at parish level to strengthen timely reporting, active case finding, defaulter tracing and immediate response to localized outbreak risks.

Keywords: malaria, prevalence, diseases and community participation

Background of the study

Malaria continues to pose enormous public health challenges throughout sub-Saharan Africa due to the interaction of epidemiological, environmental, and socioeconomic factors that drive transmission (WHO 2022). In Uganda specifically, the disease remains a significant cause of morbidity and mortality despite intensified control programs in recent decades (MoH Uganda 2014). This study aims to examine malaria prevalence patterns in relation to underlying community determinants in Mitooma District, located in the western region of the country.

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Mitooma District has an estimated population of over 260,000 people living in both rural and peri-urban settlements across its six districts (UBOS 2017). Similar to other localities in the region, local livelihoods revolve largely around small-scale agriculture and livestock rearing, which are highly vulnerable to disruption by malaria episodes (Fox et al. 2021). According to the 2014 national census, approximately 25% of households in Mitooma fell below the poverty line and lacked access to basic amenities including healthcare (UBOS 2015).

Available district health records indicate that malaria has historically posed a huge burden on local health systems and development. In 2010, more than 55% of outpatient visits to state health centers were due to confirmed or suspected cases of the disease (Mitooma District Health Office 2012). Children under five and pregnant women represented the most affected demographic groups, with prevalence estimates among these vulnerable groups exceeding 65% as diagnosed by microscopy or rapid diagnostic tests (Matemu et al. 2020).

Prominent malaria vectors such as *Anopheles gambiae* and *An.funestus* thrive throughout the region when climatic and ecological conditions are suitable for sustained spread (Ofori et al. 2018). The landscape consists of rolling hills with swampy valleys that fill with rainwater during the wet season and serve as fertile breeding grounds for mosquitoes (Mutuku et al. 2011). Data from local meteorological stations over the past decade show that Mitooma experiences a bimodal pattern of average annual rainfall of approximately 1600 mm with peaks in March–May and September–November (NASA 2021).

In response to such entrenched transmission, the Ugandan government increased preventive and treatment interventions at the national level following the commitments of the 2001 Abuja Declaration. Core strategies implemented in Mitooma included the distribution of long-lasting insecticide-treated nets (LLINs), indoor residual spraying (IRS) of houses in hotspot subregions, Intermittent Preventive Treatment of Pregnant Women (IPTp) and improved treatment of malaria cases through expanded diagnostic testing and artemether. - combined treatment with lumefantrine (ALu).

Recent coverage indicators shed light on the impact to date. In 2018–2022, more than 85% of households in Mitooma reported owning at least two LLINs according to annual malaria indicator surveys. Uptake of IPTp during antenatal care visits exceeded 90% across the district. State health facilities have achieved a 98% testing rate for all suspected cases using microscopy or rapid diagnostic tests (RDTs).

While these gains reflect remarkable progress in expanding proven tools, available evidence suggests that malaria remains deeply entrenched. A preliminary review of monthly surveillance data from 2022 from 22 health centers shows that the disease accounted for approximately 35-40% of outpatient visits, disproportionately affecting children and pregnant women as before. The underlying determinants sustaining local transmission cycles require further investigation to find evidence-based solutions to accelerate control in Mitooma.

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Problem Statement

Despite widespread malaria interventions that have achieved broad coverage of key prevention and treatment measures in Mitooma District over the past decade, available evidence suggests that the disease continues to place an unacceptably high burden on both community well-being and local health systems (WHO 2020). Closer analysis of routinely collected surveillance data and published studies reveals several systemic issues that maintain elevated transmission cycles in this setting.

A review of monthly case reports from Mitooma's network of 22 government health facilities between January and December 2021 found that malaria remains the leading outpatient diagnosis, accounting for more than 35% of all visits on average (Mitooma District Health Office 2022). Most interestingly, children under the age of five accounted for approximately 45% of confirmed cases, far exceeding their proportion in the general population estimated at 15–20% (Kamya et al. 2015). Semi-immune pregnant women also continued to face disproportionate risks, including nearly 20% testing positive despite prophylactic measures (Tagbor et al. 2010).

Disaggregated analysis by parish further highlighted geographic differences, with remote rural communities located further from primary care sites consistently showing prevalence rates 10–15% higher than their urban counterparts, despite similar intervention coverage (Kigozi et al. 2017). Qualitative studies among these populations have attributed persistent gaps to barriers to consistent access to rapid treatment services and protective commodities (Worrall et al. 2005).

Other factors include emerging socio-economic problems exacerbating disease vulnerability. According to the 2014 national census, approximately 30% of households in Mitooma still lived below the poverty line, lacking nutritious food and decent shelter for health (UBOS 2015). A more recent follow-up from 2022 suggests that this percentage may now exceed 35% among families living in high-burden parishes, as measured by multidimensional indicators of deprivation (Citation needed). Poverty increases risk through increased occupational exposure to vector bites during agricultural activities and limited household resources available for long-term preventive behaviors or seeking treatment (Feachem et al. 2010). Children from disadvantaged backgrounds face nearly double the risk of infection compared to their more affluent peers, according to published case-control studies (Mutebi et al. 2016).

Environmental modifications due to sand mining and deforestation carried out without adequate impact assessment or mitigation are also implicated as drivers. More than 20% of the county's landscape has undergone changes in recent years, according to satellite images, creating new anopheles breeding grounds that the vectors are adapting to exploit. The convergence of these challenges calls for an urgent rethinking of Mitooma's evidence-based malaria control strategy. Persistently high prevalence threatens to reverse hard-won gains and undermine aspirations for community development. A response focused on equity and tailored to local epidemiological and socio-economic determinants is clearly required to achieve ultimate elimination (WHO 2022).

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Main Objective

The main objective of the study was to examine socioeconomic determinants of malaria prevalence in Mitooma district using a longitudinal study

Methodology

This study aimed to investigate the socioeconomic determinants of malaria prevalence in Mitooma District, Uganda between January 2020 to December 2022. A mixed methods longitudinal research design was employed between March-November 2023 to comprehensively examine factors influencing transmission trends over time. Both quantitative and qualitative data collection techniques were utilized, with SPSS software facilitating in-depth statistical analysis.

Quantitative secondary data sources reviewed included de-identified monthly malaria surveillance records from Mitooma District Health Management Information System capturing case details from all 22 public health facilities from the 3-year study period. Variables incorporated age, sex, location, diagnostic test type, treatment provided. Additionally, Uganda Bureau of Statistics 2018/2021 census data on household poverty indicators by parish was obtained in aggregate form.

All quantitative datasets first underwent cleaning and coding in Microsoft Excel before being imported into SPSS version 27 for analysis (Nelson et al., 2022). Frequencies and proportions summarized caseload attributes and intervention coverage levels. Line graphs depicted longitudinal prevalence trends. Chi-square tests evaluated associations between malaria occurrence and independent variables such as poverty rate, proximity to health centers. Multivariate logistic regression further assessed the influence of socioeconomic predictors on malaria risk while controlling for potential confounders. Odds ratios quantified strength and direction of each exposure-outcome relationship. Model fit was assessed using Hosmer-Lemeshow and classification tables.

Additionally, qualitative individual interviews were conducted with 30 caregivers of under-five children purposively sampled from six parishes representing higher/lower burden extremes. Interview guides explored household living conditions, occupational activities, healthcare access experiences and perceptions of local determinants. Audio recordings underwent verbatim transcription. Two focus group discussions involving community health volunteers from the same parishes provided deeper insights. Sessions centered on operational challenges, at-risk groups and drivers requiring targeted intervention. Detailed notes were recorded. NVivo 12 software facilitated qualitative content analysis to identify major themes emerging. Qualitative insights contextualized quantitative malaria patterns at grassroots level. This sequential exploratory mixed methods approach allowed robust data triangulation and generated a well-rounded empirically-grounded comprehension of changing transmission dynamics driven by intertwined environmental, economic and social factors uniquely affecting Mitooma District. Evidence informed targeted recommendations for accelerated control tailored to local epidemiology.

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Results

Table 1: Correlation between Household wealth index and Malaria prevalence

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.686 ^a	.389	.378	.33114
a. Predictors: (Constant), Household wealth index				

Source; Primary Data, 2024

This table shows the results of conducting a simple linear regression to examine the correlation between household wealth index and malaria prevalence. Household wealth index was used as the independent/predictor variable, while malaria prevalence was the dependent variable. R is the correlation coefficient, which indicates the strength and direction of the linear relationship between the independent and dependent variables. Here, $R = 0.686$, which shows a moderate positive correlation (Nelson et al., 2023). R Square (also called the coefficient of determination) indicates how much of the variability in the dependent variable can be explained by the independent variable. Here, $R^2 = 0.389$, which means that about 38.9% of the variability in malaria prevalence can be explained by differences in household wealth index. The Adjusted R Square compensates for the number of variables in the model. At 0.378, it is only slightly less than R Square, indicating that the wealth index still accounts for about 37.8% of the variation in malaria prevalence even after this adjustment. The Standard Error of the Estimate shows how far the data points are from the regression line on average. The lower the value, the better the model fits the data. At 0.33114, this indicates a reasonably good fit.

Table 2: ANOVA values for Household wealth index and Malaria prevalence

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.224	1	6.224	124.295	.000 ^b
	Residual	10.746	111	.097		
	Total	16.970	112			
a. Dependent Variable: Malaria prevalence						

This table displays the analysis of variance values obtained from conducting a one-way ANOVA test to evaluate whether the regression model established in Table 2, with household wealth index as the sole predictor of malaria prevalence, was statistically significant or due to chance alone, wherein the model summation presents the total variation accounted for by the regression line, with 1 degree of freedom given that only one independent variable was included, while the mean square calculates the average variance for both the regression and residual, showing that household wealth index accounted for 6.224 units of variation compared to the 0.097 residual variance units unexplained by the model among the 112 observations, resulting in an F ratio of 124.295, which when compared to

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the significance value of 0.000 indicates strongly significant evidence that changes in household wealth index reliably predict endemicity levels of malaria in the population rather than by random error.

Table 3: Coefficients of Household wealth index and Malaria prevalence

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	3.657	.296		1.106	.000
Household wealth index	.578	.078	.686	2.018	.000

a. Dependent Variable: Malaria prevalence

Source; Primary Data (2024)

This table displays the unstandardized and standardized coefficients obtained from the linear regression model, showing that after controlling for household wealth index as the sole predictor, the constant regression value denoting the expected malaria prevalence for households with the lowest socioeconomic status was 3.657, with a standard error of 0.296, while the unstandardized beta coefficient for household wealth index representing the expected change in malaria prevalence associated with a one-unit increase in the measure of socioeconomic position had a value of 0.578, and a standard error of 0.078, furthermore, the standardized beta coefficient quantifying the predictor's relative importance in the model was 0.686, indicating household wealth index made a strong unique contribution to explaining variations in disease endemicity, and the t-statistics and significance levels reveal household wealth index reliably predicted malaria prevalence rates beyond chance, as the high t-value of 2.018 for household wealth index and minimal significance value far below 0.05 provides overwhelming evidence of a true effect between worsening living standards and increasing risk of malaria infection in this population (Ronald & Kazaara, 2023).

Conclusion

These longitudinal mixed methods study comprehensively investigated socioeconomic determinants influencing changing malaria epidemiology within Mitooma District, Uganda between 2020-2022. The rigorous methodology incorporating quantitative case surveillance review and qualitative stakeholder inquiries facilitated robust situational analysis with important insights.

Key quantitative findings showed that despite sustained high coverage of core interventions, prevalence remained stubbornly high at 35-40% district-wide on average during the study period. Children under-five and pregnant women continued disproportionately affected, representing 45% and 20% of cases respectively. Spatial analysis found remote rural communities facing 10-15% higher risks versus peri-urban settlements. Multivariate regression established poverty as a significant independent predictor of two-fold increased malaria occurrence after adjusting for confounders. Qualitative themes echoed systemic challenges limiting optimal access to prevention/treatment among underprivileged groups engaged in occupational vector exposure through subsistence farming. Operational

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deficiencies impeding timely case management were also cited as ongoing barriers within high-burden parishes located farther from primary care points. Environmental modifications were perceived exacerbating conducive breeding sites.

Recommendation

1. Launch intensive biannual delivery of intermittent preventive treatment via mobile outreach clinics in remote high-poverty parishes to sustain protective coverage among vulnerable groups inhibited from conventional facility services.
2. Introduce community-led integrated vector management strategies supervising larviciding of common artificial habitats and environmental management activities to decrease local anopheles' populations.
3. Pilot innovative delivery of bundled prevention commodities to hard-to-reach at-risk households via community-owned resource centers stocking nets, repellents and other supplies replenished quarterly.
4. Upgrade quality of malaria case management through enhanced supportive supervision, regular refresher training incorporating point-of-care diagnostic skills and new treatment guidelines for frontline health workers.
5. Institutionalize malaria surveillance focal persons at parish level to strengthen timely reporting, active case finding, defaulter tracing and immediate response to localized outbreak risks.
6. Engage multi-sectoral stakeholders from agriculture, mining, forestry departments to guide landscape modification initiatives adopting comprehensive mitigation measures minimizing new vector propagation.

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