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FACTORS CONTRIBUTING TO THE RISING PREVALENCE OF MALARIA IN COPPERBELT PROVINCE, ZAMBIA: A CROSS-SECTIONAL STUDY IN KAWAMA EAST COMPOUND

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Abstract

Background: *Malaria remains one of Zambia's most persistent public health problems despite long-standing investments in case management, vector control, health education and surveillance. Local heterogeneity means that national averages can hide community-level drivers of transmission. This paper examined demographic, preventive and social factors associated with malaria infection in Kawama East Compound, Mufulira District, Copperbelt Province.*

Methods: *The study used an analytical cross-sectional design. A multistage sampling approach was used to select households from Kawama East Compound, and 355 participants were included. Data were collected using semi-structured questionnaires and analysed using descriptive statistics, chi-square tests and logistic regression. Adjusted odds ratios were used to identify factors independently associated with malaria infection.*

Results: *Most respondents were female (77.7%), while 22.3% were male. Although 70% of respondents reported participation in environmental sanitation and 72% recognised malaria as a serious problem, uptake of personal preventive measures was weak: 71.8% did not sleep under insecticide-treated nets and 72% did not apply mosquito repellents. Higher adjusted odds of malaria infection were observed among respondents aged 30-35 years (AOR = 4.05, 95% CI: 1.95-8.42), males (AOR = 3.24, 95% CI: 1.75-5.97), married participants (AOR = 4.97, 95% CI: 2.67-9.28), participants from households with five or more members (AOR = 2.20, 95% CI: 1.20-4.06), respondents not using ITNs (AOR = 2.60, 95% CI: 1.21-5.60), respondents not using repellents (AOR = 3.91, 95% CI: 1.87-8.18), and those living near mosquito breeding sites (AOR = 2.10, 95% CI: 1.13-3.61).*

Conclusion: *Malaria risk in Kawama East Compound is shaped by household conditions, limited use of preventive measures and environmental exposure. Control efforts should move beyond generalised messaging and focus on targeted ITN coverage, repellent promotion, household-level environmental management, and risk communication tailored to men, married households and larger families.*

1. INTRODUCTION

Malaria is a life-threatening parasitic disease transmitted through the bite of infected female Anopheles mosquitoes. The disease remains concentrated in tropical and subtropical settings where climatic conditions, poverty, housing

quality and gaps in public health infrastructure allow sustained vector breeding and human-vector contact. Although global malaria control has recorded important gains, the disease still produces a large burden of outpatient visits, hospitalisations and preventable deaths in sub-Saharan Africa. Zambia remains one of the countries where malaria continues to strain households and the health system, particularly in communities with persistent transmission despite routine interventions (Ramdzan et al., 2020).

The Copperbelt Province presents an important setting for examining malaria because the disease pattern is not uniform across Zambia. Community-level differences in housing, household density, sanitation, population movement, economic activity and use of preventive tools can produce localised transmission even where national programmes distribute insecticide-treated nets, conduct indoor residual spraying and promote early diagnosis. For that reason, a local study is useful when the aim is not merely to restate national malaria trends but to identify what is still driving infection in a specific compound (Zambia Ministry of Health, 2017).

Kawama East Compound in Mufulira District is relevant because malaria cases have continued to occur in a setting where control interventions are known and available. This creates a practical public health question: why does malaria persist when people have heard about the disease and when control measures are part of routine health programming? The answer is unlikely to be a single cause. It is more likely to be the interaction of demographic exposure, inadequate prevention, environmental breeding conditions and household-level socioeconomic constraints (Ryan et al., 2020).

Previous malaria studies in Zambia and elsewhere in Africa show that higher malaria risk may be associated with age, sex, residence, migration, occupation, family size, housing quality, proximity to breeding sites and inconsistent use of preventive measures. However, the direction and strength of these relationships vary by locality. In some places, children and pregnant women dominate malaria burden; in other settings, working adults and men can be more exposed because of outdoor activity patterns. This makes local evidence essential for intervention planning (Zambia Ministry of Health, 2017).

Malaria prevention depends on a chain of behaviours and services. People must possess or have access to effective ITNs, sleep under them consistently, accept indoor residual spraying where implemented, reduce mosquito breeding sites around homes, seek early testing when symptomatic, and complete treatment when infected. A break in any part of this chain can sustain transmission. In Kawama East Compound, this study focused on how demographic factors, uptake of preventive measures and social/environmental factors relate to malaria prevalence (Ryan et al., 2020).

The public health value of the paper is that it translates a thesis dataset into a compact research article format. Instead of presenting findings as a full dissertation, the paper organises the evidence around a publishable structure: background, methods, results, discussion, conclusions and actionable recommendations. The central argument is simple: malaria control in Kawama East must be targeted, not generic. General awareness alone is not enough when net use, repellent use and environmental risk remain poor (Ryan et al., 2020).

2. Literature Review

Malaria transmission is influenced by the interaction between parasite biology, vector ecology, human behaviour and environmental conditions. Plasmodium falciparum is the dominant malaria parasite in much of sub-Saharan Africa and is associated with severe disease and mortality. The Anopheles mosquitoes that transmit malaria require suitable breeding habitats and are affected by rainfall, temperature, humidity and local ecological conditions. Climate variability and environmental changes can therefore alter transmission risk by affecting mosquito survival and reproductive success (Ramdzan et al., 2020).

Globally, malaria has declined in many settings because of expanded access to vector control, rapid diagnostic testing and artemisinin-based treatment. Yet progress has slowed in several high-

burden countries. The slowing of progress is partly explained by insecticide resistance, gaps in intervention coverage, health system disruption, poverty, population movement and changing climatic conditions. These factors are especially important in African settings where malaria control programmes must operate across heterogeneous communities (Ryan et al., 2020).

In Zambia, malaria remains endemic and continues to be reported as a major cause of morbidity and mortality. While national elimination strategies have promoted ITNs, IRS, case management and surveillance, the disease burden differs by province, district and catchment area. Copperbelt Province has historically reported substantial incidence, and Mufulira District has border and mobility dynamics that may complicate infectious disease control. Such local conditions justify smaller-scale studies that can provide direct evidence for district health planning (Zambia Ministry of Health, 2017).

Demographic factors may influence malaria risk through exposure and vulnerability. Age can shape immunity, work pattern and time spent outdoors. Sex may be associated with occupational activities, social roles and night-time exposure. Marital status and household size may reflect household density and resource allocation. Larger households may have more people sharing limited sleeping spaces or insufficient ITNs, creating conditions where protection is uneven across members (Nawa et al., 2019).

Preventive measures are central to malaria control. ITNs reduce human-vector contact during sleeping hours and have been one of the most widely promoted interventions in Africa. IRS can reduce indoor mosquito survival where coverage, timing and insecticide susceptibility are adequate. Mosquito repellents provide personal protection, particularly during evening outdoor activities or where ITN use is inconsistent. However, these tools only reduce risk when they are available, accepted, used correctly and maintained (Nawa et al., 2019).

Social and environmental factors also matter. Poor drainage, stagnant water, open containers, poorly managed waste and proximity to breeding sites can support mosquito production around households. Housing quality affects mosquito entry, while poverty affects the ability to purchase repellents, repair nets or improve household structures. Education and risk communication shape whether people recognise malaria symptoms, understand prevention and seek timely treatment (Ryan et al., 2020).

The literature therefore supports an integrated model of malaria risk: demographic exposure, preventive behaviour and environmental conditions interact. A household may know that malaria is serious but still fail to use ITNs if nets are unavailable, damaged, uncomfortable or insufficient for household members. Similarly, a community may participate in sanitation activities but still experience transmission if breeding sites remain near homes. This study tested these relationships using data from Kawama East Compound (Ryan et al., 2020).

3. Methods

3.1 Study Design

An analytical cross-sectional study design was used. The design was appropriate because it allowed the researcher to estimate the distribution of malaria-related characteristics and test associations between malaria infection and selected predictors at one point in time. The approach was practical for a community-based study and suitable for examining demographic, preventive and social factors (Chipoya & Shimaponda-Mataa, 2020).

3.2 Study Setting

The study was conducted in Kawama East Compound, Mufulira District, Copperbelt Province, Zambia. The area was selected because malaria remained an important public health concern despite national and district-level malaria prevention activities. The local setting allowed the study to focus on household-level and community-level factors that can be missed in broader provincial or national analyses (Zambia Ministry of Health, 2017).

3.3 Study Population and Sample

The target population consisted of households and household members in Kawama East Compound. The source population was drawn

from approximately 3,156 households. A sample of 355 participants was calculated using a 95% confidence level and a 5% margin of error. This sample size was adequate for descriptive analysis and logistic regression of selected predictors (Zambia Ministry of Health, 2017).

3.4 Sampling Procedure

A multistage sampling strategy was used. The compound was first divided into geographic strata to improve representation. Within each stratum, systematic random sampling was applied to select households. This approach helped minimise selection bias and ensured that participants were drawn from different parts of the compound rather than from one easily accessible area (Nawa et al., 2019).

3.5 Data Collection

Data were collected using semi-structured questionnaires administered to household members and household heads. The questionnaire captured demographic characteristics, household and social factors, environmental exposures, knowledge of malaria as a problem, and uptake of preventive measures such as ITN use, mosquito repellent use and indoor insecticide spraying (Ryan et al., 2020).

3.6 Variables

The dependent variable was malaria infection status. Independent variables included age, sex, marital status, family size, indoor insecticide spraying, sleeping under ITNs, use of mosquito repellents and availability of mosquito breeding sites near the household. Demographic tables also summarised education and occupation (Nawa et al., 2019).

3.7 Data Analysis

Data were analysed using SPSS version 20. Frequencies and percentages were used to summarise demographic and preventive characteristics. Logistic regression was used to estimate crude and adjusted odds ratios with 95% confidence intervals. Adjusted odds ratios were interpreted as the independent association between each predictor and malaria infection after controlling for other variables in the model (Nawa et al., 2019).

3.8 Ethical Considerations

Participation was voluntary and respondents were informed about the purpose of the study. Confidentiality was maintained by avoiding identifying information in the analysis and reporting. The paper presents aggregated findings only, and no individual participant can be identified (Tetteh et al., 2023).

4. Results

This section presents the demographic profile of respondents, preventive and environmental characteristics, and adjusted predictors of malaria infection. Tables summarise the main quantitative findings, while figures provide visual presentation of the distribution and strength of association.

4.1 Demographic Characteristics of Respondents

A total of 355 respondents were included in the study. Females represented the majority of respondents, while males constituted just over one-fifth of the sample. Age distribution was relatively broad, with the 35 years and above category being the largest group, followed by the 25-30 and 30-35 year groups. Most respondents had at least primary or secondary education, and unemployment was common.

Table 1. Demographic characteristics of respondents (n = 355).

Characteristic	Category	Frequency	Percentage
Gender	Male	79	22.3
Gender	Female	276	77.7
Age	20-25 years	50	14.0
Age	25-30 years	100	28.0
Age	30-35 years	100	28.0
Age	35 years and above	105	30.0
Marital status	Single	150	42.0
Marital status	Married	105	30.0
Marital status	Divorced	50	14.0
Marital status	Widowed	50	14.0
Education	No formal education	50	14.0
Education	Primary	105	30.0
Education	Secondary	150	42.0
Education	College and above	50	14.0
Occupation	Self-employed	100	28.0
Occupation	Not employed	200	56.0
Occupation	Employed	55	15.0

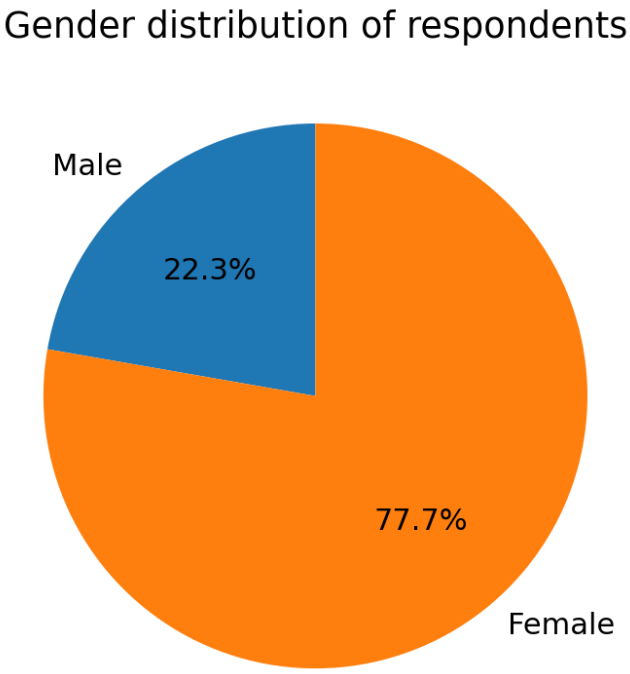

Figure 1. Gender distribution of respondents.

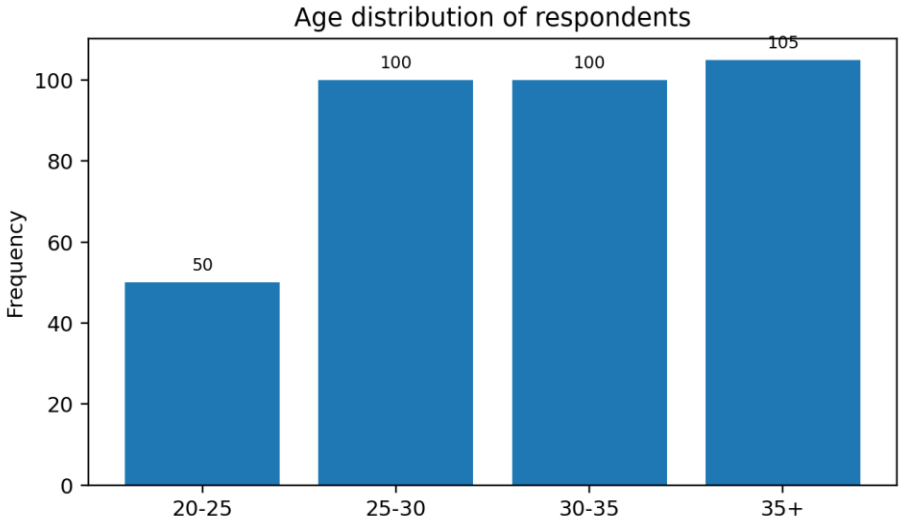

Figure 2. Age distribution of respondents.

4.2 Preventive and Environmental Characteristics

The descriptive results show a gap between recognition of malaria as a serious problem and consistent preventive behaviour. While 72% of respondents stated that malaria was a serious problem and 70% reported participation in environmental sanitation, most did not use core personal protection measures. Only 28.17% reported sleeping under an ITN and 28% reported using mosquito repellents. The majority also reported knowledge or availability of mosquito breeding sites near their environment, indicating persistent environmental exposure.

Table 2. Preventive and environmental characteristics of respondents.

Variable	Response	Frequency	Percentage
Participated in environmental sanitation	Yes	250	70.0
Participated in environmental sanitation	No	105	30.0
Malaria is a serious problem	Yes	255	72.0
Malaria is a serious problem	No	100	28.0
Spread insecticide in the room	Yes	105	30.0
Spread insecticide in the room	No	250	70.0
Sleep under ITN	Yes	100	28.17
Sleep under ITN	No	255	71.8
Applied mosquito repellents	Yes	100	28.0
Applied mosquito repellents	No	255	72.0
Mosquito breeding site nearby	Yes	250	70.0
Mosquito breeding site nearby	No	105	30.0

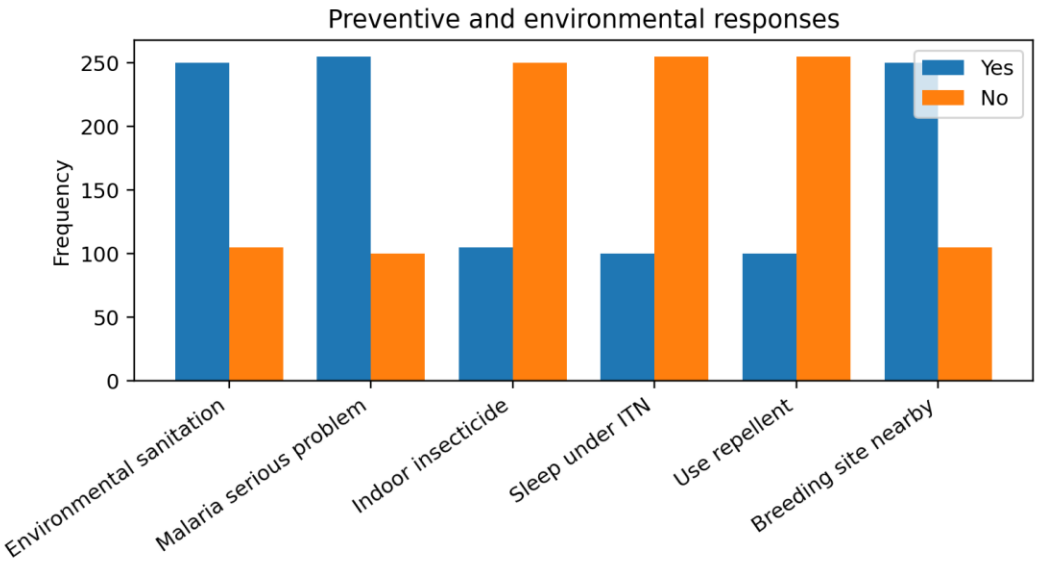

Figure 3. Preventive and environmental responses among respondents.

4.3 Factors Associated with Malaria Infection

The logistic regression results indicate that demographic, preventive and environmental factors were associated with malaria infection. The strongest adjusted association was observed for marital status, followed by age group 30-35 years, repellent non-use and male sex. Non-use of ITNs and proximity to mosquito breeding sites also remained important predictors. Indoor insecticide spraying did not show a statistically clear independent association in the adjusted model because its confidence interval included one.

Table 3. Adjusted factors associated with malaria infection.

Predictor	Malaria negative N (%)	Malaria positive N (%)	Adjusted odds ratio (95% CI)	Interpretation
Age 20-25 years	25 (7)	25 (7)	1.00	Reference
Age 25-30 years	55 (18)	45 (10)	2.31 (1.15-4.65)	Significant
Age 30-35 years	20 (5)	80 (22)	4.05 (1.95-8.42)	Significant
Age 35+ years	50 (14)	55 (15.5)	2.40 (1.20-3.50)	Significant
Male	105 (12)	50 (12)	3.24 (1.75-5.97)	Significant
Female	105 (50)	95 (23)	1.00	Reference
Married	50 (12)	100 (38)	4.97 (2.67-9.28)	Significant
Unmarried	100 (38)	55 (12)	1.00	Reference
Family size >=5	7 (18)	7 (18)	2.20 (1.20-4.06)	Significant
No indoor insecticide	100 (51)	50 (23)	1.40 (0.69-2.83)	Not significant
No ITN use	150 (51)	55 (23)	2.60 (1.21-5.60)	Significant
No repellent use	50 (12)	55 (18)	3.91 (1.87-8.18)	Significant
Breeding site nearby	100 (31)	55 (25)	2.10 (1.13-3.61)	Significant

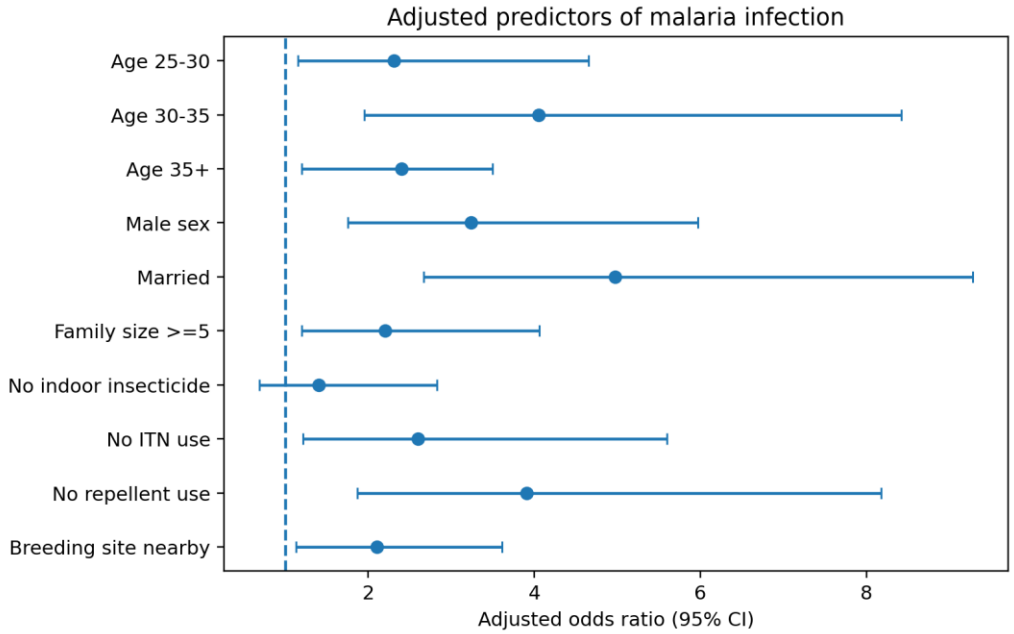

Figure 4. Forest plot of adjusted predictors of malaria infection.

4.4 Summary of Key Findings

Table 4. Practical summary of findings for district malaria control planning.

Theme	Result interpretation
Demographic risk	Older age, male sex, married status and larger household size were associated with higher malaria infection odds.
Preventive behaviour	Non-use of ITNs and mosquito repellents substantially increased the likelihood of malaria infection.
Environmental exposure	Living near mosquito breeding sites increased malaria risk, confirming the importance of local environmental management.
Programme implication	Awareness of malaria is not translating into adequate preventive practice; targeted behaviour-change and household-level intervention are required.

5. Discussion

The findings show that malaria infection in Kawama East Compound is not explained by one factor. Instead, risk is produced by the combination of household composition, behaviour and environmental exposure. The strongest adjusted association was marital status, which may reflect household density, family responsibilities and shared sleeping arrangements. Married participants may also be more likely to live in larger households, increasing the challenge of ensuring that every household member sleeps under an effective net (Ryan et al., 2020).

The increased risk among respondents aged 30-35 years suggests that adult exposure should not be ignored. Malaria programmes frequently focus on children under five and pregnant women because these groups are biologically vulnerable. That focus is justified, but it can unintentionally underplay adult exposure in communities where work, mobility and outdoor activities increase mosquito contact. In Kawama East, targeted communication should include adult men and working-age household members, not only caregivers of children (Zambia Ministry of Health, 2017).

The association between male sex and malaria infection is consistent with the possibility of behavioural and occupational exposure. Men may spend more time outdoors during evening or early morning hours when mosquitoes are active, or may be less consistent in using ITNs. This does not mean that biology alone explains the difference. The more likely explanation is the pattern of exposure and prevention, which means interventions should be designed around actual daily routines rather than generic messages (Nawa et al., 2019).

The relationship between household size and malaria infection is important because it points to a practical barrier. In larger households, the number of nets may be insufficient, sleeping spaces may be crowded, and prevention may not be distributed equally among household members. A household may be classified as having an ITN, yet some members may remain unprotected. Distribution programmes should therefore consider people per sleeping space and not merely nets per household (Ramdzan et al., 2020).

The most direct programme message from the results is that ITN use remains inadequate. More than seven in ten respondents did not sleep under an ITN, and non-use was independently associated with malaria infection. This is a major weakness because ITNs are among the most cost-effective prevention tools available. The problem may be supply-related, behaviour-related, comfort-related or linked to damaged nets. District teams should not assume that distribution equals use; follow-up is required to verify actual night-time practice (Nawa et al., 2019).

Repellent use also showed a strong association with malaria infection. Respondents who did not use repellents had higher odds of infection. Repellents are not a substitute for ITNs or IRS, but they can provide supplementary protection, especially for people exposed outdoors before bedtime or in the early evening. The challenge is affordability and sustained use. If repellents are recommended, communities need realistic guidance on when they are most useful and how they should complement other interventions (Killeen & Sougoufara, 2023).

Indoor insecticide spraying did not remain statistically clear in the adjusted model. That finding should be interpreted carefully. It does not prove that spraying is useless. It may indicate inconsistent application, inadequate coverage, timing problems, insecticide resistance, or confounding by areas selected for spraying because they already had higher risk. Programme managers should use this as a signal to audit spraying quality, timing, coverage and insecticide susceptibility rather than abandon IRS (Nawa et al., 2019).

Proximity to mosquito breeding sites was associated with malaria infection, confirming the local environmental nature of transmission. Stagnant water, poor drainage, open containers and poorly managed waste can sustain vector populations around homes. Environmental sanitation participation was high in self-report, yet breeding-site exposure remained common. This suggests that community clean-up alone may be too general or irregular. Targeted larval source management and household inspections may be more effective (Ryan et al., 2020).

The gap between malaria awareness and prevention is a critical behavioural issue. Seventy-two percent of respondents recognised malaria as a serious problem, but most did not sleep under ITNs and most did not use repellents. This is where public health messaging often fails: people may know the disease is serious yet still not perform the preventive behaviour. Practical barriers, social norms, discomfort, cost, net availability, household sleeping arrangements and perceived inconvenience must be addressed directly (Killeen & Sougoufara, 2023).

The findings support a shift from broad health education to risk-stratified community action. For example, households with five or more members should be checked for enough usable nets. Men and working adults should receive messages that address outdoor exposure. Homes near breeding sites should be prioritised for environmental control. Married households and larger families should be targeted for household-level counselling. These are more useful actions than repeating general statements that malaria is dangerous (Ryan et al., 2020).

The study also demonstrates the value of local evidence. National malaria strategies provide the framework, but local compounds determine the operational details. A district health office needs to know which households are most exposed, which preventive measures are being neglected and which environmental risks remain. Without this local evidence, interventions risk being misdirected, too broad or poorly timed (Ryan et al., 2020).

Overall, the findings align with the broader literature on malaria transmission in sub-Saharan Africa, which emphasises the combined importance of vector control, environmental management, socioeconomic conditions and health behaviour. However, the Kawama East results add specificity: the most immediate weaknesses are ITN non-use, repellent non-use and breeding-site exposure. These should be treated as priority intervention points (Ryan et al., 2020).

6. Public Health Implications

First, the district malaria programme should strengthen ITN follow-up after distribution. The relevant indicator should not only be whether households received nets, but whether each sleeping space has a usable net and whether household members actually sleep under it. Behaviour-change visits should address heat, discomfort, damaged nets and misconceptions.

Second, environmental management should be mapped at household and neighbourhood level. Homes near stagnant water, blocked drainage or unmanaged waste should be prioritised for clean-up, larval source reduction and community monitoring. General sanitation campaigns should be converted into targeted breeding-site elimination activities.

Third, malaria messages should be segmented. Adult men and working-age groups should receive prevention messages that match their exposure patterns. Larger and married households should be advised on net allocation, sleeping arrangements and early care-seeking. Schools, churches, markets and workplaces can be used for repeated messaging.

Fourth, IRS should be quality-assured. If spraying is used, programme managers should verify coverage, timing, wall acceptance, insecticide used, residual effectiveness and community acceptance. Weak implementation can create the appearance that IRS is ineffective when the real problem is coverage or timing.

Fifth, community health workers should be equipped to identify households with multiple risks: large family size, no ITN use, no repellent use and nearby breeding sites. These households should be followed up more frequently than lower-risk households.

7. Strengths and Limitations

The major strength of the study is its local focus. By concentrating on Kawama East Compound, the study provides practical evidence for district-level planning rather than relying only on national or provincial averages. The sample size of 355 participants allowed meaningful descriptive and regression analysis, and the inclusion of demographic, preventive and environmental variables made the analysis relevant for public health action.

The study also has limitations. Because the design was cross-sectional, associations cannot be interpreted as proof of causation. Self-reported preventive behaviour may be affected by recall or social desirability bias. Some variables, such as household income, housing quality, net condition, timing of mosquito exposure and laboratory confirmation details, were not deeply measured in the converted research paper. Future studies should include direct household observation, entomological assessment and longitudinal follow-up across rainy and dry seasons.

8. Conclusion

Malaria infection in Kawama East Compound is associated with demographic vulnerability, low uptake of preventive measures and environmental exposure. The highest adjusted odds were observed among married respondents, respondents aged 30-35 years, males, non-users of repellents, non-users of ITNs, larger households and those living near mosquito breeding sites.

The findings show that awareness of malaria as a serious problem has not translated into consistent use of prevention. This is the central public health failure identified by the study. The solution is not more generic awareness alone. The solution is targeted household-level implementation: enough usable nets, consistent net use, supplementary repellents where relevant, removal of breeding sites and focused follow-up of high-risk households.

District malaria control planning should therefore prioritise practical interventions that match the observed risk profile in Kawama East. Such an approach can improve the efficiency of malaria control and contribute to the broader goal of reducing malaria burden in Copperbelt Province and Zambia.

9. Recommendations

1. Increase ITN coverage and use by verifying the number of usable nets per sleeping space, replacing damaged nets and conducting household follow-up after distribution.
2. Promote mosquito repellent use as a supplementary protective measure for adults and household members exposed outdoors before bedtime or during early evening hours.
3. Conduct targeted environmental management in areas with known breeding sites, including drainage improvement, removal of stagnant water and community monitoring of high-risk locations.
4. Design risk communication for adult men, married households and larger families, because these groups showed higher adjusted odds of malaria infection.
5. Strengthen IRS quality assurance by checking coverage, timing, insecticide type, community acceptance and residual effectiveness.
6. Use community health workers to identify and follow up households with multiple risk factors, particularly non-use of ITNs, non-use of repellents, larger household size and nearby breeding sites.
7. Future research should include entomological data, seasonal analysis, direct observation of household conditions and laboratory-confirmed malaria outcomes.

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Author Contributions

Chikumbi Ndolesha conceptualised the original study, collected and analysed the data, and served as first author. Stanley Kashweka Chitenge contributed to supervision, technical review and development of the research paper structure. Both authors approved the final research paper.

Conflict of Interest

The authors declare no conflict of interest.

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