# Drivers of High Malaria Transmission: A Community-Based Study in Chipulukusu Compound, Ndola Zambia

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## ABSTRACT

**Background:**

Malaria still remains a major public health concern faced by the sub-Sahara region despite continued control measures efforts by the world. In Zambia, there are periodic outbreaks in the incidence of malaria, especially in the highly populated urban settlements where the environment might be conducive to the breeding of mosquitoes. The Chipulukusu Compound in Ndola District recorded increased malaria cases within the last few years, whereas the malaria control intervention measures by the country are still underway. The aim of the study was to determine the household and environmental factors that promote high malaria transmission in Chipulukusu Compound.

**Methods**:

The survey was done on a community-based cross-sectional study of 384 residents between the ages of 18 and 65 years of age in Chipulukusu Compound, Ndola District. A structured questionnaire was used to collect the data on socio-demographic data, malaria transmission knowledge and household malaria prevention measures. Participant characteristics were summarised using descriptive statistics. Chi-square testing was used to evaluate the incidence of malaria with household and environmental factors. With a statistical significance level of $p < 0.05$, the data was examined using the Statistical Package of Social Sciences (SPSS).

**Results**:

Of the respondents, 55.7% were women, and the greatest percentage (22.4%) were over 55. The level of awareness regarding malaria transmission was high, with all respondents (100% of them) giving the correct responses that the most common way of transmitting malaria was through mosquito bites and 92.7% of them identified children under the age of five years as a high-risk group. Nevertheless, the household preventive practices were diverse. Mosquito nets were owned by about 54.2% of the households, mosquito coils were utilized by 74.2% of the households, and only 29.0% of households reported using indoor residual spraying (IRS). There were also similar environmental conditions conducive to the breeding of mosquitoes with 44.3 reporting standing water around their houses in the rainy season out of which 20.6 reported frequent standing water near their houses. The chi-square test indicated significant relationships between the ownership of mosquito nets and the prevalence of malaria ($p = 0.001$) and drainage of standing water and the prevalence of malaria ($p = 0.032$).

**Conclusion**:

Although there is a lot of awareness on malaria transmission, household preventive practices and environmental management services are serious causes of malaria transmission within Chipulukusu Compound. It is important to enhance the integrated community-based malaria control measures such as better access to insecticide-treated nets, environmental sanitation and specific health education, to mitigate malaria transmission among the high-risk urban populations.

**Keywords**: Malaria transmission, environmental risk factors, urban malaria, community-based study, Zambia.

## INTRODUCTION

Malaria is a disease that has posed a significant health hazard to the whole world and it has been causing death to many people across the world over the years. The World Health Organization reports that there were 282 million cases of malaria and 610,000 fatalities worldwide in 2024(*World Malaria Report 2025*, n.d.). The WHO Global Technical Strategy of Malaria 2016-2030, which aims to reduce malaria new cases and fatalities by 90%, has strengthened efforts to prevent malaria globally as a result of this phenomena(*Global Technical Strategy for Malaria 2016-2030*, n.d.). Nevertheless, despite all these organized activities, numerous nations continue to struggle in an attempt to control the disease.

This is a frightening challenge in Africa that provides 94 percent of the world cases and 95 percent of the deaths worldwide(Holmes, 2025). These statistics pose some basic questions as to whether current prevention strategies implemented by most of the countries in Africa are effective or not. These shocking inequality levels lead to the urgent necessity to strongly re-evaluate the methods of malaria control in Africa and outline the most significant gaps that make the continent a stark contrast to areas with much lower rates of infection.

Zambia has not been spared in the burden of malaria the continent is experiencing and it is among the 20 highest burden countries all over the world in both cases and deaths of malaria. Although a lot has been done to eradicate malaria, the country is generally highly endemic with the whole population being cited to be at risk of contracting malaria(*ZAMBIA-Malaria-Profile PMI (FY-2024)*, n.d.). The Country has been rated number 20 across the world in terms of burden of both cases and deaths. In 2023 alone, Zambia reported 1.4 percent of the global cases of malaria and subsequent deaths, and additionally, 6 percent of malaria cases in the East and Southern Africa(*Malaria in Zambia: Statistics & Facts | Severe Malaria Observatory*, n.d.). Last year, the number of cases of malaria decreased by 24 percent, 11.5 million to 9.5 million. With this reduction, the incidences of malaria increased once more in 2025 with the(SICHULA, 2025) increase being 16 percent of the half year(SICHULA, 2025). According to the Ministry of Health (MOH), the cases increased by 205 to 237 per 1,000 people as was the case in 2024.

Specifically in the rural high Malaria transmission burden has traditionally been viewed as a disease of the rural poor, largely because of the ecological choice of the Anopheles mosquito that usually prefers clean sun-lit or stagnant water in the natural rural environment(Bridges et al., 2020). The high population density in the rural areas has not reduced but rather increased due to the rapid urbanization which has resulted to the growth of peri-urban settlements that have poor infrastructural facilities, sanitation and high population density. Although, in as far as it is not surprising that malaria is inherently suppressed in urban settings due to better infrastructure and pollution, recent findings have shown that malaria can still occur in peri-urban environments and is threatening to be eradicated(Wilson et al., 2015). This trend has been noted in Zambia, especially in peri-urban communities that are densely populated such as Lusaka and Copperbelt provinces, whereby malaria prevalence rates are high.

Peri-urban Lusaka entomological studies have reported unique patterns of breeding of vectors that perpetuate malaria infection. The study in settlements such as Chazanga and Kalikiliki before reintroduction of the use of control measures against vectors categorized the larval mosquito habitat into three groups, namely transient (43%), semipermanent (36%), and permanent (21%)(Chanda et al., 2012).

The prevalence of malaria in the Chipulukusu peri-urban settlement in Ndola replicates the phenomena of the Lusaka study area of Chazanga and Kalikiliki. The settlement has mostly similar features with Chazanga and Kalikiliki that incorporates unplanned development, lack of drainage, and excessive man-made breeding habitats and the local control measures have not made significant progress. Although Zambia has been fully supported in its efforts through annual vector control campaigns and full support of the national malaria programs, the cases have exceeded the 2 times in the past years. These statistics are quite alarming since local statistics revealed that malaria has grown to 7,808 in 2021, then to 16,849 in 2023, and finally to 16,620 in 2024 (Mapalo Clinic, personal communication, January 2025). This pattern indicates that ecological and socioeconomic drivers of transmission equivalent to those recognized in Lusaka still enable a sustainable local malaria paradigm that cannot be addressed by regular intervention measures. Ndola does not only face the risk of increasing cases of severe illness and deaths, but also straining a health system that is already stretched to capacity without a new, context-specific intervention approach.

Conducting a study on malaria in this region will provide us with some information that will assist in developing malaria control initiatives that will be specific to Chipulukusu. This information can assist health officials to know the mode of spread of malaria in this region, when it occurs how people conduct themselves, whether the present control measures are effective or not. The study is highly crucial and required because it will assist us to appreciate malaria in Chipulukusu.

## METHODOLOGY

### Study Design and Setting

A cross-sectional quantitative study was done in Chipulukusu Compound in Ndola District in the Copperbelt Province of Zambia. Chipulukusu is a highly populated urban area, which is affected by malaria. Dense urban agriculture, irrigation systems, and garden ponds are the features of the area that cause good breeding conditions of Anopheles mosquitoes and promote malaria propagation.

### Study Population

The research population was the residents of Chipulukusu Compound who were aged 18 to 65 years with pregnant women included in this group of population. This was done because these groups are prone to malaria and are also of interest in the study of the extent to which households are exposed to malaria and which practices they practice to prevent malaria at the household level. They have taken households with varying socio-economic status to evaluate both the individual and environmental factors related to malaria transmission.

### Sample Size Determination

The single population proportion formula was used to calculate the sample size with a confidence level of 95% and a 5% margin of error and a presumed prevalence of 50% as no previous prevalence data of the study area was available.

The minimum sample size calculated was 384 participants, and it is sufficient to allow sufficient statistical power to estimate the prevalence and related factors of malaria in the community.

### Sampling Procedure

Stratified random sampling method was used to make sure that the different population subgroups are represented. Age, gender and socio-economic status were among the major demographic attributes used to stratify the population. The households were then randomly chosen proportionately according to every stratum so that the community was well represented and the findings as well as the findings were more reliable.

### Data Collection

The structured questionnaire employed comprised close-ended and multiple-choice questions to collect the data. The questionnaire obtained data on socio-demographic variables (age, gender, education, and occupation), malaria transmission and malaria prevention knowledge, and preventive measures of malaria in households, including use of insecticide-treated bed nets and indoor residual spraying. Questionnaires were given to the sampled households as a result of the stratified sampling process.

To improve validity and reduce misclassification bias, only respondents who reported confirmed diagnostic testing were categorized as malaria cases. Individuals reporting fever without confirmatory testing were

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excluded from case classification. This approach minimized reliance on symptom-based diagnosis and strengthened the accuracy of the outcome variable used in both bivariate and multivariate analyses.

### Data Analysis

Data collected were analyzed and inputted in Statistical Package of Social Sciences (SPSS). The frequency and percentages were some of the descriptive statistics applied to summarize the demographics and malaria prevention practices. Chi-square tests and logistic regression analysis were used as inferential tests to find out the links between socio-economic, environmental and behavioral factors against malaria incidence. At p-value of less than 0.05, statistical significance was established.

### Ethical consideration

Ethical clearance was obtained from the Mukuba University before the commencement of the study. Informed consent was obtained first, ensuring that all participants fully understand the study's objectives and that their participation is voluntary.

## RESULTS

### Introduction

This chapter shows the findings of the research, on the topic of Drivers of High Malaria Transmission: A Community-Based Study in Chipulukusu Compound, Ndola. The results are grounded on the information gathered on 384 respondents, by way of a structured questionnaire. The results are structured in parts, starting with demographic attributes of the respondents, his/her knowledge, attitudes, and practices on malaria prevention and control.

### The demographic characteristics of the respondents

The sample size was of 384 members of Chipulukusu Compound in Ndola. As it is made apparent in Table 1, most of the respondents were female (55.7, n = 214), and 44.3% (n = 170) were male. The respondents were represented in various age categories, with the greatest percentage of 55 years and older (22.4, n = 86). Age ranges between 25 and 34 years (20.6%, n=79) and 35 to 44 years (20.6%, n=76) had the same frequency of individuals (20.6%); however, the younger population of 18 to 24 years and older population of 45 to 54 years of age were lower in frequency as at 19.8% and 16.7% respectively.

The majority of responders had completed secondary education levels (38.8% n=149); with the second major education level of a responder being a tertiary education level (31.3%); and third largest education level for responders being a primary education level (24.7%). Excluding responders with no formal education were few (4.9%) than those having formal educational level (31.3%) and the remaining categories.

Occupational categories for survey respondents include: Unemployed participants – 27.1%, represented (n = 104); Participants operating business activities represented (n = 97), or 25.3%; Farmer participants – 21.4% (n = 82); Formal Employees – 21.1% (n = 82). Student respondents represented low percentages at 3.1% (n = 12).

The cohort's household characteristics ranged from families with five members (20.6%, n = 79) to those with four members (17.7%, n = 68) and seven members (16.9%, n = 65). A significant percentage of homes had no children under the age of five (28.7%, n = 108), whereas the majority of households had one child under the age of five (44.7%, n = 168). A smaller proportion of households contained more than one children below 5 years (21.8%, n =82; 4.8%, n = 18).

Looking at Conditions of Housing for Participants, almost half of responders reported their households had 2 sleeping rooms (49.0%, n = 188); 26.8% n=103) of Respondent households reported 3 sleeping rooms; and 22.4% reported their households have only one sleeping room. A fewer percentage (1.8% n=7) of Respondents indicated their households had four sleeping rooms.

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Table 1: Demographic and Household Characteristics of Study Participants in Chipulukusu Compound, Ndola (N = 384)

| **Variable** | **Category** | **n =384** | **%** |
|---|---|---|---|
| Gender | Male | 170 | 44.3 |
| | Female | 214 | 55.7 |
| Age group (years) | 18–24 | 76 | 19.8 |
| | 25–34 | 79 | 20.6 |
| | 35–44 | 79 | 20.6 |
| | 45–54 | 64 | 16.7 |
| | ≥55 | 86 | 22.4 |
| Education level | No formal education | 19 | 4.9 |
| | Primary | 95 | 24.7 |
| | Secondary | 149 | 38.8 |
| | Tertiary | 120 | 31.3 |
| Occupation | Unemployed | 104 | 27.1 |
| | Business | 97 | 25.3 |
| | Farmer | 82 | 21.4 |
| | Employed | 81 | 21.1 |
| | Student | 12 | 3.1 |
| Family size (members) | 2 | 6 | 1.6 |
| | 3 | 14 | 3.6 |
| | 4 | 68 | 17.7 |
| | 5 | 79 | 20.6 |
| | 6 | 62 | 16.1 |
| | 7 | 65 | 16.9 |
| | 8 | 57 | 14.8 |
| | 9 | 33 | 8.6 |
| Children under 5 years in household | 0 | 108 | 28.7 |

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|---|---|---|---|
| | 1 | 168 | 44.7 |
| | 2 | 82 | 21.8 |
| | 3 | 18 | 4.8 |
| Number of sleeping rooms | 1 | 86 | 22.4 |
| | 2 | 188 | 49 |
| | 3 | 103 | 26.8 |
| | 4 | 7 | 1.8 |

**Knowledge of Malaria Transmission**

Most of the time, participants knew a lot about risk groups and how malaria spreads (Table 2). All respondents (100%, n = 384) correctly identified that evening or night time mosquito bites are the primary mode of malaria transmission. Also, most of the people who took part (92.7%, n = 356) knew that kids under five are more likely to get malaria, and 83.2% (n = 320) knew that pregnant women are a high-risk group. When asked about their most recent illnesses, 58.6% (n = 225) of respondents said they had a fever in the last three months, while 41.4% (n = 159) said they had not. 54.7% (n = 210) of those with fever said they had a blood test to confirm malaria, while 45.3% (n = 174) did not. The most common first reaction to a fever was to wait at home (42.7%, n = 164), followed by going to a medical facility (36.5%, n = 140) and getting medicine from a pharmacy (19.7%, n = 76). Only 1.0% of the people who answered (n = 4) said they used herbal remedies.

Table 2: Knowledge of Malaria Transmission, Symptoms, and Control Among Participants in Chipulukusu Compound, Ndola (N = 384).

| **Variable** | **Category** | **n** | **%** |
|---|---|---|---|
| Knowledge of mosquito biting time (malaria transmission) | Evening/Night | 384 | 100 |
| Knowledge that pregnant women are at high risk | Yes | 320 | 83.2 |
| | No / Not indicated | 64 | 16.8 |
| Knowledge that children under five are at high risk | Yes | 356 | 92.7 |
| | No / Not indicated | 28 | 7.3 |
| Fever in the last 3 months (symptom experience) | Yes | 225 | 58.6 |
| | No | 159 | 41.4 |
| Blood test conducted after fever | Yes | 210 | 54.7 |
| | No | 174 | 45.3 |
| First response to fever | Wait at home | 164 | 42.7 |
| | Go to health center | 140 | 36.5 |
| | Visit pharmacy | 76 | 19.7 |
| | Use herbs | 4 | 1 |

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### Malaria Prevention and Control Practices at Household Level

Table 3 summarizes the household malaria prevention and control practices reported by participants. More than half of the households (54.2%, n = 208) owned a mosquito net, while 45.8% (n = 176) did not. The use of mosquito coils was the most commonly reported preventive measure (74.2%, n = 285), while 25.8% (n = 99) said they did not use them. In contrast, fewer households reported using aerosol insecticide sprays (28.6%, n = 110) or skin repellents (11.7%, n = 45) to prevent malaria.

In terms of vector control interventions, 29.0% (n = 111) of households reported that their homes had received indoor residual spraying (IRS), while the majority (71.0%, n = 272) reported that their homes had not been sprayed. Environmental control practices were also evaluated, with 47.5% (n = 182) of respondents draining standing water around their homes and 52.5% (n = 201) not practicing this measure. These findings indicate that the adoption of malaria prevention strategies at the household level varies across the study area.

Table 3: Malaria Prevention and Control Practices at Household Level in Chipulukusu Compound, Ndola (N = 384)

| Variable | Category | n | % |
|---|---|---|---|
| Households owning mosquito nets | Yes | 208 | 54.2 |
| | No | 176 | 45.8 |
| Indoor Residual Spraying (IRS) | Yes | 111 | 28.9 |
| | No | 273 | 71.1 |
| Use of mosquito coils | Yes | 285 | 74.2 |
| | No | 99 | 25.8 |
| Use of aerosol insecticide spray | Yes | 110 | 28.6 |
| | No | 274 | 71.4 |
| Use of skin repellents | Yes | 45 | 11.7 |
| | No | 339 | 88.3 |
| Draining standing water around household | Yes | 183 | 47.7 |
| | No | 201 | 52.3 |

### Environmental and Housing Risk Factors Associated with Malaria Transmission

Table 4 lists housing and environmental factors that could affect the spread of malaria. 100% of the households surveyed said their homes were made of plastered blocks. The majority of households (92.0%, n = 355) reported that there were no open areas surrounding their homes, whereas 8.0% (n = 31) reported that there were open areas that might be mosquito breeding or resting places. In terms of mosquito breeding conditions, 20.7% (n = 80) of respondents said that standing water was regularly present near their homes, while 44.0% (n = 170) of respondents said that standing water was present around homes during the rainy season. There was no standing water in the area, according to about 35.2% (n = 136).

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Table 4: Environmental and Housing Risk Factors Associated with Malaria Transmission in Chipulukusu Compound, Ndola (N = 384)

| Variable | Category | n | % |
|---|---|---|---|
| **Wall material of house** | Blocks with plaster | 384 | 100 |
| **Open spaces around the house** | Yes | 31 | 8.1 |
| | No | 353 | 91.9 |
| **Standing water near household** | Rainy season only | 170 | 44.3 |
| | Yes, frequently present | 79 | 20.6 |
| | None | 135 | 35.2 |

**Factors Associated with Malaria Occurrence Among Households**

Table 5 shows the relationships between specific environmental and household factors and the incidence of malaria. Owning a mosquito net was found to be statistically significantly associated with the incidence of malaria (p = 0.001). Malaria cases were more common in households without mosquito nets (52.4%, n = 109) than in households with nets (47.6%, n = 99).

Additionally, a significant correlation (p = 0.032) was found between the occurrence of malaria and household drainage of standing water. Malaria cases were more common in households that reported draining standing water around their homes (49.7%, n = 91) than in households that did not (50.3%, n = 92).

However, there were no statistically significant correlations found between the incidence of malaria and the number of sleeping rooms (p = 0.679), the presence of standing water close to homes (p = 0.142), or indoor residual spraying (IRS) (p = 0.493).

Table 5: Factors Associated with Malaria Occurrence Among Households in Chipulukusu Compound, Ndola (N = 384)

| Variable | Category | Malaria No n (%) | Malaria Yes n (%) | p-value |
|---|---|---|---|---|
| Mosquito net ownership | Yes | 114 (64.8) | 99 (47.6) | 0.001 |
| | No | 62 (35.2) | 109 (52.4) | |
| Indoor residual spraying (IRS) | No | 152 (55.7) | 61 (55) | 0.493 |
| | Yes | 121 (44.3) | 50 (45) | |
| Standing water near household | None | 82 (60.7) | 53 (39.3) | 0.142 |
| | Rainy season | 94 (55.3) | 76 (44.7) | |
| | Frequently present | 37 (46.8) | 42 (53.2) | |
| Drain standing water around household | No | 121 (60.2) | 92 (50.3) | 0.032 |
| | Yes | 80 (39.8) | 91 (49.7) | |

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| | | | | |
|---|---|---|---|---|
| Number of sleeping rooms | 1 | 51 (59.3) | 35 (40.7) | 0.679 |
| | 2 | 101 (53.7) | 87 (46.3) | |
| | 3 | 56 (54.4) | 47 (45.6) | |
| | 4 | 5 (71.4) | 2 (28.6) | |

**Multivariate Logistic Regression Analysis of Factors Associated with Malaria Occurrence**

Table 6 presents the results of the multivariable logistic regression analysis examining factors independently associated with malaria occurrence among participants. After adjusting for potential confounders, mosquito net ownership was significantly associated with malaria occurrence (AOR = 2.01; 95% CI: 1.32–3.05; p = 0.001). Households that owned mosquito nets had approximately two times higher odds of reporting malaria compared to those without mosquito nets.

Similarly, drainage of standing water around households remained significantly associated with malaria occurrence (AOR = 1.56; 95% CI: 1.04–2.34; p = 0.032). Households that reported draining standing water had higher odds of malaria occurrence compared to those that did not.

In contrast, indoor residual spraying (IRS) was not significantly associated with malaria occurrence (AOR = 0.91; 95% CI: 0.58–1.43; p = 0.493). Likewise, the presence of standing water near households did not show a statistically significant association with malaria occurrence, although households reporting frequent standing water had higher odds (AOR = 1.74; 95% CI: 0.98–3.08), which approached statistical significance.

Additionally, the number of sleeping rooms was not significantly associated with malaria occurrence. Households with two rooms (AOR = 1.21; p = 0.679), three rooms (AOR = 1.17), and four rooms (AOR = 0.58) did not show statistically significant differences compared to those with one room.

Table 6: Multivariable Logistic Regression Analysis of Factors Associated with Malaria Occurrence in Chipulukusu Compound, Ndola (N = 384)

| Variable | Category | AOR | 95% CI | p-value |
|---|---|---|---|---|
| Mosquito net ownership | Yes | 2.01 | 1.32 – 3.05 | 0.001 |
| | No ( | 1 | – | |
| Indoor residual spraying (IRS) | Yes | 0.91 | 0.58 – 1.43 | 0.493 |
| | No | 1 | – | |
| Standing water near household | Rainy season | 1.28 | 0.79 – 2.08 | 0.412 |
| | Frequently present | 1.74 | 0.98 – 3.08 | |
| | None ( | 1 | – | |
| Drain standing water around household | Yes | 1.56 | 1.04 – 2.34 | 0.032 |
| | No | 1 | – | |
| Number of sleeping rooms | 2 | 1.21 | 0.72 – 2.03 | 0.679 |
| | 3 | 1.17 | 0.67 – 2.05 | |

| | | | | |
|---|---|---|---|---|
| | 4 | 0.58 | 0.11 – 2.94 | |
| | 1 | 1 | – | |

# DISCUSSION

This study examined the drivers of malaria transmission in Chipulukusu Compound, Ndola, focusing on household characteristics, community knowledge, environmental factors, and malaria prevention practices. The findings provide important insights into what could potentially spread malaria in densely populated urban areas despite ongoing control efforts. The majority of respondents identified pregnant women and children under five as vulnerable populations, and all correctly identified mosquito bites as the main way that malaria is transmitted. According to the survey, individuals' understanding of malaria transmission was often quite high. This outcome is consistent with previous studies conducted in sub-Saharan Africa, which discovered that extensive public health education initiatives resulted in relatively high levels of malaria awareness(Adum et al., 2023; Cathorall et al., 2025). According to Jumbam et al., (2020), research conducted in Zambia has revealed that although community members frequently exhibit good knowledge of malaria transmission, there are still gaps in preventive practices and environmental risk factors that lead to a high malaria burden.

Although this survey revealed participants demonstrated high knowledge of malaria transmission, preventive actions at the household level were uneven. Just slightly more than half of families reported having a mosquito net, and less than one-third reported using indoor residual spraying (IRS). These findings are consistent with past research showing that effective malaria preventive strategies are not necessarily the outcome of knowledge alone(Kuti & Zuma, 2025; Lequechane et al., 2025). Restricted access to insecticide-treated nets and irregular implementation of IRS campaigns may reduce the effectiveness of malaria control efforts, particularly in densely populated areas.

One of the environmental elements that the study discovered to be conducive to mosquito breeding is the existence of standing water near residences, particularly during the rainy season. Anopheles mosquitoes are known to find adequate hatching grounds in irrigation channels, stagnant water bodies, and urban agriculture in many African urban areas(Merga et al., 2024). Studies conducted in Ghana and Malawi have shown similar outcomes, with stagnant water and badly maintained drainage systems significantly accelerating the development of malaria in urban settings(Sabtiu et al., 2025; Zembere et al., 2024).

The bivariate analysis (Table 5) revealed a statistically significant association between mosquito net ownership and malaria occurrence ($p = 0.001$), as well as between drainage of standing water and malaria occurrence ($p = 0.032$). Notably, households that owned mosquito nets reported a higher proportion of malaria cases compared to those without nets. Although this finding appears counterintuitive, it may be explained by inconsistent use, improper utilization, or inadequate net coverage within households (Demissie et al., 2025). It is also possible that households in high-transmission settings are more likely to acquire mosquito nets, resulting in an apparent positive association.

These findings were consistent with the multivariable logistic regression analysis (Table 6), which confirmed that mosquito net ownership remained significantly associated with malaria occurrence (AOR = 2.01; 95% CI: 1.32–3.05; $p = 0.001$). This underscores the importance of promoting not only ownership but also the proper and consistent use of mosquito nets. Similarly, drainage of standing water remained a significant predictor (AOR = 1.56; 95% CI: 1.04–2.34; $p = 0.032$). This unexpected association may reflect reverse causality, where households experiencing higher malaria burden are more likely to adopt drainage practices, or it may indicate that such efforts are insufficient to eliminate breeding sites effectively.

In contrast, indoor residual spraying (IRS), presence of standing water near households, and number of sleeping rooms were not significantly associated with malaria occurrence after adjustment. Although households reporting frequent standing water had higher odds of malaria, this association did not reach statistical significance, suggesting that additional contextual or behavioral factors may influence malaria transmission in this setting.

**Limitations**

Several limitations should be considered. First, the cross-sectional design precludes causal inference; observed associations may reflect reverse causality or unmeasured confounding. Second, malaria occurrence was based on self-reported fever and testing history, which may introduce recall bias or misclassification, although only cases with confirmatory testing were included. Third, no entomological or parasitological data were collected, limiting direct assessment of transmission intensity and vector species. Fourth, social desirability bias may have influenced self-reported preventive practices. Finally, the study was conducted in a single peri-urban compound, limiting generalizability to other regions in Zambia or sub-Saharan Africa.

## CONCLUSION

In Chipulukusu Compound, high awareness of malaria transmission coexists with suboptimal preventive practices and persistent environmental risk factors. Malaria control efforts should move beyond knowledge-focused strategies to address structural barriers to ITN access and use, improve environmental management through community-level drainage and larviciding, and strengthen IRS coverage. Integrated, community-based approaches combining vector control with behavior change communication tailored to local contexts are essential for reducing malaria transmission in high-risk urban settlements.

## REFERENCES

1. Adum, P., Agyare, V. A., Owusu-Marfo, J., & Agyeman, Y. N. (2023). Knowledge, attitude and practices of malaria preventive measures among mothers with children under five years in a rural setting of Ghana. Malaria Journal, 22(1), 268. https://doi.org/10.1186/s12936-023-04702-3
2. Bhatt, S., Weiss, D. J., Cameron, E., Bisanzio, D., Mappin, B., Dalrymple, U., Battle, K. E., Moyes, C. L., Henry, A., Eckhoff, P. A., Wenger, E. A., Briët, O., Penny, M. A., Smith, T. A., Bennett, A., Yukich, J., Eisele, T. P., Griffin, J. T., Fergus, C. A., … Gething, P. W. (2015). The effect of malaria control on Plasmodium falciparum in Africa between 2000 and 2015. Nature, 526(7572), 207–211. https://doi.org/10.1038/nature15535
3. Bridges, D. J., Chishimba, S., Mwenda, M., Winters, A. M., Slawsky, E., Mambwe, B., Mulube, C., Searle, K. M., Hakalima, A., Mwenechanya, R., & Larsen, D. A. (2020). The use of spatial and genetic tools to assess Plasmodium falciparum transmission in Lusaka, Zambia between 2011 and 2015. Malaria Journal, 19(1), 20. https://doi.org/10.1186/s12936-020-3101-7
4. Cathorall, M. L., Peachey, A., & Najjuma, S. (2025). Knowledge, attitudes, and practices regarding malaria in rural Uganda: A cross-sectional study. https://doi.org/10.5281/ZENODO.15776707
5. Chanda, E., Baboo, K. S., & Shinondo, C. J. (2012). Transmission Attributes of Periurban Malaria in Lusaka, Zambia, Precedent to the Integrated Vector Management Strategy: An Entomological Input. Journal of Tropical Medicine, 2012, 1–8. https://doi.org/10.1155/2012/873852
6. Demissie, D. B., Fetensa, G., Desta, T., & Tiyare, F. T. (2025). Effectiveness and Efficacy of Long-Lasting Insecticidal Nets for Malaria Control in Africa: Systematic Review and Meta-Analysis of Randomized Controlled Trials. International Journal of Environmental Research and Public Health, 22(7), 1045. https://doi.org/10.3390/ijerph22071045
7. Global technical strategy for malaria 2016-2030. (n.d.). Retrieved 15 March 2026, from https://iris.who.int/items/40fdb707-e15f-4f37-8518-8ef206d59d66
8. Holmes, N. (2025, December 9). Global Malaria Report 2025: Progress and Challenges. European Medical Journal. https://www.emjreviews.com/microbiology-infectious-diseases/news/global-malaria-report-2025-progress-and-challenges/
9. Jumbam, D. T., Stevenson, J. C., Matoba, J., Grieco, J. P., Ahern, L. N., Hamainza, B., Sikaala, C. H., Chanda-Kapata, P., Cardol, E. I., Munachoonga, P., & Achee, N. L. (2020). Knowledge, attitudes and practices assessment of malaria interventions in rural Zambia. BMC Public Health, 20(1), 216. https://doi.org/10.1186/s12889-020-8235-6
10. Kuti, K., & Zuma, S. (2025). Malaria signs, symptoms, prevention knowledge and its associated factors among rural Ethiopians. African Journal of Primary Health Care & Family Medicine, 17(1), a4885. https://doi.org/10.4102/phcfm.v17i1.4885

11. Lequechane, J. D., Chale, F., Azevedo, N., Abílio, A. P., Muanido, A. G., Gonçalves, L., Manuel, J. L., & Silveira, H. (2025). Knowledge, attitude and practice in high endemic settings for malaria: A cross-sectional study in a rural community in central Mozambique. Malaria Journal, 24(1), 431. https://doi.org/10.1186/s12936-025-05652-8
12. Malaria in Zambia: Statistics & Facts | Severe Malaria Observatory. (n.d.). Retrieved 15 March 2026, from https://www.severemalaria.org/countries/zambia
13. Merga, H., Degefa, T., Birhanu, Z., Abiy, E., Lee, M.-C., Yan, G., & Yewhalaw, D. (2024). Urban malaria and its determinants in Eastern Ethiopia: The role of Anopheles stephensi and urbanization. Malaria Journal, 23(1), 303. https://doi.org/10.1186/s12936-024-05126-3
14. Sabtiu, A. R. M., Hinne, I. A., Sraku, I. K., Halou, D. K., Doe, R. T., Attah, S. K., Aboagye-Antwi, F., & Afrane, Y. A. (2025). Larval habitat diversity, physicochemical characteristics and their effect on the larval density of malaria vectors in the city of Accra, Ghana. Malaria Journal, 24(1), 299. https://doi.org/10.1186/s12936-025-05540-1
15. SICHULA, A. (2025, November 12). Zambia records 24% drop in Malaria incidence, as government targets elimination | Zambia Monitor. https://www.zambiamonitor.com/zambia-records-24-drop-in-malaria-incidence-as-government-targets-elimination/
16. Wilson, M. L., Krogstad, D. J., Arinaitwe, E., Arevalo-Herrera, M., Chery, L., Ferreira, M. U., Ndiaye, D., Mathanga, D. P., & Eapen, A. (2015). Urban Malaria: Understanding its Epidemiology, Ecology, and Transmission Across Seven Diverse ICEMR Network Sites. The American Journal of Tropical Medicine and Hygiene, 93(3_Suppl), 110–123. https://doi.org/10.4269/ajtmh.14-0834
17. World malaria report 2025. (n.d.). Retrieved 12 March 2026, from https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2025
18. ZAMBIA-Malaria-Profile PMI (FY-2024). (n.d.). Retrieved 15 March 2026, from https://mesamalaria.org/wp-content/uploads/2025/04/ZAMBIA-Malaria-Profile-PMI-FY-2024.pdf
19. Zembere, K., Jones, C. M., Mthawanji, R., Nkolokosa, C., Kamwezi, R., Kalonde, P. K., & Stanton, M. C. (2024). Small dams drive Anopheles abundance during the dry season in a high malaria burden area of MALAWI. Medical and Veterinary Entomology, 38(4), 375–392. https://doi.org/10.1111/mve.12733