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# Severe Malaria Risk Factors in Lupane District, Zimbabwe. A Retrospective Cohort Study

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**Abstract**

Zimbabwe envisions becoming a malaria-free country. However, a malaria resurgence has been reported in some of the elimination districts. This cohort study, guided by the Health Belief Model, aimed to examine risk factors associated with malaria severity in Lupane districts. Using proportionate stratified sampling, the study recruited 1207 individuals, comprising 1056 individuals who acquired malaria locally and 151 individuals who acquired malaria outside Lupane as captured in the DHIS2 electronic malaria-tracker database. The study used IBM SPSS 29.0.2.0(20)] for data analysis and odds ratios (ORs) were used to estimate relative risk (RR; 95% C.I; $p<0.05$). The study revealed relative risk for individuals who had not traveled 29.7 (8.74; 100.0), no Long-Lasting Insecticidal Nets 12.3 (7.02; 21.4), possessed LLINs but not used 7.83 (4.29; 14.3), hosted visitors 6.19 (4.16; 9.22), lived in rural residence 1.94 (1.35; 2.79), slept outdoors during the night 1.93 (1.36; 2.74), and adults 0.22(0.13; 0.36) compared to the corresponding reference groups. As the country continues to fight against malaria, it is critical to address perceived risk factors that can reintroduce the disease and sustain the gains made in malaria elimination districts.

## INTRODUCTION

Malaria is an infectious disease with high morbidity and mortality rates worldwide (Centers for Disease Control and Prevention, 2023; Chipoya & Shimaponda-Mataa, 2020; Darnius & Siahaan, 2023). In 2021, the global malaria landscape reported approximately 247 million cases, a slight increase from the 2020 figure of 245 million cases. This increase was concentrated in the WHO African Region. In 2020, the mortality rate increased to 15.1 (World Health Organization, 2023) but slightly decreased to 14.8 in 2021 globally (World Health Organization, 2023).

Globally morbidity and mortality due to falciparum malaria remain high (World Health Organization, 2023). Plasmodium falciparum stands as the predominant malaria parasite species in Zimbabwe, constituting over 98% of all reported cases (National Malaria Control Program, 2023). Malaria eradication has been a primary global health initiative for decades (Kumari et al., 2022), with member states setting goals to eliminate the disease in over 35 countries by 2030 as part of the World Health Organization's (WHO) Global Technical Strategy for Malaria (Ahmad et al., 2022).

Zimbabwe has adopted a subnational malaria elimination approach since 2012, which started with seven districts (11%) in Matabeleland South (Ministry of Health and Child Care, 2020; National Malaria Control Program, 2017). A total of (13) thirteen low-burden districts transitioned to malaria pre-elimination activities in Bulawayo Metropolitan, Midlands, Mashonaland West,

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and Matabeleland North provinces in 2015. Lupane is one of five elimination districts in Matabeleland that obtained its pre-elimination status in 2015 (Ministry of Health and Child Care, 2020; National Malaria Control Program, 2017).

By the end of 2022, the country had increased the number of pre-elimination districts to 30 (48%) out of 62 (National Malaria Control Program, 2023). In 2017, Zimbabwe released guidelines for foci investigation and response. These guidelines set standards for data analysis, foci delimitation, classification, finding drivers of transmission, reporting, and response activities that are meant to deal with drivers of transmission (National Malaria Control Program, 2017). However, the malaria resurgence has been reported among some of the elimination districts in Zimbabwe including Lupane district (National Malaria Control Program, 2023).

From 2021 to 2023, Lupane District reported 3116 confirmed malaria cases (National Malaria Control Program, 2023), despite obtaining its World Health Organisation-certified malaria elimination in 2015 (National Malaria Control Program, 2017). The district had an annual parasite incidence (API) of 2.0 to 3.5 between 2021 and 2023 (National Malaria Control Program, 2023), whereas the National Malaria Control and Elimination Strategic Plan (2021–2025) sets national targets of 0.18 per 1000 population, 0.10 per 1000 population, and 0.05 per 1000 population in 2021, 2022 and 2023, respectively (Ministry of Health and Child Care, 2020).

During the same period, Lupane reported an overall of 2787 (89%) local malaria cases, against the national elimination goal of maintaining zero local malaria transmission in this malaria elimination district (Ministry of Health and Child Care, 2020; National Malaria Control Program, 2023), showing that malaria continues to be a significant public health issue in the Lupane district. In Beitbridge (one of Zimbabwe's malaria elimination districts), a previous study found that out of 75 cases, 63 (84.0%) had no travel history exposure (Mundagowa & Chimberengwa, 2020). Malaria elimination requires interrupting the local transmission of human malaria parasites (Hasyim et al., 2024). Countries, provinces, and districts that report zero indigenous cases for at least three consecutive years are considered to have eradicated malaria (Ministry of Health and Child Care, 2020; World Health Organization, 2020).

The World Health Organisation defines re-introduction as an outbreak or the re-establishment of endemic malaria in previously eliminated areas (Guth et al., 2022; World Health Organization, 2020). A combination of prevention and control strategies achieved previous progress in combating malaria. However, these measures now face emerging challenges, leading to a resurgence of malaria (Bharti et al., 2020; Mbunge et al., 2021). To improve the effectiveness of the malaria elimination program, immediate action is required (Hasyim et al., 2024).

This retrospective cohort study, therefore, seeks to determine risk factors associated with severe malaria in Lupane District in Zimbabwe for the period from 01 January 2021 to 31 December 2023. The specific objectives of the study were (i) To identify socio-demographic characteristics that affect malaria severity, (ii) To identify and describe the effect of malaria prevention practices on malaria severity, and (iii) To model severe malaria risk factors using multivariate binary logistic regression.

The Health Belief Model (HBM), developed in the 1950s has six constructs (Hidayati et al., 2020), and holds the principle that health behavior change is a function of the individual's perceptions (Kushner, 2016). These constructs are proposed to vary between individuals and predict engagement in health-related behaviors (Hidayati et al., 2020). The model examines peoples' health-related thought processes and behavior (Jones et al., 2015). The HBM guided the present study to examine the risk factors associated with malaria severity along six dimensions. In this study, these constructs are perceived malaria susceptibility, perceived malaria severity, perceived benefits from the malaria interventions, perceived barriers to malaria prevention, self-efficacy, and cues of action.

## METHOD

This analytical observational research

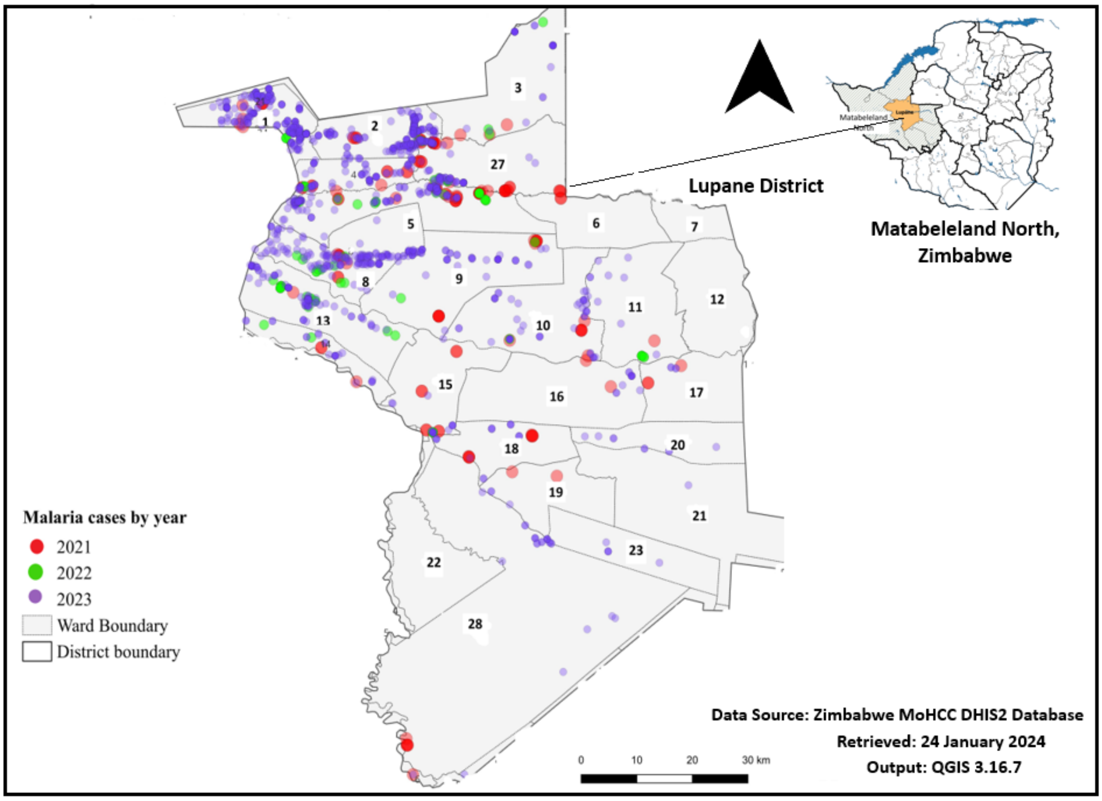


**Figure 1. Map of the Study Area**

utilized a retrospective cohort study to compare two groups. The exposed group consisted of individuals who contracted malaria outside Lupane, as confirmed by laboratory tests, and had traveled to a malarious area within six weeks before diagnosis. The unexposed group included individuals who acquired malaria locally in Lupane, as confirmed by laboratory tests, and had no travel history within six weeks before diagnosis. This present study assumed an odds ratio (OR) of 2.7 (Mundagowa & Chimberengwa, 2020) for locally acquired malaria compared to imported cases. The study used a proportion of 84.0% for non-exposed individuals with no travel history (Mundagowa & Chimberengwa, 2020), set a two-sided significance level (1-alpha) of 95.0%, a power (1-beta) of 90.0%, and an assumed ratio of unexposed to exposed (r = 7) for sample size determination.

The study employed multistage stratified random sampling to recruit 1207 individuals across all age groups and sexes, comprising 1056 cases of local malaria and 151 cases of imported malaria from secondary data reported by Lupane in the DHIS2 malaria-tracker database. The study used IBM SPSS 29.0.2.0(20)] for data analysis, and odds ratios (ORs) were used to estimate relative risk (RR; 95% C.I; $p<0.05$). The independent variable, which was obtained at a p-value of less than five ($<0.25$), proceeded to multivariate analysis. The study used the Cox and Snell R-squared and the Nagelkerke R-squared pseudo-parameters to quantify the range variation explained by the model. The Hosmer-Lemeshow test assessed the model's goodness-of-fit with a non-significant result (P-value $> 0.05$), suggesting good calibration and fit to the data (Darnius & Siahaan, 2023).

Lupane district is the provincial capital of Matabeleland North, with a population of about 107,248 (Zimbabwe National Statistics Agency, 2022). Malaria transmission is highest in the lowland areas of Zimbabwe (Gwitira et al., 2020; Pellegrino et al., 2022). However, Lupane is one of the districts located within the mid-Zambezi River Basin (Mpofu, 2014). The rural wards of Lupane border Binga district, are characterized by unstable and regular seasonal malaria transmission (Maseko & Nunu, 2020). The district is semi-arid and in agroecological region four (Mukungurutse et al., 2018). Major rivers, such as the Gwayi and Shangani, which flow northward and converge at the Gwayi Shangani Dam, and the Bubi River, which feeds into the Lupane Dam, cross through this district (Mukungurutse et al., 2018). The main livelihood activities in the Lupane district include smallholder irrigation and farming, artisanal mining, vending, cross-border trading, livestock rearing, and formal employment in public service (Mpala, 2016; Mpofu, 2014).

## RESULT AND DISCUSSION

The results showed that most individuals, 928 (77%), were male. The predominant age group was five years and above, with 1085 (90%) individuals. The percentage of severe malaria was lower, 187(17%), among five years and older compared to individuals below 5 years 64 (52%). In the bivariate analysis, the relative risk (RR) of severe malaria was 0.19 [(95% CI: 0.13-0.29); $p < 0.001$], showing that individuals aged 5 years and older were 0.19 times less likely to develop severe malaria than those aged < 5 years. The study showed that a higher proportion of individuals residing in rural areas, 176 (29%), had severe malaria compared to 75(12%) individuals residing in urban areas. Individuals residing in rural areas were approximately 2.97 times more likely to develop severe malaria compared to those in urban areas in Lupane (Table 1).

The distribution of individuals based on malaria species indicated a higher proportion of

**Table 1. Bivariate Analysis of Socio-demographic Risk Factors**

| Variable | Malaria Severity | | | | | | Chi-square | Bivariate Analysis | |
|---|---|---|---|---|---|---|---|---|---|
| | Uncomplicated | | Severe | | Total | | | | |
| | n | % | n | % | n | % | | RR; 95% CI | P-value |
| Travel History | | | | | | | | | |
| Yes | 148 | 98 | 3 | 2 | 151 | 100 | | 1 | |
| No | 808 | 77 | 248 | 23 | 1056 | 100 | N/A | 15.1(4.79;47.9) | <0.001* |
| Age group | | | | | | | | | |
| <5years | 58 | 48 | 64 | 52 | 122 | 100 | | 1 | |
| 5 years + | 898 | 83 | 187 | 17 | 1085 | 100 | <0.001* | 0.19(0.13;0.29) | <0.001* |
| Sex | | | | | | | | | |
| Female | 196 | 70 | 83 | 30 | 279 | 100 | | 1 | |
| Male | 760 | 82 | 168 | 18 | 928 | 100 | <0.001* | 0.52(0.38;0.71) | <0.001* |
| Occupation | | | | | | | | | |
| Minor | 320 | 75 | 105 | 25 | 425 | 100 | | 1 | |
| Student | 128 | 80 | 33 | 20 | 161 | 100 | | 0.79(0.51;1.22) | 0.28 |
| Unemployed | 111 | 69 | 50 | 31 | 161 | 100 | <0.001* | 1.37(0.92;2.05) | 0.12* |
| Working | 397 | 86 | 63 | 14 | 460 | 100 | | 0.48(0.34;0.68) | 0.00* |
| Had visitor(s) | | | | | | | | | |
| No | 534 | 92 | 46 | 8 | 580 | 100 | | 1 | |
| Yes | 422 | 67 | 205 | 33 | 627 | 100 | <0.001* | 5.64(4.00;7.96) | <0.001* |
| Residence | | | | | | | | | |
| Urban | 534 | 88 | 75 | 12 | 609 | 100 | | 1 | |
| Rural | 422 | 71 | 176 | 29 | 598 | 100 | <0.001* | 2.97(2.20;4.00) | <0.001* |

RR ≈ Relative Risk; Statistically significant Chi-square ($p < 0.05$*); 1 = Reference Group

**Table 2. Bivariate Analysis of Malaria Prevention Practices for Lupane**

| Variable | Malaria Severity | | | | | | Chi-square P-value | Bivariate Analysis | |
|---|---|---|---|---|---|---|---|---|---|
| | Uncomplicated | | Severe | | Total | | | | |
| | n | % | n | % | n | % | | RR; 95% CI | P-value |
| Prompt treatment | | | | | | | | | |
| Within 24 hours | 564 | 78 | 156 | 22 | 720 | 100 | | 1 | |
| After 24 hours | 392 | 81 | 95 | 19 | 487 | 100 | 0.36 | 0.88(0.66;1.17) | 0.37 |
| Malaria species | | | | | | | | | |
| Other | 29 | 97 | 1 | 3 | 30 | 100 | | 1 | |
| Malariae | 141 | 89 | 18 | 11 | 159 | 100 | N/A | 3.70(0.48;28.8) | 0.211* |
| Falciparum | 786 | 77 | 232 | 23 | 1018 | 100 | | 8.56(1.16;63.2) | 0.035* |
| LLINs use | | | | | | | | | |
| Owned used | 412 | 96 | 17 | 4 | 429 | 100 | | 1 | |
| Owned unused | 169 | 71 | 69 | 29 | 238 | 100 | <0.001* | 9.90(5.65;17.3) | <0.001* |
| None | 375 | 69 | 165 | 31 | 540 | 100 | | 10.7(6.35;17.9) | <0.001* |
| Slept outdoors | | | | | | | | | |
| No | 488 | 82 | 110 | 18 | 598 | 100 | | 1 | |
| Yes | 468 | 77 | 141 | 23 | 609 | 100 | 0.042* | 1.34(1.01;1.77) | 0.042* |

RR ≈ Relative Risk; Statistically significant Chi-square (p < 0.05*); 1 = Reference Group

severe malaria, 18(11%) and 232(23%) among individuals infected with Plasmodium malaria and Plasmodium falciparum, respectively. The relative risk (RR) of severe malaria among those infected with Plasmodium falciparum was 8.56 [(95% CI: 1.16-63.2); p = 0.035] times higher than that of the reference group in the Lupane district. Individuals who had no LLINs were 10.7 [(95%C.I: 6.35-17.9), p < 0.001] times higher, as well as individuals who had LLINs but had not used them were 9.90 [(95%C.I: 5.65-17.3, p < 0.001)] times higher to develop severe malaria than the individuals who had LLINs and used them, respectively (Table 2).

The Chi-square Omnibus results revealed that nine variables (travel history, age group, sex, occupation, had visitor(s), malaria parasite species, residence, LLINs use, and sleeping outdoors during the night) were significantly associated with the outcome at a p-value less than 0.25. The prompt treatment variable was higher than 0.25 at bivariate selection, but it is an important variable for malaria severity as the outcome of interest. As a result, ten variables continued into the multivariate model for the Lupane district. In the multivariate analysis, the study revealed that individuals who had no travel history were approximately 29.7 [(95% CI: 8.74-100.0), p<0.001) times more likely to develop severe malaria compared to those with travel history exposure after controlling for the confounding variables. The regression demonstrated a good fit ($\chi^2 = 412.1$, $p < 0.05$) with 85.0% accuracy and explained variation ranging from 29% to 45% (Cox and Snell R-square = 0.289, Nagelkerke R-squared = 0.452).

From Table 4, the logistic regression equation obtained for the variables that influenced the incidence of severe malaria is as follows:

$$Logit\ (Y) = k + b_1x_1 + b_2x_2 + \cdots + b_ix_i$$

To calculate P (1)-probability of severe malaria and P (0)-probability of uncomplicated malaria, the study used the following equation to input the dummy values for each predictor. The following logistic regression model estimates the association between travel history exposure and severe malaria, adjusting for the confounding variables in the equation. The study used the logistic regression equation to estimate the probability of severe malaria based on the significant risk factors. Below is

**Table 3. Multivariate Analysis Results**

| Variable | B | SE | Wald | Delta Exp(B) | RR; 95% CI | P-value |
|---|---|---|---|---|---|---|
| Travel History | | | | | | |
| Traveled | | | | Hold constant | 1 | |
| Not traveled | 3.392 | 0.624 | 29.53 | | 29.7(8.74;100) | <0.001* |
| LLINs use | | | | | | |
| Owned-used | | | | | 1 | |
| Owned-unused | 2.058 | 0.307 | 44.94 | 35%* | 7.83 (4.29;14.3) | <0.001* |
| None | 2.506 | 0.284 | 77.80 | | 12.3(7.02;21.4) | <0.001 |
| Slept Outdoor | | | | | | |
| No | | | | | 1 | |
| Yes | 0.657 | 0.180 | 80.37 | 51%* | 1.93(1.36;2.74) | <0.001* |
| Age group | | | | | | |
| < 5years | | | | | 1 | |
| 5 years + | -1.539 | 0.259 | 35.33 | 47%* | 0.22(0.13;0.36) | <0.001* |
| Sex | | | | | | |
| Female | | | | | 1 | |
| Male | -0.237 | 0.196 | 1.462 | 26%* | 0.79(0.54;1.16) | 0.227 |
| Occupation | | | | | | |
| Minor | | | | | 1 | |
| Student | 0.121 | 0.279 | 0.189 | | 1.13(0.65;1.95) | 0.664 |
| Unemployed | 0.702 | 0.258 | 7.391 | 27%* | 2.02(1.22;3.33) | 0.007 |
| Employed | 0.003 | 0.227 | 0.000 | | 1.00(0.64;1.56) | 0.990 |
| Had visitors | | | | | | |
| No | | | | | 1 | |
| Yes | 1.823 | 0.203 | 80.37 | 75%* | 6.19(4.16;9.22) | <0.001* |
| Residence | | | | | | |
| Urban | | | | | 1 | |
| Rural | 0.664 | 0.184 | 12.99 | 27%* | 1.94(1.35;2.79) | <0.001* |
| Treatment | | | | | | |
| Within 24 hrs | | | | | 1 | |
| After 24 hours | 0.006 | 0.185 | 0.001 | 32%* | 1.01(0.70;1.43) | 0.973 |
| Constant | -6.911 | 0.783 | 7.891 | n/a | n/a | <0.001* |

1= Reference: RR≈ Relative risks: Confounding (>10%)*: Statistically significant ($p < 0.05$*)

the logistic regression equation for the overall model:

The equation with dummies in the exposure groups

The result from the regression equation for Lupane obtained result (0.32497...). This revealed that under the conditions of no travel history, no ownership and no use of LLINs, ownership of LLINs but not used the previous night, sleeping outdoors, having visitors, rural residence, being five years or older, the individuals had a 32.5% chance of experiencing severe malaria in Lupane district. The equation with dummies in the non-exposure groups:

The obtained result (0.00319) means that

Logit p (Severe malaria) = -6.911 + 3.30*Travel history + 2.51*LLINs1 + 2.06*LLINs2 + 0.66*Slept outdoors + 1.82*Had visitors + 0.66*Residence – 1.53*Age group

The equation with dummies in the exposure groups
Logit p (Severe malaria) = -6.911 + 3.30(0) + 2.51(1) + 2.06(1) + 0.66(1) + 1.82(1) + 0.66(1) – 1.53(1)

= -0.731

P(1) = 1/(1+e^(-(logit p) ) )

= 1/(1+e^(-(-0.731) ) )

= 0.324975…

= 32.5%

Logit p (Severe malaria) = -6.911 + 3.30(1) + 2.51(0) + 2.06(0) + 0.66(0) + 1.82(0) + 0.66(0) – 1.53(0)

= -3.611

P(0) = 1/(1+e^(-(logit p) ) )

= 1/(1+e^(-(-3.611) ) )

= 0.0263136…

= 2.63%

RR ≈ p_1/p_o

≈ (0.324975...)/(0.0263136…)

≈ 12.4

under the conditions of having travel history, ownership and use of LLINs in the previous night, not sleeping outdoors, not having visitors, urban residence, and being under five years, the individuals had a 2.63% chance of experiencing severe malaria Lupane district

The present study revealed that found that individuals who had no travel history were approximately 29.7 times more likely to develop severe malaria compared to those with travel history exposure after controlling for the confounding variables. The risk ratio revealed that the individuals with the specified risk factors (no travel history, no ownership and no use of LLINs, ownership of LLINs but not used in the previous night, sleeping outdoors, had visitors, rural residence, and being five years and above), were approximately 12.4 times more likely to develop severe malaria compared to the baseline population. These findings concur with HBM constructs of perceived malaria susceptibility, perceived malaria severity, perceived benefits from the malaria interventions, perceived barriers to malaria prevention, and self-efficacy, probably because Lupane district obtained the malaria-free status over 5 years back from 2015. This could have led the individuals to have a low perceived risk of malaria infection and the progression of the disease to severe malaria. The HBM states that people are less likely to practice preventative measures if they do not believe that a certain disease is a serious illness that threatens life. This study revealed a similar pattern concerning the severity of malaria in Lupane. The significant risk among individuals without a travel history suggests a potential gap in the community's awareness of their vulnerability. Despite the high risk, individuals could not perceive themselves as susceptible to malaria, especially if they have not traveled to high-risk areas.

In this study, individuals who had no LLINs were 12.3 times more likely to develop severe malaria than those who had LLINs and used them after adjusting for confounders. Contrarily, a community-based survey conducted on the Kenyan coast reported individuals who used LLIN the previous night had a lower risk of developing malaria odds ratio (OR = 0.45, p<0.001) (Kamau et al., 2022). The study further revealed that individuals who had LLINs but had not used them were 7.82 times more likely to develop severe malaria than those who had LLINs and used them, respectively, after adjusting for confounders. Research conducted in the Majene Regency of Indonesia revealed that those who do not utilize mosquito nets at night had a 1,844 times higher chance of contracting malaria (Fadliati, 2022; Firmansyah et al., 2022).

Perceived benefits can refer to an individual's belief in the effectiveness of using long-lasting insecticidal nets (LLINs) to prevent malaria, while self-efficacy refers to their confidence in their ability to consistently use LLINs correctly to reduce the risk of infection in line with HBM. Individuals with LLINs who did not use them were significantly more likely to develop severe malaria, indicating a gap in self-efficacy. Despite possessing the required resources (LLINs), the present study's findings indicate that these individuals might have not understood the significance of their consistent use for continued malaria prevention. Prior research repeatedly confirms that those not utilizing insecticide-treated nets are at a higher risk of developing malaria (Hassen & Dinka, 2022; Wubishet et al., 2021).

The study showed that individuals who had visitors were approximately 6.190 times more likely to develop severe malaria than those who had no visitors after controlling for confounding variables. This discrepancy raises the possibility that visitors from other places, especially where malaria is more prevalent, could have increased malaria transmission levels to the residents. The HBM highlights the importance of perceived susceptibility and action cues to preventive behaviors. This study's findings suggest that individuals might not have perceived the presence of visitors as a significant risk factor in the presence of the malaria vectors to transmit malaria, as if some of the visitors had the parasite in their bodies. Previous research done in China provides strong evidence for this attribution, with the finding that visitors who had traveled to visit family or friends accounted for 19.1% of malaria cases (Yin et al., 2023).

In this study, individuals who resided in rural areas were 1.94 times more likely to develop severe malaria compared to those in urban areas after accounting for confounding variables in Lupane. The rural wards of Lupane are next to Binga district, where malaria transmission is primarily characterized by instability and a moderate level of endemicity (Maseko & Nunu, 2020). Consequently, this could have resulted in a higher prevalence of severe malaria cases in Lupane rural as opposed to its urban wards. The presence of these water bodies due to main rivers such as the Gwayi and Shangani rivers (Mukungurutse et al., 2018) , which provide conducive mosquito breeding grounds, might have facilitated the increase in the vector population and local malaria transmission in these rural wards.

The study revealed that the relative risk of developing severe malaria was approximately 0.215 times lower among individuals aged 5 years and above compared to those under 5 years. Malaria is more prevalent in children under the age of five due to the ongoing development of their immune systems (Gari et al., 2018; Haghiri et al., 2023). Furthermore, children are frequently less inclined to implement preventive measures effectively because of their dependence on carers for their implementation. In contrast, an earlier study in Sahah the Eastern state of Malaysia found no significant link between age and malaria. (Ramdzan et al., 2020).

The association between severe malaria and sleeping outdoors during the night was another significant finding in this current study.

After controlling for confounding factors, the study indicated that people who slept outside had a 1.928 times greater chance of developing severe malaria than people who did not. Similarly, a matched case-control research in the Ziway-Dugda District of Ethiopia revealed that one of the factors contributing to malaria was spending time outdoors in the evening (AOR = 2.99) (Wubishet et al., 2021). The HBM also highlights the role played by perceived barriers to preventive actions. The finding suggests that there might be cultural, social, or practical barriers that promote sleeping outdoors behaviors, including preferences for cooler outdoor environments. With the HBM, this finding further suggests these individuals could not perceive themselves as susceptible to malaria and underestimated the risk of suffering from severe malaria.

## Conclusion

The study concluded that individuals who had not traveled were more likely to develop severe malaria compared to individuals who had a travel history. Building on the study's findings, there is a need to increase awareness about the risks of local malaria transmission through community-based education programs, to strengthen the universal distribution of LLINs coupled with regular follow-up campaigns to ensure consistent usage. Additionally, malaria screening and educational programs for visitors to take preventive measures during their stay in Lupane. Regular community dialogue meetings and visible public health messages can serve as effective cues to reduce the incidence of severe malaria, especially in rural areas. The study further recommends the strengthening of malaria control measures targeting children under five years old. By addressing these areas, Lupane district can move closer to the goal of a malaria-free district.

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