International Journal of Community Medicine and Public Health
Chebii K et al. Int J Community Med Public Health. 2025 Mar;12(3):1248-1254
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20250605

Original Research Article

Impact of bedbug's infestation on use of mosquito nets in malaria control in Matayos, Busia, Kenya

Kiptanui Chebii[1]*, Wilfred E. Injera[1], Kelvin K. Juma[1], Collins A. Odiwuor[1], Concilia Ogombo[2]

[1]Department of Medical Laboratory Sciences, Alupe University, Busia, Kenya
[2]Department of Public Health, Nutrition and Behavioural Sciences, Alupe University, Kenya

Received: 05 December 2024
Revised: 14 February 2025
Accepted: 15 February 2025

***Correspondence:**
Kiptanui Chebii,
E-mail: gmchkip@gmail.com

ABSTRACT

Background: Malaria is a significant public health problem in Kenya with more than 70% of its population at risk. The Kenya government has prioritized the provision of long-lasting insecticidal nets (LLINs) and insecticide treated nets (ITNS) in prevention of malaria. However; communities in Matayos, Busia County have shown reluctance in using them, that they harbor bed bugs. This study aims to establish the impact of bedbugs on use of mosquito nets in malaria control.
Methods: This was a cross-sectional study carried out at Murende community unit, Matayos, Busia Kenya. A questionnaire was used to collect data. Data analysis was done using SPSS; descriptive statistics were summarized as frequencies and proportions. Chi square was done to measure associations between variables.
Results: 77 (respondents) were included in the study. Majority (65%) were females (85%) reported having mosquito nets whereas 15% did not have mosquito nets. Of the 85% with mosquito nets, 78% use them while 22% do not use them. 79% of those who don't use mosquito nets claimed that mosquito nets harbored bedbugs. There is association between presence of bed bugs and use of mosquito nets (p=0.001), there is association between the level of education and presence of beg bugs (p=0.001)
Conclusions: Bedbug infestation is a barrier to consistent and persistent utilization of mosquito nets and has discouraged a bigger population from using them. Concerted effort towards the control of bedbugs has to be made if collateral benefit in malaria control by use of LLINs is to be achieved.

Keywords: Malaria, Bedbugs, Insecticide treated nets, Long lasting insecticide treated nets

INTRODUCTION

Malaria is a significant public health problem in Kenya. More than 70% of the population is at constant risk from malaria, including those most vulnerable to the disease, specifically children and pregnant women.[1] In the past 5 years, there has been a concerted effort by the government and malaria partnerships to fight the disease through prevention and treatment interventions such as mass and routine mosquito net distribution programs to attain universal coverage, intermittent preventive treatment for malaria during pregnancy, and parasitological diagnosis and management of malaria cases.[2]

Over the past three years, Alupe university, school of health sciences under the community based education and service (COBES) program has consistently reported that communities in Busia county are keeping off the use of ITNs with the belief that ITNs are bedbug breeding grounds (>35% of households.[3] This being a rural community, such believes in a large number of households can seriously affect malaria control efforts and draw back the gains made by mosquito net

distribution programs. This can be catastrophic considering that the control methods the communities use are grossly ineffective. Very few uses chemical control with majority ignoring them or using hot water.[4]

The Kenya malaria indicator survey is one of the key performance monitoring tools periodically used to provide an in-depth assessment of malaria control efforts over time. Kenya has in the past undertaken three Malaria Indicator Surveys, in 2007, 2010, 2015 and 2020. The objective of the surveys is to provide reliable estimates that can be used by programme managers and policymakers to evaluate and improve existing programs including mosquito net ownership, access, and use; coverage of intermittent preventive treatment of malaria in pregnancy; case management of fever and malaria in children; knowledge, attitudes and practices regarding malaria control; and the prevalence of Plasmodium species most prevalent in Kenya.[5] The results from these surveys provide information on the performance of the key malaria control interventions as experienced by communities across the country; and are crucial to evaluation of interventions. Moreover, they enable effective planning and malaria control programming and facilitate a good understanding of the factors, dynamics, and impediments that affect control efforts. The results form a basis for redirecting efforts and reorienting both technical and operational perspectives to address the challenges and strengthen the successes observed.[5]

The ministry of health, Kenya, through the national malaria control programme (NMCP), has implemented sound policies and evidence-based strategies in the fight against malaria. Key interventions among others have included the provision of vector control methods including LLINs and prompt diagnosis and effective treatment of all malaria cases both at health facilities and community level through community health promotors (CHPs). Mosquito net ownership, access, and use is therefore one of the key indicators of the malaria control program.[2]

In June 2021, the then governor of Busia County, led the county health team in launching the mass distribution of mosquito nets to residents of Matayos health center where he opined that malaria prevalence rate in the county stands at 19 per cent which is higher compared to other counties. Thus “malaria remains a dangerous disease that requires joint efforts to tame it” he added. Health officials at this function dismissed allegations by a section of residents that mosquito nets harbor bedbugs, termed the claims as myths and misconceptions, noting that nets distributed across the County to boost the fight against malaria do not have the ecto-parasites. He added that the treated nets have made the ecto-parasites hiding in beds to be uncomfortable hence forcing them to come out of the hiding places to which the residents were attributing to increased bedbugs’ infestation.[6]

The use of mosquito nets has been hampered through beliefs that ITN harbor bedbugs which if not demystified would greatly affect malaria control strategies in Busia County. Thus, the problem of demystifying mosquito nets harboring bedbug has to be addressed. The current study was done at Matayos, Busia County. Its objective was to determine the impact of bedbug infestations on use of mosquito nets in malaria control.

METHODS

Study design

This was a community based cross sectional study done between 1st and 30th of July 2024. The study targeted households without mosquito nets, households without mosquito nets but with bedbugs, households with mosquito nets in use and households with mosquito nets not in use because of the believe it harbors bedbugs.

Study site

The study was done at Namukoye, Bukolo and Nandere villages of Murende community unit in Matayos subcounty, Busia County. This is where the COBES findings by Alupe university students indicated that bed bugs infestation is the cause of not using mosquito nets. It is also coincidentally where the mass distribution of ITN nets took place and a section of the residents raised the concern that they are reluctant to use them because of bed bugs infestations.

Inclusion criteria

Households in which adult respondents were present and consented to participate in the study during the study period in Namukoye, Bukolo and Nandere villages of Murende community unit were included in the study.

Exclusion criteria

Households in which there were no adult respondents, households that were no respondents, households that the respondents declined to participate and households out of the 3 villages of Murende community unit were excluded.

Sample size

The sample size of this study was 73 households**.** This was arrived at by adopting Fischer’s exact formula adjusted for finite population.[7]

$$n = N \times \frac{\frac{Z^2 \times p \times (1-p)}{e^2}}{\left[N - 1 + \frac{Z^2 \times P \times (1-p)}{e^2}\right]}$$

Data collection and analysis

A structured questionnaire was administered. Statistical analysis was done using SPSS version 20. Descriptive

statistics was summarized by means, frequencies and percentages. Chi-squared (X^2) test was done to measure the associations between variables. Level of significance was determined at $p \leq 0.05$

Ethical considerations

The study was approved by Alupe university institutional scientific and research ethics committee. Consent was sought from the respondents before administering the questionnaire and confidentiality maintained throughout the study.

RESULTS

Seventy-seven households were included in the study, translating to 77 respondents (65% females and 35% males). Education wise, majority (50.6%) had the level of primary school education, 24.7% had secondary education, 16.9% had no education at all, whereas 6.5% attained tertiary level of education and only 1.3% had university education. As far as occupation is concerned, majority 67.5% practiced small scale farming, 20.8% derived their income from business practice and 7.8% were in formal employment.

Table 1: Sociodemographic of the respondents.

Variables	Sub variables	N	Valid percent (%)
Gender	Female	50	64.9
	Male	27	35.1
Age (in years)	20-35	30	39.0
	36-50	11	14.3
	61-65	22	28.6
	66-80	12	15.6
	81-95	2	2.6
Level of education	University	1	1.3
	Tertiary	5	6.5
	Secondary	19	24.7
	Primary	39	50.6
	None	13	16.9
Marital status	Single	9	11.7
	Married	68	88.3
Source of income	Unskilled employment	2	2.6
	Skilled employment	6	7.8
	Business	16	20.8
	Farming	52	67.5
	Unemployed	1	1.3

Knowledge and practice on use of ITNs in malaria control

Seventy-six respondents reported that they were aware of malaria disease. The 56% (48) of who explained that malaria is caused by mosquitoes, 27.6% (21) of the respondents were able to explain malaria by symptoms, and 7.9% could not correctly explain malaria and another 7.9% did not respond to the question on malaria awareness. On mosquito net usages, five (85%) of the respondents who were aware of malaria reported that they use mosquito nets to protect themselves from malaria, 9% use a combination of both mosquito nets and mosquito repellents.

Eighty five (85%) of the respondents reported having mosquito nets in their households whereas 15% did not have mosquito nets. Of the 85% with mosquito nets, 78% use them while 22% do not use them. Seventy-nine percent of those who don't use mosquito nets said that mosquito nets harbors bed bugs, 14% reported that they don't use mosquito nets because malaria is not a serious disease while 7% claimed that mosquito nets suffocate them

Proper use of mosquito nets

Out of the 85% who use mosquito nets, 72% were able to demonstrate proper use of mosquito nets by hanging them over their beds while sleeping whereas the remaining 28% did not respond to the question

Effects of bedbug infestation of households on the use of mosquito nets

Eighty two (82%) of the respondents who claimed mosquito nets harbor bed bugs reported presence of bed bugs in their homes whereas 18 reported absence of bed bugs in their homes. Of the 82% who reported presence of bedbugs, 89% said that bed bugs distracted them from using mosquito nets and have stopped using them while 11% reported that they constantly use the mosquito nets despite the distractions by bedbugs.

Protection from bed bugs

Eighty eight percent of those who reported distraction to use of nets by bedbugs claim they have made efforts to protect themselves from bedbugs whereas 12% have done nothing to protect themselves from bedbugs. Of the 88% who reported making efforts to protect themselves, 71% use chemical sprays against the bed bugs, 29% use hot water.

Effect of level of education on use of mosquito nets

The table below shows that the level of education did not influence the use of mosquito nets in this study (X^2=5.862, df=8, p=0.663) suggesting that it did not influence the use of mosquito nets. Equally, Knowledge on how bedbugs harbor bedbugs did not in any way influence the use of mosquito nets (X^2=2.955, df=6, p=0.814). Furthermore, knowledge on presence of bedbugs in mosquito nets did not have any influence on the decision on the use of mosquito nets in the house holds (X^2=6.964, df=4, p=0.137). All these relationships were non-significant (p>0.05) suggesting that none of these factors influenced the use of mosquito nets.

Factors influencing presence of bedbugs in households

The study findings showed that the level of education influences the presence of bedbugs in the house (X^2=26.797, df=8, p=0.001) and moderate strength of association was observed (Cramers V=0.590). Marital status insignificantly influenced the presence of bed bugs in the households (X^2=4.192, df=2, p=0.123). Those that had used some form of protection significantly controlled the presence of bed bugs in their households (X^2=69.391, df=4, p=0.000) and had a very strong strength of association (Cramers V=0.949 and Phi=0.671). It is also demonstrated that knowledge on bed bugs in mosquito nets did significantly influence the presence of bed bugs in households (X^2=56.177, p=0.001) with a very strong association (Cramers V=0.834, Phi=0.604) respectively.

Table 2: Factors influencing use of mosquito nets.

Variables		Do you have a mosquito net in your house			Chi square	Df*	Cramer V	Phi	P value
		No	Yes	No response					
What is your level of education	University	0	1	0	5.862	8	0.276	0.195	0.663
	Tertiary	1	4	0					
	Secondary	0	19	0					
	Primary	8	30	1					
	None	2	11	0					
How do nets harbor bedbugs	Hiding in the nets	1	17	0	2.955	6	0.196	0.139	0.814
	Breeding sites	1	3	0					
	Attractions and chemicals	1	2	0					
	No response	8	43	1					
Has it distracted you from using Mosquito nets in any way	No	2	30	0	6.984	4	0.301	0.213	0.137
	Yes	3	19	0					
	No response	6	16	1					

*Df is the degree of freedom

Table 3: Factor influencing the presence of bed bugs in households.

Variables		Are there bed bugs in your house			Chi square	Df*	Cramer V	Phi	P value
		No	Yes	No response					
What is your level of education	University	1	0	0	26.797	8	0.590	0.417	0.001
	Tertiary	4	0	1					
	Secondary	13	6	0					
	Primary	8	21	10					
	Nonse	3	10	0					
Marital status	Single	6	3	0	4.192	2	0.233	0.233	0.123
	Married	23	34	11					
Have you done anything to protect yourself	Yes	15	6	0	69.391	4	0.949	0.671	0.000
	No	2	31	0					
	No response	12	0	11					
Has it distracted you from using Mosquito nets in any way	No	16	16	0	56.177	4	0.834	0.604	0.001
	Yes	1	21	0					
	No response	12	0	11					

*Df is the degree of freedom.

DISCUSSION

Majority of study participant were females (65% females and 35% males). In many households' women are at home during day when these visits taking place because they are responsible for the managing household chores, cooking, childcare and maintaining family harmony while men are out there to battle against odds, and provide for family. Men's job to lead, to provide, to protect.

Study participants fell in two age groups mainly; 20-35 and 61-65, majority of whose households are peasant

farmers. At 20-35 the population is in the actively productive age and with proper education this group can actively participate in malaria control efforts using mosquito nets in the community. Age 61-65 is mostly made up of retired people at whom mosquito control efforts should not be strongly targeted at as this is the group that has seen it all and might not be as effective in spreading anti-mosquito crusade in the community.

Understanding mosquito net usage with concomitant interference from bed bugs requires a little bit of higher education levels. Overall majority (50.6%) of our study participants had attained primary level education followed by 24.7% secondary education. Seventeen percent had no formal education whereas 6.5% attained tertiary level of education and 1.3% had university education. According to the Kenya malaria indicator survey 2020 (KMIS 2020), six percent of women age 15-49 in Kenya have no education. Our study showed an overall 17% of the study participants not having gone to school, probably due to the fact that quite a number of participants were aged 61-65. KMIS 2020 further reported that more than one-third of women (37% against 50.6% in our study) have attended primary school, while 41% (against 24.7% in our study) have attended secondary school and only 17% (against 7.8% in our study) have more than secondary education. Women with primary level education in Kenya have been reported to be less likely to understand how mosquito nets prevent malaria transmission than women with higher levels of education-the more years of schooling women had the more they understood how malaria is transmitted.[8] Elsewhere in the Democratic Republic of Congo, it has been reported that women with a high school education or higher are 1.3 times more likely to use insecticide-treated nets (ITNs) than women with a primary school education or less (OR=1.3, 95% CI: 1.085-1.611).[9] Elsewhere also it has been shown that children with mothers whose education level was beyond primary school were 4.7% less likely to be malaria-positive ($p<0.001$).[10] A study on the assessment of knowledge of malaria and its control practices in mining and sugarcane growing regions of Western Kenya highlands reported the high knowledge of malaria was associated with the level of education attained ($\chi2=30.108$; $p>0.0001$).[11] Thus in our study population with such low levels of education it might require extra interventions to make the population understand the intricacies between ITN use and the bed bug invasion in their households.

As regards awareness, almost all the respondents in the current study were aware of malaria as a disease. A study on the assessment of knowledge of malaria and its control practices in mining and sugarcane growing regions of Western Kenya highlands reported ninety-seven percent of the respondents had knowledge of malaria.[11] The high malaria awareness in the current study would be attributed to the efforts by the Kenya government to recruit community health volunteers and promoters at the community level whose responsibilities are to regularly advise and sensitize the community on matters primary health care including prevention and control of Malaria. Moreover, use of ITNs was found to be poor with only 15.8% having at least one ITN due to its absence in the market and poor distribution by the public health departments.

Most parts of Kenya have approached or met the roll back malaria (RBM) household ITN coverage target of at least 60%.[12] In this study 85% of our respondents reported having mosquito nets in their households with 78% of them reportedly using them. A study on the assessment of knowledge of malaria and its control practices in mining and sugarcane growing regions of Western Kenya highlands reported bed net ownership was at 86% and 92% correctly identified its use.[11] Considering that ITN ownership in Kenya has declined since 2015 when 63% of households owned at least one ITN our study shows that mosquito net ownership is high in this rural community. A study done on ITN ownership in the highlands of western Kenya observed that despite ITN ownership reaching more than 71%, compliance was low at 56.3%.[13] From KMIS 2020 analysis, it is evident that the mass mosquito net campaign has helped a lot of people in areas where the prevalence of the disease is high including areas of Kisumu, Siaya, Migori, Homa Bay, Kakamega, Vihiga, Bungoma and Busia counties. The high rate of ITN mosquito net possession in the current study confirms free regular distribution of ITN mosquito nets by the Kenya government towards eradication and control of Malaria.

Overall, 85% of women age 15-49 in Kenya know ways to avoid getting malaria. Nearly all women (94%) know sleeping under an ITN prevents malaria (Kenya Malaria Indicator Survey 2020). This study shows also that 85% of the respondents know malaria and reported that they use mosquito nets to protect themselves from malaria. In a study on malaria knowledge and bed net use in three transmission settings in southern Africa, it was reported that most of the participants correctly linked mosquito bites to malaria (85.0%) and knew of the benefit of sleeping under an ITN.[14] Findings from these two studies in Western Kenya are discordant with those of an Ethiopian study that reported only a small proportion of study respondents (15.6%) could link malaria to mosquitoes and a majority (65.6%) associated malaria transmission to poor personal hygiene and environmental sanitation.[15] Relevant knowledge of ITNs translated into the expected preventive behavior of sleeping under a bed net, underscores the need for continued health messaging on malaria prevention.

About 35% of household members in rural Kenya communities reported having slept under an ITN the night before the Kenya malaria indicator survey 2020. Our study reported an overall 78% reportedly using ITNs showing that a significant number of participants from this rural community have embraced ownership and use of ITNs. However, 79% of those who don't use mosquito

nets said that mosquito nets harbor bed bugs while 14% reported that they don't use mosquito nets because malaria is not a serious disease. The remaining 7% claimed that mosquito nets suffocate them. The issue of ITNs and bed bugs need to be addressed properly as it can badly hamper malaria control efforts especially in the endemic zones of Western Kenya. In ideal situations bed bugs should not be present anywhere near ITNs. A study on insecticides susceptibility status of the bedbugs in a rural area of Magugu, Northern Tanzania concluded that pyrethroids-impregnated bed nets can contribute to the eradication of bedbugs and that properly treated bed nets, partially treated beds and bedding material can be used to increase bedbug mortality.[16] Continuous assessment of bedbug susceptibility status in areas with broad bed net coverage like where the current study was carried out is required. It cannot be for nothing that residents believe ITNs breeds mosquitoes. And with the infestation dynamics results that showed a rapid mobility of bedbug from one house to another, use of ITNs will be compromised further eroding the gains made by high net coverage. The study also demonstrates that the level of education of the community has no effect on ITNs ownership in the homesteads contrary to the conclusion from a study on strategies to increase the ownership and use of insecticide-treated bed nets to prevent malaria that education may increase the number of adults and children using ITNs (sleeping under ITNs) compared to no education.[17] In a study on ITN ownership, usage, and malaria transmission in the highlands of western Kenya, the findings showed that when compared to household with no education, households with at least a member having primary or secondary education level had significant higher ($p<0.05$) percentage ITN ownership and that in general, houses with non-educated parents or guardians had significantly lower ITN ownership, fewer ITNs, lower ITN usage, and significantly less knowledge about malaria prevention using ITNs.[13]

Limitations

The study relied on the reported information provided by the respondents and therefore we could not ascertain the extent of the truth as regards the presence or absence of bedbugs and the extent of possession and proper utilization of mosquito nets.

CONCLUSION

This ITNS/bedbugs' narrative should not be ignored at all since bedbugs, refuge themselves in certain sites of the nets particularly at the corners of ITNS and subsequent multiplication of bed bugs at certain period of time provokes people to abandon and discard the nets that's intended to protect them from mosquito bites. To overcome this challenge, concerted efforts have to be made to eradicate bed bugs in totality so that communities may gain confidence in the use of mosquito nets thereby protecting themselves against mosquitoes thus reducing malaria incidences.

ACKNOWLEDGEMENTS

Authors would like to thank to Lupe university, Alupe university ISREC and residents of Murende community Unit, Matayos Sub County, Busia Kenya.

Funding: Funding sources by directorate of Research, Alupe University.
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Ministry of Health. National Malaria Control Programme: Strategic Plan 2020-2025. Nairobi: MOH. 2020.
2. National Malaria Control Programme. Malaria prevention and treatment strategies in Kenya. Nairobi: MOH. 2020.
3. Alupe University. Community-Based Education and Service (COBES) program annual report. Alupe University School of Health Sciences. 2021.
4. COBES Program. Report on community attitudes towards ITNs in Busia County. Alupe University, School of Health Sciences. 2021.
5. Kenya National Bureau of Statistics. Kenya Malaria Indicator Survey 2020. KNBS. 2020.
6. Busia County Government. Launch of mass mosquito net distribution at Matayos Health Center. 2021.
7. Mugenda OM, Mugenda AG. Research methods: Quantitative and qualitative approaches. Nairobi: Acts press. 2003.
8. Dunkel FV, Hansen LM, Halvorson SJ, Bangert A. Women's perceptions of health, quality of life, and malaria management in Kakamega County, Western Province, Kenya. Geo J. 2017;82:841-65.
9. Inungu JN, Ankiba N, Minelli M, Mumford V, Bolekela D, Mukoso B, et al. Use of Insecticide-Treated Mosquito Net among Pregnant Women and Guardians of Children under Five in the Democratic Republic of the Congo. Malaria Res Treatment. 2017;2017(1):5923696.
10. Liheluka EA, Massawe IS, Chiduo MG, Mandara CI, Chacky F, Ndekuka L, et al. Community knowledge, attitude, practices and beliefs associated with persistence of malaria transmission in North-western and Southern regions of Tanzania. Malaria J. 2023;22(1):304.
11. Mukabane DK, Kitungulu N, Ogutu PA, Korir JC, Mulama DH. Assessment of knowledge of malaria and its control practices in mining and sugarcane growing regions of Western Kenya highlands. Afr Heal Sci. 2022;22(2):194-203.
12. Noor AM, Amin AA, Akhwale WS, Snow RW. Increasing coverage and decreasing inequity in insecticide-treated bed net use among rural Kenyan children. PLoS Med. 2007;4(8):e255.

13. Atieli HE, Zhou G, Afrane Y, Lee MC, Mwanzo I, Githeko AK, et al. Insecticide-treated net (ITN) ownership, usage, and malaria transmission in the highlands of western Kenya. Parasites Vectors. 2011;4:113.
14. Kanyangarara M, Hamapumbu H, Mamini E, James L, Jennifer CS, Sungano M, et al. Malaria knowledge and bed net use in three transmission settings in southern Africa. Malar J. 2018;17(1):41.
15. Fuge TG, Ayanto SY, Gurmamo FL. Assessment of knowledge, attitude and practice about malaria and ITNs utilization among pregnant women in Shashogo District, Southern Ethiopia. Malaria J. 2015;14:1-9.
16. Kweka EJ, Mwang'onde BJ, Kimaro EE, Msangi S, Tenu F, Mahande AM. Insecticides Susceptibility Status of the Bedbugs (Cimex lectularius) in a Rural Area of Magugu, Northern Tanzania. J Glob Infect Dis. 2009;1(2):102-6.
17. Augustincic Polec L, Petkovic J, Welch V, Ueffing E, Tanjong Ghogomu E, Pardo Pardo J, et al. Strategies to increase the ownership and use of insecticide-treated bednets to prevent malaria. Cochrane Database Syst Rev. 2015;2015(3):CD009186.

Cite this article as: Chebii K, Injera WE, Juma KK, Odiwuor CA, Ogombo C. Impact of bedbug's infestation on use of mosquito nets in malaria control in Matayos, Busia, Kenya. Int J Community Med Public Health 2025;12:1248-54.