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Original Research Article

Factors Influencing Use of Malaria Control Methods among the Residents of Nyando Sub-County, Kisumu County

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ABSTRACT

Background: Malaria affects millions of people worldwide with 24 million Kenyans at risk of infection annually. To develop strategies to improve use of malaria control methods, it is necessary to determine factors that limit their use.
Objective: To determine factors influencing use of malaria control methods among the residents of Nyando Sub-County.
Methodology: A cross-sectional study was conducted among 402 study participants selected through simple random sampling. A questionnaire was administered to determine social demographic characteristics, knowledge, attitude and utilization of malaria control methods; with accompanying focus group discussion. Quantitative data was analyzed using SPSS, with manual thematic analysis done for qualitative data.
Results: All study participants were aware of ITNs and used them. EM was known by 96.3% of the respondents and practiced by 95.5%, larviciding was known by 22.9% and practiced by 7.5% of the respondents. Knowledge of screens was poor (14.7%) and practiced by 3.5% of the respondents. Majority of the respondents perceived ITNs to be important in malaria control while larviciding was perceived as unimportant. Knowledge and Perception of all the malaria control methods was associated their use. Social cultural factors were associated with use of larvicides, mosquito repellents, screens, and IRS.
Conclusion: Knowledge, practices, socio-cultural factors and perception towards malaria control methods, were associated with their use.
Recommendation: Active campaigns to sensitize Nyando residents on malaria control methods should be initiated. Those living in traditional huts should be encouraged to screen their huts since space that is left for ventilation allows mosquitoes into their houses.
Keywords: Malaria control, Utilization, Perceptions, Knowledge, Nyando.

INTRODUCTION

Malaria remains one of the world's worst health problems, affecting individuals in 104 endemic countries where an estimated 207 million cases and an estimated 627,000 deaths were reported in 2012 (O'Brian *et al*., 2014). It is estimated that about 24 million Kenyans are at risk of infection annually, with pregnant women and children below five years being the most affected (KDHS, 2010).

Malaria is transmitted exclusively through the bites of *Anopheles* mosquitoes. About 20 different *Anopheles* species are important around the world; the important vector species bite at night (SAM, 2017). They breed in shallow collections of freshwater like puddles, rice fields, and hoof prints. Rice cultivation through irrigation

has created habitats ideal for the breeding of vectors of malaria and schistosomiasis (Ng'ang'a *et al*., 2008).

A new approach proposed by the System-wide Initiative on Malaria and Agriculture (SIMA) involves investment in malaria focused agricultural research and entails providing health education to farmers, with the aim of reducing malaria at its source in many high-risk regions. It involves management of land, water, and farming practices in ways that discourage mosquito breeding and reduce human-mosquito contact (Oladepo *et al.*, 2010). The most preventive measures according to WHO are personal protection, malaria vector control, and chemical control. The principle objective of vector control is reduction of the level of malaria transmission (Thanabouasy *et al*., 2009).

Nyando Sub-County is one of the areas in Kenya with the highest prevalence of malaria along with others also found in the former Nyanza province. They are collectively referred to as the lake endemic zone with regards to malaria prevalence. According to the Kenya Malaria Indicator Survey 2010, the lake endemic zone has a prevalence of 38%, while the rest of the country or zones have less than 5%. Since no studies have been carried out to explain this occurrence, it is important to investigate what factors could be behind this high prevalence in Nyando Sub- County, and generally the lake endemic zone.

There have been a considerable number of reports about knowledge, attitude, and practice relating to malaria and its control from different parts of Africa. These reports concluded that misconceptions concerning malaria still exist, and that practices for the control of malaria have been unsatisfactory (Aderaw *et al*., 2013). The Kenya Malaria Indicator Survey 2010 report stated that only 30.1% of the rural and 59.7% of urban community knew that mosquito bites can transmit malaria. It is necessary, thus, to gain an understanding of the current knowledge level of the community, as well as their beliefs and practices with respect to the disease in order to obtain and maintain community involvement in surveillance and control activities (Aderaw *et al*., 2013).

Development of strategies to improve use of the various malaria control methods requires determination of factors that limit their use. Thus, the objective of the study was to determine factors influencing use of various malaria control methods among the residents of Nyando Sub-County, Kisumu County. Findings from this study will be communicated to public health officials in Nyando Sub-County to inform and strengthen malaria control activities and programs.

MATERIALS AND METHODS

Study design and setting

A cross-sectional study design employing both quantitative and qualitative approaches was conducted in Nyando Sub-County, which forms part of the greater Kisumu County. The Sub-County is named after River Nyando. The study area was selected because of its high prevalence of malaria as a result of favorable mosquito breeding grounds in the flooded rice field plantations, and regular convectional rainfall that causes flooding in the area. The Sub-County is endemic for malaria and has a prevalence of 27%[1] which is greater than the national prevalence for the disease. The language spoken in the area is Dholuo.

Sample size and sampling procedure

The study included household heads in 3 wards (Ahero, East Kano, Awasi), who had been residents for at least six months prior to the study. The 3 wards were a sample representative of all wards in the Sub-County (the other two are Kobura and Kabonyo), as all the 5 wards have similar characteristics and the results can be generalized across board.

Every household in the 3 wards had an equal chance of being selected to participate in the study and they were picked randomly

[1] At the time of data collection, the prevalence of Malaria in Nyando stood at 38%.

until the required number was reached. The sample size was computed using the single population formula (Cochran *et. al*, 1963),

$$n = \frac{z^2pq}{e^2}$$

as the study was working with a known characteristic of the population (Prevalence). The following assumptions were considered: 95% confidence interval, 5% margin of error, and prevalence, p which was 38% in Nyando at the time of data collection. Simple random sampling was employed in selection of study participants.

The resultant sample size was 402, which factored in non-response of 0.9. This was divided by three so as to ensure all the sampled wards were equally represented in the study; 134 households were obtained per ward.

Data collection method

Validation of data collection instruments begun by engaging twenty respondents, not involved in the main study, for a pre-test exercise. The questionnaires used were developed based on literature, and panel revisions. The English protocols were then translated into Dholuo to cater for non-English speakers at the study site.

A finalized semi-structured questionnaire was administered to the household head, interviewed by the lead researcher with the assistance of a trained research assistant.

Six Focus Group Discussions were conducted among 8 to 12 eligible participants who were chosen using purposive sampling.

A guide which captured social cultural factors affecting use of malaria control methods, knowledge of malaria and how it can be controlled, perceptions toward malaria control methods, malaria control methods mostly used in the community and any other factors that may influence use of malaria control methods in the community was used.

Data analysis method

Quantitative data captured was entered into a database designed in SPSS. Variables were analyzed using Pearson's Chi square in SPSS in order to determine the association between the variables - determined by looking at the level of significance of 0.05. Qualitative data from FGDs was transcribed and translated to English (where applicable) and typed in Microsoft word, then manually analyzed for content/context reading, evaluation, analysis and interpretation for development of themes and subthemes where applicable - results/findings were presented verbatim (thematic analysis).

Ethical considerations

Approval to carry out the study was sought and obtained from Kenya medical research institute (KEMRI) Scientific and Ethics Review Unit (SERU).

Signed consent was obtained from all study participants after a detailed explanation of the purpose of the study.

RESULTS

The socio-demographic characteristics of respondents were captured as indicated in Table 1 below:

Table 1: Demographic characteristics of respondents

Variable	Category	Number	Percent (%)
Gender	Male	225	56
	Female	177	44
Age	18 – 25	62	15.4
	26 – 33	103	25.6
	34 – 41	53	13.2
	42 – 49	54	13.4
	50 – 57	49	12.2
	58 – 65	30	7.5
	65 and above	51	12.7
Marital status	Single	24	6
	Married	315	78.4
	Others	63	15.7
Religion	Christian	396	98.5
	Muslim	4	1%
	Hindu	0	0
	Non-religious	2	0.4
Education level	No education	53	13.2
	Primary Education	218	54.2
	Secondary Education	110	27.3
	University education	21	5.2
Monthly income	No income	96	23.9
	500 – 4499	144	35.8
	4500 – 8499	88	21.9
	8500 – 12499	43	10.7
	12500 – 16499	5	1.2
	16500 – 20499	11	2.7
	20500 – 24499	6	1.5
	24500 – 28499	2	0.5
	28500 – 32499	5	1.2
	32500 and above	2	0.5

Respondents' knowledge on Malaria and its control

As shown in Table 2, 97.8% of the respondents identified mosquitoes as the cause of malaria. When asked about the symptoms of malaria, 57% of the respondents mentioned fever, 51% headache, 37.8% muscle/joint pain, 43% vomiting, and the rest diarrhea and shivering. All respondents were aware of ITNs, but only 22.9% knew Larviciding. A small proportion, 14.7% of the respondents, was conversant with window and door screens.

Table 2: Knowledge on Malaria and its control

Variable	Category	Frequency	Percent (%)
Cause of malaria	Food	1	0.20%
	Water	3	0.70%
	Mosquitoes	393	97.80%
	Others	5	1.20%
Symptoms of malaria	Fever	229	57%
	Headache	205	51%
	Muscle/joint pains	152	37.80%
	Vomiting	173	43%
	Diarrhea	36	9%
	Shivering	72	17.90%
Malaria prevention methods	ITNs	402	100%
	Larviciding	92	22.90%
	EM	387	96.30%
	Mosquito repellants	190	47.30%
	IRS	360	89.60%
	Window and door screens	59	14.70%

Respondents' perception on the importance of malaria control methods in malaria control

As shown in Table 3, when the respondents were asked about their perception towards malaria control methods with regards to their importance, 70.1% said ITNs (Insecticide Treated Nets) are extremely important, 46.3% said larviciding was not important, and 18.7% said that window and door screens were not important. Further queries on mosquito repellants, EM (Environmental Management), and IRS (Indoor Residual Spraying) resulted in 54.7%, 60.4% and 41% respectively stating that the methods were very important.

Table 3: Importance of malaria control methods in malaria control

Malaria Control Method Level of Importance		Frequency	Percent (%)
ITNs	Extremely Important	282	70.1
	Very Important	103	25.6
	Moderately Important	15	3.7
	Not Important	2	0.5
Larviciding	Extremely Important	32	8.0
	Very Important	113	28.1
	Moderately Important	186	46.3
	Not Important	71	17.7
Window and Door Screens	Extremely Important	39	9.7
	Very Important	51	12.7
	Moderately Important	237	59.0
	Not Important	75	18.7
Mosquito repellants	Extremely Important	44	10.9
	Very Important	220	54.7
	Moderately Important	109	27.1
	Not Important	29	7.2
Environmental Management	Extremely Important	101	25.1
	Very Important	243	60.4
	Moderately Important	51	12.7
	Not Important	7	1.7
Indoor Residual Spraying	Extremely Important	51	12.7
	Very Important	165	41.0
	Moderately Important	126	31.3
	Not Important	60	14.9

Respondents' perception on safety of use of malaria control methods

When asked about their opinion on the safety of use of the different malaria control methods, 59% of the respondents said that ITNs were extremely safe, 61.4% said Larviciding was a little safe, 42.5% said window and door screens were a little safe. In terms of use of mosquito repellants, 46.8% said that it was very safe. When asked about their opinion on practicing EM, 58.5% of the respondents said that it was very safe while 33.3% said that it was extremely safe. With regards to IRS, 43.8% said it was very safe.

Respondents' perception on effectiveness of malaria control methods

Respondents were queried on the efficacy of malaria control methods: 85.8% said ITNs were very effective, 66.9% and 70.6% of the respondents said larviciding and window and door screens respectively had moderate efficacy. As concerns effectiveness of mosquito repellants in malaria control, 30.6% of the respondents said it was average, 37.8% said it was good while 29.1% said it was very good.

On further interview about effectiveness of EM and IRS, 50.7% and 35.8% of respondents respectively indicated that they were very good in malaria control.

Respondents' use of malaria control methods

As shown in Table 4, a large proportion, 99.8% of the respondents, used ITNs while Larviciding was only used by 7.5% of the respondents. Window and door screens use was very low as only 3.5% of the respondents said that they used it. Mosquito repellant was used by 18.7% of the respondents, 95.5% of respondents said they practiced EM, while 62.4% of the respondents practiced IRS.

Table 4: Use of malaria control methods in malaria control

Malaria control method	Use	
	Yes	No
ITN	402 (100%)	0
Larviciding	30 (7.5%)	372 (92.5%)
Window and door screens	14 (3.5%)	388 (96.5%)
Mosquito repellants	75 (18.7%)	327 (81.3%)
EM	384 (95.5%)	18 (4.5%)
IRS	251 (62.4%)	151 (37.6%)

Respondents' reasons for not using malaria control methods

Respondents were asked for reasons for not using certain malaria control methods. When asked for the reason for not using larviciding, 72.1% said that they had never heard of it. When queried for the reason for not using window and door screens, 77.9% said they had never heard about of it. Respondents were also asked for the reason for not using mosquito repellants, 22% said they were expensive, 29.6% said they were not available, and 44.3% of the respondents said they had never heard about it. The respondents were further asked for the reason for not practicing IRS, and 26.4% said it was not available.

Respondents' frequency of using malaria control methods

The respondents were asked how frequently they used malaria control methods: 99% of the respondents said they used ITNs on a daily basis, then 92%, 96.5%, and 78.4% of respondents said they did not use larviciding, window and door screens, and mosquito repellants respectively as they were not aware of these control methods. With regard to EM as a malaria control method, 95.5% of the respondents said they practiced it occasionally. On the frequency practicing IRS, 79.9% of the respondents reported that their houses had been sprayed a few years back, while 20.1% said they had never heard about IRS.

Respondents' practices with regard to malaria control

Respondents were asked if they wore long-sleeved clothes at night, and 45.8% said they always did. When asked if they visited health centers when they suspected that they had malaria, 88.8% said they did so. Respondents were asked if everybody in their households slept under mosquito nets, and 95.5% stated that all the members of their household did. When asked if they kept the windows of their houses closed between 5.00pm to 9.30pm and in the early morning, 71.9% of the respondents said they always closed the windows at that time.

When asked if they checked whether their mosquito nets had holes, 72.9% of the respondents said they always did, 23.1% said they did so, but sometimes, while 4% said that they never bothered to check. They were further asked if they immediately repaired their nets if they found they had holes. 50.2% of the respondents said they always did, 33.8% said they did, but sometimes, while 15.9% of the respondents said they never repaired them.

Respondents were asked about the condition of their ITNs: 28.9% of the respondents reported that their ITNs had holes (32.6% of the respondents had theirs in good condition), 90.8% said their nets were treated, and 99.8% reported that they used their nets on a daily basis.

The respondents were then asked if they washed their ITNs regularly, and 91.6% said that they did so regularly. However, only 28.6% of the respondents treated their nets after washing them.

Only 3% of the respondents reported that their houses had been sprayed in the previous 12 months; 2% said it was done once, and 1% said it was done twice. The respondents were further asked who sprayed their houses and 3% of the respondents said it was done by government/program. Of all the study participants, 95.5% practiced EM.

The respondents were asked how frequently they used mosquito repellants, 3% of the respondents reported that they used it daily, while 78.4% of the respondents said they had never used mosquito repellants. When queried on the condition of their window and door screens, 2.7% of the respondents said they were in good condition, while 96.5% of the respondents said they never used window and door screens.

Social-demographic characteristics and their influence on the knowledge of malaria control methods

Gender was significantly associated with knowledge of larviciding (P=0.006) and knowledge of mosquito repellants (P=0.006), but there was no association between gender and knowledge of EM (P=0.204) and knowledge of IRS (P=0.871). Age was significantly associated with knowledge of mosquito repellents (P<0.001) and IRS (P=0.004) but there was no association between age and knowledge of larviciding (p=0.197), EM (P=0.152), and window and door screens (P=0.713). Marital status was significantly associated with knowledge of larviciding (P<0.001), knowledge of mosquito repellants (P<0.001) and knowledge of IRS (P=0.005), but it was not associated with knowledge of EM (P=0.195).

Religion of the respondents was only significantly associated with knowledge of IRS (P=0.001), there was no association between religion and knowledge of larviciding (P=0.094), knowledge of EM (P=0.994), and knowledge of mosquito repellants (P=0.689). Respondents' level of education was significantly associated with knowledge of larviciding (P<0.001), knowledge of mosquito repellants (P <0.001) and knowledge of IRS (P=0.008). However, there was no association between the level of education and knowledge of EM (P=0.197).

Monthly income of the respondents was significantly associated with knowledge of larviciding (P=0.003), mosquito repellents (P<0.001) and window and door screens (P<0.001). In contrast, there was no association between monthly income of the respondents and knowledge of EM (P=0.981) and IRS (P=0.967).

Social-demographic characteristics and their influence on the use of malaria control methods.

There was no association between gender and use of larviciding (P=0.22), EM (P=0.314), mosquito repellants (P=0.436), IRS (P=0.119), and window and door screens (P=0.236).

The age of the respondents was not significantly associated with use of larviciding (P=0.310), EM (P=0.236), mosquito repellents (P=0.588), IRS (P=0.535) and window and door screens (P=0.544).

There was an association between the marital status of the respondents and use of larviciding (P=0.049), mosquito repellants (P<0.001) and window and door screens (P=0.001) since all of them had a P-value of less than 0.05 and, therefore, were statistically significant. However, there was no association between the marital status of the respondents and use of indoor residual sprays (P=0.113) and EM (P=0.11) since both of them had a P-value of more than 0.05 and, therefore, were not statistically significant. There was an association between the religion of the respondents and use of window and door screens (P=0.004), but there was no association between the religion of the respondents and use of larviciding (P=0.004), EM (P=0.269), mosquito repellants (P=0.456) and indoor residual spraying (P=0.198).

There was a significant association between the level of education and use of larvicides (P=0.022), window and door screens (P=0.016) and mosquito repellants (P<0.001). On the other hand, there was no association between the level of education and indoor residual spraying (P=0.352) and practicing Environmental management (P=0.155) because they both had P-values of more than 0.05 and so they are statistically not significant. The monthly income of the respondents was significantly associated with use of mosquito repellents (P=0.017) and window and door screens (P<0.001). There was no significant relationship between monthly income and use of EM (P=0.982), larviciding (P=0.146) and IRS (P=0.141).

Association between the respondents' knowledge of malaria control methods and their utilization

There was significant association between knowledge of all the malaria control methods and their use because they all had P-values of <0.001, which is less than 0.05, and so they were all statistically significant.

Table 5: Association between the respondents' knowledge of malaria control methods and their utilization

Knowledge of malaria control methods		Utilization		P-value
		Yes	No	
Larviciding	Yes	30 (33%)	62 (67%)	<0.001
	No	0	310 (100%)	
EM	Yes	383 (99%)	4 (1%)	<0.001
	No	1 (7%)	14 (93%)	
Mosquito repellant	Yes	75 (40%)	115 (60%)	<0.001
	No	0	212 (100%)	
IRS	Yes	251 (70%)	109 (30%)	<0.001
	No	0	42 (100%)	
			Continued table 5	
window and door screens	Yes	14 (24%)	45 (76%)	<0.001
	No	0	343 (100%)	

Association between perceived importance of malaria control methods and their utilization

As shown in Table 6 below, there was a statistically significant relationship between use of all the malaria control methods and their perceived importance in controlling malaria as they all had P-values of less than 0.05, and were all statistically significant.

Association between practices related to use of malaria control methods and their utilization

Practices relating to use of mosquito repellants had a significant relationship with its utilization because it had a p-value of 0.001, which was statistically significant. Practices relating to use of window and door screens had a significant relationship with its utilization because it had a p-value of <0.001. Practices relating to use of indoor residual sprays had a significant relationship with its utilization because the p-value was 0.02 which was statistically significant.

Table 6: Association between perceived importance of malaria control methods and their utilization

Perceived importance of larviciding	**Practice Larviciding**		**P-value**
	Yes	**No**	
Extremely important	9(28%)	23(72%)	<0.001
Very important	19(17%)	94(83%)	
Moderately important	2(1%)	184(99%)	
Not important	0	71(100%)	
Perceived importance of EM	**Practice EM**		**P-value**
	Yes	**No**	
Extremely important	99(98%)	2(2%)	<0.001
Very important	242(99%)	1(<1%)	
Moderately important	40(78%)	11(22%)	
Not important	3(43%)	4(57%)	
Perceived importance of mosquito repellants	**Use of mosquito repellants**		**P-value**
	Yes	**No**	
Extremely important	17(39%)	27(61%)	0.001
Very important	44(20%)	176(80%)	
Moderately important	12(11%)	97(89%)	
Not important	2(7%)	27(93%)	
Perceived importance of IRS	**Practice IRS**		**P-value**
	Yes	**No**	
Extremely important	40(78%)	11(22%)	0.025
Very important	99(60%)	66(40%)	
Moderately important	71(56%)	55(44%)	
Not important	41(68%)	19(32%)	
Perceived importance of window and door screens	**Use of window and door screens**		**P-value**
	Yes	**No**	
Extremely important	7(18%)	32(82%)	<0.001
Very important	5(10%)	46(90%)	
Moderately important	2(<1%)	235(99%)	
Not important	0	75(100%)	

Table 7: Association between practices related to use of malaria control methods and their utilization

Practices related to use of malaria control methods	**Use of malaria control methods**		**P-value**
Mosquito repellents – frequency of application	**Use of mosquito repellents**		
	Yes	No	
Daily	15 (100%)	0	0.001
occasionally	57 (84%)	11 (16%)	
I do not apply at all	3 (<1%)	316 (99%)	
Window and door screens condition	**Use window and door screens**		
	Yes	No	
They have holes	2 (100%)	0	<0.001
Not treated	1 (100%)	0	
In good condition	11 (100%)	0	
I do not use at all	0	388 (100%)	
IRS Number of times house sprayed in last 12 months	**Practice IRS**		
	Yes	No	
Once	8 (100%)	0	0.02
Two times	3 (75%)	1 (25%)	
More than two times	0	1 (100%)	
Not sprayed at all	240 (62%)	149 (38%)	

Table 8: Association between practices related to use of malaria control methods and their utilization

Practices related to use of malaria control methods		**Use of malaria control method**		**P-value**
Larviciding		**Practice larviciding**		
		Yes	No	
Rice field fenced	Yes	3 (7%)	38 (93%)	<0.001
	No	27 (7%)	334 (93%)	
EM Drain stagnant water/ clear unwanted vegetation		**Practice EM**		
		Yes	No	
	Yes	375 (99%)	1 (<1%)	<0.001
	No	9 (35%)	17 (65%)	
IRS		**Practice IRS**		
		Yes	No	
House sprayed in last 12 months	Yes	11 (92%)	1 (8%)	0.036
	No	240 (62%)	150 (38%)	

Practices such as fencing the plot or rice field had a significant relationship with use of larvicides because it had a p-value of <0.001. EM practices had a significant

relationship with its utilization because it had a p-value of <0.001. Practices relating to use of indoor residual sprays had a significant relationship with its utilization because the p-value was 0.036.

Association between social-cultural issues and malaria control methods

The type of structure of the respondents' houses was significantly associated with use of larvicides; it had a P-value of 0.042 which was less than 0.05 and, therefore, it was statistically significant. Respondents' source of water had a significant relationship with the use of larvicides (P=0.002). The type of structure of the respondents' houses had a significant relationship with the use of window and door screens; it had a P-value of <0.001. Respondents' source of water had no significant relationship with the use of window and door screens (P=0.536), because it had a P- value of more than 0.05 and, therefore, it was not statistically significant.

The type of structure of the respondents' houses had a statistically significant relationship with the use of mosquito repellants; it had a P-value of 0.006. Respondents' source of water had no significant relationship with the use of mosquito repellants (P=0.303), because it had a P- value of more than 0.05 and, therefore, was not statistically significant. There was no significant relationship between the type of structure of the respondents' houses and environmental management; it had a P-value of 0.063 which was more than 0.05 and, therefore, it was not statistically significant. Respondents' source of water had no significant relationship with practicing environmental management (P=0.378).

There was no significant relationship between the type of structure of the respondents' houses and indoor residual spraying; it had a P-value of 0.402 which was more than 0.05 and, therefore, it was not statistically significant. There was a significant relationship between Respondents' source of water and indoor residual spraying (P<0.001), because it had a P- value of less than 0.05 and, therefore, it was statistically significant.

DISCUSSION

The findings of the study indicated that all the respondents were aware of ITNs and used them. They also had good knowledge of EM (96.3%), and also its use was good (95.5%). Knowledge of IRS was good (89.6%) and had been practiced by 62.4% of the respondents although the spraying had been done more than 3 years prior to data collection, making it ineffective. These findings were lower than those of a study carried out in Ethiopia, where knowledge of ITNs was 93.7% and its use was 86.6%, knowledge of EM was 84.2% and its use was 71.2%, and knowledge of IRS was 78.9% and its use was 59.5% (Abatel *et al*., 2013). The difference in level of knowledge between the two studies could be attributed to the fact that the people of Nyando got their ITNs for free, IRS had been practiced a few years back and so most of the people remembered it, while EM was practiced even by those who did not know it was a malaria control method.

Knowledge of mosquito repellants was fair (47.3%) and its use was poor (18.7%). These findings were consistent with those of a study carried out in Nigeria where 37.8% of the respondents knew mosquito repellents and 17.5% used them (Singh *et al*., 2014).

The other malaria control methods were poorly known and used because only 22.9% of the respondents knew larviciding and only 7.5% of the respondents used it; in a similar study carried out in El-Salvador, 88.2% of the respondents were aware of larviciding and 39.1% practiced it (Mejía *et al*., 2016). The difference in results of the studies could be attributed to the fact that larviciding was not being promoted as a malaria control method in the same way as others were in Nyando.

Only 14.7% of the respondents were aware of window and door screens, and 3.5

% of the respondents used them, which was consistent with findings of a study carried out in Iran where 14.5% of respondents were aware of screening but differed in their use (Soleimani-Ahmadi *et al*., 2014). The low level of knowledge and use of this method could be attributed to the fact that it wasn't being promoted as a malaria control method in Nyando.

Larviciding was perceived as not being as important by 46.1% of the respondents which was inconsistent to results of a study carried out in Tanzania where 73% of the respondents said that they trusted larviciding in malaria control (Mboera *et al.,* 2014). The poor perceptions of the Nyando residents towards larviciding could be because they felt it could contaminate the water that they use for domestic purposes.

Window and door screens were perceived as not being as important by 59% of the respondents. These findings were similar to those of a study carried out in Iran, where in spite of 98% of the respondents knowing about malaria prevention only 14.5% of the respondents mentioned it as a malaria preventive measure (Soleimani-Ahmadi *et al.,* 2014). The respondents could probably have been dissuaded by its cost, and felt it was not a priority in their homes.

For IRS 53.7% of the respondents felt it was important in malaria control. These findings were lower than those of a study carried out in Iran where 96.2% of the respondents indicated that IRS was important in malaria prevention (Hanafi-Bojd *et al.*, 2011). The difference in results can be attributed to poor perceptions towards IRS in Nyando, since almost half of the respondents reported that it was not safe and convenient to practice. From the FGDs, some respondents said that it was effective only for a short period; others said that it requires technical expertise to practice, while others said it caused the emergence of bedbugs and fleas. Further to this, some felt that spraying their houses would interfere with their privacy.

Forty-five-point eight percent of respondents wore long-sleeved clothes at night or when going to the rice fields, which was higher than findings of a study carried out in LAO PDR where only 25.2% of the respondents wore long-sleeved clothes at night (Thanabousy *et al*., 2009). This difference could be because Nyando people had better knowledge on malaria control than those of LAO. EM related practices such clearing bushes and draining stagnant water was good because 95.5% of the respondents practiced it.

Other malaria control practices like all the members of the household sleeping under ITNs was good because 95.5% of the respondents said they always slept under ITNs, which was higher than the findings of a study carried out in Ethiopia where 73.3% of the respondents said they used ITNs (Teklemariam *et al*., 2015). Results of the studies could have differed because of good attitudes towards ITNs by the Nyando residents since 95.7% of the respondents said it was important in malaria control. With regards to keeping windows closed in the evening and early morning, 71.9% said they always did, which was higher than findings of a study carried out in Ethiopia where 40.8% of the respondents always closed their windows (Abatel *et al*., 2013). This difference could also be attributed to better knowledge and attitudes towards malaria control by the Nyando residents over their Ethiopian counterparts. Since evenings and early mornings are the times that mosquitoes enter the house, then those people who don't close their windows during this time are more likely to have mosquitoes enter their houses (Thanabousy *et al*., 2009). Only 32.6% of the respondents had nets which were in good condition. This was higher than findings of a study carried out in Kwale where 30.7% of the respondents had nets which were in good condition (Khambira, 2013). Twenty-eight-point nine percent of the respondents' nets had holes; this was lower than findings of a study carried out in Kwale where 78% of the respondents' nets had holes (Khambira,

2013). ITNs should not have holes because a single small hole is enough to render the net useless (Willy, 2005). Nine percent of the respondents used untreated nets, which was lower than findings of a study carried out in Kwale where 14.7% of the respondents used untreated nets. Nets should be treated because the insecticide used repels mosquitoes; untreated nets are not useful (Willy, 2005).

Sixty-two-point nine percent of the respondents washed their nets regularly and did not re-treat them. This can be attributed to lack of O-tab in Nyando, which is used to treat nets. These results were lower than findings of a study carried out in Kwale, where 67% of the respondents washed their nets regularly and did not retreat them (Khambira, 2013). ITNs should be regularly re-treated because they lose efficacy after three washes (Willy, 2005). The difference in the results of the two studies can be attributed to good perceptions of the Nyando residents towards ITNs, since 95.7% of the respondents said they are important in malaria control. Washing nets regularly reduces the amount of the insecticide, so it must be re-treated to make it effective (Willy, 2005).

Practices in relation to use of mosquito repellents were poor because only 3.7% of the respondents applied repellents on a daily basis, 17.9% applied repellents occasionally while 78.4% of the respondents did not use repellants at all. These results were lower than findings of a study carried out in LAO PDR where 35.1% of the respondents used it daily, 36.2% occasionally and only 28.7% never used it (Thanabousy *et al*., 2009). This difference could be due to unavailability of mosquito repellents in Nyando.

With regards to window and door screens, 96.5% of the respondents did not use the screens at all, while 3.5% of them had screens; these results were lower than findings of a study carried out in Tibet where 49.3% of the respondents used the screens (Liu *et al*., 2014). This inconsistency in the results can be attributed to lack of knowledge and unavailability of the screens in Nyando since it was known by only 14.7% of the respondents.

Marital status was significantly associated with use of larvicides, mosquito repellents and window and door screens (P=0.049, P<0.001 and P=0.001 respectively). These findings were consistent with those of a study carried out in LAO, PDR where the marital status of the respondents was significantly associated with knowledge of malaria prevention (Thanabousy *et al*., 2009). Majority of the respondents who used larvicides, mosquito repellents and window and door screens were married. Married respondents were also more knowledgeable on the malaria control methods mentioned above than respondents who were single, divorced or widowed. This high level of knowledge could have translated to them using the larvicides, mosquito repellents and window and door screens than respondents who were single, divorced or widowed.

Religion was significantly associated with use of window and door screens (P=0.04). These findings were inconsistent with those of a study carried out in Ghana where religion was not associated with use of malaria control methods (Dako-Gyeke *et al*., 2015). Majority (93%) of the respondents who used window and door screens were Christians. This could be an indication that although most of the respondents said their source of information for window and door screens was health workers, others could have heard about it in the church and that is why they used it.

The level of education was significantly associated with use of larvicides, mosquito repellents and window and doors screens (P=0.022, P<0.001 and P=0.016 respectively). These findings were similar to those of a study carried out in Ghana were the level of education of the respondents had a significant relationship with use of malaria prevention methods (Dako-Gyeke *et al*., 2015). Most of the respondents who used the three malaria control methods mentioned above had

reached secondary school level and beyond. They were also more knowledgeable on the malaria control methods, which could have made them use them as they were aware of their benefits.

Monthly income was significantly associated with use of mosquito repellents, and window and door screens (P=0.017 and P<0.001 respectively). These findings were similar to those of a study carried out in Ghana where the income of the respondents had a significant relationship with use of malaria prevention methods (Dako-Gyeke *et al*., 2015). Since mosquito repellents and window and door screens are not provided free of charge in Nyando sub-county like ITNs, people with higher income are more likely to use them.

Knowledge of larviciding, EM, mosquito repellents, IRS, and window and door screens was significantly associated with their utilization (P<0.001, P<0.001, P<0.001, P<0.001 and P<0.001 respectively). Most respondents who had knowledge of the malaria control methods were more likely to use them. This is because of the understanding of the benefits of the different malaria control methods, while those who did not know the malaria control methods did not use them. It is very hard for an individual to use something that they do not know or understand.

Type of structure of the respondents' houses was significantly associated with use of larviciding, mosquito repellents and window and door screens (P=0.042, P=0.006 and P<0.001 respectively). These findings were similar to those of a study carried out in Ghana where the type of housing of the respondents had a significant relationship with use of malaria prevention methods (Dako-Gyeke *et al*., 2015). Most of the respondents who use the malaria control methods mentioned above lived in houses built of stone. These respondents were well to do members of the society and were also more educated. Mosquito repellents and window and door screens were not provided in Nyando for free. So, those people who more likely to use them were those who could afford to buy to them, while larviciding could only be practiced by those people who were more educated. This could be the reason why people living in houses made of stone used larviciding, mosquito repellents and window and door screens.

Source of water for the respondents was significantly associated with use of larvicides and IRS (P=0.002 and P<0.001 respectively). These findings were similar to those of a study carried out in Ghana where socio-cultural issues of the respondents had a significant relationship with use of malaria prevention methods (Dako-Gyeke *et al*., 2015). Majority of the respondents who used larvicides and IRS are those who use water from boreholes. This could be due to the fact that those respondents who used water from boreholes could be more educated than those who used water from shallow wells. Shallow well water is surface runoff that collects after it rains. Educated people may not use that kind of water because they understand the risks associated with it. Knowledge of larviciding was high among respondents who had reached secondary school level and above. This could be the reason why people who used borehole water were more knowledgeable on use of larvicides and that is the reason they used it. Knowledge of IRS was not affected by the level of education because even those respondents who were not well educated remembered it because it was carried out in Nyando sometime before the study was conducted. What could have affected its use is the perceptions associated with its use like emergence of bedbugs, which was high among the respondents who were not well educated. Therefore, the respondents who were more educated were more likely to use it because they did not believe in the perceptions associated with its use and witchcraft issues.

Perceived importance of larviciding, EM, mosquito repellents, IRS and window and door screens was statistically associated with the utilization of the malaria control methods by the respondents (P<0.001, P<0.001, P=0.001, P=0.025 and P<0.001

respectively). These findings were consistent with those of a study carried out in Ghana that showed local perception and health-seeking behavior are critical to the success and sustainability of malaria management and control (Laar *et al*., 2013).

Majority of the respondents perceived Mosquito repellents as important in malaria control although a small proportion (18.7%) of respondents used it as a malaria control method. This could be due to the reasons given in the FGDs that it was expensive, not available in Nyando, and it was not known by all the respondents. A very small proportion of respondents perceived larviciding to be important in malaria control which was similar to the small proportion (7.5%) of respondents who used it. This may be attributed to reasons for not using it that came out in the FGDs: it was not known by a large proportion (78%) of the respondents, could contaminate the water that they use for domestic purposes, and is expensive. For window and door screens a small proportion (22.4%) of respondents perceived it to be important in malaria control while a very small proportion (3.5%) of the respondents used it in malaria control. This could be due to the reasons given in FGDs that it was not known by many respondents, it is expensive, and not available in Nyando.

Malaria control practices such as draining excess water/clearing bushes, frequency of using repellents, frequency of IRS application and checking the condition of window and door screens were significantly associated with use of malaria control methods ($P<0.001$, $P<0.001$, $P=0.001$, $P=0.02$ and $P<0.001$ respectively). Respondents who had good practices with regards to use of malaria control methods had a high level of utilization of the malaria control methods.

CONCLUSION AND RECOMMENDATIONS

It was determined that demographic characteristics such as marital status and the level of education of the respondents was associated with use of larvicides, mosquito repellents and window and door screens, while the monthly income of the respondents was associated with use of mosquito repellents and window and door screens. Knowledge, practices and Perceptions towards all the malaria control methods was associated their use. Social cultural factors such as the type of structure of the respondents' house was associated with use of larvicides, mosquito repellents and window and door screens while the respondents' source of water was associated with use of larvicides and IRS.

There should be an active campaign to sensitize the people of Nyando on all the malaria control methods, and not only ITNs. They should be educated on the way they are used; their importance in malaria control, and also where they can be sourced. This is because integrated malaria management has been shown to be key in malaria control. People living in traditional huts should be encouraged to screen their huts since the space that is left for ventilation allows mosquitoes to get into their houses. All the malaria control methods should be made available in Nyando for free or subsidized price to allow people to use them.

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REFERENCES

- Abatel A., Degarege A. and Erko B. (2013). Community knowledge, attitude and practice about malaria in a low endemic setting of Shewa Robit Town, northeastern Ethiopia. *Bio Med Central Public Health*. 13; 312:3
- Aderaw Z., Gedefaw M. (2013) Knowledge, Attitude and Practice of the Community

towards Malaria Prevention and Control Options in Anti-Malaria Association Intervention Zones of Amahara National Regional State, Ethiopia. *Journal of Tropical Diseases* 1; 118:2

- Cochran, W. G. (1963). *Sampling Techniques*, 2nd Ed., New York: John Wiley and Sons, Inc.
- Dako-Gyeke M. and Kofie H. M. (2015). Factors Influencing Prevention and Control of Malaria among Pregnant Women Resident in Urban Slums, Southern Ghana. *African Journal of Reproductive Health.*19 (1); 44:6
- Hanafi-Bojd A.A., Vatandoost H., Oshaghi M.A., Eshraghian M.R., Haghdoost A.A., Abedi F., Zamani Gh., Sedaghat M.M., Rashidian A., Madani A.H. and Raeisi A. (2011). Knowledge, attitudes and practices regarding malaria control in an endemic area of southern Iran. *Southeast Asian Journal of Tropical Medicine Public Health*. Vol 42 No. 3:496
- Kenya demographic health survey (2010) http://www.measuredhs.com/data/dataset/Kenya_Standard-DHS_2008.cfm
- Kenya malaria indicator survey (2010) https://dhsprogram.com/pubs/pdf/MIS7/MIS7.pdf
- Khambira M. (2013). Insecticide treated bednets ownership, use and maintenance behaviour in Kwale, Msambweni and Kinango Districts in Kenya. http://irlibrary.ku.ac.ke/bitstream/handle/123456789/7046/Maureen%20Khambira.pdf?sequence=1&isAllowed=y
- Laar A.S., Laar A.K., Dalinjong P.A. (2013). Community perception of malaria and its influence on health-seeking behaviour in rural Ghana: a descriptive study. *Malaria World Journal*. 4; 1:5
- Liu X., Wan F., Cirendunzhu., Cirenwangla., Bai L., Pengcuociren., Zhou L., Baimaciwang., Guo Y., Dazhen., Xu J., Sang S., Li X., Gu S., Wu H., Wang J., Dawa., Xiraoruodeng. and Liu Q.(2014). Community Knowledge and Experience of Mosquitoes and Personal Prevention and Control Practices in Lhasa, Tibet. *International Journal of Environmental Research and Public Health.*11 (9): 9919–9937:9927
- Mboera L. E. G., Kramer R. A. , Miranda M. L., Kilima S. P., Shayo E. H. and Lesser A. (2014). Community Knowledge and Acceptance of Larviciding for Malaria Control in a Rural District of East-Central Tanzania. *International Journal of Environmental Research and Public Health.* 11(5); 5137–5154:5145-5146.
- Mejía R., Ribó A., Quinteros E., López A., Villegas P., Vela X.F., Membreño A.R. (2016). Knowledge Attitude and Practices Related on Prevention of Mosquito Borne Diseases and Sanitation Conditions in a Salvadoran Urban community. *Occupational Diseases and Environmental Medicine*. Vol 4, 83-102:92-95
- Ng'ang'a P.N., Shililu J., Jayasinghe G., Kimani V., Kabutha C., Kabuage L., Kabiru E., Githure J. and Mutero C.(2008). Malaria vector control practices in an irrigated rice agro-ecosystem in central Kenya and implications for malaria control. *Malaria Journal*.7; 146: 2-9
- O'Brien A. T., Ramírez J. F and Martínez S.P.(2014). A descriptive study of 16 severe *Plasmodium vivax* cases from three municipalities of Colombia between 2009 and 2013. *Malaria journal*. 13;404:1
- Oladepo O., Tona G.O., Oshiname F.O., Titiloye M. (2010). Malaria knowledge and agricultural practices that promote mosquito breeding in two rural farming communities in Oyo State, Nigeria. *Malaria journal*. 9; 91:2-9
- Scientists Against Malaria. (2017). Malaria Transmission. http://scientistsagainstmalaria.net/ malaria-page. Accessed on the internet on 1/1/2017.
- Singh R., Musa J., Singh S. and Ebere U. V. (2014). Knowledge, Attitude and Practices on Malaria Among the Rural Communities in Aliero, Northern Nigeria. *Journal of Family Medicine and Primary Care*. Jan-Mar; 3(1): 39–44:6
- Soleimani-Ahmadi M., Vatandoost H., Zare M., Alizadeh A. and Salehi M.(2014). Community knowledge and practices regarding malaria and long-lasting insecticidal nets during malaria elimination programme in an endemic area in Iran. *Malaria Journal*. 13; 511:3
- Teklemariam Z., Awoke A., Dessie Y., Weldegebreal F. (2015). Ownership and utilization of insecticide-treated nets (ITNs) for malaria control in Harari National

Regional State, Eastern Ethiopia. *Pan African Medical Journal*. 21: 52.

- Thanabouasy C., Pumpaibool T. and Naowarat Kanchanakhan. (2009). Assessment of knowledge, attitude and practice regarding malaria prevention towards population in Paksong District, Champasack province, LAO PDR. *Journal of Health Research*; 23(suppl): 11 - 15
- Willy Janssen, Belgian Technical Cooperation, Rwanda (2005). Insecticide-treated nets: efficacy, impact and operational constraints. http://odihpn.org/magazine/insecticide-treated-nets-efficacy-impact-and-operational-constraints/

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