S. O. Adoka, Dip MLS, HN Dip MLS, Dip, MSc (London), D. N. Anyona, BSc, P. Abuom, BSc, MSc, PhD, A. S. Matano, BSc, MSc, S. K. Gichere, BSc, MSc, T. Okurut, BSc, MSc, PhD, Lake Victoria Basin Commission, P. O. Box 1510-40100 Kisumu, Kenya, W. O. Opiyo, MBChB, MSc, Maseno University, P. O. Private Bag, Maseno, D. Othero, BSc, MPH, PhD, Lake Victoria Basin Commission, P. O. Box 1510-40100, Kisumu, Kenya, J. M. Vulule, BSc, MSc, PhD, Kenya Medical Research Institute, P. O. Box 1578, Kisumu, Kenya and A. V. Ofulla, BSc, MSc, PhD, Maseno University, P. O. Private Bag, Maseno, Kenya

Request for reprints to: S. O. Adoka, Maseno University, P. O. Private Bag, Maseno, Kenya

KNOWLEDGE AND PERCEPTIONS ON MALARIA AND ITS ASSOCIATION WITH AQUATIC HABITATS

S. O. ADOKA, D. N. ANYONA, P. ABUOM, A. S. MATANO, S. K. GICHERE, T. OKURUT, W. O. OPIYO, D. OTHERO, J. M. VULULE and A. V. OFULLA

ABSTRACT

Background: Malaria remains the major cause of morbidity and mortality among children in Kenya. About 70 percent of the population is at risk of infection, and roughly 34,000 young children die of malaria-related causes annually.
Objective: To investigate the knowledge and perceptions of the local people for malaria in relation to aquatic habitats along the Kenyan Lake Victoria basin.
Design: Community-based cross-sectional study.
Setting: The Kenyan Lake Victoria basin Region.
Subjects: Two hundred and fourty three individuals (both women and men residing in the beaches and surrounding areas) were interviewed about their knowledge and perceptions regarding malaria.
Results: Mosquitoes were perceived to be the main cause of malaria. Most respondents were familiar with the main signs and symptoms of mild malaria. Majority of the respondents had poor knowledge of mosquito breeding habitats with 45% mentioning the lake and only 18.6 and 8.9% mentioning ponds and dams, respectively. Most female respondents did not know the difference between mosquitoes and lake flies, P=0.03, Fishers exact test. The majority (97.5%) of the respondents reported seeking conventional malaria treatment from health institutions.
Conclusion: Mosquitoes are perceived to be the main cause of malaria by both males and females. A significant proportion of the respondents were familiar with the main signs and symptoms of malaria and sought conventional medicine for treatment of the disease. Most of the respondents, however, had poor knowledge on the breeding habitats of mosquitoes. Concerted effort is needed to scale-up health education and improve the knowledge of the community about mosquitoes and their breeding habitats, particularly malaria vectors which do not breed in deep lake waters. Effective anti-malarial drugs should also be available at the grassroots level where the problem of malaria is rampant.

INTRODUCTION

Despite malaria transmission being reduced substantially in some parts of Kenya, it still remains high among the residents in the Lake Victoria basin (1, 2). In Kenya, an estimated 27 million people (about 70 percent of the population) are at risk of infection, and roughly 34,000 young children die of malaria-related causes annually (3). High transmission cases usually coincide with the rainy season. According to 2009 statistics, malaria constituted approximately 32% of the total outpatient cases in Nyanza and Western provinces in Kenya, followed by upper respiratory tract infections, skin diseases and diarrhoea (4). Current malaria control interventions in Kenya include the use of long-lasting insecticide-treated bed nets, indoor residual spraying with insecticides, and intermittent preventive therapy with sulphadoxine-pyrimethamine for expectant mothers, and artemisinin-based combination therapies for malaria case management (3). Malaria transmission along the lake is perennial and often does not take epidemic situation. However, significantly higher malaria morbidity and mortality among under fives do occur (3).

In Africa, perennial malaria transmission is often observed in villages near lakes and large reservoirs (5), (6). Previous studies have shown that malaria cases increase with decreasing distance to the shores of large water bodies (7, 8). For example, construction of dams has been observed to shift seasonal transmission to perennial transmission (9). The environment associated with the lake may maintain a high number of malaria vectors (10). Lake habitats including water hyacinth have been suspected to be the source of vectors (11).

Given that *An. funestus s.s*, an all important malaria vector, is closely associated with aquatic vegetation (12, 13), it has been proposed and even reported that the infestation of water hyacinths (*Eichhornia crassipes*) in African lakes' sheltered lagoons and lakeshore pools have increased breeding site availability for malaria mosquitoes (11), though some of these reports have been anecdotal as previously reported by Ofulla *et al* (14).

Various researchers have documented numerous findings on perceptions, knowledge, attitudes and practices among communities in many parts of the world including Africa. Most of the reports concur that wrong perceptions concerning malaria transmission and control is still common among communities living in endemic areas (15-17). Therefore, community awareness, perceptions, beliefs and practices need to be established so as to be able to come up with effective malaria surveillance and control activities within the affected communities (18).

Differing ethno medical concepts on human health prevention and treatment strategies, based on traditions and cultural beliefs, must be considered if the malaria control programme is to succeed (19). However perfectly planned a program is, the target population will not participate in it if there are misconceptions concerning the relationship between vectors and disease, and concerning conventional pharmaceutical therapies. In many areas, the primary health care practitioners in local populations do not subscribe to the conventional methods of malaria diagnosis and treatment, but instead rely on observation and patient provided information (19, 20). Folk healers commonly known as traditional medicine men may disregard the conventional means of malaria treatment, and choose to treat their patients in a traditional way (21).

Many studies have demonstrated the existence of different beliefs on causes of water-borne diseases among the affected communities, with other researchers reporting that, even if the local communities have an accurate knowledge on transmission, treatment and prevention of malaria, they could still fail to participate effectively, in National Malaria Control Programmes, if their perceptions about various aspects of malaria remains poor (19, 20). There can be no significant participation

of local communities in malaria control programmes if the locals and conventional medics' view of the disease remain divergent. Such differences in views and perceptions among the stakeholders will only lead to refusal to participate or partial participation by community members in malaria control and eradication initiatives (20). We hypothesised that community members living along the Lake Victoria basin of Kenya may have different perceptions on the scientific aspects of malaria prevalence, treatment and transmission. We investigated and now report the extent and accuracy of their knowledge and perceptions in relationship to the aquatic habitats and malaria prevalence, treatment and transmission.

MATERIALS AND METHODS

The study area included 14 beaches within the entire shoreline of Lake Victoria basin, Western Kenya (Figure 1). The study area is situated between longitude 24,350 and 34,551 E and latitude 00, 02'N and 00, 11' S. The region's topography varies and is characterised by hilly areas in the Southern and Western side and a gentle slope towards Kano plains. The area has two main rainy seasons; the long rains between March and June, and short rains from October to December (22). Temperature ranges between 17°C- 34°C with an average minimum temperature of 17.5°C and average maximum temperature of 30°C (23). A majority of the population is of Luo ethnic community practicing fishing, subsistence farming, livestock keeping and trading.

This was a cross-sectional survey in which a total of 243 respondents were randomly drawn from 14 beaches along the Kenyan Lake Victoria basin. The beaches were selected based on their close proximity to the lake and earlier anecdotal reports by the local community along the beaches, that occurrence of water hyacinth in the lake creates suitable breeding habitats of mosquitoes, leading to the high prevalence of malaria along the Kenyan Lake Victoria basin.

Structured questionnaire schedule was translated into Luo and Kiswahili languages and pretested in the same study area before being administered to the respondents. The first section of the questionnaire contained questions on demographic profiles of the participants, while the second part assessed their knowledge on malaria transmission, recognition, symptoms, treatment, control and association with aquatic vegetation in the lake and land habitats.

Administrative authorisation to carry out this study was obtained from the Nyanza Provincial Health Department through the Director of Public Health and Sanitation in Kisumu, Kenya. The objectives of the study were fully explained to community members and the participants prior to conducting the interviews. Full verbal consent

was sought from each participant prior to the interviews. Study respondents' names and personal information, which could reveal their identity and link them to the findings, were not sought.

The data obtained were entered in Microsoft Excel spread sheets, then cross-checked and transferred to SPSS for windows version 12.0 (SPSS, Atlanta GA, USA) for analysis. Descriptive statistics were carried out to determine relative frequencies, percentages and averages of variables. Chi-square test (X^2) was used to determine relationships between level of education, age, gender and occupation and correctness of responses of the study participants. $P<0.05$ was considered statistically significant.

RESULTS

Demographic profiles and knowledge of malaria prevalence and transmission: Out of 243 respondents, 56.8% (138/243) were females and 43.2% (105/243) were males. Their average age was 32 years. Majority (68%) of the respondents had primary level of education (Table 1). Symptoms of malaria such as, intermittent fever, headache, vomiting and nausea were most frequently mentioned by the study participants. Other symptoms mentioned though less frequently, were, weak body, diarrhoea and loss of appetite (Figure 2). There was no statistical difference between male and female respondents on their knowledge of the correct symptoms of malaria, and only few respondents (0.4%) did not know the symptoms of malaria, p>0.05, Chi-square test.

In total, 227/243 (93.4%), of the participants associated malaria disease transmission with mosquito bites, inclusive of those who also mentioned bites and using dirty water, being rained on, and cold weather (Figure 3). There was no significant difference between males and females on malaria transmission knowledge, (P>0.05, Chi-square test). However, a significant relationship between education level and knowledge on malaria transmission was observed, P<0.05, (X^2 =22.827). Sixty one and a half percent (61.5%), of the study respondents who were uneducated, associated malaria transmissions with the bites of mosquitoes, as compared to 86.1, 93.6 and 100% of those with primary, secondary and tertiary education, respectively. Also, 211 (86.8%) of all age group categories: 18-27, 28-37, 38-47, 48-57, and 58-67years, clearly knew that malaria is contacted from mosquito bites, and not by using dirty water eight (3.5%), being rained on 16 (6.6%) or no idea three (1.2%), P< 0.001, (X^2 = 82.207).

Since people with less entomological knowledge can easily confuse Lake flies and mosquitoes and do think that Lake flies are actually mosquitoes which can transmit malaria, questions were asked to find out the respondents knowledge of the difference between Lake flies and mosquitoes. Most male respondents knew the difference between Lake flies (Ephemeroptera; Chironomidae: *Povilla adusta*) and mosquitoes compared to female respondents (Table 2). There was a significant relationship between gender and knowledge of the difference between Lake flies and mosquitoes, P=0.002, (X^2 = 9.574). Knowledge of the difference between Lake flies and mosquitoes also depended on the occupation of the respondents. Over 85% of fishermen, fish traders and farmers knew the difference between Lake flies and mosquitoes, while only 55.4% of respondents engaged in other occupations (retail shop, bicycle operator, food vendor, stage agent, hotel operator, artisan, security guard and others) knew the difference P<0.001, (X^2 = 26.056). On the contrary, there were no significant difference in level of education of the respondents (primary, secondary, tertiary, or uneducated), or in the age categories of the respondents (18-27 years, 28-37 years, 38-47 years, 48-57 years and 58-67 years), on knowledge of the difference between lake flies and mosquitoes. Majority of the respondents (over 77%), knew the difference between Lake flies and mosquitoes regardless of their education status or age categories, P= 0.435.

Health care seeking behaviour and perceptions on mosquito habitats: The majority (97.5%) of the respondents reported seeking treatment for malaria using conventional treatment (anti malarial drugs) (Figure 4). A smaller percentage (0.8%) stated that they treated malaria using local herbs and concoctions. A similar percentage (0.8%) mentioned that malaria could be cured by medicine men while one respondent (0.4%) had no idea of how malaria is treated (Figure 4).

Most of the respondents 108 (52.7%) mentioned that mosquitoes are found in the Lake (Figure 5), compared to those who mentioned rivers 26 (12.7%), ponds 44 (21.5%) dams 21 (10.2%), wells 6 (2.9%) and other habitats 31 (13.1%). In addition, 166 (77.6%) of the respondents, regardless of occupation, reported that most macrophytes (aquatic plants generally associated with mosquito abundance), are found in the lake compared to rivers, ponds, dams, wells, and other habitats, P=0.002, (X^2 = 35.029). Slightly more males (59.6%) than females (47.4%), associated mosquitoes with lake habitats, while more female respondents associated mosquitoes with river habitats, P=0.006, (X^2 = 14.506).

Table 1

Respondents' level of formal education and age

Site/Beach	No of Respondents	Education level				Age group (in yrs)				
		Prim.	Sec.	Tert.	Uned.	18-27	28-37	38-47	48-57	58-67
Dunga	21	10	9	1	1	9	7	4	0	1
Ogal	21	17	1	0	3	7	5	8	1	0
Asembo Bay	30	20	6	0	4	5	12	5	4	4
Kaugege	22	13	9	0	0	13	6	3	0	0
Homa Bay	24	13	11	0	0	7	13	2	2	0
Kendu Bay	20	15	4	0	1	10	4	3	0	3
Kusa	19	13	4	1	1	2	8	3	3	3
Singida	21	18	2	0	1	4	8	5	4	0
Kisian Junction	10	7	3	0	0	1	6	3	0	0
Kodoyo Junction	5	3	2	0	0	2	1	2	0	0
Kolweny	9	3	6	0	0	3	4	1	1	0
Ahero market	10	7	2	0	1	1	6	3	0	0
Kendu junction	11	8	2	1	0	6	4	1	0	0
Kombewa	20	18	2	0	0	8	7	2	2	1
Total	243	165	63	3	12	78	91	45	17	12
Percentage (%)	100%	67.9%	25.9%	1.2%	4.9%	32.1%	37.5%	18.5%	7.0%	4.9%

Table 2

Gender associated knowledge between lake flies and mosquitoes

Gender	Do you know the difference between lake flies and mosquitoes?		
	Yes (%)	No (%)	Total (%)
Male	90 (87.4)	13 (12.6)	103 (100)
Female	96 (70.6)	40 (29.4)	136 (100)
Total	186 (77.8)	53 (22.2)	239 (100)

Figure 1

Map of study area
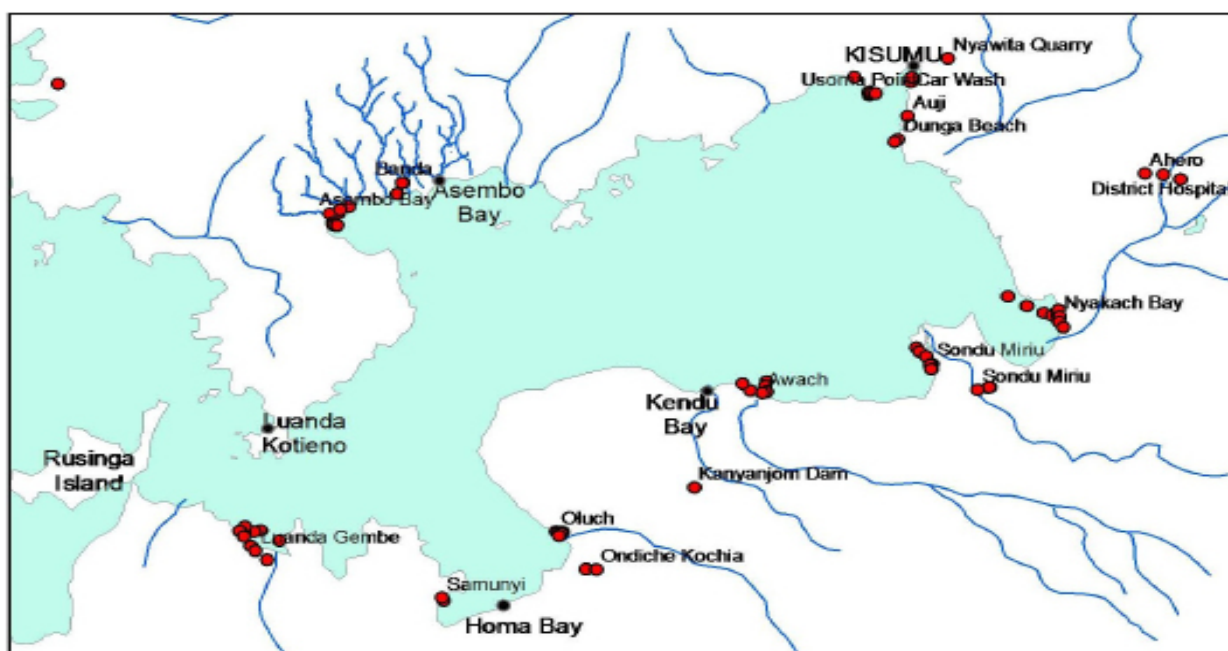
Figure 2
Symptoms of malaria

Symptoms of malaria

Figure 3
Mode of maralia transimission
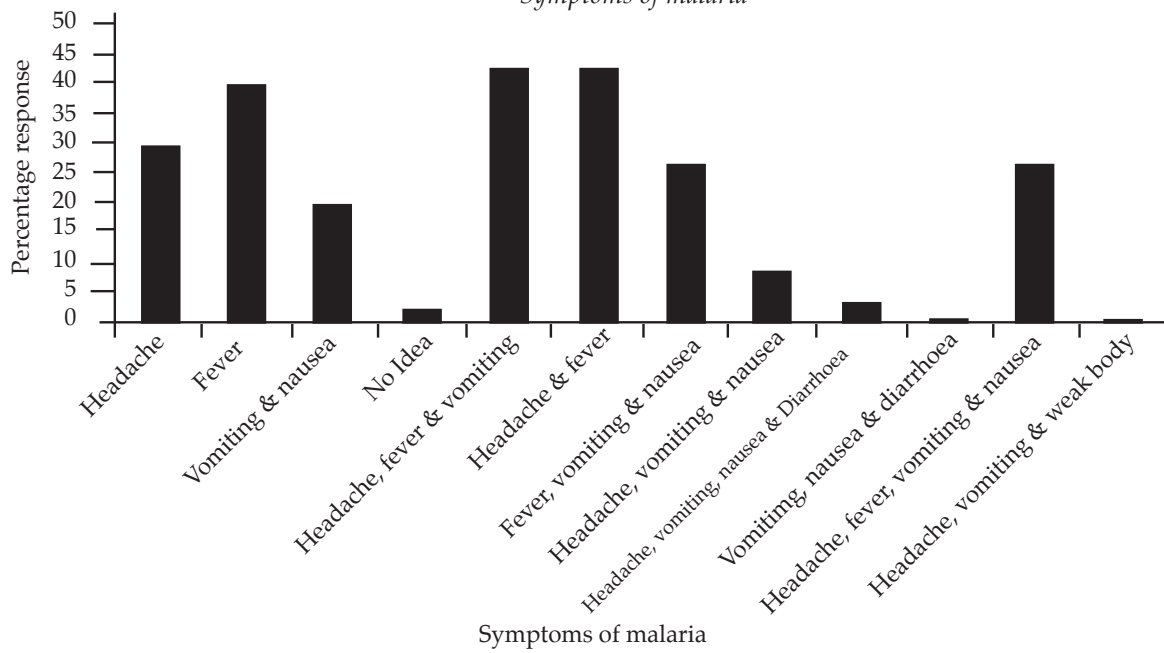
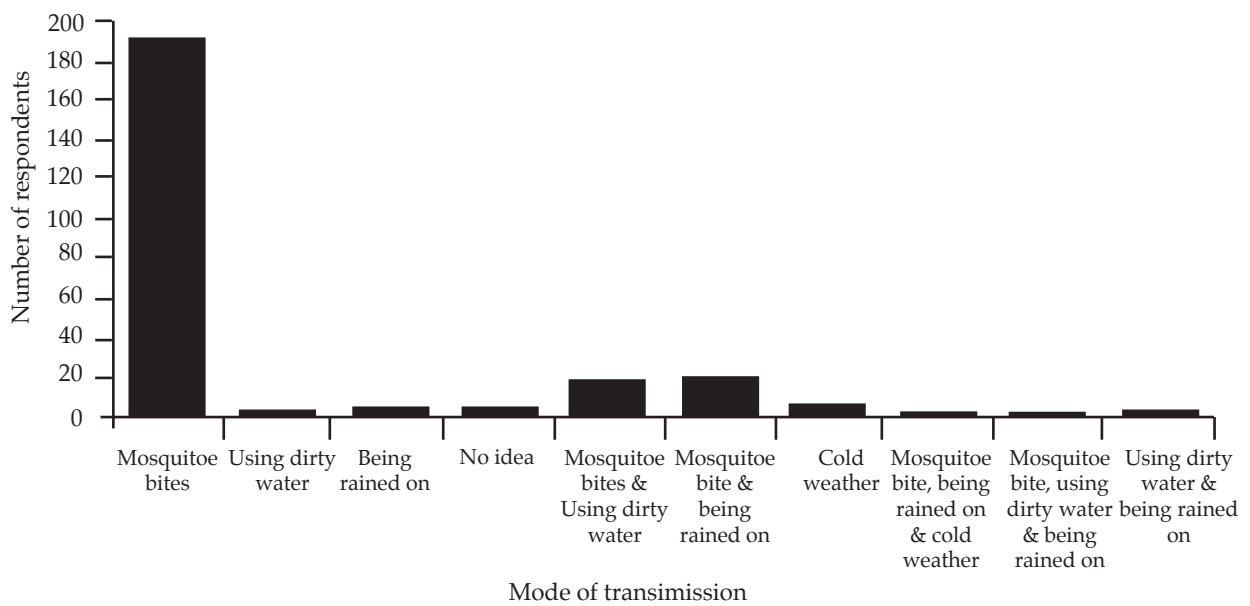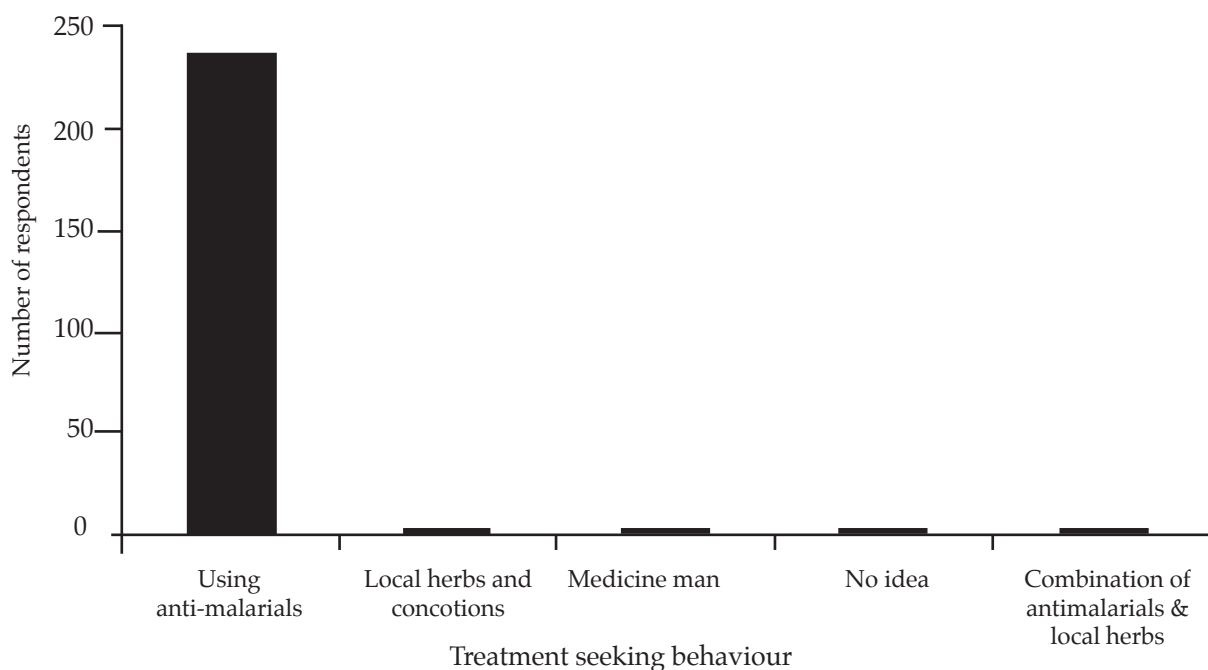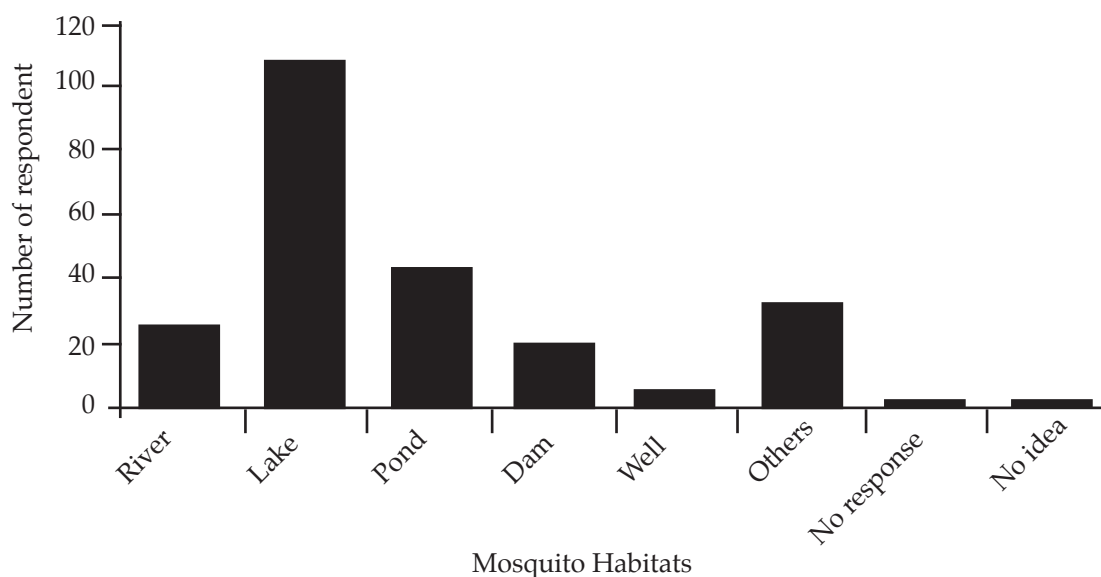
Mode of transimission

Figure 4

Treatment seeking behaviour for malaria

Figure 5
Mosquito habitats

DISCUSSION

Results from surveys on knowledge and perceptions are relevant to the design or improvement in malaria control programmes and to identify indicators for a programme's effectiveness and success. Data from this study shows that, along the Kenyan Lake Victoria basin, local community members have an understanding of malaria causes, symptoms and treatment. About 93.4% of the respondents attributed malaria transmission to mosquito bites. However, the findings also showed that 6% of the respondents linked the transmission of malaria to being rained on, using dirty water, and cold weather. This is consistent with Kenya malaria indicator survey of 2010, where 90 percent of mothers with babies under five years old, mentioned that they sought conventional malaria treatment whenever their children had fever (24).

Most respondents (over 70%) were able to state the most common symptoms of malaria accurately. However, some respondents only mentioned one or two symptoms, such as fever and vomiting, which could also be attributed to other water borne diseases such as typhoid fever. This has been identified as a

major problem since people are likely to take wrong prescriptions of drugs based on erroneous diagnosis. Some respondents were not aware of any malaria symptoms, a factor which could be attributed to the high illiteracy levels among communities living within the Lake Victoria basin. In the current study, we did not ask the respondents about the laboratory diagnosis of malaria. No respondent mentioned anaemia and convulsions which are life-threatening, particularly among the under five years old children. These findings were consistent with other studies from different parts of the world (25-27). Earlier studies reported that community members identified malaria mainly on the basis of the symptoms of high body temperature (fever), headache, and general body weakness (27, 28). A majority (97.5%) of respondents knew that treatment of malaria could be achieved by use of conventional anti-malarial drugs. This was consistent with findings from Tanzania, India and Bangladesh (26, 29, 30).

A considerable number of respondents 108 (45.8%) believed that mosquitoes were found mainly in the lake. This is a clear example of misperception among the locals, living within the Lake Victoria basin, which could be as a result of low level of education, since most respondents (67.9%) had primary level of education while 4.9% were uneducated (Table 1). There could also be confusion on differences between mosquitoes (some of which can transmit malaria) and Lake flies (which never transmit malaria), by most community members especially females, as significantly more female respondents did not know the difference between Lake flies and mosquitoes (p=0.002, X^2 = 9.574). Studies have previously shown low abundance of malaria mosquitoes associated with different aquatic weeds in the Lake and possible confusion between Lake flies and mosquitoes (14). It is, however, worth noting that a few of the respondents knew that mosquitoes were abundant in stagnant waters.

In conclusion, mosquitoes are perceived to be the main cause of malaria by the local community living along the Kenyan Lake Victoria basin. A significant proportion of the respondents were familiar with the main signs and symptoms of malaria and sought conventional medicine for treatment of the disease. Most of them, however, had poor knowledge on the breeding habitats of mosquitoes including the association of mosquitoes to aquatic vegetations. Concerted effort is needed to scale-up health education and improve the knowledge of the community about mosquitoes and their breeding habitats, particularly malaria vectors which do not breed in deep lake waters.

REFERENCES

1. O'Meara, W. P., Bejon, P., Mwangi, T. W., Okiro, E. A., Peshu, N., *et al*. Effect of a fall in malaria transmission on morbidity and mortality in Kilifi, Kenya. *Lancet*. 2008; **372**: 1555 - 1562.
2. Noor, A. M., Gething, P. W., Alegana, V. A., Patil, A. P., Hay. S. I., *et al*. The risks of malaria infection in Kenya in 2009. *BMC Infect Dis*. 2009; **9**: 180.
3. Division of Malaria Control, Kenya: *Malaria Operations Plan*. Kenya Ministry of Public Health and Sanitation. 2009.
4. Kenya National Bureau of Statistics (KNBS): Economic Survey. Government Printer, Nairobi. 2009.
5. Root, G. P. Disease environments and subnational patterns of under-five mortality in sub-Saharan Africa. *Int. J. Popul. Geogr.* 1999; **5**: 117–132.
6. Keiser, J., De Castro, M. C., Maltese, M. F., Bos, R., Tanner, M., *et al*. Effect of irrigation and large dams on the burden of malaria on a global and regional scale. *Am. J. Trop. Med. Hyg*. 2005; **72**: 392–406.
7. Lautze, J., McCartney, M., Kirshen, P., Olana, D., Jayasinghe, G., *et al*. Effect of a large dam on malaria risk: the Koka reservoir in Ethiopia. T*rop. Med. Int. Health*. 2007; **12**: 982–989.
8. Yewhalaw, D., Legesse, W., Van Bortel, W., Gebre-Selassie, S., Kloos, H., *et al*. Malaria and water resource development: the case of Gilgel-Gibe hydroelectric dam in Ethiopia. *Malar J*. 2009; **8**: 21.
9. Jobin, W. Dams and disease: Ecological design and health impacts of large dams, canals and irrigation systems. London: F & FN Spon. 1999.
10. Ministries of Public Health and Sanitation and Medical Services. National Guidelines for Diagnosis: Treatment and Prevention of malaria in Kenya. Published by the Division of Malaria Control (DOMC). 2010; www.kmis.org
11. Minakawa, N., Dida, G. O., Sonye, G. O., *et al*. Malaria vectors in Lake Victoria and adjacent habitats in Western Kenya. 2012, PLoS ONE 7 (3): e 32725.doic 10.1371/ journal pone. 0032725.
12. Gillies, M. T. and DeMeillon, B. The Anophelinae of Africa, South of the Sahara (Ethiopian Zoogeographical Region). Johannesburg: Publication of South African Institute of Medical Research no. 54. 1968; 343p.
13. Gimnig, J. E., Ombok, M., Kamau, L. and Hawley, W. A. Characteristics of larval anopheline (Diptera: Culicidae) habitats in Western Kenya. *J. Med. Entomol.*

2001; **38**: 282–288.

14. Ofulla, A. V. O., Karanja, D., Omondi, R., Okurut, T., Matano, A., *et al.* Relative abundance of mosquitoes and snails associated with water hyacinth and hipp grass in the Nyanza gulf of Lake Victoria. Lakes & Reservoirs: Research and Management. 2010; **15**: 255–271.

15. Vundule, C. and Mharakurwa, S. Knowledge, practices, and perceptions about malaria in rural communities of Zimbabwe: relevance to malaria control. *Bulletin of the World Health Organization*. 1996; **74**: 55-66.

16. Hla-Shein, T., Soe-Soe, T. and Ne-Win, K. The level of knowledge, attitude and practice in relation to malaria in Oo-do village, Myanmat. *South East Asian Journal of Tropical Medicine and Public Health.* 1998; **29**: 546-549.

17. Miguei, C. A., Tallo, V. L., Manderson, L. and Langsang, M. A. Local knowledge and treatment of malaria in Agusan deisun, the Philippines. *Social Science and Medicine*. 1999; **48**: 607-618.

18. Ruebush, T. K., Zeissig, R., Koplan, J. P., *et al.* Community participation in malaria surveillance and treatment. An evaluation of modifications in the volunteer collaborator network of Guatemala. *American Journal of Tropical Medicine and Hygiene.* 1994; **50**: 85-98.

19. Sharma, S. K., Jalees, S., Kumar, K. and Rahman, S. J. Knowledge, attitude and beliefs about malaria in a tribal area of Bastar district (Madhya Pradesh). *Indian J. Pub. Health.* 1993; **37**: 129-132.

20. Agyepong, I. A. Malaria: Ethnomedical Perceptions and Practice in an Adangbe Farming Community and Implications for Control. *Soc. Scie. and Med.* 1992**; 35**: 131 - 137.

21. Service, M. W. Community participation in vector-borne disease control. *Annals of Trop. Med. and Parasitol.* 1993; **87**: 223-234.

22. DHV. Water Resource Survey and Training Programmes Reports on Winam Division. Rural Domestic water Supply and Sanitation Programme, LBDA, Kisumu Kenya and Ministry of Foreign Affairs Kingdom of the Netherlands, Amersfoort, the Netherlands 1987.

23. Japan International Cooperation Agency: The study of Kisumu water supply and sewage systems in the Republic of Kenya. 1997; **1**: 2-11.

24. DOMC. Kenya Malaria Indicator Survey: Published by Division of Malaria Control (DOMC). 2010; Domckenya.or.ke

25. Mboera, L. E. G., Mlosi, M. R. S. and Senkoro, K. P. Malaria and Agriculture in Tanzania. Impact of land use and Agriculture practices on malaria in Mvomero District, National Institute of Medical Research, Dar es Salaam, Tz, 2007.

26. Ahmed, S. M., Haque, R., Haque, U. and Hassan, A. Knowledge on the transmission of malaria among two endemic populations of Bangladesh and their health-seeking behavior. *Malaria Journal*. 2009; **8**: 173.

27. Hlongwana, K. W., Mabaso, M. L. H., Kunene, S, Govender, D. and Maharaj, R. Community knowledge, attitudes and practices (KAP) on malaria in Swaziland: a country ear marked for malaria elimination. *Malaria Journal.* 2009; **8**: 29.

28. Dunyo, S. K., Afari, E. A., Koram, K. A. and Ahorlu, C. K. Health Centre versus home presumptive diagnosis of malaria in Southern Ghana: Implications for home-based care policy. *Trans. Royal Soc Trop. Med. Hyg.* 2000; **94**: 285-288.

29. De Savigny, D., Mayombana, C. and Mwageni, E. Care-seeing patterns for fatal malaria in Tanzania. *Malaria Journal.* 2004; **3**: 27.

30. Tuagi, P., Roy, A. and Malhotra, M. S. Knowledge, awareness and practices towards malaria in communities of rural, semi-rural and bordering areas of east Delhi, India. *Journal of Vector-Borne Diseases.* 2005; **42**: 30-35.