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Full Length Research Paper

Studying physical and sociological environment of malaria to implement an indoor insecticide spraying campaign in Oueme region, Benin

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Malaria is among the main problems of public health in Africa. In Benin, indoor residual spraying (IRS) of bendiocarb has been proposed by the National Malaria Control Programme in the districts of Adjohoun, Dangbo, Misserete and Seme to help eradicate the malaria-causing mosquito. Prior to implementing an IRS program, a study of the local physical and sociological environment was assessed to identify the existing limits of this strategy. Cross-sectional study was conducted in April 2008. A total of 3,228 persons (adult male and female heads of household) were included in the study through systematic random sampling procedure for household survey. Both qualitative and quantitative methods were applied for data collection. The findings showed that the mosquito bite was the most feared (54.4%) for all districts. The most popular practices used for malaria treatment were traditional (56.3%) and modern (43.7%) medicine. IRS was accepted by 98.7% of respondents. Most of the walls (71.5%) were smooth and lend themselves well to the insecticide treatment. Habitats made of bamboo and straw were not appropriate for IRS due to pollution and poisoning risks. Free distribution of insecticide treated nets was the strategy recommended for households of these types of habitat.

Key words: Malaria-causing mosquito, questionnaire-based interview, indoor residual spraying (IRS), insecticide-treated net, Benin.

INTRODUCTION

Malaria is an environmental problem inducing negative impacts on both the health and economy in tropical countries. Global resource requirements for malaria control were estimated to exceed US$ 5 billion a year between 2010 and 2015 (WHO, 2010). Despite considerable worldwide efforts made in recent years to control malaria (Feachem and Philipps, 2009), the disease is still a major public health problem with nearly 250 million cases and about one million deaths each year. In 2007, malaria was declared to be the most important disease in Benin, leading to 43% of all medical consultations and 29% of hospital admissions (MS, 2007b). Unfortunately, *Plasmodium falciparum* resistance to antimalarial drugs (Le Bras, 1999) and resistance of *Anopheles gambiae* to pyrethroids (Elissa et al., 1993; Chandre et al., 1999; Akogbeto and Yakoubou, 1999; Corbel et al., 2007; Yadouleton et al., 2010) used to treat mosquito nets, undermine efforts to cure the disease all over the world. In April 2000, because of this serious situation, the Heads of States and Governments of the African Union emphasized the need to increase efforts for controlling malaria. In April 2008, the United Nations put forward a vision of halting malaria deaths by ensuring universal coverage of malaria strategies by the end of 2010. The goal was for malaria vector control tools to be made available to all people at risk of malaria, especially women and children in Africa, and for all public health

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facilities to be able to provide effective malaria diagnosis and treatment (WHO, 2010). In such a context, the Ministry of Health of Benin and the National Malaria Control Program (NMCP) decided to establish a program to achieve this aim during the period 2011 to 2015 as part of its national malaria control strategic plan. The choice, by the related authorities in Benin, of indoor residual spraying (IRS) as a malaria control method, was based on the need to reinforce the action of the long-lasting insecticidal treated nets (LLITNs). Before extending the strategy to the national level, four districts in Oueme region namely Seme-Kpodji, Dangbo, Misserete and Adjohoun, were selected for a first trial. Malaria was stable in Oueme region. People were more vulnerable to malaria infection as compared to the people of other areas (MS, 2007b) due to fact that Oueme region was wet, covered with forests and crossed by perennial rivers and streams. In Africa, the major reasons for the persistence of malaria may be associated with the socio-economic situation (Farid, 1980). Social issues including people's perceptions and their coping strategies were not taken into account while planning and implementing the malaria eradication/control program. Previous studies (Ongore et al., 1989; Greenberg et al., 1989; Yeneneh et al., 1993; Aikins et al., 1994; Shey et al., 2011) show that the general public's knowledge on the cause of malaria and other determinants in Africa are poor. Analyses, using the outcomes from knowledge, attitudes and practices (KAP) studies of communities, have become important in malaria control interventions (Kyawt-Kyawt and Alan, 2004). Malaria vector control programs must be tailored to fit the local needs of the community, based on the information collected from such analyses (Ongore et al., 1989; Hla-Shein et al., 1998). The results of these types of studies could be incorporated into the decision making processes, the design of interventions with active community participation, and the implementation of vector control activities (Nieto et al., 1999). No knowledge and practices relating to malaria data from Oueme were available. Recent data are few and go back up to the year 1996 (Akogbeto and Feliho, 1996) and 2000 (Kiniffo et al., 2000). Thus, in order to collect baseline data related to the practices against mosquitoes, malaria knowledge of the people and types of human dwellings, surveys were performed during April 2008 in the study area before implementing indoor insecticide spraying. This paper reports these baseline data.

METHODS

Study areas

The study sites are located in Benin (West Africa) and include the four districts Adjohoun, Dangbo, Misserete and Seme- Kpodji, part of the Oueme region (Figure 1). The total population of those districts is 310,400 inhabitants (INSAE, 2004). All four districts cover an area of 977 km^2 and have 64,799 households with 62,890 children aged 0 to 5 years, spread in 174 villages (INSAE, 2004). The cumulative incidence of malaria (number of new cases of malaria in the year 2006 divided by the size of the population initially at risk) is 143.8 cases per 1,000 persons in Oueme region which ranks second in the country after Littoral region (146.6 cases per 1,000 persons) (MS, 2007b). The rate of use of health services in Adjohoun, Dangbo, Misserete and Seme was 32, 41, 20 and 40% respectively (MS, 2007a). The four districts are characterized by a sub-equatorial climate, with two dry seasons (August-September and December-March), and two rainy seasons (April-July and October-November). The monthly average temperatures extend from 26 to 31°C. Each district just like Oueme region, was characterized by two types of environments:

1. The first is a highland zone situated far from flooding areas. Mosquito breeding sites are created particularly during the rainy seasons.
2. The second environment is represented by a swampy zone named peripheral area and is made up of marshy land converted to vegetable gardens. Land management in this vegetable growing area creates perfect breeding site for *An, gambiae*.

Sampling

According to the characteristics ecological and sociological data relating to the prevention and management of malaria, ten representative villages were selected in each district. The sample size was determined using the formula proposed by Wayne (2005):

$$N = \frac{t^2 \times p(1-p)}{M}$$

N=required sample size; t=confidence level of 95% (typical value, 1.9); p=estimated prevalence of malaria in the area; M= error margin of 5% (typical value 0.05%).

Considering the absence of any reliable statistical data on the prevalence of malaria, this parameter was estimated at 50% (Wayne, 2005; Seck et al., 2008; Albouy-llaty, 2009) for each district. Hence, the sample size calculated was N = 384. Five percent were added to this value to reflect contingencies such as non-response or recording errors. This size was then multiplied by 2 to reduce the cluster effect (Seck et al., 2008) and the obtained value was 807 individuals per district.

Surveys

It is a cross-sectional study, descriptive and analytically based on cluster sampling, conducted in April 2008 during a period of three weeks. The survey consisted of 3,228 individuals including adult male and female heads of household (family unit). The respondents' consent was sought and gained by explaining the aims of the study. The questionnaire was administered to them by trained interviewers. The questionnaire contained items on educational level of the heads of household, their perceptions related to mosquito discomfort (bite, malaria) common practices used for malaria prevention (ITN, IRS) and treatment (traditional medicine and modern antimalarial drugs) and the type of habitat (roof, ceiling, wall nature, wall surface). Subjects who could not read or write or understand French language were communicated to in "Ouémè" – the local language of the Oueme region. The statistical unit was the head of household. During each interview of head household, observations were focused on both conditions and status of his habitat type: space between wall and roof, crack in wall, hole in ceiling, wall nature (cement, banco) as well as wall surface (smooth, rough). Only sleeping quarters were considered during the investigation. Apart from individual information collected through the questionnaire, a focus group (Krueger, 1994) involving

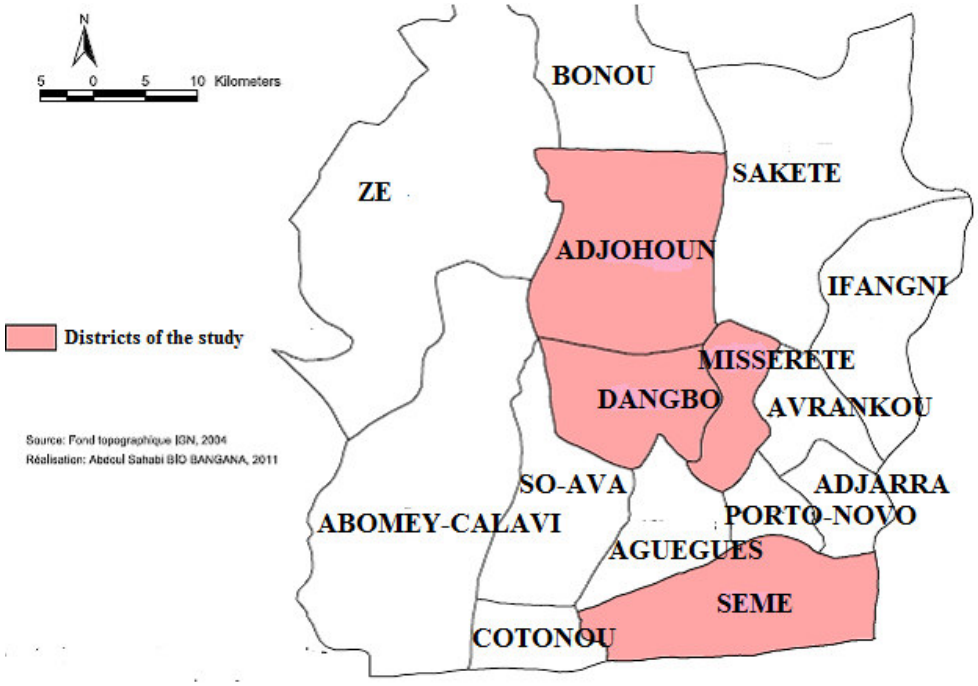

Figure 1. Map of study area.

opinion leader (size of 10) was conducted in each village to better understand the attitudes of the people, their comprehension and their perceptions of LLINs and the IRS.

Statistical analysis

Responses and information obtained from the survey were entered in computer using Microsoft Office Excel 2007 for windows. Then, simple descriptive statistics such as frequency and percentage of variables were computed and cross-tables were produced using SPSS (Version 16.0) software.

A chi-square test for the comparison of proportions was performed to compare the proportions of each variable related to each region. For binary outcome variables, a multivariate logistic regression mixed model was used to test association between knowledge of the IRS with the 3 covariates (sex, education level, and medical practices) on the one hand, and association between acceptances of IRS, with the previous 3 covariates on the other hand. The level of significance was 0.05.

RESULTS

Knowledge, attitudes and practices of the population related to malaria and its vector

Females constituted 75.9% (n=2450) of the 3,228 heads of households that were interviewed. 42.5% respondents were illiterate (Table 1). The highest illiteracy rate was observed among women and was 60.1 against 49.2% for men. The mosquito bite is the most feared (54.4%) for all districts. The knowledge on the cause of malaria was relatively poor in four districts and was 21.8, 34.2, 26.3, and 35.8% in Adjohoun, Dangbo, Misserete and Seme, respectively (Table 1). 953 (29.5%) participants in all districts stated that malaria is caused by a mosquito bite compared to 2275 (70.5%) who did not know the correct cause of malaria. However during group discussions, some people reported: "I suffer mosquito bites. When a mosquito bites me, I spend endless minutes scratching the part where I was bitten."

Like home remedy, practice of self-treatment for malaria was popular in south of Benin. In all the districts, the practice of traditional medicine (56.3%) for malaria cases was significantly higher than the practice of modern medicine (43.7%) (Table 1). During the focus group discussion, the participants argued that: "It was unwise to attempt self-medication by using traditional medicine or modern drugs in case of malaria fever. Because we are poor and have no means to visit the hospital for treatment appropriated. In addition, hospitals are rare and very far from us. But after several days of symptoms recognition when self-treatment failed to cure illness, we visit the hospital for treatment. "

Mosquito nets and others measures used by people to fight against mosquitoes

In the study area 1,042 persons (32.3%) slept under mosquito impregnated nets and 695 (21.5%) under ordinary nets (Table 2). Mosquito nets (53.8%) and spiral (27.6%) were the main means of prevention used against mosquito bites. Some people have a feeling of heat (12.3%) when sleeping under a mosquito net (Table 2); for others, it was the feeling of suffocation (0.7%). Some

Table 1. Rates (%) of education level, individuals perceptions and practices of the population related to malaria and its vector, according to localities.

Variable		Adjohoun		Dangbo		Misserete		Seme		Total	
		N	%	N	%	N	%	N	%	N	%
Educational level	Can read and write	381	**47.2**[a]	306	**37.9**[a]	344	**42.6**[a]	342	**42.3**[a]	1373	**42.5**[a]
	Cannot read and write	426	**52.7**[a]	501	**62**[b]	463	**57.3**[b]	465	**57.6**[b]	1855	**57.4**[b]
Perceptions about mosquito discomfort	Any	3	**0.4**[a]	0	**0.0**[a]	3	**0.4**[a]	9	**1.1**[a]	15	**0.5**[a]
	Bite	479	**59.4**[e]	415	**51.4**[e]	491	**60.8**[e]	372	**46.1**[e]	1757	**54.4**[e]
	Malaria	176	**21.8**[d]	276	**34.2**[d]	212	**26.3**[d]	289	**35.8**[d]	953	**29.5**[d]
	Insomnia	61	**7.6**[b]	26	**3.2**[b]	35	**4.3**[b]	54	**6.7**[b]	176	**5.5**[b]
	Noise	88	**10.9**[c]	90	**11.2**[c]	66	**8.2**[c]	83	**10.3**[c]	327	**10.1**[c]
Medicine used against malaria	Modern medicine	353	**43.7**[a]	355	**44**[a]	350	**43.40**[a]	353	**43.70**[a]	1411	**43.7**[a]
	Traditional medicine	454	**56.3**[b]	452	**56**[b]	457	**56.6**[b]	454	**56.3**[b]	1777	**6.3**[b]

Within rows, means followed by the same letter do not differ significantly ($p < 0.05$, chi-square test).

respondents used the spirals (27.6%) and aerosol sprays (10.7%) to replace the nets. Smoke (2.4%) and local plants (2.4%) were less used (Table 2). The practical use of window net, smoke, local plants, ointment and cover were in similar proportions (Table 2) and the practices have been uniform from one district to another.

The group discussions indicated that most of those treated bed nets came from the campaign conducted by the NMCP to distribute free long lasting insecticide treated nets (LLITN). During group discussions, some participant said: "Mosquito nets were recently distributed to us the poor, so that the whole family can have nets." Another one added: "The free distribution of mosquito nets initiated by the President of the Republic should continue so everyone can have nets." More than half of the population (61%) believed that nets reduced man-mosquito contact (Table 2). Furthermore, 23.7% of respondents made the connection between LLITN and malaria reduction while 11.1% associated LLITN with reduction of others disease (Table 2).

Perceptions and acceptability of populations for IRS

61.5% of total respondents knew IRS (Table 3), but the highest rate was observed in Seme (74%) and the lowest in Dangbo (54.9%). 43.4% of respondents believed that IRS contributed to reducing mosquitoes (Table 3). This was also revealed during the focus group discussion: "When the day of spraying approaches, we are warned and we put pets away. Mosquitoes and other insects such as cockroaches were killed by IRS in treated homes". A low proportion (9.7%) of respondents said that, IRS helped to lower malaria transmission but 66% mentioned no problem with IRS. Furthermore, some respondents attributed bad odors (8.8%) and toxicity (24.1%) to IRS (Table 3). Others responded: "Yes to insecticide spraying, to rid us of mosquitoes that disturb our peace. But the insecticide dose should be moderate and do not deceive us by using a dye instead of an insecticide. Tell us what product you want to use. No side effects of insecticide on humans and the environment". Moreover, the acceptability rate of IRS was very high (98.7%) in all districts.

Relationship between perception of IRS and sex, level of education and medical practices

The multivariate logistic regression performed to test associations between knowledge of IRS and the 3 covariates of sex, level of education and medical practice indicated that the odds ratio (OR) associated with the sex was 0.62 with 0.53 to 0.74 as interval confidence and p-value =0.0 (Table 4). This reflected a significant association between sex and knowledge of IRS and showed that women knew IRS better than men. There was also a significant association between educational level and knowledge of IRS (OR = 1.84 [1.58 to 2.15] p-value =0.0) (Table 4). Literate respondents were more familiar with the IRS than the illiterate. Knowledge of IRS was also significantly associated with the medicinal practice (OR = 0.75 [0.65 to 0.87] p-value =0.0) used after adjusting for sex and level of education. This association was consistent with a better understanding of IRS among practitioners of traditional medicine than modern medicine. But the association between acceptance of IRS and sex was not significant (OR = 1.18 [0.54 to 2.58]) (Table 5). The acceptance level of IRS in men did not differ significantly from that in women. There was also a non significant association between acceptance of IRS and medicinal practical used (OR = 0.85 [0.45 to 1.59]) (Table 5). However, there was a significant association between educational level and acceptance of IRS (OR = 2.70 [1.27 to 5.74]) (Table 5). The level of IRS acceptance among the literate was significantly higher than among illiterate.

Table 2. Measures used by people to fight against mosquitoes, benefits and disadvantages of ITN according to localities.

Variable		Adjohoun		Dangbo		Misserete		Seme		Total	
		N	%	N	%	N	N	%	N	%	N
Measures used by people to fight against mosquitoes	Cover	18	**2.2^{b}**	16	**2^{b}**	6	**0.7^{a}**	12	**1.5^{a}**	52	**1.6^{b}**
	Impregnated nets	257	**31.8^{e}**	279	**34.6^{f}**	241	**29.9^{c}**	265	**32.8^{d}**	1042	**32.3^{f}**
	Local plants	20	**2.5^{b}**	18	**2.2^{b}**	21	**2.6^{a}**	18	**2.2^{a}**	77	**2.4^{b}**
	Ointments	9	**1.1^{b}**	9	**1.1^{b}**	7	**0.9^{a}**	7	**0.9^{a}**	32	**1^{b}**
	Ordinary nets	168	**20.8^{d}**	157	**19.5^{d}**	190	**23.5^{c}**	180	**22.3^{c}**	695	**21.5^{d}**
	Smoke	24	**3^{b}**	22	**2.7^{b}**	15	**1.9^{a}**	17	**2.1^{a}**	78	**2.4^{b}**
	Spiral	224	**27.8^{e}**	225	**27.9^{e}**	227	**28.1^{c}**	215	**26.6^{cd}**	891	**27.6^{e}**
	Spray	84	**10.4^{c}**	78	**9.7^{c}**	95	**11.8^{b}**	88	**10.9^{b}**	345	**10.7^{c}**
	Window net	3	**0.4^{ab}**	3	**0.4^{ab}**	5	**0.6^{a}**	5	**0.6^{a}**	16	**0.5^{ab}**
Benefits of ITN	Reduction of diseases	94	**11.6^{c}**	93	**11.5^{c}**	75	**9.3^{c}**	95	**11.8^{c}**	357	**11.1^{c}**
	Reduction of mosquitoes	494	**61.2^{e}**	475	**58.9^{e}**	520	**64.4^{e}**	480	**59.5^{e}**	1969	**61^{e}**
	Reduction of insects	26	**3.2^{b}**	31	**3.8^{b}**	30	**3.7^{b}**	30	**3.7^{b}**	117	**3.6^{b}**
	Reduction of malaria	187	**23.2^{d}**	203	**25.2^{d}**	177	**21.9^{d}**	197	**24.4^{d}**	764	**23.7^{d}**
	Others	6	**0.7^{a}**	5	0.6^{a}	5	0.6^{a}	5	0.6^{a}	21	**0.7^{a}**
Disadvantage of ITN	Any	693	**85.9^{c}**	693	**85.9^{c}**	695	**86.1^{c}**	693	**85.9^{c}**	2774	**85.9^{c}**
	Heat	100	**12.4^{b}**	100	**12.4^{b}**	95	**11.8^{b}**	101	**12.5^{b}**	396	**12.3^{b}**
	Suffocation	6	**0.7^{a}**	6	**0.7^{a}**	6	**0.7^{a}**	5	**0.6^{a}**	23	**0.7^{a}**
	Others	8	**1^{a}**	8	**1^{a}**	11	**1.4^{a}**	8	**1^{a}**	35	**1.1^{a}**

Within rows, means followed by the same letter do not differ significantly ($p < 0.05$, chi-square test).

Table 3. Rate (%) of individuals perceptions and acceptability of populations for IRS.

Variable		Adjohoun		Dangbo		Misserete		Seme		Total	
		N	%	N	%	N	%	N	%	N	%
Knowledge of IRS	Know	459	**56.9^{b}**	443	**54.9^{b}**	486	**60.2^{b}**	597	**74^{b}**	1985	**61.5^{b}**
	Do not know	348	**43.1^{a}**	364	**45.1^{a}**	321	**39.8^{a}**	210	**26^{a}**	1243	**38.5^{a}**
IRS disadvantage	Any	540	**66.9^{d}**	534	**66.2^{d}**	531	**65.8^{d}**	525	**65.1^{d}**	2130	**66^{d}**
	Bad odor	68	**8.4^{b}**	70	**8.7^{b}**	73	**9^{b}**	73	**9^{b}**	284	**8.8^{b}**
	Do not know	9	**1.1^{a}**	8	**1^{a}**	10	**1.2^{a}**	10	**1.2^{a}**	37	**1.1^{a}**
	Toxic	190	**23.5^{c}**	195	**24.2^{c}**	193	**23.9^{c}**	199	**24.7^{c}**	777	**24.1^{c}**
IRS advantage	Do not know	31	**3.8^{b}**	25	**3.1^{a}**	19	**2.4^{a}**	29	**3.6^{b}**	104	**3.2^{b}**
	Reduction of disease	91	**11.3^{c}**	85	**10.5^{b}**	79	**9.8^{b}**	108	**13.4^{d}**	363	**11.2^{d}**
	Reduction of mosquitoes	335	**41.5^{e}**	392	**48.6^{d}**	331	**41^{d}**	342	**42.4^{f}**	1400	**43.4^{f}**
	Reduction of insects	260	**32.2^{d}**	226	**28^{c}**	277	**34.3^{c}**	242	**30^{e}**	1005	**31.1^{e}**
	Reduction of malaria	75	**9.3^{c}**	67	**8.3^{b}**	90	**11.2^{b}**	80	**9.9^{c}**	312	**9.7^{c}**
	Others	15	**1.9^{a}**	12	**1.5^{a}**	11	**1.4^{a}**	6	**0.7^{a}**	44	**1.4^{a}**
IRS acceptance	No	11	**1.4^{a}**	10	**1.2^{a}**	13	**1.6^{a}**	7	**0.9^{a}**	41	**1.3^{a}**
	Yes	796	**98.6^{b}**	797	**98.8^{b}**	794	**98.4^{b}**	800	**99.1^{b}**	3187	**98.7^{b}**

Within rows, means followed by the same letter do not differ significantly ($p < 0.05$, chi-square test).

Type of habitat seen and their state

Human dwellings were mostly built with concrete and mud supports in all four districts (Figures 2 and 3). Indeed, among a total of 5,164 houses surveyed, 54.3% (2,807/ 5,164) were made of cement and 30.5% of clay.

Table 4. Associations between knowledge of IRS and sex, level of study, practice of medicinal.

Covariates	Estimated coef.	p-value	OR and CI 95%
Intercept	0.47652	0.007	
Sex (male)	-0.47167	0.00	0.62 [0.53 - 0.74]
Level (>CM1)	0.61188	0.00	1.84 [1.58 - 2.15]
Medicine (modern)	-0.28839	0.0001	0.75 [0.65 - 0.87]

Level > CM1 (CM1=5th year of primary school): can read and write; OR: odds ratio; CI: confidence interval.

Table 5. Associations between acceptance of IRS and sex, level of study, practice of medicinal.

Covariates	Estimated coef.	p-value	OR and CI 95%
Intercept	4.0713	0.000	
Sex (male)	0.1682	0.673	1.18 [0.54 - 2.58]
Level (>CM1)	0.9940	0.009	2.70 [1.27 - 5.74]
Medicine (modern)	-0.1610	0.616	0.85 [0.45 - 1.59]

Level > CM1 (CM1=5th year of primary school): can read and write; OR: odds ratio; CI: confidence Interval.

Figure 2. A) Mud habitats at Dangbo; B).Habitats of bamboo and concrete built side by side in the Aholouyeme district of Seme.

Those that were built of bamboo and wood represented only 11.1 and 3.7% respectively. If Dangbo was characterized by the most modest of houses with the highest proportion of mud huts (40.7%), Seme however, was relatively more advanced with the highest proportion of concrete homes (73.4%) (1,125/ 1,531). While most of the concrete and mud walls (71.5%: 3,693/ 5,164) were smooth with surfaces that lent themselves well to insecticide treatment, 28.4% were rough surfaces. The rough walls were mainly those that were made of clay (30.5%). Only 10% of the houses that were visited had openings that facilitated the entry and exit of mosquitoes (Figures 4 and 5). These were spaces between the wall and roof, cracks through the walls and holes in ceilings.

DISCUSSION

It was observed that majority of respondents have misconceptions regarding the cause of malaria in all localities surveyed. Only 29.5% respondents associated malaria with mosquitoes. Similar to previous studies in Nigeria (Okeke and Okafor, 2008) and in Ndu community of Cameroon (Shey et al., 2011), it was perceived in the culture of southern Benin communities that the sun was one of the major causes of malaria. This has led to malaria being called "disease of the sun" translated in the local language: "Wéssivo zon". Most of the respondents have no idea how mosquitoes acquire parasites and transmit them from one person to the other. These findings

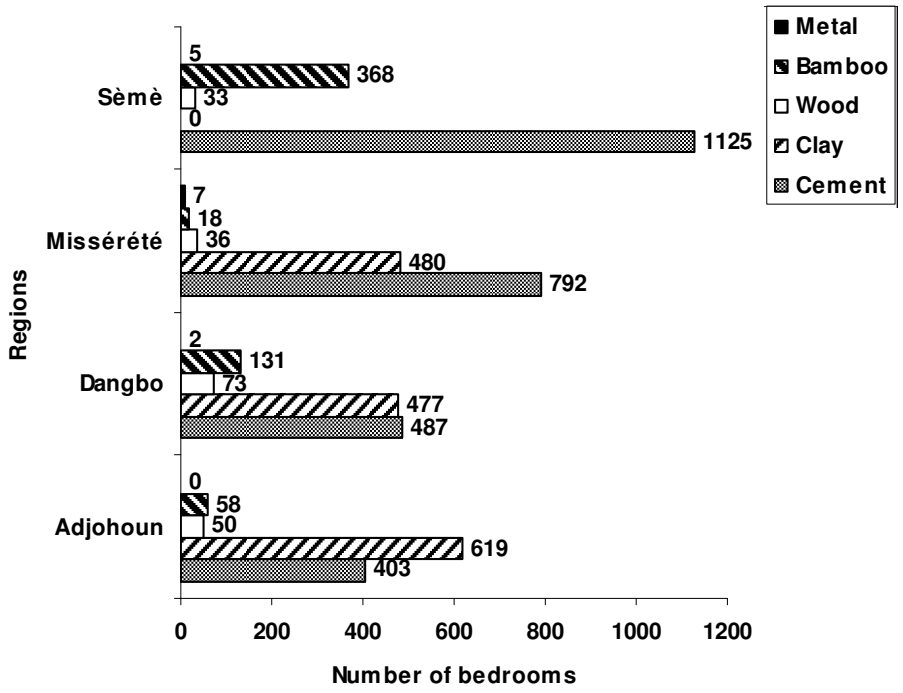

Figure 3. Numbers of habitat types (based on the nature of supports) met in each district (Adjohoun, Dangbo, Misserete and Seme).

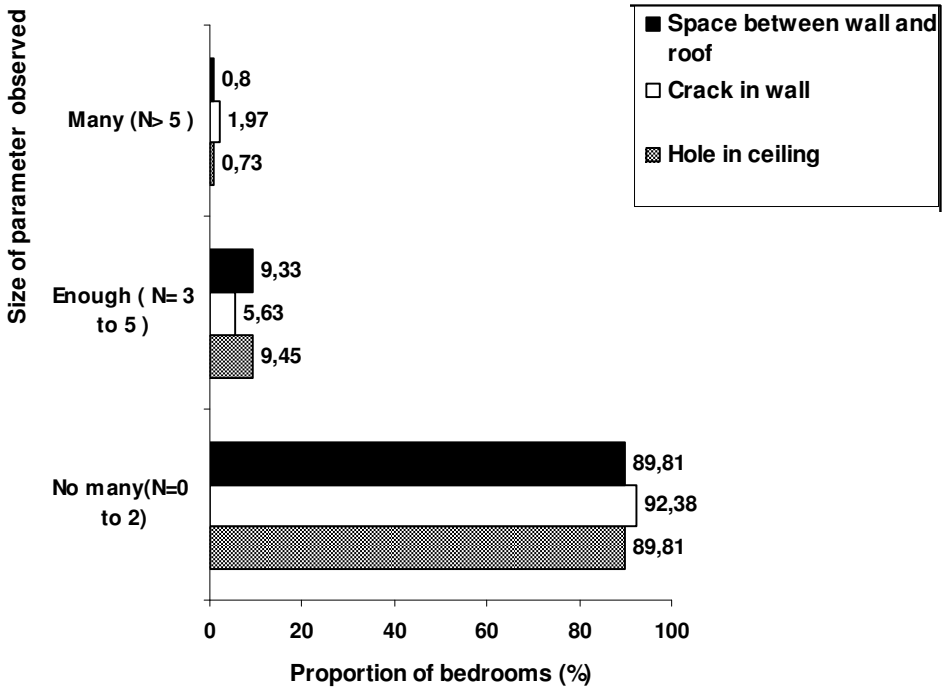

Figure 4. Proportions of sleeping rooms according to whether they are or not fitted with holes in the ceiling, crack in the wall and space between the wall and roof.

suggest a need for a health education program aimed at the local community to enhance the success of IRS. In the present study, 54.4% of those interviewed mentioned the bite as a main discomfort of mosquitoes. This is

Figure 5. A) Habitat showing a lot of space between the rough wall and the roof with several cracks in the wall (Dangbo); B) habitat with a ceiling and smooth wall without cracks or spaces (Dangbo).

similar to a previous study conducted in Bouake communities, where the major bother was the mosquito nuisance caused by their painful stings and the disturbances of sleep that result from their noise (Doannio et al., 2004).

Otherwise, self-medication was found to be a common practice in the four districts, with the use of traditional medicine or drugs purchased from drug sellers which were administered inappropriately. It is only when home treatment fails that the patient is taken to a health center. This situation confirmed the statistical data of Health Ministry about the use of health services (32, 41, 20 and 40% in Adjohoun, Dangbo, Misserete and Seme respectively). These results were similar to previous studies conducted in Togo (Derming et al., 1989) and Tanzania (Kinung'hi et al., 2010). The reasons for non-utilization of health facilities in this study could be explained by non-availability of a doctor, poor attitude of staff, lack of access because of cost, prolonged waiting time, unavailability of drugs and distance from home (Igun, 1987; Ruebush, 1995; Okeke et Okafor., 2008). The implementation of IRS is an opportunity to strengthen contacts between the staff of health services and rural communities.

The diversity of practices on vector control in all districts was similar to the findings of Doannio et al. (2004) in Kafine (Côte d'Ivoire). This diversity of practices in the four districts could be explained by the rich experience of the population in home treatment and the promotion of LLITNs justified by the relatively high rate of net use (53.8%) and other means of protection against mosquito bites (spirals and aerosols). These interventions to improve home management in our study community will be very beneficial for implementation of IRS. Nevertheless, it is very surprising that in this study, 23.7% of respondents associated nets and malaria reduction. This could be explained by misconceptions regarding the cause of malaria. However a study conducted in Ghana (Agyepong and Manderson 1999) showed that understanding of an association between mosquitoes and malaria did not predict bed net usage and that the primary reason for bed net usage pointed to avoidance of the nuisance of mosquito bites and not necessarily for prevention of malaria.

Moreover, the widespread use of spirals and aerosols in the districts surveyed could be justified by the availability on all markets of coils and aerosols, their relatively low cost and the fact that they could be bought on a retail basis. As for the repulsive gas plants, they were rarely used (2.4%) probably because of their short-term of effectiveness. Had it not been the relatively high cost of nets, the utilization rate indicated (53.8%) would have been higher. Furthermore, the heat, suffocation, beliefs and taboos seemed to also be barriers to the use of nets. Previous studies in northern Ghana reported that seasonal factors, patterns of use, and questions of cost were key factors likely to influence the dissemination and effectiveness of bednets (Binka and Adongo, 1997).

The high rate of acceptability of IRS could be explained by the rich experience of the population in home treatment and the promotion of preventive measures against malaria by the Ministry of Health. This acceptability could be also justified by the memory of the benefits of IRS operations, organized by the Ministry of Health between 1983 and 1989 in the south of Benin (Akogbeto, University of Abomey Calavi, Benin, personal communication). However, some had a bit of suspicion especially regarding the toxicity and odor of insecticides. Proper sensitization will reduce community reluctance and the success of indoor residual spraying will strengthen community practices in the fight against malaria.

There was a significant association between sex and knowledge of IRS and showed that women knew IRS better than men. This finding was similar to other studies (Raikes, 1989; Shey et al., 2011) and could be explained by the responsibility of women to provide nursing and health care for children. Men were not present due to farm work. Education level influenced the knowledge of the IRS. Educated respondents were more

knowledgeable than the illiterate (Sharma et al., 2003; Comoro et al., 2003). Moreover, the practitioners of traditional medicine understood IRS better than practitioners of modern medicine. Practitioners of traditional medicine generally live in rural areas where mosquitoes are many and malaria more endemic unlike the practitioners of modern medicine who live in urban environments that are less favorable to mosquitoes. This would justify the fact that they are less familiar protective measures in rural areas (Jones et al., 2007).

The large number of houses built with mud substrates in Dangbo, Misserete and Adjohoun, is due to the low standard of living. This type of mud walls could require the use of large quantities of insecticides during spraying, due to its high porosity. But 71.5% of these walls were plastered with a mixture of sand or cement, which could reduce the degree of porosity. However, at Seme, most of houses were built with cement. This kind of habitat was also found in small proportions in Dangbo, Misserete and Adjohoun, which was an advantage because smooth surfaces were more readily available (Najera and Zaim, 2004). In Seme, there was no lateritic red ground and the soil was mostly sand with vegetation dominated by palms and coconut trees that were used to build homes of bamboo and straw. This situation was similar in a few villages of Dangbo and Adjohoun. These houses made of bamboo and straw often had large openings that facilitated the pollution by insecticide during the spray. The desirable strategy for these types of houses was the use of nets. Another disadvantage encountered in certain households was the juxtaposition of houses of straw and lateritic red ground or cement. This probably means that two separate strategies (LLITN and IRS) will have to be used for the same household.

Conclusion

In conclusion, self-medication was found to be a common practice in Oueme region. The study has revealed reasonable knowledge of preventive measure against mosquitoes; however, there is a need for community intervention program directed towards correcting misconceptions about the cause of malaria. Despite the diversity of tools to prevent against mosquito bites, mosquito nets were used in most of the areas. Commitment to the implementation of a prevention strategy based on IRS is total; 98.7% of those surveyed agreed with the campaign and agreed to participate. A large segment of the houses were conducive to IRS. However, the distribution of LLITN to people was recommended to households that did not meet the conditions for IRS. It was suggested that an entomological and clinical investigation could be conducted as a prelude to the implementation of the IRS to complete the present study. This will help to know the endophilic character of the vector and to assess the effectiveness of the strategy, in order to share the benefits with the vector control programs.

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