Surveys on familial and individual knowledge and practices (KAP) on mosquitoes and malaria vector control in Lobito (Angola).

Abstract
A cluster sampling survey was implemented in Lobito town (Angola) before the scheduled large distribution of long lasting insecticide treated nets in the framework of the National Malaria Control Program to get base line data on the knowledge, attitude and practice (KAP) of population against mosquitoes and vector borne diseases. A total sample of 420 households (representing 2384 inhabitants) was involved and interviewed and it appeared that 94% of them complained against mosquitoes as biting and boring nuisance while 22% reported their fear about vector borne diseases. 94% are developing some method against mosquitoes at household level, mainly commercial insecticide spray cans (57%) bednets (53%), mosquito coils (38%) and often several methods are used (such as spray before sleeping then bed net or coils during the night). It was reported an average of 2.4 bed/house but only 1 bednet/house showing the need for procuring nets for everyone.
The main reasons for non-using nets are "uncomfortable" (reported by 30% while it was only 10% by people actually using the net!), hot, not easy to use while the costs did not appear as the main problem.
The estimated cost of mosquito control at household level was estimated at around 2 to 4 $/month
25% of households declared having had a child sick during the last 15 days with a cost around 5 to 10 $ US; cost which was similar for treatment of child or adults.
It would be interesting to implement such KAP surveys after the distribution of LLIN in the framework of the National Malaria Control and underline changes in perception and use of mosquito/malaria vector control at household level.

I.INTRODUCTION

Angolan population (# 30 million) is at risk for malaria all over the country, but transmission patterns vary by geographic location. Malaria is considered as the fourth causes of death (after diarrheal diseases, neonatal disorders, and HIV. It was officially reported that more than 2 million malaria cases occurred in 2020 with more than 2500 deaths and malaria could still considered as a main cause of morbidity and child mortality in Angola [1, 2]. A comprehensive Malaria Control Program was launched including vector control, case management with Rapid Diagnostic Test (RDT), improvement of diagnostic [3] and Artemisin Combined Therapy (ACT) [4], Intermittent Presumptive Treatment (IPT) for pregnant women etc.
Vector control is based upon nationwide free distribution of Long Lasting Insecticide Treated Nets (LLIN), focal Inside Residual Spraying, but several issues were already encountered [5] and larviciding with *Bacillus thuringiensis* mainly in town, while waiting for an operational vaccine.
The efficiency of LLIN is linked to the insecticide susceptibility of targeted vectors and current spreading of resistance to pyrethroid is a matter of concern [6-8], actual community participation [9], one of the main issues is to get, and maintain, an universal coverage and use [10]. This point requires a sound knowledge of usual perceptions and practices of targeted populations in term of malaria and mosquito control at family and individual level.
A great lot of KAP surveys were implemented in Ethiopia [11-16], Tanzania ([17-20], Sudan [21], Swaziland [22, 23], Nigeria [24-26], Burkina Faso [27], Cameroon [28-30], Uganda [31-33] among several other.

Long lasting insecticide treated nets were successfully tested in Angola, in Lobito at family level [34, 35] and at village scale around Balombo [36, 37].
Entomological surveys showed that in Lobito the main vector are *Anopheles coluzzii* and *An. gambiae* according to the part of the town and the season while abundant *An. listeri* are present in the lower part of the town ([38]. Huge population of *Culex quinquefasciatus* is observed due to stagnant polluted water induced by inadequate drainage and sanitation, and *Aedes aegypti* was caught with ovitraps and in anthropic containers in different part of the town [39].
It was reported that *Anopheles gambiae* are still susceptible to pyrethroid insecticide while *Culex quinquefasciatus* are already strongly resistant [40].

Parasitological and clinical surveys showed that “Malaria” constitutes a great part of medical consultation but an important overdiagnosis was observed [41, 42] and the reliability of data from Peripheral Health Centre could be questioned [43]. As recently reported a majority of true malaria cases seeking care in health facilities in Huambo [town close to Lobito] were not appropriately treated with anti-malarials, highlighting the importance of continued training and supervision of healthcare workers in malaria case management, particularly in areas with decreased malaria transmission [4] such as the situation could became with vector operations scheduled and implemented.
Recent official presentation reported a critical situation in the main hospital of Benguela, mainly in the pediatric department which reported 150 deaths of malaria and malnutrition in April 2021

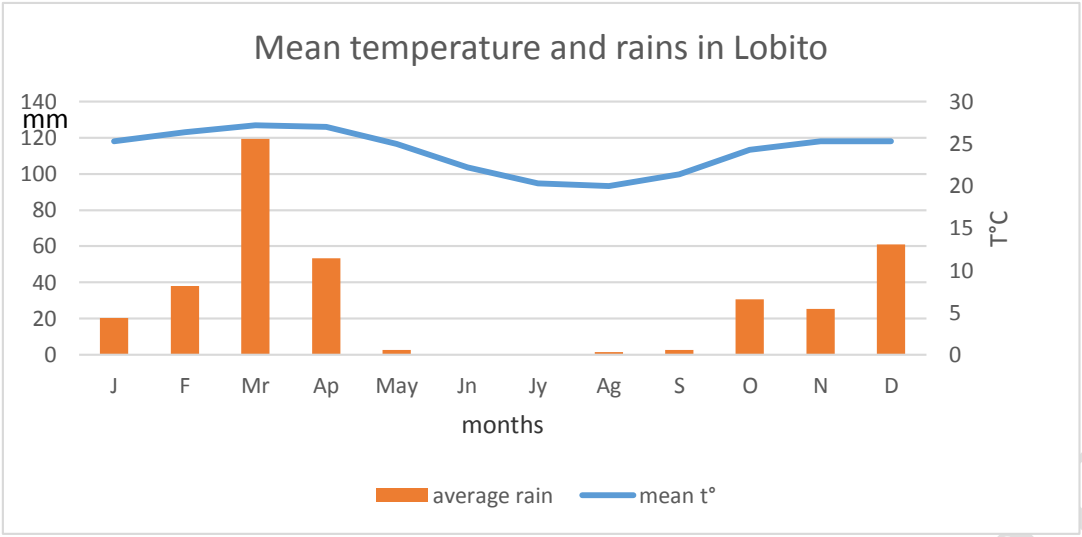
Fig 1 : In April alone, 150 children died of malaria and malnutrition in Benguela

The National Malaria Control Program (NMCP) provide long-lasting insecticide treated mosquito nets and perform mosquito surveillance but it appeared worth implementing also human behaviour studies to adapt Information, Education, Communication (IEC) campaign and increase the use and maintenance of LLIN, some surveys in Balombo area have showed that 50% of population could have removed their nets from the bed in 3 years [44] while sometimes keeping the nets inside the house, this confirming the well-known point that to have doesn’t mean to use.

II.MATERIALS AND METHODS

II-1 Lobito (Benguela Province) [12°22’S; 13°32’E].

Surveys were carried out in Lobito town (# 400,000 inhabitants) built on a sandspit and reclaimed land, where was developped the Angolese private company Sonamet© which supported these studies through its Malaria Control Program (MCP). Lobito was already described during the former entomological studies [34, 38] and clinical observations [43]. It is characterized by a lower part, at sea level, and thus with important pools of stagnant more or less polluted water suitable for mosquitoes (pictures) and an upper part (Bella Vista) where settlement are greatly increased but lack of running water was an important issues (pictures); therefore people built some tanks near their house to keep water for domestic usage but which are suitable breeding sites for *An. gambiae* (pictures).
Meteorological conditions are characterized by relatively constant temperature (average 24.1°C) (with a cold season in July and August) but well-marked rains, from October to April and an average of 354 mm/year (graph.1).



Graph. 1. Mean temperatures and rains in Lobito

II- 2. Sampling

Study was done following the classical cluster sampling method already implemented for KAP surveys in Cameroon [28, 29] and involving the different parts of the city according to their size. Two surveys were done: one month, from 24 May to 28 June 2011 (23 clusters studied) then one week 26 to 30 August 2011 (7 clusters) to get the sample size of 30 clusters of 14 households each and the 420 households needed.
Questionnaires were also developped from the Cameroon model, with open and closed questions, translated in Portuguese and tested to avoid any misinterpretation then finalized according information gained by the first interviews.
The field work was conducted with agents of the Malaria Control Program of Sonamet after prior training in the use of the questionnaire.

II-3 Information

The questionnaire was composed of 3 parts:

- description of the close environment of the house (stagnant water, grasses, etc.), obvious breeding place with/without mosquitoes etc., observation done by the questioner before entering the house;
- interview with the head of the family (and noting the composition of the family) at 2 levels:
    - mosquitoes issues: protection against mosquitoes? why? why not? How? when? Use of nets? Yes/not, why/why not; which one? Received or bought? And where? When? knowledge of ITN/LLIN ? etc and
    - diseases issues: recent cases of fever, behaviour in case of fever, etc. Open question to get as much as possible the feeling of the inhabitants;
- the third part dealt with the costs, as estimated by the head of the household, costs of mosquitoes control, costs of disease management at house or Health Center level.

II-4. Data processing and statistical analysis

Data were processed with Epi Info Version 6.04c. Confidence intervals were calculated with the exact binomial method, and a risk of error of 5%. The statistical tests used were the classical Chi ² test or Fisher for proportions, analysis of variance or test Kruskaul-Wallis for the mean or median, depending on the requirement for statistical validity of comparisons. The level of significance was set at P value ≤ 0.05.

II.RESULTS

III-1 Status of the respondent and household composition

Among the 420 households surveyed, interviewees were mainly parents 68.9% (51.8% mothers and 17.1% fathers), older children (27.8%) and other members of the family (3.3%).
The whole population of houses surveyed was 2,384 people which gave an average of 5.7 inhabitants/house; and the average composition of families was: 0.4 children less than 1 year; 2, 1 children 1-15 years and 3.1 adults over 15 years. 36.1% of families surveyed had no children under 1 year.

III- 2 Main characteristics of the habitat and its environment

Houses surveyed were mainly detached houses (53.7 %), terraced houses (26.8%), modern villa (12.6%) and 6.9% a single room.
Walls were mainly made of cement (77.1 %), mud (22.6%) and small different kind of material (0.2%).
Water collections were present around houses in 48.2 % of them (203/420); vegetation within 20m was noticed for 342 houses (i.e. 81.4%), it was sparse for 255 houses (i.e. 74.6 %), and abundant for 5%.
Potential water tanks (old boxes, tires, etc.) were observed around 334 houses (79.5%); they were considered as not abundant in 244 houses (73.1 %) and abundant in 6.9%. Old discarded tires were often observed and are potential and actual breeding sites for *Aedes aegypti* inducing high risks of yellow fever or other arbovirus outbreaks.
The average number of beds per house was 2.4 (± 0.9), minimum1; maximum 6; median 2.

III-3 Perception of mosquitoes issues

94.3% of interviewees said mosquitoes are annoying; biting (83.3%) and noisy (62.8%) being the main causes of complains; it is worth underlining that disease transmission was reported in 22.1% of answer.

III-4. Protecting behaviour against biting-boring mosquitoes at family level

Interviewees were asked about their behaviour against mosquitoes; 93.6% (393/420) reported implementing regularly some protection against bites (table I), 57% used classical commercial spray cans and 53 % have bednets; 213/420 (50.7%) used more than one method protection while 6.4% were doing nothing.
The large use of coils, and their efficacy in Cameroon, was already reported [45].

Methods	number (n=420)	%	SD 95%*
Insecticide spray cans	239	56,9%	49,9 - 63,6
bednet	222	52,8%	45,9 – 59,7
Mosquito coils	150	35,7%	29,3 -42,6
Window nets	28	6,7%	3,8 – 11,2
Repellents	3	0,7%	0,08 -3,4
Pacote	1	0,2%	0 – 2,6
nothing	27	6,4%	3,6 -10,9

Table I. Main methods implemented in Lobito against mosquitoes at family level.

III-5. Availability and use of mosquito nets

Two hundred and twenty-two of the 420 households surveyed had at least one bed net (#53%) with a total

number of 438 nets (i.e. 1.04 net ±1.03 net per household) protecting 795 inhabitants, (= 33.3% of the whole population of the surveys) (table II).
53% of babies of the sample slept under mosquito nets, 35% of kids (1-15 years old) and 30% of adults (table II)

Age group	Number sleeping under net	%	SD 95%
Babies <1 year (n=167)	89	53,3%	42,1 - 64,2
Kids 1-15 years (n=898)	318	35,4%	31,0 - 40,1
Adults >16 years (n=1319)	388	29,4%	25,9 - 33,1
Total (n=2384)	795	33,3%	30,7 - 36,1

Table II: Percentage, by age group, of inhabitants sleeping under mosquito net in Lobito.

Issues of nets.

35% of households without nets reported their "uncomfortable usage", 31% too hot; 12% not easy to use and costs is reported only by 2% as a reason for not using nets (table III).
These percentages were respectively 10%; 13%; 3% and 0.4% in households with nets.
It thus clearly appeared that non-users maximized the issues of nets and this justify the development of Information campaigns.
The estimated costs of nets (from 169 answers) was 0.57 $ (±0.43 $) i.e. around 1 $ US which explains that their costs was not considered as their main issue.

Issues	Households without nets n=192	Households with nets n=228	P
Uncomfortable use	67 (34,9%)	23 (10,1%)	<0,005
Warmth	59 (30,7%)	29 (12,7%)	<0,005
Not easy to use	23 (12,0%)	8 (3,5%)	<0,005
Cost	4 (2,1%)	1 (0,4%)	
Ineffective	0 (0%)	1 (0,4%)	

Table III: Issues mentioned for the non-use of nets.

III-6 Knowledge on Insecticide Treated Nets (ITN).

Three hundred fifty-seven households (85%) are aware of ITNs, 281 of them (66.9%) declared being ready to use. After providing families with information on the existence of ITNs which can kill mosquitoes and avoid diseases, 354 households (84.3%) would be willing to get, at an average price of 0.26 $ (+- 0.27 $) i.e. two times less than the estimated cost of a net at the market level.

III-7. Monthly reported costs of protection against mosquitoes at family level

306 interviewees gave an estimate of the cost of their current behaviour against mosquitoes at family level, the monthly average reported was 2.25 $ US (± 1.53 $) with a median of 1.77 $ and a maximum of 7.08 $.

III-8. Morbid episodes associated with mosquitoes and cost within 15 days prior the surveys

During the 15 days preceding the interview, illness (whatever it was) episodes, associated by people to mosquito bites, and their estimated costs, are gathered in Table IV.

Indicators	Children (≤15 years)	Adults > 16 years	Statistical analysis
sick	120/1065 (11.3%)	86/1319 (6.5%)	X^2= 16.82; P < 0.005 OR= 1.82 [1.36-2.43]
Households having had at least 1 patient	104/420 (24.8%)	75/420 (17.9%)	X^2=5.97; P=0.0145 0R=1.51 [1.08-2.11]
Households which gave the estimated cost of the disease	44/104 (42.3%)	20/75 (26.7%)	X^2=4.64; P=0.031 OR= 2.02 [1.06-3.83]
Patients with the estimated cost of the disease reported	52/120 (43.3%)	24/86 (27.9%)	X^2= 5.12; P=0.023 OR= 1.97 [1.09-3.58]
Estimated cost of the disease (US$)	4.73 (±5.37)	4.70 (±5.80)	

Table IV: Episodes morbid and cost within 15 days preceding the interview

Children were significantly sicker of mosquitoes borne diseases than adults (respectively 11.3% and 6.5%).The same significate trends was reported from the 420 households surveyed: #25% having had one child sick and # 18% with one adult sick during the last couple of weeks.
It is interesting to notice that the estimated costs of the treatment was similarly reported at household or patients level and the estimated cost for treatment was similar for child and adult (# 5 US $).
We unregistered the reported costs without any check to be always completely neutral.

IV – DISCUSSION

One of the most important ways for improving malaria vector control is to understand factors affecting the adherence of communities to vector control interventions [46]
Several studies on the behaviour of population against mosquitoes were done before the availability of long lasting insecticide treated nets ("LLIN") [28, 29, 47-49] and after [50, 51].
The KAP survey done in Lobito (Angola) before the scheduled large scale distribution of insecticide treated nets by the National Malaria Control Program showed that, as noticed elsewhere, the nuisance (biting, noisy) is the main cause of mosquito control at household level. People use mainly commercial insecticide spray cans, and mosquito coils, but some 50% used bednets mainly to protect babies. It was reported an average of 2 beds by house but only 1 bednet, which underlined the clear need of scaling-up long lasting insecticide treated mosquito net distribution. But the pyrethroid resistance of *Culex quinquefasciatus* is a matter of concern [40], if mosquitoes are still present in spite of treated nets people could consider them as useless and do not use as expected even if they maintain some efficacy against *Anopheles* malaria vectors. A point which has to be seriously taken into consideration for the choice of LLIN [52, 53] [54, 55] or combination of malaria vector control interventions in pyrethroid resistance areas [56, 57] and the sensitization messages.
The population awareness about the bed nets and their willingness to use them if easily available will facilitate their diffusion in the country. A cross-sectional malaria KAP Survey performed at the household level in Cape Verde a country in the pre-elimination context [58] reported that more than 97% have heard about mosquito nets but only 19% used them. In practice, 53% use coils, 45% rely on household sprays and 43% have benefited

from IRS while some gaps and misunderstandings have been noticed and contribute to the insufficient community involvement in actions against malaria. Therefore, it is crucial to increase the knowledge of the population, leading to their full ownership and participation in community actions to contribute to the malaria elimination in the country.

Tomass et al did KAP studies in Southern Ethiopia [50] showed that optimal use of long-lasting insecticidal (LLINs) for malaria prevention depends on mass distribution, the users' perception and behaviour of local malaria vectors. The average family size in the surveyed households was 5.25 (±0.70 SE, range 1-12). The majority (81.1%) of the households owned at least one LLIN. The average numbers of LLINs being used and sleeping places in the households were 1.61 (0.04 SE, range 0-4) and 2.27(0.03 SE, range 1-6), respectively While the majority of households owned at least one LLIN at the time of interview about only 53 % of them hang LLINs above their sleeping location every night. These data, in term of family size and around one LLIN /household are well in line with the observations done in Lobito.

For Tomass et al (loc.cit.) there was discrepancy between the average family size and the average number of functional LLINs owned by the households at the time of the survey. This raised the issues of the WHO target of allocating one LLIN for every two people in the household [59]. The disproportion also existed between the average numbers of nets, and average number of sleeping places (including temporary places outdoor), which was 2.27 (0.03 SE, range 1–6).

A study was recently done to assess the knowledge and practices of communities living in four eco epidemiological settings in Cameroon with different cultural backgrounds [46]. The proportion of households possessing at least a net was high in the four study sites, this might be linked to the free distribution campaigns of LLINs to the population carried out by the NMCP. But the proportion of households possessing one bed net for two people was, however, significantly low and was consistent with previous findings in the city of Yaoundé [60]. It was also noted that some people used treated nets in agriculture for the protection of young plants and for fishing and farming; these poor practices have been highlighted in previous studies [61, 62] and request further attention.

This was also noticed in villages around Balombo where the project gave, free of charges, enough LLIN to protect every sleeping units [36].

This survey was done before the scheduled large scale free of charge distribution of LLIN by the National Malaria Control program and it will be worth doing the same after this vector control operation to precise to eventual changes (or not) of behaviour and attitude towards mosquitoes and malaria vectors for further IEC and LLIN distribution.

ETHICAL APPROVAL

This analysis is a part of the comprehensive evaluation of a vector control program done with the Angola National Malaria Control Programme and Provincial Public Health Authorities.

Lobito lower part

Fig 2: Stagnant water, with larvae of *An.gambiae*

Fig 3: Stagnant water and gutter with polluted water= breeding site for *Culex quinquefasciatus*

Fig 4: Bela Vista upper part seen from lower part

Fig 5: Lower part seen from Bela Vista

Fig 6: Bela Vista part

Fig 7: Collecting *Anopheles* larvae in a tank with domestic water near a house in Bela Vista

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