Knowledge, Attitude and Practice in the Use of Insecticide-Treated Mosquito Nets Distributed through Antenatal and Vaccination Consultations in the "Cercle de Kangaba" Region of Koulikoro, Mali

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SURVEY REPORT

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Executive summary

Background

Long-lasting insecticidal nets (LNs) are an established prevention measure against malaria. Their distribution has been included as part of comprehensive malaria control in endemic countries across Africa, organized by the Malaria Consortium in collaboration with governments and different NGOs.

Here, a survey was held near to the end of a malaria program that was conducted by Médecins Sans Frontières Operational Centre Brussels (MSF-OCB) in collaboration with the Malian *Direction Nationale de la Santé* (MoH) over a period of five years. The free distribution of insecticide-treated mosquito nets to pregnant women at antenatal consultations and again after completing the baby's first-year vaccinations was part of this program. The work described here entails an appraisal of this approach.

Objectives

The key objective of this Knowledge, Attitude and Practice (KAP) survey was to determine the rate of possession of one or more WHO Pesticide Evaluation Scheme (WHOPES)-approved LN, the knowledge and attitudes about the use of the nets, and the practice of sleeping under the nets, in particular for children under five years old.

At a more general level, the execution and ensuing documentation of this study were aimed at the development of a standard survey tool that can be used in other malaria-control programs in the future.

Requirements

A total of 2.5 months was required for the execution of this survey. A full-time expat was required for this entire period, and nine national staff members were recruited for four weeks.

Survey methodology

The KAP survey used a sample size of 450 households in 30 clusters in the 11 health zones of the Cercle de Kangaba region of Koulikoro, in the South-West of Mali. A questionnaire was developed by adapting similar internationally-used examples to the local context. The survey was conducted, with appropriate publicity in the villages, by four internally trained, multi-gender teams during the period November 22nd to December 10th 2010.

Survey results & discussion

Net ownership (one net or more per household) had reached an impressive level of 98%, with the average household possessing 2.96 nets. The current system of targeted distribution of LNs at antenatal and vaccination consultations complemented with mass distribution campaigns seemed to have established a sufficient level of net ownership in the area. Comparison of the dynamics of net possession between 2008 and 2010 in two different zones of the district and a rudimentary modeling approach of the targeted distributions based on MSF-OCB supply data suggest that this approach should indeed be capable of establishing a steady-state of net ownership. However, many potentially

confounding factors exist, and more refined modeling of the different net distribution is warranted.

At least 71% of the members of the surveyed households had slept under a net the night previous to the interview, and for the vulnerable under five age group the rate reached 92%. Approximately one third of the nets observed in the survey were not being used, but one third of those were still new and kept as spares (10%) for future use. This was surprising and may be an indication that the nets were considered of value and were not sold or given away. On the other hand, it shows that many households owned more nets than they strictly needed and the excess could be considered as a partial loss of nets, as the insecticide will degrade during the storage period.

The mosquito nets were appreciated as a protection against malaria by 97% of all households. However, net practices and general net knowledge were poor. Some (male) adults did not regularly sleep under a net during the dry season when there are fewer mosquitoes. The concept that an LN did not need reimpregnation was not generally known. The nets were frequently damaged (32% of all nets in use), were washed too frequently (once a month in 76% of the households) and hanging them out in the sun to dry was common practice (not considered problematic in 78% of the households). This practice shortens the lifespan of the nets, not only because of the possibility of damage to the net, but also because the insecticide incorporated into the netting fibers diminishes every time the net is washed and it is degraded by exposure to sunlight ultraviolet light. In general, the *relais communautaire* were not up to date on the correct maintenance of LN, and the *agents palu* employed by MSF did not seem to be involved at all in vector control measures.

Conclusions

The distribution strategy of net donation to pregnant women at antenatal consultations and after the first round of vaccinations of their baby, combined with donations during distribution campaigns, can be considered to have achieved a high and seemingly stable level of net coverage. The average rate of net possession of 2.96 for an average household of 5.49 persons was sufficient, and 10% of the nets in the households were kept as spares. Mathematical modeling of this system of distribution could shed more light on the possibility of achieving a steady-state of net coverage.

In contrast to the high rates of coverage and net possession, knowledge and practice concerning net maintenance was poor. Net damage was frequent and several practices which lead to damage or degradation of the insecticide were common. Training for the staff providing the information is needed so that the concept of an LN can be better explained: people need to be correctly informed that re-impregnation/redipping should not be done, washing should be minimized and hanging LNs out in the sun avoided altogether. This should extend the lifespan of the nets and make them more effective.

1 Introduction

1.1 Rationale

Since 2005, Médecins Sans Frontières-Belgium (MSF-OCB), in collaboration with the Malian Direction Nationale de la Santé (MoH), has conducted distributions of long-lasting insecticidal nets (LNs) in the 11 "health zones" of the "Cercle de Kangaba" region of Koulikoro, in the South-West of Mali. This distribution consists of the provision of one free LN to pregnant women at one of their antenatal visits and again after completion of the baby's first-year vaccinations. Initially, this strategy was targeted towards seven out of the eleven zones (Kangaba, Kéniéba, Naréna, Salamalé, Karan, Kéniégoué and Tombola). As of 2008, the same approach was extended to include the remaining four zones (Balan Bakama, Manicoura, Selefougou and Figuira Tomo). In addition, during this period, the entire region was targeted by several mass LN distribution campaigns that were not managed by MSF-OCB.

At the same time, two new services for malaria treatment and prevention were opened with the population: (a) the *agents palu* or malaria village workers, who provided malaria diagnoses, dispensed antimalarial treatment and coordinated referrals of complicated and RDT-negative malaria cases, and (b) the *relais communautaires*, which were a community based network for the dissemination of health prevention messages, follow-up of treatment adherence and referral to the local *centre de santé communautaire* (CSCom).

The work described here entails an appraisal of this approach of distribution and communication with the population.

1.2 Setting

The Cercle de Kangaba is an administrative zone part of the region of Koulikoro in South-Western Mali (fig. 1.1). In the context of public health care, the area is divided into 11 health zones which each have a *centre de santé communautaire* (CSCom), with a reference health facility (CSRef) in Kangaba town.

1.3 Malaria profile

Malaria is a major public health challenge in Mali. On average, children under five suffer from two episodes of malaria per year, while those over five year suffer from one episode of malaria per year[1]. The proportion of child deaths in Mali due to malaria is 17%[2]. Figures from 2009 in the World Malaria Report indicate that Mali has had a steadily increasing number of reported cases and deaths (1,600 and 2,300 respectively in 2009) over the past decade[3]. However, the actual numbers of malaria cases and deaths are considered to be higher since many cases go unreported[2].

Malaria is endemic in the central and the southern regions of Mali, while the north shows a low degree of endemicity and is prone to epidemicity. The peak malaria transmission occurs during the rainy season from July to December. During this season, due to flooding, access for villages which are located more than five km from community health centers becomes extremely difficult.

The national malaria control policy aims for the prevention and the management of all malaria cases. However, in practice, the combination of environmental, geographical and economic conditions limits access to health care services in Mali for a significant part of the population.

A)

B)

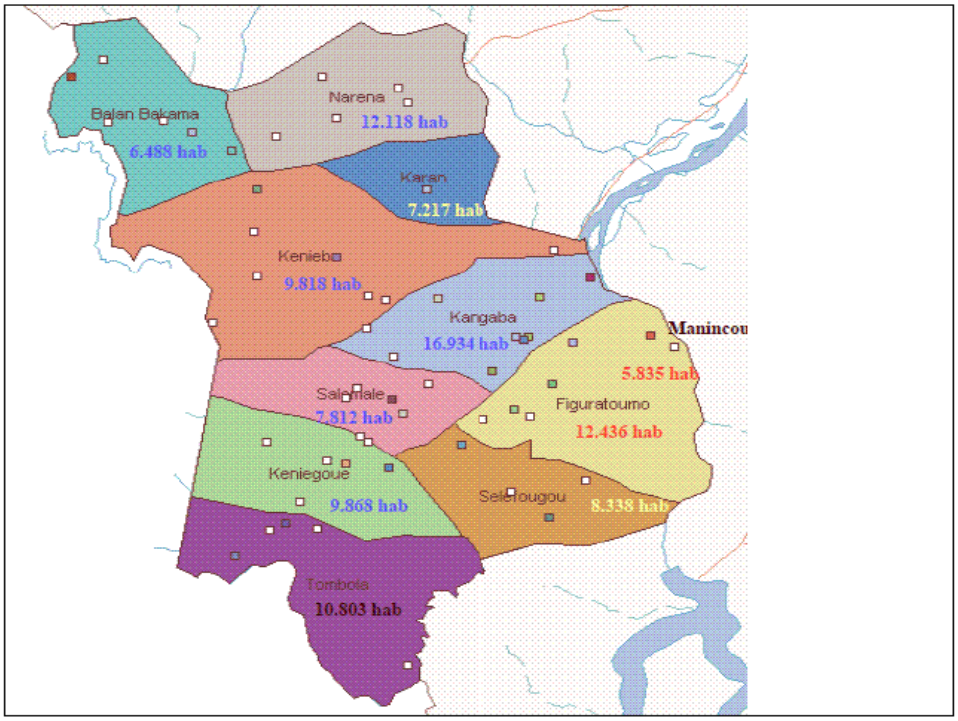

Figure 1.1: A) The region of Koulikoro; B) the Cercle de Kangaba.

2 Objectives

2.1 General objective

The general objective of this KAP survey was to ascertain the knowledge, attitude and practice of the use of WHOPES-approved insecticide-treated mosquito nets (ITNs). The team wished to determine whether the distribution strategy had led to sufficiently widespread ownership of nets in the malaria program area and whether the information on their use was adequate.

2.2 Specific objectives

The specific objectives of this study were:

1) To evaluate the LN distribution strategy
2) To obtain qualitative and quantitative data on ownership and use of LNs and mosquito nets in general
3) To evaluate the presence and the general status of LNs
4) To determine who had slept under an LN the previous night
5) To determine the degree of knowledge people had on the correct use of the LNs
6) To analyze if and by whom the users had been informed on the use of LNs
7) To develop a standard for similar future surveys
8) To formulate recommendations to improve LN distribution and usage in the future

3 Methodology

3.1 Ethics

All participants were informed about the survey and were asked for their consent prior to conducting the survey. The work was conducted under the approval of the Direction Nationale de la Santé, Bamako, Mali.

3.2 Population

The population under study consisted of approximately 100,000 people in many villages spread over the 11 health zones of the Cercle de Kangaba. The most recent available list of towns and villages, with approximate population sizes, dated back to 2005. Figures were extrapolated from this list for each village separately using the latest available average annual growth rate. This was estimated at 3.6%, based on the 1.5-fold expansion of the population between the census of 1998 and the census of 2009[4].

3.3 Sampling method

For this survey, two-stage geographical cluster sampling was used[5], with clusters taken from towns and villages, rather than taking random individual samples from the whole population. This method is considered appropriate when the population is dispersed and the availability of a list of the units in a population (the inhabitants) is lacking, and when the cluster elements (villages) are heterogeneous. The advantage is that the method is practical, time and cost saving and it facilitates planning. The disadvantage is that it introduces a higher sampling error than an unclustered study due to design effects, and therefore a higher number of samples is required to achieve equivalent precision.

Cluster surveys need to have a minimum of 30 clusters to compensate for design effects, and for the same reason the number of samples is generally doubled, following the classic WHO-EPI cluster sampling methodology[6].

Selection of clusters was done using the probability proportional to size (PPS) sampling technique, which is particularly relevant when the sampling units vary considerably in size, as it assures that clusters in larger sites have the same probability of getting into the sample as those in smaller sites, and vice verse. Clusters were selected with replacement, meaning that bigger villages had a chance of being selected twice[6].

In every cluster, 15 households were interviewed. It is usual for extended families consisting of multiple households to live in one common compound. Randomly, one household was selected per compound unless the size of the village was too small, which, on rare occasions led to the random selection of two households per compound.

3.4 Sample size

For the calculation of sample size, the assumption was made that 80% of the interviewed households owned a mosquito net, based on the WHO figures of 68% in 2006, 82% in 2008 and an estimated 90% in 2010 in rural Mali – among the highest in sub-Sahara Africa:

$$n = \frac{A}{E^2 + A/N}$$

And:

$$A = T^2 \times P \times Q \times W$$

Where:

n = approximate minimum sample size required
P = assumed prevalence of mosquito net(s) in the households = **0.8**
Q = 1 – P = **0.2**
E = maximum acceptable random sampling error = **0.05**
W = the likely design effect = **2**
N = population size = 100,000 ~approximately **16,000** households
$T^2 = 1.96^2 =$ **3.8416** ~ corresponding to 95% probability of not exceeding E.

$$\therefore n = 477$$

Retrospectively, considering that the outcome of the survey showed a net possession rate of 97.8%, the precision interval could be recalculated and was found to be approximately 2%. Setting the sample size at 450, and the number of clusters at 30, resulted in a cluster size of 15 households.

3.5 Methodology of site selection

To ensure random selection of clusters and households, a list was compiled of all villages and towns in the project area, including the cumulative population for each subsequent location. The total population of the project area was divided by 30, giving the sample interval (SI). A random number between 1 and the SI was chosen, called the random start (RS). The following series was then calculated:

$$X = RS + n \times SI$$

With:

$$n : 1 \rightarrow 30$$

Each number X corresponded to a value of the cumulative population list and thus to a site on the list of villages; these villages were then chosen to host a cluster. Two larger towns were chosen twice, bringing the total number of geographical locations for the survey to 28 (fig. 6.1).

3.6 Team composition and area plan of approach

After the random selection of villages using the PPS sampling method described above, the project area was divided into three more or less natural zones: the axis of the main roads north and south of Kangaba, the western zone around Kéniéba and the eastern zone on the other side of the Niger river, with respectively 12, 10 and 8 clusters (fig. 2.1).

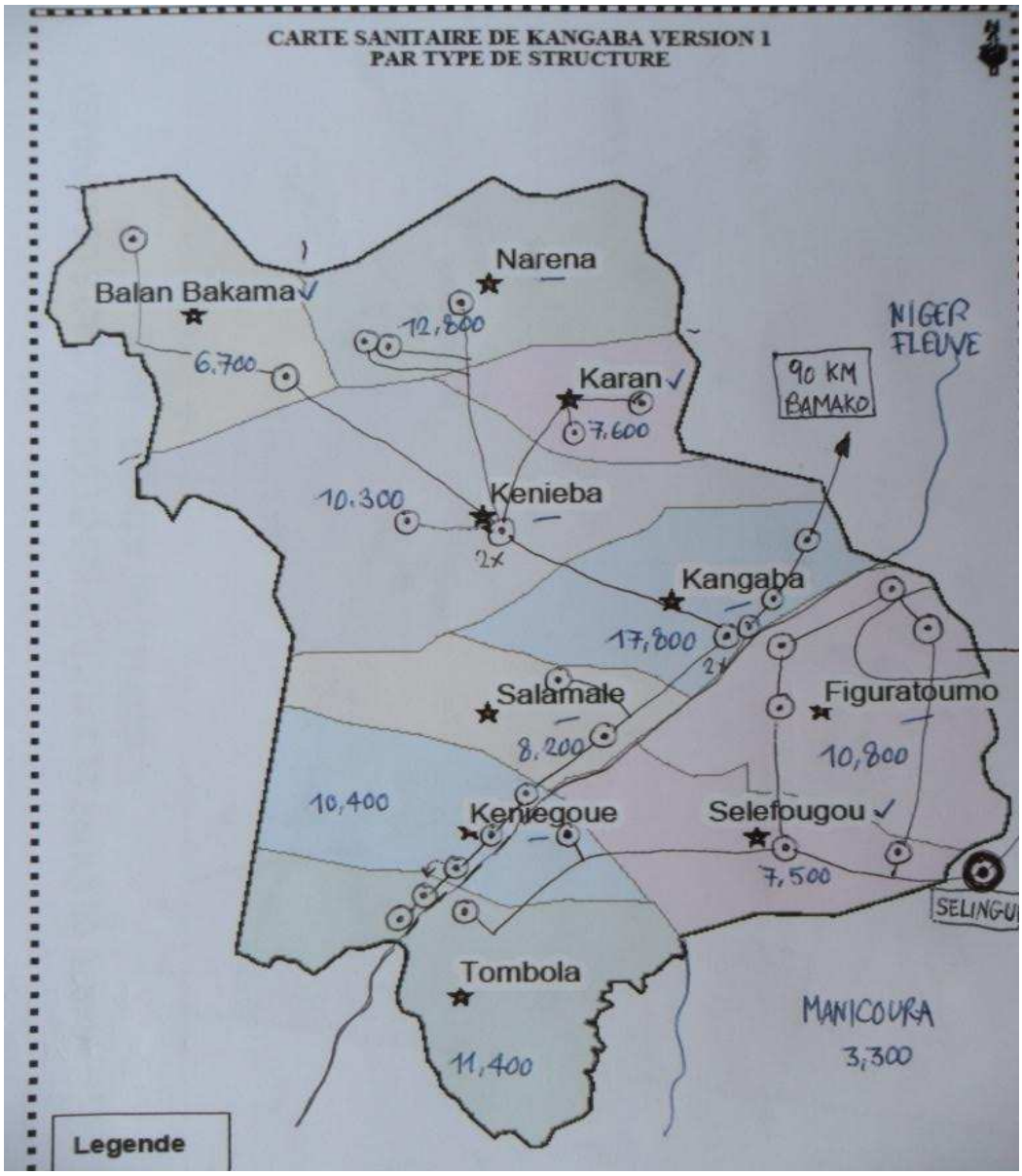

Figure 2.1: The 28 randomly chosen cluster locations.

Concerning the travel time needed between the villages and the base, each zone could be covered in one week (of six working days), using three teams and one vehicle. It was decided to work with four teams in total, to allow extra capacity in case of unexpected events (illness or other unexpected absence of interviewers), and taking into account that the car could accommodate four teams of two persons plus the coordinator. Each team consisted of a woman and a man, to avoid issues of gender in the villages. Due to the relatively small scale of the survey, a supervisor was not employed. Instead, the survey coordinator went to the villages and formed a first hand impression of the situation regarding the nets while supervising the teams.

For the first two weeks Kangaba was used as a base, while during the third week the teams moved to the other side of the river (lacking a bridge, necessitating a 240 km drive via Bamako) and used Sélingué as base.

Overall, the following resources were required to carry out this study:

- **Number of expats**: one expat for 2.5 months
- **Number of national staff**: nine national staff members for four weeks
- **Number of cars**: one Toyota Landcruiser Hardtop for 1 month
- **Estimation of time required**: 2.5 months:
    - Preparation at HQ for one week
    - Introductions and discussion with counterparts at the capital and field level for one week
    - Recruitment of interviewers for one week
    - Training of interviewers for one week
    - Actual survey for three weeks
    - Data entry for one week
    - Data analysis and reporting for two weeks

3.7 Household plan of approach

After arriving in the selected village and visiting the village authorities (to confirm permission and to be sure that their visits had been announced in advance), the survey team went to the center of the village and threw a spinning pen into the air to determine a random direction to proceed. The nearest road going in that direction was taken and followed, irrespective of its further direction (village roads are usually winding) and each consecutive compound was visited. For each compound (typically consisting of multiple households, constituting an extended family), the total number of households and the number of households represented by an adult were established. Irrespective of the size or composition of these households, a random choice between them was made by folding up numbered pieces of paper, mixing them thoroughly and letting a child choose one.

If the village boundary was reached before all 15 interviews were done, the survey team returned to the center of the village, and continued in another direction determined by throwing up the spinning pen again.

3.8 Questionnaire composition

The questionnaire consisted of various sections. The first section was aimed at general demographic data, including educational level of the families. The second section sought quantitative data on the possession of mosquito nets, followed by actual observation of the nets and their physical state. The final section collected qualitative data on attitudes and knowledge of the correct use of mosquito nets and who had slept under the nets during the previous night, and if not, why. Consent was asked and obtained from each interviewee.

3.9 Recruitment and training of interviewers

A recruitment notice was posted on the gates of the MSF-OCB offices in Bamako, Kangaba and Sélingue, and broadcast on the local FM station in Kangaba. One week later, applications of 27 candidates were reviewed and 16 were invited for interviews. After going through a

written test and an oral interview, each candidate was rated on the basis of their CV, written test results and personal presentation. On this basis four men and four women were selected.

During one week of interactive training (fig. 2.2) the interviewers were familiarized with MSF, the program, and the concept of the survey, including the sampling technique. The conceptual questionnaire was discussed and adapted, and finally translated by the interviewers to Bambalakan, the language of the Bambara people, in two working groups. Finally, a day of field testing was held in a nearby village (not on the cluster list), after which the outcome was evaluated and several changes were made to the questionnaire.

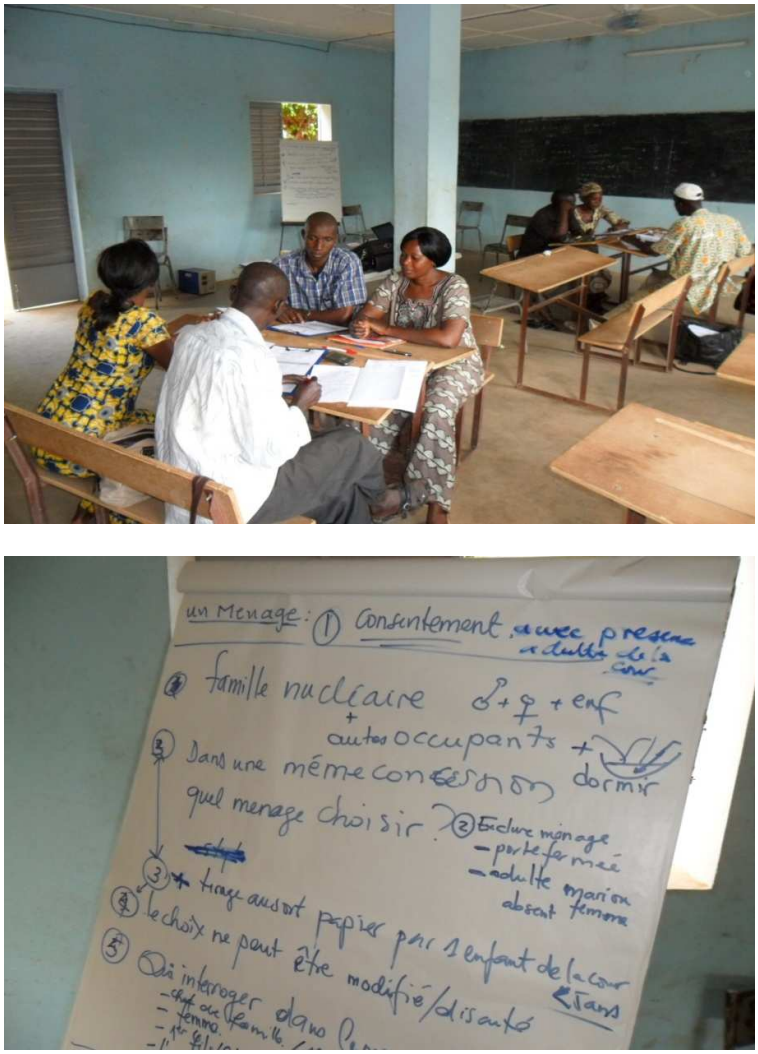

Figure 2.2: The interactive training sessions of the interview teams.

3.10 Data processing

Data were entered and processed using EPI-info v.3.5.1. by a team of MoH employees lead by Mrs. Goita Soula Fofana (IT engineer).

4 Results and Comments

4.1 Description of the study population

4.1.1 Demographics

Between November 22nd and December 10th 2010, 450 households were questioned, which included 528 children under five years of age, 869 children between five and fifteen, 569 adult females and 512 adult males. In total, 2,478 people were reached.

The average size of a household was **5.5** persons, and the average composition was 1.2 children under five; 1.9 children between five and fifteen; 1.3 females over fifteen and 1.1 males over fifteen (fig. 4.1). A considerable 26% of the households did not have children younger than five years (fig. 4.1B). In four households (less than 1%) there were no adult females, versus 42 households (more than 9%) without adult males. This may be a consequence of polygamy (the death of a husband can lead to multiple households without adult male) and of the difference in life expectancy at birth between females and males in Mali (52.3 versus 48.3 years respectively).

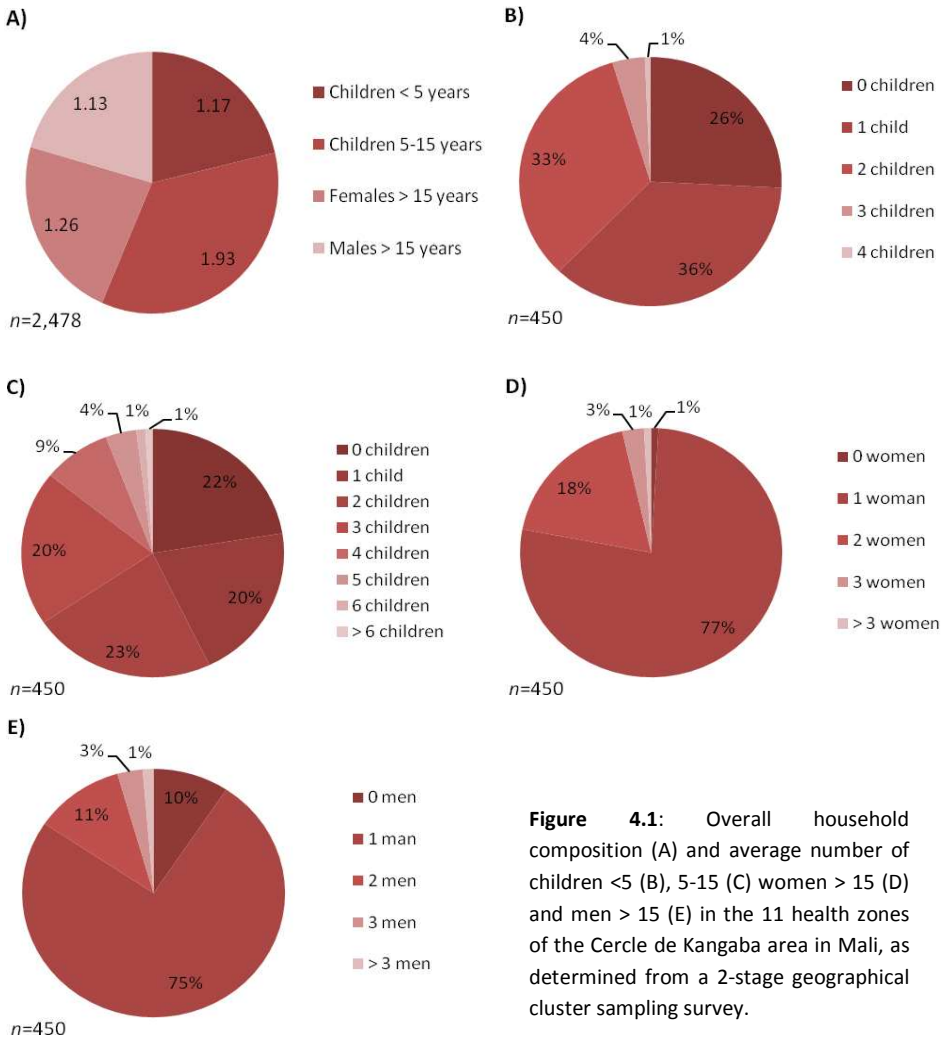

Figure 4.1: Overall household composition (A) and average number of children <5 (B), 5-15 (C) women > 15 (D) and men > 15 (E) in the 11 health zones of the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

4.1.2 Educational characteristics

The level of education in the households was relatively high: in only 19% of the households none of the family members had benefited from formal, state-organized education, while in 12% of the households, at least one family member had continued their studies beyond secondary school level (fig. 4.2).

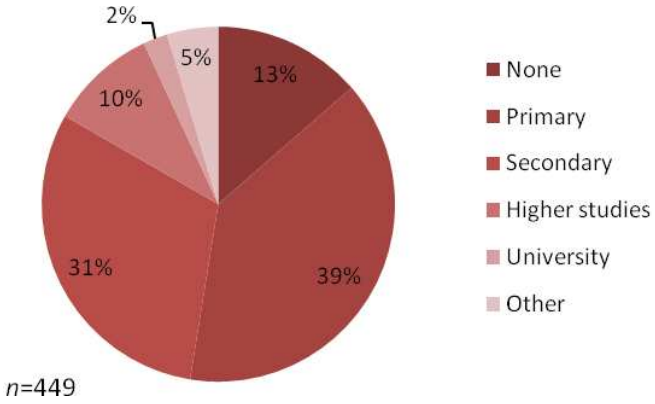

Figure 4.2: Highest level of education of one or more household members in the 11 health zones of the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

4.2 Net distribution & possession

4.2.1 Number of mosquito nets in the households

The vast majority (98%) of households interviewed owned one or more mosquito nets (fig. 4.3). The households not in possession of any mosquito net (10 out of 450) were without exception either households without pregnant women or children younger than five, or were newcomers to the area.

Ownership rates of more than one net per household were equally impressive: 86% of the households owned at least two nets, 59% owned at least three nets and 30% owned four nets or more. The 450 questioned households owned 1,345 nets in total, averaging out to 2.96 nets/household.

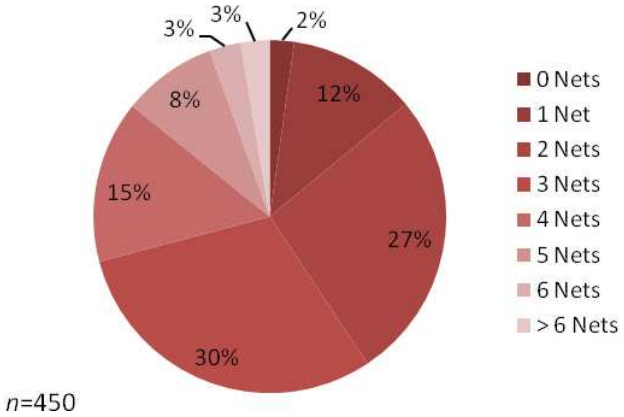

Figure 4.3: Possession rate of mosquito nets per household in the 11 health zones of the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

These data were based on reported figures, as only 1,233 nets (92.5% of all owned nets) could be directly observed and inspected. The nets which could not be directly observed were typically located in a locked room, for which the key was kept by the man who was away for work. In a few cases, nets were being washed or could not be found.

4.2.2 Changes in net possession since 2008

In mid 2008, MSF-OCB held a mortality survey in the same program area and also collected data on mosquito net possession. The 2008 survey area was divided into two zones:

- **Zone 1** ("The MSF area") consisting of the seven health zones Kangaba, Kéniéba, Naréna, Salamalé, Karan, Kéniégoué and Tombola. This was the original program area as defined in 2006. The average net possession in 2008 in this zone was **3.15** nets/household.
- **Zone 2** ("The non-MSF area") consisting of the other four health zones, Balan Bakama, Manicoura, Selefougou and Figuira Tomo, which were added to the program area in 2008. Average net possession in this zone was **2.27** nets/household.

As mentioned above, average net possession in 2010 for the whole area was **2.96** nets/household, broken down to 2.99 and 2.95 nets/household for the former MSF and non-MSF zones, respectively. This suggests that the differences between the two zones had equalized, owing to a general increase in net possession in the former non-MSF zone and a redistribution effect in net possession in the former MSF zone (fig. 4.4). This redistribution effect entails a slight decrease in average net possession over the past two years, but an overall increase in net coverage (i.e. percentage of households owning at least one net) from 93% to the aforementioned 98%.

As of 2008, both zones were subjected to the same continuous distribution strategy (i.e. no conscious catch-up strategy was directed at the former non-MSF zone). The observed equalization after two years therefore indicated that net possession at the outset had limited impact on net possession after two years of distribution campaigns, suggesting that most nets were obtained over the previous two years only . It also suggests that the strategy of targeted continuous distribution combined with occasional mass-distribution campaigns managed not only to boost net possession in the unserved area, but also to stabilize the rate of net possession in the area already being served.

4.2.3 The duration of use of mosquito nets

The majority (63%) of nets were obtained in 2008, 2009 or 2010 (fig. 4.5). Only 16% of the nets were acquired before 2006 when the MSF/Direction Nationale de la Santé program started. As the total number of nets in the area did not dramatically increase over the past two years, it is clear that nets generally did not last up to five years, and a good number probably not even up to three years. The average age of the mosquito nets was found to be 3.39 years.

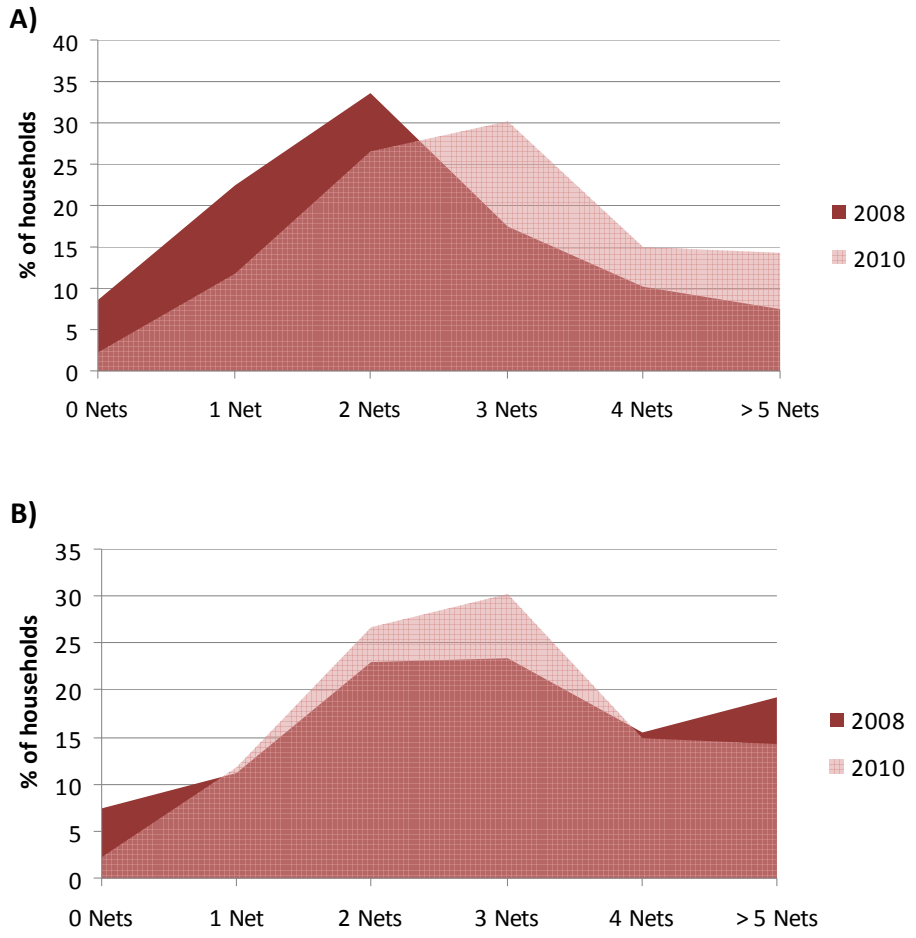

Figure 4.4: Changes in net possession rates per household between 2008 and 2010 in (A) the health zones Balan Bakama, Manicoura, Selefougou and Figuira Tomo, comprising a non-MSF zone in 2008, and (B) the health zones Kangaba, Kéniéba, Naréna, Salamalé, Karan, Kéniégoué and Tombola comprising an MSF zone in 2008. 2008 data was compiled from an MSF-OCB mortality survey; 2010 data were collected in the current 2-stage geographical cluster sampling survey.

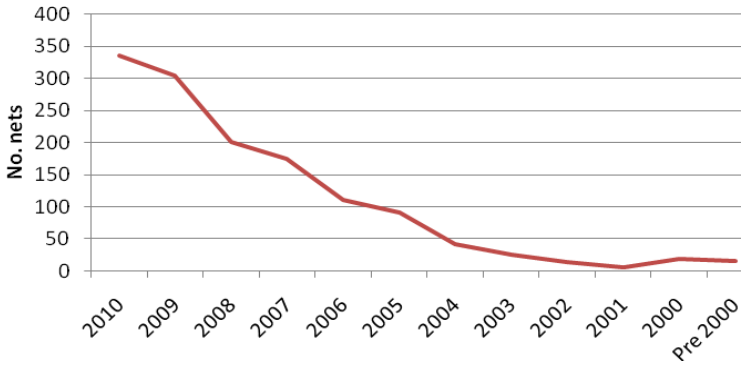

Figure 4.5: Year of acquisition for the 1,336 nets owned in the 2-stage geographical cluster sampling survey in the Cercle de Kangaba area in Mali.

Previous research by WHO has shown that the average net efficacy drops to 40% after three years use, which is generally considered the average lifespan of a LN (fig. 4.6A)[3]. As documented by studies from the Malaria Consortium, polyester-based nets decay faster than polyethylene-based nets (fig. 4.6B)[7]. Most of the nets observed in our survey were Permanet 2.0, made of polyester, with a worse durability record than the polyethylene Olyset nets.

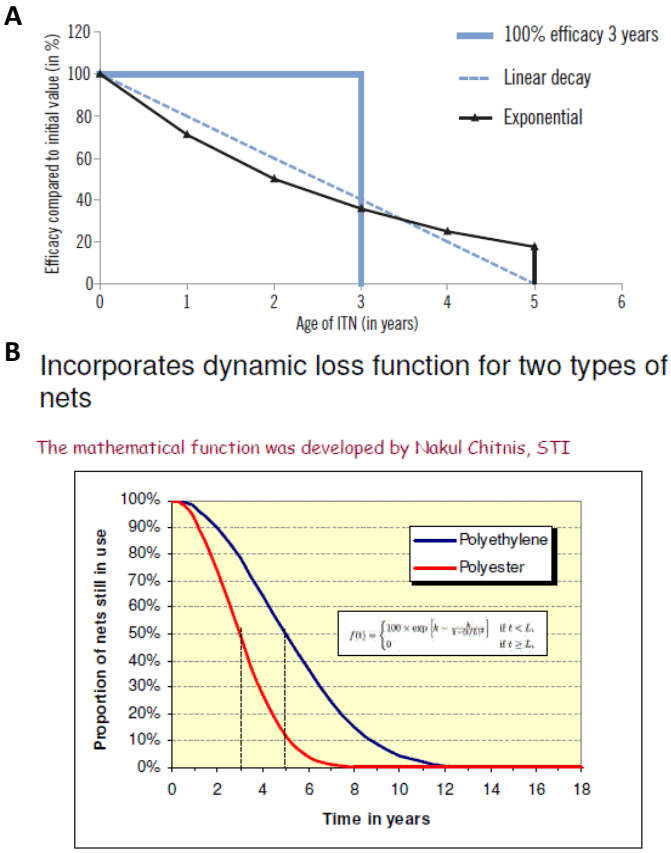

Figure 4.6: Modeling of (A) the overall decrease in average net efficacy over time, reproduced with permission from [3], and (B) the loss in function of polyethylene-based vs. polyester-based nets over time, reproduced with permission from [7].

4.2.4 Type of mosquito nets observed

Ninety one percent of the observed nets were identified as LN. Of the remainder, 2% could be labeled ITN of an earlier generation (a net dipped in insecticide), while the others were difficult to identify (several self-made mosquito nets were included). Although verification of the prevalent net brands was not part of this survey, the majority of the nets observed were Permanet 2.0, and to a lesser extent Olyset. Others included BASF Interceptor and Siamdutch.

We could not obtain confirmation that all nets distributed at the CSCom were LNs, as the Direction Nationale de la Santé is dependent on donations of nets. This also explains the observed variation in brands of LNs, which were not all recommended by the WHO pesticide evaluation scheme (Whopes). A limited number of nets were still in their original package, which is unusual as the policy is to remove the package when the net is handed over at the distribution point.

4.2.5 Mosquito net distribution strategy

The mosquito net distribution to pregnant women at antenatal consultation and to mothers completing the first round of vaccination of their baby was started in 2006 in seven of the 11 health zones of the Cercle de Kangaba. This strategy was extended to the other four health zones two years later – MSF-OCB figures on total nets distributed are provided in Annex II. These figures were used to dissect out the specific contributions of targeted LN distribution (antenatal consultation and vaccination) to net coverage in the region, based on the extrapolated annual population figures[4] and using the WHO estimation for LN coverage assuming an average of two people sleeping under the net and a binary, 100% useful net lifespan of 3 years (fig. 4.7A)[3]:

$$Coverage = \frac{LN\ distributed\ in\ the\ past\ 3\ years \times 2}{Population}$$

Or corrected for a linear net decay rate of 20% over five years (fig. 4.7B):

$$Coverage = \frac{(LN\ distributed\ in\ the\ past\ 5\ years - Decay) \times 2}{Population}$$

In line with our findings concerning the dynamics of net possession over the period 2008-2010 and with the general expectations of a distribution system with constant input and constant decay, both models indicate an increase in net coverage over the first two to three years, followed by a stagnation at <50% coverage, suggesting that these methods of distribution alone do not manage to achieve full coverage. The necessity for further developing this model to fully assess the relative impact of the different methods of distribution is discussed in §5.

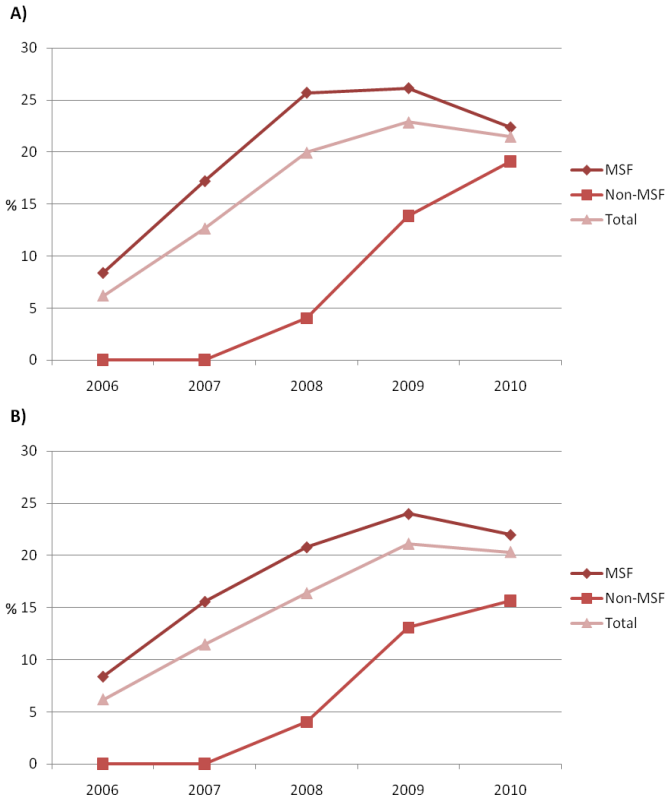

Figure 4.7: Modeling of the contribution of antenatal and vaccination consultation distribution of LN on net coverage rates, based on MSF-OCB net distribution figures, calculated according to the WHO guidelines using a binary 100% useful net lifespan of 3 years (A) or a linear net decay rate of 20% over 5 years (B).

It is interesting to note that in the former non-MSF zone, a number of pre-2008 nets were observed which were said to originate from antenatal and vaccination consultations (e.g. in Balan Bakama and Selefougou, respectively, nine out of 11 and seven out of 14 nets). This observation suggests the ease of travelling to an adjacent health zone for consultation or vaccination, in particular when free services are offered and distances are not excessive. The same may apply for people living across the border with Guinée.

Other distributions, referred to as (vaccination) campaigns and sponsored by other organizations such as "l'Organisation pour la mise en valeur du fleuve Sénégal" (OMVS) in collaboration with the Direction Nationale de la Santé, have been held, the latest one in January 2010 when as many as 15,000 nets were distributed through the CSComs in this area, according to MSF-OCB. These distributions were beyond our control. The MSF contribution to the regular distribution was limited, although a backup stock of mosquito nets was maintained in case of disruption of the normal supplies of the Direction Nationale de la Santé.

4.2.6 Sources of household mosquito nets

Specific non-MSF campaigns distributing nets began showing an impact in 2007, and became a major source of nets in 2009 and 2010, accounting for a total of 30% of the nets received (fig. 4.8). Overall, 58% of the nets were received during pre-natal visits and after the first round of vaccinations. 12% of the nets came from other sources, though some of those may have originated at the CSCom, while others came from the private market.

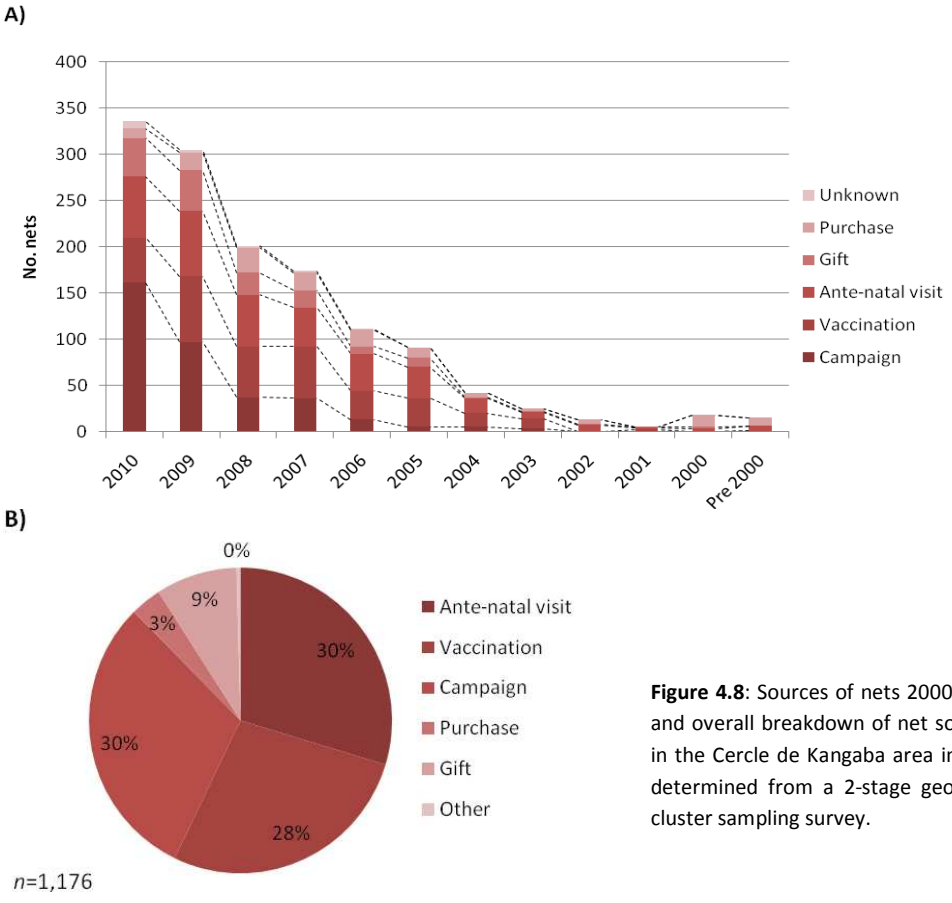

Figure 4.8: Sources of nets 2000-2010 (A) and overall breakdown of net sources (B) in the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

4.3 Net usage

4.3.1 Net suspension

In 249 households, i.e. 57% of the 440 households that owned nets, one or more nets were not suspended above the sleeping place (which is not necessarily a bed). In total, 832 (67% of directly observed nets; 62% of all reported nets) were found suspended above the sleeping place. The main reason for not suspending a net, given by 58% of the households where one or more net was not suspended, was that these nets were considered a surplus and were kept as spare (accounting for 144 households). Valid reasons (lack of space, net being washed) were given by a further 41 households (fig. 4.9).

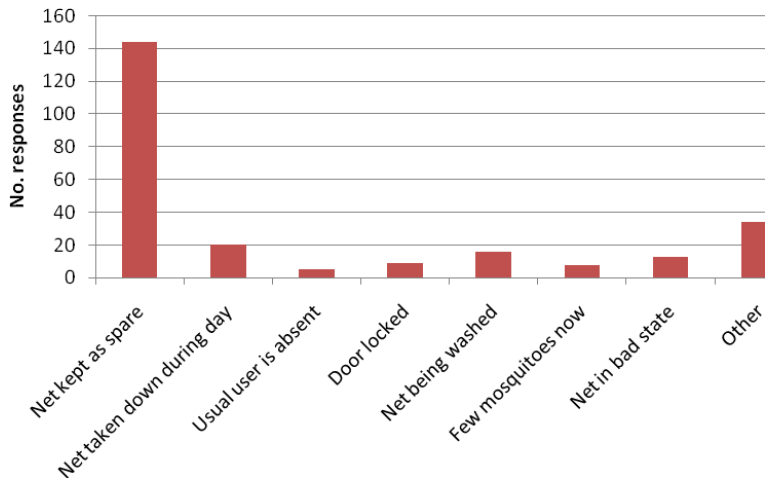

Figure 4.9: Reasons per household why nets were not suspended above the sleeping place in the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

4.3.2 Active net usage

Overall, 71% of the household members were reportedly sleeping under a net the night previous to the interview (fig. 4.10A). The status of the remaining 29% was uncertain, due to the absence of some household members, a relatively large number of nets (7.5%) could not be observed and the individuals reportedly using them could not be interviewed. Broken down by age, 92% of the children younger than five, 59% of the children between five and fifteen and 66% of the adults were documented to have slept under a mosquito net the previous night (fig. 4.10B). The actual numbers, in particular for adults, might be somewhat higher: as the interviewees in this survey were usually women, due to the absence of the men, and it is common for the women to sleep in different rooms than the men, it was often impossible to determine if the men had slept under a net the night previous to the interview. The children under five (usually sleeping together with the mother) did not necessarily sleep under the better nets: 60% of these children slept under a net which was undamaged.

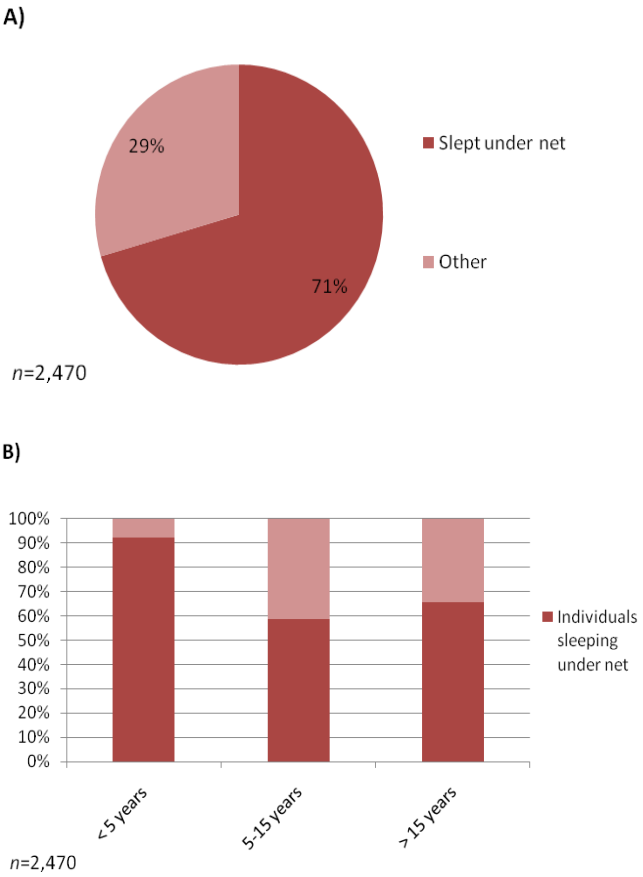

Figure 4.10: Self-reported net usage in the overall population (A) and broken down per age group (B) in the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

4.4 Net maintenance

4.4.1 Washing habits of mosquito nets

Only one household reported never washing the net. All others had the habit of regularly washing the mosquito nets: 76% of the households reported washing the mosquito nets at least once a month (fig. 4.11).

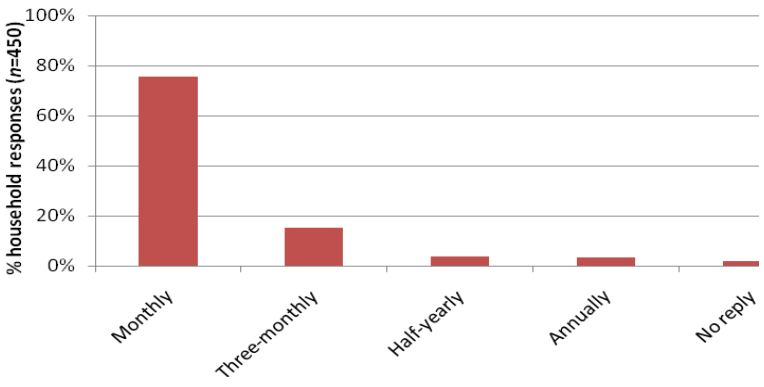

Figure 4.11: Household net washing habits in the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

4.4.2 Re-impregnation of mosquito nets

Knowledge about the new generation of nets (LN) was poor: 87% of the respondents believed that re-impregnation/redipping was still necessary, and out of those, 51% reported to already have done redipping. 17% of these respondents performed redipping in 2007, another 17% and 2008, 37% in 2009 and 10% in 2010 (fig. 4.12).

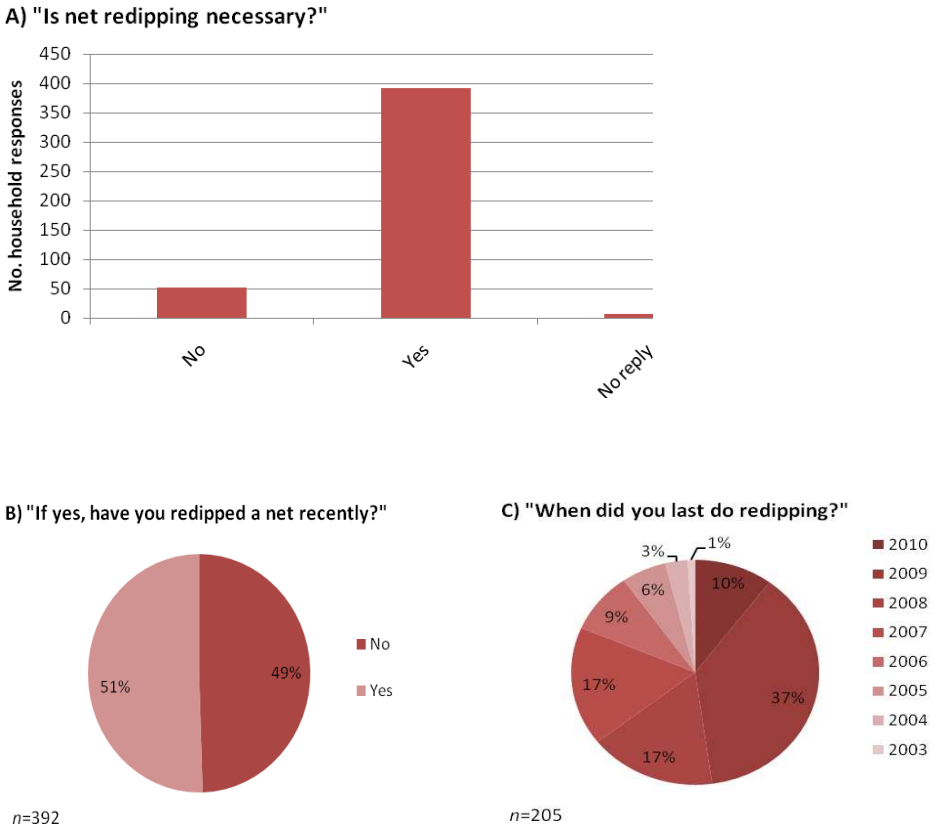

Figure 4.12: Household responses to questions on the necessity (A), history (B) and timing (C) of net re-impregnation in the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

Redipping in the villages was organized by the *relais communautaire*. The relais was a network of volunteers in the village who, at best, were reimbursed in kind. When asked, various *relais communautaires* could not give details; some insisted they were still doing it "regularly", though the last time it was done was never in 2010. The product used, which is referred to as "bloc", is bought in a pharmacy – however, no pharmacy could be found with the product in stock, and this product seems to have disappeared from the market.

While this may have ended the practice of redipping, the people were generally not aware that the latest generation of nets does not require redipping and in fact should not be redipped at all. When some of the MSF malaria liaisons in the village (the *agents palu*) were asked for comment about the redipping practices, they said that they know nothing about mosquito nets. Historically, it has been MSF policy for the *agents palu* not to interfere with the work of the *relais communautaires*.

4.4.3 Damage to mosquito nets

72% of the observed nets observed were undamaged, while the remainder (382 nets) were found with holes (fig. 4.13A). However, these undamaged nets also included the nets reported to be kept as spare (cf. §4.3.1), signifying that finally 32% of the nets in use were damaged to some extent. In terms of damage, a distinction was made between small holes and big holes. Small holes were defined as holes with a diameter of less than one small finger (0.5 cm) and big holes as holes with a diameter of a small finger or more (≥ 0.5 cm). A wide variation in the extent of the damage/number of holes was observed (fig. 4.13B-C).

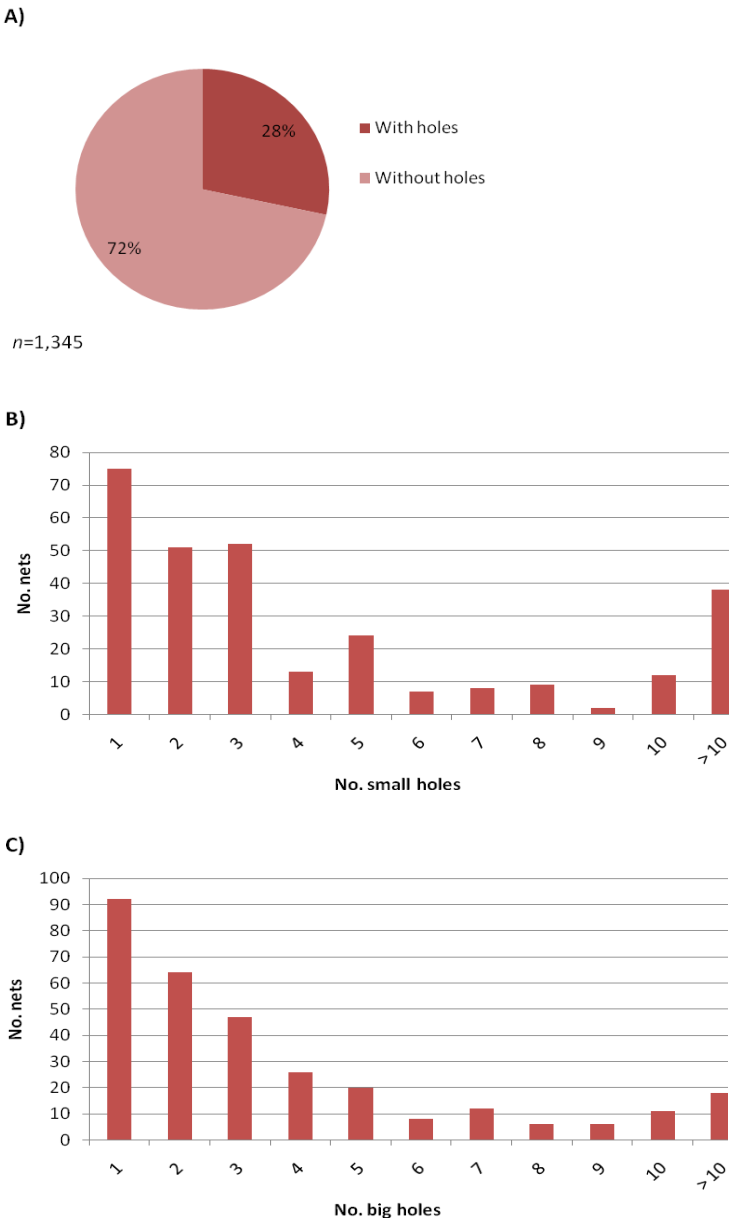

Figure 4.13: Damage assessment of nets: overall damaged/undamaged nets (A) and numbers of small (B) and large (C) holes per damaged net in the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

4.4.4 Disposal of badly damaged mosquito nets

Typically, mosquito nets were thrown away at the end of their lifetime (48% of all respondents). 17% preferred to keep the broken net, 15% burned it and 13% recycled the netting material in some way (fig. 4.14).

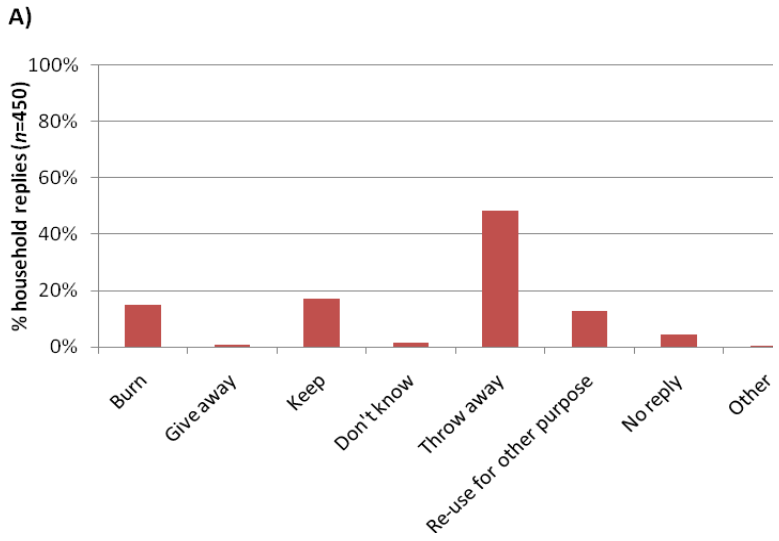

Figure 4.14: A) Disposal methods of badly damaged nets per household in the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey; B) example of a damaged mosquito net recycled as rope.

4.4.5 Mosquito net repair

Most respondents (70%) did not think a damaged mosquito net could be repaired. About half of the respondents replied that a net could be repaired and had already done so, which covered a considerable 15% of the households interviewed (fig. 4.15).

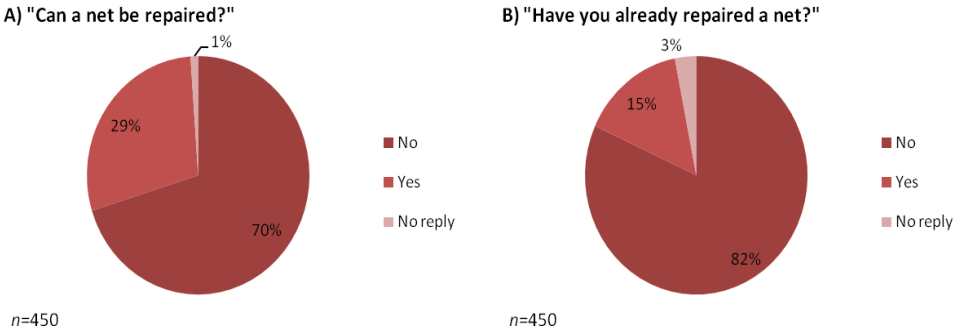

Figure 4.15: Household responses to questions on (A) the possibility of, and (B) experience with net reparation in the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

4.5 Net promotion & acceptability

4.5.1 Information received on the correct use of a net

Just over half of the respondents (55%) reported having received information on the correct use of the mosquito net. A home visit by health promotion personnel (*agents palu* or *relais communautiares*) was also received in half of the cases, while two thirds of the households reported to have received health promotion in their neighborhood. A further 71% reported having received an explanation on the use of the net when it was handed over at the CSCom (fig. 4.16).

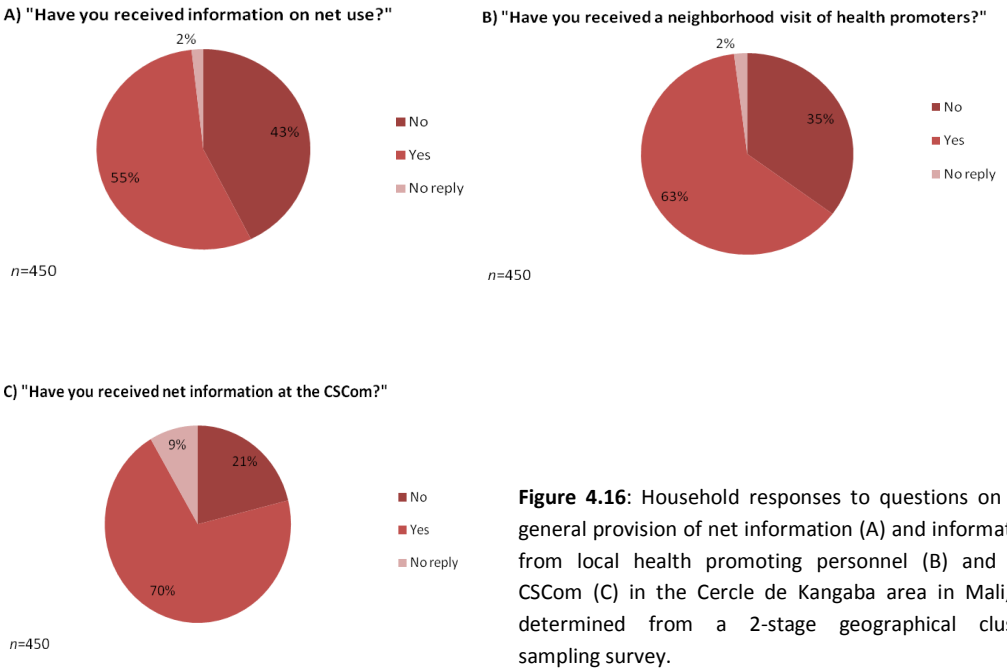

Figure 4.16: Household responses to questions on the general provision of net information (A) and information from local health promoting personnel (B) and the CSCom (C) in the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

In order to assess the knowledge of the respondents on correct use of mosquito nets, they were asked about the do's and don'ts of mosquito nets. Specifically, the following five key points were checked:

1. The net should be hung above the sleeping place
2. The net should be tucked under the mattress or mat

3. The net should be tied up during the day
4. The net can be washed when dirty
5. The net should never be exposed directly to the sun

Most (45%) of the respondents could mention four of these points, 10% knew them all and 35% had knowledge of 3 points – i.e. 90% of the people interviewed knew at least three of the basic facts concerning the correct use of a mosquito net. The fact that nets should not be exposed directly to the sun appeared to be the least known fact (fig. 4.17).

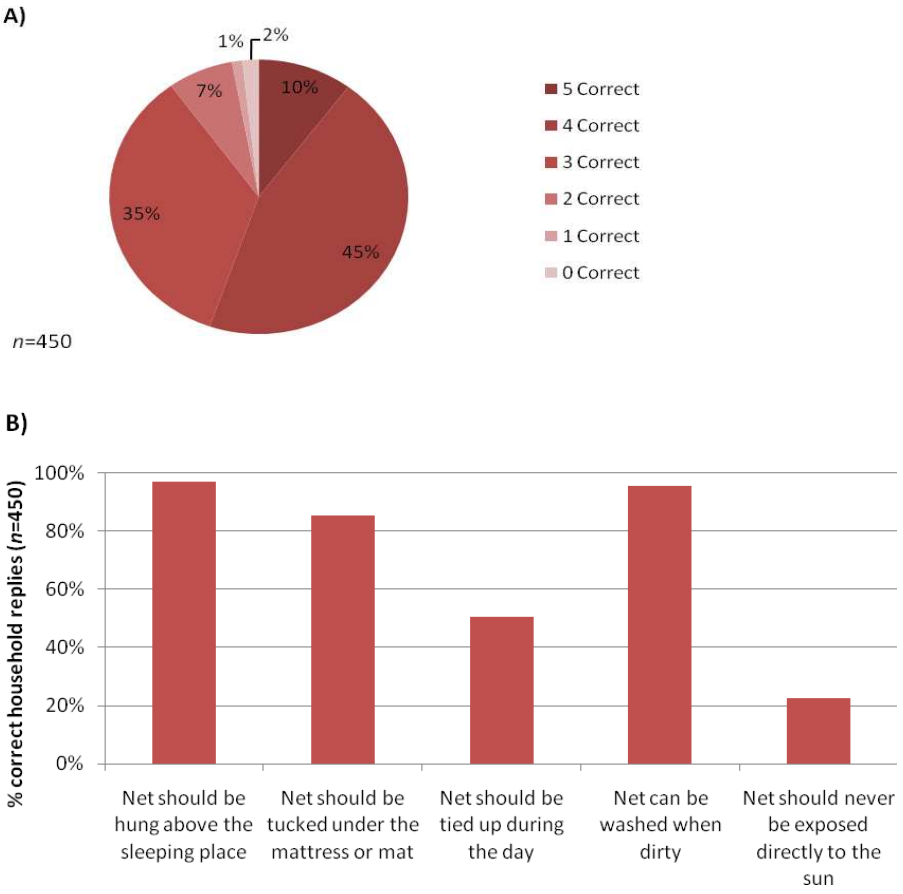

Figure 4.17: Household knowledge of the correct use of nets: numbers of correct answers on the five key points of net usage (A) and numbers of correct answers per point in the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

4.5.2 Perceptions of mosquito nets

When asked to give an opinion on mosquito nets, almost all respondents gave only positive answers, with 97% mentioning protection against malaria. Just 2% mentioned a negative trait, with two households mentioning a bad smell of the nets and three claiming they were hot to sleep under (fig. 4.18).

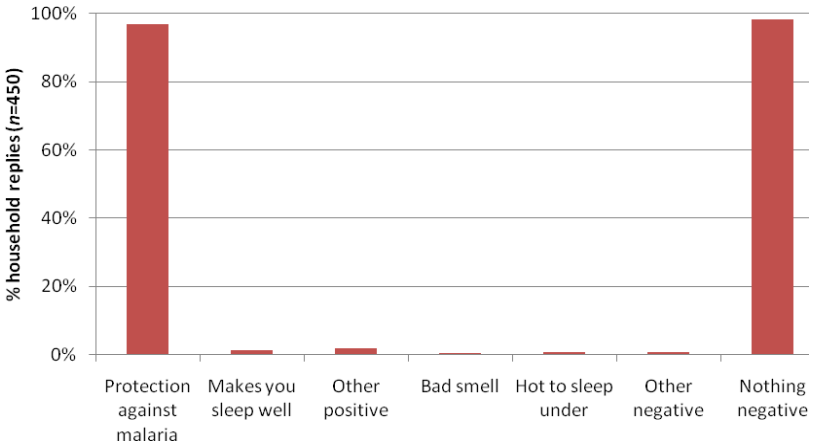

Figure 4.18: Positive and negative household opinions on net usage in the Cercle de Kangaba area in Mali, as determined from a 2-stage geographical cluster sampling survey.

5 Discussion and recommendations

5.1 Study strengths and weaknesses

This Knowledge, Attitude and Practice (KAP) survey was conducted in response to the pending closure of the MSF-OCB project in the Cercle de Kangaba in Mali. Using limited resources (36 person-weeks national staff, 2.5 months expat staff), a reliable, statistically sound overview was generated of the impact of LN distribution and LN health promotion on net coverage in this area. The KAP study demonstrated an efficient approach to the survey and a model questionnaire was developed that could be used for similar future studies; however, the questionnaire should always be reviewed and adapted in view of the local context.

A weakness, beyond the control of this study, was the limited availability of reliable historical data, both in terms of malaria morbidity/mortality and of LN distribution and coverage, regrettably precluding a full impact assessment and description of the kinetics of LN usage.

Another specific weakness of the study was an apparent confusion between LN and ITN: while the study was directed at surveying LN distribution, no systematic differentiation was made between these types of nets in the subsequent analysis. Except where mentioned specifically, data shown reflect the general net possession/usage, rather than the specifics for LN. As the protective effects of ITN are poorly characterized, data should be interpreted with care in this context.

Finally, one question (question 9, cf. Annex I) was excluded from the current analysis, as it was deemed too speculative and misleading during a retrospective evaluation of this study.

5.2 Study specifics, future perspectives & recommendations

5.2.1 Net distribution models

In general, net ownership (one net or more per household) had reached an impressive level of 98% by the end of 2010, with the average household possessing 2.96 nets. These data hold true both in regions subjected to MSF-OCB LN distribution since 2006 and regions only targeted since 2008. At least 71% of the members of the surveyed households, and for the vulnerable under five age group, up to 92% slept under a net the night previous to the interview.

This rapid equalization between the former MSF- and non-MSF zones suggested that the distribution in this area – targeted distributions at antenatal consultation and vaccination, combined with mass distribution campaigns – was characterized by a swift catch-up phase followed by a stable replenishment stage. This hypothesis was supported by a rudimentary modeling approach of the MSF-OCB net distribution figures for the distribution at antenatal consultation and vaccination alone. While these distributions would not manage to reach sufficiently high rates of coverage by themselves (ca. 50% using the WHO assumptions of useful net lifespan and individual net coverage), they did seem to manage to achieve a form of equilibrium between net distribution, net attrition and population expansion.

Theoretically, a distribution system implicitly tied to population growth should be capable of achieving steady-state net coverage after the initial catch-up phase. However, this speculative hypothesis was supported only by two cross-sectional coverage assessments (2008 and 2010) on the one hand, and a simple modeling approach of supply data on the other. Many confounders, such as the unpredictable mass distribution campaigns, may have existed. We therefore, recommend that a more rigorous mathematical modeling of this system of distribution take place, that could take into account the theoretical inflow of nets through antenatal and vaccination visits (using available demographic data), and the depletion of nets through more accurate models of annual attrition (e.g. exponential decay rather than linear or binary). The effects of random additions to the model, through e.g. mass distribution campaigns or supply shortages, could also be included, painting a more accurate picture of the requirements for keeping a region adequately covered in the long term.

5.2.2 Net usage and practices

While household coverage was relatively high, approximately one third of the nets observed in the survey were not being used. This figure included a surprising 10% of all nets which were still new and were being kept as spares. This observation, combined with the generally positive opinions found on the survey, indicated that the nets were considered of significant value and were not sold or given away. However, it also called into question certain practices during distribution: normally, LN should be removed from their packaging when they were handed over, to avoid reselling of the nets on the market. However, unwrapped LN which are stored for long periods of time will gradually lose their protective impregnation, and if the nets are stored too long as spares, their usefulness will be rendered void. It should therefore be considered whether it is more useful to leave the LN in their packaging, risking loss of nets through reselling but keeping the impregnating insecticide functional, or to remove the nets from their packaging as is being done now.

In sharp contrast with the high possession and usage rates and the positive perception of nets, knowledge about net usage and maintenance was poor. Although the majority of the people have received information on the use of mosquito nets, either at the distribution point or during a visit of health promoting personnel, the important points had not been retained. The frequency of washing the nets was too high and the nets were often exposed to the sun. Most people were not aware that, unlike the older generation of nets, yearly re-impregnation did not need to be done. Many people claimed they were doing this until recently, though it was difficult to confirm this practice as the product used was no longer available on the market.

An important contribution to this state of affairs could be the limited communication between the health promoting personnel in the region, the *agents palu* and the *relais communautaires*. In practice, some animosity existed between these – theoretically complementary – health promotion channels, based on differences in compensation, resulting in gaps in communication. In any case, training for the staff on the information required for optimal LN use is necessary, in order for people to know that re-impregnation should not be done, washing should be minimized and hanging out in the sun avoided altogether. This should extend the lifetime of the nets and make them more effective. Both

the *agents palu* and the *relais communautaires* should be included in this training. Additionally, people should also be advised that it is recommended to sleep under a net also after the rainy season, even when the mosquitoes are few.

In terms of net maintenance, around one third of the mosquito nets observed already had some degree of damage. A way of extending the lifetime of a net could be the provision of a repair kit, allowing the repair of small holes in a timely manner. Once small holes begin to develop in a net and people lack the means of repairing these, they will soon become bigger and will render the net useless. This repair kit could be delivered with and be part of each new net. A risk of such a kit might be the extension of the physical lifespan of an LN beyond the efficacious period of the insecticide (estimated at 40% after three years according to the linear decay model of WHO[3]. However, though not part of this survey, the question can be raised to what extent pyrethroid-treated nets are still effective in areas where mosquitoes have developed resistance against pyrethroids. In such areas (e.g. West Africa), the protection offered by an older, undamaged mosquito net may be significantly better than a newly impregnated but damaged net, which would be a favorable argument to introduce repair kits. In any case, the precise formulations and working conditions of such a kit should be tried and tested in the field before roll-out.

One point which had not been sufficiently addressed in the past was the disposal of badly damaged nets. In this survey, net disposal typically consisted of re-use, burning, throwing away and/or simple storage for future purposes. None of these solutions is ideal, and in the case of re-use could potentially be hazardous, e.g. when impregnated nets are recycled as material (rope, etc.) used for water collection. This issue should be given further thought, and solutions such as organized collection for controlled recycling should be considered.

5.2.3 Future perspectives

In addition to the future modeling work discussed above, further detailed analysis of the questionnaires is warranted. On two counts in particular, a more refined analysis could lead to deeper insights into net usage and practice:

- A detailed analysis of who was sleeping under a net, in particular in households with only one or two young children, could reveal whether the distribution of only one net at antenatal consultation is sufficient. The risk exists that the first net introduced into a household is used by the male head of the household for status reasons, and as such it does not reach the more vulnerable newborns. This potential problem would most likely be limited to households with only one or two newborns, as the subsequent accumulation of additional nets would allow coverage of the infants as well.

- Concerning net damage, the study has so far remained descriptive. However, the available data could be used to establish a classification system for net damage (e.g. “undamaged”, “light damage”, “heavy damage”, depending on the number of small and large holes). Such a classification could be used to evaluate who is sleeping under which kind of nets, whether the best nets are reaching the most vulnerable individuals, and which nets could be targeted for repair using the repair kits mentioned above, and which nets should be disposed of.

6 Conclusion

The distribution strategy of net donation to pregnant women at antenatal consultations and after the first round of vaccinations of their baby, complemented by mass distribution campaigns, can be considered effective, as on average, net possession rate per household was found to be 2.96, amounting to an average of 0.54 nets per person. Furthermore, 92% of the most vulnerable under five age group slept under a net, which can be considered a success. However, as a major contribution to net possession was made by the distribution campaigns, which were irregular and were outside the control of MSF, dissecting out the effects of the targeted distribution is difficult, and firm conclusions on this strategy are difficult to draw. More refined modeling approaches in this context may shed new light on this issue.

High rates of coverage and net possession were somewhat offset by poor knowledge and practice concerning net maintenance. Up to 32% of the nets in use were damaged to some extent, and practices such as (too) frequent washing (once a month in 76% of the households) and direct exposure to the sun (not considered problematic by 78% of the households) were widespread. These observations suggest the merit of further investment in health promotion activities to complement the distribution activities.

In addition to the described mapping of net distribution activities in Mali, this study has lead to the development of a surveying model (time and resource estimations, model questionnaire, general statistical approach), which has the potential to be applied in similar studies in the future.

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Annex I – Questionnaire

Questionnaire for a KAP survey on the use of mosquitonets (LN)

Cercle de Kangaba – Région de Koulikoro – MALI, November-December 2010, MSF Belgium

Team	Date	Village	N° of the cluster	N° of the household

1. **Demographical data of the household (see : definition of household !)**

1a. how many are you in the household?

Total number ☐ children <5 ☐ children 5-15 years ☐ women > 16 years ☐ men > 16 years ☐

1b. What is the highest level of education in the houshold

University ☐ Vocational ☐ Secondary ☐ Primary ☐ none ☐

2. **Quantitative data**

2a. How many mosquitonets are there in your household ?

2b. How did you get each mosquitonet (eg. bought, given...) ?

2c. How long have you had each mosquitonet ?

2d. On which occasion did you receive the mosquitonet (if applicable, eg. after vaccination, after prenatal visit, etc)

Total number of mosquitonets (M) =.....	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8
Origin (from where)								
How old (year)								
Which occasion								

3. **Check and observation of the mosquitonets actually found present**

3a. How many mosquitonets are actually present? ☐.

3b. How many mosquitonets are actually hanging above the sleeping place? ☐.

3c. If they are not hanging, why not?

1st reason:

.....

2nd reason:

.....

4. **Qualitative data**

The state of the mosquitonets. Number and size of holes (if any) for each mosquitonet

5. **Use of the mosquitonets**

5a. How many mosquitonets have been used last night? ☐.

5b. If not all mosquitonets were used, what is (are) the reason(s) ?

.....

.....

5c. Who has slept under a mosquitonet? (and who used the good and the bad nets ?)

Person N°	Sex M or F	Age	Slept under mosquitonet ? Yes or No	With holes Yes or No	Nr of small holes <small finger (0,5cm)	Nr of holes >=small finger (+0,5cm)
1.						
2.						
3.						
4.						
5.						

Person N°	Sex M or F	Age	Slept under mosquitonet ? Yes or No	With holes Yes or No	Nr of small holes <small finger (0,5cm)	Nr of holes >=small finger (+0,5cm)
6.						
7.						
8.						
9.						
10.						
11.						
12.						

6. **How the mosquitonets are treated**

6a. Do you wash the mosquitonet? Yes ☐ No ☐

6b. How often? Monthly ☐ Three-monthly ☐ Twice a year ☐ Yearly ☐

6c. Is it necessary to treat the net with insecticide again? Yes ☐ No ☐

6d. Have you done this already? Yes ☐ No ☐ If yes, in which year ? ☐

6e. What do you do with a damaged mosquitonet?

……

6f. Can it be repaired? Yes ☐ No ☐ Have you already repaired one? Yes ☐ No ☐

7. **Communication about the IEC received**

7a. Can you explain how exactly a mosquitonet is used?

Hang above the sleeping place	Tucked under the mattress / mat	Tied up during the day	Washed when dirty	Do not expose to direct sunlight

7b. Has somebody explained to you how to use a mosquitonet? Yes ☐ No ☐

7c. If yes, who?

……

7d. Have you been visited by the team of Health Promoters ?

At home Yes ☐ No ☐ In your neighbourhood Yes ☐ No ☐

7e. Have you been instructed how to use a mosquitonet when you were given one in the Health Centre ?

Yes ☐ No ☐

8. **Opinions**

What is your opinion on mosquitonets?

Positive	Negative
……	……
……	……
……	……
……	……

9. **Other**

Would you buy a mosquitonet if it is available on the market ? Yes ☐ No ☐ don't know ☐

If yes, why?

……

If no, why not?.....

10. **Any personal observation by the survey team (only remarks which have any relevance to this survey)**

……

……

……

Annex II – MSF-OCB net distribution data

Nets distributed during antenatal consultations and at first round of vaccination, 2006-2010 (MSF-OCB data)

	2006	2007	2008	2009	2010	TOTAL
Kangaba	1,073	1,286	1,405	1,490	845	6,099
Kéniéba	602	702	867	819	597	3,587
Naréna	989	1,128	1,101	1,130	697	5,045
Karan	742	711	707	716	400	3,276
Salamalé	661	502	549	603	363	2,678
Kéniégoué	962	1,087	1,152	1,066	628	4,895
Tombola	675	984	859	906	665	4,089
Balan Bakama	0	0	439	609	377	1,425
Manicoura	0	0	65	531	313	909
Selefougou	0	0	226	653	378	1,257
Figuira Tomo	0	0	329	929	551	1,809
Total	5,704	6,400	7,699	9,452	5,814	35,069