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Original article

Distribution of Subsidized Insecticide-treated Bed Nets through a Community Health Committee in Boboye Health District, Niger

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Abstract: In Niger, insecticide-treated bed nets (ITNs) have been distributed to the target group of households with young children and/or pregnant women at healthcare facilities in the course of antenatal/immunization clinics. With the aim of universal coverage, ITNs were additionally distributed to households through strengthened community health committees in 2009. This study assessed the impact of the community-based net distribution strategy involving community health committees in the ITN coverage in Boboye Health District, Niger. A cross-sectional survey was carried out on 1,034 households drawn from the intervention area (the co-existence of the community-based system together with the facility-based system) and the control area (the facility-based system alone). In the intervention area, 55.8% of households owned ITNs delivered through the community-based system, and 29.6% of households exclusively owned ITNs obtained through the community-based system. The community-based system not only reached households within the target group (54.6% ownership) but also those without (59.1% ownership). Overall, household ITN ownership was significantly higher in the intervention area than in the control area (82.5% vs. 60.7%). In combination, the community-based system and the facility-based system achieved a high ITN coverage. The community-based system contributed to reducing leakage in the facility-based system.

Key words: insecticide-treated bed net, community-based net distribution, community participation, malaria, Niger

INTRODUCTION

Insecticide-treated bed nets (ITNs) have been adopted as the principal control strategy in malaria endemic countries [1]. By providing protection against mosquito bites, the use of ITNs has shown to be highly effective in reducing morbidity and mortality from malaria [2, 3]. In sub-Saharan Africa, where an estimated 90% of the world's malaria-attributable deaths occur, intensive efforts have been made to increase coverage of ITNs among the target group, which includes children under the age of five years (U5 children) and pregnant women [1], as malaria can lead to more serious consequences in this group [4].

Although ITN coverage has dramatically improved in many sub-Saharan African countries, coverage remains below the Abuja target of 80% protection in the target group [1]. There is a need to identify distribution strategies targeting previously unreached U5 children and pregnant women [5, 6]. Furthermore, the importance of ITN use among entire populations has been increasingly recognized. A study suggested that coverage of entire populations is required to accomplish large reductions to the malaria burden of Africa,

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and that high but exclusively targeted coverage of young children and pregnant women would provide only limited protection [7]. In 2007, the World Health Organization recommended full ITN coverage of all people at risk of malaria, even in high-transmission settings [8].

With 60% of the population living on less than one USD per day, Niger is one of the poorest countries in sub-Saharan Africa. The mortality among U5 children was 259 per 100,000 live births in 2004, 14% of which were attributable to malaria [9]. In the course of routine ITN distribution, public healthcare facilities distribute long-lasting ITNs free of charge to caregivers of U5 children and pregnant women through immunization/antenatal care clinics [1]. In 2005, a nationwide health campaign with supplemental immunization and long-lasting ITN distribution took place. However, household ITN ownership still falls short of 80% coverage, and thus additional delivery channels need to be explored [5].

In some countries other than Niger, ITN distribution occasionally takes place outside healthcare facilities, and community members play an important role in ITN distribution. In Laos, for example, community members including village health volunteers help to carry ITNs from the healthcare facility to the community and to distribute them among households [10]. A similar community-based net distribution system is in place in many countries including Bangladesh, Vietnam, Kenya and Nigeria [11–14].

In collaboration with government and local health authorities, the Japan International Cooperation Agency implemented a malaria control project in Boboye Health District, Dosso Region, between 2007 and 2010. The project aimed to reduce mortality and morbidity due to malaria and focused on community-based malaria control activities with the assistance of a community health committee, Comité de Santé (COSAN), which has been mobilized by the government to promote health in the community since 2001. Although there is no specific job description, the project expected COSAN to play a critical role in distributing bed nets, educating community people about malaria and its control measures including the appropriate use of bed nets, and promoting community activities including environmental modification of potential vector breeding sites. The present study sought to assess the impact of the community-based net distribution strategy using COSAN on the coverage and use of ITN in the Boboye Health District, Niger. The specific objective was to compare differences in the household ownership of ITN, use of ITN, equity ratio of ITN ownership and knowledge pertaining to malaria between intervention and control areas.

MATERIALS AND METHODS

Study site

Boboye Health District is located in the western part of Niger, approximately 110 km from Niamey, the country's capital. In 2001 the district covered an area of 4,794 km^2 and had a population of 329,187 people. The residents of Boboye are predominately engaged in subsistence farming; the cultivation of millet and maize and keeping of sheep and cows are common. Malaria is the leading cause of morbidity and mortality in the district and accounts for 45.7% (30,933/67,714) of reported outpatient visits to the district hospital. Public healthcare facilities include one district hospital, 23 health centers (Centre de Santé Integré), and 60 health posts (Case de Santé) [15].

Intervention

A preliminary survey conducted in 2008 found that COSAN functioned in only five of the 63 villages in the project intervention area. The project helped to establish COSAN where it was not in place and strengthened the committees by holding a sensitization meeting and facilitating an election for COSAN core members such as head, deputy head, accountant and clerk at each village. Before the election, villagers prepared the list of candidates who resided in the village. Candidates for clerk were confined to villagers who were able to write, while candidates for accountant had to be able to do simple mathematical calculations. In the election, villagers selected core members by voting. As a result of the election, a village head and/or traditional birth attendant was often selected as a core member. The project also provided core members with training on activity-planning, problem-solving, accounting and malaria prevention. A one-day training session was held four times between July and November 2008 and a three-day training session was held five times between June and August 2009. In total, 260 core members participated in one of the training sessions.

Through the strengthened COSAN, the project distributed long-lasting ITNs to households irrespective of whether they included young children or pregnant women. First of all, the project asked COSAN to identify households willing to buy a net at a highly subsidized price (around 600 CFA or approximately 1.2 USD). Secondly, COSAN collected money from the households prior to distributions and listed those that had paid. Thirdly, the project invited COSAN to congregate at a designated place such as the nearest public healthcare facility or village to provide them with nets according to the lists of households that they had prepared. Fourthly, COSAN delivered the nets to the listed households after a brief explanation on how to use

them. Finally, the project guided COSAN to manage and spend the collected money on malaria control and other health-related activities. These activities included village clean-up campaigns, health education campaigns and repair of village wells and healthcare facilities. Net distribution was conducted twice in 2009: between February and April, and between July and September. In total, 7,836 long-lasting ITNs (PermaNet® and OlysetNet®) were distributed in the 63 villages of the project area.

To start, the project selected five health centers out of a total of the 23 for its intervention and defined the catchment areas of these five health centers as the intervention area, where most of the project activities took place. Other areas of the district were defined as a control area containing 18 health centers.

Data collection

As a part of the project evaluation, a cross-sectional survey was carried out in 30 villages (15 each from the intervention and control areas), between January and February 2010 (Fig. 1). Using a village list of the Boboye Health District, three villages were randomly selected from the catchment area of each of five health centers in the intervention area, with probability proportional to estimated population size. Then, using a household list obtained from a local administrative office, 35 target households and some extra households, which would be replaced with a target household if a target household happened to be unavailable, were randomly selected for each village. For the control area, five health centers, which matched the five health centers in the intervention area in terms of population size, were chosen. Then, 15 villages and 35 households with extra households per village were selected in the same manner as the intervention area. The study village selection was restricted to 109 administrative villages from a total 151 villages in the study site. Forty-two villages were excluded from the study, either because they were non-administrative villages without a list of households or because they were hamlets with a very small population.

Surveyors visited the target households to conduct an interview with household members, mostly women of reproductive age. When a target household had no adult household members, the target household was replaced with an extra household or a neighboring household in the event

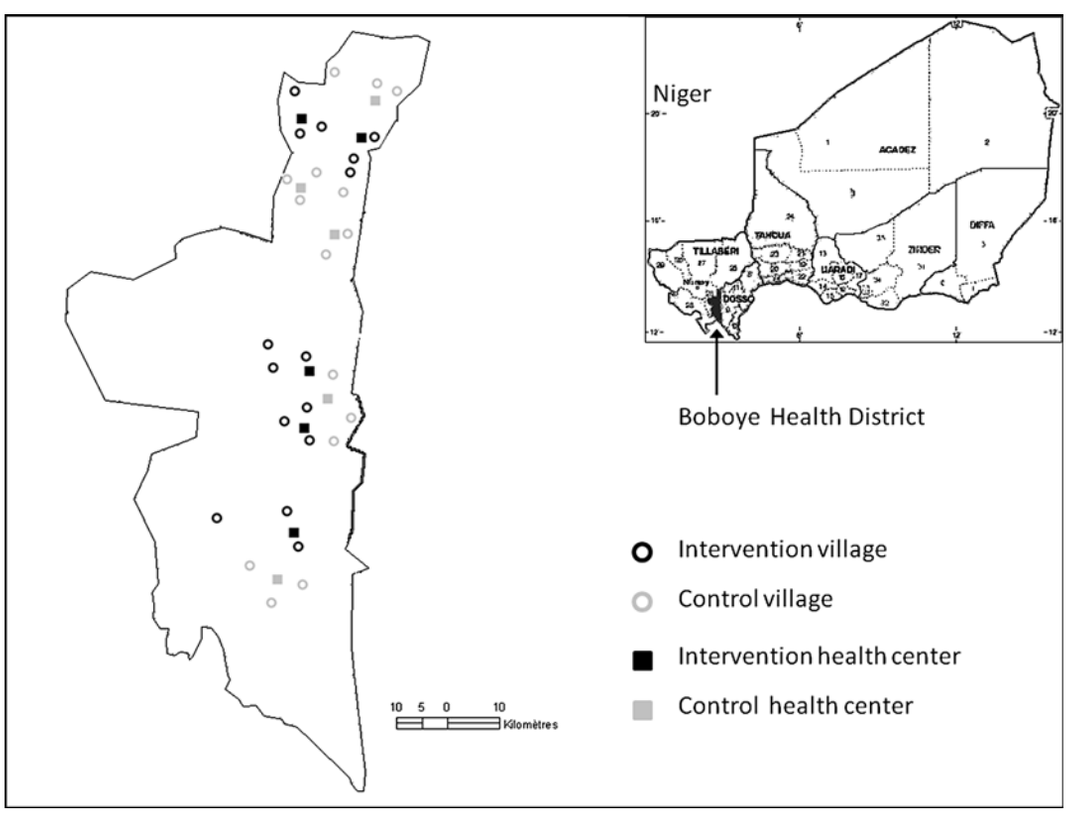

Fig. 1. Map of Boboye Health District showing the study villages. The map inserted in the top right of the figure is the country of Niger; Boboye Health District is highlighted in red. Red circles and squares indicate the locations of the intervention villages and health centers, respectively. Blue circles and squares indicate the locations of the control villages and health centers, respectively.

that an extra household was also unavailable. During the interview, the surveyors collected demographic information (age and sex of each household member); socio-economic information including the possession of household assets (radio, mobile phone, watch, motorbike, bicycle, car, animal drawn-cart and domestic animals including sheep and donkey), house type (mud wall house, straw hut or cement/bricks) and educational attainment of each household member (no formal education, primary or secondary, or above); respondent's knowledge pertaining to malaria (cause and preventive measures); and net-related information (place and time where each net was obtained and use of net the night preceding the survey by individual household members). The question regarding use of a net the night preceding the survey was asked regardless of the possession of nets. The surveyors also observed the nets in each household to determine whether they were hung and whether they bore the mark that the project put on its nets before distribution.

The study protocol was approved by the National Malaria Control Programme, Niger. Verbal consent was obtained from household respondents before the survey was conducted.

Statistical analysis

Principal component analysis was used to assess the extent of household assets and house type and to build a wealth index by which households were ranked and divided into quintiles [16]. Equity of household ownership of ITN was measured with an equity ratio defined by the ratio of household ownership of ITN in the poorest quintile to that in the wealthiest quintile. The closer the ratio was to 1, the greater the equity. Both the wealth index based on household assets and the equity ratio have been widely used elsewhere [5, 17, 18].

Statistical analysis was performed using Stata 12 (StataCorp LP, Texas, USA). As the cluster sampling design with village being a primary sampling unit was adopted in this study, village clustering was controlled, using the "svy" command of Stata [19]. Differences between the intervention and control areas were analyzed using a generalized linear model and chi-square test. Poisson distribution with log link function was used for the count variables such as the number of household members and age, whereas binomial distribution with logit link function was used for the continuous variable such as the wealth index. Chi-square test was used for the categorical variables. A p-value of <0.05 was accepted as statistically significant.

RESULTS

No households refused to participate in the survey. However, due to the absence of adult members in some of the selected households, 102 neighboring households (43 in the intervention area and 59 in the control area) were alternatively surveyed and the total number of surveyed households did not reach the intended number of 35 in each of two villages. In total, the survey covered 1,034 households (520 intervention, 514 control), with 5,788 household members (2,900 intervention, 2,888 control area) including 1,229 U5 children and 134 pregnant women.

Socio-demographic and economic status

The mean number of household members was 5.59 in the intervention area and 5.61 in the control area (Table 1). Most of the households had at least one U5 child (71.9% intervention, 69.8% control). Far fewer had a pregnant woman (12.3% intervention, 12.1% control). The heads of households were mostly males with no formal education.

Table 1. Characteristics of the households

Characteristic	Households		
	Intervention (n = 520)	Control (n = 514)	p-value
Number of household members, mean (SD)	5.59 (2.55)	5.61 (2.60)	0.93[a]
Households with a child under the age of five years, n (%)	374 (71.9%)	359 (69.8%)	0.73[b]
Households with a pregnant woman, n (%)	64 (12.3%)	62 (12.1%)	0.87[b]
Wealth index, mean (SD)	3.35 (1.19)	3.23 (1.22)	0.43[a]
Sex of household heads, male/female	454/66	429/85	0.32[b]
Age of household heads (years), mean (SD)	46.6 (14.8)	47.7 (15.9)	0.54[a]
Educational attainment of the household heads, n (%)			0.55[b]
No formal education	471 (90.6)	477 (92.8)	
Primary	38 (7.3)	26 (5.1)	
Secondary or higher	11 (2.1)	11 (2.1)	

[a]Generalized linear model, [b]Chi-square test

The mean score of the wealth index was 3.35 in the intervention area and 3.23 in the control area. No statistically significant differences were observed among these characteristics.

Net ownership

In the intervention area, the households possessed a total of 1,118 nets. These were comprised of 908 (81.2%) ITNs, 204 (18.2%) conventional nets defined as a bed net other than ITN and six (0.5%) nets of unknown type. In the control area, the households possessed 815 nets comprised of 500 (61.3%) ITNs, 314 (38.5%) conventional nets and one (0.1%) net of unknown type.

Household ownership of ITNs distributed through any channel was significantly higher in the intervention area than in the control area (82.5% vs. 60.7%; $p < .001$) (Table 2). The difference remained significant even when households were divided into two groups according to presence of U5 children or pregnant women. In the intervention area, 85.4% of households with U5 children/pregnant women owned an ITN, compared to 68.3% in the control area ($p < .001$). Similarly, among households without U5 children/pregnant women, household ownership of ITNs was higher in the intervention area than in the control area (74.5% vs. 40.8%; $p < .001$).

In the intervention area, 55.8% of households owned ITNs delivered through the community-based system, and 29.6% of households only had ITNs delivered through the community-based system. In the control area, only 1.6% of the households owned ITN delivered through the community-based system. When comparing households with U5 children/pregnant women and those without, household ITN ownership differed greatly between households with U5 children/pregnant women and those without in the facility-based system (55.9% vs. 34.3%; $p < .001$). In contrast, in the community-based system, household ITN ownership was almost the same between households with U5 children/pregnant women and those without (54.6% vs. 59.1%; $p = .74$).

Equity for ITN ownership

The equity ratio for ownership of any ITNs was higher in the intervention area (0.80) than in the control area (0.54) (Table 2). This indicated that household ITN ownership was more equitable in the intervention area than in the control area. The same trend was seen even when households were divided into two groups according to the presence of U5 children or pregnant women.

Use of nets

During the survey, almost all of the nets were hung (94.0% intervention, 96.6% control). People in the intervention area were significantly more likely to sleep under an

Table 2. Comparisons of household net ownership and equity ratio between intervention and control areas

	Total			Households with U5 children/pregnant women			Households without U5 children/pregnant women		
	Intervention (n = 520)	Control (n = 514)	*p*-value[a]	Intervention (n = 383)	Control (n = 372)	*p*-value[a]	Intervention (n = 137)	Control (n = 142)	*p*-value[a]
Households owning any ITNs, n (%)	429 (82.5)	312 (60.7)	<0.001	327 (85.4)	254 (68.3)	<0.001	102 (74.5)	58 (40.8)	<0.001
Households owning ITNs obtained from the community-based system, n (%)	290 (55.8)	8 (1.6)	<0.001	209 (54.6)	6 (1.6)	<0.001	81 (59.1)	2 (1.4)	<0.001
Households owning ITNs obtained from the facility-based system, n (%)	261 (50.2)	291 (56.6)	0.24	214 (55.9)	240 (64.5)	0.16	47 (34.3)	51 (35.9)	0.82
Households owning ITNs obtained from other channels, n (%)	22 (4.2)	28 (5.4)	0.49	17 (4.4)	19 (5.1)	0.73	5 (3.6)	9 (6.3)	0.29
Households owning ITNs obtained only from the community-based system, n (%)	154 (29.6)	5 (1.0)	<0.001	102 (26.6)	3 (0.8)	<0.001	52 (38.0)	2 (1.4)	<0.001
Equity ratio for ownership of any ITNs	0.80	0.54	—	0.86	0.67	—	0.66	0.28	—

[a]Chi-square test

Table 3. Comparison of previous night's ITN usage

Group	People who used ITN		*p*-value[a]
	Intervention (n = 2,900)	Control (n = 2,888)	
Children under the age of five years, n (%)	526 (82.8)	429 (71.4)	0.057
Pregnant women, n (%)	51 (76.1)	42 (64.6)	0.18
People other than children under the age of five years and pregnant women, n (%)	1,607 (73.1)	1,254 (56.4)	0.003
Total, n (%)	2,184 (75.3)	1,725 (59.7)	0.005

[a]Chi-square test

ITN than those in the control area on the night before the survey (75.3% vs. 59.7%; $p = .005$) (Table 3).

Knowledge

Most of the respondents in both intervention and control areas understood that mosquito bites can cause malaria (89.2% vs. 87.4%; $p = .55$). Additionally, more than half of the respondents believed sleeping under a net to be the most effective way to prevent malaria (63.8% vs. 66.8%; $p = .38$).

DISCUSSION

This study showed that more than half of the households in the intervention area owned ITNs delivered through the community-based system, which reached households with and without U5 children/pregnant women to the same extent. A more equitable household ownership of ITNs was observed in the intervention area than in the control area. In the intervention area, a community-based net distribution system was implemented together with the existing routine facility-based net distribution system. The combination of the two systems achieved high ITN coverage and met the Abuja target of 80% protection of young children and pregnant women, a target that is yet to be achieved in most sub-Saharan African countries [1].

Previous studies have reported a number of factors influencing household ITN ownership, including the price of nets, access to net distribution posts, community ITN needs/knowledge, and logistics [20–22]. In Niger, where the population is sparsely distributed and the number of healthcare facilities limited, access may be the principal constraint for household ITN ownership [5, 17, 23]. In the present study, the community-based net distribution system allowed people to obtain ITNs without visiting healthcare facilities or distribution posts. This could contribute greatly to increasing access to ITNs in the communities, particularly those that are more isolated [24].

Our results showed that the equity ratio was higher in the intervention area than in the control area, suggesting that the community-based net distribution system contributes to achieving more equitable coverage of ITNs in the intervention area. A possible reason for this is that, for the poorest quintile, the price of ITNs determined by COSAN was affordable. In addition, as shown in our results, community people recognized the value of ITNs for malaria prevention and thus community demand for ITNs may be high.

A number of studies reported that net possession does not necessarily translate into use. This is partly due to a lack of understanding of the link between mosquito bites and malaria infection [25, 26]. The results of the present study showed that respondents in both intervention and control areas had good knowledge about malaria cause and prevention and that almost all of the nets they possessed were hung (i.e., in use), suggesting that knowledge was conducive to net use in both areas. In other words, the higher ITN usage in the intervention area than in the control area may not be due to knowledge, but simply due to the higher household ownership of ITN in the intervention area.

This study has three major limitations. First, because a pre-intervention survey was not conducted, it was not possible to evaluate changes in household ITN ownership before and after the intervention. However, intervention and control areas are probably comparable, because there was no significant difference in socio- demographic and economic characteristics or household ownership of ITNs delivered through the facility-based system between the two areas. Second, for the study village selection, non-administrative villages without a list of households and hamlets with a very small population were excluded. This suggests that our data may over- or under-estimate household ownership of ITNs in the study site. However, the significance of this factor on the data is probably minor because these excluded villages account for only a fraction of the population in the study site. Finally, the long-term impact of training for COSAN core members on net distribution activities was not evaluated. The net distribution took place within a year from the training sessions, and COSAN core members were actively and successfully involved in the distribution. However, this does not necessarily ensure the long-term impact of training. Follow-up training may be necessary to sustain COSAN activities.

Scaling-up the community-based net distribution system should be easy if COSAN, which is supposed to play a critical role in promoting health in a community, is strengthened. Because COSAN is not confined to malaria control but can be utilized for a range of health promotion activities, COSAN has the potential to draw wide attention from donor agencies or NGOs which will help to strengthen COSAN if a success example is presented.

In conclusion, a combination of the community-based net distribution system and the facility-based net distribution system achieved high ITN coverage in the intervention area. The net coverage met Abuja targets calling for 80% protection of young children and pregnant women. The community-based system, which aimed at universal ITN coverage, contributed to reducing leakage present in the facility-based system by distributing nets within and beyond households with U5 children and pregnant women. To further increase ITN coverage in sub-Saharan Africa, a community-based net distribution strategy that makes use of community organizations could be applied as a complementary approach.

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