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PERCEPTIONS OF BED NETS AND MALARIA PREVENTION BEFORE AND AFTER A RANDOMIZED CONTROLLED TRIAL OF PERMETHRIN-TREATED BED NETS IN WESTERN KENYA

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Abstract. A study of mothers' perceptions regarding bed nets and malaria was conducted before and after a randomized controlled trial of insecticide (permethrin)-treated bed nets (ITNs) in western Kenya. Awareness about the trial and the rationale for bed net use increased by the end of the trial. Knowledge that mosquitoes caused malaria also increased; however, a higher proportion of mothers from control, rather than intervention villages, cited this (44.4% versus 27.9%; $P < 0.001$). Mothers from intervention villages were more knowledgeable about the use and maintenance of bed nets and re-treatment with insecticide. Both groups specified advantages of ITNs. Mothers from intervention villages noted practical advantages such as protection against bedbugs and falling roof debris. Few (< 1%) mothers indicated that ITNs protected children against malaria. Intervention homes used significantly fewer mosquito coils, insect spray, medicines, and burned cow dung less often compared with those in control villages. Mothers were willing to pay approximately U.S. $ 4.5 for a regular bed net, but only U.S. 10.5 cents (intervention) and 0.036 (control) for re-treating a bed net. This study suggests that, despite two years of experience of use, bed nets and insecticides would not be purchased as a household priority in this impoverished rural community.

INTRODUCTION

Current policy options for malaria control include prompt and effective disease treatment, and disease prevention through use of insecticide (permethrin)-treated bed nets (ITNs).[1] A review of results of efficacy trials of ITNs in sub-Saharan Africa concluded that their correct use can save up to six lives for every 1,000 protected children less than five years of age.[2] In a mortality trial in western Kenya, an estimated 34.5 lives would be saved per 1,000 infants protected with bed nets if they were re-treated twice a year with permethrin.[3] Whether similarly impressive results could be attained by malaria control programs remains to be seen.[4,5] Nonetheless, ITNs are potentially a valuable component of African malaria control programs. In most malaria-endemic communities, ITN coverage remains less than 10% and rates of re-treatment with insecticide decrease dramatically with the introduction of cost-recovery systems.[6,7] However, a social marketing program in Tanzania increased ITN coverage from 10% to 60%, with a concomitant significant improvement in child survival.[8] It is not known whether the success achieved in such programs will be sustained, particularly on a national scale. Of major concern is whether people are willing to purchase bed nets and insecticide routinely to protect their children against malarial disease. Better understanding of people's perceptions of malaria and its perceived cause, preventive action, and value attached to ITNs is needed for planning bed net programs.[9–11]

In this paper, we report on the perceptions of mothers of malaria, malaria prevention, and ITNs before and after a two-year group-randomized controlled trial of ITNs. We explore whether information disseminated for the trial was recalled at the trial's end, and whether experience with use of ITNs would influence their decision to purchase bed nets and have them re-treated with insecticide in the future.

MATERIALS AND METHODS

Study site and population. This paper forms part of a multidisciplinary trial of the efficacy of ITNs on child morbidity and mortality in rural western Kenya. Details of the study site and population are presented elsewhere.[12,13] The 200-km^2 study site of Asembo is 50 km west of Kisumu on the shores of Lake Victoria, western Kenya. The population is predominantly Luo, living in highly dispersed villages. Most inhabitants are subsistence farmers, with some fishermen or traders of perishable foods or grain. Baseline studies revealed low coverage (<5%) with untreated bed nets, with preference in bed net use given to adults and visitors to avoid mosquito nuisance.[14] Rainfall occurs year-round with two main peaks: the long rainy season between March and April, and the short rainy season between November and December. Total annual rainfall averages more than 1,000 mm. Malaria is holoendemic, with entomologic inoculation rates between 60 and 300 infective bites per person per year.[15] Up to 80% of the children less than five years of age are infected with *Plasmodium falciparum* malaria at any time.[15,16] Before and during the trial, an intensive campaign was conducted to disseminate information about the trial using different media.[12] The campaign emphasized several messages: 1) children are the group most vulnerable to malaria and thus the main target for ITN use, 2) mosquitoes alone transmit malaria, 3) ITNs can reduce child morbidity and mortality due to malaria, and 4) ITNs should be used every night year-round for maximum protection. Open meetings held in the villages provided an opportunity for discussions about the trial and its methods.

Study design. A pre-intervention study in March 1996 and a post-intervention survey conducted in January 1999 are the data sources for this study. The pre-intervention survey was conducted at the same time intensive community health edu-

cation was beginning. Multistage sampling was used to randomly select 600 of 8,707 compounds for each survey. Computer-generated lists, derived from the project-initiated household census,[12,13] defined households with children less than five years old for sampling. Interviewers were given pre-allocated lists of survey houses, by village. The post-intervention sample was stratified by intervention status prior to randomly selecting 300 homesteads each from intervention and control villages.

Baseline ethnographic studies were used to design a pre-coded questionnaire, which was translated into *Dholuo*, the local language, and pre-tested. Thirteen local field supervisors, trained for the interviews and fluent in Dholuo, conducted the surveys. The survey took place within the home of the respondent. Respondents were not prompted on answers during interview. Questions used in the post-intervention survey were an adaptation of the pre-intervention baseline questionnaire. Respondents were asked at both surveys specific questions on their knowledge of the causes of malaria, existing household protection from malaria, including use of traditional and commercial mosquito prevention measures, and cost of protective strategies deployed in the past three months. Questions on health communication asked about educational strategies to which mothers had been exposed, and key project messages they could recall. Questions on bed net use included current bed net ownership, source, cost, and advantages and disadvantages of ITNs. Since less than 5% of the population used untreated bed nets prior to the trial, and because health communication had just began at the time of the pre-intervention survey, questions specific to health communication and ITN use were asked only post-intervention. The post-intervention survey included some questions about interest in investing in bed nets and net re-treatment. This was not a formal contingent valuation survey such as that conducted by Onwujekwe and others.[17] Respondents were asked to rank in order of priority, without being presented with a list of alternatives, what their spending preferences would be if hypothetically given 1,000 Kenya Shillings (KSH) (approximately U.S. $20). Respondents were also asked if they would pay for net re-treatment at 60 KSH per bed net, based on local Population Services International's estimated cost of K-O-tab® (Bayer Environmental Sciences, East Hawthorn, Victoria, Australia), a bed net re-treatment tablet. We also asked about the price and numbers of regular-size nets people could purchase and who would get priority coverage if nets were limited. Finally, we asked about sources of income and how income varied seasonally, and solicited information on household decision-making processes for cash expenditure on items such as bed nets.

Data analysis. Data were entered into Clarion Release 2.1 (Topspeed/Soft Velocity, Pompano Beach, FL) using data screens with automatic range and consistency checks. Data were further checked for consistency using SAS Release 8.1 (SAS Institute, Cary, NC). Analysis was done using SPSS Releases 9.0 and 10.0 (SPSS, Inc., Chicago, IL). Proportions were compared using chi-square tests and independent-samples *t*-tests. To reduce the 19 items relating to recall of key messages into meaningful categories, 13 items with non-skewed distributions were subjected to principal components analysis resulting in a one -factor solution that explained 20.85% of the total variance. The Kaiser-Meyer-Olkin score was 0.736, and the Bartlett's test of spherity value was 0.001. Reliability of the factor for analysis was tested, resulting in a reduction to nine items with $\alpha = 0.70$. Based on the nine items, a recall scale was developed, assuming a score of 1 for each item in the scale. The scale had a normal distribution.

RESULTS

Of 600 different households visited in each arm of the study, data were available for analysis on 595 and 594 interviews performed pre- and post-intervention, respectively. The mean age of mothers was 28.3 years and they had a mean 7.3 years of education. Mothers had a mean of 1.6 children less than five years old. There were no significant differences in the age, educational level, or number of children of mothers pre- and post-intervention, or between mothers residing in ITN and control villages.

Pre-intervention findings. Before the trial started, 75% of the mothers recognized mosquitoes as a cause of malaria, with 27% attributing mosquitoes to be its sole cause (Table 1). A higher proportion (47%) stated that getting cold was the sole cause of this disease. Mosquito coils were reportedly used by 43% of the households, and one-third of the mothers burned cow dung (Table 2). More than half indicated that medicines were used for malaria (treatment, not prophylaxis). Use of bed nets (4%) and insecticide sprays (5%) were uncommon. In this preliminary phase, after information dissemination had begun, knowledge of the trial and proposed activities were limited. The focus of the trial, the prevention of malaria, was understood by 13% of those surveyed, with less than 1% recognizing that prevention of malaria in children and preg-

TABLE 1
Perceived causes of malaria before and after the bed net trial*

Perceived causes of malaria	Intervention			After: by intervention status		
	Before No. (%)	After No. (%)	*P*	Control No. (%)	ITN No. (%)	*P*
Mosquitoes alone	162 (27.2)	215 (36.2)	0.001	132 (44.4)	83 (27.9)	0.001
Getting cold	278 (47.0)	304 (51.2)	0.146	135 (45.5)	169 (56.9)	0.005
Unclean water	37 (6.3)	29 (4.9)	0.304	16 (5.4)	13 (4.4)	0.568
Getting rained on	36 (6.1)	21 (3.5)	0.540	7 (2.4)	14 (4.7)	0.120
Some foods	25 (4.2)	21 (3.5)	0.540	10 (3.4)	11 (3.7)	0.824
Mosquitoes, included with other causes	443 (75.1)	505 (85.0)	0.001	254 (85.5)	251 (84.5)	0.730
Climate change	35 (5.9)	33 (5.6)	0.803	12 (4.0)	21 (7.1)	0.107
Spirits	–	3 (0.5)	–	1 (0.3)	2 (0.7)	0.120
Other: dirt, heat, etc.	–	4 (0.7)	–	3 (1.0)	1 (0.03)	–

* ITN = insecticide-treated bed net.

TABLE 2
Reported measures used to prevent mosquitoes and malaria before and after the bed net trial*

Measures used	Frequency (%) of use before and after (by intervention status)			*P*		
	Before No. (%)	After (control) No. (%)	After (ITN) No. (%)	Before versus after (control)	Before versus after (ITN)	After: control versus ITN
Medicines	170 (57.2)	132 (44.4)	68 (22.9)	0.002	0.001	0.001
Herbs/cow dung	101 (34.2)	70 (23.6)	13 (4.4)	0.004	0.001	0.001
Mosquito coils	127 (42.8)	99 (33.3)	15 (5.1)	0.018	0.001	0.001
Insecticide spray	15 (5.1)	17 (5.7)	6 (2.0)	0.716	0.046	0.019

* ITN = insecticide-treated bed net.

nant women was a priority. None of the mothers offered knowledge about insecticide-treatment of bed nets, and 5% knew that some villages would be controls, while others would receive bed nets during the trial. When questioned on sources of information about the trial, one-fourth of the respondents mentioned community meetings (*barazas*), and 10% said they had read an information leaflet. Participatory theater, which was conducted in each village prior to the introduction of ITNs, was recalled by 6.5% of those surveyed.

Post-intervention findings. After two years of intervention, mothers' understanding about bed nets, malaria, and trial activities was significantly greater. Differences were evident between intervention groups (Table 1). Mosquitoes were more frequently mentioned as one of several causes of malaria at the end of the trial compared with at the start (85.0% versus 75.1%; $P < 0.001$). While the proportion of mothers who understood that mosquitoes alone caused malaria increased to 36%, significantly more than at the beginning of the trial ($P < 0.01$), the association appeared to be stronger in those from control villages than in those from intervention villages (44% versus 28%; $P < 0.001$). The proportion of mothers who associated getting cold with malaria remained constant, both before and after the trial and post-intervention, between the intervention and control groups. The proportion of mothers mentioning mosquitoes (anytime and alone) as a cause of malaria increased with educational level (Table 3). The proportion mentioning getting cold as a cause of malaria decreased with a higher level of education.

Nearly all participants were aware the trial had taken place (Table 4). A high proportion knew who was conducting the trial, and approximately 75% understood that the trial was testing the effect of ITNs, although a lower proportion understood that the end point of the trial concerned malaria and its prevention. Independent-samples *t*-tests to compare scores on the recall scale showed a higher score (mean ± SD = 5.25 ± 2.02) in intervention compared with control villages (mean ± SD = 3.97 ± 2.21; $P < 0.001$). Chi-square tests to compare specific key messages showed that information about the trial was better remembered by those from intervention villages. This included the presence of local committees, length of the trial, and most details about ITN use (Table 4). Less than 25% of both groups mentioned that the ITNs were given free of charge by the project.

At the end of the trial, 75% of the mothers cited the traditional birth attendant, locally called the *nyamrerwa*, as the main source of information about the study. Other important sources of information were the Kenya Medical Research Institute/Centers for Disease Control and Prevention field staff (37.7%), *barazas* (26.0%), and bed net calendars (24.6%). Less frequently cited were information sheets distributed during *barazas* (18%) and village bed net committees (13.8%). Role play through the participatory educational theater group was rarely mentioned (3.9%). No significant differences were noted between the intervention and control groups. Levels of valid information recall were similar for all information sources, except for village level *baraza.* Independent samples *t*-tests showed higher (mean ± SD = 4.79 ± 2.19) message recall scores for those mentioning mosquitoes as a perceived cause of malaria compared with those not mentioning mosquitoes at all (mean ± SD = 3.57 ± 2.06; $P < 0.001$).

Significantly more mothers from ITN villages, compared with control villages, stated bed nets should be used daily (68.0% versus 49.5%; $P < 0.001$). A significantly higher proportion from control villages said bed nets should be used when mosquitoes were evident (38.0% versus 25.3%; $P < 0.01$) or during rain (27.9% versus 14.2%; $P < 0.001$). Approximately 75% of mothers from both treatment groups understood that the purpose of bed nets was to protect against malaria. Other reasons for bed net use included preventing mosquito nuisance (45.5%), avoiding roof debris (9.4%), and warmth (4.9%). Privacy did not appear to be important (1.5%). No significant differences were noted between the ITN and control groups. The proportion of homes using additional control measures in the three months prior to the survey decreased significantly when compared with pre-intervention levels (Table 2). Intervention homes reportedly used significantly fewer mosquito coils ($P < 0.001$), less insecticide spray ($P = 0.019$), burned cow dung less often ($P <$

TABLE 3
Comparison of perceived causes of malaria by mother's level of education

Perceived causes of malaria	Primary education (1–7 years) No. (%)	Secondary education (8–12 years) No. (%)	High school or college (9–13 years) No. (%)	*P*
Mosquitoes, including other causes	95 (81.2)	612 (84.4)	180 (92.3)	0.009
Mosquitoes alone	34 (29.1)	229 (31.6)	88 (45.1)	0.001
Getting cold	70 (59.8)	387 (53.5)	81 (41.5)	0.002

TABLE 4
Awareness of the bed net trial two years after the introduction of bed nets*

Key message/question	Bed net No. (%)	Control No. (%)	*P*
Bed net trial			
Aware the trial existed	294 (99.0)	293 (98.7)	NS
Aware of village bed net committee	256 (86.2)	207 (69.7)	0.001
Aware who performs the trial	240 (80.8)	232 (78.1)	NS
Reason for using ITNs is to test if they prevent malaria	218 (73.3)	211 (71.7)	NS
How long trial would last	160 (54.2)	116 (39.1)	0.001
Aware trial is about malaria prevention	125 (42.1)	125 (42.1)	NS
Rationale for conducting census	118 (39.7)	99 (33.3)	NS
Aware why Asembo chosen for project	115 (38.7)	108 (36.4)	NS
Villages randomized as part of trial method	15 (5.1)	30 (10.1)	0.020
Trial mainly to protect children from malaria	1 (0.3)	–	NS
Bed nets			
Rationale for using insecticide in bed nets	272 (91.9)	225 (75.8)	0.001
ITNs should be dipped every six months	228 (76.8)	135 (45.5)	0.001
Who would retain nets at end of study	224 (75.4)	190 (64.0)	0.002
Correct use of bed nets = use every night	202 (68.0)	147 (49.5)	0.001
ITNs are to be washed every six months just before re-treatment	143 (48.1)	78 (26.3)	0.001
ITNs should be used daily/every night	129 (43.4)	85 (28.6)	0.001
ITNs are to be repaired if torn	109 (36.7)	72 (24.2)	0.001
ITNs are given free	69 (23.2)	64 (21.5)	NS
Malaria			
Mosquitoes alone cause malaria	83 (27.9)	132 (44.4)	0.001

* NS = not significant; ITN = insecticide-treated bed net.

0.001), and used fewer medicines ($P < 0.001$) compared with those in control villages. Other than a small but constant proportion of mothers using insecticide sprays, the use of other forms of protection also appeared to be lower in control villages compared with intervention villages. Use of medicines was correlated with the number of children less than five years old in both control ($P < 0.05$) and intervention ($P < 0.001$) villages.

Advantages and disadvantages of bed nets post-intervention. Regardless of treatment group, most (64.6%) mothers stated they liked ITNs because they protect against malaria. Some noted that ITNs gave warmth. Significantly more mothers from ITN villages stated they liked bed nets because they kept off and killed mosquitoes. Other significant differences between the treatment groups related to protection against other bugs and avoiding roof debris falling on the bed. The majority (82.3%) of mothers perceived no disadvantages of bed nets, although 25% of those from control villages indicated they did not know. Disadvantages listed by less than 5% related to heat, chemical smell, and daily mounting of nets. Not being able to wash bed nets for six months until re-treatment and the dark color of the bed nets was not mentioned.

Financial perceptions of ITNs post-intervention. Regardless of intervention status, decisions about spending surplus money are predominantly (67%) made by men. However, approximately 22.4% of the mothers said that they could make independent financial decisions, particularly about money raised through self-help projects. A few (7.7%) indicated decision-making was made jointly among persons providing the money (e.g., next of kin) and the adult members of the individual household. A minor role (2.9%) appeared to be played by mothers-in-law. When questioned on the best time of year to purchase bed nets or insecticide, a high proportion (89.1%) of the mothers stated only after the main harvest, while 6.6% stated any time of the year. Money could be raised by selling farm produce (75.3%) or pay-back of loans from kin (7.4%). Three percent would sell an animal or borrow money.

If given 1,000 KSH (approximately U.S. $20) to spend, few

TABLE 5
Distribution of spending preferences for respondents listing bed nets among priority items post-intervention*

	Spending preference 1		Spending preference 2		Spending preference 3	
	ITN No. (%)	Control No. (%)	ITN No. (%)	Control No. (%)	ITN No. (%)	Control No. (%)
Food items	166 (55.9)	127 (42.8)	58 (22.3)	65 (27.2)	36 (24.5)	21 (18.9)
Clothing items	30 (10.1)	31 (10.4)	71 (27.3)	64 (26.8)	31 (21.1)	32 (28.8)
Bed net	21 (7.1)	46 (15.5)	4 (1.5)	14 (5.9)	0 (0.0)	2 (1.8)
Medicine	8 (2.7)	8 (2.7)	23 (8.8)	22 (9.2)	14 (9.5)	7 (6.3)
Furnish house	9 (3.0)	5 (1.7)	10 (3.8)	10 (4.2)	5 (3.4)	2 (1.8)
Household utensils	4 (1.3)	8 (2.7)	19 (7.3)	8 (3.3)	14 (9.5)	15 (13.5)
Bicycle	5 (1.7)	0 (0.0)	3 (1.2)	1 (0.4)	1 (0.7)	0 (0.0)
School requirements	8 (2.7)	12 (4.0)	17 (6.5)	11 (4.6)	12 (8.2)	11 (9.9)
Others (e.g., buy a cow)	46 (15.5)	60 (20.2)	55 (21.2)	44 (18.4)	34 (23.1)	21 (18.9)

* ITN = insecticide-treated bed net.

(7.2%) mothers listed bed nets among the first three priority items they would wish to purchase (Table 5). Most listed food and clothing as the priority. Significantly more mothers from control villages indicated they would consider purchasing bed nets compared with those in the intervention villages (20.5% versus 8.4%; $P < 0.001$). The number of bed nets a family would purchase, if they were to pay, was negatively correlated with intervention status. Mothers from control villages indicated needing a mean ± SD of 3.15 ± 1.59 bed nets compared with 2.86 ± 1.18 from intervention villages. There was no association between the number of children less than five years old, mother's age or education, and the number of bed nets that mothers hypothesized buying. When asked how much they were willing to spend on a bed net, 78.6% of the mothers suggested paying at least 200 KSH (approximately U.S. $3.3), including 1.9% who hypothesized paying between 800 and 1,000 KSH (approximately U.S. $13.3–16.7), while 3.2% would pay less than 100 KSH. Overall, mothers from intervention villages suggested a mean ± SD of 257 ± 131 KSH, while controls indicated a mean ± SD of 278 ± 156 KSH ($P = 0.07$).

Three-fourths of the respondents said they would not pay for bed net re-treatment at an estimated cost of 60 KSH (approximately U.S. $1). When asked what they would pay instead, 368 (61.9%) said they would not want to pay at all. Of mothers suggesting an alternative price, those from intervention villages believed a mean ± SD of 6.3 ± 23.7 KSH was an appropriate cost, while those from control villages indicated a mean ± SD of 2.5 ± 8.4 KSH, which is significantly less than estimates from mothers in intervention villages ($P < 0.01$). Conversely, most (88.9%) indicated they would re-treat their own purchased bed nets twice a year, 7% said they would re-treat once a year, and 3% suggested other time periods.

Mothers thought bed net re-treatment would be best handled through women groups (24.7%), individual compounds (21.5%), village bed net committees (19.2%), or at clan level (9.1%). The remaining 25% thought it was a household affair and would depend on individual household arrangements as appropriate. However, bed net distribution should be done through traditional birth attendants (41.1%), local retail shops (9.4%), and local women groups (9.1%). Distribution through local towns was viewed as inappropriate due to distance.

DISCUSSION

Mothers' attitudes and behavior regarding malaria and its prevention in young children are important determinants of success in malaria control programs promoting ITNs in rural Africa. This study suggests that some, but not all, information disseminated to mothers about ITNs and malaria was received and retained. Awareness was significantly greater in mothers residing in intervention villages than in control villages. A number of factors contribute to this. While attempts were made throughout the trial to ensure equality in distribution of information, regardless of intervention status, it is possible that those in ITN villages received more reinforcement of messages at the time of re-treatment of bed nets, an activity undertaken in intervention villages only. Mothers from intervention villages may also have been more receptive to information faced with the daily reality of ITN use. It was thus surprising to find that a lower proportion of mothers from intervention villages identified mosquitoes to be the sole cause of malaria, compared with those from control villages. We hypothesize that this may have been motivated by their practical experience of ITN use. Information distributed during the trial indicated that ITNs reduce biting of mosquitoes and that mosquitoes are responsible for transmission of malaria. However, even with high coverage with ITNs, transmission still occurred, and mothers from intervention villages still witnessed their children becoming ill (albeit at a lower prevalence than in control areas).[18] This may be partly responsible for the observation that mothers in ITN villages still ascribed causation of malaria to causes other than mosquito-borne transmission. In parallel, mothers from control villages witnessed their children becoming ill and they associated malaria with the absence of ITNs. Previous trials have also noted that increased knowledge did not seem to resolve the gap between biomedical terms and local understanding of illness.[19,20] This type of dissonance clearly becomes even more problematic if mothers do not adequately understand the rationale and importance of re-treatment of bed nets with insecticide.

This concern is further strengthened by our disappointing finding that mothers neglected to associate the ITN trial with child health, despite the emphasis placed on this as the number one health message for the trial. This message was disseminated at community meetings, on information leaflets, during open-air theater, and on illustrated calendars, and ingrained upon all field staff, including traditional birth attendants, as a key discussion topic.[13] Furthermore, epidemiologic analysis of study results showed that ITNs were most effective in young children by decreasing the prevalence of anemia and episodes of acute malarial disease by some 40%,[18] by reducing the burden of sick child visits to peripheral health facilities by a third,[21] and by decreasing infant mortality by 26%.[3] Despite these beneficial outcomes observed at the population level, individual mothers did not necessarily perceive these benefits. This lack of perceived benefit of ITNs for individual child health may be responsible for our finding that adherence with ITN use was significantly lower in young children compared with older children and adults.[22]

Our results suggest that ITNs were generally liked by participants, even though less than 5% had prior experience with bed net use. We believe that the absence of disadvantages likely reflects the community's perception that mothers should give socially desirable answers, since before the trial a separate study revealed a number of limitations ascribed to bed nets.[23] Because ITNs were given free, and perhaps fear that they may be repossessed if negative sentiment was strong, this may have prompted an absence of named disadvantages. The majority of mothers could characterize advantages of ITNs, although those from control villages recalled the advantages described by the field staff, while those from intervention villages offered true practical advantages experienced during use. These latter attitudes are more reliable predictors of behavior than those acquired indirectly by those from control villages.[24] Therefore, the observation of more practical likes for ITNs in intervention villages may be a better indicator of likely behavior, providing useful information for program design. It is well understood that people tend to look for the practical benefits personally experienced than more strategic benefits such as malaria control.[25] The association of non-health-related advantages with bed net is not

unique to our study area.[26,27] To encourage year-round use of bed nets in areas with perennial malaria transmission, Winch and others suggested encouraging perceived benefits not related to climate or seasonality.[26] In our study area, these include avoidance of roof debris and crawling bugs, but how effective this might be depends on the importance of perceived benefits,[28] and the degree of fear or amount of inconvenience caused by crawling creatures.[29] Minja suggested reinforcing the message that even the bite of a single mosquito can be fatal.[27] This may be problematic when there is a lack of congruence between preventing nuisance biting and preventing disease, particularly when the abundance of nuisance *Culex* mosquitoes does not correspond seasonally with that of anophelines.[30]

In this study, bed nets ranked low among household expenditure priorities, regardless of intervention status. This supports similar findings from other ITN trial sites,[5,10] and preliminary research in our study area.[14] While most respondents envisaged paying nearly the current market price for a regular-size bed net, the general feeling was that nets are too expensive, highlighted by estimations up to U.S. $17 for the price of a regular-size net. Conversely, respondents could not envisage paying the price of an insecticide sachet at the current market value, indicating that insecticide treatment of bed nets may not be equally valued as owning the bed net itself. The social marketing of bed nets in Tanzania showed similar results, with people valuing bed nets more than bed net re-treatment despite subsidies for re-treatment.[8] The problem seems less of costs, and more of the value attached to use of insecticide in bed nets, and is perhaps due to the difficulty of perceiving direct benefits of the insecticide. While responses on willingness to purchase bed nets and insecticide are hypothetical and may not reflect ability to pay, they provide useful indicators for program planners. Portrayed lack of will to invest in nets in intervention households is understandable since they had already received free bed nets, while control households did not. It has been suggested that it might be more illuminating to ask people directly if they would spend money on bed nets, rather than ask open-ended questions on expenditures as we did in this study.[31] We chose the latter course in an attempt to minimize socially desirable answers. We note that mothers from intervention villages were hypothetically willing to pay two and a half-fold more (6.3 rather than 2.5 KSH) for insecticide than those from control villages, suggesting they placed a greater value on re-treatment. It was interesting to note that mothers from intervention villages failed to acknowledge that an advantage of ITNs was the financial saving associated with significantly less alternative mosquito control measures. These savings, including less frequent visits to peripheral facilities, and a reduction in costs for self-medication were not reported by any participants. An absence of any perception of the financial rewards of ITNs in the home adds further support to economic studies that predict that bed net coverage will not be sustained if the financial burden falls upon this impoverished rural community.[32] We conclude that bed nets and use of insecticides are acceptable and practically valued within this community, but despite their perceived advantages, they are not valued as a tool for protecting children against malaria. Despite the health impacts of ITNs, our study offers no evidence to suggest they would be purchased as a household priority.

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