

Assessment of Insecticide Treated Nets Coverage for Malaria Control in Kafta-Humera District, Tigray: Possession versus Use by High-risk Groups

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Abstract

Background: In endemic areas, children under five and pregnant women are vulnerable to malaria and are likely to benefit most from the use of mosquito nets. Use of insecticide treated nets (ITNs) for protection against mosquito bite during sleep is highly effective. Nevertheless, prioritization pertaining to the use of nets does not seem to be optimal in most endemic setups.

Objective: To examine the status of ITNs coverage, use and its determinants for malaria control among children under five and/or pregnant women in Kafta-Humera District in Tigray Regional State.

Methods: A comparative cross-sectional quantitative study was conducted in the rural and urban areas of the District. Qualitative data were also collected through focus group discussions (FGDs) to identify views of participants, pertaining to possession and utilization. An early morning survey was also carried out in order to observe the actual behavior of the community towards net use.

Result: Net and ITN possession was 84.5% and 80.0% for rural, but 96.1% and 91.1% for urban settings, respectively. Net possession was higher among urban (OR 3.33, 95%CI 1.39, 7.98) compared to rural areas. Observed net and ITN use during the preceding night by children under five years of age was 68.6% and 67.0% for rural; and 84.6% and 79.5% for urban areas, respectively. Likewise, similar practice for net and ITN in 52.1% and 64.7% of pregnant women was observed in rural and urban areas, respectively. The FGD results of this study suggested that lower net possession in rural areas could be due to insufficiency of mosquito net provision and inequity during distribution. Occupation, family size in rural areas; radio possession in urban areas and relative wealth and number of sleeping places had significant effect in both settings to own a net. Relative wealth, radio possession, malaria education message in rural and occupation in both settings had a positive effect on net use.

Conclusion: Not all nets owned by the households were being utilized properly. Yet, maldistribution and shortage of ITN were also observed within rural and urban settings. Effective Information, Education and Communication (IEC) should be promoted and continuous availability of ITNs should be in place to achieve effective control of malaria among the high-risk groups. [*Ethiop.J.Health Dev.* 2008;22(3):259-267]

Introduction

Malaria is the most important parasitic infection in endemic areas, accounting for more than 1 million deaths each year. Malaria kills a child somewhere in the world every 30 seconds. The majority of the deaths it causes occur in Africa (1). Over 90% of the malaria burden occurs in Sub-Saharan Africa (1, 2). There is consensus that about 0.5 billion clinical attacks of malaria take place every year, including 2-3 million severe attacks. In endemic areas, malaria infection in pregnancy is believed to account for up to a quarter of all cases of severe maternal anemia and for 10-20% of low birth weight babies (1). In Africa, one out of twenty children is likely to die of a malaria related illness before his/her fifth birthday (3).

In Ethiopia, more than three-quarter of the landmass (altitude <2000 m) of the country is malarious, and about 68% (>50 million people) of the total population is residing in areas at risk of malaria infections (4). Malaria is the leading cause of health problem in the country. The plasmodium species which have epidemiological importance in Ethiopia are *P. falciparum* and *P. vivax* (5,

6). *Anopheles arabiensis* is the major malaria vector and it breeds in small sun exposed pools mainly produced during the rains (5). Malaria transmission in Ethiopia is unstable and characterized by frequent and often large-scale epidemics (4, 7). In 2004, the disease was reported as the first cause of illness and accounted for 27% of deaths in Ethiopia (2)

Most malaria-carrying mosquitoes bite at night. However, the best hope lies with newly developed, long lasting treated nets, which may retain their insecticidal properties for four to five years, the life span of the net, thus making re-treatment unnecessary (8). The Abuja target for malaria prevention includes that 60% of children aged under five years and 60% pregnant women sleep under Insecticide Treated Nets (ITNs) by 2005 (9). The Roll Back Malaria Initiative (RBMI) has identified the under fives as one of the high risk groups for malaria, and one of the strategies to fight malaria in this group is to increase mosquito nets use (9).

In Kafta-Humera District, malaria transmission ranges from hypo-endemic to meso-endemic, with crude parasite

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rate reported in cross-sectional surveys to be ranging from 3-10% during high transmission months, and from 0-3% during low transmission months (5). In the study area, conditions conducive to both the vector and extrinsic parasite development occur from September through November, following the main rains that start in May and decline in September.

Today, there is growing interest in using ITNs as one of the leading strategies for the prevention of malaria. Therefore, this study tried to examine whether ITNs are being possessed and properly utilized by the high-risk groups and identified the loopholes that affect the possession and utilization of ITNs for malaria prevention in order to achieve the Abuja target. This study tried to share the experience regarding observed utilization instead of reported utilization to look at the actual behavior of the community in using ITNs. This will help to shed light on the determinant factors for monitoring and evaluation of ITNs program; and formulate appropriate strategy for program implementation. It will also help us to scale up and maintain the coverage and utilization of ITNs. This implies that there must be selective targeting at household level so that children and pregnant women are protected.

Methods and Materials

Study area and population:- The study was conducted in Kafta-Humera District, Tigray National Regional State, northern Ethiopia from 9 to 30 November 2005, during the high malaria transmission season. It is about 560 km to the West of Mekelle, the Capital City of Tigray Regional State, with an altitude ranging from 580-1820 meters above sea level; and estimated population of 94,210. In the study district, there are 15 rural and two urban kebeles with a population of 70, 210 and 24,000 respectively, where households in rural kebeles are clustered in confined areas, but did not have municipality (lack of which identifies as rural setting) Most of the residents are returnees from Sudan after the cessation of civil war in Ethiopia.

Kafta-Humera District, the study area, is fertile and has great potential for agricultural development. In the District more than 400 investors are being involved in large-scale agricultural activities, which require more than 200,000 daily laborers during the harvest season. Malaria transmission in Kafta-Humera District is intense from September to December, particularly among indigenous farmers, seasonal migrant agricultural workers and settlers (5). Malaria is the leading cause of morbidity and mortality. In Tigray Region as a pilot study, ITNs provided by donors (WHO/ Italian co-operation) were distributed in the northwestern area of the Region, at four kebeles of Kafta-Humera District, under a community-financing scheme (5). A total of 13,570 nets were distributed and 76% of the total population of 32,422 was covered by at least one ITN per household during piloting since 1996/97 (5).

Sample size determination:- A sample of 414 households each for rural and urban settings was determined based on the difference between two population proportions with the following assumptions. Based on the study of Net Mark in five sites of Ethiopia, 40% urban households own any net and the rural households are expected to own 30% for any net (10), with 95% confidence level ($Z_{\alpha/2}$); power of the study 80% and 10% contingency for non-response.

Source and study population:- The source population included all households with pregnant women and/or children under five years of age, but permanent residents of the District. Randomly selected households with pregnant woman and/or children under five years of age who resided in Kafta-Humera District during the study period were the study population. Heads of households in the District with at least one under five years of age and/or pregnant women were involved in the focus group discussion.

Study design and sampling procedure:- A comparative cross-sectional study was conducted using interviewer-administered questionnaire to study the coverage of ITNs. A census of households conducted by the District Health Office for polio campaign purpose in each Kebele was obtained. Both urban kebeles (from total two) and five rural kebeles (of 15) were selected by lottery method. The required households were identified using systematic random sampling for the respective Kebeles and households within these kebeles were distributed by population proportion to size.

Data collection:- A structured and pre-tested questionnaire was used to collect data from targeted households by ten trained health workers, which included nurses and a sanitarian. The major thematic areas included in the questionnaire were: socio-demographic characteristics, knowledge and perceptions about malaria and mosquitoes, mosquito net ownership and utilization and ITNs early morning observation checklist. Supervision was made by two health officers and the principal investigator. First, households were visited for early morning survey to observe their actual practice regarding net or ITN use around 5:00-6:00am early in the morning. Then, during the daytime, those households visited early in the morning were revisited to complete the household questionnaire. The respondent of the quantitative data was any adult family member. Any one whose age was 18 or more was eligible to be interviewed. The principal investigator conducted the FGDs and the two supervisors were also involved as note takers and recruiters of the FGDs. A total of four FGDs were conducted for women and men, two each for both settings. Qualitative data was recorded using audio tape.

Ethical considerations:- Ethical clearance was obtained from the Faculty of Medicine at Addis Ababa University. An informed consent was obtained from all study participants prior to interview and inspection of

household survey. When the data collectors found problems with incorrect use of nets, they educated the study participants about the correct use and maintenance upon completion of the survey.

Data analysis:- Data were originally entered, cleaned and analyzed using EPI INFO version 6.02 statistical package. Then it was exported to SPSS 11.0 for windows to analyze statistical inferences. Multivariate logistic regression statistical models were used in order to infer associations and predictions. The qualitative data were transcribed manually from audio taped records. Results were analyzed manually by summarizing the ideas obtained from the focus group discussants.

Result

Socio-demographic characteristics of the study population:- A total of 828 households participated in this study. The majority of the respondents were females, 264 (63.8%) and 287(69.3%) for rural and urban settings, respectively (Table 1). The response rate was 100% and all respondents were willing to participate in the survey. Among the study households, 338(81.6%) for rural and 354(85.5%) for urban were headed by males. The median age of the respondents was found to be 31 years, ranging from 16 to 65 years for rural areas. For urban respondents, it was also found to be 30 years, ranging from 16 to 70 years. Fifty-six percent of rural and 34% of urban respondents could not read and write and the remaining were literate, with their educational status ranging from primary education to tertiary level. Regarding occupation, 309(74.6%) and 157(37.9%) of rural and 52(12.6%) and 102(24.6%) of urban head of households were farmers and merchants, respectively.

Table 1: **Socio-demographic characteristics of respondents in Kafta-Humera District, Tigray, November 2005**

	Place of residence, Number n (%)		
	Rural	Urban	Total
Sex			
Male	150(36.2)	127(30.7)	277(33.5)
Female	264(63.8)	287(69.3)	551(66.5)
Age in years			
16-24	78(18.8)	113(27.3)	191(23.1)
25-30	122(29.5)	113(27.3)	235(28.4)
31-39	101(24.4)	82(19.8)	183(22.1)
40 and above	113(27.3)	106(25.6)	219(26.4)
Education Level			
Illiterate	232(56.1)	141(34.0)	373(45.0)
Literate	182(43.9)	273(66.0)	455(55.0)
Occupational status			
Government employee	19(4.6)	77(18.6)	96(11.6)
Farmer	309(74.6)	157(37.9)	466(56.3)
Merchant	52(12.6)	102(24.6)	154(18.6)
Others	34(8.2)	78(18.9)	112(13.5)
Family size mean \pm (SD)	5.14 \pm (1.9)	4.87 \pm (2.02)	5.0 \pm (1.97)
Children under 5 mean \pm (SD)	1.35 \pm (0.62)	1.23 \pm (0.54)	1.3 \pm (0.58)
Pregnant women mean \pm (SD)	0.12 \pm (0.33)	0.08 \pm (0.28)	0.1 \pm (0.03)
Number of rooms mean \pm (SD)	1.23 \pm (0.55)	1.23 \pm (0.54)	1.24 \pm (0.54)
Sleeping places mean \pm (SD)	3.73 \pm (1.64)	3.75 \pm (1.83)	3.74 \pm (1.74)
Nets per households mean \pm (SD)	2.34 \pm (1.62)	2.5 \pm (1.45)	2.43 \pm (1.54)
Possession of radio			
Yes	217(52.4)	311(75.1)	528(63.8)
No	197(47.6)	103(24.9)	300(36.2)

The average household size was 5, ranging from 4.87 in urban to 5.14 in rural. The total number of children under five identified in the surveyed households was 560 and 507 for rural and urban areas, respectively. Similarly, the number of pregnant women in the surveyed households in the district was 48 for rural and 34 for urban settings. The mean (\pm SD) number of rooms within these households was 1.23(\pm 0.55) and 1.23(\pm 0.54) for rural and urban areas, respectively. The mean (\pm SD) number of beds or sleeping places indoors and outdoors per household was 3.73(\pm 1.64) for rural and 3.75(\pm 1.83) for

urban areas. The mean (\pm SD) number of nets present was 2.34 \pm (1.62) for the rural and 2.5 \pm (1.45) for the urban areas.

The mean (\pm SD) number of children under five years of age was 1.35(\pm 0.62) for the rural and 1.23(\pm 0.54) for urban areas. The mean (\pm SD) number of pregnant women in the interviewed households were found to be 0.12(\pm 0.33) for rural and 0.08(\pm 0.28) for urban areas respectively. The ratio of high-risk groups (children and

pregnant women) to nets was $0.67 \pm 0.45:1$ and $0.62 \pm 0.36:1$ and the ratio of household members to nets was $2.25 \pm 1.07:1$ and $2.14 \pm 0.9:1$ for rural and urban settings respectively. The household radio possession of surveyed households in the District was 528(63.8%), which was found in 217(52.4%) and 311(75.1%) for rural and urban households accordingly.

Knowledge and perception about malaria and mosquitoes:- Almost all respondents, 410(99.0%) rural and 407(95.3%) urban, reported having heard of the

disease malaria, and 390(94.2%) and 391(94.4%) of the rural and urban settings knew that mosquitoes play a role to transmit the disease (Table 2). In the FGD, mosquito bite was reported by almost all discussants to be the major cause of malaria. Nevertheless, one rural female discussant reported, “*being hungry*” as the cause of malaria. Majority, 380(91.8%) of the rural and 362(87.4%) of the urban respondents identified fever as the main symptom of malaria; followed by feeling cold, 329(79.5%) and 266(64.3%) for rural and urban respondents, respectively.

Table 2: **Knowledge, attitude and practice of respondents and ITNs coverage Kafta-Humera District, Tigray November 2005**

	Respondents by residence		
	Rural	Urban	Total
Heard malaria	410(99.0)	407(95.3)	817(98.7)
Mosquito could transmit malaria	390(94.2)	391(94.4)	781(94.3)
Symptoms of malaria			
Fever	380(91.8)	362(87.4)	742(89.6)
Feeling cold	329(79.5)	266(64.3)	595(71.9)
Joint pain	239(57.7)	204(49.3)	443(53.5)
Headache	253(61.1)	146(35.3)	399(48.2)
Most affected group of population by malaria			
Children under five	359(86.7)	317(76.6)	676(81.6)
Pregnant women	177(42.8)	134(32.4)	311(37.6)
Adults	74(17.9)	188(45.4)	262(31.6)
Sleeping pattern of children under five			
Alone	41(9.79)	70(16.75)	111(13.26)
With mother	300(71.6)	293(70.1)	593(70.85)
With father	14(3.34)	9(2.15)	23(2.75)
With both parents	54(12.89)	33(7.89)	87(10.39)
Any Net ownership: Yes	350(84.5)	398(96.1)	748(90.3)
No	64(15.5)	16(3.9)	80(9.7)
ITN ownership: Yes	331(80.0)	377(91.1)	708(85.5)
No	83(20.0)	37(8.9)	120(14.5)
Number of nets owned			
0	64(15.5)	16(3.9)	80(9.7)
1	60(14.5)	71(17.1)	131(15.8)
2	124(29.9)	161(38.9)	285(34.4)
3 or more	166(40.1)	166(40.1)	332(40.1)
Number of ITNs owned			
0	83(20.0)	37(8.9)	120(14.5)
1	52(12.6)	67(16.2)	119(14.4)
2	117(28.3)	153(37.0)	270(36.6)
3 or more	162(39.1)	157(37.9)	319(38.5)
Type of net			
Conventional nets	550(56.8)	983(94.4)	1533(76.3)
LLINS	419(43.2)	58(5.6)	477(23.7)
Utilization of nets			
Children under five	384(68.6)	429(84.6)	813(76.2)
Pregnant women	25(52.1)	22(64.7)	47(57.3)
Children 5-14	317(52.4)	275(72.8)	592(60.2)
Women 15-49	293(62.1)	410(77.1)	703(70.0)
Utilization of ITNs			
Children under five	375(67.0)	403(79.5)	778(72.9)
Pregnant women	25(52.1)	22(64.7)	47(57.3)
Children 5-14	315(52.1)	257(68.0)	572(58.2)
Women 15-49	286(60.6)	380(71.4)	666(66.3)

Nearly 87% of the rural and 77% of urban respondents identified children less than five years of age as the most affected group by malaria followed by 177(42.8%) and 134(32.4%) pregnant women for rural and urban settings, respectively. All discussants of the FGD mentioned that it is difficult for three or more people to sleep in a single bed together since the area is too hot. The maximum number of people sleeping together is two persons, but either of them should be a child.

Mosquito net possession:- Household possession for at least one mosquito net in the surveyed households was found to be 748(90.3%). Ownership was higher in urban 398(96.1%) than in rural areas, which were 350(84.5%). As mentioned by FGD participants, ITNs has a good public acceptance and everybody tends to use a net when sleeping even in verandah or outdoor unless they face a shortage of nets. Here the indigenous people, even those who are poor, want to have a net if available at a reasonable cost. Sometimes, it is difficult to sleep indoors due to the high temperature, but they move outdoors with their nets and sleep well with comfort. One urban male discussant expressed a net as “*a mobile hut*”.

Ownership for treated nets was also 331(80.0%) for the rural and 377(91.1%) for the urban areas. About 290(70%) of rural and 317(79%) of urban households owned at least two nets, as well as 166(40.1%) of the rural and 166(40.1%) of urban households owned three or more nets. A slightly higher proportion of urban 317(79.0%) than rural 290(70.0%) households owned more than one net. Household possession for at least one treated net was found to be 708(85.5%), which was 331(80.0%), for rural and 377(91.1%) for urban settings. The type of nets found were 1533(76.3%) conventional nets that needed re-impregnation and the remaining 477(23.7%) were long lasting nets.

Ninety-three percent 968(93.0%) of urban and 486(50.2%) of rural nets were purchased with an average Ethiopian birr 28.1 (± 11.4) and 21.2(± 14.6) from public sector, shops and street vendors respectively. The remaining 483(49.8%) of rural and 73(7.0%) of urban nets were obtained mainly from public sector through the District Health Office.

Mosquito net utilization:- The proportion of children under 5 years of age who slept under a net during the night preceding the survey was 813(76.2%), which was 384(68.6%) for rural and 429(84.6%) for urban settings (Table 2). Likewise, the proportion of pregnant women who slept under net was 47(57.3%) in the surveyed households in the District, which was 25(52.1%) for rural and 22(64.7%) for urban areas. The proportion of children 5-14 years of age who slept under a net was 317(52.4%) for the rural and 275(72.8%) for urban households. Moreover, the proportion of women in the reproductive age group who slept under a net during the

night preceding the survey was 293(62.1%) and 410(77.1%) for rural and urban areas respectively.

For ITN, the proportion of children under 5 years of age who slept under treated net during the night preceding the survey was 778(72.9%), which was 375(67.0%) for rural and 403(79.5%) for urban settings. Likewise, the proportion of pregnant women who slept under treated net was 47(57.3%), which was 25(52.1%) for rural and 22(64.7%) for urban households. The proportion of children between 5-14 years of age who slept under ITN was 315(52.1%) for the rural and 257(68.0%) for urban households. Moreover, the proportion of women in the reproductive age group who slept under ITN during the night preceding the survey was 286(60.6%) and 380(71.4%) for rural and urban areas respectively. All discussants of the FGDs mentioned that when they have only one net they give priority to children under five years of age. The possible reasons they raised were that children are the most vulnerable age group to the malaria disease and need not hear complaint or seek treatment when they get sick.

Determinants of ITN ownership and utilization:-

Among the potential determinants explored regarding utilization of ITNs in the rural areas, age being 25 years old or more, being a merchant, government employee, or having better income were found to be significantly associated with net utilization (Table 3). More sleeping places and family size were significantly related to net utilization in the rural areas. Households with merchants were 0.10 times (95%CI 0.03, 0.38) less likely to let their children under five and/or pregnant women sleep under a net. Households with government employees were 0.13 times (95%CI 0.03, 0.65) less likely to have similar practice.

The households with better income were 11.44 times (95%CI 2.92, 44.12) more likely to let their children under five and/or pregnant women sleep under a net. Households with seven and more sleeping places were also 47.23 times (95%CI 12.32, 181.05) more likely to let their children under five and/or pregnant women to sleep under a net. For the highest family size, the mosquito net utilization rate was 0.95 times (95%CI 0.02, 0.19) less likely to have similar practice.

In the urban setting, households within the fourth quintile and better income were found to be significantly associated with mosquito net utilization. Having five or more sleeping places and possessing a radio were found to be the determinant factors for mosquito net utilization (Table 4). Households with better income were 4.36 times (95%CI 1.69, 11.27) more likely to let their children under five and/or pregnant women sleep under a net. Moreover, those households with more sleeping places were 0.37 times (95%CI 0.16, 0.86) less likely to have similar practice.

Table 3: Predictors of sleeping under a net for households with high-risk groups, in rural Kafta-Humera District, Tigray, November 2005.

Variables		No. (%)	OR, 95% CI (Crude)	OR, 95% CI (Adjusted)
Age in years	16-24	78(18.8)	1.00	1.00
	25-30	122(29.5)	1.88(1.05, 3.36)*	2.46(1.12, 5.39)*
	31-39	101(24.4)	3.85(1.99, 7.45)*	3.62(1.48, 8.85)*
	40 & above	113(27.3)	3.34(1.78, 6.27)*	2.55(1.06, 6.16)*
Occupational status	Others	34(8.2)	1.00	1.00
	Merchants	52(12.6)	0.63(0.26, 1.50)	0.10(0.03, 0.38)*
	Farmers	309(74.6)	3.83(1.85, 7.92)*	1.02(0.31, 3.32)
	Government employees	19(4.6)	0.73(0.23, 2.26)	0.13(0.03, 0.65)*
Household Income	Poorest	69(16.7)	1.00	1.00
	**2 nd quintile	99(23.9)	3.50(1.83, 6.68)*	4.04(1.64, 9.97)*
	**3 rd quintile	111(26.8)	11.06(5.39,22.70)*	12.90(4.71, 35.33)*
	**4 th quintile	91(22.0)	8.11(3.95, 16.64)*	9.08(3.25, 25.36)*
Sleeping places	Better income	44(10.6)	10.57(4.09, 27.34)*	11.44(2.97, 44.12)*
	One to two	97(23.4)	1.00	1.00
	Three	109(26.3)	6.56(3.55, 12.15)*	7.82(3.46, 17.67)*
	Four	95(23.0)	4.67(2.53, 8.59)*	4.25(1.69, 10.70)*
Family size	Five and above	113(27.3)	19.09(8.82, 41.29)*	47.23(12.32,181.05)*
	One to three	95(23.0)	1.00	1.00
	Four	60(14.5)	1.33(0.68, 2.62)	0.39(0.15, 0.99)*
	Five to six	167(40.3)	1.98(1.16, 3.40)*	0.25(0.10, 0.61)*
	Seven and above	92(22.2)	1.89(1.02, 3.51)*	0.05(0.02, 0.19)*

* Statistically significant at $p < 0.05$

**Level of income

Table 4: Predictors of sleeping under a net for high-risk groups, of households in urban Kafta-Humera District, Tigray, November 2005.

Variables		No. (%)	OR, 95% CI (Crude)	OR, 95% CI (Adjusted)
Sex	Male	354(85.5)	1.00	1.00
	Female	60(14.5)	0.38(0.21, 0.72)*	0.89(0.42, 1.91)
Educational Level	Illiterate	141(34.0)	1.00	1.00
	Literate	273(66.0)	2.23(1.32, 3.78)*	1.49(0.81, 2.74)
Occupational status	Others	78(18.8)	1.00	1.00
	Merchants	102(24.7)	2.25(1.09, 4.63)*	1.97(0.89, 4.39)
	Farmers	157(37.9)	2.71(1.39, 5.29)*	1.91(0.87, 4.20)
	Government employees	77(18.6)	3.61(1.50, 8.69)*	1.40(0.51, 3.81)
Household Income	Poorest	98(23.7)	1.00	1.00
	2 nd quintile	60(14.5)	1.20(0.58, 2.49)	1.04(0.47, 2.30)
	3 rd quintile	60(14.5)	2.60(1.10, 6.17)*	2.22(0.86, 5.70)
	4 th quintile	76(18.3)	2.98(1.31, 6.78)*	2.67(1.07, 6.66)*
	Better income	120(29.0)	5.60(2.42, 12.98)*	4.36(1.69, 11.27)*
Radio Possession	Do not possess	103(24.9)	1.00	1.00
	Possess	311(75.1)	2.95(1.71, 5.09)*	1.94(1.03, 3.65)*
Malaria Education	Do not heard	124(30.0)	1.00	1.00
	Heard	290(70.0)	2.28(1.34, 3.88)*	1.48(0.80, 2.73)
Sleeping Places	One to two	114(27.5)	1.00	1.00
	Three	110(26.6)	1.20(0.56, 2.57)	1.08(0.47, 2.50)
	Four	76(18.4)	0.66(0.31, 1.40)	0.49(0.21, 1.15)
	Five and above	114(27.5)	0.78(0.39, 1.56)	0.37(0.16, 0.86)*

*Statistically significant at $p < 0.05$

Being a merchant, government employee and having a better income were found to be the determinant factors of mosquito net possession in rural areas (Table 5). In the FGD an urban female discussant mentioned, "We got our nets four years back and now the nets are too old to use them. But what I did is I maintained one net by another old to have one maintained net with better protection". Having a radio was significantly associated

with net possession. Government employees were 0.06 times (95%CI 0.01, 0.34) less likely to possess a net. However, those with better income households were 81.44 times (96%CI 8.6, 770.87) more likely to own a net. Moreover, possessing a radio was 2.78 times (95%CI 1.14, 6.82) more likely to have a net. In urban areas, being a farmer was found to be significantly associated with net possession (Table 6). Farmers were

5.62 times (95%CI 1.05, 29.93) more likely to own a net. Comparing a net coverage among the rural and urban settings net possession, was found to be statistically significant among the residents. Nets were 3.33 times (95%CI 1.39, 7.98) more likely possessed in

urban than the rural areas. According to the result gained from FGD participants, the distribution was mainly based on the public sector and some of the residents owned more nets, while others did not have any due to problem in the distribution system.

Table 5: Predictors of possessing a net for households with high-risk groups, in rural Kafta-Humera District, Tigray, November 2005.

Variables		No. (%)	OR, 95% CI (Crude)	OR, 95% CI (Adjusted)
Age in years	16-24	78(18.8)	1.00	1.00
	25-30	122(29.5)	2.00(1.01, 3.99)*	1.86(0.71, 4.88)
	31-39	101(24.4)	4.57(1.91, 10.95)*	1.99(0.68, 5.83)
	40 and above	113(27.3)	2.78(1.32, 5.86)*	1.66(0.62, 4.45)
Sex	Male	338(81.6)	1.00	1.00
	Female	76(18.4)	0.22(0.13, 0.40)*	0.47(0.03, 7.99)
Educational Level	Illiterate	232(56.1)	1.00	1.00
	Literate	182(43.9)	0.94(0.55, 1.60)	0.90(0.40, 2.04)
Occupational status	Others	34(8.2)	1.00	1.00
	Merchants	52(12.6)	0.39(0.15, 0.99)*	0.07(0.02, 0.26)*
	Farmers	309(74.6)	4.48(1.87, 10.71)*	1.05(0.29, 3.87)
	Government employees	19(4.6)	0.62(0.19, 2.06)	0.06(0.01, 0.34)*
Marital Status	Single	49(11.8)	1.00	1.00
	Married	335(80.9)	6.77(3.5, 13.1)*	0.47(0.02, 9.57)
	Divorced	16(3.9)	5.7(1.17, 27.83)*	2.84(0.46, 17.75)
	Widowed	14(3.4)	2.04(0.56, 7.39)	1.34(0.21, 8.33)
Household Income	Poorest	69(16.7)	1.00	1.00
	2 nd quintile	99(23.9)	13.15(5.54, 31.2)*	10.73(3.80, 30.32)*
	3 rd quintile	111(26.8)	13.10(5.72, 30.0)*	16.50(5.59, 48.70)*
	4 th quintile	91(22.0)	10.54(4.57, 24.29)*	11.58(3.66, 36.62)*
	Better income	44(10.6)	49.69(6.48, 381.26)*	81.44(8.6, 770.87)*
Radio Possess	Do not possess	197(47.6)	1.00	1.00
	Possess	217(52.4)	2.61(1.48, 4.58)*	2.78(1.14, 6.82)*
Malaria education	Have not heard	55(13.3)	1.00	1.00
	Heard	359(86.7)	0.51(0.20, 1.33)	0.26(0.07, 0.94)*

* Statistically significant at $p < 0.05$

Table 6: Predictors of possessing a net for households with high-risk groups, in urban Kafta-Humera District, Tigray, November 2005.

Variables		No. (%)	OR, 95% CI (Crude)	OR, 95% CI (Adjusted)
Age in years	16-24	113(27.3)	1.00	1.00
	25-30	113(27.3)	0.83(0.25, 2.79)	0.71(0.19, 2.68)
	31-39	82(19.8)	1.22(0.28, 5.25)	1.03(0.20, 5.23)
	40 and above	106(25.6)	2.40(0.46, 12.65)	2.32(0.36, 15.02)
Sex	Male	354(85.5)	1.00	1.00
	Female	60(14.5)	0.20(0.07, 0.55)*	0.60(0.16, 2.22)
Educational level	Illiterate	141(34.0)	1.00	1.00
	Literate	273(66.0)	3.39(1.21, 9.54)*	2.13(0.66, 6.94)
Occupational status	Others	78(18.8)	1.00	1.00
	Merchants	102(24.7)	4.85(1.29, 18.29)*	3.82(0.94, 15.55)
	Farmers	157(37.9)	11.40(2.43, 53.41)*	5.62(1.05, 29.93)*
	Government employees	77(18.6)	11.18(1.39, 89.59)*	3.11(0.32, 30.36)
Household Income	Poorest	98(23.7)	1.00	1.00
	2 nd quintile	60(14.5)	1.92(0.5, 7.4)	1.57(0.36, 6.95)
	3 rd quintile	60(14.5)	5.97(0.74, 48.33)	2.43(0.25, 23.30)
	4 th quintile	76(18.3)	3.74(0.78, 17.86)	1.60(0.26, 9.75)
	Better income	120(29.0)	12.03(1.5, 96.59)*	3.72(0.36, 38.20)
Radio Possess	Do not possess	103(24.9)	1.00	1.00
	Possess	311(75.1)	5.47(1.94, 15.44)*	2.63(0.80, 8.66)
Malaria education	Have not heard	124(30.0)	1.00	1.00
	Heard	290(70.0)	3.16(1.15, 8.69)*	1.23(0.37, 4.18)

* Statistically significant at $p < 0.05$

Discussion

Beliefs and knowledge about mosquitoes as well as malaria were nearly universal. Malaria is a the prominent problem in the area that deters people from agricultural activities as mentioned during FGDs. Similar study conducted in Southern Nations Nationalities and People Region (SNNPR), Amhara and Oromiya revealed that about 93% of respondents knew that malaria could be transmitted through mosquito bite (11). A study conducted in Uganda revealed that almost all respondents (99.6%) reported having heard of the term “malaria” (12).

In this study District, 85.5% of households had at least one ITN. A study conducted in SNNPR, Amhara and Oromiya showed that only 5.3% respondents reported for the presence of at least one mosquito net in their household during the survey (11). A study conducted in Kenya on community wide effect of Permethrin treated nets showed that control homes within 300 meters of ITN villages received protection from ITNs in nearby homes (13). Nets and ITNs possession in this District for at least two was 74.5% and 71.1%, respectively. The possible reason may be that the area is highly malarious and due attention might have been given by the Regional Health Bureau for such anti-vector intervention.

According to RBM evaluation for 2005, the country coverage was found to be 26.5% and 13.2% for at least one and two ITN respectively (14). A study on Net and ITN conducted by Net Mark, Ethiopia in 1000 households from five urban sites: Bahir-Dar, Nazareth, Dire-Dawa, Dessie and Awassa revealed that, 25% of households owned at least one net, 11% of households owned at least one ITN (10). A study conducted by the Central Statistics Authority regarding the coverage of at least one net and ITN in the country was also 19.7% and 10.1% for altitudes less than 1500 meters respectively (15).

Net possession was higher in this study District and differs between the rural and urban areas (OR 3.33 95%CI 1.39, 7.98). The gap between the areas may reflect either low supply of nets in rural areas or nets might be transported for sale from rural to urban areas. Although, the malaria burden is highest in rural areas and among the poorest people, ITN coverage tends to be generally higher in urban areas and in wealthier households (16). Urban residents were found to be threefold higher to own a net compared to the rural residents. Net and ITNs possession by households with children under 5 years of age were twofold to threefold lower in rural areas compared to urban areas (16).

The proportion of children under five years of age who slept under a net during the night preceding the survey was a little bit lower than the proportion of households that possessed a net. This was especially true of ITNs. However, the same practice for pregnant women was considerably lower for any net and ITN. To explain why

utilization was lower than possession, the numbers of nets were compared with numbers of residents per household from the survey. Number of nets was greater than the number of children under 5 years of age and pregnant women for rural and urban areas. The average ratio of high-risk groups to nets was found to be below one but for all household members it is above one. This suggests that the average number of nets in a household would typically be not sufficient to cover all residents, but optimum to cover the high-risk groups. However, the inference does not allow for sharing of beds and nets between adults or children and adults (e.g. infants and their mothers). The reason may be maldistribution of nets and in households with extra nets; nets might be stored for the coming years due to fear of net shortage.

Use of any net and ITNs in the surveyed households in the District by children under five years of age exceeds, 60% within the targeted ITN coverage for Africa agreed in the RBM framework for 2005. Use of any net and ITNs in the District for pregnant women is nearly the Abuja target, but exceeds that in the urban areas. The possible reasons to achieve such a high coverage in the study District may be due to experience in net utilization when they migrated to the Sudan refugee camp (5). The cost recovery bed net initiative established since 1996 may have also contributed a lot since the health service coverage by the time was very low in the area and it was difficult to get early diagnosis and prompt treatment of malaria. According to the available surveys, only Eritrea in 2003, reached the Abuja target of 60% ITN usage with 63% coverage to the high-risk groups (16).

In urban areas, farmers possessed nets significantly. The reason might be that those farmers in urban areas are wealthier people and capable to purchase a net at any cost available in the market. Factors determining utilization of net were age, being a merchant, government employee, income above the poorest, with sleeping places five or more and family size above three in the rural areas. For urban areas, income fourth quintile and sleeping place above four were identified as determinants. Those with better income may own more nets whenever there is access to nets and may tend to use it. As sleeping place increases utilization also increases in rural areas. People who have more sleeping places may be economically wealthier and also have access to more nets. Therefore, the vulnerable groups in such places may be covered with ITNs.

In conclusion, possession and utilization of ITNs in the rural and urban areas showed a promising result. There is a difference in possessing any net or ITN by residence where it was higher in urban areas. Though effective IEC activities have been promoted by health extension workers, local manufacturing of nets does not encourage in improving and sustaining ITN program.

Acknowledgments

We are grateful to Dr. Rory Nefdt, Project Manager Malaria/IMCI; UNICEF for his tremendous support with relevant materials and facilitating the financial assistance. It is also our pleasure to thank UNICEF for the financial support.

Many thanks go to the Tigray Regional Health Bureau, for the logistic and material support during field work.

We would like to thank Kafta-Humera District Health Office and staff of the Office who were involved in the field work during data collection and participants of the study community.

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