ADDIS ABABA UNIVERSITY
FACULTY OF MEDCINE
DEPARTMENT OF COMMUNITY HEALTH

Assessment of Insecticide Treated Nets coverage for Malaria Control in Kafta-Humera District, Tigray: Possession vs. Use by high-risk groups

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A THESIS SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES OF ADDIS ABABA UNIVERSITY IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PUBLIC HEALTH IN THE DEPARTMENT OF COMMUNITY HEALTH

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Dedication

This is dedicated to my lovely mother ***W/ro Kidan Assefa****.*

DECLARATION

I, the under signed, declare that this is my original work and has never been presented in this or any other university and that all the source material used for the thesis have been duly acknowledged.

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Acronyms

ACT	Artemisinin-based Combination therapy
a.m.	Ante meridiem
CI	Confidence Interval
CSA	Central Statistics Authority
DHS	Demographic and Health Survey
EPI	Expanded Program of Immunization
ETB	Ethiopian Birr
FGD	Focus Group Discussion
FMOH	Federal Ministry of Health
GFATM	Global fund to fight AIDS, Tuberculosis and Malaria
HH	Household
IEC	Information, Education and Communication
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Net
LLIN	Long Lasting Insecticidal Net
MDG	Millennium Development Goals
MR	Multiple Response
MSF-H	Medicine San Frontiers of Holland
OR	Odds Ratio
p.m.	Post meridiem
PW	Pregnant women
RBM	Roll Back Malaria
SD	Standard deviation
SP	Sulphadoxine Pyrimethamine
SRS	Systematic Random Sampling
U5	Children under five years of age
UN	United Nations
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USD	United States Dollar
VAT	Value Added Tax
WHO	World Health Organization
WHO-AFRO	World Health Organization Regional Office for Africa

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 nets. Use of insecticide-treated nets (ITNs) for protection against mosquito bite during sleep is highly effective. Kafta-Humera is one of the targeted Districts in the Region for ITNs intervention, but with limited information pertaining to priority of utilization.

Objective: to examine the status of children under five years of age and/or pregnant women ITNs possession and utilization and its determinants for malaria control.

Methodology: A comparative cross-sectional study was conducted in the rural and urban areas of the District. Based on a systematic random sampling method, 414 households were interviewed each from the selected Kebeles for both settings, regarding net possession and utilization by high-risk groups. Qualitative data were also collected through focus group discussions (FGDs) to identify views of participants, pertaining to ownership 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. 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. Likewise, similar practice for pregnant women was 52.1% and 64.7%, the same for net and ITN in rural and urban areas respectively. Net re-impregnation was 93.5% for rural and 94.1% for urban areas. The FGD suggested that lower net possession in rural areas could be due to scarcity of net provision and inequity while distribution. Occupation, family size in rural areas; radio possession in urban areas and

relative wealth and number of sleeping places had 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.

Conclusions: Not all nets owned by the households were being utilized properly. Nevertheless, mal distribution, and scarcity were also observed within the settings. Effective IEC should be promoted and continues availability of ITNs should be in place in order to achieve effective control of malaria among the high-risk groups.

1. BACKGROUND

1.1 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 a 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). Pregnant women have little immunity to malaria in areas of unstable transmission (4). Malaria during pregnancy causes severe anemia, miscarriage, stillbirths and maternal deaths and may account for up to 40% of preventable low birth weight among newborns in endemic areas (3, 5).

In Ethiopia, almost 75% of the country is malarious and an estimated 51 million (68%) of the population lives in areas at risk of malaria falling below 2000 meters in altitude, short-lived transmission occurs even at altitude of 2400 meters (2,6,7). Malaria is the leading cause of health problem in the country. Plasmodium species of epidemiological importance in Ethiopia are *P.falciparum* and *P.vivax* (8, 9). *Anopheles arabiensis is* the major malaria vector, and breeds in small sun exposed pools mainly produced during the rains (8, 10). Approximately 4-5 million cases of malaria are reported annually in Ethiopia during normal transmission season (2). In 2002-2003, the disease was the primary cause of reported morbidity and

mortality, accounting for 16% of out patient visits, 20% of hospital admissions and 27% of hospital deaths (2, 4).

Malaria transmission in Ethiopia is unstable and characterized by frequent and often large-scale epidemics (4, 11). The sharp increase of reported cases after 1982-83 appears to have been caused primarily by the return of normal rains after the 1982-1985 droughts, although deterioration of living conditions, change in settlement patterns due to re-settlement programs and extensive population movement appear to have contributed to this trend (7). In 2004, the disease has been reported as the first cause of illness and 27% of deaths. The magnitude and periodicity of malaria epidemics in the country has also been on the rise in the last few years. Apart from being a major public health problem, the disease has also been identified as potential impediment to the development of water harvest, irrigated agriculture and settlement in fertile under utilized low land areas with potential to enable the country to achieve food security and improved household income (12).

Several studies have shown that bed nets treated with Insecticide are effective methods of reducing man-vector contact and child mortality (13). Most malaria-carrying mosquitoes bite at night. If nets are properly used and maintained, can provide a physical barrier to hungry mosquitoes. WHO has worked with mosquito net and insecticide manufacturers to make re-treatment as simple as possible. 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 (14). Children under five and pregnant women are the most vulnerable to get a serious malaria (10). In most malaria

endemic regions, fewer than 10 percent of children or pregnant women regularly sleep under ITNs (15).

A study conducted in five sites of Ethiopia revealed that households who owned any net and ITNs were found to be 25% and 11% respectively (16). It is also shown that children under five years of age and pregnant women who slept under ITNs the previous night were found to be 6% for each group. Among respondents in non net-owning households who had heard of nets, reasons for not having a net were cost, lack of availability and the belief that nets are not necessary (16).

Such studies are almost rare in the country and at regional levels. This study examined the relationship between household possession, use and re-impregnation of nets in a community based survey in Kafta-Humera District. It also explored determinants of the effective use by high-risk groups. Based on the findings, possible options were recommended to sustain and strengthen the ITNs program at regional level in order to target the high-risk groups.

1.2. Literature Review

1.2.1 Malaria Burden and high risk groups

Malaria is a major factor in Africa's high rate of infant and maternal mortality, of low birth weight, school absenteesim, and low productivity in farming and other work (1). Every year, at least 30 million pregnancies occur among women in malarious areas of Africa, most of whom reside in areas of relatively stable malaria transmission (3). Pregnant women residing in areas of low or unstable malaria trasmission are at a two-or threefold higher risk of developing severe disease as a result of malaria infection than non-pregnant adults living in the same area (3). In areas where malaria is prevalent, the disease contributes to 2-15 percent of cases of maternal anemia, 8-14 percent of low birth weight, and as many as 3-5 percent of infant deaths (5).

Malaria imposes tremendous costs on households, businesses, health systems, and government budgets and is believed to be one cause of the poor economic performance and persistent poverty of many Africa nations (17).

In endemic areas, children under 5 years of age are especially vulnerable to malaria and are likely to benefit most from the use of nets (18). A mortality survey conducted in Tigray showed that more than 90% of the children who died during the survey were found to be at home (8). This is probably related to the low access of women to care. Heavy workload of women leaves them little time to attend their own and young children's health needs since children are "tied to their mothers breast" (8).

1.2.2 Strategies for control of malaria

The main components of the malaria control approach in Ethiopia include diagnosis and treatment of cases, the application of selective vector control measures and strengthening the information system to facilitate the prevention, early detection and control of epidemics (9). After several decades of relative neglect, malaria control has now become a global health priority. In April 1998, the WHO-AFRO undertook the initiative to bring malaria under control, as the African Region bears 80% to 90% of the global malaria disease burden. A few months later, the Director General of WHO launched a global initiative called "Roll Back Malaria" (19).

Malaria prevention and control strategies include early diagnosis and prompt treatment with safe and effective drugs, vector control in selected areas mainly through the use of ITNs and IRS; epidemic monitoring, epidemic prepardeness and response and, cross cutting strategies that include information, communication and education materials, human resource development and monitoring and evaluation (11). Major recent achievements on prevention and control of malaria include: an evidence based change in antimalarial drug policy from SP to ACTs, development of new malaria treatment guideline, development of a national strategic plan for scaling up for the distribution and use of ITNs and revision of guidelines on prevention and control of malaria epidemics (11).

1.2.3 History of mosquito nets in Ethiopia

The promotion of ITN use has become a central element of national and international efforts against malaria control (15). ITNs are a low cost, easily produced, and practical weapon in the

fight against malaria. If properly used and maintained they can reduce all-causes of mortality in children by an average of 17% and the incidence of severe and mild malaria episodes by 45-48% (17).

In Ethiopia, ITNs provided by donors (WHO/ Italian co-operation) were distributed in the northwestern area of Tigray, at four resettlement areas of Kafta-Humera District, under a community-financing scheme (8, 20). 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. Re-impregnation rate was 64% in the first year but failed to 20 – 40% in subsequent two years after the Ethio-Eritrean war began & many of the community members were displaced. The total cost recovered 58 %(USD 41,764), was deposited in community bank accounts (8, 20).

Distribution of bed nets has also been carried out in Oromiya, Amhara & SNNPR regional states with support from WHO from the Accelerated Implementation of Malaria Control in 1997 and 1998 (20). According to reports received from these regions, there is an encouraging demand among the communities to own and utilize bed nets (20).

A full cost of ITNs delivered through the commercial sector will be unaffordable to the vast majority of Ethiopian population at current prices. Unfortunately, given that it would cost over USD 33 million to supply at least one ITN per household in target populations, it is essential to employ a market segmentation approach targeting the most vulnerable group for free ITNs (21). The seasonality of malaria and the absence in some areas of nuisance biting mosquitoes may reduce demand for ITNs and consistent year round use in some areas (21). Insecticide

Treated Nets (ITNs) are among the most effective tools at our disposal for reducing malaria transmission and mortality.

1.2.4 Opportunities and prospects of ITNs

ITN programmes, more than other vector control methods, depend to a large extent on the acceptance and active involvement of individuals and communities (22). Communities should certainly be involved as much as possible in re-treatment issues, but there must be a lead organization to ensure that re-treatment is accessible to the communities and families most at risk, is done at the right time and achieves high coverage and correct dosage (22). The Government of Ethiopia is highly committed to strengthen malaria prevention and control activities in the country. The continued commitment and interest of the RBM partners, the community and stakeholders is expected to bring in more resources and concerted efforts for the large scale distribution of ITNs (21).

The MDGs target 8 indicated to have halted by 2015 and begun to reverse the incidence of malaria and other major diseases and RBM partnership to halve malaria-associated mortality by 2010 again by 2015 (23). Indicator 21 is about prevalence and death rates associated with malaria and indicator 22 is regarding proportion of population in malaria-risk areas using effective malaria prevention and treatment measures (23). Therefore, this global partnership gives due attention for high-risk groups to be supported with the necessary supplies in order to achieve the targeted goal.

1.2.5 Policies, Tarrifs and Taxes regarding ITNs

On 25 April 2000, the Heads of States or Representatives of 44 African countries assembled in Abuja, Nigeria, to approve a plan of action for controlling malaria. Among the specific steps called for was the removal of tariffs and taxes on ITNs and untreated nets packed with a single insecticide treatment and the materials they are made from (17). The Africa Summit on Roll Back Malaria set an ambitious target for expanding ITN use in Africa by at least 60% coverage of high-risk groups by the year 2005 (15).

Community based randomized trials in Africa have documented average reductions of 20% in all-causes of under 5 years mortality within 2 years of increasing ITN use from 0 to 50-70% (18). Based on this evidence, programs of ITN promotion through social marketing, tax exemption and health education started in many countries during the 1990s (18). One way for Africa to encourage the use of ITNs, at least in the short run, is to reduce or remove tariffs and taxes on treated and untreated nets, netting materials, and insecticides (24). In the Abuja Declaration, African governments committed themselves to reduce or eliminate the tariffs and taxes imposed on mosquito nets, netting materials and insecticides, in order to help lower retails prices. Almost 20 countries have reduced or waived such taxes and tariffs since the summit (14).

According to the national stands on ITNs, Ethiopia will achieve at least 60% of pregnant mother and children less than 5 years of age to be covered (2 ITNs per household) by the end of 2007 (25). Ethiopia has reduced two custom duties on ITNs from 10% to 5% as of January 2003 and exempted from Value Added Tax (VAT). Customs duty imposed on insecticides has

been reduced from 15% to 10% since December 1997 and insecticide products are free of VAT (25).

According to the policy of ITNs use in Ethiopia, it has been fully agreed and endorsed for free distribution and re-treatment of ITNs to children under five years of age and pregnant women living in targeted areas (21). Some have argued that nets should be seen as a 'global public good' and should be given out at no cost to young children and pregnant women who compose the group at most risk of life-threatening malaria in most of Sub-Saharan Africa (26).

1.2.6 Possession , use and benefits of ITNs

A series of trials in Africa have shown that proper mosquito net use reduces malaria incidence among children by anywhere from 14 to 63 percent. With ITNs use, all causes of mortality in children have been shown to decline by 25 percent in The Gambia, 33 percent in Kenya, and 17 percent in Ghana (15). In Malawi, a national survey conducted in 2004, revealed that 43% of households own at least one net, compared to only 5% in 2000 (23). More significantly, 35% of children under 5 years of age and 31% of pregnant women sleep under an ITN, and 4 districts out of 27 have achieved the Abuja target (23).

Additionally, malaria morbidity in children under five has been shown to decrease by as much as 21-72% when ITNs are used (17). Based on the Ugandan DHS, it is estimated that only 13 percent households in Uganda own a mosquito net and eight percent of under-fives usually use them (15).

Controlled trials in different African countries showed that ITN reduce clinical malaria episodes by 48% and protect six of every 1000 children's lives in the age group 1-59 months every year (13). Use of insecticide-treated mosquito nets (ITNs) for protection against mosquito bites during sleep is a highly effective and cost-effective intervention against intervention against malaria. In surveys in the Gambia, Ghana and Kenya that reported on seasonal distribution, net use was considerably higher in the rainy, cooler months than in the dry, hot season (18).

A survey in Kampala, Uganda showed that net use for young children during the preceding night increased with the number of nets present in the household, being 35% for (any) children under 5 years of age and 78% for (any) adult in households with one net (18). A study conducted in different regions of Africa revealed that the proportion of children under 5 years of age who slept under a net during the night preceding a survey was considerably lower than the proportion of households that possess a net (18). A randomized controlled trial in Western Kenya revealed that age, temperature, rainfall, relative wealth, and educational status are associated with the probability that an individual will properly deploy his or her ITN (27). It is often suggested that ITNs provided free or highly subsidized will not be valued, or will be misused or sold. However, in the UNICEF donation of 70000 nets to pregnant women in Kenya, it was found that virtually none of the nets received were sold and that 80-91% were used by pregnant women as intended (28). Achieving high, appropriate and sustained bednet usage in the groups with significant morbidity and mortality is crucial to the success of any

insecticide-treated bednet(ITN) program (22). Most effect of ITN on a vector's lifespan and population numbers can be expected with species that are highly endophagic, anthropophilic and bite mostly during the time when people are under nets (22).The level of biting nuisance by insects in general (i.e. mostly non-vector species) can be regarded as an external environmental factor that has a postive effect on the proper use of bednet by people (22). Villagers reported a significantly higher net usage rate than observed directly, confirming that self-reports need to be validated in some way (22). In the Gambia where the ITNs program was successfully introduced, the impregnation services were provided free of charge, with satisfactory results (19). A net impregnation rate of 80% was recorded, which then dropped below unacceptable levels of 16%, when communities were asked to pay for the impregnation services (19).

ITNs coverage in Ethiopia is 24.2% in highly malarious districts with up to 6 months or more transmission and 16% from total malarious districts up to a minimum of three months transmission with the assumption of only one ITN per household (25). A baseline survey for implementation of ITNs conducted in Amhara Region (Bahir Dar, Metema),Oromia Region (Gida Kiremu), and Southern Nations, Nationalities Peoples Region(Alaba,), revealed that the household mosquito net ownership was found 12.9% (29).

The RBM baseline survey in Ethiopia showed that proportion of pregnant women sleeping under any net and ITN was 4.7% and 0.5% respectively but 28.9% for children under five who sleep under any net the preceding night (30).

1.2.7 Re-impregnation of ITNs

Multi-center trials have shown that insecticide (permethrin) –treated benets (ITNs) or curtains reduce all-causes of childhood mortality by 14-33% in rural Sub-Saharan Africa (27). Mosquito nets treated with insecticide are one of only a few malaria control tools with a proven effect on child survival (26). In one area of Tanzania where retreatement is provided by proactive visits to each village by one supervisor bringing free insecticide and working with local health workers, morethan 90% of nets are retreated in 2-3 days (28).

1.2.8 Factors affecting ITNs coverage

In some areas where mosquito nets are already widely used, it has been estimated that less than 5% are re-treated to achieve their expected impact (14). World Health Organization estimates that fewer than 10% of at-risk children and pregnant women in Africa and Afghan refugee camps regularly sleep under ITNs (17, 31). Although the current level of knowledge concerning ITNs is relatively low, experience has shown that it is relatively easy to create awareness through a demand creation program (21).

1.3 Statement of the problem

The Abuja target for malaria prevention includes that 60% of children aged under five years and 60% pregnant women to sleep under ITNs by 2005 (2,4,12). For Ethiopia this is an enormous challenge, mainly because of its large population (51 million at risk of malaria), and also because of a relatively under developed public health system, and low community based awareness for malaria control. More than 1.4 million ITNs procured by UNICEF have been delivered within Ethiopia by the Governments RBM team, but at least another six million nets are required to attain the Abuja target (2). At current rates of net delivery, Ethiopia is unlikely to reach this target by 2005, but may succeed in later years (2, 21). The Roll Back Malaria Initiative has identified the under fives as one of the high risk group for malaria, and one of the strategies to fight malaria in this group is increasing mosquito nets use (15). This implies that there must be selective targeting at the household level such that the children are protected (15). Kafta-Humera District, the study area, is fertile and has great potential for agricultural development. However, malaria transmission is intense September through December, and frequent illness amongst indigenous farmers, migrant seasonal agricultural workers and resettlers compromise productivity (8). In the study District malaria transmission ranges from hypo endemic to meso-endemic, with crude parasite rate in cross sectional surveys ranging from 3-10% during high transmission months, and from 0-3% during low

transmission months (32). In the study area spleen rate in children 2-10 years range from 15%-18% (33).

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 declines in September (8). Today, there are growing interests in using ITNs as one of the leading strategies for the prevention of malaria. Different trials have shown a promising result that ITNs or curtains reduce all-causes of childhood mortality by 14-33% in rural Sub-Saharan Africa (27). Donors like UNICEF, WHO, the GFATM and others delivered large amount of ITNs to prevent malaria. Therefore, this study tried to elucidate whether ITNs are being possessed and properly utilized by the high-risk group and identified the loopholes that affect the possession and utilization of ITNs for malaria prevention in order to achieve the MDGs and Abuja target. Although, this study will help for monitoring and evaluation of ITNs program, also help as baseline for other studies and formulate appropriate strategy for program implementation.

2. Objectives

2.1 General objective

- To examine the status of coverage and determinants in the possession and utilization of Insecticide Treated Nets.

2.2 Specific objectives

- To assess household Insecticide Treated Nets possession
- To assess Insecticide Treated Nets use by children under five years of age and/or pregnant women
- To examine the status of re-impregnation of nets
- To identify determinants in ITNs possession and utilization

3. Methods and Materials

3.1 Study area and population

The study was conducted in Kafta-Humera District, Tigray National Regional State, northern Ethiopia. It is around 560 km away from Mekelle, the Capital City of Tigray Regional State, with an altitude ranging from 580-1820 meters above sea level. The District is the biggest in terms of geographic and territorial possession with an area of 6756.60 sq. km and a total population of 94210. It borders the Sudan in the North West, the Amhara National Regional State in the South and Eritrea in the North, where people live in cluster over a wide range of area in 20 sub-districts/ Kebeles (34, 35).

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. Besides, in-order to achieve food security and sustain household food sufficiency the Government is working at large in this area with resettlement and irrigation schemes.

The distribution of health facilities in the District is; 1 Hospital, 2 Health Centers, 4 Nucleus Health Centers, and 20 Health Posts where only 10 of them are functional. Malaria is the leading cause of morbidity in all health institutions out patient visits and the second cause of

mortality and admissions for the Hospital, and Health Centers following Kala-Azar (35). The randomly selected sub-districts (Kebeles) of Kafta-Humera District constitute the study area.

3.2 Source population

The eligible or source population included all households with pregnant women and/or children under five years of age. It included the permanent residents of the Kafta-Humera District, whether they owned insecticide treated nets or not.

3.3 Study population

Quantitative study

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.

Qualitative study

Heads of households in Kafta-Humera District with at least one under five years of age and/or pregnant women were involved in the focus group discussion.

Inclusion criteria:

All households with at least one under five years of age and/or pregnant women were included in the study.

Exclusion criteria:

People residing temporarily for seasonal labor works, like migrant laborers, but with children less than five years of age and/or pregnant women were excluded from the study.

3.4 Study design

For the quantitative part a comparative cross-sectional study was conducted using interviewer-administered questionnaire to study the coverage of ITNs and observation checklists for early morning survey of ITNs condition was as well done. A qualitative study was also conducted using focus group discussions among the recruited members of the community to assess ideas that support the quantitative part of ITNs coverage and use as well as their perspective and understanding regarding ITNs issues.

3.5 Sample size determination

Sample size (n) 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 (16), with 95% confidence level ($Z_{\alpha/2}$); power 80% with (r) equal urban to rural allocation and 10% contingency for non-response. Accordingly the required sample size was:

$$n_1 = \frac{\left[Z_{\alpha/2}\sqrt{(1+1/r)\,P\,(1-P)} + Z_{\beta}\sqrt{P_1(1-P_1)+P_2(1-P_2)}\right]^2}{(P_1-P_2)^2 \cdot r}$$

Where:

$Z_{1-\alpha/2}$=1.96

P=0.35

$Z_{1-\beta}$= 0.84

P_1= Net ownership in urban areas 40%

P_2= Net ownership in rural areas assumed to be 30%

r = urban to rural allocation which is 1

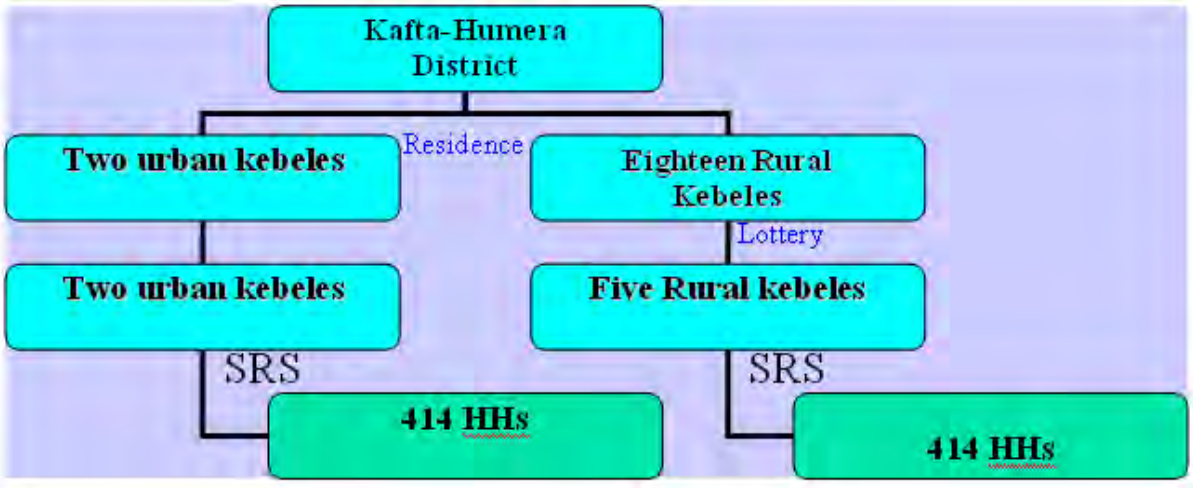
Non-response rate 10%

n_1=414

n_2=414

3.6 Sampling Procedure

First a census of households conducted by District Health Office for routine EPI vaccination and polio campaign purpose in each Kebele was obtained. Two urban and five rural kebeles were selected by lottery method. The list of households with at least one under five years of age and/or pregnant women regardless of their ITNs possession status was considered as the sampling frame from those selected kebeles. From the list, the required households were selected using systematic random sampling for the respective Kebeles where households within these kebeles were distributed by population proportion to size.



3.7 Data collection

Quantitative Study

A standardized and structured questionnaire was developed based on published studies, and adapted to local situation with certain modifications (10). The questionnaire was prepared originally in English and then translated to Tigrigna and back to English to assess consistency. The interview process was administered in Tigrigna. In the field data were collected by the help of ten trained health workers, which included a Sanitarian, Nurses and two supervisors.

The principal investigator conducted a two days training regarding the objective of the study and rehearsal of the early morning ITNs observation survey was made. The questionnaire included information on socio-demographic characteristics, malaria, mosquito net possession, use, and re-impregnation and early morning survey observation checklist. Questionnaire was pre-tested in Rawyan, one of Kafta-Humera Kebeles, which was out of the surveyed Kebeles, but with similar characteristics with in the study District. After that, the data collection process was carried out following minor amendments incorporated within the final questionnaire. 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 on the daytime, those households visited early in the morning were revisited to fill the remained household questionnaire.

Qualitative Study

Qualitative assessment was used to gather information, to explore and understand some aspects of life and their consequences for health. Issues addressed were etiology and extent of malaria, prevention methods, general beliefs on ITNs and factors that affect possession, continuous use or non-use of ITNs and re-treatment of nets. Focus group discussions were held within four groups. The principal investigator conducted the focus group discussion and the two supervisors were also involved as note takers and recruiters of focus group discussants. The size of the groups was 8 to 10 individuals in order to assure that all individuals participate, and that each participant has enough time to speak. It also helped to reduce dominance within groups and reduce the

tendency for side conversation between respondents. A total of four FGDs for women and men were conducted, two each for both settings. After the information obtained was similar and new ideas were not generated, the FGD was ended.

3.8 Data quality assurance

Questionnaires were checked for completeness on daily basis by immediate supervisors. After checking for consistency and completeness, the supervisors' submitted the filled questionnaire to the principal investigator. Incorrectly filled or missed ones were sent back to the respective data collectors for correction. The principal investigator also rechecked the completed questionnaires to maintain the quality of data. The principal investigator supervised five percent of the surveyed households to confirm whether the houses were visited twice a day and at what time the first visit carried out.

3.9 Operational definitions

Insecticide-Treated Nets	A net or screen dipped in an insecticide for protection against mosquito bite during sleeping.
Untreated nets	Nets to be treated with insecticide before use.
Re-impregnation	Nets treated with one of the pyrethroid insecticides at home or community level.
Long-lasting insecticidal nets	PermaNets™ or Olyset™ Net ready-to-use, factory-pretreated nets that require no further treatment during its expected lifespan of 4-5 years.
Possession	Proportion of households, which own at least one ITN during the time of survey.
Use	Proportion of high-risk groups who slept under ITN the previous night.
District(Woreda)	Administrative unit with population of about 97,000.
Sub-district or Kebele (Tabia)	Locality, most periphery administrative unit consisting of a cluster of 3 to 5 ketenas (kushets), population ranging from 1500 to 5000.
Ketena (Kushet)	Village, usually 100 to 150 households with average household size 5.2, population ranging from 500 to 1000.
High risk groups	Part of the populations, which are highly vulnerable to the disease malaria and identified as children less than 5 years of age and/or pregnant women.

3.10 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. Ten percent of the data were re-entered in order to compare and assure the quality of the data. Multiple logistic regressions were used in order to infer associations and predictions. The qualitative data was transcribed manually from audio taped records. Results were analyzed manually written by summarizing the ideas forwarded by the focus group discussants.

4. Ethical Considerations

The ethical approval and clearance were obtained from the Department of Community Health and Medical Faculty of the Addis Ababa University. Permission was also obtained from the concerned bodies of Tigray Regional Health Bureau, Kafta-Humera District Administration and District Health Office. Prior to interview and inspection of household survey, data collectors requested for the respondents' consent. Respondents were informed about the confidentiality of the information they provided and their name or address was not taken and their answers were anonymous. Interview with a respondent or observation was privileged and was not discussed to third parties. Data was presented in aggregated form in order to generalize their behavior towards ITNs use. Data collectors were health professionals and created a trusting environment by respecting participants' privacy that can encourage them to be as honest as possible during the course of the survey. Participation in the survey was voluntary and they could choose not to participate, but were told that their views were important to strengthen the program. 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. Clinically ill patients found during the survey were advised to consult the nearby health facility to get health service.

5. Dissemination of Findings

The findings of this study will be disseminated to Department of Community Health, Addis Ababa University, Federal Ministry of Health, Tigray Health Bureau, Kafta-Humera District Administration, District Health Office and UNICEF. The findings will be also disseminated to different organizations that will have a contribution to improve the status of ITNs in the Region. The findings will be also presented in various seminars and workshops. Findings will be published in a scientific journal.

6. RESULT

6.1 Descriptive

6.1.1 General Information

The survey on assessment of ITNs coverage for malaria control in Kafta-Humera District carried out from 9 November through 30 November 2005, during the high malaria transmission season. During the study period, information was collected with an early morning survey using observation checklist, household questionnaire and focus group discussions. In the District after the current restructuring of the administrative Kebeles, there are two urban and eighteen rural Kebeles. Based on the census information obtained from the District Health Office for immunization purpose, 828 households were interviewed during the study period, which consisted of 414 urban and 414 rural settings. An early morning survey using observation checklist was performed prior to the interviewing of the households. The non-response rate was none and all targeted households participated in the survey. Data were collected from two urban kebeles, and five rural selected Kebeles of the District.

6.1.2 Socio-Demographic Characteristics of Study Population

The majority of the respondents were females, 264(63.8%) and 287(69.3%) for rural and urban settings respectively (Table 1). Among the interviewed, 338(81.6%) for rural and 354(85.5%) for urban were headed by males. The median age of the head of households were found to be 31 years, ranging from 16 to 65 years for rural areas. Also for urban heads it was found to be 30 years, ranging from 16 to 70 years. Fifty-six percent of rural and 34.1% of

urban heads of households could not read and write and the remaining were literates, with the educational status ranging from primary education to tertiary level. Among the head of households 383(92.5%) of the rural and 379(91.6%) of the urban were followers of the Orthodox Christian. Regarding marital status, 335(80.9%) and 341(82.4%) for rural and urban settings were married, followed by 49(11.8%) and 21(5.1%) singles for respective settings. The occupation of 309(74.6%) and 157(37.9%) of rural and 157(37.9%) and 102(24.6%) of urban head of households were farmers and merchants respectively. The mean (±SD) monthly income for the rural and urban households was found ETB 427.77±(331.21) and 557.62±(515.03) respectively.

The total number of household members was on average 5.0±1.97 for the District and, 5.14±1.9 for rural and 4.87±(2.02) for urban households. The number of high risk groups (children under 5 years of age and pregnant women) were (1.39 ± 0.57) in the District and (1.47±0.60) for the rural and (1.31±0.53) for the urban areas. The mean number of rooms within these households was 1.23(±0.55) and 1.23(±0.54) for rural and urban areas respectively. The mean number of beds or sleeping places indoors and outdoors per household was 3.73(± 1.64) for rural and 3.75(±1.83) for urban areas.The total number of nets present was (mean ±SD) (2.34±1.62) for the rural and (2.5±1.45) for the urban areas.

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

0.67±0.45:1 and 0.62 ± 0.36:1 and the ratio of household members to nets was 2.25 ± 1.07: 1 and 2.14 ± 0.9:1 for rural and urban settings respectively. The household radio possession was 528(63.8%), which was found 217(52.4%) and 311(75.1%) for surveyed rural and urban householders.

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

Variables	**Place of residence, Number n (%)**		
	Rural	Urban	Total
Sex of respondents			
Male	150(36.2)	127(30.7)	277(33.5)
Female	264(63.8)	287(69.3)	551(66.5)
Sex of Household head			
Male	338(81.6)	354(85.5)	692(83.6)
Female	76(18.4)	60(14.5)	136(16.4)
Age of Household head			
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)
Educational level of Household head			
Illiterate	232(56.1)	141(34.0)	373(45.0)
Literate	182(43.9)	273(66.0)	455(55.0)
Religion of Household head			
Orthodox	383(92.5)	379(91.6)	762(92.0)
Muslim	31(7.5)	32(7.7)	63(7.3)
Catholic	0(0.0)	2(0.5)	2(0.2)
Protestant	0(0.0)	1(0.2)	1(0.1)
Marital status of Household head			
Married	335(80.9)	341(82.4)	676(81.6)
Single	49(11.8)	21(5.1)	70(8.5)
Divorced	16(3.9)	27(6.5)	43(5.2)
Widowed	14(3.4)	25(6.1)	39(4.7)
Occupation of Household head			
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)
Monthly income of HHs mean ±(SD)	427.77±(331.21)	557.62±(515.03)	492.5±(437.6)
Family size mean ±(SD)	5.14±(1.9)	4.87±(2.02)	5.0±(1.97)
Children under 5 mean ±(SD)	1.35±(0.62)	1.23±(0.54)	1.3±(0.58)

Pregnant women mean ±(SD)	0.12± (0.33)	0.08±(0.28)	0.1±(0.03)
Number of rooms mean ±(SD)	1.23±(0.55)	1.23±(0.54)	1.24±(0.54)
Sleeping places mean ±(SD)	3.73±(1.64)	3.75± (1.83)	3.74±(1.74)
Nets per households mean ±(SD)	2.34±(1.62)	2.5±(1.45)	2.43±(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)

6.1.3 Knowledge and Practice about Malaria and Mosquitoes

Almost all respondents, 410(99.0%) rural and 407(95.3%) urban reported having heard of the disease malaria, 390(94.2%) and 391(94.4%) of the rural and urban settings knew that mosquitoes play a role to transmit malaria (Table 2). Majority of the respondents, 380(91.8%) of the rural and 363(87.4%) of the urban 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. Seventy percent (290) of urban and 359(86.7%) of rural had heard malaria education message.

Pertaining to the way they protect themselves from malaria, 340(82.1%) rural and 387(93.5%) urban respondents mentioned that they sleep under mosquito nets, 222(53.6%) rural and 116(28.0%) urban reported that they participate in the community environmental sanitation activities to their area around the house during the transmission period. Nearly eight seven percent, 359(86.7%) of the rural and 317(76.6%) urban respondents identified children less than five years of age as the most affected age group by malaria followed by 177(42.4%) and 134(32.4%) pregnant women for respective settings. Almost eighty percent (324) of urban and 309(75.6%) of rural respondents reported the advantage of re-treatment of mosquito nets with insecticide to kill mosquitoes. Eighty-nine percent, 369(89%) of the rural and

346(83.6%) of urban respondents reported that they did not get malaria since they were sleeping under net. As to the disadvantage of sleeping under a treated net, 359(86.7%) rural and 377(91.1%) urban respondents did not cite any disadvantage of children under five and/or pregnant women sleeping under a treated net. Regarding the sleeping pattern of children under five years of age, most children 300(71.6%) for rural and 293(70.1%) for urban areas sleep with their mothers.

Table 2: Knowledge and practice of respondents about the cause and prevention of malaria and children sleeping pattern in Kafta-Humera District, Tigray November 2005

Variables	**Respondents by residence Number n (%)**		
	Rural	Urban	Total
Heard malaria	410(99.0)	407(95.3)	817(98.7)
Mosquito could cause malaria	390(94.2)	391(94.4)	781(94.3)
Symptoms of malaria (MR)			
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)
Vomiting	194(46.9)	197(47.6)	391(47.2)
Heard malaria education message	359(86.7)	290(70.1)	649(78.4)
Ways prevent from malaria (MR)			
Use mosquito net	340(82.1)	387(93.5)	727(90.6)
Clear surrounding	222(53.6)	116(28..0)	338(42.1)
Smoking	216(52.2)	64(15.5)	280(34.9)
Group most affected by malaria (MR)			
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)
Advantage sleeping under net (MR)			
Do not get malaria	369(89.1)	346(83.6)	715(86.4
Do not bother by other insects	249(60.2)	183(44.2)	432(52.2)
Sleep better	53(12.8)	10(2.4)	63(7.6)
Disadvantage sleeping under net (MR)			
No disadvantage	359(86.7)	377(91.1)	736(88.9)
Too hot to sleep	28(6.8)	28(6.8)	56(6.8)
Difficult to get up in the night	17(4.1)	2(0.5)	19(2.3)
Mosquito cause trouble	409(98.8)	360(87.0)	769(92.9)
Season mosquito bite most (MR)			
Rainy season	344(83.1)	370(89.4)	714(86.2)
Sleeping patter n of Children under five (MR)			
Alone	41(9.79)	70(16.75)	111(13.26)
Mother	300(71.6)	293(70.1)	593(70.85)

Father	14(3.34)	9(2.15)	23(2.75)
Parents	54(12.89)	33(7.89)	87(10.39)
Others	10(2.39)	13(3.11)	23(2.75)

6.1.4 Mosquito Nets Possession

As per the early morning survey and household questionnaire, respondents were asked if their household owned any mosquito nets and, if so how many. Household possession for at least one mosquito net was found to be 748(90.3%), table 3 and figure 1. Ownership was higher in urban 398(96.1%) than in rural areas, which were 350(84.5%). 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 somewhat greater 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. Regarding distribution of nets, majority of the conventional nets were distributed in the urban areas and the large proportion of LLINs were found in the rural areas.

More than two-third (69.2%) of nets owned by households were acquired within the past 3 years. Nets in rural settings tended to be newer, 682(70.4%) than 709(68.1%) in the urban areas. About 125(12.9 %) of the rural and 189(18.2%) urban nets were also acquired four or more years ago. Initially, nets were obtained through the formal public sector on cost recovery scheme. Ninety-three percent 968(93.0%) of urban and 486(50.2%) of rural nets were purchased with 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 and a few from MSF-H for free.

6.1.5 Mosquito Net Utilization

In the survey, 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 3 and Figure 1). Likewise the proportion of pregnant women who slept under net was 47(57.3%), which was 25(52.1%) for rural and 22(64.7%) for urban. The proportion 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 a survey was 293(62.1%) and 410(77.1%) for rural and urban areas respectively.

For ITN proportion of children under 5 years of age who slept under treated net during the night preceding a 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 525(2.1%) for rural and 22(64.7%) for urban households. The

proportion children 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 a survey was 286(60.6%) and 380(71.4%) for rural and urban areas respectively. The proportion of at least one net hanged the preceding night in the survey was 1377(68.5%), which was 590(60.9%) for urban and 787(75.6%) for urban households. The possession of nets per sleeping place was also 969(62.7%) for rural and 1041(67.1%) for urban households respectively.

Among the houses surveyed, 594(71.7%), which was 257(62.1%) of rural and 337(81.4%) of urban had tucked at least half of the nets they owned. The average number of months that people sleep under mosquito nets was 6 months for both settings. The median time people go to bed was found to be 8:00 pm and 9:00 pm in the evening for under five years of age and pregnant women respectively, but similar for both settings.

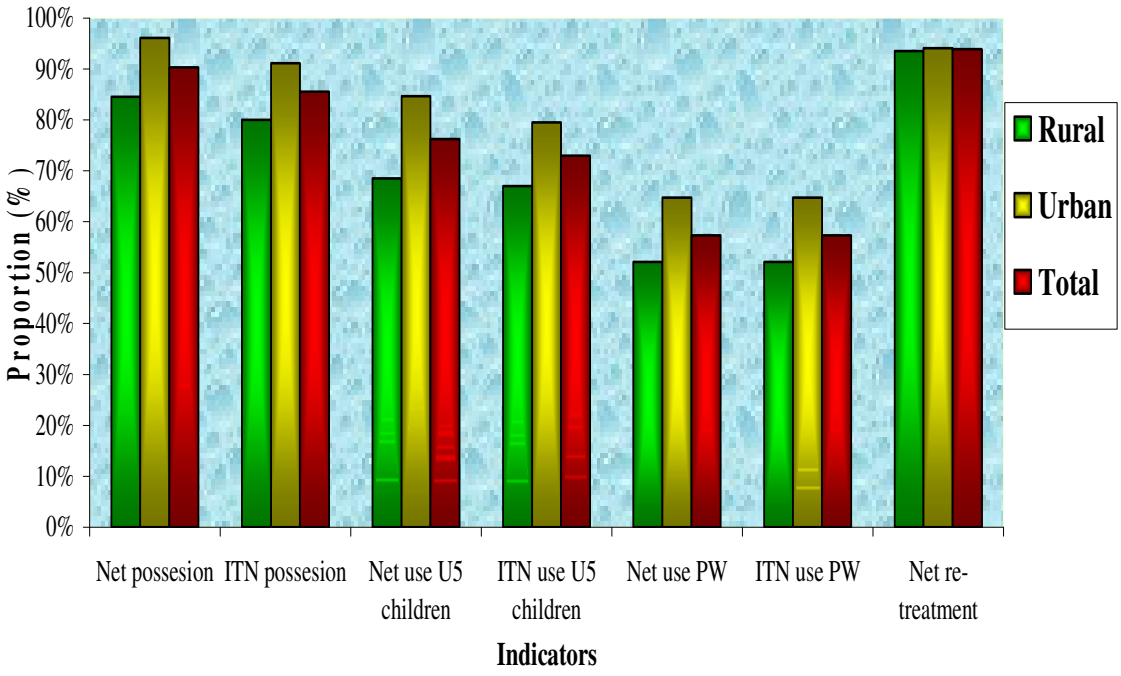
6.1.6 Mosquito Nets Treatment and Washing Pattern

In this survey, 1439(93.9%) re-impregnation rate was reported, which was 514(94.1%) in urban and 925(93.5%) in rural settings (Table 3 and Figure 1). About fifteen percent (15.3%) owned re-treated nets washed at least once, which was 13.4% for rural and 16.3% for urban settings. Most respondents said that their net had been washed 1-4 times since last treated. The reason of respondents mentioned for net washing was 83(95.4%) due to dirt, which was reported by 34(94.4%) of rural and 49(96.1%) of urban respondents.

Table 3: Net and ITN possession, utilization and re-impregnation status by head of households of Kafta-Humera District, Tigray November 2005

Variables	Respondents by residence Number n (%)		
	Rural	Urban	Total
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)
Duration of nets owned			
<12 months	432(44.6)	318(30.5)	750(37.3)
12-24 months	119(12.3)	204(19.6)	323(16.1)
25-36 months	131(13.5)	187(18.0)	318(15.8)
37-48 months	162(16.7)	143(13.7)	305(15.2)
>48 months	125(12.9)	189(18.2)	314(15.6)
Payment of nets			
Paid	486(50.2)	968(93.0)	1454(72.3)
Free	483(49.8)	73(7.0)	556(27.7)
Utilization of nets in percent			
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 in percent			
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)
Net hanged mean ±(SD)	1.43±(1.27)	1.9±(1.36)	1.66±(1.34)
Net possession per sleeping places	969(62.7)	1041(67.1)	2010(64.9)
ITN possession per sleeping places	933(60.4)	983(63.3)	1916(61.9)
Net treatment status			
Untreated nets	36(6.5)	58(5.9)	94(6.1)
Re-treated nets	514(93.5)	925(94.1)	1439(93.9)

Figure 1: Net and ITN coverage in Kafta-Humera District, Tigray, November 2005



6.2 FOCUS GROUP DISCUSSION

Cause and problem of malaria

Mosquito bite was reported by almost all discussants, to be the major cause of the disease malaria in their area. Nevertheless, one rural female discussant reported, "*being hungry"* as the cause of malaria. All discussants agreed that malaria is the leading health problem in the area as its transmission coincides with the harvest season and cause great loss if they get sick. Almost all discussants agreed as well that the impact of the disease is disastrous and leads them to stay long time at home or on bed with no active participation in farming activities compared with the healthy persons and resulting often with death.

One rural discussant expressed the risk of malaria *"I come here a few months back to reside in this village and have four children; but I can not perform my day to day activities for a long period since my children get sick of malaria one after the other"*. Another rural male discussant also expressed the risk of malaria in his area as *"If I can not work due to being attacked by malaria, I will not be able to survive, so by any means I should protect my self and my family members from the disease"*.

Methods of prevention and control against malaria

Nearly all women and men discussants of the rural and urban settings identified the major breeding sites as water pools created after the rainy season. The possible

prevention and control means raised by all discussants to prevent malaria was draining, and filling the breeding areas, sleeping under ITN and prompt diagnosis and treatment. Some discussants also mentioned clearing non-functional equipments near by households that holds water like festal, metal tin, old tyres etc.

Almost all rural women and men discussants also mentioned smoking, using repellents, wearing long cloths and planting *neem* trees as prevention and control methods. Some rural men discussants mentioned larviciding and indoor residual spray as options to control the larval and adult mosquitoes.

Practices or beliefs towards ITNs possession, use and re-impregnation

Almost all discussants from both settings appreciated the advantage of a net particularly ITNs. They described ITNs as it protects not only malaria but also Kala-Azar, bite of other insects like flies, spiders, scorpion, also rats and snakes too.

One rural male discussant explained the use of net as *"I had been in Sudan working on remote agricultural field as a laborer for about four years; and the only property I had was a mosquito net. It helped me as a weapon not only to protect malaria or kala-Azar but also bite of snakes since the area was known with the trouble of snakes".* Almost all discussants reported that they had never observed any harm or disadvantage against sleeping or using a net or ITNs.

One rural male discussant explained, *"Every thing has a limit or proper way of use even drugs; ITNs after treatment should be hanged for a while until it get dried, but if you make contact with soiled net, skin irritation and sort of rash appears particularly on*

children". In this area ITNs has a good public acceptance and every body tends to use a net when sleeping even in verandah or out door 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"*.

Sleeping pattern within the community

All discussants mentioned that it is difficult to sleep three or more people in a single bed together since the area is too hot. The maximum number people sleeping together is two persons but either of them should be a child. Most of the time husbands, elder children or children above five years of age, and pregnant women above six months of gestation period sleep independently. But children under five years of age sleep most of the time with their mothers even if she is pregnant, but less than six months gestation period.

All discussants 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 disease malaria and not complain or seek treatment when they get sick. However, one urban male discussant mentioned that he give priority to pregnant women since they are the most vulnerable to the disease and protecting them means protecting the fetus too. He said that, *"It is just like kicking two birds at the same time with a single stone"*.

Factors that affect continous ITNs possession, use and re-impregnation

In the study area, ITNs have a good public acceptance, but the problem is shortage of nets. 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 distribution system.

One rural male discussant reported, *"There is discrimination during mosquito net distribution, it is up to your personal relation with the local administration that you will get a net"*.

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"*.

A rural male regarding distribution of nets said the following in Tigrigna **ህበይ ምስሓስፈ መደረንሕ** that means *"for this season ITNs was distributed very late after the major malaria transmission period"*. Almost all discussants mentioned that there is no problem in using a net because most of the residents of the Humera area were in the Sudan refugee camp and have practiced it there. Even after they re-settled in Humera, they were buying the mosquito net from the cost recovery scheme initiated by the Tigray Regional Health Bureau since 1995/96.

All discussants appreciated the re-impregnation process since it is a house-to-house approach. Even if the residents go to the field during the house-to-house re-impregnation campaign, any person in the house can deliver the nets for the re-impregnation team. They have also mentioned that before the re-impregnation day, the local administration announces by microphone to wash and make ready the available nets for re-impregnation.

Suggestions to improve continous possession, use and re-impregnation of ITNs

Majority of the discussants responded that ITNs could save lives if properly utilized. The major challenge they have raised was availability of nets. The major net distribution system in the area is through the public health sector and delivered for family size one to four and above four members one and two nets respectively.

However, they said it is not optimum due to the sleeping pattern of the community. The discussants recommended that either through the cost recovery scheme established since 1995/96 or other means, access to any net should be improved. If so, they said that are be able to pay as much as they need but supplied with a reasonable price through out the year.

6.3 Determinants of ITN ownership and utilization

Among the potential determinants explored regarding utilization of ITNs in the rural areas, being head of households 25 years old or more, being a merchant, government employee, or having better income were found to be significantly associated with net utilization (Table 4). Having more options pertaining to sleeping places and more family size were as well significantly related to net utilization in the rural areas. Households headed by merchants were 0.90 times (95%CI 0.03, 0.38) less likely to let their children under five and/or pregnant women to sleep under a net. Households headed with government employees were 0.87 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 sleep under a net. For the highest family size the net use was 0.95 times (95%CI 0.02, 0.19) less likely to have similar practice. However, being educated head of household did not matter on utilization of a net by children under five and/or pregnant women p=0.136.

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

Description		No. (%)	OR, 95% CI (Crude)	OR, 95% CI (Adjusted)
Age of Heads	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)*
Sex of Head	Male	338(81.6)	1.00	1.00
	Female	76(18.4)	0.34(0.21, 0.57)*	0.35(0.04, 2.78)
Education of Head	Illiterate	232(56.1)	1.00	1.00
	Literate	182(43.9)	1.24(0.81, 1.90)	1.60(0.86, 2.98)
Occupation of Head	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)*
Marital Status of Head	Single	49(11.8)	1.00	1.00
	Married	335(80.9)	4.64(2.49, 8.68)*	0.24(0.03, 2.07)
	Divorced	16(3.9)	4.74(1.33, 16.85)*	1.54(0.24, 10.01)
	Widowed	14(3.4)	2.84(0.83, 9.77)	1.61(0.27, 9.51)
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)*
	Better income	44(10.6)	10.57(4.09, 27.34)*	11.44(2.97, 44.12)*
Radio Possess	Not possess	197(47.6)	1.00	1.00
	Possess	217(52.4)	1.66(1.09, 2.54)*	0.84(0.43, 1.62)
Malaria education	Not heard	55(13.3)	1.00	1.00
	Heard	359(86.7)	3.10(1.74, 5.53)*	1.76(0.76, 4.05)
Sleeping place	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)*
	Five and above	113(27.3)	19.09(8.82, 41.29)*	47.23(12.32,181.05)*
Family size	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

In the urban setting, head of households within the fourth quintile and better income, were found to be significantly associated with net utilization. Having more options pertaining to five or more sleeping places and possessing a radio were found to be the determinant factors for net utilization (Table5). 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 0.63 times (95%CI 0.16, 0.86) less likely to have similar practice.

Table 5: Predictors of sleeping under a net for high-risk groups, of households in urban Kafta-Humera District, Tigray, November 2005.

Description		No. (%)	OR, 95% CI (Crude)	OR, 95% CI (Adjusted)
Age of Heads	16-24	113(27.3)	1.00	1.00
	25-30	113(27.3)	0.89(0.46, 1.74)	0.83(0.39, 1.74)
	31-39	82(19.8)	1.55(0.68, 3.51)	1.61(0.65, 3.97)
	40 and above	106(25.6)	1.21(0.59, 2.48)	1.42(0.61, 3.32)
Sex of Head	Male	354(85.5)	1.00	1.00
	Female	60(14.5)	0.38(0.21, 0.72)*	0.89(0.42, 1.91)
Education of Head	Illiterate	141(34.0)	1.00	1.00
	Literate	273(66.0)	2.23(1.32, 3.78)*	1.49(0.81, 2.74)
Occupation of Head	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 Possess	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 place	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

Among the potential determinants explored regarding net possession in rural areas, head of households being a merchant, government employee, better income were found to be determinant factors (Table 6). Having a radio was as well significantly associated with net possession. Households headed by government employees were 0.94 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.

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

Description		No. (%)	OR, 95% CI (Crude)	OR, 95% CI (Adjusted)
Age of Heads	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 of Head	Male	338(81.6)	1.00	1.00
	Female	76(18.4)	0.22(0.13, 0.40)*	0.47(0.03, 7.99)
Education of Head	Illiterate	232(56.1)	1.00	1.00
	Literate	182(43.9)	0.94(0.55, 1.60)	0.90(0.40, 2.04)
Occupation of Head	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 of Head	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	Do not heard	55(13.3)	1.00	1.00

education	Heard	359(86.7)	0.51(0.20, 1.33)	0.26(0.07, 0.94)*

* Statistically significant at p<0.05

In urban areas, being a farmer was found to be significantly associated with net possession (Table 7). Households headed by farmers were 5.62 times (95%CI 1.05, 29.93) more likely to own a net.

Table 7: Predictors of possessing a net for households with high-risk groups, in urban Kafta-Humera District, Tigray, November 2005.

Description		No. (%)	OR, 95% CI (Crude)	OR, 95% CI (Adjusted)
Age of Heads	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 of Head	Male	354(85.5)	1.00	1.00
	Female	60(14.5)	0.20(0.07, 0.55)*	0.60(0.16, 2.22)
Education of Head	Illiterate	141(34.0)	1.00	1.00
	Literate	273(66.0)	3.39(1.21, 9.54)*	2.13(0.66, 6.94)
Occupation of Head	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	Do 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

Comparing a net coverage among the rural and urban settings net possession, was found to be statistically significant among the residence while net utilization and treatment

were found similar (Table 8). Nets were 3.33 times (95%CI 1.39, 7.98) more likely possessed in urban than the rural areas. See also appendix I.

Table 8: Predictors of urban and rural households with high-risk groups of Kafta-Humera District, Tigray, November 2005.

Description		No. (%)	OR, 95% CI (Crude)	OR, 95% CI (Adjusted)
Sleep under net	No	192(46.4)	1.00	1.00
	Yes	636(53.6)	2.18(1.56, 3.04)*	1.37(0.92, 2.06)
Net treated	No	121(29.2)	1.00	1.00
	Yes	707(70.8)	2.59(1.71, 3.92)*	1.05(0.56, 1.97)
Net owned	No	80(19.3)	1.00	1.00
	Yes	748(80.7)	4.55(2.58, 8.01)*	3.33(1.39, 7.98)*

* Statistically significant at $p<0.05$

7. DISCUSSION

Beliefs and knowledge about mosquitoes as well as malaria was nearly universal. Ninety-nine percent of rural and 95.3% of urban respondents heard about malaria. About ninety-four percent (94.2%) of rural and urban (94.4%) households knew that mosquito transmits malaria. Malaria is the prominent problem in the area that deters them from agricultural activities as they mentioned during FGDs. They get the information on malaria education message from health workers, and during their history of migration. A study conducted in Uganda on malaria revealed that all respondents (99.6%) reported having heard of the term "malaria" (10). However, knowledge of mosquitoes as the only cause of malaria was poor, only 21% knew that mosquitoes are the *only* cause of malaria (10).

Knowledge of symptoms and vulnerable groups was very high. Almost ninety-two percent (91.8%) of rural and 87.4% of urban residents identified fever as a major symptom. Significant number of respondents also identified children under five and pregnant women as the most vulnerable group. In the area, there are community health workers treating malaria clinically taking fever as the major symptom particularly during the major transmission season. During malaria education they taught fever as the main symptom and also know it from their own experience of being infected with malaria. A study in Senegal revealed that, symptoms matching clinical descriptions of mild malaria, such as fever/"hot body," feeling hot and/or cold/shivering were mentioned by 85% of the respondents (36). Similar studies in Uganda also revealed that, (71%) mentioned fever as a main symptom of malaria and most (80%) knew that

children under five and pregnant women are most susceptible to get a serious case of malaria (10).

Levels of perceived advantages of net use by vulnerable groups (children under five and pregnant women) were extremely high. Nets were seen as providing good protection against mosquitoes and malaria. Treated nets were seen as especially effective, with the added advantage of being better at preventing malaria and killing and repelling mosquitoes during the quantitative and qualitative study.

Net possession was higher in the 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 scarcity of nets in rural areas or nets might be transported for sale from rural to urban areas during distribution. Although nets imported from neighboring country like Sudan through borders were sold in urban areas, the possible reasons may be that urban residents are on the average with better income status compared to rural areas to buy a net. 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 (23).

Net possession could predict what reported and observed rural and urban settings would have been, within certain circumstance. From the survey, urban residents were found to be threefold higher to own a net compared to the rural residents. Net and ITNs possession by children under 5 years of age were twofold to threefold lower in rural areas compared to urban areas (23). Net possession could also predict reported income

status. Rural with better income were eighty-one fold higher to own a net as compared to the poorest of the same residence. This might be households with better income may tend to purchase a net if available in the market but the poor people might give priority to fulfill their basic needs like food. Net and ITNs possession are between twofold and eighty fold lower in the poorest households compared with the better income households (23).

Nets and ITNs possession in the District for at least two was 74.5% and 71.1% respectively. It is considerably higher compared to the over all country as well as regional profile. The possible reason may be that the area is highly malarious and due attention might have been given by the Tigray Regional Health Bureau for such anti-vector interventions despite the importation of nets also from Sudan. The community in the District has the ability to buy nets during the harvest season since the area is known for cash crops like sesame. Country coverage based on distribution in terms of two per household was 12.1% and 8% for any net and ITNs respectively (25). 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 assuming 2.7 million newly distributed nets the same year(37). The ITNs coverage for Tigray Region for at least one per household was about 38.2% (38). 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, (16). 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 (39). But the limitation with this survey is

there was a huge net distribution through out the country to address the GFATM support carried out immediately after completion of the DHS study.

In the District, almost 85.5% of households had at least one ITN. This indicates that a few households within the District lack ITN, but may have protection due to the massive killing effect of the highest coverage within the buffer area. 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 (40).

The proportion of children under five years of age who slept under a net during the night preceding a survey was a little bit lower than the proportion of households that possess 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. The rural and urban mean number of nets is (2.34±1.62) and (2.5±1.45) respectively. Number of nets were greater than the number of high-risk groups (children under 5 years of age and or pregnant women) (1.39 ± 0.57) in the District as well as (1.47±0.60) and (1.31±0.53) for rural and urban areas respectively. The average ratio of high-risk groups (children and/or pregnant women) to nets was 0.67±0.45: 1 and 0.62 ± 0.36:1 and the ratio of household members to nets was 2.25 ± 1.07: 1 and 2.14 ± 0.9:1 for rural and urban areas respectively. This suggests that the average number of nets in a household would typically not suffice 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, children and adults (e.g. infants and their mothers).

The reason may be mal distribution of nets and households with extra nets might store it for the coming years due to fear of net shortage. According to the data collected by observation checklist during the early morning survey, nets were stored with out any purpose. Net use was higher in children under five years of age and lower among the pregnant women when compared with other segments of the population. The other reason may be care given to children under five years of age in order to protect them not only from malaria, but also from bite of other insects, lizards, and rats, which was also supported by the FGD participants. Among the high-risk groups, pregnant women may be less advantageous due to some cultural aspect that difficult to get satisfactory explanation both from qualitative and quantitative study. From 34 surveys conducted in a median survey year of 2001, the population-weighted coverage of ITN usage in Africa children under 5 years of age was 3% (23). A study on Net and ITN conducted by Net Mark revealed that, 16% of children under five slept under a net the prior night, 6% of children under five slept under an ITN the prior night, 9% of pregnant women slept under a net the prior night, 6% of pregnant women slept under an ITN the prior night (16). A study conducted by CSA also revealed that net utilization for children under 5 years of age and pregnant women was 5.9% and 4.1% for altitudes less than 1500 meters (39).

Pregnant women with children under five years of age, beyond sixth months of gestation period, in most cases slept alone as to FGD in-order to protect the fetus in their womb from any harm. A study conducted in rural Gambia revealed that, use of nets was > 90% coverage of targeted groups for children 5 years of age (41). A study conducted in

different regions of Africa also revealed that reported use during the preceding night by children under five years of age was between 0% and 16% for ITNs and between 0.7 and 74.5% for any net. On average, in households owning ITNs, 55% of children sleep under it (18).

Use of any net and ITNs 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 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 refuge camp (8). 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 difficult to get malaria prompt diagnosis and treatment. In Contonou in Benin and Dar es Salaam in the United Republic of Tanzania, use of any net by children under five years of age exceeds 60% (18), the targeted ITN coverage for Africa agreed under RBM. The 60% target for all populations at risk, in many rural areas, thus remains to be extremely ambitious (18). 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 (23). Data from national household surveys conducted between 1999 and 2004 in Africa revealed that net and ITN usage by children under five years of age are twofold to threefold in rural areas compared with urban areas (23).

Among the nets owned in the district, 49.2% for rural and 7% for urban areas were distributed free of charge. This is because due attention was given by the Tigray Regional Health Bureau to scale up the ITNs coverage in the rural areas in order to avert the malaria burden. Use between 50% and 70% are in fact the level achieved in mosquito net intervention trials, in which nets are provided free of charge and in abundance (18). But in the study District if nets are available even with reasonable fee such coverage is achievable.

In the study area, there is no difference in net utilization among the high-risk groups of rural and urban areas (OR 1.37 95%CI 0.92, 2.06). In urban and rural areas net utilization by the high-risk groups is almost fivefold and twelve fold higher in the better income group as compared to the poorest households for respective areas. Data from 25 surveys in Africa conducted between 1999 and 2004 revealed that net and ITN usage are between twofold and eightfold lower in the poorest households compared with the better income households (23).

The median time most children under five and pregnant women go to bed was 8:00pm and 9:00pm respectively for both settings. Though due to late biting of mosquitoes majority of the high-risk groups may be protected by the nets if they sleep under it and also have less risk to be infected by malaria. Nets are relatively effective for children under five years of age since their long sleeping hours will more often include the dusk hours, with greatest mosquitoes abundance than do the sleeping hours of adults (21). A study conducted in one of the rural study sites of Kafta-Humera District, Beaker Kebele the nocturnal biting time of mosquitoes was observed 11:00-12:00pm in the mid evening

(42). Ninety percent of mosquitoes biting take place between 10:00pm and 5:00 am in the evening (43).

The net re-impregnation rate for the surveyed season was 93.9%, large enough to bring a massive killing effect on the targeted vectors. The re-impregnation coverage of nets for the Tigray Region for the same year was 85.4% (38). Actually such coverage was achieved after transition from fixed re-treatment center to house-to-house re-treatment approach and free insecticide as usual prior to the transmission season. Pyrethroid-impregnated bed nets reduce man-vector contact by acting as a physical barrier and by repelling mosquitoes, driving them out of houses also offers some protection for others sleeping in the same room, even if they are not sleeping under the net (10, 44). The high coverage of re-impregnation of nets may also reduce mosquito density dramatically and contribute much against clinical attack of malaria in the areas. Insecticide-treated bed nets were more effective at preventing infections with high-density parasitamia than were untreated nets (45). Village wide use of permethrin-treated bed nets, compared with placebo treated nets, has reduced clinical attacks of malaria by 63% in the Gambia (46).

About 12.9% of rural and 18.2% of urban nets were acquired 4 or more years ago and became worn out and torn. Nevertheless, majority of these nets were re-impregnated and due to the deterrent effect of the pyrethroid may be deriving out the mosquitoes and result to reduce the man vector contact. Impregnation improves the effectiveness of a

torn or is not completely tucked in bed net and prevents mosquitoes from feeding on a limb, which may touch, the bed net during the night (10, 44).

People with low income and do not possess a radio are the most un-favored group to own a net in rural areas. The current distribution of nets is free of charge, but the possible reasons might be focusing particularly on the indigenous inhabitants as well their personal relationship compared to the shortage of nets as explained by the FGD participants. Social marketing and subsidized or free of charge distribution of ITNs for target groups can effectively reduce this inequality. UNICEF-supported program in the deprived areas of Ghana and Nigeria, have supplied highly subsidized ITNs to pregnant women and children under 5 years of age through routine public health service. Usage of ITNs by children under 5 years of age and pregnant women in rural areas was similar to or higher than those in urban areas. Net possession in Nigeria and net possession and usage in Ghana were equally high or higher in the poorest households compared with the better income households (23).

In urban areas, farmers possessed nets significantly. The reason might be that farmers in urban areas are investors and are capable to purchase a net at any cost available in the market. But, in the rural areas merchants and government employees are less likely to own nets may be more attention given to the indigenous farmers. Generally, in both settings every person regardless of socio-demographic characteristics was willing to have a net. But, the major constraint as explained by the FGD participants were mal-distribution of nets within the settings even to purchase nets at a reasonable cost from

the earlier cost recovery scheme. The success or failure of ITN program in many cases may be related to human behavioral factors that affect coverage and proper use (22).

Factors determining utilization were age, being a merchant or government employee, income above the poorest, with three sleeping place or five and more and family size more than three in the rural areas. For urban area, income fourth quintile and more 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 have more nets. Therefore, the vulnerable groups in such places may be covered with ITNs. But as family size increases with limited income utilization status also decreases due to shortage of nets to cover the available beds that may incur additional cost for those economically poor even though they have more sleeping places. Also nets in urban areas may get old and out of use as to long period of distribution through the public sector. Studies showed that social, behavioral, and economic aspects such as lack of information about the benefit of ITNs, poor access to markets for ITNs, cultural preferences, and low income are barrier for ITNs use (24).

8. STRENGTHS AND LIMITATIONS OF THE STUDY

Strength of the study:

- The study included the rural and urban areas to illustrate the actual coverage of nets and ITNs within the District.
- The study focused on the most vulnerable segment of the population.
- Early morning survey was carried out to observe the actual behavior of the community with regard to ITNs coverage.
- The study was carried out during the major malaria transmission season.
- The study was also carried out immediately after the new distribution of nets to support the RBM initiative through GFATM.
- The non-response rate was almost none even during the early morning survey.
- The design was compatible with the duration of the study.
- The study compared study population with different socio-demographic characteristics.

Limitations:

- Difficult to know whether the determinant or the outcome occurred first.
- A pattern of hidden sequence in the selected households may introduce bias.

9. CONCLUSION AND RECOMMENDATIONS

Possession, utilization and re-impregnation 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, but it was similar regarding utilization and re-impregnation of nets. The rural and urban residents were found to be with better knowledge and practice to combat the risk of malaria. Net and ITN possession in the District was considerably high. The proportion of children under five years of age and pregnant women who slept under a net during the night preceding the survey was found to be very high. But pregnant women were found to be less likely to use nets compared to other segments of the population. The re-impregnation rate in the District for the surveyed season was large enough to bring about a massive killing effect on the targeted vectors.

Occupation, family size in rural areas; radio possession in urban areas and relative wealth and number of sleeping places had 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.

Given the sleeping pattern of the community, nets were scarce and there was mal distribution of nets in the study settings. Despite these, the District achieved the Roll Back Malaria core population coverage indicators set in the Abuja framework.

In order to maintain as well as to increase the ITNs possession, utilization and re-impregnation coverage the following are recommended:

1. Nets or ITNs should be available at any time, everywhere in the District supported by commercial or social marketing at a reasonable cost.
2. In order to sustain ITNs program, the government should support local manufacturing of nets or ITNs.
3. Re-impregnation of conventional nets should be with KO tab 1-2-3 or completely replaced with LLINs in order to minimize operational cost and improve re-impregnation coverage.
4. Effective IEC should be promoted to improve and sustain ITN program through demonstration in health facilities, schools and other relevant places, translating leaflets to ethnic language, adaptation of pictures to culturally acceptable aspect and face to face communication.

5. Due attention should be given when nets or ITNs are distributed through the public sector.
6. Effectiveness of the insecticide within the net should be monitored to identify the vector behavior and resistance status.
7. Large-scale study on net coverage should be conducted through out the Region in order to assess Regional coverage with respect to RBM framework.

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Appendix I

SPSS OUTPUT

Multiple logistic regressions for urban net utilization

Dependent Variable Encoding

Original Value	Internal Value
No	0
Yes	1

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp (B)	95.0% C.I.for EXP (B)	
Step 1[a]							Lower	Upper
AGEGR			2.950	3	.399			
AGEGR(1)	-.188	.380	.246	1	.620	.828	.394	1.743
AGEGR(2)	.477	.460	1.073	1	.300	1.611	.654	3.969
AGEGR(3)	.352	.432	.662	1	.416	1.421	.609	3.316
SEXHHH(1)	-.115	.389	.088	1	.767	.891	.416	1.909
HHFRADIO(1)	.662	.322	4.228	1	.040	1.939	1.031	3.646
EDUTION(1)	.396	.313	1.608	1	.205	1.486	.806	2.743
OCCUPATN			3.607	3	.307			
OCCUPATN(1)	.680	.408	2.774	1	.096	1.974	.887	4.393
OCCUPATN(2)	.645	.403	2.563	1	.109	1.907	.865	4.201
OCCUPATN(3)	.335	.511	.431	1	.511	1.399	.514	3.807
INCOMEQN			12.503	4	.014			
INCOMEQN(1)	.040	.404	.010	1	.921	1.041	.472	2.298

INCOMEQN(2)	.795	.482	2.716	1	.099	2.214	.860	5.696
INCOMEQN(3)	.981	.467	4.408	1	.036	2.667	1.067	6.663
INCOMEQN(4)	1.472	.485	9.221	1	.002	4.357	1.685	11.265
MALEDU(1)	.391	.312	1.570	1	.210	1.478	.802	2.725
SLEPLACE			8.946	3	.030			
SLEPLACE(1)	.080	.426	.035	1	.852	1.083	.470	2.496
SLEPLACE(2)	-.708	.431	2.707	1	.100	.492	.212	1.145
SLEPLACE(3)	-.993	.429	5.356	1	.021	.370	.160	.859
Constant	-.034	.510	.005	1	.946	.966		

a Variable(s) entered on step 1: AGEGR, SEXHHH, HHFRADIO, EDUTION, OCCUPATN, INCOMEQN, MALEDU, SLEPLACE.

Multiple logistic regressions for rural net utilization

Dependent Variable Encoding

Original Value	Internal Value
No	0
Yes	1

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp (B)	95.0% C.I.for EXP (B)	
Step 1[a]							Lower	Upper
EDUTION(1)	.472	.317	2.218	1	.136	1.603	.861	2.984
AGEGR			8.981	3	.030			
AGEGR(1)	.900	.400	5.064	1	.024	2.460	1.123	5.387
AGEGR(2)	1.285	.457	7.921	1	.005	3.616	1.477	8.851
AGEGR(3)	.937	.449	4.350	1	.037	2.553	1.058	6.159
OCCUPATN			29.133	3	.000			
OCCUPATN(1)	-2.280	.670	11.566	1	.001	.102	.027	.381
OCCUPATN(2)	.017	.604	.001	1	.978	1.017	.312	3.321
OCCUPATN(3)	-2.035	.814	6.244	1	.012	.131	.026	.645
MSTATUS			2.665	3	.446			
MSTATUS(1)	-1.428	1.100	1.686	1	.194	.240	.028	2.071
MSTATUS(2)	.431	.955	.203	1	.652	1.539	.237	10.008
MSTATUS(3)	.478	.906	.278	1	.598	1.612	.273	9.514
INCOMEQN			28.080	4	.000			
INCOMEQN(1)	1.395	.461	9.156	1	.002	4.036	1.635	9.965
INCOMEQN(2)	2.558	.514	24.769	1	.000	12.904	4.713	35.329
INCOMEQN(3)	2.206	.524	17.721	1	.000	9.080	3.251	25.359

INCOMEQN(4)	2.437	.689	12.532	1	.000	11.444	2.968	44.120
MALEDU(1)	.564	.425	1.758	1	.185	1.758	.764	4.045
SLEPLACE			41.300	3	.000			
SLEPLACE(1)	2.056	.416	24.433	1	.000	7.818	3.459	17.670
SLEPLACE(2)	1.447	.471	9.436	1	.002	4.251	1.688	10.704
SLEPLACE(3)	3.855	.686	31.622	1	.000	47.233	12.323	181.046
FSIZE			21.014	3	.000			
FSIZE(1)	-.954	.483	3.906	1	.048	.385	.150	.992
FSIZE(2)	-1.391	.455	9.337	1	.002	.249	.102	.607
FSIZE(3)	-2.917	.637	20.941	1	.000	.054	.016	.189
HHFRADIO(1)	-.180	.339	.284	1	.594	.835	.430	1.622
SEXHHH(1)	-1.056	1.060	.993	1	.319	.348	.044	2.776
Constant	-.772	1.168	.438	1	.508	.462		

a Variable(s) entered on step 1: EDUTION, AGEGR, OCCUPATN, MSTATUS, INCOMEQN, MALEDU, SLEPLACE, FSIZE, HHFRADIO, SEXHHH.

Multiple logistic regressions for urban net possession

Dependent Variable Encoding

Original Value	Internal Value
No	0
Yes	1

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp (B)	95.0% C.I.for EXP (B)	
Step 1[a]							Lower	Upper
AGEGR			1.712	3	.634			
AGEGR(1)	-.349	.681	.262	1	.609	.706	.186	2.680
AGEGR(2)	.030	.829	.001	1	.971	1.030	.203	5.230
AGEGR(3)	.842	.953	.781	1	.377	2.321	.359	15.023
SEXHHH(1)	-.520	.671	.599	1	.439	.595	.160	2.217
HHFRADIO(1)	.967	.608	2.527	1	.112	2.630	.798	8.662
EDUTION(1)	.758	.601	1.589	1	.207	2.134	.657	6.935
OCCUPATN			6.127	3	.106			
OCCUPATN(1)	1.340	.716	3.502	1	.061	3.820	.939	15.546
OCCUPATN(2)	1.726	.854	4.085	1	.043	5.616	1.054	29.933
OCCUPATN(3)	1.133	1.163	.950	1	.330	3.106	.318	30.360
INCOMEQN			1.577	4	.813			
INCOMEQN(1)	.452	.758	.356	1	.551	1.572	.356	6.952
INCOMEQN(2)	.889	1.153	.594	1	.441	2.432	.254	23.298
INCOMEQN(3)	.469	.923	.259	1	.611	1.599	.262	9.753
INCOMEQN(4)	1.313	1.189	1.220	1	.269	3.718	.362	38.201

MALEDU(1)	.211	.622	.114	1	.735	1.234	.365	4.178
Constant	.848	.806	1.107	1	.293	2.335		

a Variable(s) entered on step 1: AGEGR, SEXHHH, HHFRADIO, EDUTION, OCCUPATN, INCOMEQN, MALEDU.

Multiple logistic regressions for rural net possession

Dependent Variable Encoding

Original Value	Internal Value
No	0
Yes	1

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp (B)	95.0% C.I.for EXP (B)	
Step 1[a]							Lower	Upper
OCCUPATN			35.799	3	.000			
OCCUPATN(1)	-2.719	.702	14.997	1	.000	.066	.017	.261
OCCUPATN(2)	.051	.664	.006	1	.939	1.053	.286	3.870
OCCUPATN(3)	-2.786	.870	10.246	1	.001	.062	.011	.340
HHFRADIO(1)	1.024	.457	5.023	1	.025	2.784	1.137	6.817
AGEGR			2.261	3	.520			
AGEGR(1)	.620	.493	1.587	1	.208	1.860	.708	4.883
AGEGR(2)	.690	.547	1.593	1	.207	1.994	.683	5.827
AGEGR(3)	.505	.504	1.004	1	.316	1.657	.617	4.448
SEXHHH(1)	-.748	1.442	.269	1	.604	.473	.028	7.985
EDUTION(1)	-.100	.414	.059	1	.808	.904	.402	2.035
MSTATUS			1.771	3	.621			
MSTATUS(1)	-.764	1.542	.246	1	.620	.466	.023	9.566
MSTATUS(2)	1.045	.934	1.250	1	.264	2.843	.455	17.748
MSTATUS(3)	.290	.934	.097	1	.756	1.337	.214	8.332
INCOMEQN			38.333	4	.000			
INCOMEQN(1)	2.373	.530	20.053	1	.000	10.730	3.798	30.316
INCOMEQN(2)	2.803	.552	25.781	1	.000	16.501	5.592	48.697
INCOMEQN(3)	2.449	.587	17.386	1	.000	11.581	3.662	36.622
INCOMEQN(4)	4.400	1.147	14.721	1	.000	81.442	8.604	770.874
MALEDU(1)	-1.367	.663	4.251	1	.039	.255	.070	.935
Constant	1.599	1.625	.968	1	.325	4.946		

a Variable(s) entered on step 1: OCCUPATN, HHFRADIO, AGEGR, SEXHHH, EDUTION, MSTATUS, INCOMEQN, MALEDU.

Multiple logistic regressions for urban and rural residence of net coverage

Dependent Variable Encoding

Original Value	Internal Value
Rural	0
Urban	1

Variables in the Equation

	B	S.E.	Wald	df	Sig.	Exp (B)	95.0% C.I.for EXP (B)	
Step 1[a]							Lower	Upper
HHMOSNET(1)	1.203	.446	7.269	1	.007	3.330	1.389	7.982
NETTREAT(1)	.045	.323	.019	1	.890	1.046	.555	1.970
USE(1)	.317	.206	2.370	1	.124	1.374	.917	2.057
Constant	-1.386	.280	24.599	1	.000	.250		

a Variable(s) entered on step 1: HHMOSNET, NETTREAT, USE.

Appendix II

Questionnaire ID Number_____

HOUSEHOLD QUESTIONNAIRE

District Name _____Kebele Name_____Ketena Name_____

SECTION 1. General Information

INTRODUCTION AND CONSENT

INFORMED CONSENT

Hello. My name is _____ and I am part of a team of people who are carrying out a survey on "Assessment of ITNs coverage for malaria control in Kafta-Humera District" (Show a letter of approval from DHO). We would very much appreciate your participation in this survey. I would like to ask you some questions and it will take about 25 minutes. Your answers will remain confidential, and we will not be taking down your name or address, so your answers will be anonymous.

Participation in this survey is voluntary and you can choose not to answer any individual question or all of the questions. However, we hope that you will participate in this survey since your views are important.

At this time, do you want to ask me anything about the survey?
May I begin the interview now?

Start time____: ___ End time____: ___ Date_____/____/_____

RESPONDENT AGREES TO BE INTERVIEWED..... 1 ?	RESPONDENT DOES NOT AGREE TO BE INTERVIEWED..... END

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
101	Residence	Urban ……..……1 Rural ……..……..…2	
102	Sex of head of household If you are interviewing head of the household go to Q.105	Male …….1 Female ……..…2	
103	What is the sex of the head of household?	Male …….1 Female ……..……..2	
104	What is your relationship to the head of household	Him/her self…….0 Wife……..…1 Husband……..2 Daughter……..3 Son……..4 Sister……5 Brother…….6 Cousin…….7 Other……8	
105	Age of the head of households?	☐☐ Age in complete years	
106	Educational status of the head of household?	Can't read and write……1 Primary (1-4)……2 Junior (5-8)……...3 Secondary (9-12) ……4 Higher (Tertiary)..……5	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
107	Religion of head of household	Orthodox……..……1 Catholic……..……..2 Muslim…….……3 Protestant……...4 Others (Specify)…….5	
108	Marital status of the head of household	Married……..…..……1 Single…….……..2 Divorced…….…..……3 Widowed……...4	
109	What is the occupation of the head of household	Gov/private government employee.……1 Farmer…….……2 Merchant…….……...3 Daily laborer…… ……4 Unemployed……..……5 Others (Specify)……..6	
110	Average monthly family income	☐☐	
111	What is the source of light for your house?	Electricity……..1 Kerosene/paraffin lamp…….2 Candle……...3 Other (Specify)……..……4	
112	Do you or anyone in your household own a functioning radio?	YES.....1 NO.....2	—<115
113	When do you most often listen? DO NOT PROMPT (Circle all possible answers)	In the morning…….……1 In the afternoon……2 In the evening……..3 All day…….……4 Sometimes……...5 Never listen……..6	
114	What day(s) of the week do you most often listen to the radio? DO NOT PROMPT (Circle all possible answers)	Week days…….……..1 Week ends……...2 Every day…….……3 Sometimes……...4 Never listen……..5	
115	How many sleeping room do you have?	☐☐	
116	How many sleeping places (Beds, mats etc) do you have in your house in door and out door?	☐☐	
117	How many people slept in your house in door and out door last night?	☐☐	
118	How many children less than 5 years of age slept in your house in door and out door last night?	☐☐	
119	How many pregnant women slept in your house in door and out door last night?	☐☐	

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
120	How many children aged between 5 and 14 slept in your house in door and out door last night?	☐☐	
121	How many females aged between 15 and 49 other than pregnant women slept in your house in door and out door last night?	☐☐	
122	At what time do the children under 5 normally go to bed?	☐☐	
123	At what time do the pregnant women normally go to bed?	☐☐	

SECTION 2. Malaria

NO.	QUESTIONS	CODING CATEGORIES	SKIP
201	Have you heard of malaria?	Yes ……..…1 No …….……..……2	
202	Can you tell me the cause of malaria? DO NOT PROMPT (circle all possible answers)	From being bitten by mosquito……1 From being in the rain…….……2 From getting cold…….…….…..3 From drinking dirty water……...4 From another person with malaria…5 Working in the sun……...……6 Being hungry…….7 Other (Specify)…….8	
203	Can you tell me the main symptoms of malaria? DO NOT PROMPT (circle all possible answers)	Fever……...1 Feeling cold……..……...…2 Headache……..……3 Vomiting;……4 Diarrhea……..…….5 Weakness…….……6 Loss of appetite……..7 Body pain/joint pain……8 Do not know……9	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
204	Which age group is most affected by malaria? DO NOT PROMPT (circle all possible answers)	Adults……..……1 Children under 5…….……..2 Elderly…….…..……3 Pregnant Women…….……4 Adult men……..……..……5 Adult Female……6 Any person…….……..7 Other (Specify)_____8	
205	Have you seen or heard malaria education message from?	YES.....1 NO.....2	—<207
206	Where did you get these education messages? DO NOT PROMPT (circle all possible answers)	Radio…….1 Posters/leaflets……..2 Friends/patterns……..……..3 Health worker……..……..4 Government official…….5 Schools…….6	
207	What are the ways you prevent your self from getting malaria?	Sleeping under ITNs……1 Avoiding being bitten by mosquitoes2 Prophylaxis……3 Spraying chemical…..……..….4 Avoiding getting cold…….…..5 Keep the surrounding clean…….…6 Drinking clean water…….……7 Use repellents…….……..8 Do not know…….……9 Other (Specify)……10	

Section 3 Mosquitoes

NO.	QUESTIONS	CODING CATEGORIES	SKIP
301	Do mosquitoes cause you any trouble?	YES.....1 NO.....2	–<303
302	In what ways do they cause you trouble? DO NOT PROMPT (circle all possible answers)	They bite……..……1 Their bites are itchy..……2 They transmit malaria…….3 Their noise keeps me awake……..4 They carry disease……5 Other (specify)……6	
303	During what season do mosquitoes bite the most? DO NOT PROMPT (circle all possible answers)	During the dry season……..1 During the rainy season……2 All year round ……..……3 Do not know……4 Other (Specify)…….……5	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
304	At what time do mosquitoes bite the most? DO NOT PROMPT (circle all possible answers)	The morning……1 The afternoon……2 The evening……..3 At night in bed……..4 All day……5 Do not know……6 Other (Specify)……7	
305	Do you protect your self from mosquitoes?	YES.....1 NO.....2	–<307
306	How do you protect your self? DO NOT PROMPT (circle all possible answers)	Use a mosquito net…….……..1 Use insecticide…….…….2 Clear the area around the house……3 Close windows and doors…….4 Light the fire in the house…….5 Use aerosols……..6 Use traditional plants……7 Light a candle…….……..8 Smoking…….……..9 Apply mosquito repellent……10 Improve diet……11 Others (Specify)…….……12	
307	Why do not protect your self against mosquitoes? DO NOT PROMPT (circle all possible answers)	I do not know how to……1 I do not have the money……..2 I can not get hold the anti-mosquito measure……3 I do not have time……..…….4 I can not be bother…..……5 Other (Specify)…..……..6	

Section 4. Mosquito nets

NO.	QUESTIONS	CODING CATEGORIES	SKIP
401	Does your household have any mosquito nets that can be used while sleeping?	YES.....1 NO.....2	–<405
402	How many nets have you in your household at the moment?	☐☐ Free ☐☐ Paid	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
403	How did you obtain your nets?	Paid ..... 1 Free ..... 2 Others (Specify)……3 I do not know…….4	
404	If paid, What is the average price of medium size nets	☐☐	
405	Would you like to have a net?	YES..... 1 NO..... 2	→<407
406	Why you have not bought a net? DO NOT PROMPT (circle all possible answers)	We do not bother by mosquitoes….1 Nets are too expensive……..2 I do not know where to buy them...3 Nets have worn out……..4 Nets are not available……..5 Nets do not protect against malaria.6 We have enough nets……..……7 Other (Specify)……8	
407	At what price could you buy of medium size nets if available?	☐☐	
408	Have the high risk groups sleep under a net the previous night?	YES..... 1 NO..... 2	
409	What are the advantages of sleeping under a net? DO NOT PROMPT (circle all possible answers)	Do not have any advantage……...1 Do not get malaria…….……2 Do not get bothered by other insects.3 Sleep better…….…….…….4 It is warmer…….…….…….5 Other (Specify)…….…….……6 I do not know……..……..7	
410	What are the disadvantages of sleeping under a net? DO NOT PROMPT (circle all possible answers)	It is too hot……..…..……1 Mosquitoes still bite through the net.2 It is difficult if you want to get up in the night……..……..3 It takes time to tuck the net each night…….….4There is not enough air…….5 No disadvantage……6 Skin irritation……7 I don't know…….……8 Other (Specify)…….……9	
411	How many months a year do you use a mosquito net	☐☐	
412	Last night how many people slept under mosquito nets in doors and out doors?	☐☐	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
413	Last night how many children under 5 years of age slept under mosquito nets in doors and out doors?	☐☐	
414	Last night how many pregnant women slept under mosquito nets in doors and out doors?	☐☐	
415	Last night how many children between 5 and 14 slept under mosquito nets in doors and out doors?	☐☐	
416	Last night how many female between 15 and 49 (except pregnant women) slept under mosquito nets in doors and out doors?	☐☐	
417	With whom under five children sleep	Alone……1 With mother only……..2 With father only……..……..3 With both parents……..……4 With elder brothers……..……..5 With grand father/mother……..6 No under five at all……7	
418	Was there a malaria attack among regularly users of nets within this year?	YES.....1 NO.....2	
419	How common are malaria episodes?	Less than the non user……..1 Same as non user…….……2 More than non user……3 No attached……..……4 I do not know……..…..5	
420	How long have you had your mosquito nets for this household in months?	No. of nets	
	Less than 12 months	☐☐	
	12-24 months	☐☐	
	25-36 months	☐☐	
	37-48 months	☐☐	
	More than 48 months	☐☐	
421	Are any of your nets treated with insecticide? (Remember for LLINs)	YES.....1 NO.....2	
	PermaNets	YES.....1 NO.....2	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
422	If yes, how many?	☐☐ Treated	
		☐☐ PermaNets	
423	Do you know why nets are treated with insecticide?	YES.....1 NO.....2	–<424
424	If yes, what is the reason? DO NOT PROMPT (circle all possible answers)	To kill other vectors……1 To make a net stronger……2 To kill mosquitoes……3 To repel mosquitoes……4 Other (Specify)……5	
425	How long has it been since your nets last treated in months?	☐☐	
426	What do you expect the interval months of net re-impregnation to be?	☐☐	
427	Are any of your nets washed after treatment?	YES.....1 NO.....2 We don't have nets……3 Not treated……4 I DONOT KNOW……5	–<430
428	If yes, how many times?	Frequency washed	
	Net 1	☐☐	
	Net 2	☐☐	
	Net 3	☐☐	
	Net 4	☐☐	
	Net 5	☐☐	
	Net 6	☐☐	
	Net 7	☐☐	
	Net 8	☐☐	
429	What is the last date washed?	_____/_____/_____	
	Net 1	_____/_____/_____	
	Net 2	_____/_____/_____	
	Net 3	_____/_____/_____	
	Net 4	_____/_____/_____	

NO.	QUESTIONS	CODING CATEGORIES	SKIP
	Net 5	_____/_____/_____	
	Net 6	_____/_____/_____	
	Net 7	_____/_____/_____	
	Net 8	_____/_____/_____	
430	What do you expect the reasons for net washing to be?	Nets become dirt…..……1 The Chemical with it is poisonous... 2 Net attractive to see it. ……..3 Nets not washed…….4 Others (Specify)……...……5	
431	Reasons for net not treated?	Service not available ..... 1 Do not know the exact time ..... 2 Do not know the benefit……3 Asked for payment……4 We were absent……..…5 Net not in use……6 Others……7	

The interview is now finished. Thank you for taking the time to answer these questions.

Data collector	Checked by Supervisor	Checked by Principal Investigator	Data Entered
NAME _____ DATE _____ Signature_____	NAME _____ DATE _____ Signature_____	1. Yes 2. No	1. Yes 2. No Date_____

Appendix III

Insecticide Treated Nets observation check list

1.

How many mosquito nets does your household have?	Number of nets [ ]							
Ask respondent to show you the net(s) in the household [Newest net = net 1,	Net 1 Observed	Net 2 Observed	Net 3 Observed	Net 4 Observed	Net 5 Observed	Net 6 Observed	Net 7 Observed	Net 8 Observed

etc.]	Yes…1	Yes.1	Yes…1	Yes.1	Yes…1	Yes…1	Yes..1	Yes…1
	No ...2	No ..2	No ...2	No ...2	No ...2	No ..2	No ..2	No ..2
	No net..3	No net..3	No net..3	No net..3	No net..3	No net..3	No net..3	No net..3

2. Total number of nets hanged ☐
3. How many sleeping places are there in doors and out doors? ☐
4. How many people slept under net last night in doors and out doors?
    a. Total ☐
    b. Under 5 years of age ☐
    c. Pregnant women ☐
    d. Children between 5-14 ☐
    e. Female between 15-49 excluding pregnant women ☐
    f. Adult men and others ☐
5. Does the net has any tears or holes?

a. Net 1	Yes ……..1	No……2	Don't have nets…….3
b. Net 2	Yes ……..1	No……2	Don't have nets…….3
c. Net 3	Yes ……..1	No……2	Don't have nets…….3
d. Net 4	Yes ……..1	No……2	Don't have nets…….3
e. Net 5	Yes ……..1	No……2	Don't have nets…….3
f. Net 6	Yes ……..1	No……2	Don't have nets…….3
g. Net 7	Yes ……..1	No……2	Don't have nets…….3
h. Net 8	Yes ……..1	No……2	Don't have nets…….3

6. Does the net tucked under the mattress ? Yes …..1 No……2 Don't have nets…….3

Appendix IV

ADDIS ABABA UNIVERSITY

MEDICAL FACULTY

DEPARTMENT OF COMMUNITY HEALTH

FOCUS GROUP DISCUSSION GUIDE

A. INTRODUCTION

1- We thank you all for coming to this session

2- As much as possible we will try to use our time efficiently

3- My name is Mr. X and my colleague here with me is called ---------- we are a team from the District Health Office and the Addis Ababa University.

B. PURPOSE

1. We will be discussing your reactions towards ITNs possession, use and re-impregnation and its determinants
2. I am interested in all your ideas, comments and suggestions.
3. There are no wrong or right answers.
4. All comments, both positive and negative to the point of discussion are welcomed.
5. Please feel free to agree or disagree with one another.

We will audiotape all your comments and opinions so that we could not miss any of your ideas while trying to take notes. And I assure you that all your comments are confidential, used for research purpose only. I want our session to be a group discussion, so you need not wait for me to call on you. Please speak one at a time, so that the tape-recorder can pick up every one of your suggestions and comments. We have a lot of points to cover, so I may change the subject or move ahead, please stop me incase if you want to add some thing.

FGD FOR MEN WITH EITHER PREGNANT WOMEN OR CHILDREN UNDER FIVE AND PREGNANT WOMEN OR WOMEN WITH CHILDREN UNDER FIVE

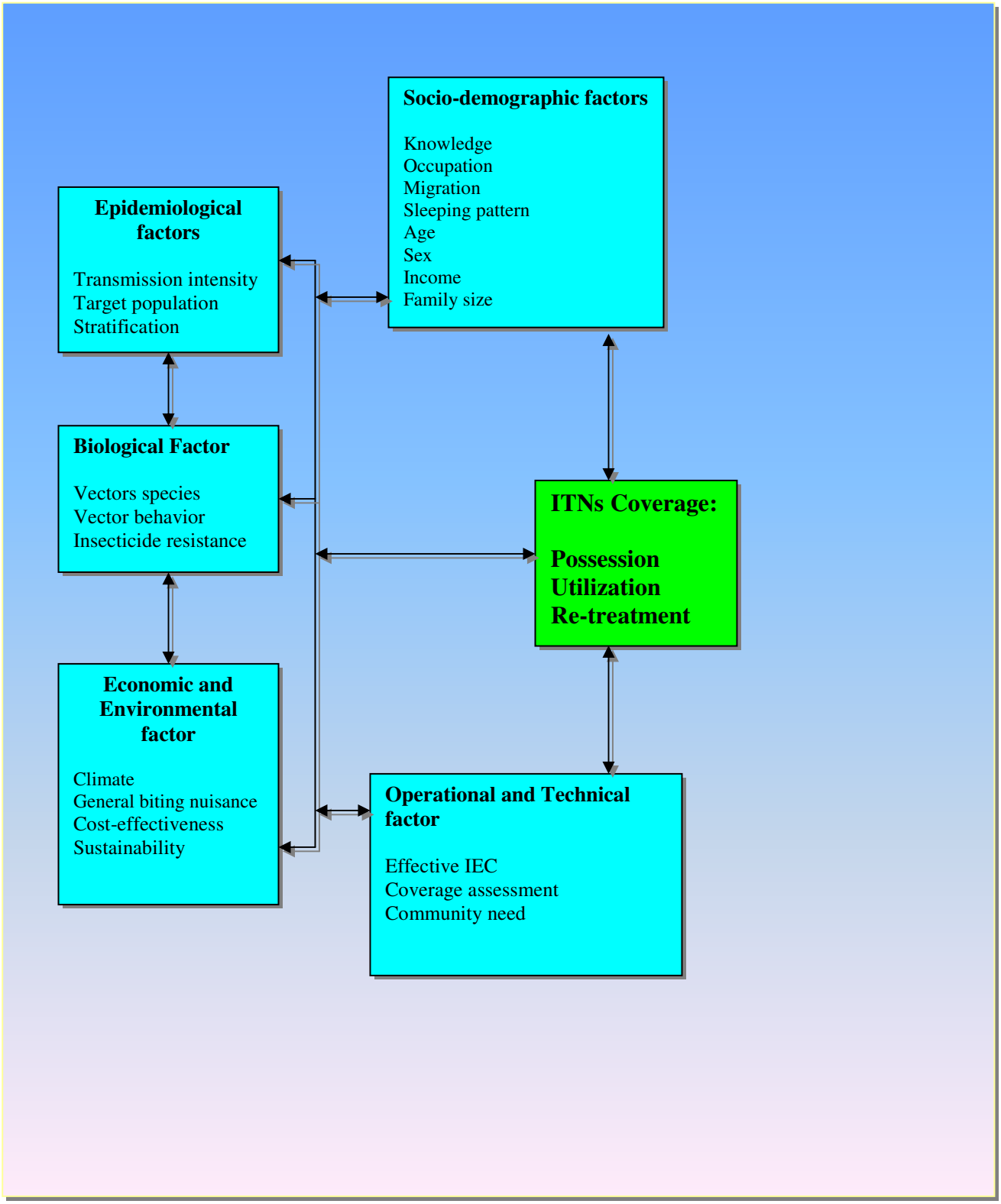
1. Could you tell me to what extent malaria is a problem in your area and its cause?
2. Tell me about the methods of prevention and control against malaria?
3. Could you tell me the general practices or beliefs towards ITNs possession, use and re-impregnation in your setting?
4. Could you tell me about difference in sleeping place by age, sex or heads within the households in your area?
5. Could you describe the major factors that affect continues ITNs possession, use and re-impregnation?
6. What do you suggest to improve for continues possession, use and re-impregnation of ITNs?

CLOSING: -

- Before we end, I would like to go around the audience once more and ask each one of them if there is any thing else they would like to say about the idea of ITNs possession, use re-impregnation and its determinants.
- Thank you so much for coming to this session. Your time is very much appreciated and your insights have been very helpful.

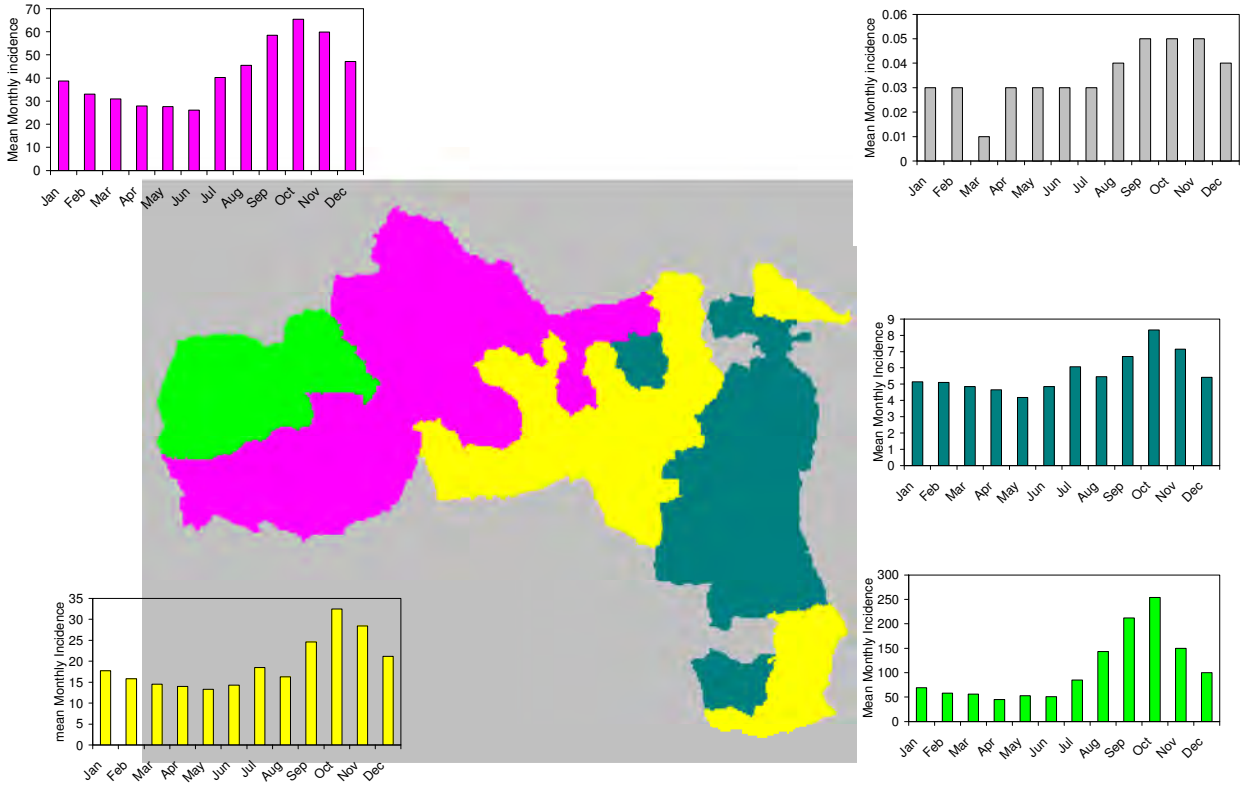
Appendix V

Figure 2: Conceptual framework for determinants of ITNs possession, utilization and re-treatment



Appendix VI

Map-1 Stratification of the region on the basis of institution based 5 years mean malaria incidence (2000/01-2004/05), Tigray.



Appendix VII