Original article

Knowledge, Attitude and Practice about Malaria Transmission and Its Preventive Measures among Households in Urban Areas of Assosa Zone, Western Ethiopia

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Abstract

Background: Knowledge about the modes of transmission and preventive measures of malaria are important preceding factors for the acceptance and use of proven control tools by the community.

Objective: To assess knowledge, attitude and practices (KAP) about modes of malaria transmission and preventive methods in the study areas.

Methods: A cross-sectional study was conducted in three urban areas of Assosa zone, Western Ethiopia from January to February, 2006. Data analysis was carried out using SPSS for windows version 12.0.1. Adjusted odds ratio and 95% confidence intervals were employed to test the strength of association.

Results: About 48% of the study participants were aware that malaria can be transmitted by mosquito bites. Thirty percent (30%), of respondents were aware that mosquitoes carry disease causing microorganism, 95% were aware that mosquitoes bite during night, and 61% were aware that mosquitoes rest at dark places inside the house. Sleeping under a mosquito net and eliminating mosquito-breeding sites were identified by 58% and 52% of respondents, respectively, as major malaria preventive measures. Respondents' education and wealth status were associated with comprehensive knowledge on malaria preventive measures (OR= 2.42, 95% CI: 1.09, 5.4 and OR= 3.89, 95% CI: 1.99, 7.6, respectively).

Conclusion: Knowledge of the role of mosquitoes in malaria transmission and comprehensive knowledge about malaria prevention strategies among the study population were observed to be lower than 50%. Comprehensive behavioral change and communication is required to improve the knowledge of the mode of malaria transmission and its preventive and control measures. [*Ethiop.J.Health Dev.* 2007;21(2):157-165]

Introduction

Malaria is one of the most severe public health problems worldwide with 300 to 500 million cases and about one million deaths reported to date, 90% of which were reported from sub Saharan African (SSA) countries (1). It is the fourth leading cause of death of children under the age of five years in developing countries (2-5). In 2004-05, malaria was reported as the primary cause of health problems in Ethiopia, accounting for 17 percent of outpatient visits, 15 percent of hospital admissions, and 29 percent of in-patient deaths (6). More than four million new clinical malaria cases are reported each year. Almost 75 percent of the land is malarious and an estimated 48 million people (68 percent of the population) live in areas at risk of malaria (7). According to available reports, almost all (99%) of the Beneshangul Gumuz Region (BGR) is malarious (8, 9).

The Beneshangul Gumuz Regional Health Bureau (BGRHB) has attempted to increase the communities' knowledge, and to develop desirable attitude and practices regarding malaria and its preventive measures, particularly use of insecticide treated nets (ITNs). Despite these efforts, the impact of preventive measures and ITN uptake for the past three years has been very low. This is evidenced by the high number of malaria outpatient visits at hospitals and health centers, accounting for 47.3% of hospital and health center outpatient (OPD) cases, 45.3% of hospital and health center admission, and 36.3% of hospital deaths (8). BGRHB records reveal that about 10 focal outbreaks of malaria occur each year in the six epidemic prone woredas in the region and the major cause of the outbreaks was reported to be *P. falciparum* (8-11).

Perceptions about malaria illness, particularly households' perceived susceptibility and beliefs about the seriousness of malaria are important preceding factors for decisions to take preventive and curative actions against malaria (12). The understanding of the possible causes, modes of transmission, and individuals' preference and decision about adoption of preventive and control measures vary from community to community and among individual households (13-15).

Rapid and unprecedented urbanization, along with declining economies, may have profound implications for the epidemiology and control of malaria, as the relative disease burden increases among urban dwellers (16). This situation should be anticipated in Ethiopia in general, and BGR in particular as there has been decentralization with high proliferation of urban centers in each district in the region. Against this background, basic health care delivery systems providing malaria

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preventive and control measures through mother and child health programs, and the promotion of ITNs for the rapidly growing numbers of the urban poor must be assessed to design well-tailored and integrated malaria control strategies. Therefore, this study aims to generate information on knowledge, attitude, and practices regarding malaria and factors determining comprehensive knowledge on malaria preventive measures in general and ITN use in particular in three urban areas of Assosa Zone, Western Ethiopia.

Methods

The study was conducted in three urban areas in Assosa Zone, Assosa, Bambasi and Menge towns from Assosa, Bambasi and Menge woredas, respectively. The study was carried out from January 26th to February 14th, 2006. Assosa town is the capital of the Assosa woreda and BGR, which is located about 600 kilometers west of Addis Ababa. Menge is located at about 62 kilometers north of Assosa town; whereas Bambasi town is 45 kilometers east of Assosa town. Assosa town has four kebeles, while Bambasi and Menge towns comprise of two and one urban kebele, respectively, with an estimated 4606, 1512, and 528 households, respectively. Each town has an average family size of 3.7 persons per household (8, 9). Malaria cases were reported throughout the year from all health facilities in these study areas, and the data showed that malaria remained the top leading cause of morbidity and mortality (8).

The study employed a community based cross-sectional design. Study participants were heads of households or their spouses who had lived in the study area as permanent residents for at least six months.

The sample size was determined by using Epi Info Version 6.04d statistical package for estimating two population proportions. According to the 2004 NetMark survey of Ethiopia, the proportion of households who own ITNs as the primary anti-malarial preventive measure was 24% among the wealthiest households and 2% among the least wealthy (17). Thus, the aim of the present study was to detect a minimum of 22% difference between the lowest and highest levels of socioeconomic status with 80% power and a 95% confidence interval (CI). Based on the assumptions above, a total sample size of 606 households was calculated, allowing for a 10% non-response rate. Samples were proportional to the size of each kebele in the three towns. The sampling frame was constructed using household data recorded for the 2005 national election. Households were selected using a systematic sampling technique at an interval of every eleventh household. The first household was randomly selected from the first eleven households in the sampling frame.

Data were collected using a standard structured questionnaire adopted from the 2004 WHO/UNICEF (18) guidelines for core population coverage survey, translated into Amharic and pre-tested. Twelve data collectors who had completed twelfth-grade and fluent in the local language and three supervisors (health professionals) were recruited from the respective study areas. A two-day training oriented data collectors and supervisors on the tools to be used, purpose of the study, and how to approach respondents and obtain consent. The heads of households or their spouses were interviewed in their own language (Amharic, Oromo or Berta). Supervisors checked for completeness of questionnaires every day. Incomplete questionnaires were returned to the data collectors on the following day for correction by revisiting the households. Five percent of interviewed households were randomly selected and re-interviewed by the supervisors.

Data were entered, cleaned and stored into two different computers. Descriptive, bivariate and multivariate analyses were run using SPSS for windows version 12.0.1. Variables that showed significant association were selected for further analysis using multiple logistic regression models. The strength of association was interpreted using the adjusted odds ratio and confidence interval.

Wealth quintiles were determined using durable household assets. A total of 23 different durable assets were identified and assigned as dummy variables. For each household asset a mean asset score was calculated. The distribution of the asset mean scores was visually assessed for normality by plotting a histogram. The asset mean scores were re-categorized into five different wealth quintiles, each with approximately equal number of households.

Ethical clearance and approval was obtained from Jimma University ethical committee. Informed written consents were obtained from all levels of the local government before data collection, and verbal consents obtained from individual respondents during data collection. The respondents were given the right to refuse to take part in the study as well as to withdraw any time during the interview. Privacy and confidentiality were maintained throughout the study.

Results

Of 606 households selected for the study, 581 households participated, yielding a response rate of 95.87%. Respondents' ages ranged from 16 to 88 years with a mean age of 35.6 (± 12.44) years. Forty nine percent (285) of respondents were females. About 80% of participants had attended formal education and 44.9% of them had a job with a regular source of income. Of the total study participants, 113 (19.4%) were indigenous peoples of the region namely; Berta, Gumuz, Shinasha, Mao and Komo nationalities. One hundred forty one

(24.3%) and 101 (17.4 %) households were in the lowest 20% and the highest 20% wealth groups, respectively (Table 1).

Table 1: **Socio-demographic characteristics of respondents in the three urban areas, Assosa Zone, Ethiopia, 2006 (n= 581)**

Variables	Assosa(n=404)	Bambasi(n=129)	Menge(n=48)	Total(n=581)
Sex				
Male	185 (45.8)	59 (45.7)	41 (85.7)	285 (49.1)
Female	219 (54.2)	70 (54.3)	7 (14.6)	296 (50.9)
Marital status				
Single	33 (8.2)	6 (4.7)	10 (20.8)	49 (8.5)
Married	337 (83.4)	107 (82.9)	36 (75.0)	480 (82.6)
Divorced	9 (2.2)	5 (3.9)	2 (4.2)	16 (2.8)
Widowed	25 (6.2)	11 (8.5)	-	36 (6.2)
Ethnicity				
Indigenous	73 (18.1)	19 (14.9)	21 (56.3)	113 (19.4)
Oromo	153 (37.9)	58 (45.0)	10 (20.8)	221 (38.0)
Amhara	141 (34.9)	44 (34.1)	15 (31.3)	200 (34.4)
Tigrie	22 (5.4)	5 (3.9)	2 (4.2)	29 (5.0)
Gurage /other	15 (3.7)	3 (2.3)	-	18 (3.1)
Religion				
Muslim	119 (29.5)	61 (47.3)	27 (56.3)	207 (35.6)
Orthodox Christian	202 (50.0)	48 (37.2)	17 (35.4)	267 (46.0)
Protestants Christian	83 (20.5)	20 (15.5)	4 (8.3)	107 (18.4)
Family size				
Single person household	14 (3.5)	2 (1.6)	10 (20.8)	26 (4.8)
2-5 persons household	244 (60.4)	76 (58.9)	28 (58.3)	348 (59.9)
6-9 persons household	129 (31.9)	46 (35.7)	7 (14.6)	182 (31.3)
10 or more persons household	17 (4.2)	5 (3.9)	3 (6.3)	25 (4.3)
Educational status				
No formal education	62 (15.3)	47 (36.4)	2 (4.2)	111 (19.0)
1-4th grade	72 (17.8)	42 (32.6)	12 (25.0)	126 (21.7)
5-8th grade	101 (25.0)	25 (19.4)	8 (16.7)	134 (23.1)
9-12th grade	105 (26.0)	10 (7.8)	11 (22.9)	126 (21.7)
College/University	64 (15.8)	5 (3.9)	15 (31.3)	84 (14.5)
Occupation (job with)				
Variable sources of income	206 (51.0)	105 (81.4)	9 (18.7)	320 (55.1)
Regular sources of income	198 (49.0)	24 (18.6)	39 (81.3)	261 (44.9)
Wealth status				
Poorest	106 (26.2)	29 (22.5)	6 (12.5)	141 (24.3)
Next to poorest	78 (19.3)	47 (36.4)	30 (62.5)	155 (26.7)
Medium	42 (10.4)	17 (13.2)	5 (10.4)	64 (11.0)
Next to well-off	87 (21.5)	28 (21.7)	5 (10.4)	120 (20.7)
Well-off	91 (22.5)	8 (6.2)	2 (4.2)	101 (17.4)

Seventy two percent of the respondents stated that mosquitoes were nuisances to them because they bite and cause itching and 226 (38.9%) identified the noise that mosquitoes make as being a nuisance (Table 2). Mosquitoes' ability to transmit malaria was mentioned by 174 (29.9%) of the respondents. Five hundred fifty five (95%) of respondents identified that mosquitoes bite during the night. Three hundred fifty two (60.6%) of the respondents stated that mosquitoes rest in dark places inside the house during the day. Other mosquito resting places like dirty areas and the edge of the river/stagnant water were identified by 197 (33.9%) and 111 (19.1%) of the respondents, respectively. Measures to avoid mosquitoes identified by respondents included the use of bed nets, insecticide aerosols, elimination of mosquito breeding sites, and smoking (Table 2). Modes of malaria transmission recognized by study participants were dirty environment (53%) and mosquito bites (47.5%) (Figure 1).

Respondents from Menge town were four times more likely to state that malaria is transmitted by mosquito bites than were those from Assosa town (OR = 4.0, 95% CI: 1.9, 8.2). Those who attended college/university were twice as likely to identify mosquito bites as a mode of malaria transmission when compared to those who had no formal education (OR = 2.2, 95% CI: 1.2, 20.0).

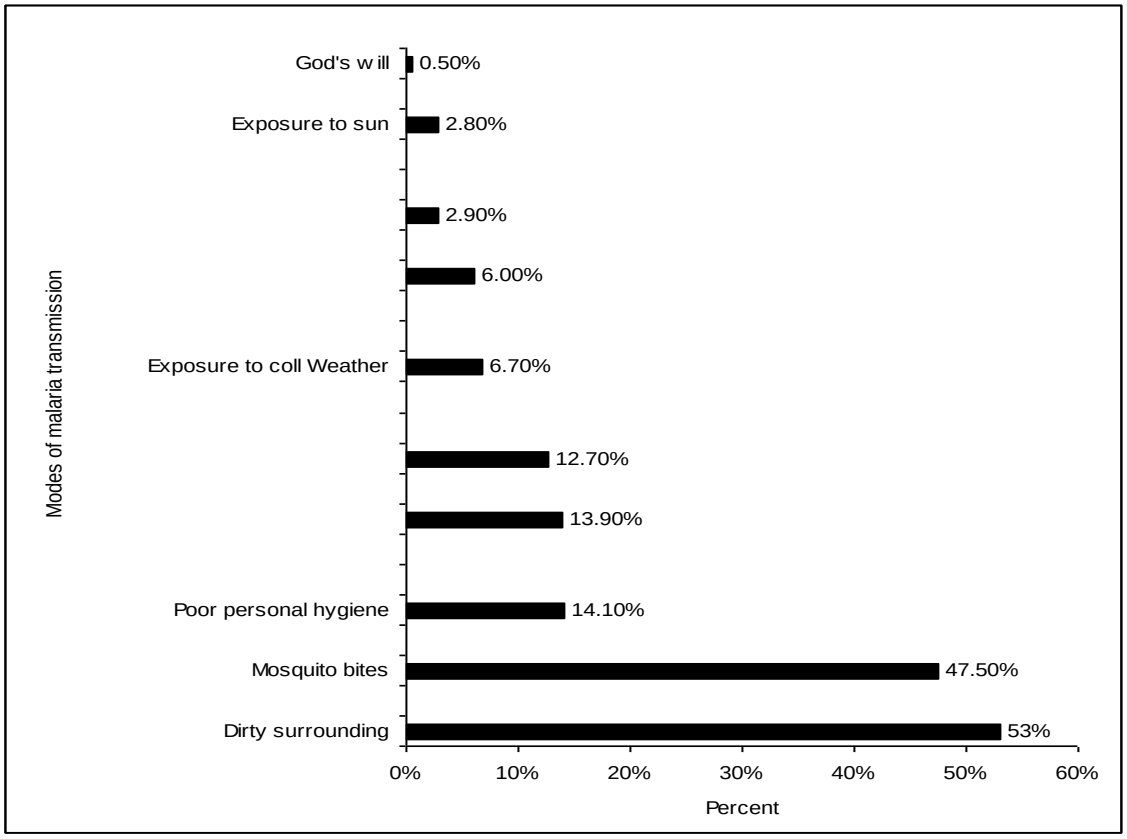

Figure 1: **Modes of malaria transmission reported by study participants in the three urban areas, Assosa Zone, Ethiopia, 2006 (n = 581).**

Table 2: **Knowledge about mosquito behavior and mosquito preventive measures among the three urban areas, Assosa Zone, Ethiopia, 2006 (n= 581)**

Knowledge about mosquito behaviors	Responses	
	Yes (%)	No (%)
Mosquito characteristics		
Mosquitoes bite and cause itchiness	417 (71.8)	164 (28.2)
Mosquitoes make noise	226 (38.9)	355 (61.1)
Mosquitoes carry disease	174 (29.9)	407 (69.1)
Mosquitoes contaminate food	7 (1.2)	574 (98.8)
Do not know	22 (3.8)	--
Biting time		
During night time	555 (95.0)	26 (5.0)
During day time	13 (2.3)	568 (97.7)
Any time	10 (1.8)	571 (98.2)
Do not know	12 (2.4)	--
Resting places		
Dark place inside the house during day	352 (60.6)	229 (39.4)
Dirty areas	197 (33.9)	384 (66.1)
Edge of the river/stagnant water/ponds	111 (19.1)	470 (80.9)
Do not know	107 (18.4)	--
Others (latrine, cattle shed)	13 (2.2)	568 (97.8)
Currently used mosquito preventive measures		
Use mosquito (bed)net	258 (44.4)	323 (55.6)
Clean surroundings	188 (32.4)	393 (67.6)
Take no measure (do nothing)	124 (21.3)	457 (78.7)
Use insecticide aerosols	94 (16.2)	487 (83.8)
Smoke cow dung and/or leaves	81 (13.9)	500 (85.1)
Use DDT (indoor residual spray)	26 (4.5)	555(95.5)
Close windows and doors	22 (3.8)	559 (95.2)

Note: Percentages do not add up to 100, because of multiple responses

There were differences between study sites and ethnic groups in reporting modes of malaria transmission with the exception of identifying mosquito bites. Respondents from Bambasi Town were 2.1 times more likely than those from Assosa Town to report other modes of malaria transmission. In addition, respondents belonging to the Tigrie and Gurage ethnic groups were more likely to have misconceptions about modes of malaria transmission compared to those belonging to ethnic groups indigenous to the region (OR = 6.01, 95% CI: 2.4, 15.23; and OR = 3.99, 95% CI: 1.3, 12.1, respectively) (Table 3). Sleeping under ITNs (58%) and eliminating mosquito-breeding sites (52%) were the major preventive measures identified by the respondents (Figure 2).

Forty-eight percent of the study participants had comprehensive knowledge (above the mean knowledge score) about effective malaria control strategies. Differences in knowledge scores were observed among respondents from different study areas, wealth groups and education levels. Along with various socioeconomic and demographic factors, individual factors such as level of education as well as community factors such as wealth status and area of residence were found to vary significantly with comprehensive knowledge (Table 3). Comprehensive knowledge about malaria preventive measures was significantly higher among those who completed college / university, those in the well-off wealth quintile, and respondents from Menge Town compared to those who have no formal education, those in the poorest wealth quintiles and those from Assosa Town (OR = 2.42, 95% CI: 1.09, 5.4; OR = 3.89, 95% CI: 1.99, 7.6; and OR = 2.57, 95% CI: 1.1, 5.9, respectively) (Table 3).

Five hundred twenty one (89.7%) of the study participants reported that they had seen and/or heard of ITNs. The sources of ITN information were health education sessions from health workers (47.9%) and radio programs (37.0%) (Table 4). Two hundred fifty four (43.7) of households had at least one ITN. Among households that had an ITN, only 12 (3.8%) stated they obtained it free of charge. Awareness of ITNs was higher among participants with an education level of high school or higher compared to those with no formal education (OR = 5.27, 95% CI: 1.6, 16.8) and among participants in the next to the well-off wealth quintiles (OR = 2.6, 95% CI: 1.06, 6.4), when compared to those in the poorest wealth quintiles (Table 5).

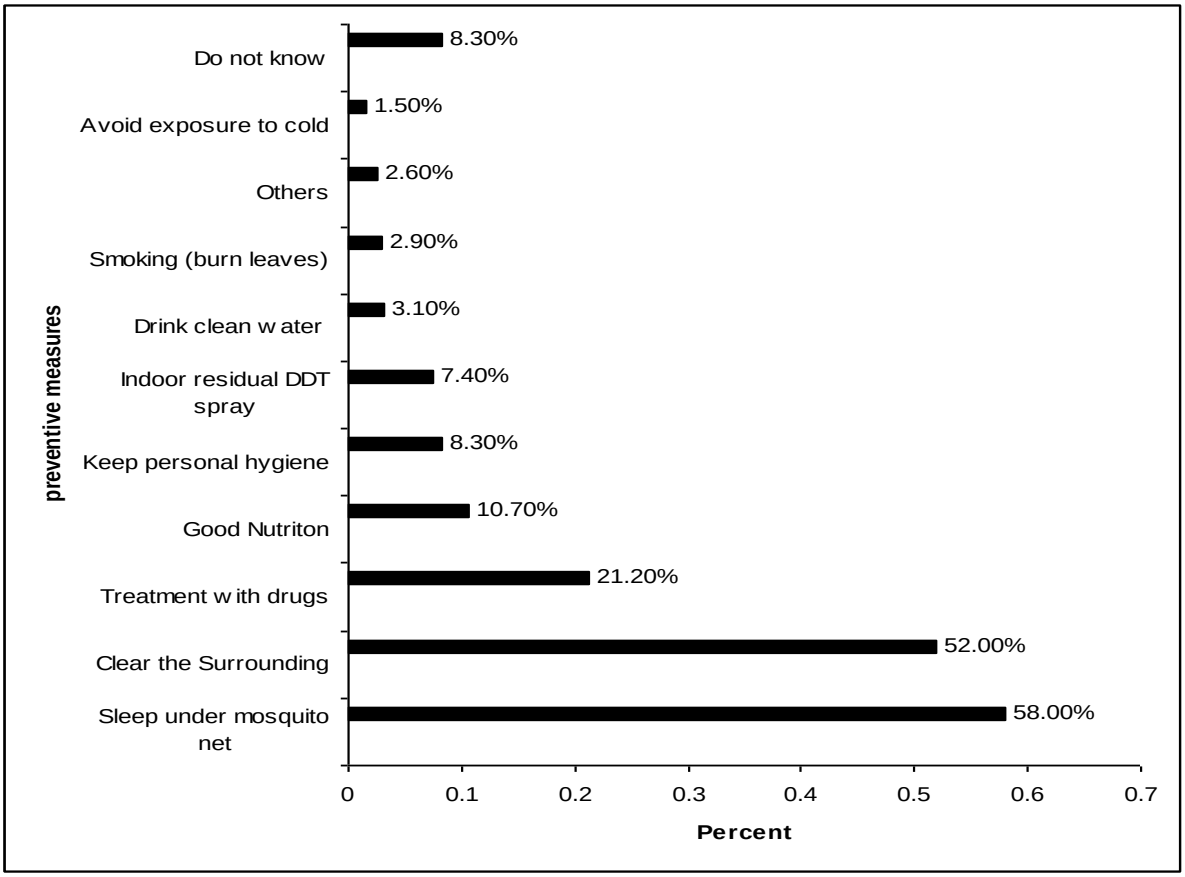

Figure 2: **Knowledge of malaria preventive measures as reported by the respondents in the three urban areas, Ethiopia, February, 2006 (n = 581)**

Table 3: **Relationship between socio-economic characteristics and knowledge about malaria mode of transmission and preventive measures among respondents in the three urban areas, Assosa zone, Northwest Ethiopia, February 2006**

Variables	Mosquito bites are malaria modes of transmission (n=581)		Crude OR(95% CI)	Adjusted OR (95%CI)
	Yes (%)	No (%)		
Study areas				
Assosa	178 (44.1)	226 (55.9)	1.0	1.0
Menge	37 (77.1)	11 (22.9)	4.3 (2.1, 8.6)	4.0 (1.9, 8.2)
Bambasi	61(47.3)	68 (52.7)	1.1(0.7, 1.7)	1.4 (0.4, 1.2)
Level of education				
No formal education	47 (42.3)	64 (57.7)	1.0	1.0
1-4th grade	52 (41.6)	73 (58.4)	0.9 (0.5, 1.6)	0.9 (0.5, 1.5)
5-8th grade	56 (41.8)	78 (58.2)	0.9 (0.6, 1.6)	1.0 (0.6, 1.7)
9-12th grade	68 (54.0)	58 (46.0)	1.6 (0.9, 2.7)	1.7 (0.9, 2.9)
College/ University level	53 (63.1)	31 (36.9)	2.3 (1.3, 4.2)	2.2 (1.2, 4.1)
	Other modes of transmission [a]			
Study areas	**Yes**	**No**		
Assosa	282 (63.8)	122 (36.2)	1.0	1.0
Menge	25 (52.0)	23 (48.0)	0.5 (0.2, 1.4)	0.6 (0.23, 1.66)
Bambasi	103 (79.8)	26 (20.2)	2.04 (1.3, 3.2)	2.15 (1.35, 3.4)
Ethnic groups (place of birth)				
Indigenous to the region	59 (52.2)	54 (47.8)	1.0	1.0
Oromo	170 (76.9)	51 (23.1)	1.8 (0.99, 3.5)	1.65 (0.86, 3.1)
Amhara	147 (73.5)	53 (26.5)	1.3 (0.67, 2.5)	1.9 (0.6, 2.3)
Tigrie	21 (72.4)	8 (27.6)	6.1 (2.5, 15.1)	6.06 (2.4, 15.23)
Gurage and others	13 (72.2)	5 (27.8)	4.2 (1.4, 12.4)	3.99 (1.3, 12.1)
Gender				
Male	10 (3.5)	27 (96.5)	1.0	
Female	25 (8.4)	27 (91.6)	2.5 (1.2, 5.4)	
	Stated Preventive measures			
	Yes	**No**		
Education				
No formal education	41 (46.1)	48 (63.9)	1.0	1.0
1-4th grade	72 (65.5)	38 (34.5)	2.2 (1.25, 3.9)	1.58 (0.86, 2.9)
5-8th grade	71 (55.5)	57 (44.5)	1.4 (0.8, 2.5)	0.83 (0.45, 1.53)
9-12th grade	83 (68.0)	39 (32.0)	2.5 (1.4, 4.4)	1.28 (0.66, 2.43)
College/University	70 (83.3)	14 (16.7)	5.85 (2.88, 11.89)	2.42 (1.09, 5.4)
Wealth quintiles				
Poorest	52 (44.4)	65 (55.6)	1.0	1.0
Next to poorest	90 (62.1)	55 (37.9)	2.05 (1.25, 3.38)	1.82 (1.07, 3.2)
Medium	44 (73.3)	16 (26.7)	3.44 (1.74, 6.78)	3.33 (1.63, 6.8)
Next to well-off	78 (67.2)	38 (32.8)	2.56 (1.50, 4.37)	2.36 (1.33, 4.2)
Well-off	73 (76.8)	22 (23.2)	4.15 (2.3, 7.6)	3.89 (1.99, 7.6)
Study Town				
Assosa	239(64.2)	133 35.8)	1.0	1.0
Menge	39 (83.0)	8 (17.0)	2.7 (1.23, 5.97)	2.57 (1.1, 5.9)
Bambasi	59 (51.8)	55 (42.2)	0.59 (0.39, 0.91)	0.69 (0.43, 1.33)

Note: OR = Odds ratio, CI = Confidence intervals

[a] Other modes of malaria transmission include (exposure to cold weather, drinking dirty water, exposure to dirty surrounding, poor personal hygiene, exposure to sun, eating contaminated foods, and God's will)

Discussion

Less than half (47.5%) of the study participants mentioned mosquito bites as a mode of malaria transmission. The knowledge level of respondents about the mode of malaria transmission was very low when compared to the findings in previous studies carried out in Ethiopia which reported awareness levels of up to 93% (19, 20). Findings in this study are also lower than those reported in other studies across Africa (14, 21, 22), and in countries like India and Mexico (15, 23). The 2004 NetMark survey did report a slightly lower level of knowledge about modes of transmission (39.5%) (17).

A majority of respondents reported mosquito bites and mosquito disturbance during sleeping as nuisances. However, only a small proportion (29.9%) of the respondents mentioned the role of mosquitoes as a vector for malaria transmission, indicating their limited

knowledge of the relationship between mosquitoes and malaria. This lack of awareness may also contribute to misconceptions about causes of malaria. In the present study, exposure to dirty environments and cold weather, drinking dirty water, poor personal hygiene, eating contaminated foods, and exposures to the sun were identified as possible causes of malaria. Such misconceptions have also been reported from other studies in Ethiopia and other countries (12-14, 19-21, 24-26).

Table 4: **Knowledge about ITN among respondents in the three urban areas, Assosa zone, BG region, N.W. Ethiopia, February 2006 (n= 581)**

Variables	No.	%
Awareness about ITN and sources of information Ever seen and/or heard about ITN	521	89.7
Sources of ITN information (n =521)		
Heard from health workers	250	47.9
Heard on the radio	193	37.0
Heard on the television	137	26.3
Heard from kebele meetings	62	11.9
Heard/seen from neighbors	43	8.1
Heard from those who use the net	20	3.8
Other sources of information	13	2.5

Note: percentages do not add up to 100% because of multiple responses

Table 5: **Determinants of respondents' awareness of ITNs in the three urban areas, Assosa zone, Ethiopia, February 2006 (n = 581).**

Socioeconomic variables	Awareness of ITNs		Crude OR (95% CI)	Adjusted OR (95%CI)
	Yes (%)	No (%)		
Level of education				
No formal education	91(82)	20 (18.0)	1.0	1.0
1-4th grade	106(84.8)	19 (15.2)	1.2 (0.6, 2.4)	1.05 (0.5, 2.13)
5-8th grade	120(89.6)	14 (10.4)	1.8 (0.9, 3.9)	1.56 (0.7, 3.3)
9-12th grade	122(96.8)	4 (3.2)	6.7 (2.2, 20.3)	5.27 (1.6, 16.8)
College/university	81(96.4)	3 (3.6)	5.9 (1.7, 20.7)	4.04 (0.9, 16.5)
Occupation				
Job with variable income	277(86.6)	43 (13.4)	1.0	1.0
Job with regular income	244(93.5)	17 (6.5)	2.23 (1.2, 4.0)	1.2 (0.6, 2.24)
Wealth quintiles				
Poorest	115(81.6)	26 (18.4)	1.0	1.0
Next to Poorest	140(90.3)	15 (9.7)	2.1 (1.07, 4.1)	1.9 (0.9, 3.86)
Medium	60(93.8)	4 (6.3)	3.4 (1.13, 10.2)	2.65 (0.8, 8.2)
Next to Well-off	113(94.2)	7 (5.8)	3.7 (1.5, 8.7)	2.61 (1.06, 6.4)
Well-off	93 (92.1)	8 (7.9)	2.6 (1.13, 6.1)	1.62 (0.6, 4.02)

OR = Odds ratio, CI= Confidence Interval

Misconceptions about malaria transmission were observed to differ among the study areas and ethnic groups. Such misconceptions may arise from the way health education about malaria prevention and control is provided to the community. For example, the key message '*keeping environmental sanitation*' is commonly used in malaria prevention and control interventions. However, the meaning of environmental sanitation may be different for different people and may be interpreted differently beyond mere action for prevention of malaria.

Education clearly influences knowledge about modes of malaria transmission. Educated communities have better understanding of the modes of malaria transmission as evidenced in this study. Educated communities have multiple sources of information as compared to uneducated communities. The findings of this study are in accordance with a study conducted in Mexico where higher knowledge about malaria transmission was reported among women who completed elementary school compared to those who had no formal education (15).

Knowledge of mosquito behavior (resting and breeding places and feeding time) is important to take appropriate malaria preventive actions and for the proper use of ITNs. A majority of respondents identified the indoor resting characteristic of mosquitoes (60.6%) as well as mosquitoes' habit of night-time feeding (95%). In another study conducted in rural parts of Ethiopia, indoor resting was reported by less than half (44.3%) and night biting habits of the mosquitoes by about three fourth of the study participants (20). Knowledge about mosquito resting and feeding behaviors was relatively high among participants of the present study.

The proportion of study participants who have comprehensive knowledge about effective malaria control strategies (44.8%) was found to be quite low. Differences in respondents' knowledge were associated with such individual and community factors as residence, study area, education and wealth status. The higher level of knowledge among participants from Menge Town was related to the facility based health education program, as evidenced by the large proportion of respondents from Menge Town who identified the main source of ITN information as the health facility.

In addition to the comprehensive knowledge of malaria preventive methods, the perceived benefit of sleeping under ITNs as a method of malaria prevention was higher among well-off and educated respondents. Generally, well-off and educated communities had better access to multiple ITN information sources such as television.

Ineffective traditional mosquito avoidance measures like burning leaves and aerosol-insecticide were common practices in the present study areas. Use of aerosol insecticide was higher among those in the well-off wealth quintiles (32.6%) versus in the poorest (15.7%). Such practices have also been reported in other urban areas of Ethiopia (17) and in other African countries (26). It is important to note that the purpose of these mosquito avoidance measures was primarily to prevent the nuisance of mosquito bites and not to prevent malaria. The use of aerosol insecticides and smoking as a measure against mosquitoes were observed to have a negative effect on ITN ownership and use.

The observed ITN awareness level (89.7%) is similar to the 89.5% (17) and 41% (14) level of awareness found in the ITN baseline survey recently conducted in major Towns of Ethiopia. A high level of awareness was reported in a Kenyan study, in which caregivers of children under five had an awareness level of 97% (21). On the other hand, a Ugandan KAP survey reported a very low level of awareness (14.1%) (22). In this study, the differences in awareness level among study participants were due to differential access (exposure) to multiple sources of ITN information such as community meetings, facility based health education, and mass media (radio and television). Access to multiple sources of ITN information differed by wealth status and educational level of the respondents.

In conclusion, knowledge on the role of mosquitoes in malaria transmission and comprehensive knowledge about malaria prevention strategies was observed to be lower than 50% among the study population. There were significant misconceptions about both modes of malaria transmission and preventive measures. Despite the fact that respondents were well aware of ITNs, access to various sources of malaria prevention information differed by socioeconomic status.

These results call for targeted health education/communication to increase the population's comprehensive knowledge of effective malaria control strategies in general, and ITNs in particular. Better knowledge about malaria transmission and benefits of using available effective preventive and control measures by the individual households and the community could contribute much to the overall reduction of the malaria burden. Provision of comprehensive behavior change communication through media that are accessible and appropriate to economically vulnerable populations would increase the participation of the population in different socioeconomic strata. Such efforts should focus on correcting misconceptions about malaria transmission and prevention.

Acknowledgements

This study was financially supported by the graduate program of Jimma University. The Authors extend their appreciation to the community members from the Assosa, Menge and Bambasi Towns who participated in the study. The contribution of Benshangul Gumuz Regional Administration especially Mr. Sebil Albekhit, Dr. Abeje Zegeye, Dr. Deriba Agegnew are highly appreciated.

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