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Assessment of Plasmodium Species Infection and Proper Utilization of Insecticide Treated Mosquito Nets in Merawi Town and Its Surroundings, Northwest Ethiopia

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Abstract
The study was conducted to assess the prevalence of *Plasmodium* species infection and proper use of insecticide treated mosquito nets in Merawi town and its surroundings, West Gojjam from October 2010 to January 2011. The study consisted of a total of 403 selected subjects. Both thick and thin films were prepared from the study subjects, and stained by using 10% Giemsa solution and examined under a microscope for parasite species identification. Questionnaires were used to get information about insecticide treated mosquito net utilization. The overall prevalence of Plasmodium was 32.3% in which the prevalence of *P. falciparum* was higher (52.3%) than *P. vivax* (37.7%). Pregnant women were highly infected by a mixed infection of P. falciparum and *P. vivax* (38.5%) than non-pregnant women (30.8%). There was an association ($p<0.05$) between Plasmodium species infection and residence, sex, and age of the study subjects. Children below 5 years were highly infected by *P. falciparum* and *P. vivax* with prevalence of 29.4% and 20.6%, respectively. Despite the possession of insecticide treated mosquito nets, there was a gap in coverage and utilization. Educational status, age, and occupation of study participants were associated with utilization pattern of insecticide treated mosquito nets.
Keywords: Insecticide treated mosquito net, *Plasmodium*, prevalence, proper utilization, Merawi.

1. Introduction

Malaria is a serious and highly complex mosquito born infectious disease caused by microscopic and eukaryotic protists of the genus *Plasmodium* which infects red blood cells and transmitted to humans by the bite of an infected female *Anopheles* mosquito vector (11).

There are four species of malaria causing parasites that can infect humans; *Plasmodium falciparum, P. vivax, P. ovale* and *P. malariae* (2). The species differ in many aspects of their biology and geographical distribution. *Plasmodium falciparum* is found in most tropical regions of the world but it is more prevalent in Asia, Oceania and Latin America than in Africa (MOH, 2006).

Among the four species of *Plasmodium* infecting humans, *P. falciparum* is the most dangerous which represents a growing threat and burden to human health and welfare. It is justifiably regarded as the greater menace because of the high levels of mortality which is associated with its resistance to anti-malaria drugs and widespread dominance in the world's most malarious continents (1).

Malaria remains a major public health problem particularly in Sub-Saharan Africa and estimated to cause 300-500 million clinical cases and over 1 million deaths of which, 90% occurs in sub-Saharan Africa. Ethiopia is one of the sub-Saharan African countries that are seriously affected by malaria disease (1). Three quarters (75%) of the land mass at an altitude below 2000 meters are regarded as malarious with more than two thirds (68%) of the total population at a risk of malaria infection with unstable transmission that lends itself to the outbreak of epidemics, and disease transmission peaks bi-annually from September to December and April to May (5, 10).

Vector control remains the most effective measure to prevent malaria transmission. Insecticide treated mosquito nets have a renewed interest that provides a simple and cost-effective means for preventing malaria in highly endemic areas. However, consistent follow up of whether insecticide treated mosquito nets are properly used by households is very crucial (11). The maximum malaria reduction effect of insecticide treated mosquito nets will only be achieved if people acquire nets used all year round and the vulnerable household members sleep under them (2). Even though there are reports about the prevalence of malaria and the way the population use bed nets across the country, information on these two issues is particularly lacking in Merawi town and its surroundings. The study was therefore designed to assess the prevalence of *Plasmodium* species infection and proper utilization of insecticide treated mosquito nets at household level and factors affecting its utilization in the study area.

2. Materials and Methods

2.1. Description of the study area

A community based cross-sectional study was conducted from October 2010 to January 2011 in Merawi town and its surroundings, which is located 523 km north-west of Addis Ababa, the capital city of Ethiopia; Merawi

town is located 34 km south of Bahir Dar town, the capital of Amhara Regional State. The town has an altitude range of 1500-2400 m above sea level and characterized by maximum and minimum mean daily temperature of 30°C and 13°C, respectively. The study district consists of 9 kebeles with a total of 58,247 residents.

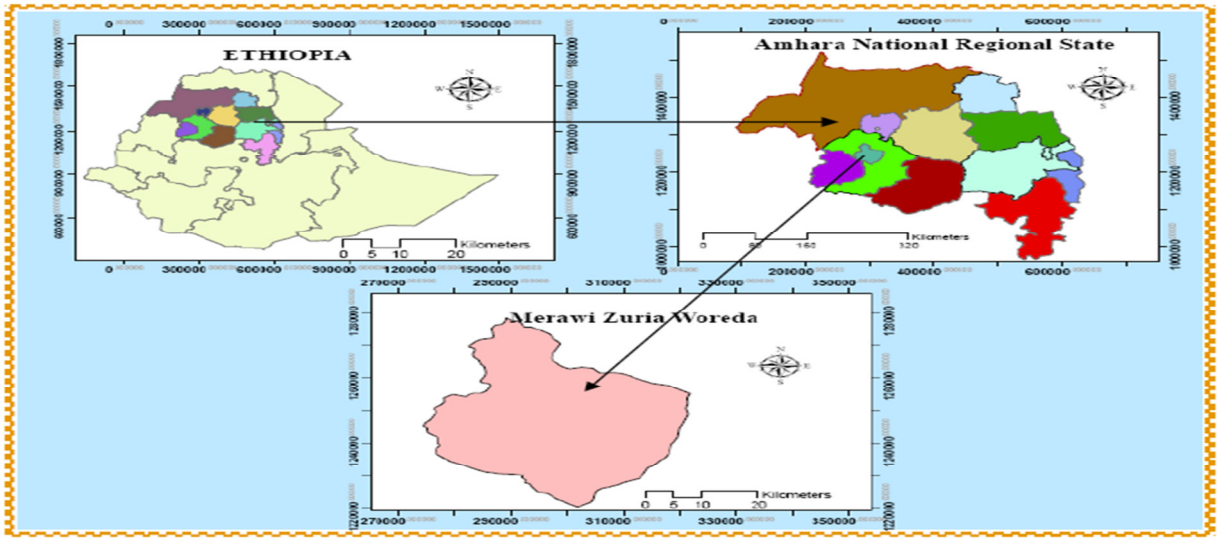

Figure 4. Topography map of the study area, Merawi Zuria Woreda (2011).

2.2. Sample size determination and sampling techniques

The representative samples were selected by using simple random sampling. Three rural (Enashenifalen, Bachima and Kudime) and one urban (Merawi-02), a total of four kebeles were randomly selected. A total of 403 individuals were randomly determined by considering a prevalence of 50% as there was no any prevalence report in the study area (6). Moreover, in the second part of our study, well structured and pre-tested questionnaires were administered to study subjects to collect information on insecticide treated mosquito net utilization.

2.3. Sample collection procedures and techniques

Thick and thin blood films were prepared to confirm the presence of any type of *Plasmodium* species and to identify specific *Plasmodium* species, respectively. After selecting representative samples, the research objectives were first explained to study subjects and then blood samples were drawn. Careful procedures were adopted in collecting finger prick blood samples by swabbing the area to be sampled with 70% alcohol and allowed to dry before collection. Once both thick and thin blood smears were prepared and dried, the slides were labeled with a lead pencil and immediately brought to Merawi Health Center for parasite identification. The thin smears were fixed with methanol and then both thin and thick smears were stained with 10% Giemsa stain for 30 minutes and subsequently read using a light microscope with an oil-immersion objective lens (100×). After the first reading of all slides, all positive and a randomly selected proportion of negative slides were allowed to be read by an independent microscopist for quality control.

2.4. Data Analysis

The statistical analysis was carried out by using Ms-excel (2003) and SPSS 16 window data version. This raw data set were interpreted and analyzed by using Chi-square test (χ^2) percentage and 95% confidence interval. All statistical test of significance were done at p value <0.05.

2.5. Ethical consideration

The study was ethically approved by ethical approval committee of Bahir Dar University. After explaining the objectives of the study to officials of the local health district office and administrative body, permission was obtained to conduct the research. Verbal consent was then obtained from all study participants after a thorough explanation of the purpose of the study before taking the blood smears and administering the questionnaires. Study participants who were found positive for *Plasmodium* species were treated by appropriate drugs by medical doctor of Merawi Health Center.

3. Result

3.1. Socio-demographic characteristics of the respondents

The total number of participants included in the study was 403 individuals. Of these, 58.1 % were males and

41.9 % were females. Most of the respondents were young adults between the ages of 15-31 years (25.3 %) and 31-45 years (24.3 %).

The majorities (48.1 %) of the respondents were farmers and illiterates (42.9 %), the rest 25.6 % were students while 20.8 % government employees and 5.5 % were others (Table 1).

Table 1. Socio-demographic characteristics of respondents in Merawi town and its surroundings

Variables		Frequency	Percent
Sex	Male	234	58.1
	Female	169	41.9
Age (year)	<5	68	16.87
	6-14	86	21.3
	15-30	102	25.3
	31-45	98	24.3
	>45	49	12.1
Occupation	Farmer	194	48.1
	Student	103	25.6
	Government employee	84	20.8
	Others	22	5.4
Level of education	Illiterate	173	42.9
	Elementary grade	84	20.9
	High school grade	67	16.6
	College grade	53	13.6
	University grade	26	6.4
Number of individuals per household	One	24	6.6
	Two	32	7.9
	Three	64	15.8
	Four	148	36.7
	Five and above	135	33.5

3.2. Prevalence of *Plasmodium* parasites

Out of 403 individuals examined, a total of 130 (32.25 %) subjects were found to be positive for malaria parasite. *Plasmodium falciparum* was found to be the highest, 52.31 % followed by *P. vivax*, 37.7 %, and mixed infection of *P. falciparum* and *P. vivax*, 10 % (Figure 1).

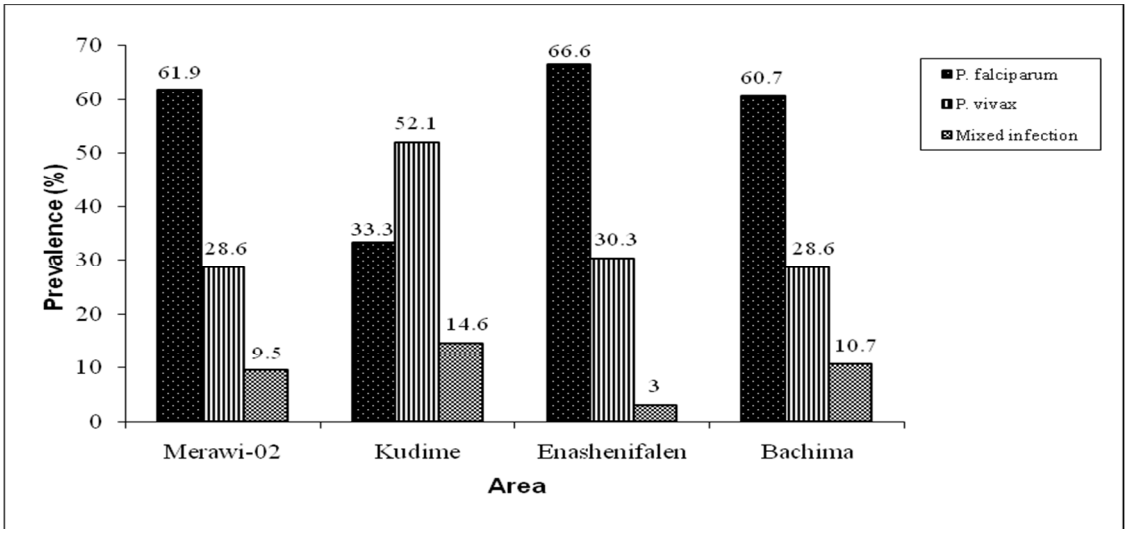

Figure 1. Prevalence of malaria parasite infection in Merawi town and its surroundings

Plasmodium falciparum infection was higher (66.6 %) in Enashenifalen and lower (33.3 %) in Kudime Kebeles while, *P. vivax* was higher (52.1 %) in Kudime and lower in Mrerawi-02, (28.6%) and in Bachima Kebeles (28.6 %).

Our study revealed a mixed infection of *P. falciparum* and *P. vivax* malaria in the study area which was higher (14.6 %) in Kudime and lower (3.0 %) in Enashenifalen Kebeles (Figure 1). This result showed that there was an association between residential area and prevalence of *Plasmodium* species infection and it was statistically significant (p=0.23). Pregnant women were highly infected by a mixed infection of *P. falciparum* and *P. vivax* (38.5 %) than and non-pregnant women (30.8 %).

In the study, there was an association between sex and type of *Plasmodium* species infection and this was statistically significant (*p*=0.23). Among *Plasmodium* parasite positive individuals, children below 5 years were highly infected by *P. falciparum* and *P. vivax* malaria with parasite prevalence rate of 29.4% and 20.6 %, respectively.

3.3. Insecticide treated mosquito net possession

Out of 403 individuals included in the study, 347(86.1%) subjects possessed insecticide treated mosquito nets. The majority (91.6 %) of insecticide treated mosquito nets were provided to the households freely by the local health authorities while 8.4 % were purchased privately from market (Table 2). Out of 347 individuals who possessed insecticide treated mosquito nets, 25.1 % had one, 61.7 % had two and 13.2 % three and above with an average of two insecticides treated mosquito nets per household.

Table 2. Insecticide treated mosquito net possession in the studied area

Variables		Frequency	Percent
Possession of ITMNs (n=403)	Yes	347	86.1
	No	56	13.9
Shape of ITMNs (n=347)	Rectangular	294	84.7
	Conical	53	15.3
Color of ITMNs (n=347)	Blue	281	80.9
	White	59	17.0
	Others	7	2.01
Source of ITMNs (n=347)	freely supplied from health sectors	318	91.6
	purchased from market	29	8.4
Number of ITMNs supplied per household (n=347)	One	87	25.1
	Two	214	61.7
	three and above	46	13.3

ITMNs = insecticide treated mosquito net.

3.4. Insecticide treated mosquito net utilization

Out of 347 individuals who owned insecticide treated mosquito nets, 76.1% used their insecticide treated mosquito nets at one time or the other. And of those who used ITMNs, 52.5 % used their nets consistently throughout the year, 10.4% used theirs during malaria transmission season, 5.5 % occasionally and 7.8 % when hearing mosquito buzzing inside their house.-23.9 % did not use the available insecticide treated mosquito nets at all, 24.1 % used their nets for another purpose, and 6.4 % sold to another persons (Table 3). Out of 83 respondents who gave reasons for not using the already available bed nets at their disposal, 18.1 % explained that house structure and absence of bed as reason for not using the bed net; 15.7 % explained that it took time to hang and take down the net; while 13.4 % of the study subjects reported presence of heat when sleeping and difficulties to wake up at night and 9.6 % of them mentioned-other related factors impeding on proper utilization of insecticide treated mosquito nets. On the dissemination of information about bed nets; Kebele health extension workers (62.3 %), mass media mainly through radio (25.1%), television (10.4%) and other sources (2.3%) played a great role in awareness creation and educating the respondents of the study area (Table 3).

Table 3. Insecticide treated mosquito net utilization pattern in the studied area

Variables		Frequency	Percent
Sources of information about ITMNs utilization (n=347)	Health extension workers	216	62.3
	Through radio	87	25.1
	TV	36	10.4
	Other sources	8	2.3
Frequency of sleeping under ITMNs (n=347)	Daily	182	52.4
	During transmission season	36	10.4
	Occasionally	19	5.5
	When hearing mosquito buzzing	27	7.9
	Not used at all	83	23.9
Reasons for not using the possessed and available ITMNs (n=83)	Lack of knowledge and poor perception	9	10.8
	Used for another purpose	20	24.1
	Sold	7	8.4
	House structure and absence of bed for hanging the net	15	18.1
	It is too hot to sleep and difficult to wake up at night	11	13.2
	It takes time to hang and take down the net	13	15.7
	Other reasons	8	9.6

ITMNs= insecticide treated mosquito net.

Educational status of individuals influenced the proper utilization of insecticide treated mosquito nets in the study area. Of those included in the study, elementary and college students showed a good practice of nets utilization and the least of net utilization was found in those illiterates who used the available net intermittently.

4. Discussion

In the study, the overall *Plasmodium* prevalence rate of 32.25 % was recorded. The prevalence of *P. falciparum* (52.3 %) was higher than that *P. vivax* (37.7%), and the most dangerous of malaria infections, 18% of deaths in children less than 5 years and 19 to 24 million pregnant women infections throughout the world and all none or less immune persons, regardless of age and sex are more susceptible to *P. falciparum* malaria infection (3). In malaria endemic areas, *P. falciparum* infection during pregnancy was more severe than non pregnant women and increased the likelihood of pregnancy outcomes including maternal anaemia, abortion, still birth, prematurity, growth retardation and low birth weight (4).

In the present study, *Plasmodium falciparum* was found to be higher in Enashenifalen and lower in Kudime Kebeles while *P. vivax* was higher in Kudime and lower in Merawi-02 and Bachima Kebeles. This might be due to differences in ecological conditions especially the presence of logged water in the area that favored the development and survival of *Anopheles* mosquito vector. It is known that warm and moist climatic conditions are conducive for the development of the parasite and breeding places of the *Anopheles* vector (9). The temperature of the study area could reach 30°C which falls within a temperature range of 21-32°C which is conductive for maintenance of the disease. The disease transmission might not only be influenced by

temperature but also by factors like the number of infected persons and mosquitoes during the study period. The disease usually occurs when the factors limiting transmission are altered as the result of either temporary climatic changes such as long periods of increased humidity and high temperature or more permanent changes of the climate such as the development of agricultural irrigations (10).

The prevalence of malaria parasites among different age groups in the study subjects varied greatly. In our study, children below 5 years were highly infected by *P. falciparum* and *P. vivax* with prevalence of 29.4% and 20.6 %, respectively. Children, particularly under five years are at risk of severe malaria due to their relatively less developed immunity (Abose *et al*., 1998). Similar type of study by Tassawar and Mannan, (2003) also showed a higher prevalence of *P. falciparum* (6.5 %) than that of *P. vivax* (4.8 %) in patients aged between one month to 5 years. Suleman and Yasin, (2008) showed that in endemic areas, malariometric incidence was found to be highest in children less than 5 years of age and it decreased with increasing age which indicated an increased antibody production through acquired immunity. 39.7 % of non pregnant women were infected by *P. falciparum,* 36.7 % by *P. vivax* and 30.8 % by mixed infection of *P. falciparum* and *P. vivax* malaria parasites. Pregnant women were highly infected by a mixed infection of *P. falciparun* and *P. vivax* than males and non-pregnant women. The burden of malaria during pregnancy is mainly caused by *P. falciparum* and the symptoms and complications of the disease differs with the intensity of malaria transmission and level of immunity that the pregnant woman has acquired (7).

Our study showed an association between residential area of the study subjects, sex and that of *Plasmodium* species infection. In highly endemic areas adults usually have substantially acquired resistance to local strains of *Plasmodium* but, the prevalence of clinical malaria is higher and the severity is greater in pregnant women than non-pregnant women (5).

Usage of insecticide treated mosquito nets has been shown to be an extremely cost effective method for preventing malaria disease and it was estimated to be twice as effective as untreated mosquito nets and offer greater than 70 % protection as compared to no net especially among children under 5 years of age and pregnant women (2, 5). In our study, of study subjects who used bed nets, only half (52.5 %) used their nets consistently throughout the year indicating that the rest are at the highest risk of getting the infection. Similar type of study in Arbaminch zuria district also showed that the use of insecticide treated mosquito nets at one time or another (2).

References

1. Abose, T., Alamirew Desta, Regassa Lemma and Mengesha Tefera. (1998). The Epidemiology and control of malaria with special emphasis on the distribution, behavior and susceptibility of insecticides on *Anopheleine* vectors and chloroquine resistance in Hawassa, Ethiopia. (Pp. 19-25).
2. Ayalew Astatkie and Amsalu Feleke (2009). Utilization of insecticide treated nets in Arbaminch town and the malarious villages of Arbaminch Zuria district, Southern Ethiopia. *Ethiop J Health Dev.* 2009; 24(1): 15-24.
3. Guyatt, H., Snow R. (2001). The epidemiology and burden of *Plasmodium falciparum* related anemia among pregnant women in sub-Saharan Africa. *Am J Trop Med Hyg*; **64**:36– 44.
4. Hassan, W., Adeyeba, A., Adefioye, O., Oyeniran, A. (2007). Prevalence of malaria parasite infection among pregnant women in Osogbo, South West, Nigeria. *Am Eurans J Sci Res*; **2**:43–45.
5. Ministry of Health (MOH) (2006). National five year strategic plan for malaria prevention and control in Ethiopia. Addis Ababa. (Pp.21-32).
6. Naing, L., Winn, T., and Rusil, B. (2006). Practical issues in calculating sample size for prevalence studies. *Arch Orofacial Sci*; **1**:9–14.
7. Nigatu Wondatir, Abebe Animut, Dejene Amare (1992). *Plasmodium vivax* and *Plasmodium falciparum* epidemiology in Gambella, South West Ethiopia. *Trop Med Parasitol*; **43**:181–185.
8. Suleman, K., and Yasin, M. (2008). Incidence of human malaria infection in desert areas of Pakistan. Am *J Agri Soc Sci;* **4**:1–8.
9. Temu, E., Minjas, J., Coetzee, M., Hunt, R. and Shift, C. (1998). The role of four *Anopheles* species in malaria transmission. *Trans Royal Society of Trop Med Hyg* ; **92**:142– 159.
10. Tulu, N. (1993). Malaria transmission in the highlands of Ethiopia. *Am J Trop Med Hyg*; **82**:347–359.
11. World Health Organization (WHO) (2003). Insecticide treated mosquito net intervention: A manual for national control program managers. Global partnership to roll back malaria. Geneva.
12. Zeibig, E. (1997). Clinica parasitology: a practical approach. Saunders College Pub. Philadelphia.