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Impact of bed nets on the prevalence of malaria in Yaso district, Benishangul Gumuz Regional State

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COLLEGE OF SCIENCE

DEPARTEMENT OF BIOLOGY

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By: Ayele Mindaye

A thesis submitted to the School of Graduate Studies of Bahir Dar University in partial fulfill ment of the requirements for the degree of Master of Science in Biology

BDU, Ethiopia

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APPROVAL SHEET OF THE MSc THESIS DEPARTMENT OF GRADUTE COMMITTEE

BAHIR DAR UNIVERSITY

As members of the Examining Board of the Final MSc Open Defense, we certify that we have read and evaluated the thesis prepared by AYELE MIDAYE entitled, Impact of bed nets on the prevalence of malaria in Yaso district, Benishangul Gumuz Regional State and recommend that it be accepted as fulfilling the thesis requirement for the degree of Master of Science in Biology.

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Declaration of Originality

I, AYELE MINDAYE TEFERA, hereby declare that this thesis is a true discourse of my own original study and any other supportive information derived from published and unpublished articles have been acknowledged and cited appropriately. I therefore summit this thesis to the graduate school of Bahir Dar University, Ethiopia for the partial fulfillment of the requirements for the acquisition of the degree of Master of Science in Biology.

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Signature€€€€€€€..

This thesis has been submitted for examination with approval as an advisor

Advisor name: Melaku Wale (PhD)

Signature& & & & & & & & & & & & & &

Dedication

I dedicate this manuscript to Yaso district local government, and Yaso employees for nursing me with warmth, wonderful and for their dedicated partnership in the success of my life as well as my study.

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List of Acronyms

ACR	Artemisinin-based Combination Therapy
BoFED	Benishangul Gumuz of Finance and Economic Development
CSA	Central Statistics Agency
DHS	Health Development Strategy
FMoH	Federal Ministry of Health of Ethiopia
HEWs	Health Extension Workers
HSDP	Health Sector Development Plan
IEC	Information Education Communication
IRS	Indoor residual spray
ITNs	Insecticide treated nets
KAP	Knowledge Attitude Practice
LLIN	Long-lasting insecticide treated nets
MDG	Millennium Development Goal
MIS	Malaria indicator survey
NSP	National children strategic plan
PMI	President Malaria Initiatives
RBM	Roll Back Malaria
RDTs	Rapid Diagnostic Tests
SNNP	Southern Nations Nationalities and Peoples Region

ABSTRACT

Insecticide Treated Nets (ITNs) reduce malaria mortality and morbidity. Considering this in to account, the government donated ITNs freely. Hence, this study was conducted to determine the impact of the bed nets on the prevalence of malaria of the study subjects. A cross-sectional study was conducted during peak malaria transmission season (October-November 2014) in Yaso District, Benishangul Gumuz Region, Western Ethiopia. Data were collected using structured questionnaires, analyzed using SAS for windows version JMP 5.0.1 software. Adjusted odds ratio and 95% confidence intervals were employed to test the strength of association and the criterion for statistical significance was set 0.05. The probability of falling ill was regressed against groups of explanatory variables using multiple logistic regression. This was done for both the questionnaire and the blood film results. The results revealed that about 40% of the study subjects were found positive for *P.falciparum*. *Falciparum*, *vivax*, mixed infection accounted for 74.5% of the study subjects. All the 384 study subjects had insecticide treated nets; 50.5% possessed one, 39.3% two and 10.2% more than two ITNs. Proper ITNs utilization increased with increasing educational status. According to the logistic regression, there was significant association between illness due to malaria and at least one of the explanatory variables (χ^2_6 =271.9, P<0.0001). For *Plasmodium* species, education level, and age appeared to be significant beneficial factors (OR<1 and negative values). Occupation was a significant risk factor. Increasing education improved the likelihood of proper ITN utilization. Illiterate farmers must be targeted in the utilization of ITNs. Schools may be used for awareness creation and distribution of ITN instead of mass campaign. It is recommended that integration of stakeholder (school communities, Community Health Workers (CHWs), women health army and the government) to administer health education activities about the benefit and utilization of ITNs to the population must be launched. Adult education, health education and information were needed to address the gap of improper ITNs practice.

Key words: Malaria, insecticide treated bednets, utilization, Yaso district, Benishangul Gumuz

1. INTRODUCTION

1.1. Background and justification

Ethiopia is among the top five main contributing countries to the overall African malaria burden. Despite the long history of malaria eradication and control since the 1950s, malaria is still a major public health problem in the country and main cause of hospitalization and death in all corners of the country (Paulander et al., 2009).

Malaria in Ethiopia is seasonal, predominantly unstable and focal, depending largely on rainfall and altitude. Two transmission seasons are known; the first transmission period is from September to December and the short transmission period also April to May. The unstable nature of malaria makes the population non-immune and prone to focal and cyclical epidemics (Lemma Hailemariam et al., 2010).

About 75% of the geographic area of the Ethiopia is at risk off malaria (area < 2000 m above sea level) (FMoH, 2011; TCC, 2013). Malaria is one of the leading causes of morbidity and mortality in Ethiopia. P. falciparum accounts for 65-75% of malaria infection, P.vivax for 25-35%, P. ovale and P. malariae are rare (FMoH, 2012b; TCC, 2013; PMI, 2014).

The Federal Ministry of Health planed a strategy to receive a vital malaria preventive intervention i.e., the supply of long-lasting insecticidal nets (LLINs), indoor residual sprays (IRS), and ready diagnostic tests using microscopic examination of blood smears and rapid diagnostic tests (RDT) coupled with effective case treatment with Artemisinin-based combination therapy (ACT) in malarious area particularly area altitude below 2000 meters above sea level. The application of this package is considered crucial if any positive results were to be achieved (FMoH, 2011; FMoH, 2012a).

According to International Development Association (IDA) Foundation, with about 40% of the world's population at risk of malaria today, prevention by using mosquito nets is an important weapon to avoid this life-threatening disease (IDA Foundation, 2015). Insecticide treated mosquito net (ITNs) is used for protection against mosquito bites and has proven to be a practical, highly effective and cost-effective intervention against malaria (WHO, 2005; WHO, 2015).

Past malaria prevalence studies show mixed findings with respect to sex and age. More prevalence was reported on men than on females (Yared Legesse *et al*., 2007; Rebecca Samuel and Sani Abdullahi, 2014; Abeje Kassie *et al*., 2014; Alemayehu Gutnse *et al*., 2015). In contrast, other findings in Metekel zone of the study region reported more infection in females than men (Habitamu Bedimo *et al*., 2015). Whereas others predicted no association with respect to sex (Graves *et al*., 2009). Rebecca Samuel and Sani Abdullahi, (2014) reported that only 57.7% of ITNs were put into use in Nigeria.

Despite the relatively high education coverage, illiteracy rate in the study region is high (82%) (BoFED, 2004). World Bank placed this region with socioeconomic risks/potential. The risks were included malaria with prevalence of 85% in Kemashi Zone (World Bank, 2004).

According to a recent study rural residence and illiterate individuals were more prone to malarial infection than those who received formal education. This might be due to low awareness about the malaria control mechanism and the improper handling of ITNs (Abeje Kassie *et al*., 2014; Habitamu Bedimo *et al*., 2015).

Data from the Benishangul Gumuz regional state, Ethiopia, Yaso District Health office clearly shows that there was no study conducted on the coverage and consistent use of ITN among the population of the District. Therefore, this study was initiated to investigate the use and impact of bed nets on the prevalence of malaria in the district.

1.2. Objective of the study

1.2.1 General objective

The main objective of this study was to assess the utilization of bed nets and determine the impact of bed net on malarial prevalence in the study area

1.2.2. Specific objectives

- To determine the contribution of socio-demographic and ITN utilization variables to malaria occurrence
- To determine the degree of access to and coverage and use of long-lasting insecticide treated bed nets (LLINs)
- To assess knowledge, attitude and practices of people towards bed nets and their role in malaria prevention and control.
- To determine the prevalence of malaria parasite among the population.

1.3. Statement of the problem

According to the Federal Ministry of Health (FMoH) report in 2008/2009, malaria was the first cause of outpatient visits, health facility admissions and in-patient deaths, accounting for 12% of out- patient visits and 9.9% of admissions. However, as 36% of the population does not have access to health care services, these figures probably under-represent the true burden of malaria in the country. The mortality due to malaria is reported to be 70,000 deaths each year (PMI, 2011)

Ethiopia has realized the effectiveness of ITNs for prevention of malaria transmission and scaled up the distribution and utilization of ITNs at high risk area of malaria transmission. The government and donors took part in this drive (BoFED, 2004).

About 75% of the land mass of Ethiopia and Benishangul Gumuz Region is malarious (PMI, 2014). Malaria leads in morbidity (40%) and death (33%). Yaso district is entirely malarious. The government tried to prevent and control malaria in the region, exclusively in the district (BoFED, 2004). Despite different preventive measures taken, the magnitude of the disease has remained the leading cause of morbidity and mortality, always nurturing the question why?

There is a serious lack of data about ITNs utilization rate, level of awareness of the people and an impact of bed net on prevalence of malaria in Yaso district and this study was carried out to fill the gap.

The data generated helps to assist the local authority and Regional Health Bureau to prepare implementation plan and evaluation of their activities. Similarly, it could contribute for national database.

2. LITERATURE REVIEW

Ethiopia is one of the most malaria epidemic-prone countries in Africa. Approximately 52 million people (68%) live in malaria risk areas in Ethiopia, primarily at altitudes below 2,000 meters (FMoH, 2012a). Malaria is mainly seasonal with unstable transmission in the highland fringe areas and of relatively longer transmission duration in lowland areas, river basins and valleys. Historically, there have been an estimated 10 million clinical malaria cases annually. However, cases have reduced substantially (FMoH, 2012a; PMI, 2014).

Rates of morbidity and mortality increase dramatically i.e. 3-5 folds during epidemics (FMoH, 2011). Since 2005, Ethiopia has scaled-up one of the largest and most ambitious malaria control programs in Africa, designed to support the country„s Health Sector Development Plan (HSDP), the NSP and the national child survival strategy, in order to reduce under-five mortality rates by two thirds by 2015. These resources have enabled an unprecedented scale-up of malaria control interventions: prompt and effective treatment, case management through rolling-out of the highly efficacious anti-malaria drugs (i.e. ACTs), and selective vector control, with a special emphasis on increasing coverage and use of ITNs, and targeted and timely application of IRS of households with insecticide (FMoH, 2012a).

Malaria is a lifethreatening disease caused by *Plasmodium* parasite infection. Malaria is the most deadly, and it predominates in Africa (Tewoderos Adhanom et al., 2006). The problem of malaria is very severe in Ethiopia where it has been the major causes of illness and death for many years. According to recent records from the Ethiopian Federal Ministry of Health, 75% of the country is malarious (Tewoderos Adhanom et al., 2006; FMoH, 2014).

Insecticide-treated mosquito net (ITNs) is used for protection against mosquito bites has proven to be a practical, highly effective, and cost-effective intervention against malaria (WHO, 2005a). The evidence of the public health impact of ITNs, supporting their wide-scale use in Africa, is drawn from areas of stable malaria transmission where Plasmodium falciparum infection prevalence in the community is often over 40% (WHO, 2002; WHO, 2005a).

According to the strategy of FMoH, area lower than 2000 meter in altitude is considered ˂malaria-endemics˃ and is targeted to receive key malaria control intervention (FMoH, 2011; PMI, 2013). Interventions include the supply of long-lasting insecticidal nets (LLINs), indoor residual sprays (IRS), and prompt diagnosis using microscopic examination of blood smears and rapid diagnostic tests (RDT's) coupled with prompt and effective case management with Artemisinin-based combination therapy (ACT). The implementation of this program is considered crucial if any positive results were to be achieved (FMoH, 2011).

Targeting individual protection to these vulnerable groups is a well-founded and explicitly accepted priority of all three interventions such as supply of long-lasting insecticide nets, indoor residual sprays, diagnosis using microscope examination of blood smear and rapid diagnostic test, because these groups bear the highest risk of morbidity and mortality from malaria (WHO, 2000).

2.1. Impact of malaria on health

In 2004, globally 107 countries and territories have reported that they own areas at risk of malaria transmission and 3.2 billion people were living at risk (WHO, 2002; WHO, 2005b). It is also estimated that around 350-500 million clinical disease episodes occur annually. Most of these are caused by Plasmodium falciparum which is accountable for more than one million deaths each year. Malaria contributes synergistically with HIV/AIDS to morbidity and mortality in areas where both infections are highly prevalent and evidences continue to accumulate to support the view that adult infected with HIV, in addition to children <5 years of age and pregnant women (WHO, 2002).

Recent studies had shown some evidence that malaria and poverty are intimately connected. Currently malaria is given as a cause of poverty in poor and malarious countries with intensive transmission. Not only malarial countries are poor, but their economic growth is reducing. WHO report has showed that the disease is estimated to be responsible for an estimated average annual reduction of 1.3% in economic growth for those countries with the highest burden (WHO, 2002; WHO, 2005a).

Africa remains the region that has the greatest burden of malaria cases and deaths in the world. Plasmodum falciparum accounts for 93% of parasitological species of malaria cases, which is predominantly transmitted by Anopheles gambiae and Anopheles funestus vectors. Two-third (66%) of African population is at risk of malaria. The estimated contribution of Africa to the global burden of clinical falciparum malaria cases and malarial mortality burden were 74% and 89%, respectively (WHO, 2005a). Each year approximately 25 million African women become pregnant in malaria endemic area and at risk of Plasmodium falcipharum infection during pregnancy (WHO, 2005b; CSA, 2005).

2.2 Malaria in Ethiopia

2.2.1 Epidemiology

Transmission of malaria depends greatly on local environmental factors: - Temperature, relative humidity, rainfall pattern, availability of breeding sources and man-made environment. The others are parasite; host and vector factors. Altitude and climatic factors are the main determinants of malaria epidemiology in the country. Areas below 2000meter altitude are classified as malarious (PMI, 2013).

In Ethiopia, malaria transmission is largely determined by altitude and climate as affected by Indian Ocean conditions and global weather patterns, including El Nino and La Nina. Most of the malaria transmission occurs between September and December, after the main rainy season from June to August (PMI, 2014).

Malaria transmission in Ethiopia is mostly seasonal and unstable in characteristics, thus, predisposing majority of the population to frequent and often large scale epidemics (TCC, 2013).

On the other hand, recent studies have shown that malaria occurs in highland fringe areas including urban sites, the main factor being climate change (AdugnaWoyessa et al., 2002; TCC, 2013; PMI, 2014).

Five main malaria eco-epidemiological strata are recognized. These arestable, year round, transmission in the western lowlands and river basin areas of Gambella and Benishangul-Gumuz Regional States, seasonal transmission in lowland areas <1,500 meters; epidemic-prone areas in highland fringes between 1,500 to 2,500 meters; arid areas where malaria is only found near semi-permanent water bodies; and malaria-free highland areas >2,500meters (TCC, 2013;PMI, 2014).

2.2.2 Malaria vector and Parasite species

Anopheles arabiensis, a member of the An. gambiae complex, is the primary malaria vector in Ethiopia, with An. funestus, An. pharoensis and An. nili as secondary vectors. The sporozoite rate for An. arabiensis has been recorded to be as much as 5.4%. The host-seeking behavior of An. Arabiensis varies with the human blood index collected from different areas ranging between 7.7 and 100%. An. funestus, a mosquito that prefers to feed on humans, can be found along the swamps of Baro and Awash rivers and the shores of lakes Tana in the North and the Rift Valley area. An. pharoensis is widely distributed in Ethiopia and has shown high levels of insecticide resistance, but its role in malaria transmission is unclear. An. nili can be an important vector for malaria, particularly in Gambella Regional State (PMI, 2014).

Of all the four Plasmodium species occurring in the country, the two epidemiologically important species are Plasmodium falciparum and P.vivax, 60% and 40%, respectively. Anopheles arabiensis is the principal vector adapted to different ecological locations in Ethiopia (PMI, 2014).

2.3. Malaria prevention and control strategies in Ethiopia

In the absence of any vaccine, and with the problems associated with drug resistance, revention of malaria has to return to basic principles such as anti-mosquito measures and the use of mosquito nets over beds for protection. Globally, malaria control policies and strategies vary with local malaria endemicity. The national control policies of malarious countries generally conform to the key strategies advocated by Roll Back Malaria (RBM) (WHO, 2000). This new global initiative against malaria has key elements:-Effective management of malaria, rapid diagnosis and treatment, multiple and cost effective means of preventing diseaseand well co-coordinated movement, etc. (Pierre, 2001; David, 2001).

Approximately 80% of the 736 woredas (districts) in Ethiopia are considered ‥malarious†. Malaria transmission is generally seasonal and unstable, though patterns and intensity of transmission vary throughout the country due to differences in altitude, rainfall and population movement. Protective immunity in Ethiopian populations is relatively low due to unstabletransmission and, unlike large parts of sub-Saharan Africa; all age groups are at risk of infection and disease. P. falciparum accountsfor 65-75% of infections, while P. vivax accountsfor 25-35%. P. ovale and P. malariae are rare (TCC, 2013).

The goals of the 2010-2015 National Strategic Plan for Malaria Prevention, Control and Elimination in Ethiopia were:

- By 2015, achieve malaria elimination within specific geographical areas with historically low malaria transmission.
- By 2015, achieve near zero malaria transmission in the remaining malarious areas of the country (TCC, 2013; FMoH, 2014).

Key components of malaria control program are implemented by different units in the Federal Ministry of Health. Out of this unit prevention are the main vector control activities implemented in Ethiopia i.e. LLINs, IRS, and environmental control. The LLIN objectives are to ensure that 100% of households in malarious areas own at least one LLIN per sleeping space, and that at least 80% of people at risk of malaria use LLINs (TCC, 2013; WHO, 2005a).

Utilization of Insecticide Treated mosquito Net is the principal strategy for malaria prevention in areas where sustained vector control is required. All countries in Africa south of the Sahara, majority of Asian malaria endemic countries and some American countries have adopted ITNs as a key malaria control strategy (WHO, 2005a; Yared Legesse et al., 2008).

In Africa, where the burden of malaria is greatest, scaling-up access to treatment and prevention began even more recently. With respect to progress on prevention, the number of ITNs distributed has increased 10 fold during the past 3 years in more than 14 African countries (WHO, 2005a).

However, the current public health challenge is to increase household demand for and access to ITN on a scale (WHO, 2005a) In order to achieve the Abuja target, it would be necessary for Africans to purchase and utilize appropriately 32 million new nets annually for the next 10 years. (ASTMHCEEBM, 2001; WHO, 2005a)

2.4. Efforts made to prevent and control malaria in Ethiopia

Coordinated action against malaria (as malaria eradication) was launched between 1955 and 1969, Ethiopia being one of the 3 countries in Africa to implement the program. Although the program had remarkable result in industrialized countries and lager areas of sub-tropical Asia and Latin America, the problem of malaria has remained serious in Ethiopia and same for the continent. Hence, the program was reorganized in to malaria control program (WHO, 2005a; TewoderosAdhanom et al., 2006)

The country has adopted a new strategy of malaria control that integrates the program in to primary health care system along with the ongoing decentralization and health sector reform. An enabling environment that recognizes malaria as a serious development problem has been created. Malaria control is no longer seen as a largely top-down vertical intervention. Instead, effective malaria actions are being included in local health development efforts. Furthermore, Ethiopia has adopted the WHOƒs Global Roll Back Malaria (RBM) strategy which mainly relies on early diagnosis and treatment by community health workers, vector control with insecticides and use of insecticide treated nets (WHO, 2000; FMoH, 2004).

Currently, progress in malaria control activities is seen. Among the major recent achievements:- change in anti-malarial drug policy, development of new malarial treatment guidelines, development of a national strategic plan for scaling-up the distribution and use of ITNs (WHO, 2005a).

2.5. Impact of ITNs on morbidity and mortality

A new analysis of data reveals that the prevalence of malaria parasite infection, including symptomatic and asymptomatic infections, has decreased significantly across sub-Saharan Africa since 2000. In sub-Saharan Africa, average infection prevalence in children aged 2‡10 years fell from 26% in 2000 to 14% in 2013 a relative decline of 46%. Although declines in malaria parasite infection were seen across the African continent, they were particularly pronounced in Central Africa. Even with a large growth of populations in stable transmission areas, the number of infections at any one time across Africa fell from 173 million in 2000 to 128 million in 2013 a reduction of 26% in the number of people infected. According to World Malaria Report death in malaria gradually reduced throughout the world (WHO, 2014)

Insecticide treated nets (ITNs) are effective in reducing malaria mortality and over all child mortality. The lives of 400,000 to 500,000 children could be saved if every child under 5 years of age in Africa properly slept under a treated net. The study done in high risk area of Malaysia has shown that ITNs distribution and improved diagnosis and treatment services reduced malaria incidence 28 fold between 1995 and 2003 (ASTMHCEEBM, 2001)

ITN utilization has demonstrated a reduction in all causes less than 5 years of age children mortality by up to 25%. Similarly, other study has identified that proper use of ITNs can reduce mortality in children by an average of 17% and incidence of severe and mild malaria episodes by 45- 48% (WHO, 2005b).

2.6. Insecticide treated bed net possession and utilization

One of the strongest weapons in the fight against malaria is the use of insecticide-treated mosquito nets (ITNs) while sleeping. Research has shown that malaria incidence rates fall dramatically with the use of ITNs (Abebe Animut et al., 2014).

Past malaria prevalence studies show mixed findings with respect to sex and age. Researchers were found no association (Graves et al., 2009) whereas others were reported more prevalence on men than on women. Furthermore, possession of ITNs does not guarantee of appropriate utilization. According to Rebecca and Sani outcome was reported only 57.7% of ITNs were put into use (Rebecca Samuel and Sani Abdullahi, 2014).

2.6.1. Knowledge of bed net

According to Zewdneh Tomass et al., (2011), there was no significant difference among the responses provided by the different age groups of the interviewees to knowledge, attitude and practice (KAP) variables including knowledge on the role of ITNs in malaria prevention, mode of malaria prevention by ITNs, priority groups to sleep under ITNs in the family, when and where to use ITNs, other benefits of ITNs in the household and interest to buy ITNs if supplied. Similarly, the responses provided by male and female household heads to KAP variables including knowledge on the role of ITNs in malaria (Zewdneh Tomass et al., 2011).

According to the finding in Dejen woreda of Amhara region concerning knowledge about ITNs, prevention mechanisms had showed that majority of the respondents believed that ITN prevents malaria infection. Their study also indicated that all the respondent have knowledge of mosquito net. So awareness about ITN is high in this study area such (Abeje Kassie et al., 2014).

Awareness of the study subjects to associate mode of malaria prevention by ITNs via protection from mosquito bites is much higher but lower in a similar study carried out in other parts of Tigray, Mereb Lake and Tselemti (Abebe Animut et al., 2008).

However, the result of studies was showed that participants didn׳t have sufficient knowledge regarding vulnerability of pregnant women to malaria in terms of prioritizing them for ITN use in the household (Abebe Animut et al., 2008; Zewdneh Tomass et al., 2011).

Based on the study of Yamrot Debela on students, malaria related knowledge and child to parent communication regarding prevention and control of malaria. Although the student's perception that stagnant water as direct cause of malaria seem incorrect but it could be risk factor for malaria as it is breeding site for mosquito. Despite this fact, this perception of the student as direct causes of malaria may influence the actual prevention method they may choose (Yamrot Debela et al., 2014).

2.6.2. Utilization of bed net

The study of Abebe Animut suggested that Insecticide Treated Net (ITN) usage is increased in Ethiopia and large-scale distribution is underway to cover malarious areas. In his study showed, the overall distributional coverage and utilization of LLITNs was high (Abebe Animut et al., 2008). This implies that the net distribution program is going well and has attained the Roll Back Malaria and World Health organization targets (WHO, 2000; WHO, 2005).

This higher utilization, within a short period of experience, edicts the great role played by the FMoH and acceptance of nets by users as a major malaria control tool. However, most households had a single net and on average four individuals shared a single net. Most parts of the country are epidemic prone and households require extra nets to reduce the occupant per net gap in order to attain sustainable control of the disease (WHO, 2000; WHO, 2005).

The finding of researchers showed that the following socio-economic factors are related to malaria risk:- construction material of walls, roof and floor of house; main source of drinking water; time taken to collect water; toilet facilities and availability of electricity (Crookson et al, 2006; Dawit Ayele et al., 2015). Besides socio-economic factors, there are demographic and geographic factors that also had an effect on the risk of malaria. These include gender, age, family size and the region where the respondents lived (Dawit Ayele et al., 2015).

In a recent study reported that illiterate individuals were more prone to malarial infection than those who received formal education (Abeje Kassie et al., 2014). This might be due to low awareness about the malaria control mechanism and the improper handling of ITNs. Malaria is still a major public health issue among pregnant women mainly due to illiteracy and non-compliance to using ITNs. Increasing awareness about malaria preventive measures and early attendance of antenatal care services will help to reduce malaria and, consequently, its associated morbidities and mortalities (Abeje Kassie et al., 2014; Sani et al., 2015).

3. MATERIALS AND METHODS

3.1. Description of the study area

This study was carried out in Benishangul-Gumuz Regional State which is one of the nine regional states established in 1994 by the new constitution of Ethiopia that created a federal system of governance. The region is located in the western part of the country between 09.17° - 12.06° North latitude and 34.10° - 37.04° East longitude. The regional capital, Assosa, is located at a distance of 687 km west of Addis Ababa (BoFED, 2004) (Figure 1).

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Traditional agroecologies indicate about 75% Kolla (lowlands below 1500 meter above sea level (masl), 24% Woina Dega about (midland between 1,500-2,500 masl) and 1% Dega about (highland above 2,500 masl) (BoFED, 2004).

This study was conducted in Yaso district, which is one of the twenty districts, located in Kemashi zone, Benishangul Gumuz regional state, western Ethiopia. It is situated 318 km East of Assosa town and 599 km west of Addis Ababa, the capital city of Ethiopia. Its altitude ranges from 1200 to 2000 meters above sea level, i.e., Yaso district is considered as semi-arid and much of the area is arid, annual temperature rises to 35°C. Average rainfall ranges from 1700 to 1800 mm (YADO, 2013). In 2014, the total population in the woreda was 26,012 (12,746 male and 13,266 females) (YHO, 2014) (Figure 1)

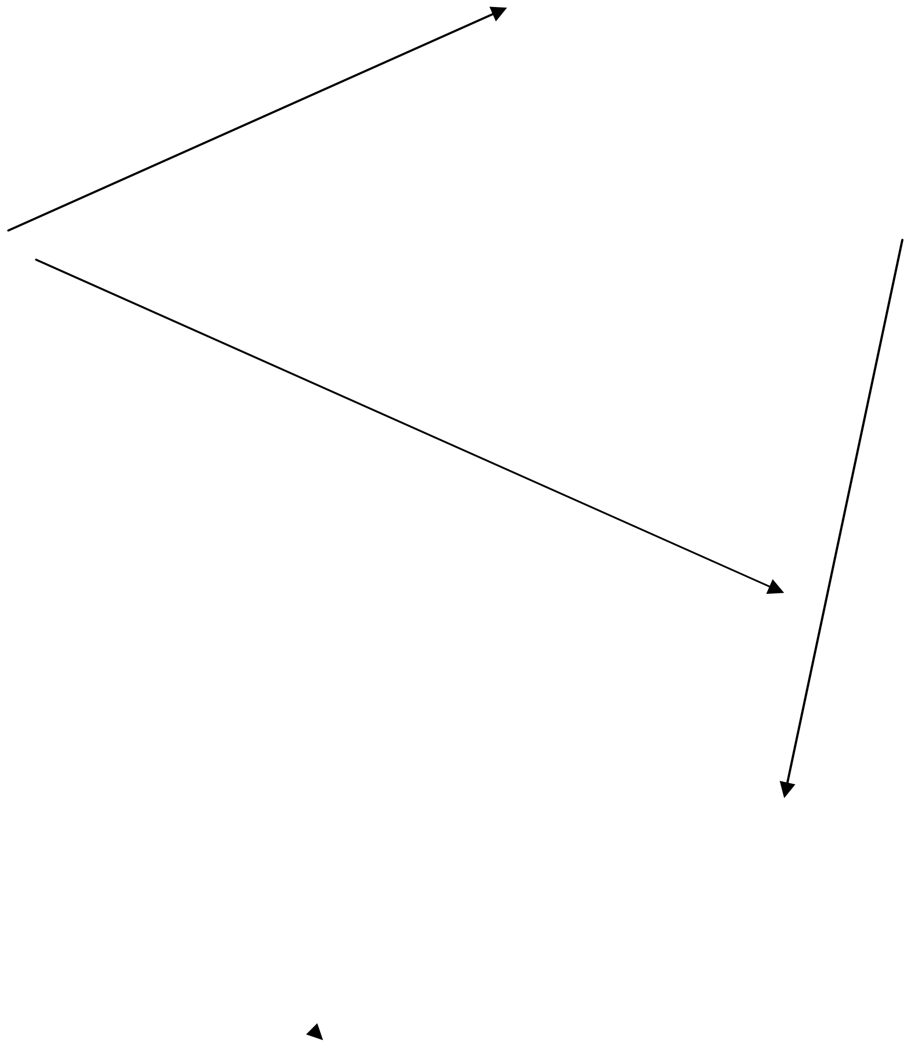

Figure 1 Map of the study area

Source htt://www.ochaeth.org/Maps/downloadables/BENESHANGUL.pdf

3.2. Sampling design

Simple random sampling procedure was adopted to select representative families from the district. Easily reached villages to roads were included in the study. Villages were categorized as hotspots or better places in terms of malaria. A total of 384 families were studied. The malaria history of all members in the family was recorded.

3.3. Sample size

Sample size was determined by using the formula (Daniel, 1999)

$$n = \frac{Z^2 * P(1-P)}{D^2}$$

Where n =sample size of the study

Z=standard number for the level of confidence (95%)

P=expected prevalence

D=marginal error. The prevalence of malaria was not known in the study area. Therefore, an expected prevalence value of P=50% was taken. This prevalence gave a sample size of 384 at 5% margin of error.

The study group was stratified once and the design effect was taken to be 1; the total sample was 1x384= 384, 10% contingency was considered =38 subjects, which gives a total of 422 study subjects.

3.4. Data collection

Several explanatory variables were chosen to determine if they contributed for the occurrence of malaria. A total of 384 people were requested to complete a questionnaire prepared for this purpose (Appendix 1).

The explanatory variables included age, sex, residence, religion, occupation, education level of the respondents, number of insecticide treated bed nets in the house (ITN), who in the house was using ITN, if ITN was used properly or not, and period of utilization (Table 1). The outcome variable was a dichotomous variable with two possibilities (illness or healthy). It was also broken down to plasmodium species when found infected.

3.4.1. Parasitological techniques

Plasmodium infection was checked from blood film by pricking the finger using blood lancet. Thick and thin blood smears were taken on the same slide. Thin films were fixed with 100% methanol and both thin and thick films were stained in the same slide with 3% Giemsa solution at health facility following a standard World Health Organization protocol (Garcia, 2001). Thick films were using high power magnification (100%) for the presence of plasmodium parasites. Then, parasite positivity was determined from thick smear and species identification was carried out from thin smear slide preparations. Examination for parasites was carried out by using light microscope and rapid diagnostic test by laboratory technician.

3.4.2. Ethical Consideration

Primarily, ethical clearance was obtained from science college, Bahir Dar University. Formal letter was written to Yaso district from Department of Biology. All respondents were asked for their willingness to be involved in the study. Data collectors put their signature for they had informed verbal agreement for the interview and blood film test. In regard to ethical consideration, the right of individuals and institutions were respected. The researcher first sought agreement of all the respondents prior to the interviews and respondents were assured confidentiality of the responses and that information would not be used for anything else other than of the study.

Table 1 List of explanatory variables with levels denoted with dummy variables

Explanatory variable	Categories and assigned dummy variables
Age	<5 years old =0
	5-14 years old=1
	>15 years old =2
Sex	Female =0
	Male =1
Residence	Urban =0
	Rural =1
Religion	Christian =0
	Muslim =1
Occupation	Government employee =0
	Merchant =1
	Daily laborer =2
	Farmer =3
	Other =4
Education	Higher institution =0
	Secondary school =1
	Elementary school =2
	Read and write =3
	Illiterate =4
ITN user	Mother =0
	Mother and children =1
	Wife and husband =2
	All family members =3
Number of ITN in the house	More than two =0
	Two =1
	One =2
Period of ITN use	All year round =0
	During rainy season =1
	During dry season =2
	Other =3
Proper use of ITN in the house	Yes =0
	No =1

3.5. Statistical analysis

Data were collected using structured questionnaires, analyzed using SAS for windows version JMP 5.0.1 software. The probability of falling ill (outcome variable) was regressed against groups of explanatory variables using multiple logistic regression. Because there were several explanatory variables associated with the outcome variable, odds ratios were calculated for each of them separately.

The odds ratio is denoted as P/1-P , i.e., the probability of an event occurring, in the present case illness due to malaria, over the probability of the event not occurring, i.e., healthy.

The joint effect of all independent (explanatory) variables put together may be expressed mathematically as: Odds P/1-P= • $e^{(ˆ + ,1x1 +,2x2+€€€..,p\ xp)}$ (1)

Where e=2.718282

ˆ=intercept

$,_{1}$=coefficient of variable 1

$,_{2}$=coefficient of variable 2, etc.

The term log P/1-P was referred to as logarithmic transformation of the probability P, and was written as logit (P). Transforming the counted proportion P (many successes out of many trials or subjects) to logit got rid of the drawback of probability which varied from 0 to 1, whereas the logit could vary from -% to +%, therefore, the natural logarithm of

P/1-P=logit (P)=ˆ+, $_{1}x_{1}$+, $_{2}x_{2}$+€€€€€€€€€€€., $_{p}x_{p}$ (2) was sketched.

In equation 2, with this two possible outcomes of presence (coded 1) and absence (coded 0) of malaria on the subject under study, ˆ represented the overall disease risk, $,_{1}$ denoted the fraction by which the risk increased (or decreased) by every unit change in X_1, and $,_{2}$ was the fraction by which the disease risk was altered by a unit change in X_2, and so on. The independent variables were qualitative and quantitative for which dummy variables were assigned.

Using this regression, parameters were estimated such that the coefficients made observed the results most likely, the method known as maximum likelihood.

The logit of a proportion P is the logarithm of the corresponding odds. If an X variable had a coefficient,, then a unit increase in X increased the log odds by an amount equal to ,. This meant that the odds themselves increased by a factor of e.

The independent variables were grouped into two, the first group was socio demographic variables and the second was insecticide treated net (ITN) utilization variables. Logistic regression was invoked separately for the two groups.

4. RESULTS AND DISCUSSION

4.1. Results

The current study revealed that about 40% of the study subjects were found positive for P.falciparum (Figure 2). Falciparum, vivax and mixed infections accounted for 74.5% of the study subjects.

Figure 2 Percentage infection for all Plasmodium species (n=384)

4.1.1. All Plasmodium species

Out of the total of 384 subjects studied, 74.5% (286) responded to have had malaria experience of some kind.

According to the results of the logistic regression, the overall model showed that there was significant association between malaria illness and at least one of the explanatory variables (χ^2_6=271.93, P<0.0001).

The lack of fit model also revealed that the logistic model described the data well enough (Prob<Chisq=0.658). If P value was lower than 0.05, it could be concluded that the model was unfit for the data.

Socio-demographic variables

When the socio-demographic variables as explanatory variables were considered, education level, and age appeared to be significant beneficial factors because they had OR lower than 1 and negative , values (Table 2). On the other hand, occupation status (OR=4.34, P=0.0146) was a significant risk factor. A non-significant risk factor was sex (OR=1.7, P>0.05) and non-significant beneficial factors included residence (P=0.28) and religion (P=0.10) (Table 2).

Although there was no clear distinction between sexes in relation to infection rates by different Plasmodium species, falciparum appeared to attack men more than women (Figure 3a); vivax prevalence was slightly more in rural residents than urban dwellers (Figure 3b); religion did not show discernible pattern (Figure 3c); subjects older than 15 years were more susceptible but not statistically significant (Figure 3d); better utilization of bed nets was observed on people who were better educated and that contributed for less malaria incidence (Figure 3e). Malaria attack was lower on merchants than on daily laborers, farmers, government employees and others (Figure 3f).

Figure 3 Socio-demographic variables with respect to *Plasmodium* species infection levels (n=384). (a) Sex, b) Residence, c) Religion d) Age, e) Education

Insecticide treated nets utilization

Proper utilization and period of utilization tended to reduce malarial infections but were not significant (P>0.05) (Table 2) Bed net utilization improved with the level of education rising (Figure 4).

Table 2 Logistic regression between malaria occurrences caused by any spe Plasmodium against selected explanatory variables.

Parameter	Estimate	Std Error	Wald ChiSquare	Prob>ChiSq	Odds Ratio
		Socio-demographic variables			
Intercept	2.24	0.54	17.01	<.0001	-
Sex	0.51	0.42	1.47	0.23	1.67
Residence	-0.47	0.43	1.16	0.28	0.63
Religion	-0.90	0.54	2.73	0.10	0.41
Occupation	0.37	0.15	5.97	0.01	4.34
Education	-1.80	0.19	89.39	<.001	0.00
Age	-0.60	0.28	4.52	0.03	0.30
		Insecticide treated net utilization			
Intercept	-0.54	0.37	2.15	0.143	-
Number of ITN	0.38	0.20	3.54	0.060	2.15
User of ITN	0.07	0.11	0.39	0.535	1.23
Proper utilization	-13.18	54.65	0.06	0.810	0.00
Period of utilization	-0.28	0.22	1.65	0.199	0.57

Proper utilization bed nets steadily improved with the level of education (Figure 4). The number of people in each level was different and percentages were computed on that basis. Proper use slightly increased between illiterate and elementary school, but dramatically improved from high school onwards.

Figure 4: Effect of education level on the quality of bed net utilization

4.1.2 Mixed *Plasmodium* species (*P. falciparum* and *P. vivax*)

Socio-demographic variables

When the socio-demographic variables as explanatory variables were considered, residence and education level had significant beneficial (reducing) roles in malaria incidence (P<0.05). Religion had the same beneficial role but it was not significant. Sex, occupation and age were non-significant risk factors (Table 3).

Insecticide treated nets utilization

Proper utilization of nets had significant beneficial role against malaria incidence (OR=0.02, P<0.02). Other variables except number of ITN were also beneficial risk factors but they were not statistically significant (Table 3).

Table 3 The results of logistic regression between malaria occurrence caused by (falciparum and vivax) Plasmodium against selected explanatory variables

parameter	Estimate	Std Error	Wald ChiSquare	Prob>ChiSq	Odds Ratio
		Socio-demographic variables			
Intercept	3.50	0.67	27.28	<.0001	.
Sex	0.59	0.37	2.57	0.109	1.80
Residence	-0.90	0.36	6.19	0.012	0.41
Religion	-0.26	0.43	0.37	0.542	0.77
Occupation	0.19	0.11	2.87	0.090	2.12
Education	-0.57	0.16	12.37	0.000	0.10
Age	-0.09	0.20	0.23	0.632	1.21
		Insecticide treated net utilization			
Intercept	2.31	0.47	24.01	<.0001	.
Number of ITN	0.24	0.23	1.05	0.305	1.61
User of ITN	-0.12	0.13	0.80	0.370	0.70
Proper utilization of ITN	-0.77	0.32	5.71	0.017	0.46
Period of utilization	-0.13	0.24	0.28	0.596	0.77

4.1.3 Infection by P.falciparum species

Socio-demographic variables

Looking at the contribution of individual explanatory variables for infection by falcipharum species, only two of the explanatory variables were significantly associated to the outcome variable (illness). The parameter estimates for residence and education level were significant (P<0.05) (Table 4). Higher odds ratio was recorded for residence [OR=1.97]. Residence and education were significantly associated with malaria occurrence by Plasmodium falciparum parasite.

Insecticide treated net utilization

Proper utilization of nets had significant beneficial role against malaria incidence because odds ratio was less than 1 and value was negative (OR=0.36, P<0.001) (Table 4). Other variables did not contribute significantly.

4.1.4. Infection by P.vivax species

Socio-demographic variables

Looking at the contribution of individual explanatory variables, four of them were significantly associated to the outcome variable (illness). Therefore, the parameter estimates for education level, age and sex were significant (P<0.05) (Table 5). Higher odds ratio was recorded for occupation. Beneficial factors include sex, residence, religion, education and age, but not occupation.

Table 4 The results of logistic regression between malaria occurrences caused by Plasmodium falciparum against selected explanatory variables

Parameter	Estimate	Std Error	Wald ChiSquare	Prob>ChiSq	Odds Ratio
			Socio-demographic variables		
Intercept	1.88	.38	24.97	<.0001	-
Sex	0.20	0.24	0.68	0.410	1.22
Residence	0.68	0.24	7.74	0.005	1.97
Religion	0.24	0.32	0.59	0.444	1.28
Occupation	0.03	0.08	0.15	0.695	1.14
Education	-0.62	0.09	43.87	<.0001	0.09
Age	-0.24	0.15	2.66	0.103	0.62
			Insecticide treated net utilization		
Intercept	0.63	0.32	3.99	0.0458	-
Number of ITN	0.11	0.16	0.48	0.4891	1.25
User of ITN	0.07	0.09	0.69	0.4047	1.25
Proper utilization	-1.03	0.22	22.26	<.0001	0.36
Period of utilization	0.06	0.17	0.13	0.7160	1.13

Insecticide treated net utilization

The study individuals used nets all year round. According the records, a little more than half (53.4%) of the study subjects used bed nets daily; 47.7% of them used insecticide treated nets all year round. Proper utilization and period of utilization were significant beneficial factors while the other two, i.e. number of ITN and use of ITN were risk factors, but were not significant.

Table 5 The results of logistic regression of malaria occurrence caused by *Plasmodium vivax* against selected explanatory variables

Parameter	Estimate	Std Error	Wald ChiSquare	Prob>ChiSq	Odds Ratio
			Socio-demographic variables		
Intercept	3.22	0.47	45.99	<.0001	-
Sex	-0.57	0.26	4.70	0.030	0.57
Residence	-0.33	0.27	1.58	0.210	0.72
Religion	-0.86	0.32	7.37	0.007	0.43
Occupation	0.02	0.09	0.03	0.866	1.06
Education	-0.35	0.10	11.38	0.001	0.24
Age	-0.35	0.17	4.26	0.039	0.50
			Insecticide treated bed nets utilization		
Intercept	1.78	0.38	21.39	<.0001	-
Number of ITN	0.07	0.19	0.15	0.702	1.16
User of ITN	0.06	0.10	0.30	0.582	1.19
Proper utilization	-0.94	0.26	13.51	0.000	0.39
Period of utilization	-0.38	0.19	4.01	0.045	0.46

4.2. Discussion

Malaria is one of the leading causes of morbidity and mortality in Ethiopia. It is a major community health problem in Ethiopia. Over the past years, the disease has been consistently reported as the first leading cause of outpatient visits, hospitalization, and death in health facilities across the country (Wakgari Deressa *et al.*, 2011; PMI, 2014).

In the current study, about 75% of the study subjects were found infected, about 40% of them by *P. falciparum*. Only about 25% were found free. This showed decline in malaria prevalence reported in Kemashi Zone before 11 years which was 85% (World Bank, 2004). This result was higher than similar studies done other parts of Ethiopia (Wakgari Deressa *et al.*, 2011; Abebe Alemu *et al.*, 2012; Andargaie Abate *et al.*, 2013; Belayneh Regasa, 2014). This difference might be due to altitude variation and climatological difference that may contribute to a great role for breeding of *Anopheles* vector. The predominant *Plasmodium* species detected was *Plasmodium falciparum*, followed by *Plasmodium vivax*. This was consistent with other previous studies (TCC, 2013; PMI, 2014; Belayneh Regasa, 2014; Fissiha Yimer *et al.*, 2015). But other a studies reported that the most prevalent species was *Plasmodium vivax*, followed by *Plasmodium falciparum*. That means prevalence can be location specific (Andargaie Abate *et al.*, 2013; Abeje Kassie *et al.*, 2014).

As education level increased, the knowledge of people towards risk factors and income improved which may contribute for less prevalence of malaria. Some (67%) in Pawe area had no formal education and were unable to read and write (Habtamu Bedimo *et al.*, 2015). But a similar study was carried out in other districts (Menge, Bambasi and Assosa) which showed that about 80% of participants had attended formal education. Among this 19.4% were indigenous peoples of the region (Yared Legesse *et al.*, 2007). Other studies showed that study subjects were illiterate farmers (Abebe Animut *et al.*, 2008; Zewdneh Tomass *et al.*, 2011; Abeje Kassie *et al.*, 2014). They were unlikely to use bed nets as government employees, merchants and others did (Girma Desta *et al.*, 2015).

More than half of the study participants were rural residents (50.8%) and illiterate (40.6%) who increased the odds ratio of the occurrence of the mixed species of *Plasmodium*. This might be low malaria control intervention practice (Alemayehu Gutasa *et al*., 2015) and improper hanging of ITN. This study corroborates results of other studies regarding educational status and residence; illiterate participants and rural occupier were more infected by malaria, respectively. Improper utilization of bed net enhances the incidence of *Plasmodium* infection (Abeje Kassie *et al*., 2014).

Also as age increases from childhood to adulthood, immunity improves helping the patient to overcome malarial infections. The overall malaria prevalence among the households with children under five years of age was 20.8%. This was lower than reports from Nigeria (24.4%) (Rebecca Samuel and Sani Abdullahi, 2014) ITN utilization was higher in Nigeria (57.7%) (Rebecca Samuel and Sani Abdullahi, 2014) than the present study (53.7%) but lower than other reports from Oromia and Amhara regions (63.4% and 62.4%, respectively) (Wakgari Deressa *et al*., 2011).

Reducing under-five mortality rate remains a major concern for countries especially the developing countries. A lower under-five mortality rate is an indication of an improved child well-being as well as the coverage and success of child survival intervention programme. The Millennium Development Goal 4 (MDG 4) specifically draws the world's attention to the need to reduce under-five mortality rate by two-thirds between 1990 and 2015. The World Health Organization (WHO) reported that about 6.3 million children under age five died worldwide in 2013, while about 17,000 under-five children die every day (WHO, 2013).

Furthermore, participants below 14 years old in this study (52.3%) were more susceptible to malaria compared to those 15 years and above. In Cameron as high as 87.6% was reported (Tobias *et al*., 2015). This may be linked to the way people share sleeping structures in a household. In contrast, a study in Dejen district, Ethiopia, revealed prevalence was higher on individuals older than 15 years (Abeje Kassie *et al*., 2014). When there are only a limited number of ITNs, it could be that priority is given to the younger children, or as the children grow older. Family size also matters whereby as the ratio of nets/family increases, the use of mosquito nets improves (Khan et al., 2008; Eisele et al., 2009).

All the 384 study subjects had insecticide treated nets; 194 (50.5%) possessed one, 151 (39.3%) possessed two and 39 (10.2%) possessed more than two ITNs. This finding was the highest ITNs possession which was regularly reported in south-central Ethiopia (Fissiha Yimer et al., 2015). In yet the previous studies (Zewdneh Tomass et al., 2011; Sibhatu Biadgilign et al., 2012; Rebecca Samuel and Sani Abdullahi, 2014) two-thirds of the study group had insecticide treated nets. This implies that the net distribution programme is very much on progress and had attained the MDG (millenniums development goal) target of 100% of ITNs coverage (TCC, 2013; PMI, 2014; WHO, 2015).

In this study all the net was acquired through donation to address MDG. In a similar study in south-central Ethiopia, 98.7 % of the study subjects possessed ITNs (FMoH, 2012; Fissiha Yimer et al., 2015). In contrast, other reports claimed that 60.5% of the nets were endowed by the local health authorities freely and among the remains only 24.6% nets were purchased from the market (Ayalew Aistatke and Amsalu Feleke, 2009; Lelisa Sena et al., 2013).

Regarding the pattern of bed net utilization, 53.4% of the respondents reported correct use of ITNs (all year round and all family members slept under net). This is lower than the result (69.9%) reported in Pawe district of this region (Habitamu Bedimo et al., 2015). This study report was higher (88.8%) bed net use while sleeping (Fissiha Yimer et al., 2015). However, this was higher than the result reported in Assosa zone of other area of the study region (Yared Legesse et al, 2008). Differences may come from differences in environmental factors like period of the study, hot weather, absence of mosquito nuisance, and the local community socio-cultural factor.

Other researchers reported that 58% of nets were utilized (Sani et al., 2014). Proper use of bed nets help to reduce malaria incidence. Malaria could be eliminated if 75% of the population were to use bed nets (Folashade et al., 2015). Possession and appropriate utilization of ITNs do not automatically go hand in hand (Sani et al., 2014; Folashade et al., 2015)

Bed nets reduced prevalence by 60.7% across age groups. However, the specific procedures of net treatment were not recorded. Given the relatively higher prevalence of infection through older childhood and into adulthood, it is important to recognize the need to provide ITN to all members of a community and not focus only on young children in areas of low transmission (Abdisalan et al., 2008; Abeje Kassie et al., 2014) This resounds with recent calls for high coverage among all community members across the range of transmission settings (Killeen et al., 2007) where it is also recognized that individuals older that five years contribute to transmission.

The evidence on the public health impact supporting the wide- scale use of insecticide treated nets (ITNs) in Africa is drawn from areas of stable malaria transmission where Plasmodium falciparum infection prevalence in the community is often over 40% (Phillips-Howard et al., 2003; Lenger, 2009). There is a scarcity of parasitological or health impact data on the benefits of ITN in Africa that support low stable or unstable transmission.

The current study showed all individuals had awareness of ITNs. Other researchers have reported 60% awareness of ITNs (Gashaw Dagne and Wakgari Deressa, 2008; Gashaw Tesfa, 2012) and (Zewdneh Tomass et al., 2011) 82.3% of the respondents had awareness about the role of ITNs that it prevents against mosquito bite while sleep. Some 77.3% of those owning ITN used their nets consistently throughout the year (Ayalew Asitatke and Amsalu Feleke, 2009).

Education level and knowledge about malaria transmission were some of the noteworthy reasons affecting usage of ITNs. Knowledge on transmission of malaria was different among educated and illiterate individuals. Educated individuals had knowledge about malaria and with high level of ITN usage (Harrysone et al., 2011).

4.3. Conclusion

In conclusion, the current study underpinned that ITN possession mattered in malaria occurrence. There was also high awareness of the role of ITNs of the subjects. Sleeping under bed net was the common malaria prevention measure reported. But a gap of appropriate utilization of bed net was identified. Despite the high awareness towards bed nets, there were still gaps about malaria prevention strategies, i.e., utilization of bed nets. Education had a significant role to use bed nets properly for preventing against mosquito bite while sleeping. Age and residence of the subjects also influenced bed net utilization directly or indirectly for reduction of the overall malaria burden.

In this study 46% of the ages above 15 years were susceptible to malaria incidence in the area. Since highest malaria transmission often overlaps with the planting and harvesting season and there was malaria incidence among working age group and working adults in agrarian communities. This implied a heavy economic burden in the region as well as to the country. So the mode of ITNs distribution must be altered. The distribution of ITNs carried with in school while seeking awareness about proper utilization instead of mass campaign. The HEWs follow up the proper hanging and utilization of the agrarian communities house to house.

4.4. Recommendations

- Finally, it is recommended that health education activities about the benefit and utilization of ITNs to the population must be launched
- Effective Information, Education and Communication (IEC) should be promoted to improve and sustain ITNs programme.

- Collaboration with stakeholders i.e. community health workers (CHW), teachers in school and others, health education in relevant places to enrich proper bed net practice must be advocated.
- The government should strengthen, support with facilities and follow implementation of adult education in the area also strengthen women health development army which encourages malaria preventive interventions practice, i.e., proper ITN utilization.

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Annex

Annex 1 KAP Questionnaire

KAP Questionnaire

Note that: The English version translated in to Amharic

Title: assessment of the proper utilization of ITNs and the prevalence of malaria, in Yaso district, Benishangul Gumuz Region State of Ethiopia.

A. Area identification
    1. District€€€€€€ €€
    2. Kebele€€€€€€€€.
    3. Goti/ketene€€€€€€.
    4. Name€€€€€€€€..
    5. Sex€€€€€€€€€.
    6. Age€€€€€€€€€.
    7. Occupation€€€€€€
    8. Religion€€€€€€€..
    9. Education (illiterate€€.read and write only€€elementary school€€ high school€..higher institution€€.

B. KAP questionnaires (underline on your reaction)

I. Do you know ITN? Yes/no

II. Do you have ITN in your home? Yes/no

III. If yes, how did you obtain the ITNs? Free of fee/ with payment

IV. How many ITNs do you have?

V. Do you use ITNs properly? Yes/no

VI. Who usually sleeps under the net at night? Mother/mother and child/husband and wife/all family

VII. When do you sleep under the net? All year/only during rainy season/during winter

VIII. Does sleeping under ITN reduce the risk of getting malaria? Yes/no

IX. Have you ever experienced malaria or fever? Yes/no (adopted from Abeje Kassie et al., 2014)

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Appendices

Appendix 1 Knowledge, Attitude and Practices of study subjects towards ITNs

Table 6 Knowledge, Attitude and Practices of study subjects towards ITNs

KAP Variables		Frequency	Percent
Proper utilization of ITNs	Properly utilized	20	53.3
	Improperly used	179	46.6
User of ITNs	Mother	106	27.6
	Mother and child	87	22.7
	Husband and wife	51	13.3
	All family	140	36.5
Period of utilization	All year round	183	47.7
	During rainy season	166	43.2
	During winter	35	9.1
Source of ITNs	Freely donated	384	100.00
	With payment	0	0
Awareness about ITNs	Yes	384	100.00
	No	0	0
Ownership of ITNs	Yes	384	100.00
	No	0	0
Number of ITNs possessed p household	One	194	50.5
	Two	151	39.3
	More than two	39	10.2
ITNs prevent malaria	Yes	298	77.6
	No	86	22.4

Appendix 2 Socio-demographic variables with respect to Plasmodium species (n=384)

Table 7 Socio-demographic variables with respect to Plasmodium species (n=384)

Socio-demographic variables		Falciparum	Vivax	Mixed	Negative	Total
Sex	Male	97	46	36	47	226
	Female	54	41	12	51	158
Residence	Rural	73	57	35	30	195
	Urban	78	30	13	68	189
Religion	Christian	131	65	39	84	319
	Muslim	20	22	9	14	65
Age	<5	35	19	12	14	80
	5-14	20	12	11	78	121
	>15	96	56	25	6	183
Education	Higher institution	2	0	0	66	68
	secondary school	2	1	0	25	28
	Elementary school	36	23	9	0	68
	Reading /writing	32	26	5	1	64
	Illiterate	79	37	34	6	156
Occupation	Government employee	28	18	12	18	76
	Merchant	21	11	8	11	51
	Daily laborer	5	3	1	3	12
	Farmer	72	30	17	48	167
	Other	25	25	10	18	78