

**Malaria Prevention in Vulnerable Groups:
Literature Review to Identify Determinants and
Interventions to Promote Mosquito Net use in
Ethiopia**

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Ethiopia

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Malaria Prevention in Vulnerable Groups: Literature Review to Identify Determinants and Interventions to Promote Mosquito Net use in Ethiopia

A thesis submitted in partial fulfilment of the requirement for the degree of Master of Public Health

By

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Declaration:

Where other people's work has been used (either from a printed source, internet or any other source) this has been carefully acknowledged and referenced in accordance with departmental requirements.

The thesis **Malaria Prevention in Vulnerable Groups: Literature Review to Identify Determinants and Interventions to Promote Mosquito Net use in Ethiopia** is my own work.

Signature-----

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Dedication

I dedicate this work to my wife Zenebech Medhin and My daughter Feben.

Acknowledgment

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I would like to thank the Netherlands Government for providing me scholarship through Netherlands Fellowship Programs/NFP/ to study at Royal Tropical Institute (KIT), Amsterdam.

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Abbreviations

A.	Anopheles
AMP	Alliance for Malaria Prevention
AMREF	African Medical and Research Foundation
AOR	Adjusted Odds Ratio
BCC	Behavioural Change Communication
CI	Confidence Interval
CSA	Central Statistical Agency
EFY	Ethiopian Fiscal Year
EHNRI	Ethiopian Health and Nutrition Research Institute
EMA	Essential Malaria Actions
EMoH	Ethiopian Ministry of Health
EPHI	Ethiopian Public Health Institute
FHC	Family Health Card
FMOH	Federal Ministry Of Health
GDP	Gross Domestic Product
GGFRC	Gilgele Gibe Field Research Centre
GGHD	Gilgele Gibe Hydroelectric Dam
HDA	Health Development Army
HEP	Health Extension Program
HEWs	Health Extension Workers
HIV/AIDS	Human Immuno Deficiency Virus/Acquired Immuno Deficiency Syndrome
HSDP	Health Sector Development Program
IEC	Information Education and Communication
IRS	Insecticide Residual Spray
ITNs	Insecticide Treated Nets
LLINs	Long Lasting Insecticidal Nets

LLITN	Long Lasting Insecticide Treated Net
MDG	Millennium Development Goal
MIS	Malaria Indicator Survey
MoFED	Ministry of Finance and Economic Development
MOH	Ministry Of Health
MTN	Malaria No More
OR	Odds ratio
P.	Plasmodium
PSA	Public Service Announcements
RBM	Roll Back Malaria
RDT	Rapid Diagnostic Test
RHB	Regional Health Bureau
SMS	Short Message Service
SNNPR	Southern Nations, Nationalities and People's Region
UNICEF	United Nations Children's Fund
USD	United States Dollar
WHO	World Health Organizations

Glossary

1. **Vulnerable groups:** under five children and pregnant women are considered as vulnerable groups in this study
2. **Mosquito nets:** in this study mosquito net refers to Insecticidal treated nets (ITNs) and Long lasting insecticide treated nets (LLIN/LLITNs).
3. **Information education and communication (IEC):** is 'the process of providing knowledge to help individuals' (RBM 2012).
4. **Behavioural change communication (BCC) :** 'The process of using communication to encourage continues positive behaviour; BCC works by influencing social norms, perception of risk, self-efficacy and, increasing knowledge, encouraging dialogue and promoting services' (AMP 2012).
5. **Plasmodium:** 'A genus of protozoan vertebrate blood parasites that includes casual agents of malaria. Plasmodium falciparum, p. malariae, p.ovale and P.vivax cause malaria in humans. The human infection with monkey malaria parasite, p. knowlesi has been reported in forest regions of South-East Asia' (WHO 2015b).

Abstract

Background: Malaria is second cause of morbidity and the sixth cause mortality in Ethiopia in 2012/13 and about 52 million people live in malaria endemic areas. Mosquito nets are used as major vector control methods for malaria prevention but approximately 35% of under five children and 36% of pregnant women in Ethiopia did not sleep under mosquito nets.

Objectives: Identifying the main determinants of mosquito net use by under-five children and pregnant women in Ethiopia, and identifying interventions that have promoted the use and find out the effective working mechanisms of these interventions.

Methodology: The study was accomplished by literature review. The adapted Anderson's 1995 behavioural model of health service use was used as guide for identification of determinants.

Findings: Health belief was identified as most likely to influence mosquito net use. Low awareness, perception and attitude towards mosquito net, and limited knowledge of households on mosquito net use are key determinants. Under-five children and pregnant women living with large families and from poor, uneducated, rural households are less likely to use. Moreover, unavailability, colour and shape of mosquito nets, gender inequity, seasonality of malaria, and housing structure are affecting mosquito net use. Furthermore, the study found lack of targeted health promotion interventions for under five children and pregnant women's mosquito net use in Ethiopia.

Conclusions and recommendations

Strengthening health promotion interventions addressing the identified determinants is important. The Night watch campaign and hang up home visit should be adapted to Ethiopia context to improve mosquito net utilization among vulnerable groups.

Key words: Ethiopia, malaria, mosquito net use, health promotion, under-five children and pregnant women,

Word count 12,683

Introduction

I have a bachelor degree in environmental health and have been working in the health sector for the last eight years at Woreda (District) Health Office and at the national level, at the Ministry of Health. In these years, I have experienced the challenges faced due to malaria in Ethiopia. When I was in the District Health Office as head of the office, we were distributing mosquito nets to malaria endemic 'kebeles' and conducted supportive supervision whether households were using mosquito nets or not to prevent malaria. The nets were not used properly and I was asking myself why that happened.

At the Ministry of Health, I was involved in malaria prevention and control interventions as senior communication officer responsible for malaria and other communicable diseases. As members of national team, I went for supervision to different regions and health facilities where the issue of not using mosquito net was arising as a big challenge.

Ethiopia is one of the countries in Sub Saharan Africa with a high burden of malaria. In the country malaria is the leading cause of morbidity and mortality. The disease mostly affects women and under- five children in the country. Malaria is prevalent in three-quarter of the country's landmass with seasonal and geographic variations. It is the leading cause of death and in 2010 about 4 million cases of malaria were reported country wide with about 1,600 death attributable to malaria (FMOH 2011a).

In Ethiopia following the rain seasons mothers and children were suffering from malaria even if the mosquito nets were distributed and I was asking myself what are the factors influencing mosquito net use? This motivated me to select the current topic malaria Prevention in vulnerable groups: literature review to identify determinants and interventions to promote mosquito net use in Ethiopia.

The first objective of the thesis is identifying by means of literature review the main determinants of mosquito nets use by pregnant women and under-five children. The second objective is identifying interventions that have promoted the mosquito net use and find out the effective working mechanism of these interventions.

The findings of the thesis will inform the Ministry of Health in the production of behavioural intervention to promote mosquito net use by identifying key determinants which should be targeted for the desired behaviour change and by learning from previous interventions.

1. CHAPTER ONE: Background Information of Ethiopia

1.1. Geography and Climate

The Federal Democratic Republic of Ethiopia is located in the horn of Africa and borders with Eritrea, Djibouti, Somalia, Kenya, South Sudan and Sudan. Its total area covers 1.1 million square km. The country has the topographic feature of the highlands up to 4,550m above sea level and lowlands up to 110m below sea level in Afar Depression. Ethiopia has three main ecological zones; 'kolla' which comprises hot lowlands found below an altitude of 1000m, 'woyina Dega' from 1000m to 1500m, and 'Dega' also called cool temperate highlands between 1500 and 3000 m above sea level. The mean annual temperature ranges between 10 to 16 degrees in 'Dega', and 16 to 29 degrees in 'woyina Dega' and 23 to 33 degrees in 'kolla'. The highlands have more rain falls than the low lands (FMOH 2011a).

1.2. Demography

Ethiopia has nine regional states, namely Tigray, Amhara, Oromia, Southern Nations, Nationalities and People's Regional state (SNNPR), Somali, Afar, Benshangul-Gumuz, Gambela, Harari, and two city administrations Addis Ababa, and Dire Dawa. It has the total population of about 87 million of which 83 percent live in rural areas while about 17 percent lives in urban places (CSA 2013). Children under five years old are estimated to be 13.6% of the total population. The average household size in Ethiopia is 4.8 persons (CSA 2014). The major religions are Orthodox, Catholic and Protestant Christianity and Muslim according to the latest census report of Ethiopia in 2007 (CSA 2007). Under-five mortality rate of the country is 88 per 1000 (CSA 2012).

1.3 Education and Media Coverage

Ethiopia has a low literacy level with 38% women of age 15-49 and 65% men of age 15-59 are literate. Literacy rate increases with decreasing age (64% among women aged from 15-19, and 13% for 45-49). In Ethiopia men aged 15-49 are more likely to be literate (67%) than women. Literacy rate is higher among urban women (69%) than rural counterparts (29%) (CSA 2012).

About 50% urban and 2% of rural households in Ethiopia have television while approximately 50% of urban and 31% rural households have a radio. Mobile phone ownership in Ethiopia is about 85% for urban and 40% for rural households (CSA 2014). Media coverage and level of exposure to mass media is also low in the country. For instance, 68% of women and 53% of men aged from 15-49 years are not exposed to any mass media in the country (CSA 2012).

1.4. Socio-economy

Ethiopia’s economy depends on agriculture and agriculture accounts for about 43% of the gross domestic product (GDP) in 2013. Ethiopia has a five year growth and transformation plan which emphasizes on transforming agricultural sector and industrializations. The country has the fastest growing economy among the non-oil producing countries in Africa. The GDP growth rate is 10 percent per annum in the last five years. Ethiopia has the total GDP of 550 USD per capita and still has the least developed economy (MoFED 2014).

1.5 Health System

Ethiopia has the three tier health care delivery systems (see Figure 1 below). The primary level health care system includes health posts, health centres and primary hospitals. Secondary level health care includes the general hospitals providing services for about 1-1.5 million population, and tertiary level includes the specialized hospitals which give services for about 3.5-5 million people (FMOH 2010a). Woreda Health Office is responsible for supervising all activities in primary level health care system and work as a linkage with zonal Health Department (FMOH 2015).

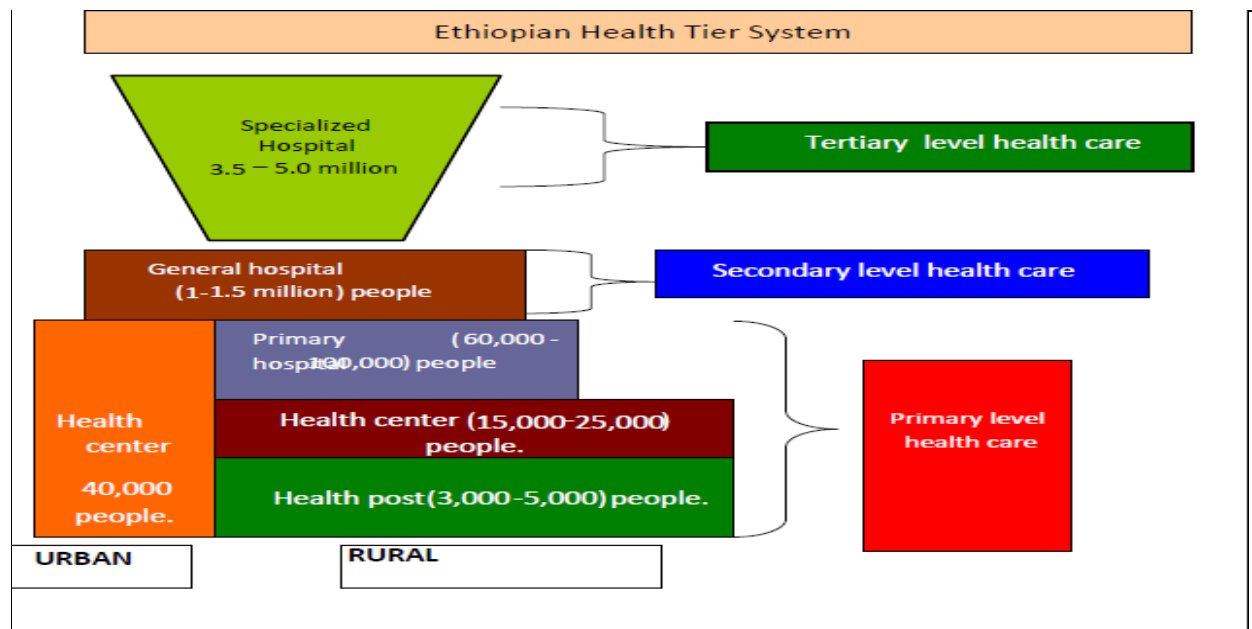


Figure 1: Ethiopian Health Tier system

Source (FMOH 2015)

The country has a flagship health extension program which was introduced in 2005. The health extension program has 16 packages and contributed a lot for the health sector of Ethiopia. There are about 39,000 health extension

workers (HEWs) across the country working at health post level. Ethiopia has about 107,928 health workers in 2013 giving the health work force density of 1.3 per 1000 population. The health work force density of the country is far behind the World Health Organization (WHO) standard of 2.3 per 1000 population (FMOH 2014b). The major health sector priority issues in Ethiopia are prevention and control of HIV/AIDS, Malaria, Tuberculosis, and improving maternal and child health services (FMOH 2010a).

1.6 Health Care Financing

The health care financing in Ethiopia has been known by the low government expenditure for many years. Government expenditure as percentage of total health expenditure accounts for 16% and private sector expenditure comprises about 34% of the total health expenditure. The country's health care financing is donor dependent; donor funds account for 50% of the total health expenditure in the country. The source of financing for health care in Ethiopia includes private sectors, local, regional, and federal governments, loans and grants from donors and non-governmental organizations. The largest amount of money is spent in malaria prevention and control in the country. In 2010/11, 241 million USD was spent on malaria; this accounts for 15 percent of the total national health expenditure in that same period (EMoH 2014).

1.7. Malaria and Its Prevention

The transmission of malaria in Ethiopia mainly occurs at altitude below 2000 meter (m); however, it can affect areas up 2300m. Moreover, the level of risk and transmission intensity in these geographical ranges shows seasonal, inter-annual, and spatial variabilities. These variabilities are because of large difference in climate, topography, human settlement, and population movements (FMOH 2014c).

Ethiopia has unstable seasonal pattern of malaria transmission, because of this protective immunity of the population is low. Children under five years and pregnant women are most vulnerable to the severe effects of malaria, although the populations in all age groups are at risk. Historically there are about 10 million clinical malaria cases annually but since 2006 cases have reduced dramatically (FMOH 2014c)(EHNRI 2012). The interventions that have been implemented contributed to this reduction. Plasmodium (P) falciparum and plasmodium vivax are the most common malaria parasites in Ethiopia. Approximately 77% of all reported malaria cases are due to P. falciparum and the remaining percent is caused by P.vivax. Both parasites are prevalent in the malaria endemic areas of the country. Anopheles (A) arabiensis is the main malaria vector in Ethiopia, in certain places A.Pharoens, A.funestus and A.nill has minor roles in the transmission of the disease.

In Ethiopia various strategies have been implemented for malaria prevention and control in the last years. These strategies focus on expanding vector control and strengthening early diagnosis, case detection, and treatment. The major vector control strategies being implemented are indoor residual spray (IRS) in malaria endemic places and increasing the availability and use of mosquito nets to prevent mosquito bites. Accordingly, about 72% households living in malaria endemic areas were protected by either long lasting insecticide treated nets (LLINs) or IRS according to 2011 MIS. On the other hand, environmental management is also implemented by community members to destroy temporary and permanent breeding sites of mosquitos. Besides, early diagnosis and treatment services are provided at health facilities (FMOH 2014c) (EHNRI 2012) (FMOH 2014a).

The Ministry of Health in collaboration with development partners has distributed about 59 million LLINs approximately costing 170 million USD in the last 5 years (see Figure 2 below). Priority was given for under-five children and pregnant women during distribution of LLINs (FMOH 2014a).

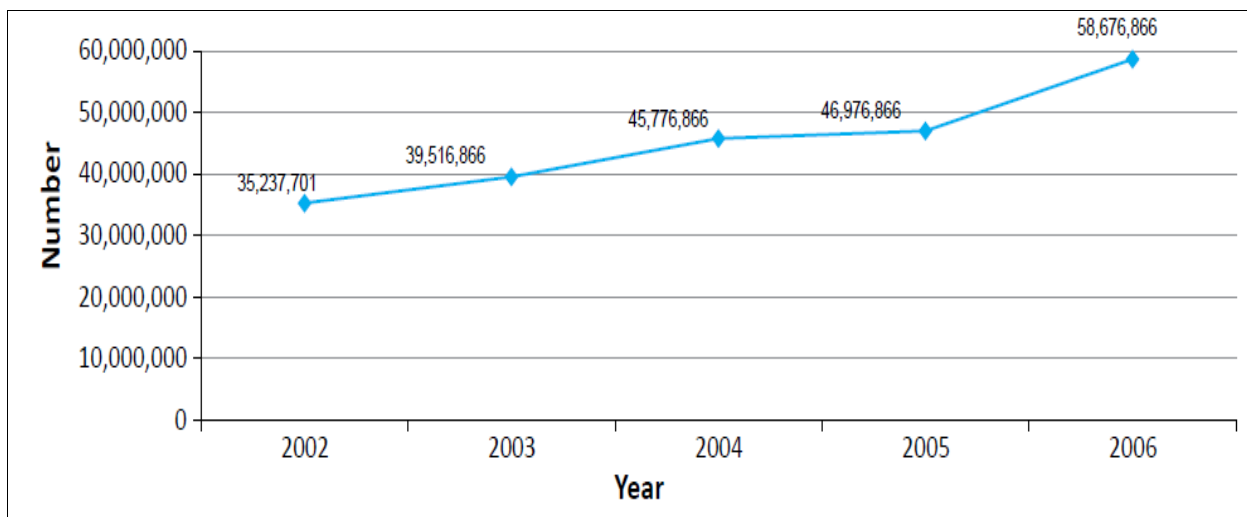


Figure 2: Trends in Cumulative number of LLINs distribution (EFY 2002-2006)

Source (FMOH 2014a)

CHAPTER TWO: Problem Statement, Justification, Objectives, and Methodology

2.1 Problem Statement

Malaria is the major public health problem and caused 584,000 deaths in 2013. There were about 198 million cases of malaria in 2013. Besides about 3.3 billion people are at risk of being infected with malaria globally (WHO 2014).

About 90% of all malaria deaths occur in Africa and the death among under-five children accounts for about 78% of all these deaths. Malaria is responsible for about 430,000 child deaths each year in Africa. Malaria is the main cause of death for children less than five years in Sub-Saharan Africa and is killing a child every minute (WHO 2014)(RBM 2014).

Ethiopia is one of the malaria endemic countries in Africa with high burden of cases during epidemics. Malaria is a major public health problem in the country. Malaria (confirmed with *P. Falciparum*) is second cause of morbidity and the sixth cause mortality in the country in 2012/13 (MOH 2014). Approximately 52 million people live in malaria endemic areas. The estimated annual malaria case is about 5 million per year excluding the epidemics; during the epidemics the cases may be two to three times greater (FMOH 2014c)(EHNRI 2012).

Malaria hampers the economic growth and is responsible for an economic growth reduction of 1.3% per year in endemic Africa countries (RBM 2014). Malaria is also a burden to social and economic development. For instance, in endemic areas it affects people in planting and harvesting times and results in reduced productive capacity for agriculture when greatest human power is needed. Malaria is also linked with loss of earnings, schools absenteeism among school age children, and high treatment cost which leads households to impoverishment in Ethiopia (FMOH 2011a).

In Africa an estimated 25 million women become pregnant each year in malarious areas and are at risk of falciparum infection during pregnancy. An estimated 10,000 maternal deaths occur each year in Africa due to malaria related anaemia (WHO 2004).

Malaria is associated with high prevalence of anaemia during pregnancy in Ethiopia. Furthermore, anaemia in pregnant women may result in increased risk of premature birth, low birth weight and even maternal death (Nega et al. 2015)(Getachew et al. 2012). Besides, Ethiopia has high maternal mortality ratio of 676 per 100,000 live births (CSA 2012) and malaria contributes for indirect causes of maternal death in malaria endemic areas of the country (Abdella 2010). Moreover, the malaria parasite prevalence is

increasing in the country; it was less than 1% in 2007 but 1.3% in 2011 according to MIS 2011 (EHNRI 2012).

About 35% of under five children and 36% of pregnant women in Ethiopia did not sleep under mosquito nets even if their households have mosquito nets according to MIS 2011. This survey also showed that there is no improvement in mosquito net use among pregnant women across the country between 2007 and 2011 (EHNRI 2012).

According to MIS 2011 about 63 % of women knew that mosquito nets can prevent malaria in the country with regional variations, 82% in Benshangual Gumuzi and Gambela and 53% in the SNNPR. Even though there is knowledge on mosquito net use, which can be further improved, there is still a huge gap in utilization of the mosquito nets across the country. Therefore, insight into the determinants of mosquito net use is essential to develop appropriate intervention programs.

2.2 Justification

Ending the epidemics of malaria by 2030 is the upcoming Sustainable Development Goals agenda and countries are targeting the malaria elimination strategies. WHO urges countries to incorporate in their national strategic plan the provision, use and timely replacement of LLINs to mitigate the problem due to malaria (WHO 2015a). Ethiopia is targeting the elimination of malaria in the post MDG era, for effectiveness evidence informed interventions are important. One of the interventions is scaling up and sustaining the utilization of LLINs (FMOH 2014a).

Under-five children are vulnerable to severe malaria because of their weak immune status and pregnant women are at risk as a result of the impairment of protective immunity during pregnancy (RBM 2014). Twenty two percent of pregnant women and 44% of under-five children in Ethiopia are anaemic. Blood loss due to worm infestation and malaria are the major contributors (CSA 2012).

LLINs protect people from being bitten by infected mosquitoes and are effective in reducing morbidity and mortality due to malaria. LLINs have knock-down effect; that is temporarily incapacitating and killing mosquitoes, has repellent effect and reduces contact between person and mosquito by acting as physical barrier (WHO 2004)(AMP 2012). Mosquito net use reduces about 50 percent of malaria illness among under-five children and pregnant women (AMP 2012).

Malaria is heavily contributing to the economic burden in rural Ethiopia at the household and individual level due to high out of pocket payment and

person's day lost. Promotion of LLINs may play a role in mitigating the economic burden of the disease (Deressa et al. 2007).

This study will explore and identify determinants of mosquito net use by pregnant women and under-five children and provide recommendations for policy makers for the development of malaria prevention and control programs in Ethiopia.

2.3 Objectives

Identifying by means of literature review the main determinants of mosquito net use by under-five children and pregnant women in Ethiopia, identifying interventions that have promoted the mosquito net use and find out the effective working mechanism of these interventions, and providing recommendations to the malaria prevention team and policy makers at the Ministry of Health

- Identify key determinants of mosquito net use by under-five children and pregnant women in Ethiopia
- Identify key interventions that have promoted the mosquito net use in Ethiopia
- Identify the effective working mechanisms of key interventions
- Provide recommendations based on study findings to the national malaria team and policy makers

2.4 Methodology: Literature Review

Literature review was done on determinants of mosquito net use among under-five children and pregnant women in Ethiopia and interventions that have promoted mosquito net use. The literature review included national policy documents such as Health Policy, HSDP, National malaria program documents, National health communication strategy, and FHC containing malaria messages, HEP, FMOH reports and MIS and published articles in scientific journals on determinants of mosquito net use and interventions used to promote it in Ethiopia. Literatures from similar Sub Saharan Africa countries were reviewed for effective interventions.

Literatures were collected from the online databases of Cochrane, and PubMed, and VU University library which were identified using Google and Google scholar. FMOH, EPHI, WHO, RBM websites were used. Literatures written in English were searched. Grey literatures written in Amharic were also used (See table 1 below).

Inclusion Criteria; Since the current health policy of Ethiopia was formulated in 1993, literatures from that time to 2015 were used.

Exclusion Criteria; - Literatures before the current health policy and incomparable other countries were excluded.

Table 1. Search Table.

N O .	Objectives	Key words and combinations used	Type of literatures searched	Databases and websites used for search
1	Identify key determinants of mosquito net use by under-five children and pregnant women in Ethiopia	Malaria, mosquito net use, under-five children, pregnant women, Determinant for mosquito net use, acceptability, availability, behaviour, perception, attitude, health belief, awareness, knowledge, and Ethiopia. AND/ OR were used for combination of words to reach the number of articles for required review of information.	Published, Peer reviewed articles Grey literatures	PubMed, Science Direct, VU University Library, Federal Ministry of Health(FMOH), Ethiopian Public Health Institute (EPHI) websites
2	Identify key interventions that have promoted the mosquito net use	Health promotion in Ethiopia Intervention for the mosquito net promotion in Ethiopia Mosquito net promotion in Ethiopia Mosquito net use promotion for Under-five children and pregnant women in Ethiopia	Published, Peer reviewed articles Grey literatures	PubMed, Science Direct, VU University Library Federal Ministry of Health(FMOH), Ethiopian Public Health Institute(EPHI) websites
3	Identify the effective working mechanisms of key interventions	Effective intervention for mosquito net promotion, Sub Saharan Africa, and Ethiopia	Published, Peer Reviewed articles	Science Direct, Cochran Library, Roll Back Malaria(RBM) website, google, google scholar

Conceptual framework

Different studies were reviewed for selection of appropriate conceptual framework for analysis of determinants of mosquito net use in various scientific articles. Finally the 1995 Anderson's Behavioural model of Health service utilization (Anderson 1995) was selected and adapted in order to analyse the determinants of mosquito net use.

Anderson behavioural model explains the interrelated effect of environmental and population characteristics for individual health service utilization (Anderson 1995). Using the framework, this study assumed that mosquito net utilization by under-five children and pregnant women can be explained as follows in environment and population characteristics.

In this study the environment includes health care system. Accordingly, health care system factors under the environment include National health policy, HSDP, National malaria program, HEP and Health development army.

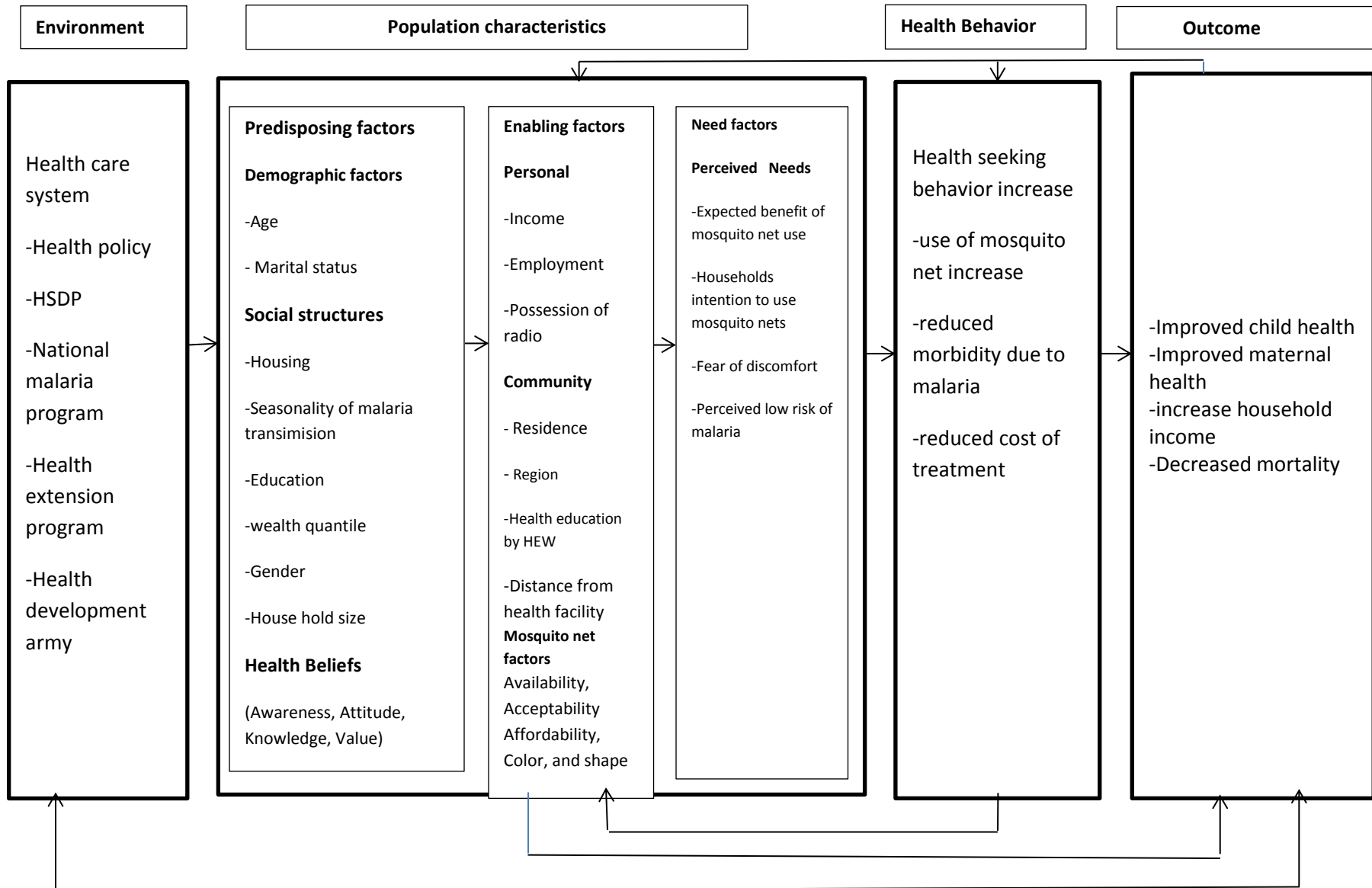
Population characteristics are further classified as predisposing, enabling and need factors. Predisposing factors are personal characteristics that are obstacles or motivators for the use of health services. These predisposing factors include demographic, social structure, and health belief (Anderson 1995). In this study demographic factors include age and marital status. Social structures include housing, seasonality of malaria transmission, education, wealth quantile, gender, and household size.

Health belief factors are awareness, attitude, and knowledge of household heads on malaria prevention and control. Need factors are expected benefits of mosquito net use, household's intention to use mosquito nets, fear of side effects, perceived low risk of malaria. In this study need factors are categorized under health belief factors for the purpose of analysis.

Enabling factors are personal factors, community factors and mosquito nets factors. In this study personal factors are income of households, radio possession, and employment. Community factors are place of residence, region, health education of health extension workers, and distance from the health facility.

Mosquito net related factors are availability, acceptability, affordability, shape and colour of mosquito net.

Figure 3: Adapted Anderson’s 1995 Behavioural Model of Health Service Utilization (Anderson 1995)



CHAPTER THREE: Study Results/Findings

3.1 Health Care systems

This section explores health care system factors influencing mosquito net use of under-five children and pregnant women in Ethiopia. These factors are National health policy, HSDP, National malaria guidelines, Health extension programs and Health Development Army. These factors address mosquito nets use and related issues from Ministry of Health to health post as well as to the community level. In this study, these factors are assumed to be essential in addressing mosquito net use by creating a favourable policy environment across the country.

3.1.1 Policy Related factors

National Health Policy

The health policy of Ethiopia gives priority for disease prevention and control in general and for control of communicable diseases like malaria in particular. The policy gives especial attention to women and child health. In the policy different health promotion interventions to enhance better health outcome are outlined (EMoH 1993). This indicates that the health policy of Ethiopia is an enabler for mosquito net use by under five children and pregnant women since it focuses on prevention and control of communicable disease like malaria. Furthermore, it gives emphasis for health promotion interventions to bring behaviour change which fosters mosquito net use.

Health Sector Development Program

The Health Sector Development Program (HSDP) is a twenty-year strategic roadmap for the Ethiopia health sector and focusing on the most important public health problems of the country. It is divided into five consecutive years and each five-year plan builds on the experiences and lessons of the previous one. Since 1997/8 Ethiopia has been implementing HSDP which is currently in its fourth phase. HSDP IV has given due concern for prevention and control of malaria in order to improve the health and wellbeing of Ethiopian. In HSPD IV, targeted utilization of LLINs coverage for pregnant women and under-five children is 86% for 2015 (FMOH 2010a). This shows that HSDP is the key enablers for the promotion of mosquito nets and its utilization among the target groups.

National Malaria Guidelines

The national malaria guidelines outlined utilization of mosquito nets as one of the major vector control strategy for malaria prevention. The guidelines state that HEWs living and working in malarious areas regularly follow the

availability of LLINs and provide for newly pregnant women in their vicinities. Besides, during the distribution HEWs ensure that pregnant women and household with under-five children receive an adequate number of LLINs. And also demonstrate for households the correct use of nets. The guideline also elaborates the importance of social and behavioural change communication for malaria control programs and utilization of different channels for message dissemination (FMOH 2012b). This suggests that the national malaria guidelines are an important pillar for the utilization of mosquito nets by under-five children and pregnant women.

Health Extension Program

The health extension program is “a package which is part of the overall primary health care service that can improve the health of a population through family and population centred knowledge and skill development.” It is implemented by trained HEWs. The Health extension program focuses on health promotion and disease prevention as well as empowering community members to make their own decision and take action on various health problems. The program has sixteen packages, and malaria prevention and control is one of the major packages (FMOH 2012a). For malaria prevention and control HEWs have been trained and deployed at rural kebeles (villages) and responsible for home to home visit and provision of health education, diagnoses by RDT, distribution of LLINs as well as treatments at the health post level. HEWs also regularly monitor the use of LLINs in their villages (FMOH 2012b). This suggests that health extension program is an important predictor for the successful implementation of malaria programmes and utilization of mosquito nets by the under-five children and pregnant women in Ethiopia.

Health Development Army

According to Ministry of Health, health development army is “a group of persons or households heads organized based on settlement or social proximity to participate, teach and learn each other and take practical actions for the betterment of individuals, families and community health.” (FMOH 2014c). Health development army (HDA) is organized to scale up the best practices documented by the health extension program to ensure wider community participation in order to enhance community ownership for sustainability. Inhabitants within a half to 1 km are organized to form a one to five networks and based on the neighbourhood approximately six one to five networks again reorganized to 25 to 30 households living in the same village to form development team. In one to five networks HDAs discuss about different health issues in their areas, make decision and support each other by sharing their best practices of HEP (FMOH 2012a)(FMOH 2015).

This program may play a key role in motivating households to use mosquito nets as household who are using mosquito nets correctly share their experiences with other one to five networks members. Therefore, HDA may foster positive behaviour change among households; this may improve the utilization of mosquito nets by under-five children and pregnant women.

3.2 Predisposing factors

This section explored predisposing factors for mosquito net use by under-five children and pregnant women in Ethiopia. Predisposing factors are variables which are describing individual factors indirectly associated with mosquito net use (Anderson 1995). Based on the adapted Anderson's model the predisposing factors explored are;

3.2.1 Demographic Factors

Age

According to MIS 2011, utilization of LLINs was higher among children less than 12 months (71.4%) than the other age groups. Similarly MIS also shows that reported use of LLINs was higher among pregnant women aged 30-39 (38%) than 40-49 (22.5%) (EHNRI 2012). Furthermore, a study conducted in Shashogo district Southern Ethiopia, also shows that utilization of insecticide treated nets (ITNs) by pregnant women was higher among younger age ($p < 0.05$) (Fuge et al. 2015). Likewise, in Western Ethiopia Deribew et al documented that adults of age 35-49 and greater than or equal to 50 years were more likely to use LLITNs than under-five children in intervention villages. Besides, adults aged 35-49 were 1.3 times more likely to use LLITNs than children under-five years in the control villages, (OR=1.3, (95% CI:1.08-11.56)) (Deribew et al. 2010). These three studies agree that age as determinant for mosquito nets use among vulnerable groups in Ethiopia. As the above studies show there is an age difference in utilization of mosquito nets in different places this might be due to cultural related issues in some areas which gives priority for adults than under-five children and pregnant women (personal observation).

Marital status

In Western Ethiopia Sena et al found that married household heads reported more than three times the use LLIN/ITNs than divorced, widowed and separated individuals (Sena et al. 2013). Similarly, study in Raya Alamata district, Southern Tigray found that head of households who were divorced (AOR=0.431, 95% CI (0.186-0.997) were less likely to use LLINs than those who were married (Araya et. al 2015). These studies agree that marital status influences utilization of mosquito nets. This might be due to the

cultural related position towards marriage, and that may affect ownership of mosquito nets freely distributed.

3.2.2 Social structures

Housing

Seventy percent of Ethiopian households use one sleeping room while 25% and 5% respectively use two and three or more rooms for sleeping (CSA 2012). In Eastern Ethiopia, Kersa a study documented that households with single sleeping room (AOR=0.6, 95% CI (0.45-0.69) were less likely to use LLINs (Gobena et al. 2012). On the other hand, Deribew et al also documented in Western Ethiopia that 95% of the houses were 'conical shapes, thatched roofs and high ceiling', as a result of these only 35% of the observed LLITNs in the intervention villages and 20% in control villages were hanged properly over the bed and only 34% and 39% of the LLITNs in the control and intervention villages could reach the mattress or bed while hanged. In this study a thirty years old house wife stated that " we have one net in our house, but we do not know how to hang and use it. The ceiling is too high" (Deribew et al. 2010). Besides, Loha et al also found in Southern Ethiopia that lack of enough space for hanging as major barrier for utilization of ITNs (Loha et al. 2013). As shown in the above studies, lack of enough space in houses for hanging and the housing structures are impeding mosquito net utilization by under-five children and pregnant women in Ethiopia.

Education

Education plays a key role in boosting economic and social development of individuals. Furthermore, educational attainment has major effect on awareness, attitude and behaviour change related to health promotion and disease prevention (CSA 2012). A study conducted in Shashogo documented that 86.7% of pregnant women with secondary education or above had good practice of using ITNs ($p=0.01$) but only 21.7% of the illiterate had good practice (Fuge et al. 2015). Similarly, Gobena et al found in Kersa that presence of illiterate women in the house (AOR=0.39, 95% CI:0.24-0.62) relates to less LLINs use (Gobena et al. 2012). A study in Raya Azebo district found that higher educational attainment among pregnant women was the major predictor of LLINs use (OR=3.1, 95% CI=2.1-4.6) (Belay & Deressa 2008). On the contrary, Derbew et al documented that level of education of the head of household did not have a statistically significant association with LLITNs utilization in Western Ethiopia Gilgele Gibe Field Research Centre (GGFRC) (Deribew et al. 2010). The findings show that education is a determinant of mosquito net use among vulnerable groups. Further, it shows how educational attainment obstructs behaviour and attitude change by impeding social and economic development and finally leads to lack of

utilization of the mosquito net by under-five children and pregnant women in Ethiopia.

Wealth quantile

In Ethiopia about 88 percent of the population living in urban are in highest wealth quantile while only five percent rural counterparts are in the same quantile. This shows there is high inequality among the urban and rural population and this may hamper utilization of health services (CSA 2012). A community-based cross-sectional comparative household survey conducted in Gilgel Gibe, in West Ethiopia identified that the wealthiest household are more than 3 times likely to use LLIN/ITNs than the poorest (Sena et al. 2013). On the other hands, MIS 2011 documented that the use of LLINs by under-five children living in malaria endemic area was almost similar among the poorest (63.6%) and the richest (64%) while 66.4% of the richest and 44.6% the poorest households had at least one LLINs (EHNRI 2012). According to MIS 2011 disparity in wealth index determines possession of LLINs which may also affect utilization. The difference in the two studies might be due to variation of time of the study. The time variation might lead to more possession of LLINs during MIS. On the other hands, inequality in wealth as indicated above may indirectly lead to poor utilization of malaria programs due to poor knowledge and awareness on prevention and control strategies.

Household size

In Ethiopia urban households have fewer members than the rural counterparts. The average household size in urban settings was 3.6 persons while in rural settings it was 5.1 persons in 2014 (CSA 2014). A study in Shashogo district documented that pregnant women (47.6%) with family size greater than six and having only two ITNs were not using the ITNs (Fuge et al. 2015). Similarly according to Sena et al, households with large family size were less likely to use LLIN/ITNs than households with three or less family size (Sena et al. 2013). The above studies documented that household size as a major determinant of mosquito nets use by under-five children and pregnant women in Ethiopia. When the family size is large, it affects utilization of mosquito nets as there might be fewer nets for the family or there might be a lack of enough space for hanging the mosquito nets because of the housing structure.

Gender

In Ethiopia decision making power is mostly dominated by men due to poor attitude towards women and gender roles. As a result, women are not exercising their right of using health care. For instance, only 13% of

currently married women make their decisions on their own health care (CSA 2012). On the contrary in GGFRC western Ethiopia, among the intervention and control villages, in intervention villages LLITNs use was more common when the house is headed by a female (OR=1.92, 95% CI = 1.34 - 2.74) (Deribew et al. 2010). This might be due to women's responsibility to household activities because of social norms in the areas. On the other hand, MIS 2011 documented that LLINs use was nearly similar for under-five children of both genders, for boys it was 65.4% and for girls 64.1% (EHNRI 2012). Similarly Sena et al found that there was no significant association on gender of household head and utilization of LLIN/ITNs by under-five children and pregnant women (Sena et al. 2013). The above studies suggest that gender plays a role in decision making for utilization of mosquito nets among under-five children and pregnant women in Ethiopia.

3.2.3 Health Beliefs

Health belief here means the awareness, knowledge, attitude and values of household members, especially women, household heads and caretaker on mosquito nets and its utilization. Need factors are also explored under health beliefs.

Awareness

A study in western Ethiopia found in its qualitative parts that low awareness on how to use LLITNs was a major influencing factor hampering mosquito net use in the community (Deribew et al. 2010). Similarly in Eastern Ethiopia a study found that women's lack of awareness on prevention of malaria (AOR=0.43, 95% CI=0.27-0.68) was a major contributor for non-use of LLINs (Gobena et al. 2012). These two studies documented similar result on awareness and how it affects mosquito net use by under-five children and pregnant women in Ethiopia.

Knowledge and attitude

Fuge et al documented in Shashogo that 74.3% pregnant women participated in the study had knowledge about malaria and ITNs. This study also identified that women who got information about malaria and ITNs had positive attitude towards ITNs than those who had not received (Fuge et al. 2015). Similarly a study conducted in Shewa Robit Town, Northeastern Ethiopia documented that majority of the community members believed that malaria was major public health problem and ITNs use can prevent it (Abate et al. 2013). Besides, a study conducted in Samre Saharit, Tigray, Northern Ethiopia documented that most of the study participants believed that malaria was considered as major health problem in the community and ITNs was mentioned as good prevention method (Paulander et al. 2009).

Similarly a study conducted in GGHD, western Ethiopia, found that most of caretakers believed that childhood malaria is preventable disease and the use of ITNs was mentioned as method for malaria prevention (Yewhalaw et al. 2010). Furthermore, MIS 2011 also found that 71.2% of women participated in the survey were reported that malaria is caused by mosquito bite; while knowledge of malaria transmission was higher in women of the richest households (79.6%) than the poorest (68.8%) (EHNRI 2012). On the contrary, Belay and Deressa et al also documented that lack of support from household members, especially husband as barriers for ITNs use during pregnancy in Tigray. This might be due to lack of positive attitude for ITNs among the family members (Belay & Deressa 2008). The above studies suggest that knowledge and attitude on malaria and mosquito net in the country is a key determinant for utilization of mosquito nets among the under-five children and pregnant women in Ethiopia. The studies show that household heads and caregiver beliefs towards malaria affect mosquito net use by the target groups.

3.2.4 Seasonality of Malaria Transimision

Malaria has unstable transmissions in highlands and longer transmission durations in low land areas, river basins, and valleys. In Ethiopia major malaria transmission follows the main rain season from June to September each year. The pick incidence of malaria occurs from September to December in most parts of the county and in some places March to May following the small rain season from February to March (FMOH 2014c). This unstable transmission may affect utilization of mosquito nets. A study in shashogo documented that 78.6% of pregnant women reported the use of mosquito nets seasonally while 21.4 reported regularly use (Fuge et al. 2015). Similarly, Jima et al and Biadigligh et al documented the same results (Jima et al. 2005) (Biadigilgn et al.2012).

Need Factors

Expected benefit of mosquito net use

A study in Pawe district in Northwest Ethiopia shows that malaria was considered as curable disease and sleeping under a mosquito net was reported as the major prevention mechanism among the participants (Beyene et al. 2015). Similarly, a Study in Serbo town shows that about 96% of the respondents believed that regular bed net utilization would prevent malaria (Karunamoorthi & Kumera 2010). On the contrary, in rural area in Northern Tigray the use of ITNs as prevention method for malaria was less reported among the study participants (Belay & Deressa 2008). Similar results were documented in Shashogo district; 65% pregnant women responded that malaria was transmitted by poor personal hygiene and

environmental sanitation, 18.8% because of bad weather while 15.6% mentioned that malaria is transmitted by mosquito bite (Fuge et al. 2015). The above studies show that expected benefit of mosquito net is a potential factor for its use among the target groups.

Households' intention to use mosquito net

A study in Jabi Tehnan district, Northwestern Ethiopia shows that 74.1% of the participants were mentioned using LLINs as the most favoured malaria prevention strategy (Animut et al. 2014). A similar result was documented in GGHD; western Ethiopia, among care givers of under five children (Yewhalaw et al. 2010). On the contrary, in Raya Azebo district the perception that mosquito nets could not prevent malaria was the main reasons for non-ownership of it (Belay & Deressa 2008). These findings suggest that household intention is an influencing factor for mosquito nets use among vulnerable groups.

Fear of discomfort

In Shewa Robit town 20 percent of study participants said that using mosquito net was not comfortable because of becoming hot during sleeping and its bad smell (Abate et al. 2013). This shows the fear of discomfort may hinder utilization of mosquito nets by under-five children and pregnant women in Ethiopia.

Perceived low risk of malaria

In town areas of Oromia region low perception towards malaria and mosquito was documented as main reasons for non-utilization of ITNs (Baume et al. 2009). This indicates that perceived low risk of malaria might be determinant for mosquito net use.

3.3 Enabling Factors

This section explored enabling factors for mosquito net use by under-five children and pregnant women. Enabling factors are resources that can enhance the use of mosquito nets by vulnerable groups (Anderson 1995). Enabling factors are explored at personal and community level. In addition, mosquito net related factors are included.

3.3.1 Personal Income

Income also affects the utilization of mosquito nets where mosquito nets are not provided freely by the government or development partners. Deribew et al found that income did not have statistically significant association with utilization of LLITNs in households (Deribew et al. 2010). This might be due

to the availability of freely distributed LLITNs in the community during the study period. In Ethiopia about 40% of women in urban area and 34% in rural area are independently making decisions on the use of their income (CSA 2012). This suggests majorities of Ethiopian women cannot make decisions on their income. This may affect, as elaborated upon in the section under gender above, the utilization of a mosquito net by pregnant women and under five children in Ethiopia.

Employment

A study in Shashogo found that civil servants had better practice of using ITNs than house wives (the difference was not statistically significant $p=0.28$) (Fuge et al. 2015). Another study conducted in Eastern Ethiopia also documented that households headed by farmers and house wives were less likely to use ITNs than households headed by traders (Biadgilign et al. 2012). Besides, study conducted in six districts of zone three and zone five in Afar National Regional State, Northeastern Ethiopia documented that under-five children and pregnant women whose households were led by day labourer were 4.8 times more likely to sleep under LLINs than those living in households led by other occupational types (Negash et al. 2012). On the contrary, a study conducted in Raya Azebo district Northern Tigray region documented that employment was not associated with ITNs use among pregnant women. This might be due to 88% of pregnant women interviewed were housewives (Belay & Deressa 2008). As the above studies suggest employment status may affect access to information which finally leading to poor attitude and behaviour change with regard to mosquito net use. Therefore, employment is the determinant for mosquito use by under-five children and pregnant women in Ethiopia.

Possession of radio

In Northern Ethiopia a study found that possession of radio by household was a factor affecting utilization of ITNs among pregnant women in that community (Belay & Deressa 2008). Similarly, Negash et al found that under-five children and pregnant women in households who did not have radio were 0.38 times (95% CI: 0.25-0.59) less likely to sleep under LLINs than households with radio (Negash et al. 2012). Fuge et al also documented that information got from radio had power in attitude change than other sources of information like friends or neighbours on mosquito net use among pregnant women (Fuge et al. 2015). The three studies in different parts of Ethiopia agree that possession of radio is a key determinant for mosquito net use among under-five children and pregnant women.

3.3.2 Community Place of residence

In Eastern Ethiopia a study documented that LLINs use was lower among urban residents (27.6%) than rural (34.4%) counterpart (AOR=0.51, 95% CI=0.34-0.76) (Gobena et al. 2012). On the contrary Belay and Deressa et al in Raya Azebo documented that the utilization of ITNs among pregnant women was higher in urban than rural residents (Belay & Deressa 2008). Similarly Deressa et al also documented in Oromia and Amhara regions higher utilization of LLINs among urban than rural residents (Deressa et al. 2011). The difference in the above studies result might be due to geographical and cultural variations. Two of the above studies agree that place of residence affects the utilization of mosquito nets among the vulnerable groups. Furthermore, people living in urban area have more access to health facilities and information than their rural counterparts and this enhance them to use health services more than the rural population. As the above studies depict place of residence has a key role in utilization of mosquito nets by under-five children and pregnant women in Ethiopia.

Regions

According to MIS 2011 there was variation in LLINs ownership across regions; Amhara region had 73.6% coverage of at least one LLINs. On the other hands, Oromia regions had the least (43.7%). This might also affect the utilization of mosquito nets among the vulnerable groups, for instance in Oromia only 55% of under-five children were used LLINs in 2011 (EHNRI 2012). Moreover, there is huge variation and inequities among regions in availability of health facilities and human resource. This may indirectly affect utilization of mosquito nets among under-five children and pregnant women in Ethiopia. For instance, in Afar and Somali region, there is a high shortage of trained health personnel (personal observation). This may also influence awareness creation activities and other interventions which foster mosquito net use in the region. This suggests that the region is a determinant for mosquito net use.

Health Education by Health Extension workers

Different studies documented that health education by HEWs plays a vital role in strengthening the utilization of mosquito nets. Fuge et al found that information obtained from HEW was strong predictor of attitude change towards an ITNs among pregnant women in Shashogo district (Fuge et al. 2015). According to MOH annual performance report of 2013/14 HEWs conducted home to home visit and provided information on malaria prevention and control activities. Moreover, they provided health education

on LLINs use in malaria endemic areas (FMOH 2014a). This might influence knowledge and attitude towards mosquito nets and improve practices of using it among under-five children and pregnant women. On contrary, Biadilign et al documented that in Gursum district Eastern Ethiopia, the major source of information on malaria was mass media (48.6%) while about 8% got information from HEWs (Biadgilign et al. 2012). This might be due to weak home visit for health education by HEWs in the study area. The above studies suggest health education and information from HEWs affect utilization of mosquito nets among vulnerable groups.

Distance to the nearest health facility

Sena et al found that households living in one Kilo meter distance from the health facility were 17 times more likely to use LLIN/ITNs when compared with others in GGHD, in Southwestern Ethiopia (Sena et al. 2013). This study finding shows that distance from the nearest health facility is important in mosquito net use. Living near to health facilities may enhance frequent visits by HEWs and lead to proper utilization of mosquito nets among the vulnerable groups.

3.3.3. Mosquito Net Related Factors

Availability

Gobena et al in Eastern Ethiopia documented in the qualitative parts of the study that lack of enough LLINs for the whole household members was influencing factor for LLINs use among vulnerable groups (Gobena et al. 2012). Deribew et al also documented the same result in western Ethiopia (Deribew et al. 2010). Fuge et al also found that unavailability of enough ITNs for the whole family members led pregnant women for non-use of it in Southern Ethiopia (Fuge et al. 2015). Besides a study conducted in 29 woredas of Oromia and Amhara regional states documented that availability of LLINs in the household (AOR=2.93, 95% CI=2.21-3.90) was a major determinant for its use by under-five children and pregnant women in the study areas (Deressa et al. 2011). MIS 2011 documented that about fifty five percent (54.8%) households in malaria endemic areas had at least one mosquito net while 23.4% have more than one. According to this survey on average there was 0.7 mosquito nets per household in 2011, it was 1.1 in 2007 (EHNRI 2012). This shows there is a shortage of mosquito nets in Ethiopia and it affects utilization by under-five children and pregnant women. All above studies agree that availability of mosquito net is key determinants for its utilization among the vulnerable groups.

Colour and Shape of Mosquito Nets

A study conducted in Amhara and Oromia regions shows that 'conical' shaped nets were more preferred than 'rectangular' shaped ones (OR=2.27 (95% C.I=1.10-4.68). Rectangular shaped LLINs were difficult to hang in traditional houses (Baume et al. 2009). Similarly Gobena et al documented in Kersa possession of white colour and rectangular shaped LLINs were the main reason for non-use of LLINs among households. Blue coloured nets were more preferred than the others (Gobena et al. 2012). The above two studies show that shape and colour of mosquito nets are important determinants for prevention and control of malaria among vulnerable groups.

Acceptability

Acceptability of mosquito nets is important to improve utilization by the target groups. According to Gobena et al poor perception towards malaria prevention by mosquito nets, and undermining the extent of malaria were leading for non-utilization of LLINs in Kersa (Gobena et al. 2012). Similarly Araya et al found that considering the LLINs as too hot is one of the factors which leads to unacceptability of it among the vulnerable groups in Raya Azebo district (Araya et al. 2015). In Amhara and Oromia region the age of LLINs also affects its acceptance. Older LLINs were less likely to be used than the newer (Baume et al. 2009). The above study results agree that the acceptability of mosquito net is key predictors for its utilization.

Affordability

Sena et al documented in west Ethiopia that most of the households reported that LLIN/ITNs should be provided free of charge and that would be enough for the household members. This might be due to lack of enough money to buy mosquito nets. This also may impede the utilization (Sena et al. 2013). Similarly Jima et al also found affordability as predictor for LLINs use among community in selected kebeles of SNNPR, Oromia and Amhara regional states (Jima et al. 2005). These two studies agree that affordability is a determinants for mosquito net use among vulnerable groups in Ethiopia.

3.4 Interventions

This section explored interventions which have been implemented for the promotion of mosquito net use in Ethiopia.

Intervention implemented for mosquito net promotion in Ethiopia

Ensuring 100% coverage of LLINs provision to households living in malaria endemic places and achieving 80% of LLINs utilization is one of the major

objectives set by the Ministry of Health to be achieved at the end of 2015. To achieve these targets different strategies are being implemented so far in the country (FMOH 2010b). The national health communication strategy outlined women (mothers) and men (fathers) as target audience for malaria messages in order to foster vulnerable groups' mosquito net use (FMOH 2004). But there is implementation gap of the strategy. Advocacy, communication and social mobilization intervention were indicated as pivotal strategies for strengthening ownership and utilization of mosquito nets in Ethiopia.

Interventions done by Health Extension workers

According to the national malaria guidelines HEWs are responsible for home to home visit and provide health education in malaria endemic places. They also demonstrate how to use mosquito nets to households in malaria endemic places. At national level integrated refresher training manual was developed for training of HEWs in different health topics. One of the modules consists of malaria prevention and control intervention and refresher training was provided to all HEWs working in malaria endemic places. The training addressed all malaria prevention and control intervention at the health post level. The module has messages on LLINs use and its benefits in preventing malaria. Integrated refresher training was assumed to increase the knowledge and awareness of health extension workers on malaria prevention and control, thus enhance them to promote mosquito nets and provide adequate services as deemed (FMOH 2011b).

In addition, at national level family health cards (FHC) were developed to be used by HEWs during the home to home visits as teaching aid on maternal and child health, nutrition, malaria prevention and control and other health topics. FHCs were distributed to all HEWs, used as health promotional material on different health issues. The FHC also contains major malaria messages like utilization of LLINs and the importance of LLINs in mitigating the transmission of malaria. The messages in FHC were developed at national level by different professional from government and development partners. The messages were once developed and distributed to health posts. In the health posts HEWs use these messages when they conduct home to home visit and use at a health post level as aid for health education sessions. The FHC contains only one message which focuses on mosquito net use and it says "*Family; to protect family members from malaria, always use mosquito nets; if there is shortage of mosquito nets give priority for pregnant women and under-five children.....*" (FMOH 2009).

Mass Media activities

Posters, brochures, leaflets containing malaria messages were developed and distributed to health facilities. These materials were developed by Ministry Health Malaria Team and Communication Directorate in collaboration; and distributed to health facilities and health professional working in antenatal clinics use them for counselling of pregnant women during antenatal care visits on mosquito net utilizations as job aids. Ministry of Health in collaboration with development partners also use different multimedia like mobile vans for provision of health education to the general communities living in malaria endemic places using audio and video messages on malaria prevention and control (FMOH 2015).

Radio and television spot messages are also developed and aired during malaria transmission seasons by national and some local media. These messages were translated into local languages. According to Ministry of Health reports, various promotional materials were prepared on LLINs use, vector control, diagnoses and early treatment and disseminated via different media. For instance the radio spot for LLINs promotion says "*...malaria mosquitoes feed during the night time. But if you use LLINs during sleeping time, you can prevent mosquito bites; are you living in malarious area, use LLINs regularly...*". (FMOH 2013). This promotional message is more generic and does not explicitly address pregnant women and under five children who are more vulnerable for malaria in endemic places.

World malaria day celebration events

During the celebration of world malaria day different health promotion activities are implemented at national level. The Ministry of Health in collaboration with development partners mobilizes community on malaria prevention and control at this event. As indicated in the Malaria Case Team report of 2007 Ethiopian calendar (2014/15), the event is commemorated annually. During this event social mobilization activities on malaria prevention and control take place. However, Social mobilization activities done were focusing on malaria prevention and control strategies and not specific on LLINs utilization by vulnerable groups alone (FMOH 2015).

However, for the implementation of the above activities no clear behavioural change method was applied and effectiveness of the interventions was not evaluated (personal observation). This suggests lack of targeted health promotion intervention for mosquito net use among pregnant women and under five children in Ethiopia.

3.5 Interventions implemented that need to be scaled up

This section explored interventions implemented in other countries for the promotion of mosquito nets. Besides intervention implemented in Afar and Oromia Regions of Ethiopia are explored.

In 2010 Malaria No More and Lalela project had been designed and implemented "Night Watch" Campaign in Senegal. The aim of the campaign was to recall people to sleep under the mosquito nets. They used powerful behavioural triggering message called "*it is 9 P.m. Are you and your family safe under your mosquito nets tonight?*" This project used different multimedia for dissemination of messages. They used well known celebrities (role models) for the preparation of public service announcements (PSA) and these PSAs' were aired on local and national television and radio stations at 9 p.m. around the time malaria carrying mosquitos are assumed to come out for biting. In addition, they used nightly SMS (Short Message Service) messages sent by the telecommunication agency for mobile subscribers (awareness rising). In Senegal an evaluation conducted in 2011 showed that children whose parents heard the campaign message were 8% more likely to have slept under mosquito net the night before (RBM 2012).

In Cameroon Ministry of Health in collaboration with development partners working in malaria coordinated national malaria communication campaign after the distribution of LLINs in 2011. The campaign was coordinated under unified brand "**KO Palu**" (**knock out malaria**) campaign. In the process mass media activities were led by Malaria No More (MNM) and MNM adopted its Night Watch to the Cameroon context. The notion of the Night watch platform was communication contributes for malaria prevention and control program and mosquito net use by supporting individual action by means of communicating knowledge, influencing attitudes and social norms, through providing regular and motivational reminders (cues) (Bowen 2013) (RBM 2012).

Furthermore, in Cameroon different multimedia platforms were used for dissemination of the message. An original music song and video educating about malaria control called "**KO Palu anthem**" was produced by popular artists (modelling) and released during Night Watch launching event. The song was released in local radios and it was televised on local and national television agencies and gained popularity. Besides "KO Palu Night Watch" PSAs' was produced and aired via different radios and television channels. The PSAs' were produced in different languages and aired on daily basis by local and national media. Besides, " KO Palu Night Watch" SMS messages were disseminated by 'MTN' telecommunication agency to the mobile subscribers. Billboards and calendars containing night watch messages were used in various places. After 8 months the impact of the campaign was

evaluated and it was found that exposure to “KO Palu Night Watch” messages was associated with 6.6% increase in LLINs use among respondents (65.7% versus 59.1%, $p < 0.05$). Furthermore, it showed 12% increase in last night net use among under-five children of the respondents (79.6% versus 67.6%, $p < 0.025$) (Bowen 2013).

A hung up home visit by volunteers was implemented in Togo after the mass distribution of LLINs in 2011 by the Ministry of Health and development partners. This intervention was implemented to find out whether home visit has an impact on utilization of LLINs after mass distribution. The intervention deployed volunteers to conduct door to door visits with educational messages. During this time volunteers provided health information (persuasion) on the importance of nets in the prevention of malaria and how to hang LLINs at the household (skills training) to heads of households. The intervention also had control groups without door to door visit by volunteers. After eight months in the Plateaux Region of Togo randomized controlled trial was conducted in districts found out those households who received the intervention had level of use that was five to ten percent higher than the control household with similar access both in intervention and control groups. ITN use eight months after campaign by all individuals, under five children and women of reproductive age was 11.3% to 14.4% greater in the study group that received three intervention visits than the control (Desrochers et al. 2014). This suggests that door to door visit after distribution of mosquito nets is important in changing the behaviour of households with regard to mosquito net use. This can be implemented in Ethiopia context with the existing system.

In the Afar Regional State of Ethiopia, AMREF used mothers as coordinator for LLINs distribution as well as to motivate and educate families on malaria prevention and control activities. For this intervention AMREF trained local leaders on malaria prevention and control. The trained local leaders were participated in selection of mothers for home to home visits. For the selected mothers training was provided on malaria signs and symptoms, mode of transmission, prevention and control strategies with emphasis on mosquito net utilization. Furthermore, teaching aids supported with pictures were prepared with other development partners such as UNICEF and RHB. These materials were pre-tested before dissemination and use by the mother coordinators. The materials were developed in local language and were easy for the mothers to understand during home to the home visits. In each village trained mothers conducted home to home visits and provided health education and disseminated information on LLINs use and other malaria prevention and control interventions. The result of the intervention was evaluated and showed that proportion of under five children and pregnant

women who slept under mosquito nets the previous night increased from 17% to 84% and 27% to 86.5% from 2005 to 2007 (AMREF 2007). This shows involvement of local leaders and mothers coordinators (community involvement) in malaria prevention and control had played a key role among Afar pastoral communities. This suggests that the intervention can be scaled up to other pastoral communities in Ethiopia and contribute for prevention and control of malaria by enhancing utilization of mosquito nets among the vulnerable groups.

Another communication intervention was implemented by C-Change (Communication for Change) in Oromia Regional State of Ethiopia from 2009 to 2012. The main objective of the intervention was using model families as champions and change agent in promoting the mosquito net use and other malaria prevention and control interventions. C-Change in collaboration with other partners working in malaria prevention and control developed 8 Essential Malaria Actions (EMA). In the process of developing EMA C-change conducted formative assessment and identified barriers for behaviour change intervention for malaria prevention and control. EMA was drafted, pretested, and modified based on the findings of the pre-test. The final version was used for dissemination through different channels. Some of the EMAs were "*All family members should sleep under (ITNs) or (LLINs) every night*", "*give priority to pregnant women and children under five to sleep under LLINs.*" Furthermore, C-change used multimedia strategy as well as built capacity of local leaders and HEWs in malaria communication interventions and provided recognition for champions during an event which was locally organized. This project was implemented in 4 districts of Oromia regional state and reached about 437,000 families (C-Change 2012).

The project was assumed to increase the utilization of LLINs and treatment seeking behaviour among households in these malaria endemic districts, but impact of the project was not indicated in the case study document and its effect was not evaluated.

The notion of EMA was very interesting in identifying community norms and barriers for desired behaviour change in order to improve mosquito net use in specific regions. This intervention may be also scaled up in certain regions of the country with the existing health system since C-change used existing health system for promotion of EMA.

CHAPTER FOUR: Discussion

This chapter not only discusses key determinants for mosquito net use by under-five children and pregnant women and key intervention that have promoted mosquito net use in Ethiopia but also provides implications and identifies gaps in knowledge that need to be addressed in the future. The chapter also discusses interventions implemented in other countries and a certain part of the Ethiopia that have good impacts.

4.1 Key determinants

National Health Policy, HSDP, National Malaria Guidelines, HEP are key enablers for mosquito net use by under-five children and pregnant women. These policy documents and HDA are focusing on fostering utilization of mosquito nets by under-five children and pregnant women in Ethiopia. They outlined priority interventions and strategies which boost prevention and control of malaria among vulnerable groups. However, mosquito net use promotion related interventions were not successfully implemented as indicated in the policy documents.

Younger Children (less than 12 months old) and younger pregnant women are more likely to use mosquito net than others (EHNRI 2012)(Fuge et al. 2015). This might be due to more love and caring given for too young children in the country and relatively higher level of education among younger women in Ethiopia, which enhanced them to access more information on mosquito net use. In contrast, older men and adults are more likely to use mosquito nets than children under five in west part of Ethiopia (Deribew et al. 2010). This might be due to cultural issues which gave emphasis for adults and older people than under five children in the study areas.

In married households there is more utilization of mosquito nets than the others (Sena et al. 2013)(Araya et al. 2015). This might be due to the cultural related position towards marriage, which indirectly affects possession of mosquito nets freely distributed.

Unavailability of enough sleeping room and housing structure affects utilization of mosquito nets (CSA 2012)(Gobena et al. 2012)(Deribew et al. 2010)(Loha et al. 2013). This might be due to lack of adequate hanging space for mosquito nets during sleeping time. Besides, shape of roof structures might be difficult to hang mosquito nets in traditional houses. This might affect under five children and pregnant women living there. Furthermore, seasonality of malaria transmission also affects mosquito nets use. Because of seasonal transmission of the disease, households did not practice regular use of mosquito nets (Fuge et al. 2015). This might lead to

lack of utilization during the main transmission season and expose pregnant women and under five children at risk of getting the disease.

Highly educated pregnant women are more likely to use mosquito nets (Gobena et al. 2012)(Fuge et al. 2015)(Belay & Deressa 2008). This might be education enhanced access to more information on mosquito net use. Besides, more educated women have a higher chance of living in improved housing and get a higher income. This might improve the utilization of mosquito nets for their under five children. However, only 38% of Ethiopian women are literate (CSA 2012) and this might limit understanding of messages on mosquito net use.

Wealthiest households are more likely to use mosquito nets (Sena et al. 2013) (EHNRI 2012). This might be wealthiest households have resources which enhanced them to access information on malaria prevention and control. Furthermore, wealthiest households might have money for procurement of mosquito nets which the poorest could not afford and may live in better houses with enough sleeping rooms.

Pregnant women and under-five children in households with large family size are less likely to use mosquito nets (Fuge et al. 2015)(Sena et al. 2013). This might be due to lack of enough mosquito nets for the whole families, and poor awareness and knowledge on who should use mosquito nets when there is a shortage. Under five children living in households headed by a woman are more likely to use mosquito nets (Deribew et al. 2010). This might be due to women's responsibility to household activities because of social norms in the areas. On the other hands, utilization of mosquito nets for both gender of under five children is nearly similar (EHNRI 2012). This might be due to emerging attitudinal change towards gender in the country. However, there is still gender inequity in the country and this might affect utilization of mosquito net among vulnerable groups. Pregnant woman who lacks support from their husband are less likely to use mosquito nets than others (Belay & Deressa 2008). This might be due to gender discrimination and considering pregnancy the only responsibility of women in some parts of rural Ethiopia. This may lead pregnant women to the burden of malaria and result in life threatening situation.

Income did not have a statistically significant association with utilization of mosquito net in households (Deribew et al. 2010). This might be due to the availability of freely distributed mosquito nets in the community during the study period. However, it may affect the utilization of mosquito nets where mosquito nets are not provided freely by the government or development partners.

Pregnant women employed as civil servants are more likely to use mosquito nets (Fuge et al. 2015). This might be due to their better access for information on malaria prevention and mosquito net use. Besides, they might make the decision by themselves to use a mosquito net than others. Children under five and pregnant women living in households led by farmers and housewives are less likely to use mosquito nets. This might be farmers and housewives might lack access to information on importance of mosquito net use (Biadgilign et al. 2012) (Negash et al. 2012). On the contrary, employment was not associated with the mosquito net use among pregnant women in Tigray.

In households having radio under five children and pregnant women are more likely to use mosquito nets (Negash et al. 2012)(Fuge et al. 2015)(Belay & Deressa 2008). This might be information obtained from radio have more power in attitude change on mosquito net use than others. The other reason may be in Ethiopia messages disseminated through the media are considered as more reliable. However, only 50% of urban and 31% of rural households have radio (CSA 2014).

Urban residents are more likely to use mosquito nets than rural counterparts (Belay & Deressa 2008)(Deressa et al. 2011). This might be people living in urban area have more access to health facilities and information. However, 83% of Ethiopian households live in rural areas (CSA 2013). On the other hands, in Eastern Ethiopia mosquito net use was lower among urban residents than rural counterpart (Gobena et al. 2012). This might be due to geographical and cultural variations.

Oromia region has the least utilization of mosquito nets by under-five children than the other regions (EHNRI 2012). Moreover, there might be disparity and inequities among regions in availability of health facilities and human resources. This disparity might limit access to information on malaria prevention, including mosquito net use.

Unavailability of enough mosquito nets for the households affects its use by under five children and pregnant women (Gobena et al. 2012) (Fuge et al. 2015)(Deressa et al. 2011). On average there was 0.7 mosquito nets per household in 2011, it was 1.1 in 2007 (EHNRI 2012). There might be improper use of mosquito nets for other purposes and lack of regular replacement. Households favour free distribution of mosquito nets rather than buying from markets (Jima et al. 2005)(Sena et al. 2013). This might be due to mosquito nets being too expensive to buy. This also affects the poor households who cannot afford to buy mosquito nets. Conical shaped and blue coloured mosquito nets are more likely to be used than rectangular shaped and white coloured nets (Baume et al. 2009) (Gobena et al. 2012).

This might be due to the housing structures which is not conducive for hanging on rectangular shaped mosquito nets. Besides, white nets might be easily got dirty in rural settings. This might lead to unacceptability of mosquito nets.

Pregnant women who got information from HEWs on mosquito net use and its benefits are more likely to use (Fuge et al. 2015). This might be frequent home visits by HEWs for health education enhanced pregnant women to access information and build trust. Furthermore, this may influenced knowledge and attitude towards mosquito nets and improved practices of pregnant women.

Pregnant women who got information on malaria prevention and mosquito net are more likely to have positive health beliefs towards mosquito net use (Fuge et al. 2015). This might be the information influenced attitude and practice towards mosquito net use. Children under five and pregnant women are more likely to use mosquito nets in households who believed that mosquito bite causes malaria. This might be due to household's knowledge and information on malaria transmission and prevention methods. Moreover, knowledge of malaria transmission is higher in women of the richest wealth quantile. This might be due to access to information on malaria prevention and control methods. Furthermore, care-giver who believed childhood malaria is preventable are more likely to use mosquito nets (Yewhalaw et al. 2010). Low awareness on malaria prevention and mosquito net use is influencing its utilization in the community (Deribew et al. 2010) (Gobena et al. 2012). This might be households lack exposure to sources of information on malaria prevention and control methods and benefits of mosquito net use.

Poor perception towards malaria prevention by mosquito nets, undermining the extent of malaria (Gobena et al. 2012) and considering the mosquito nets too hot leads to unacceptability and non-use of mosquito nets among under five children and pregnant women (Araya et al. 2015). This might be due to information, and knowledge gap on mosquito net use. The authors suggest strong information and communication intervention to shape perception and attitudes.

The findings indicate that utilization of mosquito net among vulnerable groups in Ethiopia might be influenced by different determinants. Therefore, future interventions should address determinants that can be changed to ensure utilization. Moreover, conducting further research on behavioural determinants is important.

4.2 Key interventions that have promoted the mosquito net use

Provision of mosquito nets to malaria endemic areas, preparation of advocacy and communication materials are the major enablers for mosquito net use (FMOH 2014a). This might play a role in mosquito net use among the vulnerable groups. Integrated refresher training is very important to increase knowledge and skill of HEWs on malaria prevention and control, and mosquito net use. This training might enhanced HEWs to promote mosquito net use (FMOH 2011b). FHCs might support HEWs for health promotion interventions. But FHCs developed once and used for long times. From my experience, FHC is not recently updated and contain only one message on mosquito net use. Therefore, it may not be effective for the current situation. The use of posters, brochures, and leaflets with malaria messages for counselling of pregnant women during antenatal care visits might help pregnant women for attitude and behaviour change. However, it needs further strengthening.

Moreover, Mobile Vans were used for provision of health education to the general communities in malaria endemic places using audio and video messages. But it might not address the rural and hard to reach areas. Radio and television spot messages are aired during malaria transmission seasons through national and some local media (FMOH 2013). However, these messages did not explicitly address the mosquito net use by pregnant women and under five children. Besides, during the commemoration of the World Malaria Day messages were disseminated to the general public. This might be due to lack of targeted health promotion intervention for mosquito net use among pregnant women and under five children in Ethiopia. The findings show that there is no systematic and evidence informed as well as targeted health promotion intervention for mosquito net uses in the country. Moreover, the effectiveness of the interventions is not evaluated.

This might be due to lack of proper health promotion planning and implementation mechanisms. Therefore, the authors suggest an intervention mapping approach (Bartholomew et al. 2011) for planning and implementation of mosquito net promotion interventions in Ethiopia. The Intervention mapping approach is “a stepwise approach for theory and evidence based development and implementation of interventions. It comprises six steps; each leading to a product that guides the next steps.” (Godin et al. 2007). It is systematic theory and evidence based planning procedure for behaviour change (See the annex 1).

4.3 Effective working Mechanism for Key Interventions

4.3.1 Interventions implemented elsewhere

Night Watch

Night Watch campaign was implemented in Senegal, Cameroon and other African countries. The program was successful in changing behaviour and attitude towards mosquito net use. The night watch campaign uses multimedia for message dissemination. In Senegal an evaluation conducted in 2011 showed that children whose parents heard the campaign message were 8 percent more likely to have slept under mosquito net the night before (RBM 2012). Moreover, in Cameroon after the 8 months implementation, it was associated with a 6.6% increase in LLINs use among respondents. Furthermore, it showed 12% increase in last night net use among under-five children of the respondents (Bowen 2013).

The night watch campaign can be adapted in Ethiopia context since it was implemented in similar Sub Saharan Africa countries. Government of Ethiopia is working to eliminate malaria from the country and one of the major vector control strategy is mosquito net use. Therefore, the night watch campaign can bring contribution for malaria program. Government commitment to malaria prevention and control program is an opportunity for this campaign. Another opportunity to implement this campaign program includes, there are a lot development partners working in malaria prevention and control and they can cooperate in the project. The national and local media can be used for message dissemination. Besides, SMS messages can be sent to mobile subscribers in collaborations with Ethio telecom. Artists and celebrities may cooperate in the program as they have been contributed for HIV/AIDS prevention and control communication interventions.

A hung up home visit

A hung up home visit was implemented in Togo. An ITN use eight months after campaign by all individuals, under five children and women of reproductive age was 11.3% to 14.4% greater in the study group that received three intervention visits than the control (Desrochers et al. 2014). A hung up home visit can be implemented in Ethiopia context with the existing health development army and health extension program. HEWs are conducting home visits, but it is not similar to what was done in Togo. Therefore, HEWs and HDAs can implement this program in Ethiopia. It needs only coordination and provision of health education materials; it does not need additional cost for implementation.

4.3.2 Interventions implemented Afar Region of Ethiopia

In the Afar Regional State of Ethiopia, the use of mother coordinators for LLINs distribution and health education on malaria prevention and control had good impact. The evaluation of the intervention showed an increase in

proportion of under five children and pregnant women who slept under mosquito nets the previous night. This intervention can be scaled up to other pastoral communities in Ethiopia and contribute for prevention and control of malaria by enhancing utilization of mosquito nets among the vulnerable groups. Mother groups can be organized and support HEWs since HDA has not been functioning in pastoral communities. This may play a crucial role in mosquito net use among children under five and pregnant women in less privileged pastoral communities.

4.4 Limitation of the study findings

- Shortage of literatures on mosquito net promotion in Ethiopia may influence representatives of the findings
- Most of the studies used are cross-sectional studies and do not show cause and effect relationships
- Grey literatures are used for interventions implemented in Ethiopia to promote mosquito net use
- External environmental factors in conceptual framework were not explored

FIVE: Conclusions and Recommendations

5.1 Conclusions

The study identified health beliefs as an important determinant for mosquito net use. Low awareness, perception and attitude towards mosquito nets and malaria prevention among the community, and limited knowledge of households on malaria prevention and control methods are influencing mosquito net use among under five children and pregnant women. Mosquito net related factors such as availability, affordability, colour and shape of nets are also influencing the utilization.

Furthermore, the study identified lack of targeted and evidence informed strategies of mosquito net promotion in Ethiopia. The health promotion interventions implemented are specifically not targeting under five children and pregnant women's mosquito net use. Therefore, implementing targeted strategies addressing the identified determinants is important to improve mosquito net use by under five children and pregnant women in Ethiopia.

Implementation of targeted interventions in other Sub-Saharan Africa countries for mosquito net promotion showed promising results. Therefore, adapting these interventions in Ethiopia context can improve mosquito net use by under five children and pregnant women.

5.2 Recommendations

Based on the identified determinants and interventions that have promoted mosquito net use in Ethiopia and working interventions implemented in Sub-Saharan African countries the following recommendation are provided.

At Community level

- Strengthen health education during home visits by HEWs on the benefits of mosquito net use
- Strengthen demonstration of mosquito net use to households during distribution
- Use HDAs for sharing of experiences of their mosquito net use with neighbours
- Use HDAs and HEWs for hang up home visits and messages dissemination on mosquito net use
- Involve local leaders in awareness creation activities at community level and use local media for dissemination of messages on mosquito net use

At Program and Policy level

- Design and develop mosquito net use promotion interventions based on an intervention mapping approach
- Develop appropriate messages for mosquito net promotion based on evidences and use celebrities for PSA development at national level
- Mobilize partners and resources, and implement Night watch campaign for mosquito net promotion
- Use multimedia strategies for dissemination of messages for mosquito net use by vulnerable groups
- Avail IEC/BCC materials on benefits of mosquito net use at health facilities and ensure utilization by health workers during ANC counselling
- Provide adequate mosquito nets for households in malaria endemic areas
- Scale up the use of mother coordinator for LLINs distribution and health education on malaria prevention and control activities in pastoral communities
- Implement a hung up home visit after distribution of mosquito nets to ensure utilization by under five children and pregnant women
- Monitor the implementation of mosquito net promotion interventions and take appropriate actions and conduct further research

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7. Annexes

Annex one: Intervention Mapping Steps

