# FACTORS AFFECTING CONTRACTING MALARIA IN CHANKA TOWN, ETHIOPIA

ASSEFA BEYI, BEDADA

GRADUATE SCHOOL OF PUBLIC HEALTH

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DETECTION PROGRAM

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DIRECTED BY PROFESSOR MYUNG KEN LEE

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This certifies that the Master's Thesis

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**Abstract**

Malaria is usually considered as problem of the rural poor and the disease has been overlooked in urban settings due to assumption that economic development in urban areas results in better life conditions, such as improved housing, drainage system and environmental situations that enable urban settings not favorable for breeding of mosquitoes. However, for many African countries, including Ethiopia, in most urban areas, although there is rapid development, they are characterized by poor housing, lack of sanitation and drainage of surface water that would provide conducive situations for vector breeding. Inadequate studies have been conducted as far as urban malaria is concerned in Ethiopia. The purpose of this study is to assess factors contributing to contracting malaria in one of rapidly growing town, Chanka, Ethiopia. So identifying factors affecting contracting malaria in rapidly growing small towns; where public health interventions are minimal is helpful for policy makers and stakeholders to design effective and efficient intervention strategies targeting those settings. 227 households were randomly selected from family folder in five health posts in Chanka town, Ethiopia. Volunteer households were visited and interviewed by using pretested questionnaire. Observation of the household and the surrounding area was one of the main activities conducted by the data collector. The study was retrospective community based cross-sectional household survey which was conducted between the beginnings of March to the end of May 2018. Demographic characteristics, window screened with mosquito wire mesh, indoor residual spray, latrine usage, main materials of rooms' wall and insecticide treated nets usage were investigated using logistic regression analysis in SPSS version 25 against prevalence/morbidity of malaria in the households which was dependent variable. Out of 227 respondents 146(64.3%) were male and 81(35.7%) were female. Majority of the houses of the study respondents, 136(59.9%) interior wall had been sprayed against mosquitoes in the past one year and 91(40.1%) were not sprayed which showed statistically significant difference between sprayed and non-sprayed in contracting

malaria/morbidity. In case of toilet facility used by households, more than half of the study participants 119(52.4%) use latrine with cement slab, while 91(47.6%) of them have no standard toilet facility or used open field. 118(52.0%) and 109(48.0%) of the study participants house room walls were made from cement and mud blocks respectively . In case of screening window with mosquito wire mesh, although it minimizes the contact between people and mosquito it is not statistically significant. This study showed that Factors that affect contracting malaria in rural areas are also there in rapidly growing towns in developing countries; which are supposed to have better housing conditions, environmental situations, surface water drainage and sanitation. Contracting malaria in poor urban areas is affected by several factors such as window screened by mosquito wire mesh, types of material for homes' wall, indoor residual spraying and sanitation facilities. Therefore, attention should be given to those poor urban areas with respect to malaria intervention strategies and further research should be conducted.

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**List of Abbreviations**

| | |
|---|---|
| IRS | Indoor Residual Spry |
| ITNs | Insecticide Treated Nets |
| KOICA | Korean International Cooperation Agency |
| RDT | Rapid Diagnostic Test |
| CI | Confidence Interval |
| OR | Odds Ratio |

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# 1 Introduction

Malaria is one of life-threatening infectious disease which is caused by protozoan parasite called Plasmodium[1]. An estimated 219 million cases of malaria occurred globally in 2017 compared with 239 million cases in 2010 and 217 million cases in 2016. Evidences for the period 2015 to 2017 (estimated 20 million fewer malaria cases) highlight that no significant progress in reducing global malaria burden was made in this timeline[2]. Out of this global burden, WHO African Region accounts 92% which is 200 million cases and 93% of malaria deaths in 2017[2]. Malaria remains one of major causes of mortality and morbidity in sub-Saharan Africa where Ethiopia has contributed for 1.2% of malaria related mortality in Africa and 1.07% of global malaria mortality[3].

It is one of major public health problems in Ethiopia where an estimated 68% of the populations live in malarious areas and three-quarters of the total land mass is regarded as malarious with two-third of the country's population at risk. That is, more than 50 million people are at risk of malaria, and four to five million people are affected by malaria annually[4].

In the Country, Plasmodium falciparum and Plasmodium vivax account for 60-70% and 30-40% of malaria cases, respectively (figure 1). The former has been the major cause of epidemics, and of most malaria deaths. Anopheles arabiensis is the main vector of malaria, and it has a wide geographical distribution. Anopheles pharoensis, Anopheles funestus and Anopheles nili are secondary vectors in some areas[5][6]. Even though much of Ethiopia remains at risk of malaria, routine surveillance data from the last decade have noted declines in malaria outpatient morbidity and inpatient mortality trends. Relatively better access to malaria case management, including laboratory-based diagnosis in remote rural areas, has improved dramatically over the last decade together with surveillance systems that

capture malaria morbidity and mortality. Numerous stakeholders in Ethiopia provide technical expertise and resources to support the Ethiopian Ministry of Health's National Malaria Control Program in achieving malaria prevention, control, and elimination nationwide[7].

Malaria is seasonal in most parts of Ethiopia, with variable transmission and prevalence patterns affected by the large diversity in altitude and rainfall with a delay time varying from a few weeks before the beginning of the rainy season to more than a month after the end of the rainy season. Epidemics of malaria are relatively frequent involving highland or highland border areas of Ethiopia, mainly areas 1,000–2,000 m above sea level. Malaria transmission peaks biannually from September to December and from April to May, coinciding with the major harvesting seasons[8].

The main malaria control strategies in Ethiopia include: early diagnosis and early treatment, discriminatory vector control, epidemic management, and control, environmental management and personal protection through the use of insecticide-treated bed nets[9]. Despite recent efforts to control the disease, malaria remains one of major cause of mortality and morbidity in the country. Nationally, Insecticide Treated Nets (ITNs) and Indoor Residual Spray (IRS) are specific vector control methods to lessen malaria infection by targeting non-outdoor biting of mosquitoes. Even though the methods are found to be operational in malaria control they are not sufficient to eliminate the disease. The major challenges with these two methods are insecticide resistance, misuse of the interventions, host behavior, such as staying outdoor, during early night or sleeping outdoor without using protective measures, and vector behavior including feeding on bovine blood, outdoor biting and outdoor resting[10]. This study was intended whether these factors affect contracting

malaria in urban areas which is usually assumed to be better in sociodemographic, environmental, knowledge and attitude aspects.

Urbanization rate in developing countries like Ethiopia is increasing because of limited infrastructure in rural areas. So that the culture, knowledge and attitude of the people somewhat remain the same as the rural ones but towns are assumed as if they have better housing and environmental conditions where policy makers and stakeholders are showing some sort of unwillingness in giving attention concerning malaria control. The case in Oromia region where this study was conducted is not far from this fact. In the Region about 65% of the population is living in malaria endemic area. Likewise, malaria is among primary causes of outpatient and inpatient consultations and hospital deaths[11].

A large number of studies have attempted to identify household and individual level factors associated with malaria. Factors examined include housing type, proximity to vector breeding site and vector abundance, socioeconomic status, age, occupation, sex, residential mobility and travel, knowledge of malaria, household size, sleeping room density, presence of domestic animals near home, use of preventive methods (e.g., coils, house spraying), bed net use, and local area population density.

Inadequate studies have been conducted as far as urban malaria is concerned in Ethiopia. The purpose of this study is to assess factors contributing to contracting malaria in one of rapidly growing town, Chanka, Oromia Regional Government State, Ethiopia. So identifying factors affecting contracting malaria in rapidly growing small towns; where minimal public health interventions are implemented is important. It will be helpful for policy makers and stakeholders to design effective and efficient intervention strategies

targeting those settings because identification of factors influencing malaria risk in households can guide targeted interventions to control malaria.

### 1.1. Significance of the study

In view of rapidly growing number of small and medium-sized towns in Ethiopia, there is a persistent need to enhance our understanding of contracting malaria in those settings. Like most towns of developing countries; in Ethiopia towns are also characterized by poor housing, lack of proper sanitation, poor drainage of surface water, weak health services and wide spread economic disparity, which independently or together facilitate condition for urban malaria transmission. In order to design and implement cost-effective appropriate interventions, knowledge on local prevalence, distribution of malaria and its influencing factors such as housing condition and sanitation, knowledge and attitude of the community and health seeking behavior in those urban settings are nevertheless principal importance. Therefore, this study was initiated as to assess contracting malaria and associated factors in Chanka Town, Ethiopia. The study will provide understanding of factors that influence contracting of malaria in the town. The information in the study will be an essential component in the effectiveness of Malaria control and Elimination interventions that are currently being scaled up hence it will be used to readjust the effectiveness of Malaria control measures so as to effectively reduce malaria burden and achieve elimination.

### 1.2. Thesis Objectives

The aim within the context of this thesis is to assess factors affecting contracting malaria in rapidly growing small town; Chanka, Oromia Regional State Government, Ethiopia. Assessing factors affecting contracting malaria in those small growing town, where there is no clear difference between rural areas enable policy makers and stakeholders to design effective and efficient public health interventions to reduce malaria burden.

## 2 Methods

### 2.1. Study area and period

Ethiopia is administratively divided in to nine regional states and two chartered cities, which are further sub divided in to zones, sub-cities, town administrations, woredas (districts), and kebeles(wards/villages/neighborhood)[12].

Chanka town is found in Oromia Regional State Government, Qellem Wollega Zone, Sadi Chanka Woreda/District at a distance of 583 km, altitude of 1493m above sea level to West of Addis Ababa which is the Capital City of Ethiopia[13]. Coffee plantation is the main cash crop in the area. The two major malaria transmission periods in the area are from September to December and from April to June; following rainy seasons with higher transmission is during the former period. The study was perforemed from the beginning of March to the end of May 2018, three months period.

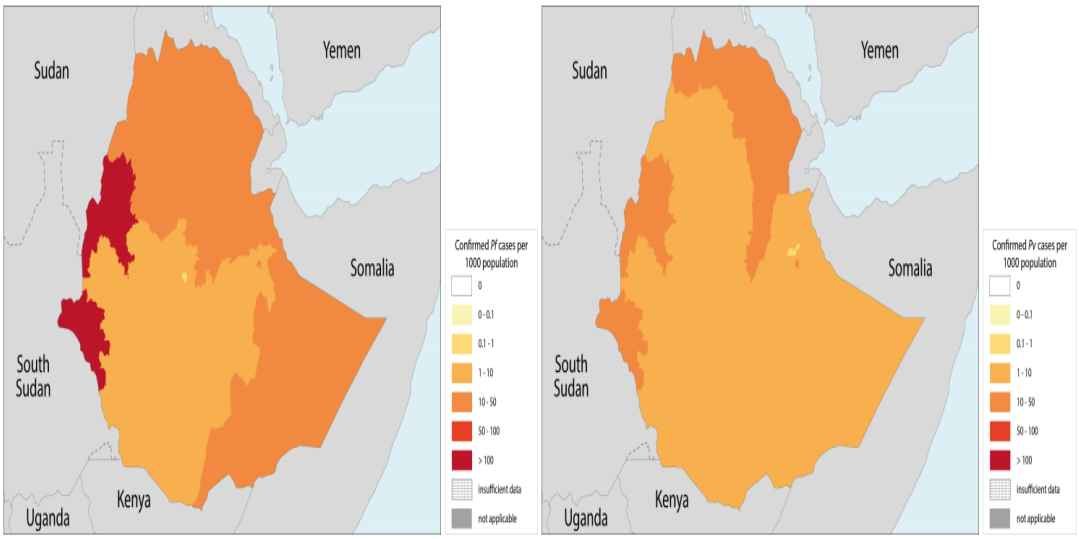


**Figure 1:** Epidemiological Profile, World Malaria Report 2018, WHO

## 2.2. Study population

The study population was all population who were living in Chanka town, Ethiopia during the Survey period. Total population was 91,534. There were 19,070 households out of which 227 individuals (who represent households) were surveyed based on the questionnaire. In Ethiopia there are health posts for each kebeles/neighborhoods where every household has its own family folder; family record about sociodemographic data. In this study Sampling was performed primarily by clustering kebeles/neighborhoods which were five in Chanka town that was followed by random sampling of the households from family folder on the shelf of health posts in each five kebeles/neighborhoods (figure 2). Selection was performed by someone who did not know which folder belonged to which household in order to minimize sampling bias. All households were given informal house numbers which corresponded the family folder. A total of ten Health Extension Workers for the five health posts were assigned to serve 2,500 households each who were supervised by one technical supervisor (the data collector for this study) . Individuals who lived at least one year in the study area were recruited/ included to/in the study whereas those who lived less than one year were excluded from the study.

## 2.3. Study Design

The study is retrospective community based cross-sectional household survey which was conducted from beginning of March to end of May 2018 in five selected kebeles of Chenka town.

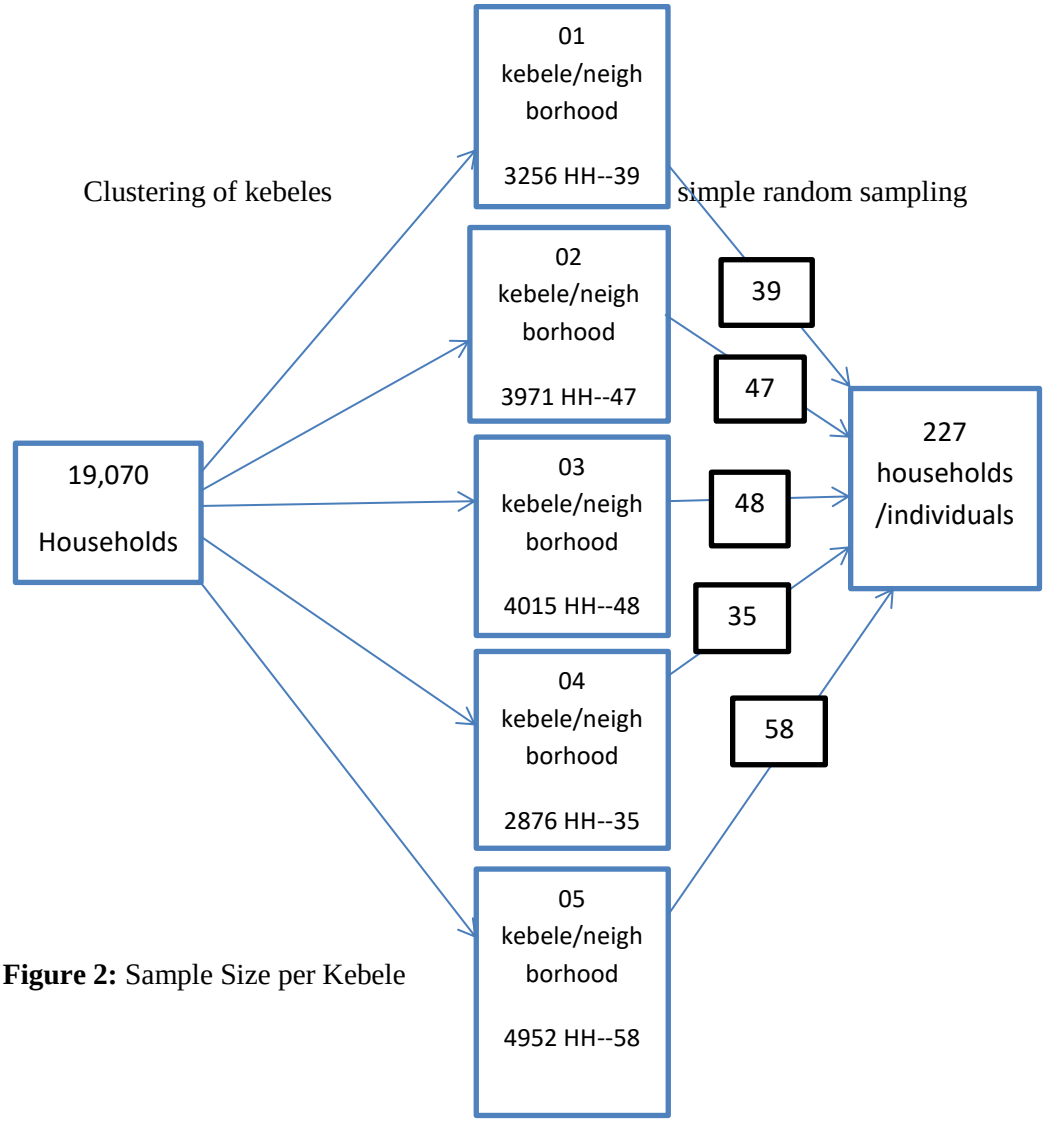


**Figure 2:** Sample Size per Kebele

### 2.4. Data collection, preparation and analysis

Socio-demographic and other malaria related data were collected by using semi structured questionnaire. The questionnaire was adapted by reviewing different literatures and considering the local situation of the study population. It was prepared in English and then translated to Oromic (the local language) and its consistency was checked before data analysis. The data collection tool/questionnaire was close ended type and it contained dichotomous questions which required respondents to make a choice between two alternative responses and multiple choice questions which offered more than two alternatives.

Cross-sectional survey was carried out on randomly selected households where health professional (one data collector; routine technical supervisor of the five kebeles); who knew the locality collected the data based on the questionnaire and observation of the households and their surroundings. Questionnaires were read by the health professional (data collector) to make the issues clear for those who can't read. Malaria contracting/morbidity data was collected if a person lived more than one year in Chanka town was sick of malaria which was diagnosed either by RDT or Laboratory and was given antimalarial treatment. If more than one member of household contracted malaria we only considered later case and if it happened at the same time, we took younger age.

The collected data were coded and entered to computer, using SPSS version 25 statistical packages. Logistic regression and cross tabulation analysis were done for the association. The results are described using frequency tables in numbers, percentages, and summarized using tabular presentation.

# 3 Results

## 3.1. Analysis of background information (socio-demographic) of study participants

**Table 1** socio-demographic characteristic

| Variable | Response/observation | frequency | Percent |
|---|---|---|---|
| Sex | male | 146 | 64.3 |
| | female | 81 | 35.7 |
| Age group | 5 up to 14 | 16 | 7.0 |
| | 15-24 | 23 | 10.1 |
| | 25-34 | 75 | 33.0 |
| | 35-44 | 79 | 34.8 |
| | 45-54 | 21 | 9.3 |
| | >55 | 13 | 5.7 |
| educational status | illiterate | 32 | 14.1 |
| | primary | 65 | 28.6 |
| | secondary | 77 | 33.9 |
| | graduate and above | 53 | 23.3 |
| Occupation | farmer | 32 | 14.1 |
| | government employee | 60 | 26.4 |
| | merchant | 75 | 33.0 |
| | daily labor | 60 | 26.4 |
| Marital status | single | 96 | 42.3 |
| | married | 131 | 57.7 |

| | | | |
|---|---|---|---|
| Family size | 0 | 19 | 8.4 |
| | 1 to 3 | 160 | 70.5 |
| | 4 to 5 | 33 | 14.5 |
| | >5 | 15 | 6.6 |

Based on descriptive statistics, out of 227 study participants majorities were male volunteers 146(64.3%) the rest are female volunteers 81(35.7%), the largest part of them were in 35 to 44 years old 79( 34.8% ) followed by 25 to 34 75 ( 33.0%) and the rest 23(10.1%), 21(9.3%), 16(7.0%), and 13(5.7%) were 15-24, 45-54, 5-14 and > 55 years old respectively. When we came to marital status of the participants the majorities were married 131(57.7%) and the rest were single 96(42.3%). Based on education, majority of the study participants were in secondary education level 77(33.9%), 65(28.6) were at primary level, but from the study participants 53(23.3%) were at graduate and above level whereas 32(14.1) were illiterate (cannot write and read at least one local language). Occupationally, 75(33.0%) of the respondents were worked as merchant. Whereas the rest 60(26.4%), and 60(26.4%) and 32(14.1%) of the study participants were worked as government employee, daily labor and farmer respectively. In the case of family size, 160(70.5%) of the respondents had 1-3 family, and also 33(14.5%) of the respondents had 4-5 family. Whereas the rest 15(6.6%) and 19(8.4%) of respondents had more than 5 and 0 family respectively.

### 3.2. Health seeking behavior (knowledge & information on malaria)

Based on the study result, majority of the study participants 205 (90.3%) said that they heard about an illness called malaria, whereas the rest 22(9.7%) of the participants were not informed about malaria. From total study participants, most of them had understanding on malaria and its transmission. 196(86.3%) of the study participants had knowledge of malaria as a disease and transmission.

Among those who know malaria is transmittable, 176(89.9%) of the respondents were aware of that malaria is transmitted by mosquito bite. Conversely, few respondents; 6(3.1%) said that malaria is transmitted by fly bite. However, some participants 11(5.7%) had misconceptions about the mode of transmission and associated it with eating unhygienic foods. While the rest of the study participants 3(1.3%) had no information about how malaria is transmitted.

The study result indicated that over 120(52.90%) of the respondents believe that children are highly vulnerable to malaria infection. And also 80(35.20%) of the participants said that pregnant women are highly susceptible to malaria infection. Additionally, 20(8.80%) of the study participants believe that sick persons and 7(3.10%) said others like travelers, and youths are highly vulnerable to malaria infection.

Based on the study results more than half of the study participants 133(58.6%) said that there are morbidity associated with malaria in the household within the last one year. While the rest 94(41.4%) said there were no morbidity or mortality associated with malaria in their household during the past one year.

In this study, most of respondents 65.8% are familiar with at least 3 signs/symptoms associated with malaria 155(68.3%), 153(67.4%), 140(61.7%), 45(19.8%), 23(10.1%), 10(4.4%) respondents (multiple response was possible) reported fever, headache,

body/joint pains, dizziness, vomiting and diarrhea respectively, as a common symptoms of malaria.

Majority of study participants 139(61.2%) believe that using ITNs is the best way to prevent malaria. Similarly, 81(35.7%), 94(41.4%), 100(44.1%), and 48(21.1%) respondents said that they can prevent malaria through protecting their environment, destroying the breading sites of mosquito, spraying the house with insecticides, and by keeping the house hygiene respectively.

### 3.3. Attitude related to Risk factors and Malaria Prevention and control

Majorities of the respondents which accounts 130(57.3%) replied and strongly disagreed that malaria is not a serious and life-threatening disease, and 88(38.8%) disagreed. On the contrary, out of the total participants, 9(4.0%) of them were unable to reply on agreement and disagreement of the item which means they are neutral.

Almost all respondents 173(76.2%) have the same opinion on disagreement with the idea all people can't be diseased with malaria, out of which 45(19.8%) cover strongly disagree. Whereas, 9(4.0) of respondents agreed that all people can't be diseased with malaria.

Concerning sleeping under ITNs has problem; 188(82.8%) of respondents prefer to disagree, 22(9.7%) strongly disagree, 9(4.0%) agree and 8(3.5%) of participants prefer to neutral. Majority of respondents 203(89.4%) disagreed that stagnant water and environmental sanitation has no role on malaria prevention, and 8(3.5%) strongly disagreed with this item. From the total population only 9(4.0%) participants were agreed, whereas 7(3.1%) of the total respondents were neutral to answer this question.

Finally about 197(86.8%) disagreed on the issue that visiting health facility is not necessary for malaria disease. On the other hand, 9(4.0%) favored ‘agree’ and 21(9.3%) remain neutral.

### 3.4. Availability and Accessibility of Health Facilities and Health Seeking Behavior

210 (92.5%) of the study participants answered yes for the availability of health facilities near to their vicinity within 10 km radius. While the rest study participants 17(7.5%) answered No for the availability of health facilities near to their locality.

Majority of the study participants 198(87.2%) were prefer to go to health institutes when they get sick with malaria. And also equal number of study participants 7(3.1) prefer to go community health worker and drug shop/pharmacy. But, 15(6.6%) prefer nowhere to go when they get sick with malaria.

The respondents stated that their primary source of information on malaria prevention and control are health workers 107(47.10%), followed by media 104(45.80%), community leaders 9(4.0%), and traditional healers 7(3.1%).

### 3.5. Household & Environmental Risk Factors for Malaria

**Table 2:** Housing condition, common malaria prevention methods and total household, who contracted malaria during last one year of study period

| Variable | Response/observation | frequency | Percent |
|---|---|---|---|
| Morbidity associated with malaria in the household in the past one | Yes | 133 | 58.6 |
| | No | 94 | 41.4 |
| windows screened with mosquito wire mesh | yes | 23 | 10.1 |
| | no | 204 | 89.9 |
| spraying interior wall against mosquitos in the past one year | yes | 136 | 59.9 |
| | no | 91 | 40.1 |
| latrine usage | use pit latrine cement slab | 119 | 52.4 |
| | Not use ‘standard’ latrine | 108 | 47.6 |
| main material of rooms' walls | Cement blocks | 118 | 52.0 |
| | mud blocks | 109 | 48.0 |
| usage of ITNs | yes | 156 | 68.7 |
| | no | 71 | 31.3 |

From table 2 and table 4 which show frequency of the responses/observations of housing conditions and common malaria preventions methods, and statistical analysis results respectively, 136(59.9%) agreed that interior wall of their room has sprayed against mosquitoes in the past one year. While the rest of the study participants 91(40.1%) said that in the past one year the interior walls of their room were not sprayed against mosquitoes. Regression analysis indicates that, there is significant difference between sprayed household and non-sprayed one in contracting malaria (p-value= 0.004, OR=0.367, 95% CI 0.186-0.724).

Most of the study participants 204(89.1%) didn't screen their window with mosquito wire mesh only 23(10.1%) of the households screened their window. Statistical result from logistic regression doesn't show statistical significance in contracting malaria among families with screened window and non-screened one (p-value=0.599, OR=1.330, 95% CI 0.459-3.853).

In the case of toilet facility used by households, more than half of the study participants 119(52.4%) use latrine with cement slab, while 91(47.6%) of the study participants have no standard toilet facility or used open fields. Statistically, there is significant difference in contracting malaria between households who use latrine with cement slab and those who don't use standard latrine with cement slab (p-value=0.001, OR=0.310, 95% CI 0.158-0.607).

118(52.0%) and 109(48.0%) of the study participants house room wall is made from cement and mud blocks respectively. Logistic regression analysis shows that there is no significant difference in contracting malaria between individuals with mud blocks of house rooms and individuals who live in cement wall house (p-value=0.081, OR=0.540, 95% CI 0.270-1.078).

Table 5 illustrates that most of study participants know more than one method that is used to eliminate breeding site of mosquitoes. The study shows that 165(72.70%), 143(63%), 102(44.9%), 98(43.2%) of the study participants said that preventing stagnant water, proper disposal of wastes, changing water found in storage tanks in regular base, and covering containers are the best solution to prevent malaria causing mosquito breeding respectively. While 48(21.10%) of study participants were not informed about any method that is used to control breeding site of mosquitoes.

### 3.6. ITNs ownership, utilization and constraints to use it

The study result indicated that 156(68.7%) % of the study participants used ITNs. In contrary, 71(31.3%) of the study participants did not use ITNs when they were sleeping. Logistic regression analysis indicates that, individuals who are using ITNs while they are sleeping has likely lower chance of contracting malaria than those who don't use ITNs when they sleep (p-value <0.001, OR= 0.101, 95% CI 0.048-.0211) (Table 4).

Among those who used ITNs when they sleep, majority 89(39.2%) of them has 2 ITNS and the rest of the study participants 44(19.4%) and 21(9.3%) had 1 and 3 and above ITNs respectively. This means each household use average 2 ITNs. When we look the frequency of mosquito net usage, only 63(27.8%) of the households used the nets always, while the rest 94(41.4%) of the study participants use the net sometimes.

The respondents identified the source of the ITNs they had acquired in the households. 205 (90.3%) said it was by the local government through clinics, hospitals and community health workers, 11(4.8%) said that they purchased the ITNs they had in their household from shops and pharmacies, and similarly 11(4.8%) said it was donation from NGOs.

The study also tried to assess the reason why the households didn't use ITNs, majority of the participants 37(16.3%) said that the reason why they did not use the nets was afraid of toxicity and 14(6.2%) of the study participants said they didn't use because of absence of bed. While the rest of the subjects 10(4.4%), 7(3.1%) and 3(1.3%) put their reason housing structure not for hugging the net, the weather condition, and ITNs doesn't prevent malaria respectively.

# 4 Discussion

## 4.1. General discussion

Malaria continues to pose a major public health burden in Ethiopia; it is the leading cause of inpatient and outpatient illness and remains an impediment to socio-economic growth and welfare, especially in rural areas[14]. But these days knowing the trend of malaria transmission in urban areas and what factors are affecting contracting the disease is indispensable because there is high rate of urbanization in developing countries like Ethiopia which is usually happened due to search for better infrastructure. Based on the study result more than half 133(58.6%) of the study participants said that there are morbidity associated with malaria in the household within the last one year. More than fifty percent cases with 227 sample size are too big where many efforts have been invested by international and local stakeholders.

Concerning occupational category daily laborers were among more prone in contracting malaria next to farmers because most of the time they come from other areas during coffee harvesting seasons and they spent most of their time in the farm even during night which exposed them to be easily accessed by mosquito. In areas where malaria occurs frequently, individuals may be bitten by infected mosquitos 1,000 times a year. Many people slowly acquire natural immunity[15]. This keeps them from developing severe symptoms. However, until they acquire natural personal defense mechanism, newcomers such as migrants and travelers arriving in malarias areas are highly vulnerable[16]. Farmers were more prone than any other occupation because they spent much of their time in the farm including night to protect their crops from theft during harvesting time which in turn increases chance of exposure to outdoor biting by mosquito.

Most of study respondent agreed that children and pregnant mothers are among vulnerable groups of community. Young children, under five years of age have insufficient natural immunity and are therefore in special need of protection[17]. Pregnant women, especially primigravidas (women who are pregnant for the first time) are also very susceptible because their natural immunity against the disease often declines during pregnancy[18]. Malaria remains important cause of illness and death in children and adults in countries in which it is endemic[19]. From simple descriptive cross tabulation showed in table 3, 65% (13/20) of the study respondents who said sick persons are more prone in contracting malaria were observed to have malaria cases in their household in the last one year. Knowing who is more vulnerable in the community may play important role in protecting those segment of the population against contracting malaria and minimizes the burden in the household.

Related to knowledge and attitude, most of the study participants if not all agreed that malaria is serous and life threatening disease where two third (6/9) of the participants who remained neutral showed contracting malaria, this result was the same for those who agreed malaria can't affect all people; all people can be diseased by malaria and sleeping under ITNs has no problem. Perceptions on malaria are very heterogeneous, can vary from community to community and among individual households[20]. The respondents' knowledge on signs and symptoms of malaria was overwhelming. They were able to mention most of the signs and symptoms associated with malaria. Headache, fever, shivering (body or joint pain), vomiting, loss of appetite and dizziness were some of the most common signs and symptoms mentioned. Corroborate findings from studies conducted in North Central Nigeria[21] and Northern Ethiopia[22] where residents of the study areas showed high levels of knowledge on symptoms of malaria mentioning fever, chills and headache as the most common signs and symptoms. Mentioning common signs and symptoms of malaria

could play important role in seeking treatment among the community which helps to minimize sickness time and mortality.

210 (92.5%) of the respondents were living in areas where health facilities are found to their vicinity within 10 km radius. While the rest of study respondents 17(7.5%) were living in areas where no health facilities were found near to their locality 14 out of 17 showed malaria cases. Despite the fact that nearby households to health facility are more advantageous in utilizing both preventive and curative health services, contracting malaria between households who lived within 10km of radius with health facility and those more than 10km radius was not statistically significant (P-value=0.51, OR=0.280, 95% CI=0.078-1.004). Majority of respondents, 198(87.2%) preferred to go to health institutions when they get sick with malaria. And also equal number of study respondents 7(3.1%) preferred to go to community health workers and drug shop/pharmacy. But, 15(6.6%) prefer nowhere to go when they got sick of malaria. Study on malaria related perception supported the results[21]. This shows that it is also important to think of other institutions other than health facilities where people prefer to go when they get sick in finding cases or data to know the burden of malaria in areas under study.

The respondents stated as their primary source of information on malaria prevention and control was health workers 107(47.10%), followed by media 104(45.80%), community leaders 9(4.0%), and traditional healers 7(3.1%). Those who got information from traditional headers 6/7were found had malaria cases in their household. This result is similar with the study which is conducted in Cameroon[23]. To come to scientific understanding of the community it is crucial to confirm whether certain parties are disseminating appropriate information or not because it can mislead audience to wrong direction which in turn can cost even life with respect to affecting malaria transmission .

Study respondents agreed that avoiding stagnant water and applying good environmental sanitation has role in prevention of malaria. Likewise, marshy and poorly drained environments affect the health and wellbeing of the residents. Malaria is highly prevalent within zones of low environmental quality such area exhibit high rate of malaria mainly due to indiscriminate waste disposal, marshy environments and the availability of stagnant water that propagates mosquitoes[24].

Certain types of housing may influence malaria transmission. Greater exposure to the outdoor (lack of windows or screens, for example), may increase contact between an individual and mosquito vector. Similarly, presences of particular structural features that limit contact with mosquito are likely to reduce infection[25]. The study, even though screening the window is so important to decrease contact between an individual and mosquito, illustrated that, most of the study participants 204(89.9%) didn't screen their windows with mosquito wire mesh and it was not statistically significant (there was no difference in contracting malaria between households which screened their window against mosquito and those who didn't have screened window) as well (p-value= 0.599, OR=1.330, 95% CI=0.459-3.853). Even though, mechanical barriers are well known to protect against mosquito biting it is statistically violated in this particular study.

In the case of toilet facility used by households, more than half of the study participants use latrine with cement slab, whereas, the rest of study respondents have no standard toilet facility or used open field which may expose a person to be bitten by mosquito during visiting toilet at night time[26]. The study indicated that there was statistically significant difference between households with standard toilet facility and substandard one in contracting malaria (p-value= 0.001, OR=0.310, 95% CI= 0.158-0.607). Therefore, toilet facility is among the factors which may influence contracting malaria among the households.

Concerning type of material for constructing wall of the houses, cement or mud block wall of a room can influence effectiveness of sprayed chemical against mosquito[27]. IRS is considered as effective means of mosquito (vector) control which involves spraying internal walls and ceilings of dwellings using insecticides with residual action (i.e. insecticides that remain on the surface for a long time). The effectiveness of this control method depends to a large extent on the vector's sensitivity to insecticide used and how much they like to rest indoors. Sprayed chemical effectiveness against mosquito can easily be compromised by material for homes' wall. Mud block walls are so porous and cannot be uniformly sprayed by the chemical which enables mosquito not to be accessed by the chemical. In this particular study participants who were living in homes whose walls are made of muds were not statistically (P= 0.081) different (significant) in contracting malaria when compared with those who lived in cement brick walls. Even though IRS is effective proven strategy of preventing malaria there is no statistical significance between households whose houses were sprayed and which were not sprayed in this particular study.

In this study majority of the households were using ITNs to be protected from mosquito biting and the statistical analysis showed that there were significant difference between households who used ITNs and those who didn't use it during night(p-value=0.001, OR=0.101, 95%CI= 0.048-0.211). The Net acts as physical barrier, preventing access by mosquitoes and thus proving personal protection against malaria to individual(s) using it. The use of bed nets reduce the degree of human-vector contact and malaria transmission and the prevalence of malaria infection can be significantly lowered by the use of insecticide impregnated bed nets[10]. The study proved that using ITNs is one of the factors that can affect contracting malaria in particular households.

In case of number of ITNs used by household, most respondents mentioned that they were using two, 90 out of 156 (57.7%), where 70.5% of the household have 1-3 family

size and only 40.1% of the households always use. Other studies showed that family size and number of ITNs are directly proportional and continuous utilization is important[28][29].

The study also tried to assess the reason why the households didn't use ITNs and reached on majority of the participants said that the reason why they did not use was afraid of toxicity. Strong health education strategies need to be implemented to increase awareness of the community.

## 4.2. Strength and limitations

### 4.2.1 Strength of the study

Most of the studies are conducted in rural settings, following government attention with respect to intervention strategies. But this particular study focused on urban setting where little attention is given by assuming sanitation, environmental condition, surface water drainage, housing and educational status, knowledge and attitude are better, where the reality does not reflect the fact.

### 4.2.2 Limitation of the study

Contracting malaria does not show the actual prevalence of malaria in the town which is simply identified by RDT and cured after antimalarial drug was given. ITNs utilization was not objectively observed because of night time use except observing it while it was actively hanged above sleeping place on the ceiling of the roof. Travel history (for some short period) of the household member who might contract malaria was not traced by this study because if a person contracted malaria from other place during his/her journey it might mislead the generalization.

## 5 Conclusion

Even though urban areas, in developing countries are assumed relatively good in housing condition, environmental situations and common malaria control methods, the reality does not reflect the situation. Because major factors such as window screen for mosquito prevention, toilet facility, material used for making wall of the house, indoor residual spray and insecticide treated bed net utilization are affecting household residents in those settings like they commonly affect rural communities in contracting malaria. Therefore, considering these findings will help policy makers and stakeholders to give financial and resource attention to those urban settings without generalizing that they are in a better condition than rural areas in malaria control and prevention.

Our study showed that, housing condition, sanitation aspects and common malaria control and prevention methods affect urban areas in developing countries in contracting malaria but types of dominant malaria species epidemiology and status of detailed magnitude of the prevalence need further research.

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# 7. Appendices

**Table 3**: socio-demographic status of study respondents versus household morbidity associated with malaria with respect to response/observation

| Variables | Response & Morbidity associated with malaria in the household in the last one year | p-value | OR(95% CI) |
|---|---|---|---|
| Sex | Male (n=146, 81/146=55%) | 0.631 | 0.737(0.212,2.564) |
| | Female (n=81, 52/81=64%) | | |
| Marital status | Single (n=96, 62/96=65%) | 0.989 | 1.008(0.328,3.194) |
| | Married (n=131, 71/131=54%) | | |
| Age group | 5-14(n=16, 10/16=63%) | | |
| | 15-24(n=22, 16/22=73%) | | |
| | 25-34 (n=76, 38/76=50%) | | |
| | 35-44 (n=79. 49/79=62%) | | |
| | 45-54 (n=21, 15/21=71%) | | |
| | >55 (n=13, 5/13=38%) | | |
| Educational status | Illiterate (n=32, 27/32=84%) | | |
| | Primary (n=65, 37/65=57%) | | |
| | Secondary (n=77, 41/77=53%) | | |
| | Graduate & Above (n=53, 28/53=53%) | | |

| | |
|---|---|
| Occupation | Farmer (n=32, 27/32=84%) |
| | Employee (n=61, 28/61=46%) |
| | Merchant (n=74, 31/74=42%) |
| | Daily laborer (n=60, 47/60=78%) |
| Family size | 0(n=19, 4/19=21%) |
| | 1 to 3(n=160, 89/160=56%) |
| | 4 to 5(n=33, 26/33=79%) |
| | >5 (n=15, 14/15=93%) |

**Table 4:** Housing situations and Malaria intervention methods versus contracting malaria from descriptive cross-tabulation and logistic regression statistical analysis

| Variables | Response & Morbidity associated with malaria in the household in the last one year | p-value | OR (95% CI) |
|---|---|---|---|
| Latrine usage | Use standard latrine with cement Slab (n=97, 38/97=39%) | .001 | 0.310(0.158,0.607) |
| | Not use standard latrine(or with no Cement slab) (n=130, 95/130=73%) | | |
| Window screened with mosquito wire mesh | Yes (n=21, 11/21=52%) | .599 | 1.330(0.459,3.853) |
| | No (n=206, 122/206=59%) | | |
| Spraying interior wall against mosquito in the past one year | Yes (n=112, 51/112=46%) | .004 | 0.367(0.186,0.724) |
| | No (n=115, 82/115=71%) | | |
| Main material of rooms' walls | Cement blocks (n=118, 54/118=46%) | .081 | 0.540(0.270,1.078) |
| | Mud blocks (n=109, 79/109=72%) | | |
| Usage of ITNs | Yes (n=125, 44/125=35%) | <.001 | 0.101(0.048,0.211) |
| | No (n=102, 89/102=87%) | | |

**Table 5:** Knowledge and attitude and health service accessibility with respect to malaria cases

| Variables | Response & Morbidity associated with malaria in the household in the last one year | p-value | OR(95% CI) |
|---|---|---|---|
| Knowledge of the respondents about malaria | Heard about Malaria (n=205, 116/205=57%) | .028 | .094(0.011,0.0772) |
| | No information about malaria (n=21, 16/21=76%) | | |
| Transmissibility of malaria | Yes (n=196, 110/196=56%) | .031 | .175(0.036,0.855) |
| | No (n=31, 23/31=74%) | | |
| Malaria is not a serious & life-threatening disease | Strongly disagree (n=130, 72/130=55%) | | |
| | Disagree (n=88, 58/88=66%) | | |
| | Neutral (n=9, 3/9=33%) | | |
| All people can't be diseased with malaria | Strongly disagree (n=45, 26/45=58%) | | |
| | Disagree (n=173, 101/173=58%) | | |
| | Agree (n=9, 6/9=67%) | | |
| Sleeping under ITNs has problem | Strongly disagree (n=22, 11/22=50%) | | |
| | Disagree (n=188, 108/188=57%) | | |

| | |
|---|---|
| | Neutral (n=8, 6/8=75%) |
| | Agree (n=9, 8/9=89%) |
| Stagnant water & environmental sanitation has no role on malaria prevention | Strongly disagree (n=8, 4/8=50%) |
| | Disagree (n=203, 119/203=59%) |
| | Neutral (n=7, 2/7=29%) |
| | Agree (n=9, 8/9=89%) |
| Visiting health facility is not necessary for malaria disease | Disagree (n=197, 113/197=57%) |
| | Neutral (n=21, 12/21=57%) |
| | Agree (n=9, 8/9=89%) |
| Mode of transmission | Mosquito bite (n=204, 113/204=55%) |
| | Fly bite (n=7, 6/7=86%) |
| | Unhygienic food (n=13, 11/13=85%) |
| | I don't know (n=3, 3/3=100%) |
| Signs/symptoms associated with malaria | Fever (n=155, 91/155=59%) |
| | Headache (n=153, 92/153=60%) |
| | Body/joint pain (n=140, 89/140=64%) |
| | Dizziness (n=45, 31/45=69%) |
| | Vomiting (n=23, 10/23=43%) |
| | Diarrhea (n=10, 2/10=20%) |
| Malaria prevention | By cleaning house (n=48, 33/48=69%) |

| | |
|---|---|
| methods | Use insecticide sprays (n=100, 59/100=59%) |
| | Destroying the breading sites (n=94, 55/94=59%) |
| | Environmental cleanliness (n=81, 44/81=54%) |
| | Use ITNs (n=139, 79/139=57%) |
| Available health facility to the vicinity within 10 k | Yes (n=210, 119/210=57%) |
| | No (n=17, 14/17=82%) |
| Where did the client prefer to go in case he/she got sick | Health institutions (n=198, 121/198=61%) |
| | Community health workers (n=7, 4/7=57%) |
| | Drug shop/pharmacy (n=7, 3/7=43%) |
| | Nowhere (n=15, 5/15=33%) |
| Main source of Information for malaria prevention & control | Health workers (n=107, 61/107=57%) |
| | Media (n=104, 63/104=61%) |
| | Community leaders (n=9, 3/9=33%) |
| | Traditional leaders (n=7, 6/7=86%) |
| Knowledge of mosquito breading site reduction methods | Prevent water stagnation (n=165, 88/165=53%) |
| | Covering containers (n=98, 56/98=57%) |
| | Changing water in storage tanks (n=102, 58/102=57%) |
| | Dispose waste properly (n=143, 85/143=59%) |
| Number of ITNs used by household | 1 (n=44, 29/44=66%) |
| | 2 (n=89, 42/89=47%) |

| | |
|---|---|
| | 3 and above (n=21, 3/21=14%) |
| Frequency of using ITNs | Always (n=63, 0/63=0%) |
| | Not always (n=94, 76/94=81%) |
| Source of ITNs acquired by households | Government (n=205,117/205=57%) |
| | Shopping (n=11, 7/11=64%) |
| | NGOs (n=11, 9/11=82%) |
| The reason why they are not using ITNs | Afraid of toxicity (n=37, 30/37=81%) |
| | Absence of bed (n=14, 12/14=86%) |
| | Weather (n=7, 5/7=71%) |
| | Housing structure affects net Use (n=10, 9/10=90%) |
| | Nets do not prevent malaria (n=3, 3/3=100%) |
| Who do you think is more vulnerable in community in contracting malaria in your area? | Children (n=120, 62/120=52%) |
| | Pregnant women (n=80, 51/80=64%) |
| | Sick persons (n=20, 13/21=65%) |
| | Others (n=7, 7/7=100%) |

**Operational definition of terms and local terminologies**

- **Illiterate**:-those who cannot read and write at least local language
- **Primary education**:-from grade 1 to 8
- **Secondary education**:-from grade 9 to 12
- **Graduate and above**:-at least college certificate and above
- **Daily laborer**:-those who are working under physical hardship and paid based on performance
- **Zero family size**:-those who do not have child/children
- **Single**: unmarried, divorced , widowed and separated marital status
- **Substandard latrine**:-latrine which is made of no cement slab just by digging the ground and covered with wood and doesn't have any shade as upper structure/open
- **Kebele**:-the smallest administrative unit of community living in one big neighborhood which contains 3000 to 5000 households
- **Woreda:**- District
- **Contracting malaria/morbidity:**-a person or household member contracted malaria/sick by malaria if he/she was diagnosed with either RDT or laboratory and given antimalarial treatment in the last one year.