Addis Ababa University
Faculty of Medicine
Department of Community Health

Prevalence of Malaria and its influencing factors in Awassa District, Southern Ethiopia.

By

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List of Acronyms

ACT: Artemesinin Combination Therapy

An: Anopheles

API: Annual Parasite Index

DDT: Dichlorodiphenyltrichloroethane

DHS: Demographic and Health Survey

HH: House Hold

HP: Haemoparsite

IEC: Information Education Communication

IRS: Indoor Residual Spraying

ITNs: Insecticide Treated bed Nets

MOH: Ministry Of Health

PF: *Plasmodium falciparum*

PV: *Plasmodium vivax*

SNNPR: Southern Nation Nationalities and Peoples' Region

SP: Sulphadoxine-Pyrimethamine

WHO: World Health Organization

ABSTRACT

Malaria is a leading public health problem in Ethiopia where an estimated 68% of the population lives in malarious areas. In 2005, malaria has been reported as the first leading cause of morbidity & mortality accounting for 48% of out patient consultation, 20% admissions and 24.9% inpatient deaths. It has also been documented in the nationwide child survival study that malaria affected school attendance by 20% and contributes to 47% of the child deaths in Ethiopia.

Knowledge on local malaria situations is an important step in planning intervention and control activities since the transmission dynamics and determinants differ from place to place and in time. In the study area there is scarcity of community based studies which could provide recent information on the epidemiology of malaria for planning and implementation of effective prevention and control activities.

A cross sectional study was carried out in Bushulo, Awassa District ,Sidama Zone, SNNPR from February 2006 to May 2006 with the objective to estimate prevalence of malaria and Factors influencing it.

A total of 487 children and 200 households were studied from four rural localities selected by simple random sampling and using proportional to size allocation to each locality. The response rate was 98.2%. Household and clinical data were collected using semi-structured questionnaires and a format was used for laboratory data. Blood samples were taken with aseptic technique from 487children 2 -9 years of age for microscopy.

Results of the study revealed that malaria parasite rate was 3.9% (95% CI: 2.4-6.1) where as fever rate and spleen rates were 9% (95% CI: 6.7-12) and 10.9% (95%CI: 8.3-14) respectively. Household ITNs prevalence was 39%. Multivariate logistic regression analysis was done to identify risk factors and the result revealed that family size ≤5 (p value<0.05), child's age 2-5 years (p value<0.05) and residing in houses with corrugated Iron sheet roofs (p value <0.05) were found to be associated with higher risk of getting malaria (parasite rate).

Residing in a locality called "Finchawa" (p value<0.05) and distance of settlement within less than 1km from Lake shore of Awassa (p value<0.01) were associated with a higher risk of malaria (spleen rate).

As the proportion of partially immune population is very low in hypoendemic areas, these localities are prone to waves of epidemics. In areas where the option of environmental manipulations may be difficult especially after the major rainy season, it is advisable to apply indoor residual spraying up to a distance of 1km to effectively use scarce resources and minimize environmental contamination. Awareness creation for the proper use of ITNs and community mobilization is needed for environmental manipulation where possible. Prompt diagnosis and effective treatment, as well as, where environmental manipulations are difficult as in communities residing near Lake Awassa, Indoor residual spraying is advised to be applied prior to the rainy season to prevent and control epidemic outbreaks.

1. Introduction

Malaria causes an estimated 300 to 500 million cases and 1.5 to 2.7 million deaths each year worldwide and Africa shares 80% of the cases and 90% of deaths(1). *Plasmodium falciparum* is by far the most aggressive species, distributed globally especially common in Africa (1, 2).

Malaria is a leading public health problem in Ethiopia where an estimated 68% of the population lives in malarious areas (3). In 2003 the disease was the primary cause of reported morbidity and mortality accounting for 15.5% of out patient visits , 20% of hospital admissions and 27% of hospital deaths(4). Malaria transmission in Ethiopia is unstable and characterized by frequent and often large-scale epidemics (3, 5). In 2003, large scale malaria epidemics occurred from April to December resulting in 2 million clinical and confirmed cases and 3000 deaths, affecting 3368 localities in 211 districts(3).

Over the last five years (2001 – 2005) the proportion of malaria in out patient department, admission and in-patient deaths has been increasing with the highest being recorded in 2003 and 2004 while a slight reduction was observed in 2005. In 2005, malaria was still the first leading cause of health problem accounting for 48% of out patient consultations, 20% admissions and 24.9% inpatient deaths(3). It has also been documented in the nationwide child survival study that malaria affected school attendance by 20% and contributes to 47% of the child deaths in Ethiopia(3).

The annual average number of malaria cases reported over the period from 2001 – 2005 was 9.4 million (range 8.4 – 11.5) while the annual average number of confirmed cases was 487,984 (range 392,419 – 591,442). In addition to this, an estimated 36% of the

population is out of the reach of the health service coverage. Therefore, the actual number of malaria cases that might occur annually throughout the country is estimated to be higher (3).

P.falciparum and *P.vivax* are the main species accounting for 60% and 40% of malaria cases (6). *Anopheles arabiensis* is the major malaria vector followed by *An. pharoensis* and other secondary vectors include *An.funestus* and *An. nili* (5, 6).

Malaria control is a big challenge due to many factors. The complexity of disease control process, expensiveness of the control program, resistance of the parasite to antimalarial drugs and vectors to insecticides are some of the challenges. There is a variation of disease patterns and transmission dynamics from place to place, by season and according to climate and environmental circumstances. The approaches in the planning and implementation of prevention and control activities also vary based on local realities (5).

To design and implement cost effective appropriate interventions, knowledge on local prevalence and distribution of malaria is of paramount importance. In this regard, there was scarcity of information since there were no community based studies in Awassa District, Sidama Zone. Hence, a cross-sectional study was carried out from February 2006 to May 2006 in Awassa District, Sidama Zone, SNNPR and the objective was to assess prevalence of malaria and its influencing factors in the study area.

2. Literature Review

Malaria morbidity and mortality

Despite Considerable progress in malaria control over the past decade, malaria remains a serious problem particularly in Sub Saharan Africa. An estimated 300 million to 500 million cases and 1.5 to 2.7 million deaths occur world wide each year due to malaria, and over 2400 million remain at risk(1) . In the last decade, the prevalence of malaria has been escalating at an alarming rate, especially in Africa. One of four childhood deaths in Africa is caused by malaria and 80% of global malarial morbidity and 90% of malarial deaths occur in Sub Saharan Africa (1, 2).

Dramatic reductions in the annual parasite index (API) achieved by pilot IRS projects in many parts of the world inspired the world Health Assembly to adopt malaria eradication as a goal in 1955. However, the goal of eradication proved elusive in most malaria endemic countries in the tropics (7, 8). A number of factors appear to be contributing to the resurgence of malaria which include: resistance of parasite to drugs, conflicts forcing mass migration of people to or from malaria endemic areas, migration of non– immune people to endemic areas for agricultural reasons, changing rainfall patterns favoring mosquitoes breeding, adverse socioeconomic conditions leading to inadequate health budget to fight malaria, high birth rate leading to a rapid increase in susceptible population of under 5 children and changes in behavior of vectors and resistance to insecticides(9).

In Ethiopia, malaria stands as the leading cause of morbidity and mortality where three quarters of the landmass is regarded as malarious and nearly 68% of the total population live in malaria risk areas(3). In 2003 the disease was the primary cause of reported morbidity and mortality accounting for 15.5% of out patient visits , 20% of hospital

admissions and 27% of hospital deaths(4). Malaria transmission in Ethiopia is unstable and characterized by frequent and often large-scale epidemics (3, 5). In 2003, large scale malaria epidemics occurred from April to December resulting in 2 million clinical and confirmed cases and 3000 deaths, affecting 3368 localities in 211 districts(3).

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Changes have been observed in the epidemiology of malaria through time. Previously, malaria was known to occur in areas below 2000m a.s.l, but currently it has been documented to occur indigenously even in areas above 2400m a.s.l, such as Addis Ababa and Akaki (10,11). *Plasmodium falciparum* is the dominant species followed by *P. vivax*. These two species account for 60% and 40% of all malaria cases respectively. *P.malariae* accounts only for less than 1% of cases and is restricted in distribution. *P.ovale* is rarely

reported (3). However, the relative frequency of the species varies from place to place and from season to season. *P.falciparum* accounts for 69% of confirmed malaria cases in SNNPR, while in other regions ranging from 36% in Addis Ababa to 84% in Harari(4). *P.falciparum* is responsible for most, if not all, epidemics of malaria in Ethiopia. *An. arabiensis* is the main vector and *An. pharoensis*, *An. funestus* and *An. nili* are considered secondary vectors (5, 6).

Prevention and control

Prevention and control activities as guided by the National Strategic Plan (2006-2010) include: I) Early diagnosis and effective treatment II) Selective vector control mainly through the use of ITNs and IRS, III) Epidemic prevention & control IV) IEC & BCC on malaria V) Human resource development VI) Health Management & Information System VII) Monitoring & evaluation VIII) Operational Research (3) .

Physical health service coverage of Ethiopia is 64% and a significant segment of the population does not utilize the already available health services (4). Studies have shown that *Plasmodium falciparum* malaria was resistant to Sulphadoxine-pyremethamine (SP) which had been the first line anti malarial drug for the past few years (12). This has triggered a shift to more effective antimalarial, particularly, Artemisinin combination therapy (ACT); now the first line treatment for uncomplicated falciparum malaria is Artemether Lumefantrine (12). But, shortage of the new anti malarial drugs poses a problem for prompt & effective treatment of cases in some areas. For instance, it was only 43% of the total doses needed for 2004/05 that was available in the Southern Nations, Nationalities & Peoples' Region (13).

Chemical spray of houses is done just before the transmission season to prevent epidemics

and check seasonal peaks. DDT is used for indoor spraying of houses and organophosphates use is limited to areas where DDT resistant vectors are detected. As the trend of malaria changes over time, there should be a strong monitoring system for the effectiveness of the insecticides used (5).

Insecticide treated nets (ITNs) are used for personal protection against malaria. Currently, ITNs are provided at highly subsidized price or free of charge, to population groups at higher risk such as non - immune settlers moving to malaria endemic areas, children under five years and pregnant women(12). Estimates of ITNs coverage from a national survey show that household ITNs possession (at least one ITN per household) was 24 %(14).

Prevalence of malaria

Point prevalence of malaria, expressed by the parasite rate, is by far the most commonly available measure of malaria endemicity. It has been widely used as proxy for transmission intensity over several decades (15). The principal drawback to using parasite rate is that they are liable to vary significantly over time, particularly in areas of unstable malaria transmission. Some of variability associated with parasite rates can be avoided by using spleen rates (the prevalence of enlarged spleens). These reflect chronic and latent infections in partially immune hosts and as such provide an indication of prevailing levels of malaria endemicity in the sample population (15, 16).

A study conducted in Khartoum has shown parasite rate of 0.21%and spleen rate of 0.17 %(17). From cross sectional malaria prevalence surveys in Southern Mozambique, parasite rate and spleen rate were 35.3% and 23% respectively, in the first survey(Feb 1997) and in the second survey conducted in October 1997 the parasite rate was 24.2%,

while, the spleen rate was 24.9% showing little variation in contrast to the parasite rate(18). In another study conducted in Prabis, Guinea-Bissau level of malaria endemicity determined using parasitemia and spleen rate during rainy and dry seasons revealed that 49% of villages during rainy season and 71% of villages during the dry season were mesoendemic as measured by the parasite rate. Where as, 92% of the villages during the rainy season and 90% of the villages during the dry season were mesoendemic as measured by spleen rate (19).

Splenomegaly

Acute clinical episodes of malaria can cause splenomegaly which regresses after the infection has been treated or resolved; but when malaria infections are recurrent, splenomegaly does not regress between attacks, and a high proportion of children resident in malaria-endemic areas have enlarged spleens (23)

Spleen examination is one of the earliest methods for estimation of the amount of malaria in a given locality by determining the proportion of persons with palpable enlargement of the spleen. This method has been introduced by Dempster in India in 1848 and is still commonly used. The objective of the palpation of the spleen is to determine not only the percentage of Spleen with lowest point palpable beyond the lower limit of class 4 individuals with demonstrable enlargement of the organ but also the approximate degree of splenomegaly (24).

Two techniques of spleen palpation are used. In one the individual is examined lying down, with the examiner seated on the subject's right, so that the right hand can explore the splenic region below the left costal margin. The second method, less cumbersome in the field, has the subject standing, with the examiner sitting on a low stool in front of the examined person. The examiner's right hand gently explores the left side of the abdomen

from below the umbilicus towards the costal border. If no spleen is palpable, the subject is requested to breathe deeply, while the exploring hand attempts to feel the tip of the spleen by pressing the abdomen under the costal border (24). The proportion expressed as a percentage) of enlarged spleens in a sample of the population is known as the spleen rate and is a crude but nevertheless valuable measure of endemic malaria. Usually the spleen rate is determined in children 2-10 years of age; this is because the enlargement of the spleen is greatest when the immune response is building up.

For the determination of the degree of enlarged spleens Hackett's method of arbitrary classification of the size of the palpated spleen is generally accepted according to the criteria given in the table below (24):

Classification of sizes of the spleen according to Hackett

Class of spleen	Description
0	Normal spleen not palpable even on deep inspiration
1	Spleen palpable below the costal margin, usually on deep inspiration
2	Spleen palpable below the costal margin, but not projected beyond a horizontal line half way between the costal margin and the umbilicus, measured along a line dropped vertically from the left nipple
3	Spleen with lowest palpable point projected more than half way to the umbilicus but not below a line drawn horizontally through it.
4	Spleen with lowest palpable point below the umbilical level but not projected beyond a horizontal line situated half way between the umbilicus and the symphysis pubis
5	Spleen with lowest point palpable beyond the lower limit of class 4

Socio-demographic factors

Age dependence of malaria

Many studies have shown that malaria is not a common cause of death among children under the age of 6 months and that in malaria endemic areas; very young infants rarely contract malaria (25, 26). This protection has mainly been attributed to transplacentally acquired malaria antibodies, as well as to other biological factors. However, after six months of age, unprotected infants suffer repeated and severe attacks that become milder as they grow older. A study in Nigeria; first infections were contracted during the second half of the first year of life (26). These findings also showed that malaria parasite rates and densities increased rapidly until the age of 6 months and thereafter decreased gradually until one year of age. Otherwise, the proportion of infected infants increases with age, with a tendency to plateau after the age of 4 months and the prevalence of hyperparasitaemia (parasite density greater than 10 000 mL) also shows an increase with age over the first 6 months in an area of very high transmission intensity (27).

In all areas of high malaria endemicity, the incidence of clinical malaria is highest in young children (under two years of age) with an average of two to six malaria attacks per year (28) and both the incidence and the severity of the disease decreases considerably thereafter. By the age of five years, immunoprotection is reflected by a low rate of malaria attacks despite frequently high parasite densities (26).

Climatic and geographical parameters and malaria

Malaria is governed by a large number of environmental factors, which affect its distribution, seasonality and transmission intensity (22)

The peak in morbidity and mortality is generally obtained in the rainy season, the time when malaria transmission is at its peak, and the number of deaths during this period has been shown to be over threefold higher than in the rest of the year (29).

The relationship between malaria vector density and the distance of a settlement from a river is an important indicator of malaria transmission. In The Gambia ITN study, there was an inverse relationship between the numbers of mosquitoes in a village and the distance of settlement from the river (30)

Socio-economic parameters

Mosquito net use and malaria

A close association has been observed between people's perception of the cause of malaria and the type of protective measure used. In a longitudinal cohort study in Kenya, 8.5% of women reported using a bed net regularly, 17.5% burned mosquito coils, 2.7% used an insecticide spray, and 12.1% reported burning dung or leaves. Overall, 67% of the women reported not taking protective measures on a regular basis, and only 5% reported using more than one method regularly (31)

An intervention trial conducted in young children (1-9 years) in a rural area of The Gambia to assess the impact of the traditional use of bed nets on malaria morbidity has found no significant difference in the incidence of clinical attacks of malaria or in any other malariometric measurements between the 2 groups of children (one group sleeping under bed nets and the second without bed nets). Thus, bed nets were considered not very effective in reducing malaria morbidity in this group of children (32).

On the other hand, other studies on Insecticide Treated Nets (ITN) undertaken in different African and Asian countries have consistently documented significant reduction in the rate of malaria parasitaemia and malaria morbidity (33, 34).

In order to plan and implement cost effective malaria prevention and control activities, the importance of accurate information on the epidemiology of malaria is unquestionable.

Accordingly, there was no community based study which shows the true picture of prevalence of malaria and its influencing factors in Awassa Woreda. Therefore, in this study both parasite and spleen rates were used to measure prevalence and its influencing factors in the study area.

3. Objective

General Objective

- To estimate prevalence of malaria and identify factors influencing it.

Specific Objectives

- To estimate prevalence of malaria by spleen rate and parasitological rate.
- To estimate household insecticide treated bed nets possession coverage
- To identify factors that influence prevalence of malaria.

4. Materials and Methods

4.1. Study area and Population

The study was conducted in Awassa Zuria Woreda of Sidama Zone; Southern Nations, Nationalities and Peoples' Regional State. Awassa Woreda has a population of 498,534 residing in an area of 920.8 sq km making the population density 525 people /sq km. The rural population accounts for 75.2 % of the Woreda`s total population. The area has three geloclimatic zones. Dega (highland > 2500m altitude a.s.l) accounts for 33%, Weinadega (mid-land 1500-2500 m altitude a.s.l) constitutes 44% and kola (low land < 1500 m a.s.l) accounts for the remaining 23%. The Woreda Town, Awassa, is 275 kms south of Addis Ababa. There are 5 health centers, 29 health stations, 14 health posts, 9 pharmacies, 8 drug shops and 25 rural drug vendors with potential health service coverage of 42.7 %. Among ten top diseases in the District, malaria is the leading cause of morbidity and mortality (20). The study area (Bushulo Heath center's catchments) has 5 peasants' associations with a total population of 31840 and 6367 households. Localities called "Jara Damuwa" and "Jara Gelelcha" are adjacent to each other and they have the same topography. "Jara Damuwa" has small number of households. In this study, these two kebeles were treated as one for analysis purposes. Therefore, the total number of localities would be four and the common name for the above mentioned localities in this study is "Jara".

4.2. Study Design

A cross-sectional study was conducted from February 2006 to May 2006 in Awassa Zuria Woreda, Bushulo major health center catchment's area to estimate prevalence of malaria and identify factors influencing it. The study units were children age 2-9 years old drawn from all kebeles using probability proportional to size allocation.

4.3. Sample size determination

The formula for calculating sample size was: $n = Z(\alpha/2)^2 \frac{p(1-p)}{d^2}$

Assumptions

Based on the District data, prevalence was assumed to be 12% (21) and other assumptions were as follows:

- C.I=95% α=0.05
- Precision (d) =0.03 then, the sample size (n) =451
- Non-response rate (10%) = 45
- Total Sample size = 496

4.4. Inclusion and Exclusion Criteria

4.4.1. Inclusion criteria

- Children age 2-9 years old residents in the area for at least two years.

4.4.2. Exclusion criteria

- Children who came from another area and lived for less than two years.

4.5. Sampling Procedures

Based on proportional to size allocation sample size of children to be drawn from each kebele was determined. Then, by dividing the sample size to the average number of children 2-9 years of age per household, the number of households to be selected from each kebele was determined. Finally, simple random sampling method was employed to select households from each kebele's household registry using a table of random numbers. Then, children 2-9 years of age who were members of randomly selected households were studied.

4.6. Data collection

Interviewer administered semi-structured questionnaire was used to collect socio demographic and malaria related variables. Two laboratory technicians (Diploma) and one Health Officer were recruited & provided with two days training on the study protocol as well as recording formats. The Health Officer examined the children for splenomegally, took temperature readings, filled the questionnaire and prescribed antimalarial drugs for children with history of fever (3 days duration) and or who had fever on examination as per the National protocol.

A pretest was carried out in children (10% of the total sample size) in an area that was not included in the main study. Based on the results, some modifications were made on the questionnaire.

4.7. Study Variables

4.7.1. Independent

A/ Socioeconomic variables

B/ Demographic variables

C/ Malaria related variables

- Household ITNs possession
- Distance from the nearest health institution
- Distance from mosquito breeding sites

4.7.2. Dependent

- Parasitological prevalence of Malaria
- Enlarged spleen prevalence
- Fever prevalence

4.8. Data processing and Analysis

After the collection of all the necessary data, it was coded on pre arranged coding sheet by the principal investigator. Data entry and cleaning were done using SPSS ver.10 and EPI info.2002 statistical packages. Tables and graphs are used to present frequencies of pertinent findings. The association between the independent and dependent variables were measured and tested using OR and 95 % CI. The relative contribution of each selected variables to the outcome of interest were assessed using logistic regression.

4.9. Data Quality Control

During data collection in the field and at the end of each day, the questionnaires were reviewed and checked for completeness, accuracy and consistency by the principal investigator and corrective measures were taken.

4.10. Ethical Consideration

Blood smears were taken under aseptic technique using sterile gloves and disposable sterile lancets by experienced laboratory technicians. To address confidentiality of Laboratory results, codes were used instead of names. All cases with history of fever in the preceding three days and/or those who had fever on examination were offered antimalarial treatment as per the National protocol.

Ethical clearance was obtained from AAU, Faculty of Medicine. After thoroughly discussing the ultimate purpose and method of the study, a written consent was sought from local authorities and concerned government officials. Additionally, an informed verbal consent was obtained from parents to involve their children in the study and anyone not wiling to take part in the study had full right to do so.

5. Results

A total of 487 children 2-9 yrs of age were studied from 200 households visited in 4 rural localities (Kebeles). From the total sample size of 496 children to be studied, parents of 6 children refused to participate and information collected from three children was incomplete that made the response rate of 98.2%.

Socio demographic characteristics of respondents

One hundred six (53%) of household heads were in the age group 35-44years. Their mean age was 38.7 ± 7.5 yrs and the minimum and the maximum age was 28 & 68 years respectively (see table.1).One hundred ninety five (97.5%) of household heads were males. Protestant Christianity was the major religion in the area accounting for 71.5% of respondents. Majorities (98.5%) of the respondents were Sidama by ethnicity and the same proportion was married. Most (60.5%) of the household heads had no formal education. One hundred & thirty nine (70%) of households had family size of more than 5 persons per head. The average family size of the respondents was 6.6±1.9. One hundred & twenty two (61%) of households had an estimated monthly family income of less than 100 ETB .One hundred & eighty one (90.5%) of mothers had no formal education.

Table.1. Socio demographic characteristics of household respondents, Awassa district, 2006.

Characteristics	Respondents	
	Number	%
Age of HH head		
25-34	55	27.5
35-44	106	53
45+	39	19.5
Mean age of household heads(years)	38.7±7.5	
Sex (HH head)		
Male	195	97.5
Female	5	2.5
Religion		
Orthodox	3	1.5
Muslim	37	18.5
Protestant	143	71.5
Catholic	17	8.5
Ethnicity		
Sidama	197	98.5
Amhara	3	1.5
Marital Status		
Married	197	98.5
Widowed	3	1.5
Educational Status (HH head)		
Illiterate	121	60.5
Read and Write	2	1
Primary	57	28.5
Secondary	12	6
High school	5	2.5
High school+	3	1.5
Family size		
≤ 5	61	30
> 5	139	70
Family monthly Income		
< 100 ETB	122	61
101-300 ETB	71	35.5
> 301	7	3.5
Educational Status (mother)		
Illiterate	181	90.5
Read and write	1	0.5
Primary	16	8
Secondary	2	1

Health service and environmental factors

Travel time to the nearest Health facility on foot for the majority (71.7%) of the respondents was less than an hour (See table 2). Seventy eight (39%) of respondents and 198(40.6%) of children 2-9 years had at least one Insecticide treated bed net per household. Of the total 198(40.6%) study subjects who had at least one ITN per household, more than half of them (56.1%) had never slept under insecticide treated bed net. From 83(41.5%) of households with reported febrile cases in the previous one-month, 28(24.8%) did not visit any health facility. With regard to housing, 398(81.7%) of children lived in houses with thatch roof, 70(14.4%) of children lived in houses that had opening on their eaves, 393(80.7%) of children lived in houses which had no windows, 126(25.9%) of children lived in houses with thatch wall & 278(57.1%) of children lived in houses that had openings on their walls. Two hundred eight (42.7%) of the study subjects reside with in a distance of less than1km from the shore of Lake Awassa. Out of the total 487 children, 276(56.7%) were in the age group of 2-5 years and females account for 50.5% of the total. The mean number of children 2-9 years of age per household was 2.4 ± 0.9.

Table.2. Distribution of study subjects by selected demographic, health Service and environmental factors, Awassa, 2006.

Characteristics	Children 2-9yrs of age	
	Number(n=487)	%
Travel time to a nearby health facility		
≤1hr	349	71.7
>1hr	138	28.3
Availability of ITNs		
Yes	198	40.7
No	289	59.3
Type of house roof		
Thatch	398	81.7
Corrugated iron sheet	89	18.3
Presence of opening on the eave		
Yes	70	14.4
No	380	85.6
Availability of windows		
Yes	94	19.3
No	393	80.7
Type of wall		
Mud	361	74.1
Thatch	126	25.9
Presence of opening on wall		
Yes	278	57.1
No	209	42.9
Distance from shore of Lake Awassa		
<1km	208	42.7
≥1km	279	57.3
Residence locality(kebele)		
Alamura	136	27.9
Tulo	140	28.7
Finchawa	111	22.8
Jara	100	20.5
Age of child(years)		
2-5	276	56.7
6-9	211	43.7
Sex		
Male	241	49.5
Female	246	50.5
Mean number of children(2-9years) per household	**2.4±0.9**	

Clinical and laboratory findings

From the total of 487 children 2-9 years, 44(9 %; 95% CI =6.7-12) had reported fever and chills preceding three days prior to visit (see table.3.). Of these, 29(66%) had rigors and 36(82%) sweating. Twenty-seven (5.5%) of the study subjects had fever on examination as measured by axillary's temperature readings of ≥37.5 ^{0}C. Fifty-three (10.9%; 95% CI: 8.3-14) children had enlarged spleen and the average spleen size was 2.26 +0.62.

Four hundred & eight-seven blood samples with thick and thin smears were collected and examined within 12 hrs after staining with giemsa sol (10% w/w) for 10 minutes and washing with distilled water followed by air drying. Out of the total examined slides, malaria parasites were found in 19 (3.9%) samples, of which *Plasmodium vivax* accounts for 16(84.21%) and *Plasmodium falciparum* for the remaining percentage (15.8%).

Table.3. Distribution of children 2-9 years by clinical presentations & Laboratory findings, Awassa, 2006.

Clinical presentations & Laboratory results		Children2-9years of age(n=487)	
		Number	%
Fever (in the last 3 days)			
	Yes	44	9
	No	443	91
chills			
	Yes	44	9
	No	443	91
rigors			
	Yes	29	6
	No	458	94
sweating			
	Yes	36	7.4
	No	451	92.6
Axillary temperature (in degree Celsius)			
	≥37.5	27	5.5
	<37.5	460	94.5
Splenomegally			
	Yes	53	10.9
	No	434	89.1
Blood smear results (Plasmodium spp.)			
	P.falciparum	3	0.6
	P.vivax	16	3.3
	No haemoparasite	468	96.1

The highest prevalence of microscopically confirmed malaria cases were observed in a locality (Kebele) called "Tulo" (5% prevalence) followed by "Finchawa" (4.5%). Reported fever prevalence was also higher for "Tulo" (12.1%) followed by "Finchawa" (11.7%) where as, the highest splenomegally prevalence (17.1% vs. 15%) was observed in "Finchawa" and "Jara" respectively (See Fig. 1).

Parasitological prevalence was higher in the age group 2-5 years than those in the age group 6-9 years 5.9% and 1.4% respectively and still, reported fever was higher for the lower age group than the higher age group (10.9 and 6.6%), respectively. Conversely, splenomegally prevalence was a bit higher in the higher age group (11.3%) than the lower age group (10.5%) (See Fig. 2).

Parasitological prevalence was higher in females (5.3%) than males (2.5%) whereas, reported fever prevalence in the males was 9.1% as compared to 8.9% in females and splenomegally prevalence was 11.2%& 10.5% in males females respectively (See Fig. 3).

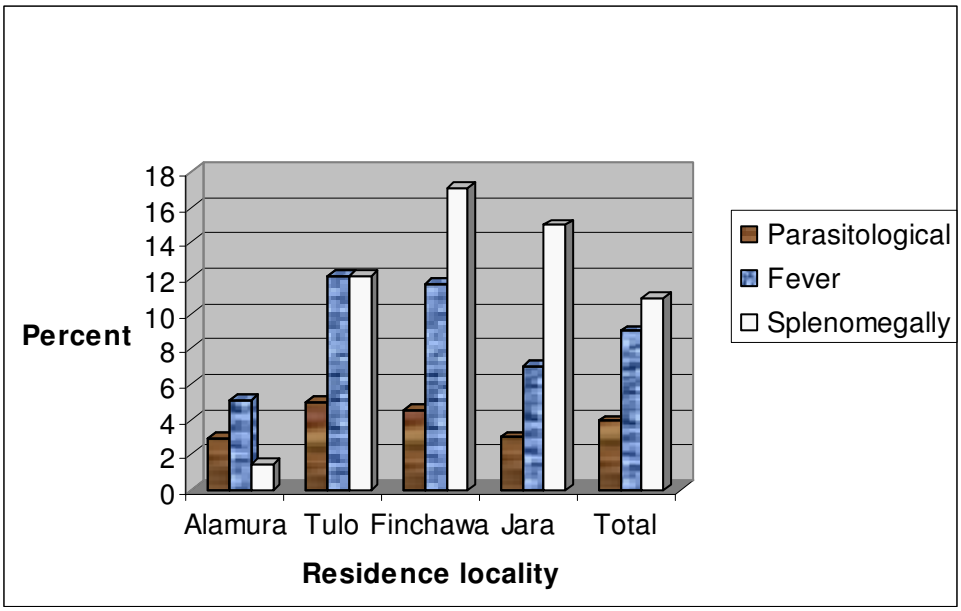

Figure.1 Distribution of malaria prevalence by residence locality, Awassa woreda, 2006

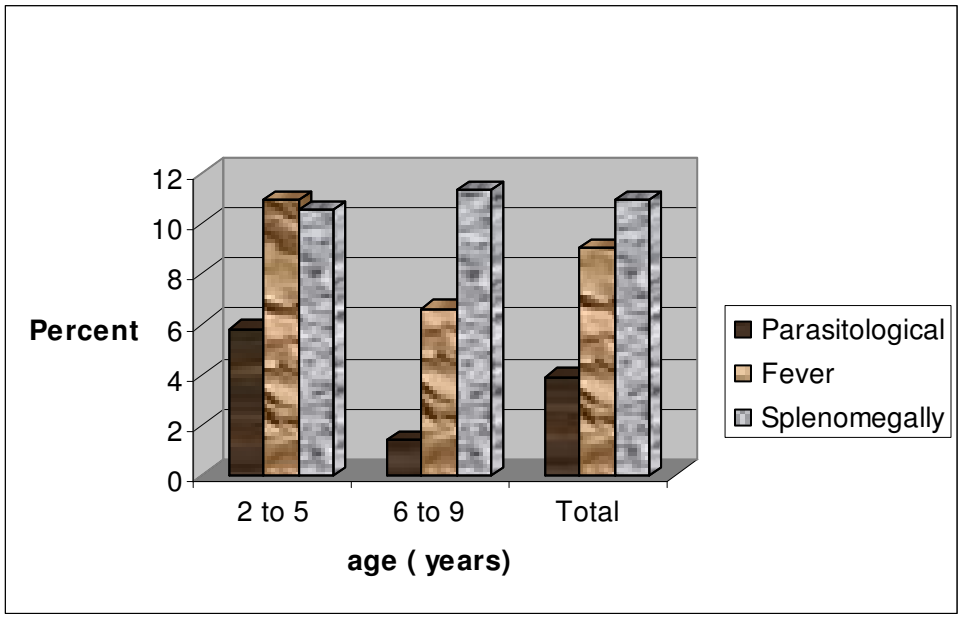

Figure.2. Distribution of malaria prevalence by age, Awassa woreda, 2006.

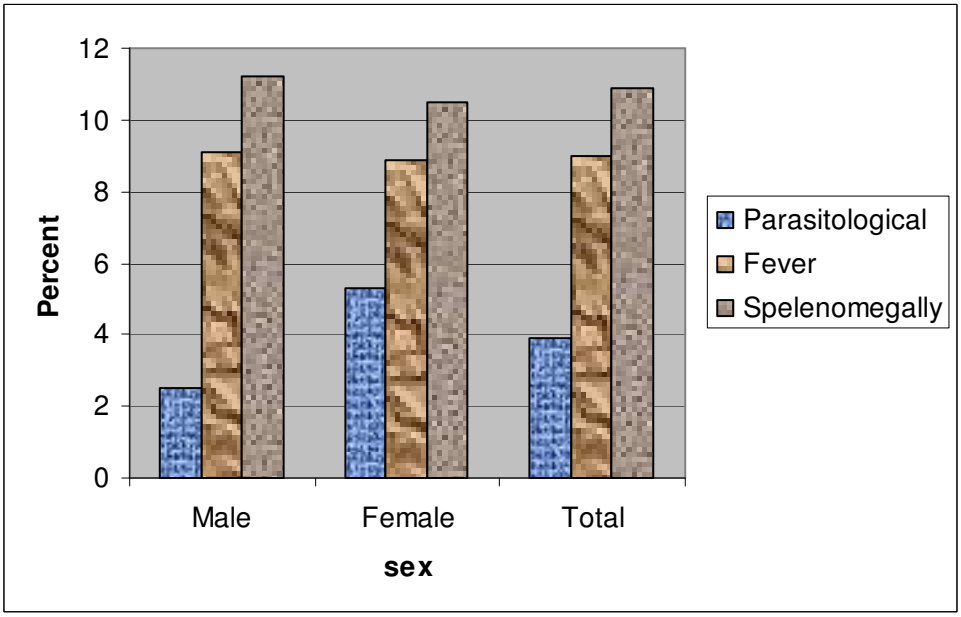

Figure.3 Distribution of malaria prevalence by sex, Awassa, woreda, 2006

Socio demographic factors and malaria

A two fold increased reported prevalence of fever was observed in children whose parents(household heads)were in the age group of 25-34 years compared to those children with age of their parents 35years and above(p-value<0.05). On the other hand, no significant difference in fever prevalence was seen with other household socio demographic characteristics (see table 4).

Table.4. Comparison of reported fever prevalence in children 2-9 years of age with selected socio demographic factors, Awassa, 2006.

Factors	**Fever report in children**				
	Yes(n=44)	**No(n=443)**	**OR**	**95%CI**	**P-value**
Age of HH head					
25-34	19	112	1		
35+	25	331	0.44	0.24, 0.84	0.012*
Educational Status (HH head)					
Non-formal	29	271	1		
Formal	15	172	.82	0.43,1.56	0.540
Family size					
≤5	16	103	1		
>5	28	340	0.53	0.28, 1.02	0.057
Family monthly income					
<100 ETB	23	262	1		
≥100ETB	21	181	1.32	0.71, 2.46	0.379
Educational Status (Mother)					
Non-formal	40	396	1		
Formal	4	47	.84	0.29, 2.46	0.754
Child's age(years)					
2-5	30	246	1		
6-9	14	198	0.58	0.30, 1.13	0.110
Child's sex					
Male	22	219	1		
Female	22	225	0.978	0.526, 1.82	0.978

*P-value < 0.05

The proportion of children with microscopically confirmed malaria from house holds whose family heads in the age group 25-34years were three fold higher compared to those children whose household heads' age 35 years and above(P-value<0.05) (see table.5.). A four fold increased prevalence of microscopically confirmed malaria was observed in children with family size of five or less relative to those study subjects with family size of greater than five (p-value<0.01) and in children with age group of 2-5years as compared to those 6 years old and above (p-value<0.05) . Otherwise, there was no significant difference with other socio demographic factors.

Table.5. Comparison of Malaria parasitological rate with selected socio demographic characteristics, Awassa Woreda, 2006.

Factor	Microscopically confirmed malaria in children		OR(95% CI)	P- value
	Yes(n=19)	No(n=468)		
Age of HH head				
25-34	10	121	1	
35+	9	347	.314(.125,.791)	.014*
Educational status(HH head)				
Non formal	13	287	1	
Formal	6	181	.73(.27,1.96)	.535
Family size				
≤5	10	109	1	
>5	9	359	.27(.11,.69)	.008**
Family monthly income				
<100	7	278	1	
≥100	12	190	2.5(.97,6.5)	.058
Educational status (mother)				
Non formal	17	419	1	
Formal	2	49	1.01(.23,4.48)	.994
Child's age(years)				
2-5	16	260	1	
6-9	3	208	.234(.067,.811)	.023*
Child's sex				
Male	6	235	1	
Female	13	233	2.2(.82,5.84)	.120

*P-value<0.05
**P-value<0.01

As depicted in table 6, spleen rate didn't show a significant difference with all the selected socio demographic factors.

Table.6. Comparison of enlarged spleen prevalence in children 2-9yrs with selected socio demographic factors, Awassa Woreda, 2006.

Factors	Enlarged spleen in children		OR (95%CI)	P-value
	Yes (n=53)	No (n=434)		
Age (HH head)				
25-34	14	117	1	
35+	39	317	1.025(0.54, 1.96)	0.940
Educational Status (HH head)				
Non formal	33	267	1	
Formal	20	167	.97(.54, 1.75)	0.916
Family size				
≤5	22	149	1	
>5	31	286	0.898(0.47, 1.72)	0.744
Family monthly income				
< 100	30	255	1	
≥ 100	23	179	1.09(0.61, 1.94)	0.764
Educational status (mother)				
Non formal	49	387	1	
Formal	4	47	.672(0.232, 1.95)	0.640
Child's age(years)				
2-6	29	247	1	
7-9	24	187	1.05(0.575, 1.92)	0.874
Child's sex				
Male	27	214	1	
Female	26	220	0.93(0.53, 1.65)	0.810

Health service and environmental determinants of malaria

Reported fever prevalence was 2.6 times higher in a locality called "Tulo" compared to "Alamura" (P-value< 0.05) and 2.5 times higher in "Finchawa" compared to "Alamura" though it had no significant association (P-value > 0.05) as shown in table 7. Prevalence of reported fever has not showed a significant difference with household availability of insecticide treated bed nets (p-value>0.05). Study subjects living at a distance of less than 1km from shore of Lake Awassa had shown 1.7 times higher prevalence of fever compared

to those residing at a distance of ≥1km away from Lake Shore, though the difference was not statistically significant (P-value > 0.05).

Table.7. Comparison of reported fever prevalence in children 2-9 years of age by health service and environmental factors, Awassa Woreda, 2006.

	Fever report in children			
Factors	**Yes(n=44)**	**No(n=443)**	**OR (95%CI)**	**P-value**
Residence				
Alamura	7	129	1	
Tulo	17	123	2.54(1.03, 6.4)	0.045*
Finchawa	13	98	2.46(0.95, 6.4)	0.067
Jara	7	93	1.4(0.47, 4.1)	0.554
Travel time to the nearby health facility				
<1 hour	31	318	1	
≥1 hour	13	125	1.07(0.54, 2.1)	0.845
ITN availability				
Yes	21	177	1	
No	23	266	0.73(0.39, 1.35)	0.313
Type of house roof				
Thatch	34	364	1	
Iron sheet	10	79	1.36(0.65, 2.87)	0.425
Opening on the eave				
Yes	7	63	1	
No	37	381	.874(0.37, 2.05)	0.761
Availability of window				
Yes	9	78	1	
No	35	366	0.793(0.37, 1.67)	0.547
Type of wall				
Mud	30	332	1	
Thatch	14	112	1.38(0.71, 2.7)	0.342
Opening on the wall				
Yes	24	255	1	
No	20	189	1.1290.6, 2.09)	0.721
Distance from lake shore				
≥1 K.M.	24	184	1	
<1 K.M.	20	260	1.69(0.91, 3.15)	0.099

*P-value <0.05

As presented in table 8, parasite rate of malaria has shown nearly a three fold increase in children who lived in houses with roofs that had corrugated Iron sheet compared to those children who lived in houses with thatch roofs (p-value <0.05). Even though the difference was not statistically significant ,2.6 times increase in parasite rate was observed in children who lived in houses that had windows compared to those children who lived in houses

with no windows(p-value>0.05). Otherwise, no significant differences were observed with differences in residence localities, neither household availability of ITNs nor distance variation of settlement from the Lake Awassa (p-value>0.05).

Table.8.Comparison of Malaria parasitological prevalence in children 2-9years with selected health service and environmental factors, Awassa Woreda, 2006.

Factor	Microscopically confirmed malaria in children		OR(95% CI)	P -value
	Yes(n=19)	No(n=468)		
Residence				
Alamura	4	132	1	
Tulo	7	133	1.74(.50,6.10)	.387
Finchawa	5	106	1.56(.41,5.98)	.517
Jara	3	97	1.02(.22,4.70)	.979
Travel time to nearby heath facility				
<1 hour	13	336	1	
≥1 hour	6	132	1.18(.44,3.16)	.749
ITN availability				
Yes	10	188	1	
No	9	280	.60(.24,1.51)	.283
Type of roof				
Thatch	12	386	1	
Iron sheet	7	82	2.75(1.05,7.20)	.040*
Opening on the eave				
Yes	3	67		
No	16	401	.89(.25,3.13)	.858
Availability of window				
Yes	7	87	1	
No	12	381	.39(.15,1.02)	.056
Type of wall				
Mud	13	348	1	
Thatch	6	120	1.34(.499,3.61)	.564
Opening on the wall				
Yes	9	269	1	
No	10	199	1.50(.60,3.77)	.386
Distance from lake shore				
≥1 K.M.	9	271	1	
<1 K.M.	10	198	1.50(.60,3.77)	.376

*P-value<0.05

On the other hand, the scenario was different with spleen rate in that, significant differences in enlarged spleen prevalence were observed between residence localities, with variation in distance of settlement from shore of Lake Awassa, and by differences with travel time to the nearest health institution. Compared to a locality called 'Alamura', those children living in 'Tulo' had a 9 fold increased spleen rate (p-value<0.01), those living in 'Finchawa' had 13 fold increase (p-value<0.01 and children in "Jara" had 11 fold increased prevalence (P-value < 0.01) (see table 9).

Travel time elapsed for parents to reach the nearest health facility on foot more than an hour had shown nearly a 3 fold increased prevalence of enlarged spleen in children compared to those children whose parents walk only an hour or less to reach the nearest health facility (P-value < 0.01). In addition, children living within a distance of less than 1km from shore of Lake Awassa had shown 5 times increased prevalence of enlarged spleen (P-value<0.001). But, availability of household ITNs didn't show a difference (P-value > 0.05).

It was reported that indoor residual spraying had not been applied in all the study localities at least in the past one year prior to the study; therefore, it was omitted from further analysis.

Table.9. Comparison of enlarged spleen prevalence with selected health service and environmental factors, Awassa Woreda, 2006.

Factor	Enlarged spleen in children		OR(95% CI)	P value
	Yes(n=53)	No(n=434)		
Residence				
Alamura	2	134	1.00	
Tulo	17	123	9.21(2.09,40.54)	.003**
Finchawa	19	92	13.76(3.14,60.74)	.001**
Jara	15	85	11.76(2.63,52.54)	.001**
Travel time to nearby facility				
<1 hour	27	322	1	
≥1 hour	26	112	2.77(1.55,4.94)	.001**
ITN availability				
Yes	21	177	1	
No	32	257	.95(.53,1.71)	.871
Type of house roof				
Thatch	41	357	1	
Iron sheet	12	77	1.36(.68,2.70)	.385
Opening on the eave				
Yes	3	67	1	
No	50	367	.33(.10,1.08)	.068
Availability of window				
Yes	12	82	1	
No	41	352	.796(.40,1.58)	.515
Type of wall				
Mud	35	326	1	
Thatch	18	108	1.56(.85,2.85)	.157
Opening on the wall				
Yes	30	248	1	
No	23	186	1.02(.57,1.82)	.940
Distance from Lake shore				
≥1 K.M.	13	266	1	
<1 K.M.	40	168	4.87(2.53,9.38)	.000***

**P-value<0.01

**P-value<0.0001

Multivariate Logistic regression analysis results

All socio demographic, health service and environmental factors that showed significant associations with malaria prevalence in univariate analysis were selected and entered for multivariate logistic regression analysis to identify the most important predictors of malaria risk factors.

Then, the result showed that reported fever prevalence in "Tulo' and "Finchawa" was two fold higher compared to "Alamura" but it was not statistically significant (p-value>0.05) and all other factors also didn't show significant associations (see table 10).

The same independent variables were entered in analysis for parasite rate and spleen rate. Then, the result revealed that family size ≤5 (p value<0.05), child's age 2-5 years (p value<0.05) and residing in houses with corrugated Iron sheet roofs (p value <0.05) were found to be associated with higher risk of getting malaria (parasite rate) as presented in table 11.

Residing in a locality called "Finchawa" (p value<0.05) and distance of settlement within less than 1km from Lake shore of Awassa (p value<0.01) were associated with a higher risk of malaria (spleen rate) as depicted in table 12.

Table.10. Multivariate Logistic regression analysis of reported fever prevalence in children 2-9 years of age by socio demographic and environmental factors, Awassa, 2006.

Factors	*Fever in children* Yes	No	β	SE	OR (95%CI)	p- value
Residence						
Alamura†	7	129				
Tulo	17	123	.600	.600	1.82(.63,5.24)	.266
Finchawa	13	98	.717	.576	2.05(.66,6.34)	.213
Jara	7	93	-.192	.780	.825(.179,3.81)	.805
Age(HH head)						
25-34†	19	112				
35+	25	332	-.573	.377	.564(.269,1.18)	.129
Family size						
≤ 5†	16	103				
> 5	28	340	-.473	.387	.623(.292,1.33)	.222
Travel time to nearby health facility						
<1hr†	31	318				
≥1hr	13	125	.208	.620	1.23(.366,4.15)	.737
Type of house roof						
Thatch†	34	364				
Iron sheet	10	79	.288	.424	1.33(.581,3.08)	.497
Child's age (years)						
2-5†	30	246				
6-9	14	197	-.499	.348	.607(.307,1.20)	.151
Distance from lake shore						
≥1 km†	24	184				
<1 km	20	259	.488	.431	1.63(.699,3.79)	.259
Constant			-2.111	.460	.061	.000

†Reference category

Model chi-square=17.259 P-value=0.045

-2Log Likelihood=278.199

Table.11.Multivariate logistic regression analysis of Malaria parasitological rate with selected socio demographic and environmental factors, Awassa Woreda, 2006.

	Microscopically confirmed malaria in children					
Factor	Yes(n=19)	No(n=468)	**β**	**SE**	**OR(95% CI)**	**P- value**
Residence						
Alamura	4	132				
Tulo	7	133	.147	.768	1.16(.26,5.22)	.848
Finchawa	5	106	.058	.915	1.06(.177,6.37)	.949
Jara	3	97	-1.052	1.21	.349(.033,3.74)	.384
Age(HH head)						
25-34†	10	121				
35+	9	347	-.504	.542	.604(.209,1.75)	.352
Family size						
≤5†	10	109				
>5	9	359	-1.29	.564	.275(.091,.830)	.022*
Travel time to nearby health facility						
<1hr	13	336				
≥1hr	6	132	.935	1.023	2.55(.343,18.92)	.361
Type of roof						
Thatch†	12	386				
Iron sheet	7	82	1.381	.588	3.98(1.26,12.60)	.019*
Child's age(years)						
2-5†	16	260				
6-9	3	208	-1.461	.658	.232(.064,.843)	.026*
Distance from lake shore						
≥1 km†	9	270				
<1 km	10	198	.288	.669	1.33(.36,4.94)	.667
Constant			-2.320	.590		.000

†Reference category
*P value <0 .05
Model Chi-square = 23.353 and P- value =0.005
- 2 log likelihood = 137.162

Table.12.Multivariate logistic regression analysis of enlarged spleen prevalence in children with selected socio demographic and environmental factors, Awassa Woreda, 2006.

Factor	Enlarged spleen in children 2-9yrs		β	SE	OR(95% CI)	P- value
	Yes(n=53)	No(n=434)				
Residence						
Alamura†	2	134				
Tulo	17	123	1.554	.815	4.73(.96,23.36)	.057
Finchawa	19	92	1.868	.822	6.47(1.29,32.41)	.023*
Jara	15	85	1.054	.915	2.87(.477,17.24)	.249
Age(HH head)						
25-34†	14	117				
35+	39	317	.241	.389	1.27(.593,2.73)	.536
Family size						
≤5†	14	105				
>5	39	329	-.515	.382	.597(.280,1.26)	.177
Travel time to the nearby health facility						
≤1hour†	27	322				
>1 hour	26	112	.406	.539	1.50(.522,4.32)	.451
Type of roof						
Thatch†	41	357				
Iron sheet	12	77	.345	.398	1.41(.647,3.08)	.386
Child's age(years)						
2-5†	29	247				
6-9	24	187	.047	.311	1.05(.570,1.93)	.880
Distance from lake shore						
≥1km†	13	266				
<1km	40	168	1.118	.416	3.06(1.35,6.92)	.007**
constant			-4.100	.785		.000

†Reference category
*P-value < 0.05 **P-value<0.01
Model Chi-square = 38.57 and P-value = 0.000
- 2 log likelihood = 296.546

6. Discussion

The results of this study revealed that malaria parasite rate was 3.9% (95% CI: 2.4-6.1) where as fever rate and spleen rate were 9% (95% CI: 6.7-12) and 10.9% (95%CI: 8.3-14) respectively. The explanation for the difference between spleen rate and parasite rate is that spleen rate is a relatively stable measure of malaria prevalence, which does not significantly vary, with seasonal fluctuations of malaria prevalence as opposed to parasite rate that fluctuates with seasonal variations in intensity of malaria transmission (15, 16).

This cross-sectional study was conducted during the dry season when the intensity of malaria transmission is expected to be lowest compared to the major and minor transmission periods (following the major rainy season ("kiremt") and the minor rainy season ("Belg"). The parasite rate indicates the dry season prevalence while the spleen rate indicates the prevailing annual malaria prevalence of the area (15, 16, and 29). Household ITNs possession prevalence was 39% which is relatively higher than the National coverage (24%) (14).

Several studies indicate that the use of insecticide treated bed nets significantly reduce the proportion of malaria morbidity and mortality in children1-10yrs (33, 34). To the contrary, some studies conducted in African countries revealed that the use of ITNs didn't show a significant difference in malaria morbidity and mortality in children 1-10yrs of age (32). In line with this, a difference was not observed in malaria prevalence among ITNs users and non-users in this study as demonstrated by fever, parasite as well as spleen rate with multivariate logistic regression analysis. The mere presence of ITNs in households may not protect children from Malaria morbidity unless it is properly used that could also be the implication of this finding.

Malaria is governed by a number of environmental, socio demographic and economic factors, which affect its distribution, seasonal occurrence and transmission intensity (22).

Among the socio demographic factors, studies indicate that malaria morbidity and mortality in children under the age of 5 yrs of age is higher compared to children above five years old. In agreement with this, the result of this study shows a four fold increased parasite rate in children 2-5 yrs of age compared to those children 6-9 yrs old (P-value < 0.05) (25,26). The other socio demographic factor which showed a significant association was house hold size $\leq$ 5 that revealed a 4 fold increase in percentage of malaria cases(parasite rate) compared to family size above 5 (P-value < 0.05).

From environmental factors, area of residence has shown a significant association (P-value < 0.05). Namely two localities ('Tulo' and 'Finchawa') have showed higher prevalence of fever compared to 'Alamura' and 'Finchawa' has also showed a higher prevalence of spleen rate compared to 'Alamura' (P-value < 0.05). Studies also witness that the relationship between malaria vector density and the distance of settlement from a water body like river is an important indicator of malaria transmission, as revealed in ITNs study in Gambia, they found out an inverse relationship between the number of mosquitoes in village and the distance of settlement from the river (30). This study also showed that spelnomegally prevalence had a three fold increase in those children residing within a distance of less than 1km form the shore of 'Lake Awassa' compared to those residing 1km further away from the Lake shore of Awassa (P-value < 0.01). Some studies indicate physical access like distance to health service was a determinant factor for malaria. In this study, though distance variation to the nearest health facility had shown significant association with prevalence of malaria with univariate analysis, it lost its significance with multivariate logistic regression analysis.

Strengths and limitations

Strengths

- Two measures (spleen rate & parasite rate) were used to estimate the prevalence of malaria.
- Simple random sampling was used

Limitations

- As any cross-sectional study, it is difficult to establish a causal relationship in this study.
- Household ITNs prevalence was studied but knowledge, attitude and practice about ITNs use and application was not included.
- The study was conducted during dry season, when the parasitological yield is expected to be low.

Conclusions

- Though house hold prevalence of ITNs was relatively higher than the national one (39% Vs 24%), more than half a proportion of children were not sleeping under it. This provides a clue for improper use of bed nets that needs further exploration and design strategies to improve its appropriate use.
- The result of this study showed that the area in general could be classified as hypoendemic as demonstrated by spleen rate of 10.9% (95% CI. 8.3 – 14) but among the four localities "Finchawa" can be classified as mesoendemic area.

- In general; Residing in "Finchawa", Age < 5 yrs, Distance of settlement <1km from the Lake shore of Awassa, and Household size $\leq$ 5 were the risk factors identified in this study.

Recommendations

- In areas where the option of environmental manipulations may be difficult especially after the major rainy season, it is advisable to apply indoor residual spraying up to a distance of 1km to effectively use scarce resources and to minimize environmental contamination.
- Children especially those under 5 years of age should be given due emphasis for prompt diagnosis and effective treatment as well as increased use rate of ITN.
- Proper awareness creation for appropriate utilization of ITNs.
- Community mobilization for environmental manipulation where possible.
- As well as, where environmental manipulations are difficult as in communities residing near Lake Awassa Indoor residual spraying is advised to be applied prior to the rainy season to prevent and control epidemic outbreaks.

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Annexes

Annex 1: Questionnaire for data collection

Questionnaire No.....

ADISS ABABA UNIVERSITY
MPH RESEARCH PROJECT
ON
PREVALENCE OF MALARIA

Part I- Socioeconomic status of households

101.Name of Kebeles 1.Alamura 2. Tulo 3. Finchawa 4. Jara Damuwa 5. Jara Gelelcha	
102.ID No of Household head	
103.Age of Household head.....	
104.Sex of household head 1. Male 2. Female	
105.Religion 1. Orthodox 3.protestant 2. Moslem 4. Catholic 5. Other specify	
106. Ethnicity 1. Sidama 2.Wolaita 3. Amahara 4. Oromo 5. Others Specify _____.	
107. Marital status 1. Single 2.Maried 3. Divorced 4. Widowed	
108. Educational status of house hold head 1. Illiterate 2. Read and write 3. Primary school 4. Secondary school 5. High school 6. Above high school	
109. Household size.....	
110. Number of children 2-9years of age in a house hold.....	
111. House hold income in a month 1. <100birr 2. 101-300birr 3.301-500bir 4. >500birr	
112. Educational status of spouse 1. Illiterate 2. Read and write 3. Primary school 4. Secondary school 5. High school 6. Above high school 7. NA	

Part II - Malaria related questions and observations

201. How long does it take to reach the nearest health institution on foot? 1. <15 minutes 2. 15-30 minutes 3. 30-45minutes 4. 45-60 minutes 5. >l hr	☐
202. Is there insecticide treated bed net in the household? 1. Yes 2. No… skip to No 205	☐
203. If yes how many ITNs do you have?..... 1. 01 2. 02 3. 03 4. >3	☐
204. Who uses the ITNs? 1. Children only 2.mother only 3. Father only 4. Father and mother only 5. The whole family 6.Children and mother	☐
205. Is there any one in the family who had fever with in the last month? 1. Yes 2. No	☐
206. If yes, Where did you go for treatment? 1. Drug vendor 2. Health center 3. Health post 4. Health station 5. Hospital 6. Traditional healers 7. No where (managed at home)	☐
207. Distance of the nearest health institution? 1. <5km 2. 5-10km 3. >10km	☐
208. Type of house roof? 1. Thatch 2. Corrugated Iron sheet 3. Mud 4. Other specify.....	☐
209. Is there an opening on the eave? 1.Yes 2.No	☐
210. Number of windows available?..... 1. 0 2. 1 3. 2 4. ≥3	☐

211. Type of wall 1. Mud 2. Thatch 3.Other	
212. Is there an opening on the wall? 1. Yes 2.No	
213. Distance of the house from lake shore 1. <1km 2. 1-3km 3. 3-5km 4. >5km	
214. Was the house sprayed with insecticide in the last 6 months? 1. Yes 2. No ⟶ skip to part III	
215. If yes, what type of insecticide was sprayed? 1.DDT 2.Malathion 3.others specify _____	
216. When was last sprayed? 1.3 months back 2. 6 months back 3.other specify_____	

Questionnaire No_____

HH Head ID No_____

Child ID No_____

Part III. Clinical History and Examination

301. Age of the child in completed years.....	
302. Sex of the child 1.Male 2. Female	
303. Does the child have history of fever in the last 3 days? 1. Yes 2. No	
304. Does the child have chills? 1. Yes 2. No	
305. Does the child have rigors? 1. Yes 2. No	
306. Does the child have sweating? 1. Yes 2. No	
307. Spleen size 1. Class I 2. Class II 3. Class III 4. Class IV 5. Class V	
308. Temperature in degree Celsius..... 1. <37.5 2. ≥ 37.5	
309. Laboratory diagnosis 1. P. Falciparum 2. P. Vivax 3. Mixed infection 4. No haemoparasite 5. Other specify.....	

Annex 2: Laboratory results reporting format

Laboratory results reporting format

S.NO	Kebele	H.H ID NO	Child ID No	Blood Film Result					
				1. P.F	2.P.V	3.Mixed	4.NO H/P	5.Other	Remark
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
11.									
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15.									
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21.									
22.									
23.									
24.									
25.									

Remark:
kebeles

1. Alamura
2. Tulo
3. Finchawa
4. Jara Damuwa
5. Jara Gelelcha

Annex 3: ***Consent Form***

Addis Ababa University
Faculty of Medicine
Department of Community Health

CONSENT OF THE INTERVIEWEE

Hello? I am ……..from AAU, I am here with my colleagues to study about Malaria in children 2-9yrs old. We will ask you some questions related to malaria and examine your children for signs of malaria and will take blood smear to examine for malaria parasites. Please be assured that the information will be confidential since we do not register names and you may choose to stop your child's/children's participation or refrain from answering any question at any time. If you decide not to participate, your care here will not be affected.

At this time do you want to ask me any thing about this study?

Do I have your agreement to participate _____ (yes or no?)

Signature_____