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Prevalence of Malaria Infection in Endagergis area,South Western Eritrea, East Africa

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ABSTRACT

Over the past years, malaria was a major public health problem in Eritrea. But since 1998, it has experienced a dramatic decline in malaria incidence. In this year, the MoH launched a massive expansion of the malaria prevention and control program. The program was aimed mainly at the reduction of malaria in populations living in all *zobas* of the country in general and in the malarious areas in particular. Since Endagergis is one of the malarious areas in Eritrea, the Government put much effort to reduce morbidity and mortality rates in this area. However, there is still a need to generate new information on the prevalence of malaria at the villages of Endagergis locality at the moment. A total of 30 blood slides were examined. Out of these 6 (20%) (95% CI; 5% - 34.9%) were found to be infected. The malaria parasite prevalence differed markedly among villages from 0 to 2.2%, with 40% of the five villages having no positive cases. Four (13.3%) of positive slides had *P. falciparum* and two (6.7%) had *P. vivax*. Among the total tested, 4 (28.6%) of the males and 2 (12.5%) of the females had malaria infection and infection was occurred in all age groups, with a slightly higher prevalence (66.7%) of the parasite observed in age groups of below 15 years old. This study reports a significant drop in the prevalence of malaria infection in the inhabitants of Endagergis locality, due to an appropriate implementation of many preventive strategies. However, malaria prevalence still exists in some areas of the locality and is strongly associated with presence of mosquito breeding sites. The prevalence varies according to location of villages with Endagergis, AdiGuor and AdiSeyabo showing statistically higher prevalence. Malaria prevalence was higher in August 2012 than in other months of the surveillance periods.

Introduction

Malaria is an ancient disease having a huge social, economic and health burden in the world. Each year an estimated 300-500 million clinical cases and more than one million malaria related deaths occur (1, 2). In many malarious areas of the world, especially sub-Saharan Africa, malaria is ranked among the most frequent causes of morbidity and mortality – primarily among children under five years and pregnant women due to immature and weakened immunity respectively (1). World Health Organization (WHO) estimates that more than 90% of the deaths attributed to malaria each year occur in African children (2-4). The afro-tropical region, which is only 8% of the world's population, bears the heaviest malaria burden, which is one of the biggest impediments to progress with 85 to 90% of morbidity cases and 90% of the global malaria related deaths occurring in this continent(2,5,6), 90% of the cases and deaths in Africa are due to *P. falciparum* (7,8).

Malaria has been highly prevalent in the tropical regions of Africa, Asia, Central and South America (9). In 2008 it was declared that the disease was endemic 109 countries (1). This is due to the favorable climatic factors allowing for breeding and survival of the *Anopheles* mosquitoes and for the malaria parasites to complete their growth cycles (10). In recent times malaria has gained prominence due to climate change.

Global warming is predicted to have unexpected effects on its incidence. Both increase and fluctuation in temperature affects the vector and parasite life cycle. This can cause reduced prevalence of the disease in some areas, while it may increase in others. Thus climate change can affect malaria prevalence pattern by moving away from lower latitudes to regions where populations have not developed immunity to the disease (1, 11).

Over the past years, it was a major public health problem in Eritrea. Since 1998, Eritrea has experienced a dramatic decline in malaria incidence (12). In this year, the MoH launched a massive expansion of the malaria prevention and control program. The program was aimed mainly at the reduction of malaria in populations living in all *zobas* of the country. Since Endagergis is one of the malarious areas in Eritrea, the Government put much effort to reduce morbidity and mortality rates in this area. However, there is still a need to generate new information on the prevalence of malaria at the villages of Endagergis locality at the moment.

Problem Statement

The problem is that the prevalence of malaria is low and the trend seems towards malaria elimination. But in Endagergis there is high malaria prevalence compared to other diseases yet a lot of resources have been injected in numerous programs like RBM, Malaria Control Program under MoH, IPTs.

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Therefore, the study aims at identifying the risk factors of malaria prevalence and once known, then it will become easier to devise control mechanisms that can halt or reduced the rate of occurrence. The alternative hypothesis used to study the malaria prevalence status in Endagergis is community awareness; utilization of malaria control interventions and patients' early treatment seeking behavior influence the prevalence of malaria.

Research Question

The study was guided by the research questions for the investigation of the socio economic and environmental determinants of malaria prevalence in Endagergis locality, if not adequately identified; it will continue to be a challenge to the residents of this locality. Some of the questions need to be answered to fill the gap are: What is the rate of malaria incidence in the locality? What is the influence of environmental sanitation, socio economic factors such as housing type and education level on the prevalence of malaria in Endagergis locality?

Objectives of the Study

The primary objectives of this study were to estimate the prevalence and distribution of malaria in the locality using a rapid diagnostic test and to identify major risk factors associated with parasitemia. It also aimed to examine the relationship between malaria prevalence and socio-economic status of households.

Significance of the Study

The information gathered will be used by concerned authorities in Eritrea in developing viable policies and measures aimed at developing the region. The dwellers will be made aware of their health status and other aspects related with malaria prevalence like, sanitation, hygiene, education, poverty and immunization rates. These will be used for sensitization and improving standards of living of these people.

Factors that Influence Malaria Prevalence

Factors that influence malaria prevalence in a community are manifold and can be grouped into agent, host and environmental factors. However, the scope of this study did not include factors such as temperature, precipitation, humidity, insecticide resistance, IPT up take, mosquito repellents, and availability of medicines, availability and attitude of staff fig1. This study sought to identify the socio-demographic characteristics, domicile characteristics, awareness, intervention strategies and health service factors that influence the prevalence of malaria among inhabitants of the five villages of Endagergis locality. It also aimed at assessing malaria prevention practices of the population residing in Endagergis locality.

Materials and Methods

Over view of the Study Design

The study was designed to provide malaria prevalence estimates at locality level, using descriptive cross-sectional study. The survey used a stratified random sample design with villages as the first-stage and households as the second stage strata(13). Household heads were interviewed for malaria indicators (N=120) and 25% (N=30) of the participants in the study were provided blood films for malaria parasite detection; both thick and thin blood films were read and a structured questionnaire was used covering questions on socio-demographic data, knowledge on transmissibility, preventive measures on malaria, availability of integrated mosquito nets, and health seeking behavior of the patients.

Study Site

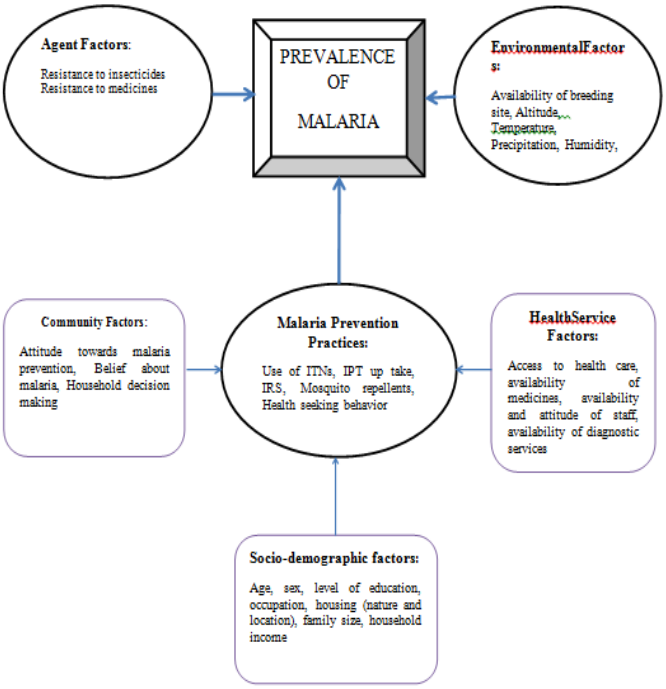

Figure 1.Conceptual framework of determinants of malaria prevalence.

The study was conducted from June to October 2012 in Endagergis (14°58´-14°59´N and 38°76´- 38°79´E), 17km South of AdiQuala in Debub *zone*, southern Eritrea Fig 2. This low lying area is heavily agricultural region. Endagergis is located close to the border with Tigray, northern Ethiopia, at an altitude of ranging from 1500 to 1710 meters above sea level and had a population of 8578 inhabitants. Most of the villagers are farmers, who lived in iron sheet roofed and stone and mud walled houses, with a few who lived in Hidumo, flat roofs of wattle and earth. The number of people per household ranges from 1 to 10 with a mean household size of 5.09, most kept cattle, goats, sheep and pack animals, which are corraved in open stone walled enclosures attached to their houses.

Endagergis was chosen based on the previous history of the area as far as malaria morbidity and mortality is concerned. That is, it is one of the malarious areas of the Debub region and has both high land and low land climatic conditions which favor for mosquito and malaria parasite multiplication.

Study Type

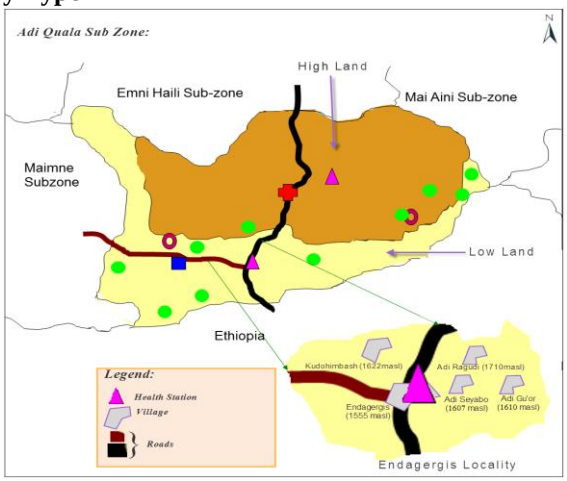

Figure 2. Map of the study site.

The survey was conducted between June and October 2012 corresponding to the peak malaria transmission season in the country.

During this time interval blood samples were collected from 30 randomly selected individuals and screened by both rapid diagnostic test and microscopic blood examinations of thick and thin blood films in the laboratory. Secondary data were also collected from the previously recorded sources, of Endagergis Health station. In addition, primary data were collected using self-administered questionnaire from 90 individuals, who were selected using stratified probability proportional to population size and previous history of malaria prevalence of the five villages.

Sample Selection

Households were selected using stratified probability proportional to population size and previous history of malaria prevalence of Endagergis locality, which is an agglomeration of five villages, (Endagergis, Kudohimbasha, AdiRagudi, AdiGuor, and AdiSeyabo). In each village the households were selected using stratified probability proportional to population size.

Sampling Plan

The survey used a stratified random sample design with villages as the first and households as the second stage strata.

Sample Size Determination

Taking the amount of cost and time required factors into consideration, a sample of 120 households were estimated as the number sufficient to determine malaria prevalence in Endagergis locality. The sample size for the survey was estimated taking population size and the historical back ground of malaria prevalence in the five villages in to consideration, the proportions of household samples were allocated among the five villages.

Data Collection

Quantitative data was collected from household survey using self – administered questionnaires and blood samples were collected and screened by both rapid diagnostic test and microscopic blood examinations of thick and thin blood films in the laboratory.

The questionnaire form asked interviewees to record their age, gender, education level, period of residence, awareness of disease, how one learnt of malaria, how one gets malaria, symptoms, health seeking behavior when one is infected, conditions encouraging spread of malaria, prevention methods known, disease burden on family, who are most affected in the family, and methods of control they used.

Moreover, the questionnaire checklist sought to find the following; knowledge of malaria and bed nets, and bed net ownership and use, room construction materials; indoor residual spraying; presence and type of mosquito net (verified by observation); demographic information on residents; and where people slept. The researcher asked to see each net by room in the house, determined whether it was a Long Lasting Insecticide Nets (LLIN) or not, and asked who slept under it the previous night. The questionnaire was also designed to determine whether any household residents slept outside, and if so whether they used a net (ITN or untreated) or LLIN, were assessed.

Experiment: after obtaining consent from the respondents, blood samples were collected from the study groups to conduct laboratory experiment. Before blood collection the finger was cleansed with an alcohol-moistened swab, dried with a piece of dry cotton, punctured with a disposable blood lancet. After wiping off the first drop of blood, the blood samples were diagnosed by a Rapid Diagnostic Test and microscopic blood examination using thick and thin blood smear preparations on the same slide to determine whether or not the individual was infected. After being air-dried in a horizontal position, the thin blood films were fixed in methanol for 30 sec. Then smears (thick and thin) were stained using 10% Giemsa solution for 20 min (14). The stained slides were examined under a light microscope using 100x oil immersion microscopic objective by two laboratory technicians, who were certified in malaria diagnosis and species identification by the MoH.

Data Management

To manage the data collected efficiently, data entry forms were developed using EPIDATA (data entry and management software). The data entry was designed to be as similar as possible to the hard copy questionnaires. In order to develop the data entry template, initially a Coding Manual / Data Dictionary was developed. Data was double entered into the system to check the validity of the data entered and to minimize data entry errors. On top of that, consistency checks were incorporated to control errors during data entry in order to minimize data entry errors. That is, data consistency was evaluated by checking for coding and filters errors, incorrect non-responses, range checks and any other irregularities. EPIDATA was chosen as a data entry program because the software allows data merging, cleaning, and validation processes. From the EPIDATA, data was exported to the SPSS software package for major statistical analysis.

Data Analysis

Data collected from both the household and individual surveys were matched using a unique village/ household/ individual variable, resulting in 120 observations, that is, 30+90 individuals who were screened for malaria parasites and completed the household questionnaire respectively(15). Data was entered and analyzed by SPSS 16 software package. The frequency distribution of both dependent and independent variables were worked out by using cross tabulation(16).

Statistical Methods

Data were double entered using EPIDATA (version 3.1, Odense, Denmark software). Statistical analysis was performed using the SPSS (IBM 'SPSS' statistics version 20) software package for major statistical analysis (17).

Results

Respondents' Identifications

The study involved a household survey of 120 participants, of which 90 (75%) were participated in the self-administered questionnaire and 30 (25%) individuals were participated in the blood examination of both rapid diagnostic test (RDT) and the laboratory diagnostic of malaria is made by microscopic examination of a giemsa stained thin smear of peripheral blood examine under oil immersion objective lens of a compound light microscope, the protozoa can be detected growing in the RBCs the *Plasmodium* infected erythrocytes in blood smears are slightly enlarged, the feeding protozoan resembles a ring shaped trophozoites within the RBCs. Typically all sizes of red blood cells are infected. Often 5% or more of the circulating erythrocytes are infected. Multiple ring forms can be seen in a single red blood cell. Multiple smears may be needed before the diagnosis is confirmed.

The age of most (75.6%) participants who completed the questionnaire ranges from 15 to 44 years. Majority of the participants 49 (54.4%) were females and 41(45.6%) were males and the mean and median age of the participants were 30.20 and 23 years respectively. The observed difference between the mean age of male and female participants was not statistically significant (P-value = 0.001). More than half of the respondents (53.3%) had attained education level in the

range of 6-11years of schooling followed by those who did not attend any formal education 22 (24.4%) then those with primary education 18 (20.0%) and only a few of them, 2 (2.2%) went beyond 11th grade. Families with small household size (1-3 persons per household), those with an average household size (4-6) and households with large family size (7 and above persons per household) with a standard deviation of 2.18 and also describes the minimum, average (3.48) and maximum number of children per household. It also indicates minimum, average and maximum number of children for both groups, below five years, and five and above years.

The majority of the study participants 87 (96.7%) were living in iron sheet roof type houses followed by those who live in Hidumo 3 (3.3%) and none of them live in grass, wood + mat and other roof type houses. Majority of the participants 65 (72.2%) were live in stone walled houses followed by those who live in brick or concrete block walled houses 24 (26.7%) and only one live in stick + mat walled house. With regard to presence of an animal pen within 20 meters from the house majority of the respondents 57 (63.3%) said that animal pen is present around their house but 33 (36.7%) of the respondents indicated that there are no animal pen around their houses.

Awareness on clinical manifestation, mode of transmission, care – seeking behavior

Majority, 36 (40%) of the respondents explained malaria using some clinical manifestations (mild symptoms), followed by those who defined malaria as a vector born disease 33 (36.7%), while 10 (11.1%) of the respondents perceived that malaria as a disease caused by dirty, hunger, weakness, clouds and about 8 (8.9%) said "I don't know."With regard to malaria transmission varied responses were given. 70 (92.1%) of the responses indicated that the mosquito bite was the mode of malaria transmission. The remainder identified house fly 2 (2.6%), marsh area 2 (2.6%), and drinking dirty water 2 (2.6%), as the mode of transmission. But 2% responded that they didn't know the mode of transmission of malaria.

With regard to mosquito presence majority of the respondents 55 (61%) said that mosquitoes were present in their surroundings but 35 (39%) of the participants replied that mosquitoes were not present in their surroundings. Out of the 90 study participants, 68 (75.6%) said that malaria is communicable but 22 (24.4%) replied that malaria is not communicable.

With regard to reasons for the mosquito presence the majority of the respondents 32 (55.2%) replied that the presence of stagnant water in their surroundings. This is followed by those who said that mosquitoes were present due to presence of dirty surroundings (32.7%) and the least 7 (12.1%) said mosquito presence was due to presence of weeds in their surroundings.

The study participants were also asked whether they were sick of malaria since June 2012, the majority of the participants, 71(78.9%) replied that they were not sick since June 2012 – October 2012 while 19 (21.1%) were responded that they were sick of malaria.

With regard to the symptoms of malaria, 28 (31.5%) of the respondents said that they detect with fever plus three other classical symptoms, followed by those who explained malaria as a disease detected by the clinical manifestations of fever plus two other symptoms and 25 (28.1%) of the responses indicated that malaria is detected by fever plus four other symptoms while 7 (7.9%) said malaria can be detected by fever plus one other classical symptom. Two participants (2.2%) said that malaria can be detected by shivering. Other two participants (2.2%) also said that malaria is detected by diagnosis. As to the first action respondents were taking after they got sick of malaria is concerned 85 (95.5%) said they sought medical help from the health facility and 2 (2.2%) said they take paracitamol. Others 2 (2.2%) said that they did nothing after they got ill. The table 1, summarizes the responses of the study participants with respect to the communicability of malaria, reasons for mosquito presence in their surroundings, whether they were sick of malaria or not since June 2012, clinical manifestations (signs and symptoms), first action they take after got ill.

Table 1. Knowledge of respondents with respect to malaria and related aspects.

Characteristic	Frequency	Percent
Communicable		
Yes	68	75.6
No	22	24.4
Reason for presence		
Stagnant water	32	55.2
Dirty surroundings	19	32.7
Weeds	7	12.1
Others(1)	0	0
Sick of malaria since June 2012?		
Yes	19	21.1
No	71	78.9
Signs and symptoms		
Fever only	0	0
Fever + one	7	7.9
Fever + two	25	28.1
Fever +thee	28	31.5
Fever + four	25	28.1
Shivering	2	2.2
Diagnosis	2	2.2
First action after got ill		
Paracitamol	2	2.2
Artesunate	0	0
Health facility	85	95.5
Nothing	2	2.2
Others(2)	0	0

*. Others (1) = animal pen*Others (2) = traditional medication

Knowledge and practice regarding malaria causation, prevention and control

Regarding the utilization of intervention strategies, the responses of the participants were summarized using graphs for the first three types of strategies (such as, keeping mosquitoes away, bed net use and type of intervention utilized), while the responses of the respondents for the rest were summarized in a table 2. As shown in the fig 3 below 77 (88 %) of the respondents replied that they kept mosquitoes away using bed net followed by those who kept mosquitoes away using chemical spray (10%) and some of the respondents 2 (2%) said that they kept mosquitoes by burning herbs and none of them used mosquito coil, clothes and others as a method of keeping mosquitoes away.

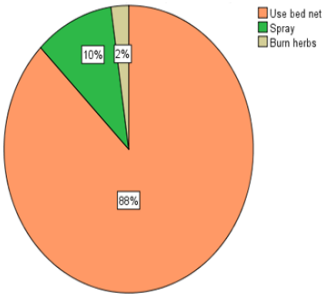

Figure 3. Mechanisms employed to keep mosquitoes away.

Out of the 90 participants the majority 50 (55.6%) replied that they constantly use bed net followed by those who use only 'some times' 33 (36.6%) while 7 (7.8%) responded that they did not use bed net at all fig 4.

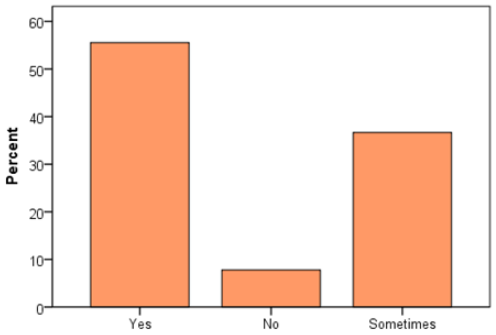

Figure 4. Mosquito bed net utilization.

Table 2. Intervention strategies employed by the study participants.

Strategy type	Frequency	Percent
Education or campaign		
Yes	85	94.4
No	5	5.6
Source of bed net		
NGOs	7	8
Made at home	0	0
Bought	1	1.1
Others($)	79	90.8
Sleep under net		
Yes	40	44
No	17	19
Some times	33	37
House sprayed		
Yes	61	77.2
No	18	22.8
Travel before encounter		
Yes	4	21.1
No	15	78.9
Environmental management		
Yes	62	80.5
No	15	19.5

The study participants were also asked to mention the mechanisms they use to prevent malaria. 75 (83.3%) of them said by keeping mosquitoes away. Other 10 (11.1%) said they prevent malaria by taking drugs regularly and the least 5 (5.6%) of the respondents replied do not known the prevention fig 5.

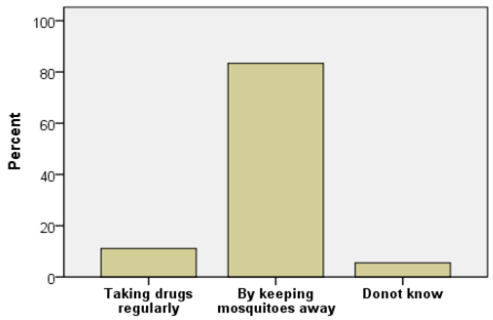

Figure 5. Methods of malaria prevention.

The responses of respondents in terms of frequencies and percentages for the different types of intervention strategies (such as education or campaign, bed net sources, sleep under net, house sprayed and environmental managements) utilized by the study participants. Of all the respondents 85 (94.4%) replied that education or campaign was given to them as an intervention strategy but only 5 (5.6%) said that there were no education or campaign.

Table 2 also shows that the majority, 79 (90.8%) of the respondents acquired bed net from the MoH, followed by those who said from Non-Governmental Organizations (NGOs) 7 (8.0%) and only 1 (1.1%) bought bed net from market.

The responses of the study subjects with respect to the question was your house sprayed with chemicals this summer. Majority of the study participants 61(77.2%) said that their houses were sprayed with chemicals and 18 (22.8%) responded that their houses did not sprayed this summer but 11 study participants did not give any response. In case of environmental management during the peak malaria transmission season, majority 62 (80.5%) of the participants replied that they were conducted environmental sanitation followed by those who said that there was no any sort of environmental management, 15 (19.5%) and 13 study subjects did not give any response.

Presentation of Data Collected Through Blood Examination

Total of 30 blood slides were examined table 3 and fig 6. Out of the total whose blood was examined 6 (20%) (95% CI; 5%- 34.9%) were found to be infected. Among the total tested, 4 (13.3%) of the males and 2 (6.7%) of the females had malaria infection. Among all tested individuals, infection occurred in all age groups and the highest prevalence 4 (66.7%) of the parasite was observed in age groups of below 15 years. The results show a good concordance between the RDTs and microscopic reading (overall agreement was 100%). The malaria parasite prevalence differed markedly among villages from 0 to 2.2%, with 40% of the five villages having no positive cases. Malaria prevalence was observed in the three villages of the study areas. Among tested individuals in each village, 2 (6.7%), 2 (6.7%) and 2 (6.7%) of infection occurred in Endagergis (1555 masl), AdiGuor (1610 masl) and AdiSeyabo (1607 masl), respectively, which was statistically significant table 4. The prevalence was higher in Endagergis, AdiGuor and AdiSeyabo and lower/zero in Kudohimbasha (1622 masl) and AdiRagudi (1710 masl). The malaria parasite species seen most frequently was *P.falciparum*, 4 (13.3%) of the positive slides and 2 (6.7%) had *P.vivax*. No mixed infections of *P.falciparum* and *P.vivax* were observed.

Table 3. Blood examination result by sex.

Sex	Blood examination results		Total
	Positive (%)	Negative (%)	
Male	4 (13.3%)	10 (33.4%)	14 (46.7%)
Female	2 (6.7%)	14 (46.6%)	16 (53.3%)
Total	6 (20%)	24 (80%)	30 (100%)

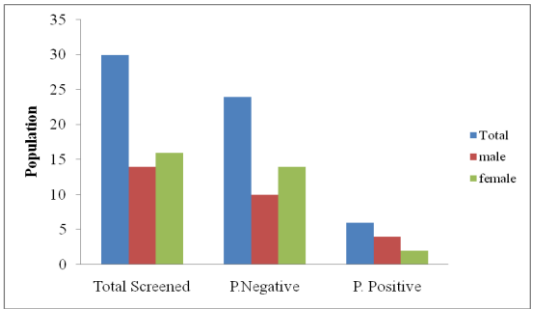

Figure 6. Total population screened and blood examination results by sex.

***P. Negative = Plasmodium Negative,*P. Positive = Plasmodium Positive.**

Table 4. Population screened, parasite detected and prevalence rate of malaria from June - October 2012.

Village	Population Screened	*Pf* +ve(%)	*Pv* +ve(%)	Total +ve	Prevalence rate
Endagergis	10	1(3.3%)	1(3.3%)	2	6.7%
AdiGuor	5	2 (6.7%)	0 (0 %)	2	6.7%
Kudohimbasha	6	0 (0 %)	0 (0 %)	0	0%
AdiRagudi	4	0 (0%)	0 (0%)	0	0%
AdiSeyabo	5	1 (3.3%)	1(3.4%)	2	6.6%
Total	30	4 (13.3%)	2 (6.7%)	6	20%

*Pf +ve= Plasmodium falciparum positive,*Pv+ ve = Plasmodium vivax positive

Presentation of Data Collected from Document Analysis

In comparison, the prevalence rates of malaria in Endagergis, AdiGuor, Kudohimbasha, AdiRagudi and AdiSeyabo were 14.8%, 2.1%, 1.9%,0.2% and 2.3% respectively with highest prevalence rate in Endagergis (14.8%), followed by AdiSeyabo (2.3%) then AdiGuor (2.1%) next Kudohimbasha (1.9%) and the least was AdiRagudi (0.2%) table 5. The higher prevalence villages seemed to be the areas with low altitudes ranging from 1555 masl- 1710 masl. At the village level and even at the houses with in the same village, significant differences were the result of slight ecological variations and also due to population density and mobility.

Discussion

The study was designed to provide malaria prevalence estimates at locality level, using descriptive cross-sectional study. The study involved a household survey of 120 participants, were participated in the self-administered questionnaire and 30 individuals were participated in the blood examination of both rapid diagnostic test (RDT) and microscopic tests of thick and thin blood films. The laboratory diagnostic of malaria is made by microscopic examination of a giemsa stained thin smear of peripheral blood examine under oil immersion objective lens of a compound light microscope, the diagnostic features was investigated by (18,19). Typically all sizes of red blood cells are infected. Often 5% or more of the circulating erythrocytes are infected (20,21). Multiple ring forms can be seen in a single red blood cell (22). Multiple smears may be needed before the diagnosis is confirmed (23). As it was expected the main malaria parasite observed was *P.falciparum* followed by *P.vivax*[1]. The *P.falciparum* accounts 67.18% and *P.vivax* accounts 32.82% of the total observed malaria cases.

The findings of this study indicated that the disease is seasonal which occurs predominantly after the main rainy season. The Chi square (χ^2) test was used to compare trends in malaria prevalence rate in the locality over the five months period at a 95% confidence interval. The results also indicated that there was a significant difference in malaria prevalence among inhabitants of the five villages of the locality and even among houses of the same villages.

Inhabitants of Endagergis, AdiGuor and AdiSeyabo were more likely to suffer from malaria compared to the inhabitants of AdiRagudiand Kudohimbasha.

The result showed that there was heterogeneity in the risk of malaria among dwellers of those villages even though they are in the same locality. The variations are possibly associated with vector density, survival of the mosquitoes, vector and host contact, and innate feeding preference of vectors, the slight difference in altitude among the villages and other environmental factors.

This finding concur with the study conducted(15) which argue that in areas of low endemicity, malaria risk can be widely varied between localities or even households and it has been suggested that these differences may be due to specific characteristics of houses (household's socioeconomic wealth) or their locations that may facilitate contact between humans and mosquitoes.

Conclusion

This prevalence survey was intended to assess the prevalence and distribution of malaria parasites in Eritrea. The questionnaire that was developed sought to obtain preliminary data on the risk factors associated with malaria and the methods of treatment and prevention used by the participating households. The finding point out that there was no significant difference among gender, in malaria prevalence, that is, analysis of the infection of malaria between male and female respondents in this locality revealed that there was no significant differences among the sexes. The study findings also showed that malaria infection occurred in all age groups, with a slightly higher in the younger age groups and elder age groups in the findings of both blood examination and self-administered questionnaire respectively. That is, almost all segments of the population are equally at risk for malaria.

With regard to the household size, the findings of the study indicated that there was no significant difference among different family size households and malaria prevalence. However, the study result revealed that there was a significant difference among inhabitants of the locality with difference of the education level they have attained, that is, those individuals who attend a higher education level have better awareness of malaria and malaria related aspects than the rest members of the population in the locality. Even those individuals who attend the primary level of education have good awareness of the disease and other aspects related with it in comparison to those persons who never attending school and malaria infection was observed relatively more among none educated and those who attained only low education level than those who attend higher level of education.

The finding of the study point out that there were no significant differences in malaria infection among individuals who lived in different roof type and wall type houses and also shown that the presence or absence of an animal pen near the houses have no any effect on the inhabitants in causing malaria infection. With regard to malaria prevention practices of the residents, the study revealed that there was a significant

Table 3. Population screened, malaria parasites detected and prevalence rate from June- October 2012.

Village	Population Screened	*Pf* +ve (%)	*Pv* +ve (%)	Total +ve	Prevalence rate
Endagergis	377	35 (7.3%)	36 (7.5%)	71	14.8%
AdiGuor	30	7 (1.5%)	3 (0.6%)	10	2.1%
Kudohimbasha	33	6 (1.3%)	3 (0.6%)	9	1.9%
AdiRagudi	9	1(0.2%)	0 (0.0%)	1	0.2%
AdiSeyabo	30	6 (1.3%)	5 (1.0%)	11	2.3%
Total	479	55 (11.6%)	47 (9.7%)	102	21.3%

difference in the utilization of mosquito nets by the inhabitants of the five villages of the locality, among households of the same villages and even among individuals of the same household. These differences in malaria prevention practices of the inhabitants might partly explain the observed difference in the prevalence of malaria among the five villages of the locality. There is therefore need the local health authorities or the NMCP to pay attention to the present malaria prevalence rate difference among households and villages of the locality when carrying out malaria prevention interventions in the locality.

Result of this study revealed that the use of ITNs, has contributed to most of the reduction in malaria morbidity and mortality. A preventive measure used by the majority of the respondents which is an indication of their increasing awareness about modes of malaria transmission. ITNs were found to be effective tool for the prevention of morbidity and mortality caused by malaria. The introduction of Long Lasting Insecticide impregnated Nets (LLINs) which simplify the strategy by reducing the need for re-treatment also played a big role in the reduction of malaria. The result indicated that the malaria parasite prevalence differed markedly among villages from 0 to 2.2%, with two of the five villages(Kudohimbasha and AdiRagudi) having no positive cases but the 20% positive slides were found to be equally distributed among the other three villages of this locality.

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