Prevalence and Prevention Methods of Malaria in the Case of Butajira Sub-City, Gurage Zone, Southern Ethiopia

[1]Etalem Alemayeh, [2]*Ayana Wubie (DVM), [2]Wale Firew (DVM), [2]Hailehzeb Cheru (DVM)

[1] Wolaita Sodo University; College of Natural and Computational Science; Department of Biology
[2] Lectures at Burie Poly Technic College; Department of Animal Health; Burie; Ethiopia P.O.Box.75;
Email: ayanawb10@gmail.com

Abstract: Malaria is a parasitic disease transmitted by female anopheles mosquito. The causative agent of malaria is an obligate in intracellular protozoan in genus plasmodium. The purpose of this study was to determine the relative prevalence of malaria with respect to sex, age and season as well as prevention methods used by the communities of Butajira sub city Gurage Zone, Southern Ethiopia. During conducting of this research, 613 respondents were selected by simple random sampling technique and the data was collected by using interview and questionnaire. When performing this task, about 97% data was collected by using interview and the remaining 3% was covered by questionnaires. The secondary data was collected from patient registration book of Butajira hea1th center of 2015 and 2016. From those 200people, (32.6%) were positive for plasmodium parasite. Regarding plasmodium parasite, p.falciparum accounts 44%), p.vivax (36%) and double infection case was about (20%). Nothing was recorded about *P.ovale* and *P.malariae.* According to analysis of the result and interpretation, females were more infected groups that account (58.1%). In terms of age, patients less than 15 years were the most infected that account (36.1%), seasonally; high prevention was occurred in Autum followed by winter with regard to prevalence, Indoor residual spraying, environmental management and personal protection were used by the communities as prevention means. Thus, alternative strategies should be designed in order to minimize and control the problems in the study area were also recommended.

[Etalem Alemayeh, Ayana Wubie (DVM), Wale Firew (DVM), Hailehzeb Cheru (DVM). **Prevalence and Prevention Methods of Malaria in the Case of Butajira Sub-City, Gurage Zone, Southern Ethiopia.** *Researcher* 2017;9(7):81-87]. ISSN 1553-9865 (print); ISSN 2163-8950 (online). http://www.sciencepub.net/researcher. 13. doi:10.7537/marsrsj090717.13.

Key Words: Double infection, Malaria, Morbidity, Mortality, Plasmodium species

1. Introduction

1.1. Background

Malaria is a protozoan disease transmitted to man by the bite of the female anopheles mosquito. It is caused by the genus *plasmodium*. Four species of *plasmodium* known to cause disease in man *P. falciparum*: also called malignant malaria, *P. vivax* tertian malaria, *P. ovale*, tertian malaria and *P. malariae* quartan malaria (FMH, 2006).

Malaria continues to be a leading cause of morbidity and mortality in many tropical regions of the world, despite global efforts to eradicate the disease. Even thought the disease is easily preventable, curable and treatable, it remains a big health problem to many communities of the world, especially in Sub-Saharan Africa. Although there have been advances in terms of new drugs and vaccines, eradication is still a way off and many health strategies now focus on malaria prevention and control (Ahmed *et al*.,2009).

Tropical Africa is generally epidemic to *Plasmodium falciparum* due to the absence of Fya/Fyb Duffy antigens. It is however reported to be allopathic to *Plasmodium ovalae* which is epidemic in the western part of the continent. Among the four *plasmodium* species known to cause malaria in Ethiopia, the two epidemiologically important species are *Plasmodium falciparum* and *Plasmodium vivax* comprising 60% and 40% respectively. *Plasmodium falciparum* is the cause of severe and complicated malaria which cause fatality rate of about 10% in hospitalized adults and up to 33% in children <12 years old (FMH, 2004).

Seventy five percent of the total landmass of Ethiopia is malarious and 68% of its population (48 million) is estimated to be at risk of malaria infection (WMR, 2008). The transmission is depend on altitude and rainfall with lag time varying from few weeks before the beginning of the rainy season to more than a month after the end of the rainy season (Deressa *et al*, 2003). Malaria transmission peaks bi annually from September to December and April to May, coinciding with the major harvesting season. This is a serious consequence for Ethiopian subsistence economy and for the nation in general. Early diagnosis and prompt treatment is one of the key strategies in controlling malaria (FMH, 2004).

Since 1950's, significant efforts have been done to control malaria in Ethiopia. However, the disease continues to be one of the major causes of illness, death and impediment to socioeconomic development

in the country (FMoH, 2006). The national Malaria Control Program (MCP) of Ethiopia developed a strategic plan to reduce the burden of the disease by 25% in the year 2005 and by 50% in the year 2010. To meet the above mentioned goal, early diagnosis and effective treatment, selective vector control and epidemic prevention and control has been the main focus (FMoH, 2006). On the contrary, both the chemotherapy and vector control arms of malaria prevention mainly through indoor residual insecticide spray (RIS) are being challenged by the appearance of drug resistance *Plasmodium* parasites and insecticide resistant Anopheles mosquito vectors, respectively in sub-Saharan Africa including Ethiopia (Schunk *et al*., 2006; Teka *et al*., 2008; Bloland, 2001; Balkew *et al*., 2003; Balkew *et al*. 2006). This together with unstable nature of malaria transmission in Ethiopia (Negash *et al*., 2004), necessitates high distribution of ITNs to malaria prone areas as one of the major vector control strategies. Insecticide treated nets are reported to be highly effective in reducing childhood mortality and morbidity from malaria (Lengeler, 2004). However, the success of ITNs depends on several factors such as, willingness of people to use nets, and behavior of the local vector (s) (WHO, 2006; Teklehaimanot *et al*., 2007).

The Southern, Nations, Nationalities and Peoples' Region (SNNPR) is the third most populous regional state next to Oromia and Amhara in Ethiopia. Malaria occurs in almost all zones with over 8 million (65%) of the population being at risk, and it ranks top among the causes of morbidity and mortality in the region. For instance, 144 out of 261 (55%) malaria deaths reported by all hospitals in the country during 2011 were from the SNNPR (FMoH, 2011).

The SNNPR Health Bureau planned a strategy for the prevention and control of malaria in order to achieve the stated RBM and FMoH targets. The main strategy to control malaria in the SNNPR stems from the national strategies. It includes the provision of early diagnosis and effective treatment, selective vector control measures (ITN, IRS and environmental management), scaling up epidemic prevention and control measures. The distribution of ITNs is an important integral part of selective vector control methods (SNNPR Health Bureau, 2009). However implementation of these nationally set strategies is expected to vary from one region to another due to differences in socio-economic, infrastructure, human resources, and environmental factors. These factors affect the effectiveness of malaria prevention and control programmes and their impact. In order to understand to what extent the implemented strategies are on the right track to meet the set targets, they need to be assessed periodically. hence the current study were conducted to determine /estimate the prevalence of malaria and its prevention method, To assess the seasonal variation of malaria as well as to know the prevention methods of malaria in the study area.

2. Literature review

2.1. Geographical distribution of malaria parasite

malaria causes over 110 million cases of illness in each year on worldwide and cases close to 2 million deaths (Muhammed *et al* 2006). The threat of malaria has been largely eliminated in industrial developed countries through mosquito eradication program and the drainage of swamps. Historically and anthropologically evidences confirm that malaria was rear before invention of agriculture. Even today, the disease is rear in under distributed forest or in hunting and gathering society (Elic and Panela, 2004).

The parasite plasmodium develops successfully in the mosquito at mean daily temperatures of 16 ^{0}c _ 21 ^{0}c. Geographically; plasmodium falciparum is the most prevalent species in the hottest and humid regions of the world. P.vivax is widely distributed in temperate sub tropic and some parts of tropic. P.falciparum and P.vivax are distributed all over Ethiopia and roughly account for 60% and 40% of malaria cases respectively (Meseret and Haile, 1990). Commonly plasmodium species causing malaria in Ethiopia (MOH, 2004).

2.2. Life cycle of Malaria parasite

Plasmodium parasite that causes malaria undergoes many stage of development (William and Keeton, 1972). Life cycle of malaria parasite is complex cycles which need the human and mosquito as intermediate and definite host respectively. When the infected mosquito with the malaria parasite ingest blood from the healthy human, passes the sporozoite to the human blood stream. Then the sporozoite travel to liver cell. Each sporozoite undergoes asexual reproduction and develops into schizonts. Then after it grows and divided to produce a maximum number of merozoites, it develops into sex cells or gametocytes. When mosquito bite infected human, it ingested the gametocyte in the blood stream. In the mosquito gut, the gametocyte reaches maturity and undergoes sexual reproduction to form zygote. The zygote changes into ookinate over the next 10-25 hours by the formation of polar rings, The collar, microtubules of cytoskeleton and the inner two layers of pellicle membrane beneath the cell surface. The ookinate migrates through the mid gut wall, but does not penetrate enveloping basal lamina. Then it differentiates into oocyte between the basement membrane and the basal lamina of the mid gut. During this transformation, the cytoskeleton, apical complex and inner pellicular membrane are reabsorbed. Each of oocyte undergoes numerous cytoplasm subdivisions producing sporoplast which yield many thousands of invasive sporozoite.

Sporozoite invade the entire mosquito, many of them enter the salivary gland and thus are in favorable position to infect the next host when the mosquito feeds on human blood (William and Keeton,1972).

2.3. Mode of Transmission

Malaria mainly transmitted by the bites if infected female anopheles mosquito. The main vectors in Ethiopia are A.ganbia, A.funestus, A.nili, A.arebinics and A.pharonchsis. Blood transfusion, contaminated syringe and needles also causes of transmission of malaria (Muhammed *et al*, 2006).

2.4. Public Health Important of Malaria

Even though P.vivax is the most widely distributed malaria parasite, clinically P.falciparum is the most important, each the year more than five millions malaria cases are estimated to occur in Ethiopia (Senay and Verdin, 2005). The two epidemiologically important species in Ethiopia are P.falciparum and P.vivax. P.ovare is rarely reported (Kloas and Zein, 1993). P.falciparum causes the most frequent fatal disease of malaria in Ethiopia. It is the cause of severe and complicated malaria in which mortality is about 10% in hospitalized adults and up to 33% in children, less than twelve years old (Kloas and Zein, 1993).

The second higher mortality rate caused by plasmodium species comes due to P.vivax. It is widely distributed in Ethiopia and after precedes the transmission of P.falciparum. it is more common during dry and winter season. It is due to active transmission or relapse has not clearly determined (Kloas and Zein, 1993). Infection more than one species are more common. The most common mixed malaria infection consists of P.falciparum and P.vivax. However, any combination is possible depending on the presence of species in particular areas but infection with three plasmodium species is rear. Children's are most likely to be infected with more than a single plasmodium species than adult (WHO, 2001).

2.5. Clinical features and pathology of Malaria

The symptomatology of malaria depends on the species, presence of organisms in different organs and the parasite burden. The incubation period varies generally between 10-30 days. As the parasite load become significant, the patient develops headache, loss appetite, vague pains in the bones and joints, chilly sensation and fever. As the disease progresses, the chills and fever become more prominent, the chills and fever follow cyclic pattern (paroxysm) with the symptomatic period lasting 8-12 hours. In between symptomatic period, there is a period relative dormancy; the duration depends upon the species of the infecting parasite (Muhammed *et al*, 2006).

This interval is about 34-36 hours in the cases of P.vivax and P.ovare (tertian malaria) and 58-60 hours in the case of p.malariae (quartan malaria) (MOH,1983).classical tertian paroxysm is rarely seen in p.falciparum and persistent spiking on daily paroxysm is more usual. The malaria paroxysm is most dramatic frightening. It begins with a chilly sensation that also includes peripheral vasoconstriction resulting in cyanotic lips and nails (cold stage).this lasts for about an hour. At the end of this period, the body temperature begin warm. Fever is associated severe headache, nausea (vomiting) and convulsion. The patient experience euphoria and profuse, perspiration and the temperature begins to drop. With a few hours, the patient feels exhausted but symptomless and remains symptomatic until the next paroxysm. Paroxysm is due to rapture of infected erythrocyte and release of parasite (MOH, 1994).

Without treatment, all species of human malaria may ultimately result in spontaneous care except with p.falciparum which becomes more severe progressively and result in death. This organism causes sequestration of capillary, vasculation in the brain, gastrointestinal and renal tissue. Infection result in production of antibodies which are effective in containing parasite load. These antibodies are against merozoites and schizonts. The infection also results in the activation of reticuloendothelial system (phagocytes). The activated macrophage help in the destruction of infected (modified) erythrocytes and antibody coated merozoites. Cell mediated immunity also may develop and help in the elimination of infected erythrocytes. Malaria infection is associated with immune suppression (Muhemmed *et al*, 2006).

2.6. Diagnosis of plasmodium

Diagnosis of plasmodium depends on, to the some extent the clinical manifestation of the disease. However, most of important demonstration of parasite is microscopic observation of stained smear of peripheral blood. Diagnosis by this method requires training and time in case of very low parasite, which may be missed easily. It takes time and patient may loss their life in serious case. A DNA probe specific for detection of p.falcifparum is sensitive and suitable for field condition. Diagnosis can also be made based on PCR and reverse transcriptase polymerase chain reaction. Immune diagnosis also another important technique used for malaria parasite detection. Although it is helpful for field study and rapid diagnostic techniques, it may not be accurate. It can detect antibodies, which were produced during malaria case for about six months after the person cure. Now a day, microscope is the golden method for malaria parasite detection. Every trained person can find plasmodium under the microscope thick smear (MOH, 1994).

2.7. Methods of Prevention

Prevention is mainly achieved three main options, i.e. indoor residual spraying, environmental

management and personal protection. Indoor residual spraying with DDT is one of the major steps in controlling malaria. The objective being to be spray the spray able surface of individual houses at right time, with right insecticide, on the right surface, at the required dosage, and adequate interval of time in order to reduce vector-man contact and transmission. (MOH, 1983).

The second option is environmental management. This includes source reduction, biological control and chemical control of larvae. source reduction is making the environment unsuitable for development of mosquito larvae and this achieved by efficient water management and proper disposal of water to prevent unnecessary creation of mosquito breeding site. Also includes improvement of environmental and personal hygiene (MOH, 1995). Biological control refers using predatory aquatic insects and larvae of fish (MOH, 1994). The other method is chemical control method of larvae through motor oil, paris green, abate and herbicide. In Ethiopia, used motor oil has been applied and is highly recommended. When need arise proper care should be taken when using chemicals, because the applied pesticide may affect human, animals, fish or predators (MOH, 1993).

The third vector control option is personal protection measure. ITN, papyrus mats, clothes are used as barriers or repellents reduce human mosquito contact (MOH, 1994). This personal protection measure is achieved by insecticide treated materials and though early diagnosis and prompt treatment (MOH,1994; MOH,1999).

2.8. Challenges in the control and prevention of malaria

2.8.1. The global climatic changes

The global climatic change is a major contributing factor in the recent increase and propagation of malaria in many parts of the world including Ethiopia. These include unusual high temperature and rain fall on dry period that facilitate either prolonged of malaria transmission in new high land areas. For instance, in 1998 many highland fringe areas were stroked by unanticipated malaria epidemics resulting in many deaths and illnesses (MOH, 1994).

2.8.2. Drug resistance

As a result of resistance chloroquine has been replaced with sulfadoxin-pyrimethamine (SP) for the treatment of malaria. However, there is serious concern regarding the duration of the time sulfadoxin-pyrimethamine will remain effective against p.falciparum. From observation made elsewhere, unlike chloroquine sulfadoxin pyrime thamine may remain effective for quite a short time that is about five years. Therefore is a strong need to monitor the effective sp and look for other alternative drugs in case we need to replace sp at any time in the future (MOH, 1994).

2.8.3. Lack of adequate trained human resource

The control malaria requires resources. Amongest which, well-trained personnel is a crucial for implementation of effective control interventions. Following the decentralization of malaria.

3. Material and Methodology

3.1. Description of study area

The study was conducted in and around Butajira, about 130 kilometers south of Addis Ababa and 50 km to the west of Zeway town in the Rift valley. It is a town and separate woreda in south central Ethiopia. Located at the base of the Zebidar massif in the Gurage zone of the Southern Nations, Nationalities and Peoples' Region, this town has a latitude and longitude of $8^0$07'N $38^0$22'E/ 8.117^{0}N 38.367^{0}E an elevation of 2131 meters above sea level. In 2007 Butajira town had 33,393 inhabitants with a 1:1.03 male to female ratio. Currently, Butajira has one hospital, one health center and several privately owned drug stores and clinics. Various ethnic groups such as Meskan, Mareko, Silti and Sodo, live in the district. The livelihood of the residents is based on mixed farming (CSA, 2007).

3.2 Study Population

The study was conducted in Butajira in which 33,393 population inhabit with 1:1.03 male to female ratio (CSA, 2007).

3.3. Sample size determination and sampling technique

By using the statistical formula, n=N 1+1(2)^2 (Yemer, 1967), 396 respondents were taken from above defined total population. Then from above defined total sample (396), equal number of females and males were selected by using sample random sampling technique since both sexes account approximately equal proportion from total population.

3.4. Data Generation and Recording

The data will be collected from primary and secondary source.

3.4.1. Primary Data

Primary data was collected from Butajira city by using questionnaire (open and close ended) and in time of performing this task questionnaire was provided for patients, health center worker and experts in Butajira city.

3.4.2. Secondary Data

Secondary data was collected from patient registration book of Butajira health center which is data from September 2007 to September 2008.

4.5. Statistical Data Analysis

The data was analyzed by using SPSS Version 20. The frequency distribution of both dependent and

independent variables was worked out by using crosstab.

4. Results and Discussion

4.1 Results

4.1.1 Prevalence of malaria

As shown in table one (1) a total of 613 individuals were included in the study. Among the total suspected cases (patients) 200, the number of females was slightly greater than that of male' registered. From those registered patients, 200 individuals were infected by malaria. From those infected cases, females account 55.5%.

Table 1. prevelence of malaria with respect to sex

Sex	Male		Female		
	No	%	No	%	total
Number of participant	257	41.9	356	58.1	613
Plasmodium positive	89	44.5	111	55.5	200

As indicated in table two large numbers of suspected cases were registered from the age group above 15 years old in the health center following by age group 5-14 (Table-2).

Table 2: prevalence of malaria with respect to age of patients

Age	Number of participants		Plasmodium infected subjects	
	No	%	NO	%
Less than 1	121	36.1	74	37
1-4	187	30.5	55	27.5
5-14	113	18.4	47	23.5
Above 15	92	15.01	24	12
Total	613	100	200	100

As shown in table three P.falciparum infection was Sevier in autumn where as low in summer. Table three also shows that P.vivax infection was Sevier in autumn where as low in summer. In the same way double infection cases a1most low as compared to individua1 infection.

Table 3: Prevalence of malaria with respect to season.

Season	P.falciparum	P.vivax	Double infection	Total
Autumn	36	23	14	73
Winter	.27	21	12	60
Spring	13	16	8	37
Summer	12	12	6	30
Total	88	72	40	200

4.1.2 Methods of prevention used by communities

Preventive measures under taken by the communities in butajira sub city mainly include indoor residual spraying, environmental management and personal protection measures as well as using antimicrobial drugs in case (anti malarial drug). As the respondents were said that indoor residual spraying measure was under taken in all individual houses when malaria prevalence occur seriously in all over sub city in a given specific period. In addition to this, cleaning environment by destruction of all possible mosquito breeding sites was under taken by the whole community. These achieved by proper disposal of waste water, by constructing appropriate canal, drainage, leveling, filling and the like. The other and annually practiced method of prevention also included using insecticide treated bed notes and auto material drug and now in the study area there is a better situation regarding prevention activities of malaria.

4. Discussion

From the result of this study, only two plasmodium species, i.e p.falcefarium and p. vivax were commonly found in study area. The majority of individuals who were positive for malalaria infection were infected by p.falcifarium (44%). As mentioned in (adane, 2008), from the species of malaria, p.falaciparium exceeds all. i.e (44.02%) that means both studies indicates that p.falcefarium got upper hand in attacking. Also according to Awoke (2001), the two peak periods of malaria prevalence were from autumn after the long rainy season and spring, but in this study, the two peak periods of malaria period were autumn followed by winter. It was found that female

were more infected (58.1%) than male (41.9%). Among the total plasmodium infection, p.falcifarium account about (44%) followed by p.vivax which accounts (36%). This result agrees with the material figure which indicates 60% of malaria cases in Ethiopia were due to p.falcefarium and 40% is due to p.vivax (Mohamed et al., 2006). This study also indicated that most affected age group was age less than 15 years.

5. Conclusion and Recommendation

According to this study, the most prevalent plasmodium species were plasmodium falcefarium and the prevalence of malaria had an association with seasonal variation. As described, females were more affected founder group and the most affected age groups were above 15 years. Prevention methods used by the communities in Butajira sub city includes indoor residuals spraying, environmental management and by using personal protection measured. In addition to this anti malarial drug was also used as an alternative prevention method. Based on the above conclusion the following recommendations were suggested:

- Awareness creation to the community about the control and prevention mechanism should be increased to reduce the pressure of malaria infection.
- Further studies should be done to obtain better information about the prevalence and prevention of malaria in study area.
- Great attention should be given for seasons especially autumn and winter.
- Every individual should use INNs (bed nets) when sleeping.
- Government and concerning bodies should work more in allocating insecticides treated bed nets, and should work jointly with community for mosquito eradication.

Corresponding Author:
Ayana Wubie (DVM) Lecturer at Burie Poly Technic College; Department of Animal Health. Burie; Ethiopia; P.O. Box:-75
ayanawb10@gmail.com

References

1. Ahmed, S. M., Haque, R., Haque, U et al. (2009). Knowledge on the transmission prevention and treatment of Malaria among two endemic populations of Bangladesh their health-seeking behavior. *Journal of Malaria,* 8 (1):189-191.
2. Balkew, M., Elhassen, I., Ibrahim, M. *et al.* (2006). Very high DDT resistant population of Anopheles pharoensis Theobald (Diptera: Culicidae) from Gorgora, northern Ethiopia. Parasite, 13 (1): 327-329.
3. Balkew, M., Gebre Michael, T and Hailu, A. (2003). Insecticide susceptibility level of Anopheles arabiensis in two agro development localities in eastern Ethiopia. Parasitologia, 45 (1): 1-3.
4. Bloland, P. (2001). Drug resistance in malaria. World Health Organization (WHO), WHO/CDS/CSR/DRS/2001.4.
5. Cedric, M., Hazel, M., Rechard, V. (2004). Medical Microbiology.3rd edition. Elsevier, Spain. Pp 391-394. Central Statistical Agency of Ethipia, 2007.
6. Cox, F. (1993). Modern Parasitological Excel type of Letters Company Britain. Pp. 496-527.
7. Deressa, W., Ali, A and Enqu Sellassie., F. (2003). Self-treatment of malaria in rural communities, Butajira, Southern Ethiopia. *Bullet of World health Organization,* 81:261-268.
8. Elic, M. and Pamila, J. (2004). Biology today. Grland publishing, New York. Pp 249-305. Federal Ministry of Health (FMH). 2004. Malaria Diagnosis and Treatment Guideline for Health Worker in Ethiopia. Addis Ababa, Ethiopia: Federal Democratic Republic of Ethiopia, Ministry of Health.
9. Federal Ministry of Health (FMH). (2011). Health and health related indicators. Addis Ababa. Federal Ministry of health (FMH). (2006). National five-year strategic plan for malaria Prevention and control in Ethiopia 2006 - 2010. Addis Ababa, Ethiopia: Federal democratic Republic of Ethiopia, Ministry of Health.
10. FMo H. (2006). National five-year strategic plan for malaria prevention and control in Ethiopia 2006-2007 report. Ministry of Health, Addis Ababa, Ethiopia.
11. Kloos, H. and Zein, A. (1993). The ecology of health and disease in Ethiopia. West view press, INC. Pp. 330-344.
12. Lengeler, C. 2004. Insecticide-treated bed nets and curtains for preventing malaria. Cochrane Database of Systematic Reviews, Issue 2.
13. Manschot, W., Janeshuis, K. and Peter, D. (1997). Communicable disease, vector born disease. 2nd, rural health services 7, African research foundation (AMREF) Nairobi, Kenya. Pp. 53-55.
14. Meseret, S. and Haile, F. (1990). Epidemiological manual for health workers and students in Ethiopia, joint publication, MOH and Jimma Health science. Pp.19-61.
15. MOH. (1983). Guideline to malaria control program, Addis Ababa. Pp. 17-19 and 21-22.
16. MOH. (1994). Malaria epidemic privation and control in Ethiopia, Addis Ababa. Pp. 23-27.

17. MOH. (1995). Guide line in community based malaria privations and control, Addis Ababa. Pp. 3-4.
18. MOH. (1999). the area diagnosis and treated guideline for health workers in Ethiopia, Ministry of health, Addis Ababa. Pp.25-27 and 29-30.
19. MOH. (2004). Health related indicators planning program department, volumes FMOH, Addis Ababa, Ethioppia. Pp.56-79.
20. Mohammed A., Adem L. and Waqtola C. (2006). Medical parasitology. Ministry of education and ministry of health, Jimma University. Pp.5-4.
21. Negash, K., Jima, D. and Nafo Traore, F. (2004). Ethiopia roll back malaria consultative mission. Essential actions to support the attainment of the Abuja targets. Ethiopia RBM Country Consultative Mission Final Report, Addis Ababa, Ethiopia. Pp: 39.
22. Schunk, M., Kumma, W., P., Osman, I., B., M. *et al*. (2006). High prevalence of drug-resistance mutations in *Plasmodium falciparum* and *Plasmodium vivax* in southern Ethiopia. *Malaria Journal,* 5 (1): 1-8.
23. Senay, G. and verdin, J. (2005). Parasitology and vector bilogy.2nd education, Harcourt academic press London (UK). Pp.524-549.
24. SNNPR Health Bureau, (2009). Southern Nations, Nationalities and Peoples Regional Health Bureau. Hawassa.
25. Teka, H., Petros, B., Yamuah, L. et al. (2008). Chloroquine-resistant Plasmodium vivax malaria in Debre Zeit, Ethiopia. Malaria Journal, 7 (1): 1-8.
26. Teklehaimanot, A., Sachs, J. and Curtis, C. (2007). Malaria control needs mass distribution of insecticidal bed nets. Pp:506-613.
27. WHO (1991). Basic malaria microscopy part I, learners guide and part II tutors guide. World health organization, Geneva, Pp. 19-24.
28. WHO (2006). Malaria vector control and personal protection. World Health Organization Technical Report Series no. 936. Geneva.
29. WHO (2008). World Malaria Report. World Health Organization, Geneva.
30. William, J. and Keeton, G. (1972). Biological science Norton and eampalil U.S.A. Pp. 247-263.
31. Yemane, J. (1967). Statistics, An introductory analysis. 2nd. New work, Hasrver and Row. Pp. 886.

7/17/2017