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**RESEARCH PAPER**

# Prevalence and pattern of severe malaria among adults in Jimma University Specialized Hospital, Jimma, Southwest Ethiopia: A three years retrospective study

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## Abstract

*Severe malaria is a protozoan disease of human caused mainly by plasmodium falciparum (P.falciparum) but sometimes by Plasmodium vivax and mixed infections. The objective was to assess the prevalence, pattern and trends of severe and complicated malaria among adults admitted to the Medical wards of Jimma University Specialized Hospital (JUSH), South West Ethiopia, from May 1, 2013 to April 30, 2016. A retrospective medical record review study was conducted from May 1, 2013 to April 30, 2016 to assesses the files and registries of patients' with severe malaria admitted to Medical wards of JUSH. The prevalence of confirmed sever and complicated malaria in JUSH from May 1, 2013 to April 30, 2016 was 2.6 % (144) out of the total admission of 5590 patients cards in the three years to JUSH medical ward. Out of the confirmed severe and complicated malaria case mortality was 0.6 %( 32) with case fatality rate was 22.2 %( 32/144). Adult severe malaria cases showed slightly declining pattern during the study period: 90 %( 58) in 2013/14, 3.82% (33) in 2014/15 and 1.64% (53) in 2015/16. Distribution of cases over months showed bimodal pattern for all of the years with the two peaks during the months of May to July and during November to January. P. falciparum accounted for 91.6% of severe malaria causative agent. Patients with co-morbid infections account 33% of cases of severe and complicated malaria. The commonest co-morbid infection was meningitis. More than 80% of the cases were presented to the hospital after 24 hours of malaria episode, which may contributed to increased case fatality rate. Delayed hospital visit was significantly associated with average annual case fatality rate of 5.32 %(15.97% for all the study years) (X2=33.75, P=0.001).This study has shown that trend of malaria admission over three years showed marked decline from 2013/14 to 2015/16. Delay in presentation to the health facility is associated with poorer prognosis, hence early recognition and treatment would decrease mortality. Though declining pattern of malaria s being observed adult severe malaria transmission was active over the studied years even at the end of the first phase of Roll Back Malaria Initiative. Therefore, the efficiency of malaria control and treatment programs should be investigated to fill gaps.*

**Keywords:** adult severe malaria, P.falciparum, P. vivax, retrospective record review

## Introduction

Human malaria is one of the medical emergency disease (Andrej, 2003) that affects the biochemical and physiological processes of the body. It is caused by one of five obligate intra cellular protozoan parasitic protozoa of genus plasmodium, single celled organism. Malaria causing plasmodia are *P. falciparum*, *Plasmodium vivax* , Plasmodium ovale and *Plasmodium malaria*and *Plasmodium knowlesi* (Nour, 2009).

The sign and symptoms of malaria caused by different species of plasmodium vary. The common features of malaria include fever, chills, and flu-like illness (CDC, 2019). The

parasite and the disease are transmitted from infected patient to healthy person. This transmission involves two steps: initially during blood meal female anopheles bite an already infected person and pick up the parasite at its gametocyte stage in second step the same mosquito will bite the other (healthy). In the later step it will inject the parasite through saliva to the blood of the person but now at its sporozite stage that will grow first in the liver cells and later in red blood cells into merozoite stage. This will grow into gametocyte stage, completing the life cycle of the parasite When an individual is inoculated with a plasmodium parasite, a variety of clinical effects may follow, within the sequence from infection, asymptomatic parasitemia, uncomplicated illness through severe malaria to death (WHO, 2014).

Observing the stages of progression of malaria it is possible to categorize the disease into two forms: uncomplicated (non-sever) and complicated (sever) type. Detailed comparison of the two forms can be seen in references (Andrej, 2003; Nour, 2019; WHO, 2014; Grobusch and Kremsner, 2005). If promote and appropriate treatment is given before the disease transform into severe type recovery from the disease is very rapid otherwise it may cause severe complications and death (CDC, 2019). Patients with uncomplicated malaria can be treated as an outpatient while patients with severe malaria require an intensive care and treated as an inpatient (Nour, 2019) levying heavy burden on the family and health system.

Severe malaria is caused mainly by infection from *P.falciparum* but sometimes by *P.vivax* and mixed infections can contribute to the development of severe and complicated malaria. The approximate global incidence and mortality from severe malaria in one year are estimated to be two million cases and 627,000 respectively (Thwing and Steketee, 2011), which is mainly due to progression of infection to severe malaria. Severe malaria shall be treated as rapidly as possible. The case fatality rate of severe malaria in hospitals is 20% and at home is 90% (Thwing and Steketee, 2011). The distribution of severe malaria with in age and social group differs based mainly on the transmission feature of *P. falciparum.* In areas where malaria transmission is stable as in sub-Saharan Africa, severe and fatal malaria affect children < 5 years (WHO, 2012) than adults. In areas where *P. falciparum* transmission is unstable, severe malaria occurs in all age groups (young children (<5 years), older children, and adults) due to lack of protective immunity (Black et al., 2010). This disparity is basically dependent on immunological adaptation to disease. In areas where transmissions stable, a person could have malaria in the blood but s/he may be asymptomatic. The body will develop immunity against repeated infection by plasmodium by mosquito bite (WHO, 2014).

Ethiopia is one of the Sub-Saharan African countries whose large population is vulnerable to malaria. An estimated 68% of the population in Ethiopia lives in malarious areas and 75% of the total land mass is malarious. Malaria is one of the leading causes of mortality and morbidity in Ethiopia (FMoH, 2006).Though malaria is common in Ethiopia, the major malaria transmission is highly unstable in character and season (Ruth et al., 2011). *P. falciparium* is the dominant pathogen of malaria though it is also possible to find *P. vivax* (PMI, 2015).

The main malaria control strategies in Ethiopia include selective vector control, epidemic management and control, environmental management and personal protection through the use of insecticide-treated bed nets (Grobusch and Kremsner 2005; Black et al., 2010). Despite recent efforts to control the disease, malaria remains the leading cause of mortality and morbidity in the country (FMoH, 2006; FMoH, 2004; WHO, 1993). The assessment of the prevalence, pattern and trends of severe malaria will help to recognize gaps in the performance of malaria control program like gaps in: the provision of preventive measures such as insecticide- treated bed nets or indoor residual spray, the use of preventive measures, delays in seeking treatment or poor access to diagnostic testing and treatment (WHO, 2012). Furthermore, the use of data on each inpatient case of confirmed malaria (a proxy of severe malaria) or death is

important for investigation of possible program weaknesses in the prevention or treatment of malaria is recommended (WHO, 2012). However, to the knowledge of our understanding there is no data which specifically reports, about adult severe malaria from southwest Ethiopia specifically JUSH as this hospital serving people from different districts of Jimma zone and other nearby zones Southern Nation and nationalities and Gambella region in which these districts in the zone and other zones of southern nation and nationalities and Gambella region are suspected malarious area.

Therefore, the aim of this study was to assess retrospective medical recorded review on prevalence, pattern and trends of severe malaria among adult inpatients attending and admitted to JUSH Medical wards from 2013 to 2016.

# Materials and methods

## Study area

This study was conducted at JUSH, Jimma, Ethiopia. JUSH is located to the Northeast of Jimma city, which has a geographic coordinate of $07^0 40'$ N, $36^0 50'$E. Jimma city is located about 352 km from Addis Ababa, the capital city of Ethiopia to the south west. It is one of the oldest hospital in the country and established in 1930 by the Italians invaders. JUSH is the only teaching and referral hospital in the southwestern part of the country, providing services for about 15 million people with catchments area of about 250km radius(Elias and Mirkuzie, 2010). It has training center for about 700 health science students each year. The hospital has four major departments such as Medical, Surgery, Gyneclology /Obstetrics and pediatrics and five other departments. The hospital provides postgraduate training in Internal Medicine, Surgery, Gynecology/obstetrics, pediatrics and Ophthalmology. It has about 600 beds and total of more than 550 employees. The hospital provide service for inpatients and outpatients with diagnostic modalities are routine laboratory investigations, Radiology and histo-phatologic techniques.

## Study design

Retrospective study design was used on medical record review from May 1, 2013 to April 30, 2016.

## Data collection

The data was collected from medical records of medical wards focused on patients admitted for sever malaria cases. Questionnaire was used for the collection of data for the purpose of this study. The data was collected by nurses working in the medical wards during data collection time.

## Selection of medical records

All medical records of patient's visited JUSH during May 1, 2013 to April 30, 2016 were screened for severe malaria. All medical records of adult patients with presumptive and confirmed severe malaria were collected and rescreened for adult medical records with confirmed severe malaria were only selected. In then medical records of patients with presumptive severe malaria were screed out. Based on this procedure a total 5590 medical records were found in medical wards for the intended study periods of these records only 201 presumptive and confirmed records were selected. Of the 201 presumptive records only 144 medical records were retained for data abstraction (Fig.1).

Data abstraction was conducted by comparing medical records with discharge register of inpatients. This comparison was done to make sure that all the information required for this study can be located. Discharge register, which contains the final diagnosis, is the most important register for malaria surveillance systems. Data was abstracted in JUSH medical ward by trained nurses with close supervision by medical intern by using data abstraction tool. The tool was pretested before use.

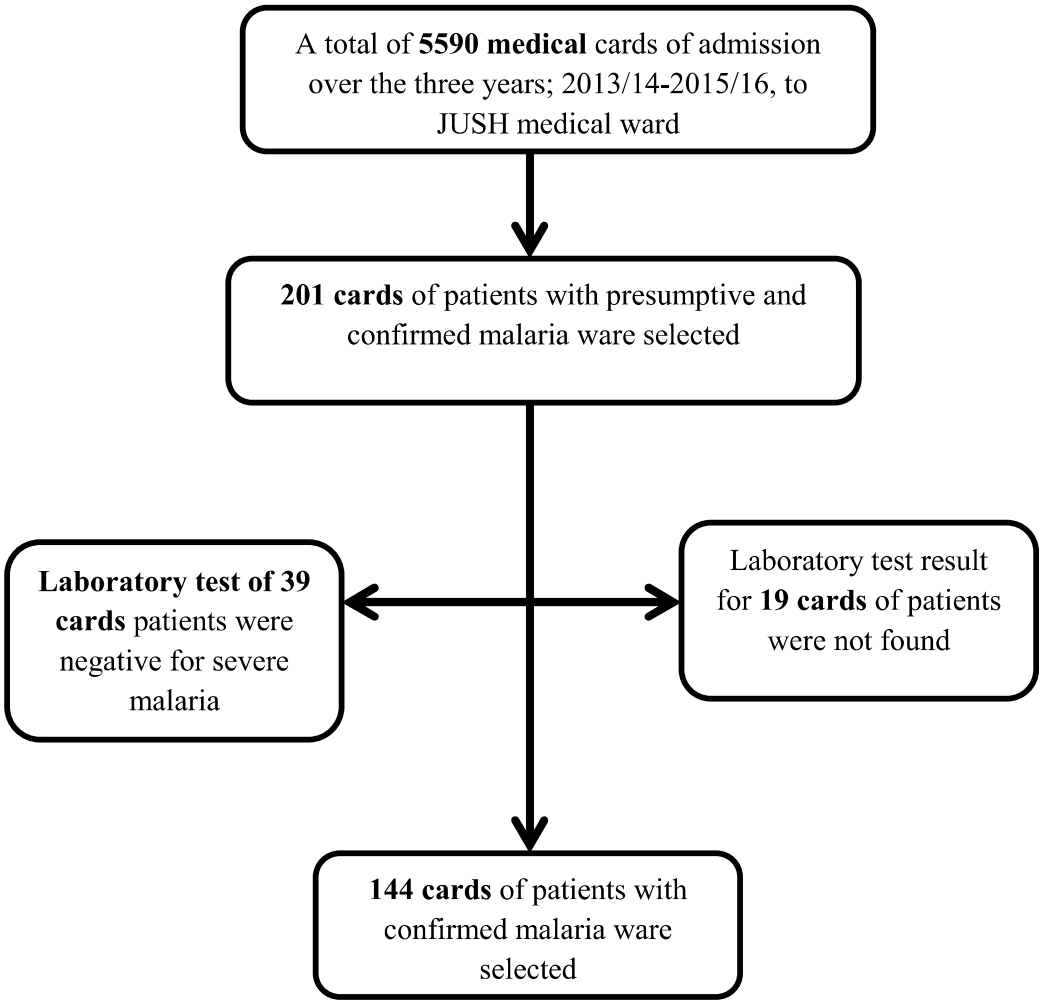


Figure 1.Flow chart for selection of cards of severe malaria patients

The data abstraction format used here was modified discharge reister and features of severe malaria. This format has six parts. The first part contains socio-demographic information the patient's. The second part contains information about diagnosis of pathogen of severe malaria pathogen and co-morbid infections. The third part contains the defining features of severe malaria in symptomatic patient. The fourth, fifth and sixth parts contain information about duration of delayed arrival in the hospital after the onset of the episode, length of stay in hospital and reason for leaving hospital (discharged, died, transferred, absconded), respectively

## Severe malaria case definition

For case definition of sever malaria we used (WHO, 2014) guideline as described in Table 1 below.

Table 1. Epidemiological and research definition of severe *falciparum malaria* criteria for this study/

| For epidemiological and research purposes, severe malaria is defined as one or more of the following, occurring in the absence of an identified alternative cause, and in the presence of *P. falciparum* asexual parasitaemia: | |
|---|---|
| **Impaired consciousness:** | A Glasgow Coma Score <11 in adults or a Blantyre coma score <3 in children |
| **Acidosis:** | A base deficit of >8 meq/l or, if unavailable, a plasma bicarbonate of <15 mM or venous plasma lactate >5 mM. Severe acidosis manifests clinically as respiratory distress – rapid, deep and laboured breathing |
| **Hypoglycaemia:** | Blood or plasma glucose <2.2 mM (<40 mg/dl) |
| **Severe malarial anaemia:** | A haemoglobin concentration <5 g/dl or a haematocrit of <15% in children <12 years of age (<7 g/dl and <20%, respectively, in adults) together with a parasite count >10 000/μl |
| **Renal impairment (acute kidney injury):** | Plasma or serum creatinine >265 μM (3 mg/dl) or blood urea >20 mM |
| **Jaundice:** | Plasma or serum bilirubin >50 μM (3 mg/dl) together with a parasite count >100 000/μl |
| **Pulmonary oedema:** | Radiologically confirmed, or oxygen saturation <92% on room air with a respiratory rate >30/min, often with chest indrawing and crepitations on auscultation |
| **Significant bleeding:** | Including recurrent or prolonged bleeding from nose gums or venepuncture sites; haematemesis or melaena |
| **Shock:** | Compensated shock is defined as capillary refill ≥3 s or temperature gradient on leg (mid to proximal limb), but no hypotension. Decompensated shock is defined as systolic blood pressure <70 mm Hg in children or <80 mm Hg in adults with evidence of impaired perfusion (cool peripheries or prolonged capillary refill) |
| **Hyperparasitaemia:** | *P. falciparum* parasitaemia>10% |

## Data Analysis

The collected data were transferred from data abstraction form to spread sheet and cross checked for completeness and proper recording. Data were presented and analyzed using charts, graphs, chi square and frequency tables.

## Ethical consideration

This study was approved by college of health science graduating class Student's Research Program organizing committee. This study was conducted after obtaining an official letter from the same committee. Furthermore, the objective of the initiative was presented to JUSH hospital managers and key stake holders to get permission.

# Results

## Prevalence and socio-demographic features of severe malaria in JUSH

A total of 5590 patients were admitted to the medical wards of JUSH during the study period: May 1, 2013 to April 30, 2016. Out of this 201 (3.6%) medical cards of patients assumed to be severe malaria possetive. But only 2.6%(144) of the total admission cards were found to havelabortory test confirmed severe malaria.

The majority of severe malaria infection was found in patients who are in the productive ages range. More than eighty five percent (85.50%) of the patients were in age range of 15-45, active working age, with the mean age of 31.9 years. The proportion of patients aged older than 45 years was 14.50 %.

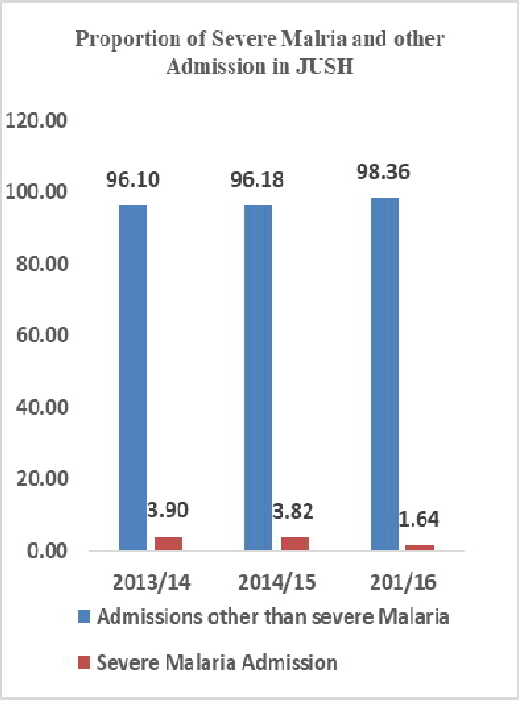


Figure 2: comparison of proportion of severe malaria admission and admission other than sever malaria over three years to the medical wards, JUSH, from May 1, 2013 to April 30, 2016

The annual admissions in the JUSH medical ward for each year from 2013/14 to 2015/2016 were 1489, 865 and 3236 while the identified severe malaria for each year was 3.90% (58), 3.82% (33) and 1.64% (53) respectively. The highest admission due to severe malaria was observed during 2013/14 with a marked decline in the proportion of cases admitted thereafter (Fig.2).

## Prevalence of malaria by parasites among severe malaria patients in JUSH

In this study microscopic test had confirmed Plasmodium in only 143 study subjects. The malaria causing parasites detected with in the blood of severe malaria patients were *P. falciparum* and *P. vivax*. The former accounted for 91.66 %( 132) of the cases and was the dominant pathogen. The same test showed that *P. vivax* was observed only in 4.16 %( 6) of the cases. The remaining 4.16% blood films showed mixed infection from both *P. falciparum* and *P. vivax* was detected (fig.3).

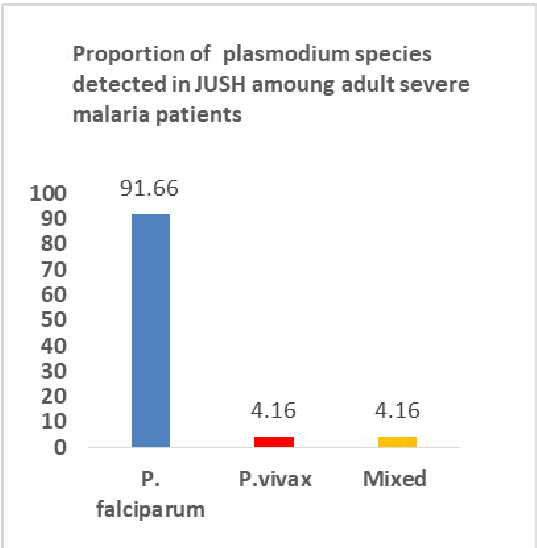


Figure 3: Malaria Pathogen species identified in patients with severe malaria admitted to medical wards, JUSH, from May 1, 2013 to April 30, 2016

## Distribution of severe malaria by months in JUSH

The distribution of severe malaria occurrence over months (Fig.4) showed bimodal pattern for all of the three years. The two peaks were during the months of April and May and during September to December. The higher peaks were recorded in the September to December throughout the study period. The moderate peaks were recorded during April and May. Both the higher and moderate peaks showed declining tendency from the years 2013-2016.

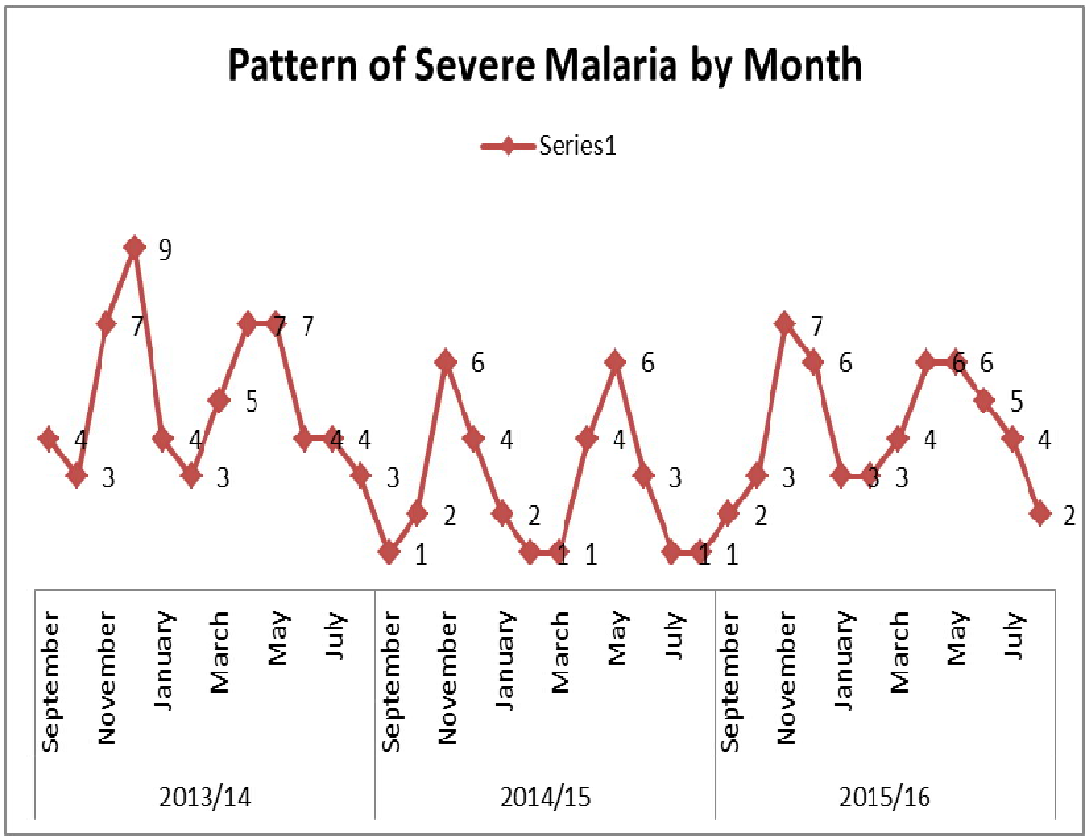


Figure 4: Patterns of malaria admission by month over three years from May 1, 2013 to April 30, 2016

## Duration of Hospital arrival after the first episode of Malaria sign-and association of hospital out comes in JUSH

The result of assessment of the charts of patients in this study showed (Table.1) that only 19 % (27) (arrived in or contacted health systems within 24hrs; 54 % (78) within 24-72hrs and the rest 27% (39) after 72 hrs of the onset of symptoms of illness. Delay in hospital visit (Table 2.) for more than 72hrs is related to more frequent deaths (16 deaths out of 144 cases). Delay in hospital visit for 24-72hrs resulted in moderate deaths (six deaths out of 144) while immediate hospital visit (< 24hr) after the initial episode caused the death of one person only. In general more than 15.97% (23) of the patients admitted with severe and have died. This showed that the development of severe malaria and its hospital outcome is significantly associated with delay in hospital visit with($X^2$ =33.75, P=P=0.001< α=0.05).

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Table 2: Duration of illness before arrival versus outcome cross tabulation of patients admitted with severe malaria to the medical wards, JUSH, from May 1, 2013 to April 30, 2016.

| | Hospital Out come | | | | | |
|---|---|---|---|---|---|---|
| **Duration** | **Improved** | **Dead** | **Total** | **%** | **$X^2$** | **P-value** |
| **<24hrs** | 26 | 1 | 27 | 19 | 33.75 | 0.001* |
| **24-72hrs** | 70 | 6 | 76 | 54 | | |
| **>72hrs** | 24 | 16 | 40 | 27 | | |
| **Total** | 120 | 23 | 143 | 100 | | |

*There is significant association between delay in hospital visit and severe malaria deaths in hospital (n=143), P=0.001< α=0.05.

## Duration of Hospital Stay for Severe malaria Cases in JUSH

Equal proportion of severe malaria patients stayed in JUSH medical ward before discharge for 3-7(three to seven days) and more than 7 (seven days) days (Table 2.). The former accounted for 43.60% and the later for 43.10% of patients. Small proportion, about 13.10% percent of patients was discharged within less than three days of admission

## Discussion

This study showed that severe malaria admissions were active atJUSH consistently over the three years of study period. This deadly disease was found affecting active, working age group. The prevalence showed slightly decreasing pattern from the years 2013-2016. The average annual server adult malaria admissions recorded in JUSH over the study period was 2.6%(48/1863) and is far less than the annual general malaria caused hospital admissions, which is 16% and reported from Oromia regional state (PMI, 2015).This discrepancy would be due to the difference in the mode of the report. We restrict our report to confirmed adult severe malaria admissions while the report from Oromia regional state includes all age groups. The result of our study was slightly less than what is reported from Gondar University Hospital, where hospital malaria admission accounted for 4.4% (Mangistu et al., 1978). Severe malaria cases showed progressively declining pattern over the three years study period. This reduction would be attributable to the implementation of malaria contention intervention program in the past few years by Federal Ministry of Health (FMoH) and Oromia Health Bureau in the study area. In 2007 the FMoH distributed 20 million Long Lasting Insecticide Nets and conducted mass drug administration with the Artemesinin Combined Treatment drug artemeter-Lumefantrine (PMI, 2015) as first line treatment. The other reason could be the fact that JUSH is a tertiary hospital; most cases may get managed in nearby health centers. However, this problem was observed in a referral hospital, JUSH even during the last phase of the Millennium Development Goal 6 (Roll Back Malaria; UN, 2015). The mean age of severe malaria affected patients in our study was 31.9 years with minimum. Similar results were reported by Van and Kim (1990) in Vietnam, Endeshaw and Assefa, (1990) in Ethiopia and, Alcantra, 1982) in Philippines.

The major annual transmission modes of adult sever malaria in this study area showed seasonal bimodal scenario. Malaria transmission in Ethiopia is mainly seasonal and has unstable character and areas with bimodal seasonal rain fall will have two major malaria transmissions seasons (National Malaria Control Team, Ethiopian Public Health Institute, World Health Organization, Addis Ababa University and the INFORM Project ., 2014).

In this study, the dominant single plasmodial species detected in the blood of severe malaria

affected patients was *P. falciparum*. Mixed infection (*P. falciparium* and *P. vivax*) contributed smaller cases. Infection rate from *P.vivax* alone was equal to mixed infection rate and it is low. The result of this study is concordant with a study done in San Lasaro Hospital (Rowena and Arturo, 1992). Tajebe et al. (2014) also reported high infection rate from *P. falciparum*, moderate infection rate from *p. vivax* and very low mixed infection in microscopic diagnoses. Another study reported higher prevalence (53.01%) and severity of adult severe malaria caused by mixed infection (Kochar et al., 2014). The difference observed in prevalence of specific plasmodium and its malaria may be due to the difference in the malaria endemicity and immunity status of study subjects in those study areas.

This study showed that delay in treatment seeking as demonstrated by late arrival in the hospital seems to contribute more to the development of severe malaria and associated morbidity and mortality. More than 80 %( 81.25%) of the cases arrived in hospital after 24hours of the onset of illness, which account for 95.65% of all dead patients ($X^2$=33.75, P=0.001). Other studies also showed that risk factors for severe malaria and associated mortality include delay in treatment, old age (> 65), severity of illness and the level of innate or acquired immunity and missed or delayed diagnosis ( Bruneel, 2003; Blumberg et al., 1996; Schwartz etla., 2001).

The average annual severe malaria case fatality rate in this study was 5.32%. This result was almost similar to (7.8%) adult severe malaria case fatality rate reported from Yemen (Sawsan, 2013). The case fatality rate of severe malaria reported in this study was less than that of both Gondar university Hospital (11%) Mangistu et al,(1978) and the one reported by Kain, (1998) on imported severe malaria that is estimated to exceed 20%; 19% in adults in hospital from western Cambodia hospital (Chanthap Lon, 2013) and 15.20% in Vietnam (Van et al., 1982). The discrepancy among the results of these studies may be due to the different diagnostic criteria used in each study, to the hospital set up & facilities used in the treatment of each case and to included study participants.

## Conclusion

This study showed malaria transmission was still occurring in south western Ethiopia during two major seasons: September to December and May to April. At least some of these cases transform into severe malaria. Delay in the health facility visit was associated with poorer prognosis; hence early recognition and treatment would decrease mortality. As the occurrence of severe malaria is an indication for malaria contention intervention inefficiency, the components of the intervention program in the south west Ethiopia should be re investigated so that possible behavioral risk factors, possible occurrence of insecticide and drug resistance will be sorted out while thinking for the WHO set technical strategy for malaria during 2016-2030.

## Limitation of the study

This study addressed adult severe malaria only. Therefore, for peoples in less than 15 years was not addressed. The study was conducted over only three year period, which relatively short. Thus the result of the study will not clearly catch the tendency of the adult severe malaria case in the study setting

## Acknowledgement

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## Author's conflict of interest

All the authors participated in this study would like to declare that we agree on the publication of this manuscript and would like to disclose that this work is not related to any person or institution that can bias our report.

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