ISSN: 2832-7748

Research Article

Advances in Sexual & Reproductive Health Research

# Malaria Outbreak Investigation and Response in Bolosso Sore Wereda, Welayta Zone, SNNPR, Ethiopia, 2019

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**Submitted**: 01 Mar 2023; **Accepted**: 21 Mar 2023; **Published**: 27 Mar 2023

**Citations:** Mohammed, A. D., Assefe, Z., Bizuneh, H. (2023). Malaria Outbreak Investigation and Response in Bolosso Sore Wereda, Welayta Zone, SNNPR, Ethiopia, 2019. *Adv Sex Reprod Health Res, 2*(1), 160-166.

## Abstract

***Objective:*** *Malaria is caused by one or more of the five species of plasmodium species that can infect by the bite of female Anopheles. In Ethiopia, about 68% of the total population resides in areas with a high malaria risk, and 2,174,707 cases and 662 deaths due to malaria were reported in 2014–2015 with a case fatality rate of 0.03%. The outbreak was reported on April 22/2019 (WHO week 17) then we investigate the outbreak to describe the magnitude of morbidity and mortality due to the malaria outbreak, identify the etiologic agent, and investigate factors associated with an occurrence of malaria outbreak.*

***Result:*** *The overall attack rate of the woreda was 36.4 per 1000. From the cases, Males are slightly more affected than females (38: 37). The most affected age group is >15 years, 54 (72%) followed by 5-14, 17(22.7%). Plasmodium falciparum is the highest proportion of malaria in the wereda. Having impregnated treated net have no problem but impregnated treated net who have used sometimes (AOR 10.214; 95% CI) was identified as a risk factor for malaria or more likely affected by malaria ten times each respectively than those impregnated treated net used always.*

## Introduction

Malaria is caused by one or more of the five species of plasmodium species that can infect by the bite of female Anopheles [1]. Humans are infected by malaria through the bite of a female Anopheles mosquito. Once in the human body, the parasites multiply rapidly, first in the liver, followed by the blood.

Due to Ethiopia's complex topography and seasonal rainfall support largely seasonal short-term transmission, malaria is generally unstable that put the population non-immune [2]. Recurrent outbreaks and epidemics are associated with cyclical climatic variations that lead to increased vector survival in the country. Generally, malaria cases are peaked after two rainy seasons (March-May and July-September). The country has experienced the worst malaria epidemics in 1958 with three million cases and 150,000 deaths [3].

Malaria outbreak occurs within the first five years this is the highest one in the district. Moreover, prevention programs and timely investigation of outbreaks by using surveillance data are the main purposes of Integrated Disease Surveillance. The purpose of this study is to verify the existence of the outbreak, identify gaps and risk factors that contributed to the existence of the outbreak and provide proper public health intervention for the outbreak in Bolosso Sore woreda.

## Methodology

### Study Area

Boloso Sore is one of the woredas in the SNNPR of Ethiopia. Bolosso Sore is located from the North and East latitude: 7°04'60.00"N longitude: 37° 39' 59.99" E respectively. It has 32 kebeles and 8 health centers. Some kebeles of the wereda are high malaria i.e., 17 kebeles of the wereda are malaria area and the outbreak occurs in all clusters but differ in magnitude. The climate and the topography of the area are favourable for malaria insect breeding.

### Study Design and Period

Conducted descriptive and unmatched case-control study for the analytical part of the study on the active patients. And it was conducted from April 22/2019-August 28/2019.

### Sample Size Determination

The sample size was calculated based on power requirements in both cases and control. It is done by using two by two tables by adjusting two-sided confidence level at 95%, power (percentage chance of detecting) was 80 %, ratio of control to case at 2, the

hypothetical proportion of controls with exposure at 50% and least extreme Odds Ratio to be detected was OR of 2.3 of Gemechu malaria outbreak investigation (calculated from Epiinfo7.2.0.1) [4]. The total number of people included in the study was 225 individuals, 75 were cases and 150 were controls. And All Case subjects were active cases and controls were selected for each case in 1:2 ratio bases on the same Community family or neighbour from controls were at the same time.

### Sampling Procedure and Sampling Technique

Health centers were selected for cases- control study and community diagnosis based on the high weekly Malaria case report i.e., purposely. We used a structured and semi-structured questionnaire to conduct an interview with cases and controls on the risk factors. And also interviewed the health office and health cluster (HCs) PHEM officers on the control and prevention program in the woreda. The sampling technique was those patients who came to the health center and became malaria positive and were selected randomly from the list. That means we use a simple random sampling technique.

### Environmental Assessment

Data was collected on the presence of potential mosquito breeding sites. Selected case-patients and controls were interviewed about the presence of mosquito breeding sites in their compound and near to home. In addition, the availability of uncovered plastic water containers, old tires, stagnant water, and broken glasses in the home or outside the home was also critically assessed.

### Data Analysis

Quantitative data were collected using face-to-face interviews by an administered questionnaire that addressed socio-demographic characteristics, clinical manifestation, potential exposures (risk factor), review of weekly integrated disease surveillance and response at different levels (Wereda Health office), visit of the affected village, and interview community members. We entered data by using Epi Info version 7.2.0.1 and we use SPSS to analyze associated factors. The significance of risk factors for the outbreak was determined through logistic regression of bivariate and multivariate analysis by calculating Odds Ratio and 95% Confidence Interval. A p-value of less than 0.05 was considered significant.

## Results

There was a total of 225 samples of malaria cases and throughout the outbreak, there were no death occurred. From the total of malaria confirmed cases the most affected age group was >15 years, 54 (72%) followed by 5-14, 17(22.7%). Of the total 50% of them were > 15 years of age. Males 38 (51%) were slightly more affected than females. And nobody refused to be interviewed.

### Descriptive Epidemiology

### Description of the Overall Epidemic Situation

Five years woreda data was shows that there was no outbreak within those five years. Bolosso Sore woreda Weekly malaria case passed the threshold level on WHO Week 18 (from April 22) and the health office has detected the outbreak on Week 18 based on the established threshold and writing letters about the outbreak to health centers for alerting the outbreak then similarly to Zonal health department. And the wereda was actively worked for the response of the outbreak and they controlled it. There was no death reported.

### Description of Cases by Time

The number of cases passed the threshold level in epi. Week of 18 /2019 continued consistently increasing and reached a peak on the week (20) and then with a sharp decrease on each week and steadily decreasing from week 29 up to Week 35 and it was decreased and controlled. The outbreak started on Week 18 of the epidemiologic week by crossing the threshold and reached a peak on week 20.

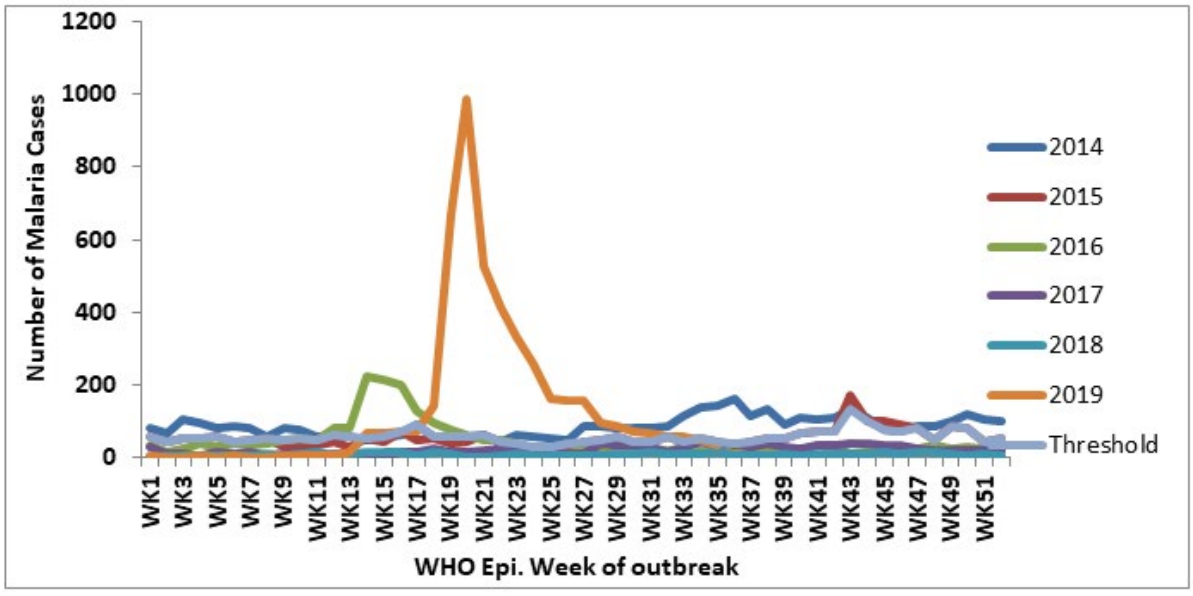


**Figure 1:** Epidemic threshold of malaria in Bolosso Sore Woreda from 2014

## Epi Curve of the Outbreak

The outbreak was started from week 18, peaks at week 20 and then stopped or controlled from week 34 till this investigation done.

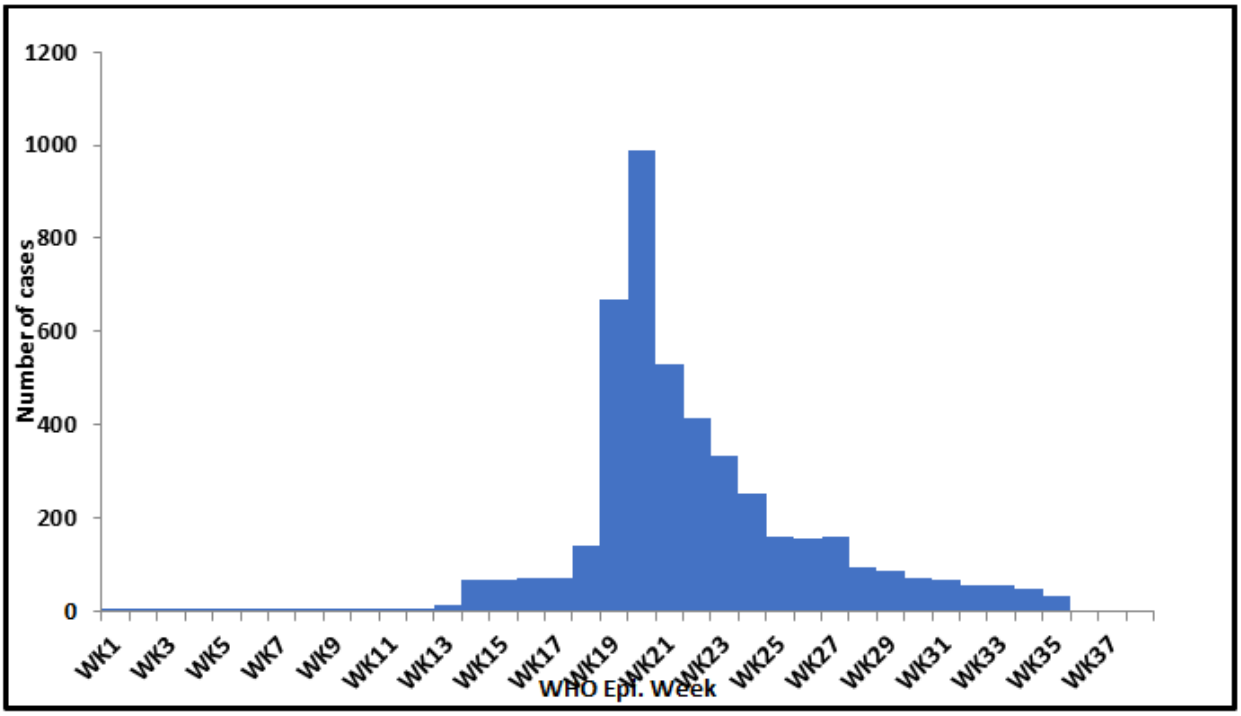


**Figure 2:** Epi curve of Bolosso Sore woreda based on PHEM weekly data Wolayta Zone, SNNPR, and Ethiopia September, 2019

## Description of Cases by Person

Bolosso Sore Woreda has a total population under surveillance of 211,145 out of this 120,252 are at risk of malaria. The overall attack rate (AR) for the woreda was 36.4/1000. From the cases Males are more affected than females (38: 37). The most affected age group is >15 years, 54 (72%) followed by 5-14, 17(22.7%). The educational status of the study participants was illiterate (7) and 31 attended school at primary level. Regarding Marital status of study participants, 52% were married, 16% NA or underage and 32% single.

**Table 1: Socio demographic Characteristics of Bolosso Sore Woreda,Wolayta zone, SNNPR, September,2019**

| SNO. | *Variables* | *Case* | *Control* | *AR* | | *Total* | *%* |
|---|---|---|---|---|---|---|---|
| *1* | Occupation | Employed | 2 | 23 | 3% | 25 | 11% |
| | | Unemployed | 5 | 8 | 7% | 13 | 6% |
| | | Student | 31 | 38 | 41% | 69 | 30.7% |
| | | Pastoralist | 5 | 1 | 5% | 6 | 2.7% |
| | | Farmer | 32 | 81 | 44% | 113 | 50.2% |
| *2* | Total family Size | 2-5 members | 30 | 40 | 40% | 70 | 31% |
| | | >5 members | 46 | 109 | 61% | 155 | 69% |
| *3* | Marital Status | Married | 39 | 80 | 52% | 119 | 53% |
| | | Single | 24 | 51 | 32% | 75 | 33% |
| | | NA | 12 | 19 | 16% | 31 | 14% |
| *4* | Education | Ilitrate | 7 | 24 | 9% | 31 | 14% |
| | | Primary | 31 | 58 | 41% | 89 | 40% |
| | | Secondary | 16 | 23 | 21% | 39 | 17% |
| | | Tertiary | 4 | 11 | 5% | 15 | 7% |
| | | Non-formal | 8 | 21 | 11% | 29 | 13% |
| | | NA | 5 | 17 | 7% | 22 | 10% |

**Table 2: distributions of Total malaria positivity by age group and sex in Bolosso Sore Wereda, Wolayta Zone, August 2019 (from the interview of cases)**

| *Characteristics* | | *Total Malaria* | *PF* | *PV* |
|---|---|---|---|---|
| *Sex* | Male | 38 | 35 | 3 |
| | Female | 37 | 27 | 10 |
| | Total | 75 | 62 | 13 |
| *Age* | <5 years | 5 | 5 | 0 |
| | 5-14 years | 17 | 15 | 2 |
| | >15 years | 53 | 42 | 13 |

## Description of Cases by Place

Most active cases were from Gurmo Koysha cluster. The wereda has 8 clusters in which in each cluster has three to five kebeles. Embecho and Afama Bancha clusters were not included in case controls study because of their topography difficulty and the number of cases somehow small. We interviewed 75 a case from six clusters (G/koysha H/C, Gara Gudo H/C, Achura H/C, D/salata H/C, Legama H/C and Woybo H/C). Attack rate per 1000 people of the all the H/C Dangara salata H/C was the highest one (AR=46.1%) and the least one was Woybo H/C which was (AR= 6%). The investigation team treated a total of serologically confirmed (positive) 4119 cases.

**Table 3: Distribution of malaria cases by cluster/health center and AR in Bolosso Sore Wereda, Wolayta zone, SNNRP, April 21 to August 25, 2019 (from WHO epi week 17-35)**

| *SNO* | *Name of H/C* | *Total population* | *Number of PF* | *Number of PV* | *Total number of cases* | *AR per 1000* |
|---|---|---|---|---|---|---|
| *01* | G/koysha H/C | 23,225 | 785 | 257 | 1,042 | 45% |
| *02* | Gara gudo H/C | 37,106 | 378 | 63 | 441 | 11.9% |
| *03* | Achura H/C | 17,309 | 131 | 78 | 209 | 12% |
| *04* | Dangra Salata H/C | 19,473 | 741 | 157 | 898 | 46.1% |
| *05* | Legama H/C | 20,470 | 524 | 116 | 640 | 31.3% |
| *06* | Woybo H/C | 25,381 | 111 | 41 | 152 | 6% |
| *07* | Embecho H/C | 33,883 | 232 | 276 | 508 | 15% |
| *08* | Afama Bancha H/C | 32,589 | 110 | 119 | 229 | 7% |

## Analytical Epidemiology (Case -Control)

A total of 75 malaria cases and 150 apparently healthy controls were included into this analysis. We assessed possible risk factors that contribute to contracting malaria. In another bi-varate analysis who staying overnight 43% (P-value 0.028) is less likely affected by malaria than those not staying overnight. ITN who have used sometimes (COR 2.343) and those have ITN and they never use ITN (COR 2.248) were identified as a risk factor for malaria or more likely affected by malaria two times each respectively than those used ITN always.

In multi variate logistic regression some times and never ITN usage (AOR 10.214, 95 % CI1.163-89.725 and AOR 32.098, 95% CI 3.570-288.133 respectively) were found to be independent risk factors of malaria infection in the study area or they were the highest risk factors. In general, those who have an AOR < 1 they were found to be preventive or had less risk for malaria infection.

**Table 4: Socio-demographic Bi-varate Analysis of Bolosso Sore Wereda, SNNPR, 2019**

| *SNO* | *Variables* | | *Case in %* | *control in %* | *95% CI* | | *COR* | *P-value* |
|---|---|---|---|---|---|---|---|---|
| | | | | | **Lower** | **Upper** | | |
| 1 | Sex | Male | 38(51%) | 57(38%) | 1 | 1 | 1 | 1 |
| | | Female | 37(49%) | 93(62%) | 0.96 | 2.934 | 1.676 | 0.071 |
| 2 | Age group | <5 years | 5(6%) | 18(12%) | 1 | 1 | 1 | 1 |
| | | 5-14 y | 17(23%) | 37(25%) | 0.192 | 1.9 | 0.605 | 0.389 |
| | | >15 | 53(71%) | 95(63%) | 0.18 | 1.417 | 0.498 | 0.191 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | Occupation | Employee | 2(2.7%) | 23(15%) | 1.024 | 20.656 | 4.600 | 0.046 |
| | | unemployed | 5(6.7%) | 8(5.3%) | 0.195 | 2.104 | 0.640 | 0.462 |
| | | Student | 31(41%) | 38(25%) | 0.262 | 0.918 | 0.490 | 0.026 |
| | | Pastoralist | 5(7%) | 1(0.7%) | 0.009 | 0.712 | 0.080 | 0.024 |
| | | Farmer | 33(44%) | 80(54%) | 1 | 1 | 1 | 1 |
| 4 | Total family size | 2-5 family member | 29(39%) | 41(27%) | 1 | 1 | 1 | 1 |
| | | >5 family member | 46(61%) | 109(73%) | 0.932 | 3.015 | 1.676 | 0.085 |
| 5 | Education | Ilitrate | 10(13%) | 21(14%) | 1 | 1 | 1 | 1 |
| | | Primary | 31(41%) | 58(39%) | 0.373 | 2.127 | 0.891 | 0.795 |
| | | Secondary | 17(23%) | 22(15%) | 0.23 | 1.648 | 0.616 | 0.335 |
| | | Teritiary | 4(5%) | 11(7%) | 0.333 | 5.153 | 1.31 | 0.7 |
| | | Non formal | 8(11%) | 21(14%) | 0.412 | 3.79 | 1.25 | 0.693 |
| | | NA | 5(7%) | 17(11%) | 0.464 | 5.648 | 1.619 | 0.45 |

**Table 5: Risk factors Bi-varate Analysis of Bolosso Sore Wereda, SNNPR, 2019**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **1** | ***Travel History*** | ***Yes*** | ***5(7%)*** | ***0*** | ***0*** | ***0*** | ***0*** | ***0.999*** |
| | | No | 70(93%) | 150(100%) | 1 | 1 | 1 | 1 |
| *2* | Staying overnight | yes | 32(43%) | 42(28%) | 0.293 | 0.933 | 0.523 | 0.028 |
| | | No | 43(57%) | 108(72%) | 1 | 1 | 1 | 1 |
| *3* | Having ITN | yes | 70(93%) | 129(86%) | 0.159 | 1.214 | 0.439 | 0.113 |
| | | No | 5(7%) | 21(14%) | 1 | 1 | 1 | 1 |
| *4* | ITN Usage | Always | 36(48%) | 30(20%) | 1 | 1 | 1 | 1 |
| | | Sometimes | 34(45%) | 99(66%) | 1.240 | 4.425 | 2.343 | 0.009 |
| | | Never | 5(7%) | 21(14%) | 1.007 | 5.021 | 2.248 | 0.048 |
| *5* | Number of ITN | One | 6(8%) | 57(38%) | 0.788 | 9.354 | 2.714 | 0.114 |
| | | 2-3 ITN | 53(71%) | 70(47%) | 0.142 | 1.000 | 0.377 | 0.050 |
| | | 4-6 ITN | 10(13%) | 2(1%) | 0.010 | 0.335 | 0.057 | 0.002 |
| | | Non have | 6(8%) | 21(14%) | 0.164 | 1 | 1 | 1 |
| *6* | IRS | Yes | 35(47%) | 28(19%) | 0.242 | 0.844 | 0.452 | 0.013 |
| | | No | 40(53%) | 122(81%) | 1 | 1 | 1 | 1 |
| *7* | Open deep wel | Yes | 39(52%) | 57(38%) | 1.009 | 3.095 | 1.768 | 0.046 |
| | | No | 36(48%) | 93(62%) | 1 | 1 | 1 | 1 |
| *8* | Broken glass | Yes | 36(48%) | 43(29%) | 0.245 | 0.774 | 0.435 | 0.005 |
| | | No | 39(52%) | 107(71%) | 1 | 1 | 1 | 1 |
| *9* | Plastic container | Yes | 61(81%) | 59(39%) | 0.109 | 0.411 | 0.212 | 0.00 |
| | | No | 14(19%) | 91(61%) | 1 | 1 | 1 | 1 |
| *10* | Gutter | Yes | 24(32%) | 42(28%) | 0.453 | 1.509 | 0.826 | 0.535 |
| | | No | 51(78%) | 108(72%) | 1 | 1 | 1 | 1 |
| *11* | Stagnant water | Yes | 58(77%) | 88(59%) | 0.221 | 0.782 | 0.416 | 0.006 |
| | | No | 17(23%) | 62(41%) | 1 | 1 | 1 | 1 |
| *12* | Intermittent River | Yes | 41(55%) | 61(41%) | 1.032 | 3.162 | 1.806 | 0.038 |
| | | No | 34(45%) | 89(59%) | 1 | 1 | 1 | 1 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *13* | Tick grass | Yes | 6(8%) | 14(9%) | 0.436 | 3.216 | 1.184 | 0.741 |
| | | No | 69(92%) | 136(91%) | 1 | 1 | 1 | 1 |

### Environmental Assessment

Observation was conducted for availability of stagnant water, building for fish breeding, broken glass, intermittent river near to the community and other potential mosquito breeding sites. In all assessed kebeles, it was identified that there were larvae of mosquitoes in observed stagnant water by naked eye.

### Public Health Intervention

A Total of 10 kebeles were sprayed with profoxer chemical. Communities were mobilized and taught on prevention and control measures of malaria disease. Active case search and early management were done at community and health facility level. Larvicide was done those had stagnant water and larvae were seen by Abet chemical.

**Figure 3:** Stagnant water that found in Achura Cluster Tiyo Kebele

### Discussion

Age group of 15 years and greater than 15 years were more affected with AR of 72 per 100 populations than other age group. Similar studies were done in Zimbabuwe (50 per 100) and it is higher than that of Zimbabwe [5]. This is might be due to higher ages have lower immunity and the productive ages were in night activities.

Presence of intermittent rivers nearest to the community, OR 1.806 (95 %CI; 1.032-3.162) and open deep well OR 1.768 (95% CI ;1.009-3.095) were independent risk factors for onset of the outbreak of malaria. A similar study done in Northwest Ethiopia, Smada District, Amhara region OR 5.41 (95 %CI; 2.11-10.00) and our study is lower than that of Asgede Tsimbla district and the above one. This independent risk factor was due to the fact that following high rainy season there will be flooding as a result, in lowland areas the water stays as stagnant water facilitating mosquito breeding result in malaria infection [6].

The odds of developing malaria among people who used ITN sometimes and never use ITN was nearly 32 and 10 times (AOR; 32.098; 95%CI: 3.570-288.633 and AOR 10.214; 1.163-89.725 respectively) compared to who use ITNs frequently. Similar finding was also reported from study in India and it is higher than that of India. This might be due to lack of knowledge about the use of ITN. Having poor knowledge related to malaria prevention and transmission, stagnant water and tick grass had no association with malaria illness in multivariate analysis (OR=0.83; 95%CI; 0.401-1.716) [7]. Similar study is done in Dasenech wereda in South Ommo in SNNPR.

### Conclusion and Recommendation

In conclusion there were malaria outbreak in Bolosso Sore wereda over two months starting from the mid of 17th Epi Week to 28th epi. week. Presence of intermittent rivers nearest to the community, open deep well near to their home and usage of ITN (those ITN use sometimes and never use ITN) were independent risk factors for onset/occurrence of the outbreak of malaria. And IRS, tick grass, staying overnight, number of ITN those given to the community or poor accesses, broken glass and plastic container were less risk factor for the infection of malaria than their counterparts or preventive factors for malaria infection. And also, there were no malaria repellents all over the wereda. And the malaria patients or risky kebeleas of their homes were not screened.

Therefore, malarias areas of the wereda insecticide treated bed net should be distributed for all households according to their family member. Beside this, utilization of bed net should be monitored

and optimized. Regular indoor residual spray per required standard should kept in place. I dentification and removal of potential mosquito breeding sites should be conducted by maximizing community participation. And during the outbreak they should be use line list format that is used for response.

## Abbreviations

| | |
|---|---|
| AOR | Adjusted Odd Ratio |
| AR | Attack Rate |
| CI | Confidence Interval |
| CO | Congestive Odd Ratio |
| IRS | Indoor Residual Spray |
| ITN | Impregnated Treated Net |
| OR | Odd Ratio |
| HCs | Health Centres |
| RDT | Rapid Diagnostic Test |
| SNNPR | South Nation Nationality and People Region |
| SPHMMC | Saint Paul Hospital Millennium Medical College |
| WHO | World Health Organization |


## Acknowledgements

We would like to thanks our advisors, for their guidance and constructive comments during our work. Our heartfelt gratitude goes to the Saint Paul's Hospital Millennium Medical College for giving us this opportunity and funding for this research. In addition, we would like to thank SPHMMC psychiatry department staff for their constructive advice, guidance and help. In general, our sincere gratitude also goes to all supervisors, data collectors and study participants.


## Authors' Contributions

AD designed the study, participated in the training and data collection, performed analysis, interpretation of data, drafted the paper and prepared the manuscript. HH and ZA assisted in the design, participated in data analysis and comment the drafts of the manuscript. All authors read and approved the final manuscript.


## Funding

We have no any means of funding of this research.


## Availability of Data and Materials

The dataset is available on from Mr. Awol Dawud of the corresponding author.

## Declarations

### Ethical Approval and Consent to Participate

All participants were informed about the objective of the study, confidentiality of the participant was assured and informed consent was sought from and given by the participants, with the knowledge they were free to withdraw at any time. Ethical clearance was obtained from the institutional review board of Ethiopian public health institute and the support letter was written from Welayta zone health bureau to Bolosso sore wereda health office.

### Consent for Publication

Not applicable

### Competing Interests

We have declared that we have no competing interests.

## References


1. Jima, D., Wondabeku, M., Alemu, A., Teferra, A., Awel, N., Deressa, W., ... & Graves, P. M. (2012). Analysis of malaria surveillance data in Ethiopia: what can be learned from the Integrated Disease Surveillance and Response System?. Malaria journal, 11(1), 1-14.
2. Draft Guideline for malaria vector control in Ethiopia; Malaria and Other Vector-borne Diseases Prevention and Control Team; Diseases Prevention and Control Department; Federal Ministry of Health, Addis Ababa, Ethiopia, January 2002
3. Dawud, A. M., Bizuneh, H., & Assefa, Z. (2021). Malaria Outbreak Investigation and Response in Bolosso Sore Wereda, Welayta Zone, SNNPR, Ethiopia, 2019.
4. Sharma, R. (2006). Epidemiological investigation of malaria outbreak in village Santej, district Gandhi Nagar (Gujarat). Indian Journal Preventive Social Medicine, 37(3-4), 125-132.
5. Workineh, B., Mekonnen, F. A., Sisay, M., & Gonete, K. A. (2019). Malaria outbreak investigation and contracting factors in Simada District, Northwest Ethiopia: a case–control study. BMC research notes, 12, 1-6.
6. Yadav, K., Dhiman, S., Rabha, B., Saikia, P. K., & Veer, V. (2014). Socio-economic determinants for malaria transmission risk in an endemic primary health centre in Assam, India. Infectious diseases of poverty, 3(1), 1-8.
7. Seyoum, w. (2018). Malaria outbreak investigation and Response in Dasenech District, South Omo zone, SNNRP