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Full Length Research Paper

Prevalence of malaria and the associated risk factors among pregnant women attending antenatal care in health institutions of Damot Woyide district, Southern Ethiopia

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Malaria during pregnancy is a cause of morbidity and mortality in pregnant women and their fetuses eventually the newborns and infants. Hence, this study was conducted to determine the prevalence and risk factors of malaria among pregnant women that attend antenatal clinics in health institutions found in Damote Woyide district. A health institution based cross-sectional study was conducted. Socio-demographic data were collected using semi-structured questionnaire and Giemsa stained blood smear samples were examined using microscope. Data were coded, entered and analyzed using SPSS version 20. The overall prevalence of malaria was 8.2% and the prominent species was Plasmodium falciparum (5.4%). Individuals in the third trimester were more infected (5.0%) than those in second (2.4%) and first (1%). Multigravidae (AOR: 0.1, 95% CI: 0.001-0.07), using ITN always (AOR: 0.01, 95% CI: 0.03-0.31), using Indoor IRS in the last twelve months (AOR: 0.02, 95% CI: 0. 01-0.05) and family size 1-3 (AOR: 0.27, 95% CI: 0.01-0.90) were identified as protective factors of malaria among pregnant women. The overall prevalence of malaria in the pregnant women requires special attention, so efforts should be made to minimize the problem by promoting frequent visiting of antenatal clinics and supplying bed nets.

Key words: *Plasmodium* species, pregnant women, antenatal care, malaria in pregnancy.

INTRODUCTION

Malaria is a life-threatening disease caused by parasites belonging to the genus *Plasmodium* transmitted from infected individuals to other people via the bites of infected female Anopheles mosquitoes. Other comparatively rare mechanisms for transmission include congenitally acquired disease, blood transfusion, sharing of contaminated needles, organ transplantation, and noso-comial transmission (Gruell et al., 2017). Five malaria parasite species *Plasmodium falciparum, Plasmodium malariae, Plasmodium ovale, Plasmodium vivax* and *Plasmodium knowlesi* are responsible for the cause of malaria in humans, and 2 of these species *P. falciparum* and *P. vivax* cause the greatest threat (CDC, 2018). In 2017, *P. falciparum* accounted for 99.7% of estimated malaria cases in the WHO African Region, as well as in the majority of cases in the WHO regions of

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South-East Asia (62.8%), the Eastern Mediterranean (69%) and the Western Pacific (71.9%). *P. vivax* is the predominant parasite in the WHO Region of the Americas, representing 74.1% of malaria cases (WHO, 2018).

Malaria is one of the most serious and a major public health problem in the world and has been consistently reported as one of the leading cause of morbidity and mortality. As the 2018 WHO report indicated malaria is still one of the most serious and a major public health problem in the world. As to the report, there were an estimated 219 million cases and 435, 000 deaths of malaria in 90 countries (WHO, 2018). The highest burden of global malaria 92% of malaria cases and 93% of malaria deaths occur in Africa (WHO, 2017). The economic burden associated with malaria was high; malaria prevention control and elimination programs cause 12 billion US dollar loses in African countries each year (CDC, 2018). Some population groups are at considerably higher risk of contracting malaria, and developing severe disease, than others. These include infants, children under 5 years of age, pregnant women and patients with HIV/AIDS, as well as non-immune migrants, mobile populations and travelers (WHO, 2018).

Malaria in pregnancy is a major public health problem in sub-Saharan Africa, where about 35 million pregnant women are at risk of malaria infection annually (WHO, 2016). During pregnancy, malaria can lead to several adverse pregnancy associated consequences including intrauterine growth retardation, abortions, stillbirths (Cot and Deloron, 2003; Yatich et al., 2010), preterm delivery, low birth weight, maternal anemia (Steketee et al., 2001) and maternal and infant mortality (Kalilani-Phiri et al., 2013). Women predominantly at high risk of malaria associated complications during pregnancy are those with relatively low levels of previously acquired immunity (Recker et al., 2009). The fundamental mechanism of increased vulnerability is not well understood, however studies indicated that it allied with parasitologic, immunologic and epidemiologic factors (Schantz-Dunn and Nour, 2009). Factors such as the level of endemicity, acquired immunity before pregnancy and parity are major contributors of the epidemiology of malaria in pregnancy (Newman et al., 2003).

Malaria still remains a major public health problem in Ethiopia an estimated 68% of the population is at risk of the disease (WHO, 2017). In Ethiopia transmission of malaria is seasonal and mostly unstable leading to epidemics and *P. falciparum* and *P. vivax* are the main species responsible for 60 and 40% cases, respectively, while *P. malariae* and *P. ovale* infection are rare and account for < 1% of confirmed malaria cases (FMOH, 2012). Investigations conducted in the country indicated that the prevalence of malaria during pregnancy was relatively low and was strongly associated with adverse pregnancy outcomes such as maternal anemia, low birth weight (LBW), premature delivery, and stillbirths (Newman et al., 2003). Pregnant women especially from unstable transmission areas were at higher risk of hospitalization and fatal outcomes including their fetuses (Newman et al., 2003). Since there was variation in prevalence of malaria among pregnant women within and between countries, having local data will be essential to consider protective measures accordingly. Hence, this study was conducted to determine the prevalence and associated risk factors of malaria among pregnant women attending ANC clinic in Damot Woyide district, where such a study has not been conducted in the past.

METHODOLOGY

Description of the study area

The study was conducted in four primary Health Centers of Damot Woyide district, Wolaita Zone. The district is located at 384 and 90 km South of Addis Ababa and Hawassa, respectively (Figure 1). According to the Central Statistical Agency (CSA, 2015), the population of the district was 115558, 57670 males and 57888 females. There are four health centers and 25 health posts. Malaria transmission in the district occurs in two seasons, September to December, after the heavy rain and April to May, after the light rain ((FMOH, 2011).

Study design and study population

Health institution based cross-sectional study was conducted during malaria transmission season between April and May, 2016. Pregnant women attending antenatal clinic (ANC) in the four health centers and willing to participate in the study were included after signing informed consent. Individuals that were not interested to participate in the study and those on any treatment in the past six weeks prior to data collection were excluded.

Sample size determination and sampling technique

The sample size of this study was calculated by using the formula to estimate a single population proportions, with the following assumption, anemia prevalence 50%, with confidence level of 95%, margin of error of 5 and 10% non-response rate. Total sample size of 422 pregnant women were selected by using systematic random sampling technique, where the first one was selected randomly during visit to ANC; every other one was selected till the total sample size was attained (Figure 2).

Methods of data collection

Standard structured and pre-tested questionnaires were used to collect socio demographic data. Data on prevalence of malaria and species type was congregated by dropping finger prick blood of each participant on labeled slide and preparing thick and thin smear and observing under light microscope.

Data analysis

Data were entered, cleaned and analyzed using SPSS version 20 for windows (SPSS, Chicago, IL, USA). Descriptive statistics were employed to describe the study population in relation to socio-

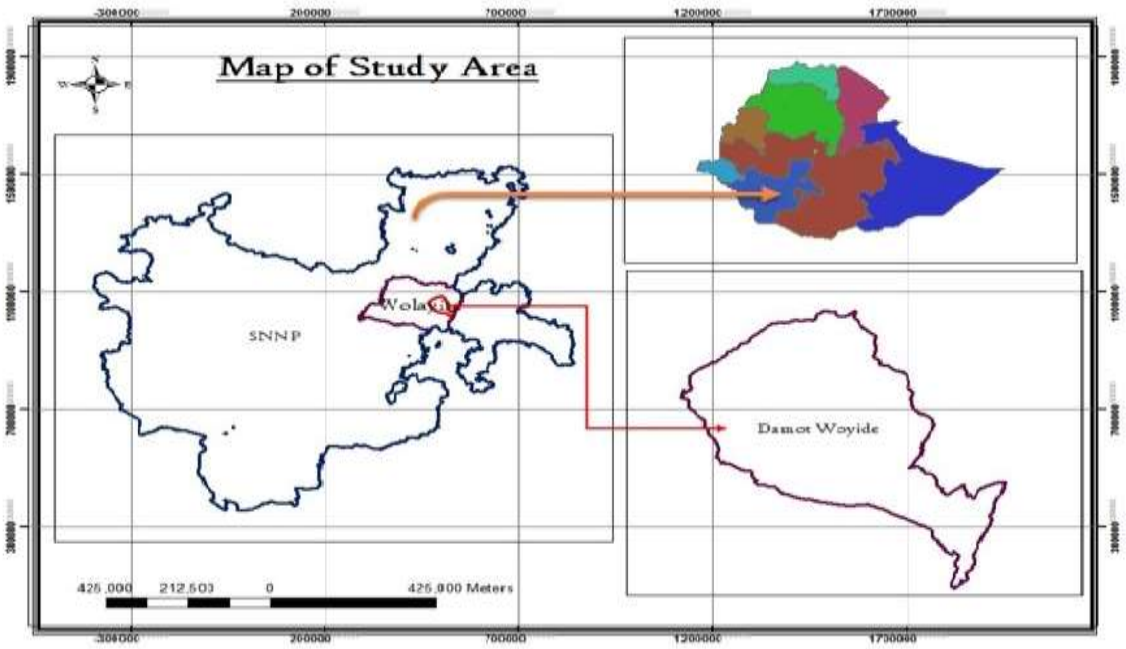

Figure 1. A map of DamotWoyide district, South Ethiopia.

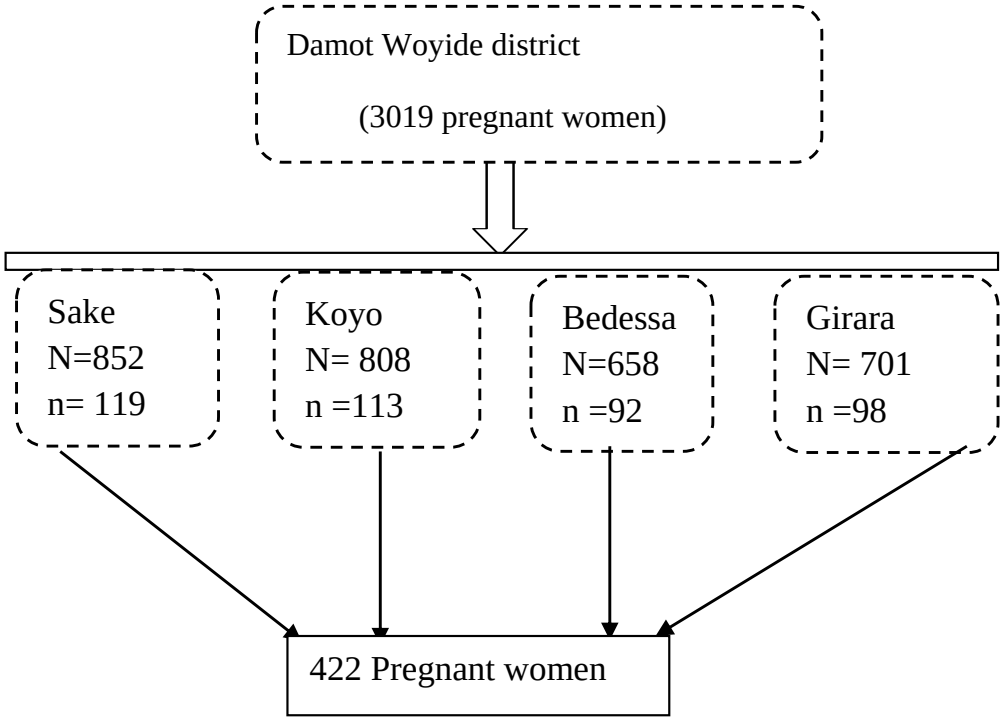

Figure 2. Flow chart indicating the sampling procedure of study participants in Damot Woyide district, South Ethiopia.

demographic and other relevant variables. Bivariate and multivariate logistic regression analyses were done to identify independent predictors of malaria. Variables with p value < 0.25 by the bivariate analysis were candidates for the multiple logistic regression model. P < 0.05 was considered as statistically significant.

Ethical clearance

The proposal was reviewed and approved by Hawassa University, College of Natural and Computational Science, Department of Biology ethical committee. Permission was obtained from Damot Woyide district health office administration before data collection. Ahead of enrollment into the study written informed consent was obtained from the study participants. Information obtained from the participants and laboratory tests findings were kept strictly confidential. They were assured that only aggregate data will be reported. Confirmed malaria positive cases were immediately communicated to the antenatal care clinics of the health centers, for treatment and follow up.

RESULTS

Sociodemographic characteristics

The sociodemographic characteristics of the pregnant women that were involved in this study are summarized in Table 1. Data were successfully gathered from 422 pregnant mothers who attended ANC in the four health centers of Damot Woyide district, which made the response rate 100%. Most of the pregnant women were within the age group of 18 to 25 years (52.1%). Majority, 165 (39.1%) of the pregnant women were in the second trimester and a large proportion of them were Primigravidae (34.8%). The family size of study participants ranged from 1 to 8 with an average of 4.81 persons per household. Among all study participants, 48 (11.4%) had formal education. The monthly income of almost half of the participants was in the range of 700 to 1500 Birr (49.8%). Majority of the participants (75.4%) live in the rural area and greater part (41.7%) were merchants.

Prevalence of malaria among pregnant women

The overall prevalence of malaria infection among the pregnant women in the study area was 8.2%. The finding further indicated that among the infected malaria cases majority were due to *P. falciparum* 5.4%. Primigravida women were more infected with *P. falciparum* (17) as compared to multigravidae ones, while multigravida women were more infected with *P. vivax* (5) as compared to Primigravida. Individuals in the third trimester were more infected (4%) than those in the first trimester (1%), and the difference was statistically significant (χ^2 = 8.524, P = 0.014) (Table 2).

Knowledge about malaria among pregnant women

More than 99% of the respondents had information about malaria and majority (83.2%) claimed that their source of information was health workers and community meetings. Nine in ten (91.7%) women knew that malaria was transmitted by the bite of mosquitoes. Moreover, 346 (82%) of the participants were fully aware that ITNs protect from mosquito bite and play a major role in controlling malaria transmission. Three hundred and fifteen (74.6%) mentioned that they obtained ITNs from public health facilities and 308 (73%) stated that they use ITNs regularly. Almost 80% perceived that using Indoor Residue Spray (IRS) was advantageous, since it killed mosquitoes, while 91 (21.6%) worry that IRS has side effect due to its bad smell and with the fear that it may kill domestic animals (Table 3).

Factors associated with prevalence of malaria

Multiple logistic regression analysis was performed to identify independent predictors of malaria among pregnant women. Ten explanatory variables that were associated with malaria in bivariable analyses at 25% level of significance were entered into multiple logistic regression model, in the last step of analysis, seven variables were excluded. Family size, gravidity, use of ITNs, and use of IRS in the last twelve month showed significant association with prevalence of malaria P < 0.05. Accordingly as the adjusted odds ration result indicated having family size less than or equal to three, 73% (AOR: 0.27, 95% CI: 0.01-0.90) less likely exposed to malaria than family size greater than 3. Multigravidae 90% (AOR: 0.1, 95% CI: 0.001-0.07) less likely infected with malaria as compared to Primigravidae. Women using ITNs always were 99% (AOR: 0.01, 95% CI: 0.03-0.31) less likely infected with malaria as compared to those not using at all. In addition use of IRS in the last twelve month was 98% (AOR: 0.02, 0. 01-0.05) protective than not using.

DISCUSSION

Of the total of 422 pregnant women who attended the antenatal clinics in the four health centers of Damot-Woyide district, 8.2% were found to be infected with malaria. The result was also similar to other reports of investigations conducted in Ethiopia (10.4%) (Newman et al., 2003), Sudan (13.7%) (Adam et al., 2005), Malawi (8.9%) (Rogerson et al., 2000) and Rwanda (13.6%) (Van Geertruyden et al., 2005). The finding was greater than other investigations conducted in malaria endemic areas of Ethiopia (1.8%) (Newman et al., 2003), India (5.4%) (Singh et al., 2012). But less than investigations done in North West Ethiopia 16.3% (Getachew and Tsige, 2017), Burkina Faso (18.1%) (Cisse et al., 2014), Nigeria (42%) (Jombo et al., 2010) and Ghana (47%) (Clerk et al., 2009). The lower prevalence might be associated with high utilization of ITN by most of the women and improved awareness of the women about the transmission of malaria and possible other prevention ways. In addition, it might be also associated with strengthened efforts of local, regional and national level

Table 1. Sociodemographic characteristics of study participants in Damot Woyide district, South Ethiopia.

Characteristics	Number	Percentage (%)
Age group (year)		
18-25	220	52.1
26-35	180	42.7
>35	22	5.2
Parity		
Primigravidae	164	38.9
Secundigravidae	149	35.3
Multigravidae	144	34.1
Gestation period		
First trimester	141	33.4
Second trimester	165	39.1
Third trimester	116	27.5
Educational status	48	11. 4
None		
Primary	151	35.8
Secondary	151	35.8
Above college	72	17.1
Occupation		
Daily laborer	102	24.2
House wife	69	16.4
Merchant	176	41.7
Gov't employee	75	17.8
Residence		
Rural	319	75.4
Urban	103	24.3
Monthly income		
≤700.00Birr	139	32.9
701-1500.00 Birr	210	49.8
>1500.00 Birr	73	17.3
House roof type		
Grass roof	121	28.7
Tin sheet	301	71.3
Family size		
1-3	112	26.5
4-6	182	43.1
7& above	128	30.3

health authorities that work in the prevention, management and control of malaria by giving special consideration to pregnant women.

P. falciparum is a more prevalent species (5.5%) as compared to *P. vivax* (1.9%); similar findings were also reported by other studies conducted in Northern Ethiopia (Tegenaw et al., 2013), Rwanda (Van Geertruyden et al., 2005), Sudan (Gabbad et al., 2014; Dafallah et al., 2003) and Ghana (Clerk et al., 2009). The high prevalence of *P. falciparum* might be associated with its prominence in tropical part of the world as compared to *P. vivax* which was mostly dominant in the temperate zone. As compared to multigravidae the prevalence of malaria was higher in primigravidae and secundigravidae. The present

Table 2. Distribution of *Plasmodium* species among study participant in DamotWoyide district, South Ethiopia.

Characteristics	Categories	Malaria species				p-value
		***P. falciparum* (%)**	***P. vivax* (%)**	**Mixed (%)**	**Total (%)**	
Gravidity	Primigravidae	17 (4.0)	----	----	17 (4.0)	0.361
	Secundigravidae	6 (1.4)	3 (0.7)	1 (0.2)	10 (2.4)	0.268
	Multigravidae	0	5 (1.2)	3 (0.7)	8 (1.9)	-
Trimester	1st	2	-	2	4	-
	2nd	6	2	2	10	0.06
	3rd	15	6	-	21	0.002*

Table 3. Knowledge about malaria among study participants in Damot Woyide district, South Ethiopia.

Knowledge	Number	Percent
Way of transmission		
Biting of mosquito	387	91.7
Biting of bee	-	-
Contamination of food	35	8.3
Protective measures		
Use of ITN	346	82
Cleaning environment	35	8.3
Scents-smock	41	9.7
Do you use ITN regularly		
Yes	308	73
No	114	27
Did you sleep under ITN last night		
Yes	334	79.1
No	88	20.9
Opinion about IRS		
Advantageous	331	78.4
Side effect	91	21.6
Source of information		
Media	72	17
Health workers	190	45
Community meeting	160	38
Source of ITN		
In public health facility	315	74.6
In private health facility	33	7.8
Buying from shop	74	17.6

finding was in harmony with investigations conducted in Nigeria (Idowu et al., 2006), Rwanda (Van Geertruyden et al., 2005) and Malawi (Rogerson et al., 2000). However, investigation conducted in Sudan (Dafallah et al., 2003), Mali (Adam and Elbashir, 2005) and Angola (Campos et al., 2012) indicated no association between parity and malaria infection. The highest prevalence in primigravidae might be associated with suppressed immune status of the pregnant women, which make the women more susceptible to malaria as compared to the multigravidae, whose immune system was more competent due to exposure to the parasite during successive pregnancies (D' Alessandro et al., 1996) (Table 4).

Table 4. Risk factors associated with malaria among study participant in Damot Woyide district, South Ethiopia.

Variable	Category	No. exam. (%)	+ve (%)	COR(95% CI)	P value	AOR (95% CI)	P value
Education	Illiterate	48 (11.4)	10 (20.8)	1		1	
	Elementary	151 (35.8)	21 (13.9)	0.61(0.38-1.00)	0.26	4.44 (0.29-0.68)	0.28
	Secondary	151 (35.8)	7 (4.6)	0.19 (0.10-0.34)	0.03*	4.71 (1.19-1.83)	0.36
	College and above	72 (17)	1 (1.4)	0.05 (0.02-0.18)	0.01*	2.61 (0.18-3.76)	0.16
Occupation	Daily laborer	102 (24.2)	14 (1.7)	4.14 (1.95-8.76)	0.03*	0.58 (0.21-1.59)	0.53
	House wife	121 (28.7)	15 (13.2)	3.67 (1.74-7.70)	0.05*	1.49 (0.57-3.90)	0.64
	Merchant	124 (29.4)	5 (4)	1.01 (0.43-2.38)	0.99	0.54 (0.15-1.91)	0.58
	Gov't employee	75 (17.8)	3 (4)	1		1	
Family size	1-3	112 (26.6)	6 (5.4)	0.36 (0.21-0.61)	0.03*	0.17 (0.01-0.90)	0.04**
	4-6	182 (43.1)	10 (5.5)	0.38 (0.25-0.59)	0.01*	0.07 (0.03-1.06)	0.06
	7 & above	128 (30.3)	19 (14.8)	1		1	
Monthly income	<700.00birr	152 (36)	24 (15.8)	1		1	
	701-1500birr	197 (46.7)	10 (5.1)	0.29 (0.18-0.45)	0.01*	1.95 (0.48-7.90)	0.96
	>1500.00birr	73 (17.3)	5 (6.8)	0.39 (0.22-0.71)	0.07*	0.52 (0.11-2.44)	0.06
House roof type	Grass roof	121 (28.7)	22 (18.2)	1		1	
	Tin sheet	301 (71.3)	17(5.6)	0.27 (0.14-0.53)	0.01*	2.03(0.1-40.08)	0.64
Gravidity	Primigravidae	147 (34.8)	21 (14.3)	1		1	
	Secondigravidae	142 (33.6)	7 (4.9)	0.57 (0.37-0.88)	0.14*	0.26 (0.02-0.83)	0.04**
	Multigravidae	133 (31.5)	11 (8.3)	0.25 (0.14-0.45)	0.01*	0.1 (0.001-0.07)	0.01**
Gestation period	First trimester	141 (33.4)	7 (5)	1		1	
	Second trimester	165 (39.1)	14 (8.5)	0.28 (0.16-0.49)	0.21*	0.61 (0.05-7.34)	0.69
	Third trimester	116 (27.5)	18 (15.5)	0.52 (0.33-0.79)	0.08*	4.44 (0.39-51.26)	0.23
Use of ITN	Use always	311 (73.7)	6 (1.9)	0.01 (0.01-0.02)	0.00*	0.01 (0.03-0.31)	0.001**
	Use some times	90 (21.3)	18 (20)	0.10 (0.05-0.19)	0.00*	0.30 (0.05-0.58)	0.03**
	Don't use	21 (5)	15(71.4)	1		1	
Use of IRS	yes	331 (78.4)	4 (1.2)	0.02 (0.01-0.04)	0.00*	0.02 (0. 01-0.05)	0.00**
	No	91 (21.6)	35 (38.5)	1		1	

The highest prevalence of malaria in the present case was recorded in third trimester of pregnancy, which was in line with studies carried out in Angola (Campos et al., 2012), Nigeria (Idowu et al., 2006) and Mali (Adam and Elbashir, 2005). This is because as resent investigations (Hile et al., 2013) revealed women in the first trimester have more tendency to be protected from malaria, as the stage increases their prevention level decreases and infection rate increases due to weak immunity at third trimester stage. Contrast previous investigations conducted in Gambia, indicated the prevalence was higher in the first trimester (D' Alessandro et al., 1996), other investigations reported high prevalence of malaria in the second trimester of pregnancy (Brabin, 1983). Though investigations performed by Rogerson et al. (2000) and Dicko et al. (2003) designated the presence of significant association between malaria and maternal age, in the present study age was not significantly associated with malaria prevalence, similarly findings were reported by investigations conducted in other places (Clerk et al., 2009; Tegenaw et al., 2013; Adam and Elbashir, 2005; Rogerson et al., 2000).

The current investigation revealed that, households having family size less than or equal to three members have less chances of having a malaria case as compared to family having members greater than three (Table 4). This finding has also been confirmed by other earlier studies which indicated the prevalence of malaria

increased as family members increased (Abdalla et al., 2017; Sharma et al., 2015). Frequent utilization of ITN significantly protected pregnant women from malaria infection. Similar findings were stated in study conducted in Northwest Ethiopia (Getachew and Tsige, 2017) and Nigeria (Fana et al., 2015) which indicated that threat of malaria increases with a decrease utilization of ITNs. The report of WHO also indicated that use of ITNs efficiently decreases both the number of malaria cases and deaths in pregnant women (WHO, 1993). Women that used to live in houses sprayed with IRS in the last twelve months were considerably protected from malaria than those not. Similarly, this has been reported in other malaria endemic areas North West Ethiopia (Getachew and Tsige, 2017), Uganda (Muhindo et al., 2016), Cameroon (Walker-Abbey et al., 2005) and India (Sohail et al., 2015) where IRS significantly lowered malaria prevalence.

Conclusion

In the present study, the prevalence of malaria among the pregnant women in the study area was relatively high. Hence, the prevention and controlling strategies existing in the study area should be reviewed and intervention strategies should focus on associated risk factors among pregnant women. The pregnant women awareness on symptoms of malaria and use of ITNs as protective measure against mosquito bite is also high. Thus, the responsible health professionals at different level particularly in the district health office and health extension workers need to further strengthen public awareness creation about malaria and utilization of ITNs.

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CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

ABBREVIATIONS

ANC, Antenatal clinic; **AOR,** Adjusted odds ratio; **CDC,** Center for Disease Control; **COR,** crude odds ratio; **EFMOH,** Ethiopian Federal Ministry of Health; **ITN,** insecticide-treated bed nets; **WHO,** World Health Organization.

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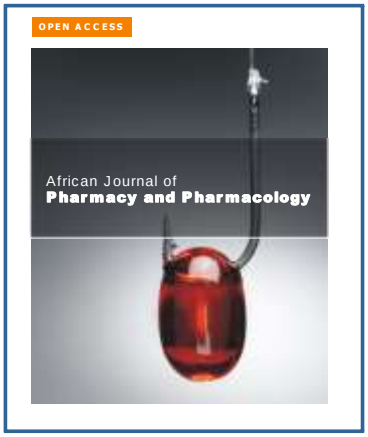

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