Malaria and Its Associated Factors among Pregnant Women Attending Maternal and Child Health Department in Bossaso General Hospital, Bossaso, Somalia

MPH Thesis

Abdirahman Jama

December 2020

Haramaya University

Malaria and Its Associated Factors among Pregnant Women Attending Maternal and Child Health Department in Bossaso General Hospital, Bossaso, Somalia

A Thesis Submitted to the School of Graduate Studies

Haramaya University

In Partial Fulfillment of the Requirements for the Degree of Master of public health in general public health

Major Advisor: **Tesfaye Assebe (Ph.D.)**

Co-Advisor: **Tedasse Alemayuhu (Ph.D.)**

December 2020

Haramaya University, Harar, Ethiopia

APPROVAL SHEET

HARAMAYA UNIVERSITY

SCHOOL OF GRADUATE STUDIES

I hereby certify that I have read and evaluated this thesis entitled Malaria and Its Associated Factors Among Pregnant Women Attending Maternal and Child Health Department in Bossaso General Hospital, Bossaso, Somalia, Prepared under my guidance by Abdirahman Jama. I recommend that it should be submitted as fulfilling the thesis requirement.

1. Tesfaye Assebe (Ph.D.)	_____	_____
Major Advisor	Signature	Date
2. Tadesse Alemayehu (Ph.D.)	_____	_____
Co-Advisor	Signature	Date

As a member of the Board of Examiners of the MPH Thesis Open Defense Examination, I certify that I have read and evaluated the thesis prepared by Abdirahman Jama and examined the candidate. I recommend that the thesis be accepted as fulfilling the thesis requirements for the degree of Master of Public Health in General Public Health.

3. _____	_____	_____
Chair Person	Signature	Date
4. _____	_____	_____
Internal Examiner	Signature	Date
5. _____	_____	_____
External Examiner	Signature	Date

Final approval and acceptance of the thesis are contingent upon submitting its final copy to the Council of Graduate Studies (CGS) through the Candidate's Department or School Graduate Committee (DGC or SGC).

STATEMENT OF THE AUTHOR

By my signature below, I declare and affirm that this thesis is my own work. I have followed all ethical and technical principles of scholarship in preparing, data collection, data analysis, and compilation of this thesis. Any scholarly matter that is included in the thesis has been given recognition through citation. This thesis is submitted in partial fulfillment of the requirements for an MPH degree at Haramaya University. The thesis is deposited in the Haramaya University Library and is made available to borrowers under the Library rules. I solemnly declare that this thesis has not been submitted to any other institution anywhere for the award of academic degree, diploma, or certificate. Brief quotations from this may be made without special permission, provided that accurate and complete acknowledgment of the source is made. Requests for permission for extended quotations from or reproduction of this thesis in whole or in part may be granted by the Head of the School or Department when in his or her judgments the proposed use of the material is in the interest of scholarship. In all other instances, however, permission must be obtained from the author of the thesis.

Name: _____ Signature: _____

Date: _____

School/Department:_____

ACKNOWLEDGEMENTS

I want to express my grateful acknowledgment to Haramaya University, notably the College of Health and Medical Sciences, for providing me with the opportunity to build my academic career and continue my master's degree thesis. Next to that, I would like to extend my gratitude to the Department of Public Health Sciences for providing me with the chance to develop my educational competency, my Major Advisor, Dr Tesfaye. A and my Co-Advisor, Dr Tadesse. A. for their unreserved efforts in providing their professional support and guiding me in preparing the research proposal.

I would like also to thank Bosasso General Hospital administration and directors, for their cooperation. I would also like to extend my acknowledgment to my beloved family members, friends, data collectors, and study participants.

Table of Contents

List of tables

List of figures

Abbreviations and Acronyms

ANC	Antenatal Care
BGH	Bossaso General Hospital
CI	Confidence Interval
IDPs	Internally Displaced Persons
IPTp-SP	Intermittent preventive treatment of malaria in pregnancy with sulfadoxine-pyrimethamine.
IRS	Indoor Residual Spray
ITNs	Insecticide-treated bed nets
LLINs	Long-lasting insecticide treated nets
MCH	Maternal and child health care
MOH	Ministry of Health
OR	Odds Ratio
PI	Principal Investigator
SPSS	Standard Package for Social Sciences
SSA	Sub-Saharan Africa
WHO	World Health Organization
RBM	Roll back malaria

Abstract

Background: Malaria is a serious disease that leads to severe adverse effects on mothers and the fetus during pregnancy. Approximately 25 million pregnant women in sub-Saharan Africa live at risk of malaria. Since no study was conducted to address the prevalence of malaria and its associated factors among pregnant women in the region, hence this study is designed to address these issues in Bossaso, Somalia.

Methods: A health institution based cross-sectional study was conducted using a systematic random sampling technique to select 422 participants among pregnant women attending the maternal and child health (MCH) department in Bossaso General Hospital (BGH) using an interview-administered questionnaire and malaria diagnosis confirmation, which was done on microscope-based laboratory techniques. The collected data were entered and cleaned using Epi INFO version 7, then the data was exported into Statistical Package for the Social Sciences (SPSS) version 25 for analysis. Both bivariable and multivariable logistic regression models were employed. Variables having p-value < 0.25 were included in the final multivariable model. Variables having p-values < 0.05 from the multivariable model were considered to be significantly associated with the dependent variable. The adjusted odds ratio (AOR) with its 95% confidence interval (CI) was used to measure association.

Results: Of the total 406 pregnant women who participated in this study, 20.9% [95%CI (15.9%, 25.9%)] were found to have malaria. Of these, 64 (75.3%), 19 (22.4%), and 2 (2.4%) were caused by Plasmodium falciparum, Plasmodium vivax, and mixed infection, respectively. The factors like the presence of water pond sites around the house or vicinity [AOR= 6.5, 95% CI (1.6, 20.5)] and always using insecticide-treated bed nets (ITNs) [AOR=0.1, 95%CI (0.01, 0.88)] were found to be significantly associated with malaria during pregnancy.

Conclusion and recommendation: Malaria is still a health problem among pregnant women in Bossaso city. The overall prevalence of malaria among pregnant women in the study area was found to be (20.9%). This study emphasized the need to provide health education and consultation to the pregnant women on the appropriate malaria preventive methods and continued strengthening other interventions.

Keywords: malaria, prevalence, pregnant women, Bossaso, Somalia.

1. INTRODUCTION

1.1 Background

Malaria is a parasitic infection caused by protozoa of the genus Plasmodium. Human malaria is caused by four different Plasmodium species: Plasmodium falciparum, Plasmodium vivax, Plasmodium Ovale, and Plasmodium Malariae. It is naturally spread to humans through a bite by an infected female Anopheles mosquito, which bites mainly between dusk and dawn. Among the four parasite species, plasmodium falciparum is the most prevalent malaria parasite in the World Health Organization (WHO) African Region, accounting for 99.7% of estimated malaria cases in 2017 (WHO, 2011).

Malaria disease can be categorized as uncomplicated or with severe complications. Individuals infected with uncomplicated malaria commonly experience a combination of fever, chills, headache, and flu-like illnesses such as muscle aches and tiredness. If left untreated, they may proceed to complicated malaria, which presents as organ failures, abnormalities in the patient's blood or metabolism, impairment of consciousness, seizures, coma, and even death (CDC, 2019).

An estimated 228 million cases of malaria occurred worldwide in 2018 compared to 231 million patients in 2017. The WHO African Region still bears the largest burden of malaria morbidity, with 213 million cases (93%) in 2018 (WHO, 2019b).

Since malaria has significant public health problems, pregnant women are more likely to become infected with malaria than non-pregnant women, and once infected, there is a tendency toward increased severity of the disease. They often present with life-threatening symptomatic disease, and the clinical course may be complicated by hyperpyrexia, severe hemolytic malaria, and cerebral malaria. In high-transmission settings, it is associated with maternal illness and low birth weight, while in low transmission areas, malaria usually presents as an acute illness with detectable peripheral parasitemia (WHO, 2018, 2019a). In addition to this, malaria susceptibility increases during pregnancy, making these women an important parasite reservoir in the community. Meanwhile, the biology and clinical presentations of Plasmodium falciparum in semi-immune women interfere with diagnosis during pregnancy, rendering targeted interventions ineffective for control. Furthermore, concerns for teratogenicity and embryotoxicity complicate

the proposed application of any drugs, vaccines, or anti-vector measures among pregnant women (Fried & Duffy, 2017)

In Somalia, although the prevalence of malaria has dropped dramatically since 2009 when more than a quarter of Somalis (27.3%) were infected to fewer than two percent of the population in 2014, yet malaria endemicity remains in most parts of the central and Southern regions and some areas in the north with other areas being prone to epidemics (UNICEF, 2018).

Malaria transmission in Somalia varies from hypo-endemic to meso-endemic with areas having year-round transmission with two peaks of an increased number of cases during the two wet seasons from April to June and October to November. Plasmodium falciparum is the predominant malaria parasite species, contributing to more than 90% of malaria infections with different levels of prevalence across the country. Different levels of endemicity, each with specific epidemiological features and epidemic-prone potential, can be found (MoH, 2016).

Vector control and management is the main way to prevent and cut back malaria transmission. If coverage of vector control interventions within a specific area is high enough, then a measure of protection was discussed across the community; thus, WHO and the international Roll Back Malaria (RBM) initiative recommended protection for all people at risk of malaria with effective malaria vector control. There are two forms of vector control, including insecticide-treated bed nets and indoor residual spraying are effective in a wide range of circumstances (WHO, 2019a).

Therefore the guidelines for the diagnosis and treatment of malaria by the Ministry of Health (MOH) of Somalia recommends at least three doses of intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP) provided through the maternal and child health centers can reduce the incidence of severe malaria and low birth weight in semi-immune women in areas of moderate to high Plasmodium falciparum transmission. Intermittent preventive treatment is an effective, safe, and operationally feasible strategy for reducing the burden of malaria among semi-immune pregnant women. Besides, parasitological confirmation of malaria should be done by either microscopy or by rapid diagnostic tests (RDT). For the treatment of pregnant women malaria cases, quinine should be used during the first trimester and artemether-lumefantrine during the second and third trimester. If quinine is not available, or adherence to a 7-day treatment regimen cannot be assured, artemether-lumefantrine can be given (MoH, 2016).

1.2 Statement of the problem

Malaria remains life-threatening and one of the most significant public health challenges worldwide, and it is amongst the top killers in sub-Saharan Africa. The WHO African Region continues to carry a disproportionately high share of the global malaria burden. In 2018 alone, the region was home to 93% of malaria cases and 94% of malaria deaths (WHO, 2019b).

During pregnancy, malaria infection is a significant health problem with substantial risks for pregnant women, the fetus, and the newborn child. Pregnant women from internally displaced persons (IDPs), Migrants, refugees, and other mobile population groups often lack partial immunity to malaria. They have limited access to prevention, diagnostic testing, and treatment services. These groups usually seek treatment from unregulated, private vendors, increasing their risk of exposure to substandard products (WHO, 2018).

In 2019, in 33 moderate to high transmission countries in the WHO African Region, there were an estimated 33.2 million pregnancies, of which 35% (11.6 million) were exposed to malaria infection. By WHO subregion, East Africa had a high prevalence of exposure to malaria during pregnancy by 2.4 million (24%) (WHO, 2020).

The entire population of Somalia is at risk of malaria, with 54% at high risk. The intensity of malaria transmission varies in different parts of the country, ranging from unstable and epidemic-prone in north-eastern Puntland and north-western Somaliland to moderate in Central Zone and moderate to high in the South Zone. From 2007 until 2009, on average, 28,900 confirmed malaria cases (reported by HMIS) and 40–50 malaria deaths were reported every year. However, these data vastly underestimate the real burden of malaria in the country, given the fragile health information system and low coverage of public health services. Over 95% of cases are due to Plasmodium falciparum (WHO, 2010b).

One out of every 20 women dies due to pregnancy-related causes (Maternal Mortality Ratio is 692 deaths of mothers for 100,000 live births). Access to maternal health services is low, with 44 and 38 percent of births in Somaliland and Puntland being attended by skilled birth attendants (F. R. O. SOMALIA, 2020; U. somalia, 2015). Additionally, an estimated 11% of neonatal deaths are attributable to LBW due to malaria in sub-Saharan Africa (Singh et al.). In pregnancy,

malaria has been associated with an increased risk of newborn infections during childhood (Accrombessi et al., 2018).

Moreover, no study has been conducted to address the prevalence and associated factors of malaria among pregnant women in the region. It is necessary, therefore, to assess the prevalence of malaria and the factors associated with its infection among pregnant women in the urban area of north-eastern Somalia.

1.3 Significance of the study

This study will be used for strengthening preventive strategies against malaria at the health facility level. The result can serve as background and also give insight to public health authorities (Bossaso city administration health facilities and health office, zonal and regional health offices) and other stakeholders to develop a workable intervention for controlling the transmission of malaria and provide information to health professionals to give due attention to enable the government to take control measures on the transmission of malaria parasites, by focusing its effort to the areas most affected by malaria.

In addition, this study will enrich the literature available on the issue and was a baseline for other studies.

1.4 STUDY OBJECTIVES

1.4.1 GENERAL OBJECTIVES

- To assess the prevalence and associated factors of malaria among pregnant women attending the MCH department in BGH, Bossaso city, Somalia, from June to September 2020.

1.4.2 SPECIFIC OBJECTIVES

- To assess the prevalence of malaria among pregnant women attending the MCH department in BGH
- To identify the factors associated with malaria in pregnancy.

2. LITERATURE REVIEW

2.1 Prevalence of malaria in pregnancy

Globally, there were an estimated 229 million malaria cases in 2019 in 87 malaria endemic countries, declining from 238 million in 2000. Twenty-nine countries accounted for 95% of malaria cases globally. The WHO African Region, contributes with an estimated 215 million cases which accounts for about 94% of cases. On the other hand, malaria case incidence reduced from 363 to 225 cases per 1000 population. By WHO subregion, Central Africa had the highest prevalence of exposure to malaria during pregnancy (40%), closely followed by West Africa (39%), while prevalence was 24% in East and Southern Africa (WHO, 2020).

In 2019, in 33 moderate to high transmission countries in the WHO African Region, there were an estimated 33 million pregnancies, of which 12 million (35%) were exposed to malaria infection during pregnancy. The 12 million pregnant women exposed to malaria infections in 2019 delivered about 822 000 children with low birth weight (16% of all children with low birth weight in these countries) (WHO, 2020).

A community-based cross-sectional study that was conducted in 2018 in Ethiopia on Prevalence and associated factors of malaria among pregnant women, showed from the total 498 pregnant women who participated in this study, 51(10.2, 95% CI: 7.72–13.24) were found to have malaria. Of these, 46 (90.2%) and 5 (9.8%) were caused by Plasmodium falciparum and Plasmodium vivax, respectively (Gontie, Wolde, & Baraki, 2020).

A Systematic Review and Meta-Analysis study on the prevalence of malaria among pregnant women in Ethiopia concluded that the estimated pooled prevalence of malaria among pregnant women in Ethiopia was 12.72% (95% CI: 7.45, 17.98) and the overall weighted pooled prevalence of Plasmodium species was Plasmodium vivax 2.74 (95% CI: 0.85,4.62), P. falciparum 7.58 (95% CI: 3.96,11.20), and mixed infection 1.44 (95% CI: -0.08,2.96) (Tegegne et al., 2019).

Cross-sectional surveys conducted in 2014 to assess the prevalence of malaria in pregnancy in southern Laos, Nigeria showed that 12/204 women (5.9 %; 95 % CI 3.1–10.0) were infected with malaria as determined by RT- qPCR; eleven were Plasmodium vivax infections, and one

was mixed Plasmodium vivax/Plasmodium falciparum infection, among which nine were sub-microscopic. At delivery, two Plasmodium falciparum sub-microscopic infections (one peripheral and one placental) were detected (4.5 %) (Briand et al., 2016).

A cross-sectional study in the semi-urban area of north-western Nigeria in 2012 stated that 41.6% out of 255 pregnant women were infected with malaria parasites, with a mean parasite density of 800 parasitesμl−1. And it was found that prevalence and parasite density decreased as age increased (Fana, Bunza, Anka, Imam, & Nataala, 2015).

A facility-based prospective cohort study on the prevalence and the predictors of malaria infection among pregnant women resident in northern Zambia were investigated Between November 2013 and April 2014 stated that the prevalence of malaria infection measured by microscopy was 31.8 % (95 % CI, 29.1–34.6) and by PCR was 57.8 % (95 % CI, 54.9–60.8). Parasite density ranged from 64 to 24,760 parasites per μl of blood with a geometric mean of 1082 (95 % CI, 962–1217) asexual parasites per μl of blood (Chaponda et al., 2015).

A 2010 cross-sectional study in primary health facilities located in Burkina Faso among pregnant women attending antenatal clinic described that the prevalence of P. falciparum parasitemia was 18.1% (95% CI = [15.1-21.2]) and the geometric mean of the parasite density (GMPD) was 2254 parasites/μL (95% CI = [1755–2894]) (Cisse et al., 2014).

A facility-based cross-sectional study on the factors associated with the risk of malaria infection among pregnant women in Nigeria enrolled between March 2007 and February 2008 claimed that the overall malaria prevalence was 7.7% (Agomo & Oyibo, 2013).

A cross-sectional study of malaria prevalence among pregnant women in India resulted that the prevalence of peripheral parasitemia was low: 1.3% among women at antenatal care (ANCs) and 1.9% at delivery units. On multivariate analysis of ANC, participants were strongly associated with peripheral parasitemia (adjusted OR [aOR] 43.4; 95% CI, 5.6-335.2). Additional covariates associated with parasitemia were moderate malaria (aOR 3.7; 95% CI 1.8-7.7), fever within the past week (aOR 3.2; 95% CI 1.2-8.6), and lack of formal education (aOR 4.6; 95% CI 2.0-10.7). Similarly, analysis of delivery units participants revealed that moderate malaria (aOR 2.5; 95% CI 1.1-5.4) and fever within the past week (aOR 5.8; 95% CI 2.4-13.9) were strongly associated with peripheral and/or placental parasitemia (Singh et al., 2012).

Cross-sectional surveys on the burden of malaria in pregnancy in India at antenatal clinics showed that 1.8% of the antenatal clinic had a positive diagnostic test for malaria (53.5% Plasmodium falciparum, 37.2% Plasmodium vivax, and 9.3% mixed infections). Peripheral parasitemia was more common in pregnant women attending antenatal clinics in rural sites (adjusted relative risk [aRR] 4.31, 95%CI 1.84-10.11) and in those who were younger than 20 years (aRR 2.68, 95%CI 1.03-6.98) (Hamer et al., 2009).

Although there are limited national data and statistics on the burden of malaria in Somalia, it is considered a significant public health problem in the country. According to the national malaria indicator survey done in 2014, malaria infection prevalence is very low nationally at about 1.9% with over 90% of all infections from the Central South zone. Infection rates in Puntland were just above 1% (MoH, 2016).

The dominant malaria species in the country has been Plasmodium falciparum accounting of more than 95%. However, an increased proportion of Plasmodium vivax has been reported from Somaliland and Puntland zones. Screening of patients with fever of history of attending the Bossaso regional hospital from 4 January to 14 February 2016 revealed 37.0% and 12.8% of Plasmodium falciparum and Plasmodium vivax respectively. Indicating that plasmodium vivax accounted for 25.6% of the infections while mixed infection accounted for 0.4% (MoH, 2016).

On the other hand, due to the inadequacy, inaccessibility, and non-availability of public health care facilities with reliable laboratory diagnostic facilities for malaria confirmation, malaria's over-diagnosis remains a serious problem. In most cases, malaria diagnosis is clinical and based only on fever or a history of fever, which makes it difficult to arrive at a true estimation of the malaria burden (MoH, 2016).

2.2 factors associated with malaria among pregnant women

2.2.1 Socio-cultural, Socio-demographic

A cross-sectional survey undertaken amongst the study population comprising pregnant women attending antenatal clinic at Ijede General Hospital, Nigeria showed that formal education were strongly and significantly associated with lower risk of malaria parasitemia (OR = 0.44, P = 0.005, 95% CI 0.34−10.50) (Olukosi et al., 2020).

A 2018 cross-sectional survey done on the malaria prevention practices and associated environmental risk factors in a rural community in Uganda stated that use of mosquito nets by households was higher with increasing education level of participants; primary (aPR = 1.27 [95% CI: 1.00–1.60]), secondary (ordinary level) (aPR = 1.47 [95% CI: 1.16–1.85]) and advanced level / tertiary (aPR = 1.55 [95% CI: 1.19–2.01]) (Musoke et al., 2018).

A cross-sectional study, conducted in Uganda 2014 claimed that Women who had education level of primary and below had reduced chances of sleeping under a mosquito net (AOR 0.49, 95 % CI 0.26–0.92) which further reduces the risk of malaria transmission (Muhumuza, Namuhani, Balugaba, Namata, & Ekirapa Kiracho, 2016).

A qualitative study in Papua New Guinea exploring Malaria in Pregnancy, Knowledge, Attitudes, and Practices Concerning Malaria in Pregnancy, showed that there were varied perceptions of the causes of malaria as well as those who reported not knowing the cause of the disease, pointing to overall community confusion like not cleaning the house and community conflicts can be the cause. Among those who reported knowing a cause of malaria, there was a general sense that the disease is related to mosquito. From the perception of symptoms. In general, respondents found the symptoms of malaria difficult to identify, though the main symptoms of malaria were reported as "skin hot," shivering, feeling cold on the inside, fever, dizziness, vomiting a yellow substance and loss of appetite. A number of women and health care workers mentioned having enlarged spleens or other spleen-related sickness. Others thought malaria could lead to seizures (Andrew et al., 2015).

A cross sectional study in (2010) in two primary health facilities located in Burkina Faso. Pregnant women attending antenatal clinic indicated that, lower level of education (AOR 1.9, 95% CI = [1.2-3.2]) had significantly associated with P. falciparum malaria infection (Cisse et al., 2014).

A cross sectional study in the semi-urban area of north western Nigeria in 2012 described a significant association between malaria prevalence and education ($x2 = 20.9$, $p = 0.000$). Malaria prevalence in women with no education was 63.0%, while in those with primary, secondary and tertiary education, it was 45.3%, 32.7%, and 27.3% respectively (Fana et al., 2015).

A 2017 case-control study risk factors associated with malaria outbreak in northern Ethiopia, cases had 75% lower odds (AOR = 0.25 95% CI 0.11–0.61) of having waste collection material in their house than controls also had nine-fold higher odds (AOR = 9.08 95% CI 3.6–22.93) of having mosquito breeding sites around their homes than controls, and nearly four times higher odds (AOR = 3.7 95% CI 1.44–9.56) of staying outdoors overnight than controls (Tesfahunegn, Berhe, & Gebregziabher, 2019).

A cross-sectional survey questionnaire was administered in households among malaria vulnerable groups in Cameroon showed the purchase of mosquito bed nets from the market was associated with marital status (P = 0.010) and urban settlement (P = 0.045). The number of respondents who did not know where to retreat/treat ITNs was significantly higher (P = 0.005) in urban than rural dwellers. The proportion of rural respondents who had once taken their mosquito bed nets for re-treatment was significantly higher (P = 0.002) than that of urban dwellers. Mosquito bed net use in pregnant women was associated with living in block-louver houses than in block-pane houses (P =0.047) (Kimbi et al., 2014).

2.2.2 Maternal factors

A cross-sectional survey undertaken amongst the study population comprising pregnant women attending antenatal clinic at Ijede General Hospital, Nigeria showed that the prevalence of infection was highest in the third trimester (n = 40, 35.4%) at 27.5% (11/40) and among those in their first pregnancy (n = 32, 28.3%) at 25.0%. Their analysis also showed that first pregnancy, anti-malarial use and insecticide-treated nets use the night before study had increased odds of malaria infection in participants (OR = 1.35, P = 0.006, 95% CI 0.52−2.49; OR = 2.3, P = 0.005, 95% CI 0.14−0.41; OR = 1.92, P = 0.001, 95% CI 0.62−5.98) while intermittent preventive treatment participation (OR = 0.95, P = 0.025, 95% CI 0.41−2.26) (Olukosi et al., 2020).

A periconceptional cohort study in Benin 2018 reported that the overall incidence rate of new malaria infections was 19.7 infections per 100 person-months (95% CI, 15.8–24.5). Early gestational age was highly prevalent and positively correlated with malaria infection, while the proportion of women with at least one microscopic malaria infection during the first trimester of pregnancy was 20.8%. Women were more likely to be infected with malaria during the first trimester than before pregnancy (21% vs 6.3%, adjusted odds ratio: 2.68; 95% confidence

interval, 1.24–5.78). This difference was also observed when restricting the comparison to women at their first ANC visit (11.7% vs 6.3%) (Accrombessi et al., 2018).

A community-based cross-sectional survey conducted in 2016 on the utilization of key preventive measures for pregnancy complications and malaria among pregnant women in rural districts of Ethiopia showed that 84% of interviewed women reported receiving at least one ANC visit during their last pregnancy, while 47% reported attending four or more ANC visits. 16% from the observed did not attend ANC services common reasons for not attending ANC included women's lack of awareness of its importance (48%), distance to health facility (23%) and unavailability of transportation (14%). Important determinants of ANC attendance included higher education level and wealth status, woman's ability to make healthcare decisions, and pregnancy intendedness (Ouedraogo et al., 2019).

A 2012 cross-sectional study in Nigeria reported that the overall prevalence of malaria among pregnant women studied was 7.7% and young maternal age (<20 years) was significantly associated with an increased risk of malaria prevalence (P=0.010) and parasite density (P=0.04) (RR =2.86, 95% CI 1.48-5.50. Contrarywise, the gravidity of the women, was not associated with either malaria prevalence or mean geometric parasite density (P>0.05). The prevalence of malaria in primigravidae, secundigravidae and multigravida were: 9.1%, 7.1% and 6.5%, respectively (P= 0.333). In contrast, the prevalence in women that booked in ANC at the first, second and third trimesters were 6.8%, 8.5% and 6.7%, respectively and finally (Agomo & Oyibo, 2013).

2.2.3 Utilization of preventive measures

As reported on the 2014 national malaria indicator survey, the reported access and use of long-lasting insecticidal nets (LLINs) were higher in Somaliland while Less than 10% of households in Central South zones where universal coverage of LLIN is the national strategy have 1 LLIN for every 1.8 persons. In Bakool region in Central South, none of the households reported owning an LLIN, despite reports from the NMCP that close to 100,000 LLINs were distributed in this region in the period 2011-2013. In Hiraan province, where 13% of persons who were tested were malaria positive, LLIN usage was also the highest with about 43% of the population sleeping under an LLIN. Although most LLINs used in Somalia were acquired within the last three years, the level of coverage clearly remains well below the target for universal coverage,

particularly in the Central South and rapid scale-up is required in this zone (MOHs of the Federal Government, 2014).

A 2018 community-based cross-sectional study done in western Ethiopia showed that lack of consultation and health education about malaria prevention (AOR 7.18; 95% CI 2.74–18.81) was found to be significantly associated with malaria during pregnancy (Gontie et al., 2020).

A health institution based cross-sectional study on the factors associated with risk of malaria infection among pregnant women in Nigeria enrolled in 2008 showed that malaria preventive methods which were associated with a reduced risk of malaria infection were the use of insecticide spray (RR=0.36, 95% CI 0.24-0.54; P < 0.001), and the combined use of insecticide spray and ITN (RR=0.15, 95% CI 0.02-1.09; P = 0.011). The use of >ITNs alone was not significantly associated with a reduction in malaria infection (RR= 0.93 95% C.I. 0.48-1.82; P = 0.506) (Agomo & Oyibo, 2013).

A cross-sectional study conducted in Uganda in 2014 on the factors associated with the use of malaria control interventions by pregnant women showed that More than half (58.6 %) of the mothers had slept under an ITN the night before the survey; 82.9 % of the respondents had used the net for at least one year (Muhumuza et al., 2016). Furthermore, an ethnographic study among health workers, pregnant women and opinion leaders in Ghana suggested that health system, socio-cultural, economic, environmental and individual factors influenced LLIN use. Health facility readiness in stocking LLINs influenced ownership and use. Receiving appropriate information from health providers and encouragement from public officials improved LLIN use, while women with a history of LLIN use prior to becoming pregnant and women who had young children remained consistent users. Pregnant women whose household and family members used LLINs were influenced positively to use them (Aberese-Ako, Magnussen, Ampofo, & Tagbor, 2019).

Assessment of the usage and effectiveness of intermittent preventive treatment and insecticide-treated nets on the indicators of malaria among pregnant women attending antenatal care in Cameroon 2014 showed that The coverage of ITN was 32.4 % and those pregnant women with at least two doses of SP and using ITN are better protected than women with just one SP dose in addition to ITN use (Fokam et al., 2016).

A cross-sectional study in the semi-urban area of northwestern Nigeria in 2012 claimed that use of ITNs was significantly associated with malaria prevalence and parasite density, as the number of participants who did not use ITNs regularly reported a high occurrence of malaria infection with a high parasite density, as compared to those who used ITNs on a daily basis (x2 = 33.6, p = 0.000) (Fana et al., 2015).

In Somalia, Intermittent preventive treatment of malaria in pregnancy with sulfadoxine-pyrimethamine (IPTp-SP) is being endorsed as effective in preventing the adverse consequences of malaria on birth outcomes. A 2019 cross-sectional survey was carried out among antenatal and postnatal women and midwives at private health facilities in Ghana accredited that 46.6% took ≥ three doses of SP, uptake was similar for those who had delivered and those yet to deliver (χ2 =2.94, p > 0.05). 55.1% of women who initiated antenatal visits during the first trimester received ≥ three doses of SP, whilst 42.0% of those who started during the second trimester received ≥ 3doses (χ2 =5.64, p =0.02). Those who initiated ANC during the second trimester received more doses compared to those who started during the third trimester (χ2 =4.43, p = 0.04). Finally, this study stated that there was poor adherence to directly observed treatment and insufficient knowledge of midwives on IPTp-SP protocol, while early initiation and regular visit to antenatal care centers promoted uptake of optimal doses of SP (Amankwah & Anto, 2019). Since there is thoughtful consideration that the uptake of IPT is being influenced by the educational status of the pregnant women a 2016 cross-sectional study conducted among pregnant women attending a hospital in Ghana accredited that Pregnant women with tertiary education [aOR=3.15, 95% CI (0.94 -10.97), and p=0.042] and ≥ 4ANC visits [aOR=24.6, 95% CI (5.87103.07), and p<0.0001] had statistically significant higher odds of completing the recommended IPT dose compared to the uneducated and those informed through the clinic respectively (Addai-Mensah et al., 2018).

2.2.4 Environmental factors

An ethnographic study design conducted among health workers, pregnant women and opinion leaders on the factors influencing bed net use in the prevention of malaria in pregnancy suggested that health system, socio-cultural, environmental and individual factors influenced LLIN to use Experiencing irritating effects of LLINs and preference for traditional methods to wade off mosquitoes, reduced LLIN use. While pregnant women whose household and family

members used LLINs were influenced positively to use them. Staying out late for business purposes and to converse exposed pregnant women to mosquito bites (Aberese-Ako et al., 2019).

A 2018 cross-sectional survey done on the malaria prevention practices and associated environmental risk factors in a rural community in Uganda stated that environmental factors that favor mosquito breeding found at households included the presence of vessels in the compound that could potentially hold water 414 (56.9%) and stagnant water in compounds 144 (19.8%) (Musoke et al., 2018).

2.3 conceptual framework

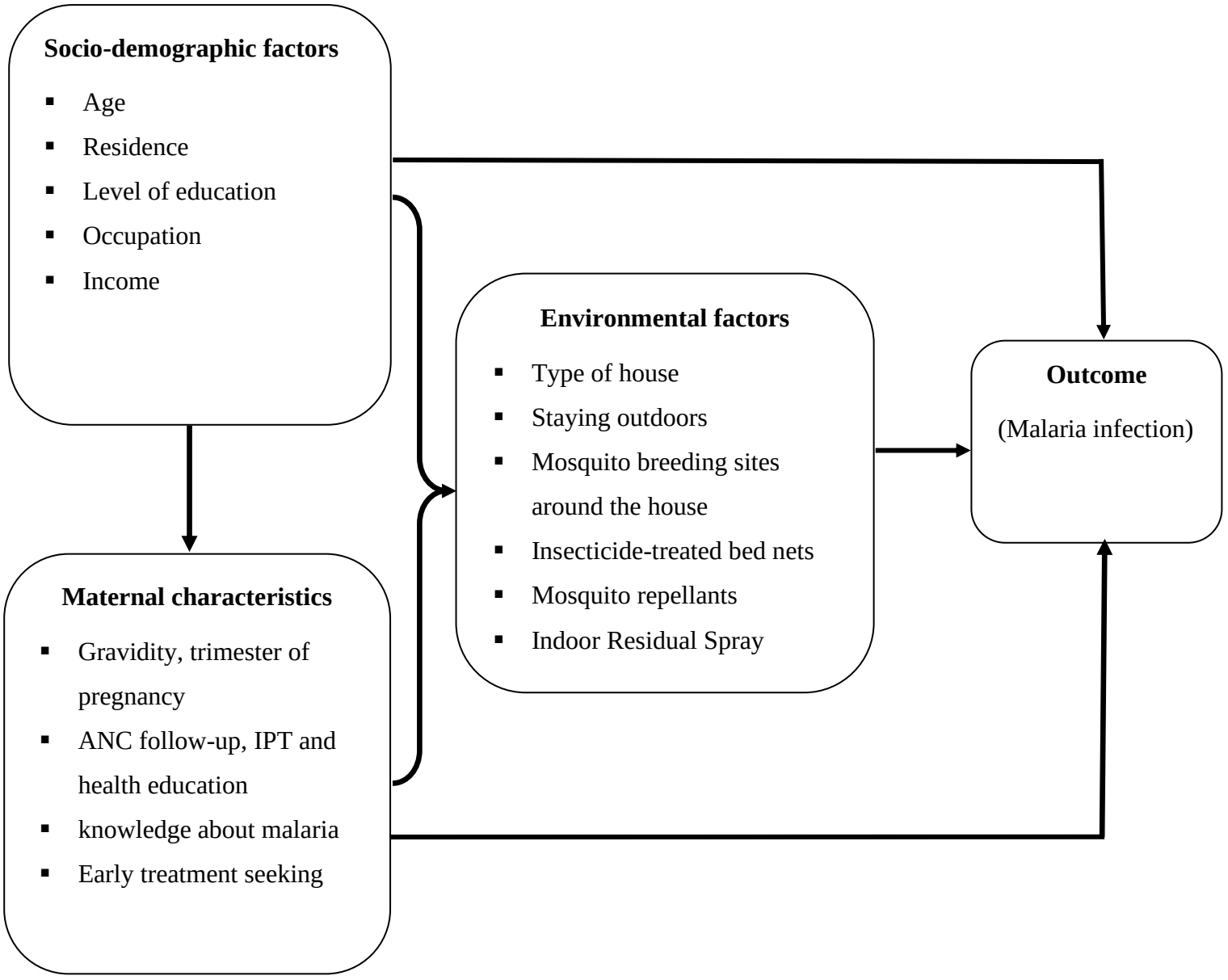

Figure 1: Conceptual framework

Source: Constructed by reviewing relevant literatures.

3. METHODS AND MATERIALS

3.1 Study area and period

The study was conducted in Bossaso city in the north-eastern Bari province, Somalia, with the Geographical coordinates in degrees minutes seconds (WGS84) of the north latitude of 11 17' 05" and east longitude of 49 10' 57". Bossaso city is located 1,389.1 km in the north of Mogadishu, the capital city of Somalia. It extends over an area of 28 km^2 and is populated by approximately 700,000 residents, its characterized by a hot temperature and a mean annual relative humidity of around 60% (Municipality, 2015).

The main ethnicity of the region is Somalis. There is a non-governmental organization in Bossaso like UNFPA, UNICEF, USAID, UNHCR, UNDP, UNHABITAT, FAO, and others. There are ten private clinics, three private hospitals, four public health centers, and one regional hospital providing health care service.

The study was carried out in Bossaso General Hospital, and the hospital operates as a regional, referral and teaching hospital that provides health services to over one million people with six primary departments (Bossaso, G.H., 2019 unpublished raw data). Among these is the maternity department that this research was conducted among pregnant women attending there from June to September 2020.

3.2 Study design

Health institution-based cross-sectional study design was employed from June 7th to September 7th, 2020, to assess the prevalence of malaria and its associated factors among pregnant women visiting BGH Bossaso city.

3.3 population

3.3.1 Source Population

All pregnant women who were visiting the MCH department in BGH, Bossaso town.

3.3.2 Study Population

All pregnant women who were visiting the MCH department in BGH, Bossaso town, during the study period.

3.4 Inclusion and Exclusion Criteria

3.4.1 Inclusion Criteria

All pregnant women who visited the MCH department in BGH during the study period were illegible to be included.

3.4.2 Exclusion Criteria

- Pregnant women who visited the MCH department in BGH and had a severe illness during the study period.

3.5 Sample Size

3.5.1 Sample size determination for the first objective

The sample size was determined using a single proportion formula using, 95% confidence level, 5% margin of error, and a 50% prevalence of malaria among pregnant women was considered since no previous studies that clearly show the prevalence of malaria among pregnant women has been done in the area and there were no enough pieces of evidence available for hypothesizing. To compensate for the non-response rate, 10% of the determined sample size was added, which gives a total sample size of **422**

$$n = \frac{(Z\alpha/2)^2 pq}{d^2}$$

n = initial sample size

z = standard normal value at the level of confidence desired, usually at 95% CL.

p= Positive prevalence

q = 1-p

d = desired degree of precision

= 384 +10% of non-respondent rate (38) = **422**.

3.5.2 Sample size determination for the second objective

The sample size was calculated for factors associated with malaria among Pregnant Women by considering various factors that were significantly associated with outcome variable with the following assumptions, a two-sided confidence level of 95%, power of 80% using Epi Info 7 Stat Calc computer software program for double population proportions formula, 10% for non-response and respective odds ratio for each factor. (Table 1).

Table 1: Sample size determination for different factors associated with malaria among Pregnant women in Bossaso, Somalia, 2020.

Factors	**Prevalence of malaria Among pregnant women**					
	Exposed	Non-exposed	OR	Initial sample size	Final Sample Size (with d10% non-response)	References
Education	No education (36%)	Primary education and above (63%)	1.77	130	143	(Fana et al., 2015)
Number of ANC visits	Four or more than four visits (59.4%)	Less than four (31.3%)	2.4	121	133	(Ouedraogo et al., 2019)

Finally, the required sample size for this particular study was determined by taking the maximum sample size from the first objective, which is 422.

3.5.3 Sampling procedure and sampling technique

There were approximately a total of 1,500 pregnant women attending the maternal and child health department of BGH for three months prior to the study period. This was obtained from the registration books of BGH. Finally, 422 pregnant women were taken by systematic sampling

technique where participants were selected according to a random starting point with a fixed whereas the sampling intervals were based on every interval adjusted, the required sample was recruited from the pregnant women who was visiting and giving blood for microscopic blood film examination in BGH until the required sample size was achieved.

3.6 Data Collection Method

3.6.1 Data collection instrument

The study subjects were interviewed using a pretested and structured interviewer-administered questionnaire, which was developed in both English and (af-Somali) languages and which was pre-tested on 5% of the sample. The questionnaire contents included socio-demographic factors, maternal, environmental and other factors, and laboratory result.

- Socio-demographic factors: Socio-demographic information was collected by face-to-face interview of pregnant women, which includes age, residence, religion, ethnicity, educational status, occupation, wealth status and family size.
- Maternal related and other risk factors: this part was also collected by face-to-face interview with pregnant women. Maternal related factors include marital status, gravidity, trimester of pregnancy, as well as the ANC follow-up and Some malaria knowledge questions.
- Environmental enquiry: this part was also collected by face-to-face interview with pregnant women regarding the type of their houses, presence of water pond sites around their houses, whether they stay outside overnight, usage of ITNs and mosquito repellants.
- Laboratory result: malaria confirmation was done with microscopic blood films, where the parasite species was classified, documented and reported.

3.6.2 Data collectors and data collection procedure

Two diploma public health and two diploma clinical nurses were recruited as data collectors and one Bachelor of Science public health was recruited as a supervisor. All of them were trained for two days on how to approach and recruit study participants, interview techniques and methods of interviewing and filling the questionnaires.

Data collectors were responsible for interviewing the study participants consistently, recording the result, and finally submitting the result to the investigator as scheduled, while the supervisor was coordinating and monitoring the different data collection tasks. Furthermore, two bachelor's

degree level trained laboratory technicians from BGH was confirming malaria diagnosis in the laboratory.

Malaria diagnosis was confirmed using the laboratory results with microscopic blood films prepared from finger-prick blood samples results collected from selected pregnant women. Experienced laboratory technicians from BGH prepared thick and thin blood films labeled and air-dried horizontally in a slide tray. Thin films were fixed with methanol for about 30 seconds, and both thick and thin films were stained with 3% Giemsa for 20–30 minutes at the study health facilities by using the WHO 2015 standard malaria laboratory procedures guideline (WHO, 2015). The thick films were used for detecting the malaria parasites, while the thin films were used for label and for species confirmation. The blood slides were read and then classified qualitatively as either negative, or Plasmodium falciparum positive, Plasmodium vivax positive, and mixed infection. Pregnant women with microscopically confirmed uncomplicated malaria infection were treated with oral quinine (first trimester); if quinine is not available, artemether+lumefantrine while in the second and third trimester: artemether+lumefantrine was given. Pregnant women with severe malaria were referred to receive the highest inpatient medical care level by the hospital level possible because of the high risk of maternal and perinatal mortality. These were followed according to the national malaria diagnosis and the national malaria treatment guidelines (NMCPs/MoH, 2016).

3.7. Study Variables

3.7.1 Dependent variable

- Status of malaria

3.7.2 Independent variables

- Age
- Marital Status
- Educational Status
- Occupation
- Bed net usage
- Indoor residual spraying
- Mosquito breeding sites

3.8 Data processing and analysis

After collection of all the necessary data was coded on the coding sheet by the principal investigators, while the collected data were entered and cleaned using Epi INFO version 7. After cleaning, the data was transported to the SPSS version 25 (Chicago, IL, USA) for analysis.

Both descriptive and inferential statistics were performed. In descriptive statistics, tables and graphs were used to depict frequencies, proportions and summary statistics in order to describe the study population in relation to relevant variables.

During analysis, both bivariate and multivariable logistic regression technique were used to determine the extent of association between the different variables related to malaria. Covariates with a p-value less than 0.25 in the bivariate logistic regression analysis were entered into the multivariable logistic regression analysis to control potential confounders and identify factors associated with malaria. In multivariable analysis, a significant association of variables with the outcome was determined using adjusted odds ratios and a 95% confidence interval. Variables with a p-value of less than 0.05 were declared as statistically significant. Model fitness was tested using pseudo R-squared model fitness test.

3.9 Data quality control

The research team got permission from the administrative organization of the hospital and the MCH sub-department. Also, written informed consent was sought from the study participants.

Attention was given to questionnaire designing, objective-based, logically sequenced, free of scientific terms and a non-leading structured questionnaire was prepared. Data collectors and supervisors were provided with two days intensive training on the study's objective, contents of the questionnaires and how to maintain confidentiality and privacy of the study subject.

Pre-testing was conducted on 21 pregnant women visiting a local private health facility called Daryeel health center in Bossaso before the actual data collection began at BGH and the necessary correction was made on the questionnaires translated by the local language, then the questionnaire was thoroughly checked for errors, impossible values and inconsistencies that may be due to coding, entry, typing and other errors. The data collection tools were checked daily for completeness, accuracy, clarity and consistency by investigators.

Stained quality control slides were used to check the quality and performance of the Giemsa stain and before examination, the stained patient slides, stained quality control slides were checked for the quality of blood components from malaria-positive blood then if the quality control slides were satisfactory, the patient slides were cross-checked.

3.10 Ethical consideration

Ethical clearance letter was obtained from Haramaya University, College of Health and Medical Sciences school of public health. The letter was communicated and permission was obtained from the personnel in charge of the hospital. The participants were informed about the purpose of the study and the importance of their participation in the study. Also, there was informed, voluntary, written and signed consent that was obtained from the participants. Only the volunteer individuals were involved and study participants had the right to withdraw from the study at any time. Personal data was kept confidential.

3.11 plan for dissemination of the finding

The findings of this study will be presented to all concerned bodies, such as the public health departments, the district health office and the hospital as well. The findings of this study will also be presented in appropriate conferences and seminars. In addition, publications on local as well as international journals will be considered.

4. RESULTS

4.1. Socio-demographic characteristics of study participants

A total of 406 pregnant women participated in the study, with a response rate of 96.2%. The participant's age ranges from 18 to 45 years, with a mean age of 28.68 (SD ± 5.6) years. The majority of pregnant women belonged to the age group of 25-34 years 216 (53.2%). Regarding the place of residence, the majority of the participants were urban residents 370 (91.1%).
Nearly all the respondents were Muslim religion followers 402 (99%). The majority ethnicity component of the participants was Somalis 331 (81.5%). The vast majority of respondents had a family size of fewer than eight individuals, 276 (68%).
Close to half of the pregnant women were housewives 195 (48%), regarding the educational status of pregnant women, close to half of the pregnant women were educated until primary school 192 (47.3%) while 132 (32.5%) had no formal education. The majority of the participants' families earn a monthly income of < 100 USD 172 (42.4%).

Table 2. Socio-demographic characteristics of pregnant women at BGH - Bossaso, Somalia 2020 (n=406).

Variable	**categories**	**frequency**	**percent (%)**
Age	15 – 24	118	29.1
	25 - 34	216	53.2
	≥ 35	72	17.7
Residence	Urban	370	91.1
	Rural	36	8.9
Religion	Muslim	402	99.0
	Christian	4	1.0
Ethnicity	Somalis	331	81.5
	Somali Bantus	60	14.8
	Arab	3	.7
	Oromo	12	3.0
Family size	≤7	276	68.0

	≥ 8	130	32
Occupation	Government employed	3	.7
	Private organizational employee	16	3.9
	Merchant	82	20.2
	Daily laborer	65	16
	Farmer	8	2.0
	Pastoralist	37	9.1
	Housewife	195	48.0
Educational status	Had no formal education	132	32.5
	Primary school (1-8th)	192	47.3
	secondary school (9-12th) and above	82	20.2
Husband's educational status (n=351)	Had no formal education	3	0.9
	Primary school (1-8th)	116	33.0
	secondary school (9-12th) and above	114	32.5
Monthly income	0 - 99 USD	172	42.4
	100 - 199 USD	119	29.3
	200 - 299 USD	70	17.2
	≥ 300 USD	45	11.1

4.2. Maternal characteristics

The largest part of the pregnant women was married 351 (86.5%), multigravidas 237 (67.2%), and slightly more than half of them were in the 3rd trimester of their gestational age 213 (52.5%). The foremost part of participants 158 (38.9%) had only one ANC visit during the current pregnancy, while 69 (17%) had no ANC visits before. Of those who visited ANC clinics, only a small portion of them had health education during their ANC visits 20 (7.7%).

From the pregnant women, 94 out of 337 (23.2%) had taken malaria drugs during ANC visits, and from these, 34 (36.2%) of them named SP (Fansidar) the drug that they had taken during their ANC visits.

Regarding malaria transmission, most pregnant women, 160 (54.9%), stated that malaria is transmitted through mosquito bites. A slightly more than half of the pregnant women expressed that malaria can be prevented by sleeping under insecticide-treated bed net 196 (48.3%) while 63 (15.5%) of them did not know that, and half of the participants suggested that they would get treatment within three days.

Table 3. maternal characteristics of pregnant women at BGH - Bossaso, Somalia 2020 (n=406).

Characteristics	**Category**	**Frequency**	**percentage**
Current marital status	Married	351	86.5
	Widowed	23	5.7
	Divorced	32	7.9
Gravidity	Primigravida	49	12.1
	Secundigravida	84	20.7
	Multigravida	237	67.2
Trimester	1st trimester	77	19
	2nd trimester	116	28.6
	3rd trimester	213	52.5
Number of ANC visits	Not visited before	69	17.0
	Once	158	38.9
	Twice	110	27.1
	Three times or more	69	17.0

Had health education during ANC visits (n=337)	Yes	26	7.7
	No	311	92.3
Taken malaria drugs during ANC visits (n=337)	Yes	94	23.2
	No	243	59.9
Types of malaria drugs taken (n=94)	SP (fansidar)	34	36.2
	Do not know	60	63.8
How is malaria transmitted	Through mosquito bites	160	54.9
	By eating tainted food	79	19.5
	By drinking contaminated water	41	10.1
	Do not know	63	15.5
How is malaria prevented	Washing fruit and vegetables before eating them	64	15.8
	Sleeping under an ITN	196	48.3
	Allowing inside the home to be sprayed with insecticides	146	36
If you think you are infected with malaria, how soon should you get tested?	Within one week	65	16.1
	Within three days	200	50
	Within 24 hours	136	33.9

4.4. Environmental characteristics

Nearly half of the participants, 194 (47.8%) live in cement made type of house; the other means of housing include Emergency and transitional shelter 70 (17.2%) and Traditional Somali house 43 (10.6%). Of the participants, 120 (29.6%) have water pond sites around their house or vicinity. A significant proportion of the respondents, 252 (62.5%), stay outside overnight while more than half 257 (63.3%) usually sleep outside their houses.

The majority of the pregnant women's households had ITNS 256 (63.1%); from these, only 45 (17.6%) mentioned that they always used it while 68 (26.6%) stated that they never used it. 98 (24.1%) use mosquito repellants from pregnant women, and 49 (12.1%) had at least one indoor residual spraying for the last 12 months.

Table 4. Environmental characteristics of pregnant women at BGH - Bossaso, Somalia 2020 (n=406).

Characteristics	**categories**	**frequency**	**percent (%)**
Type of house	Mad and Thatch	6	1.5
	cement	194	47.8
	stone	93	22.9
	Emergency and transitional shelter	70	17.2
	Traditional Somali house	43	10.6
Are there any water pond sites around your house or vicinity?	yes	120	29.6
	no	286	70.4
Do you stay outside overnight after (6:00 pm)?	yes	252	62.1
	no	154	37.9
Where do you usually sleep?	inside the house	149	36.7
	outside the house	257	63.3

Does your household have any Insecticide-treated bed nets that can be used while sleeping?	yes	256	63.1
	no	150	36.9
If yes, how often do you use it? (n=256)	Always	45	17.6
	Sometimes	143	55.9
	Never	68	26.6
If yes, do mothers and children given priority of using bed nets? (n=256)	yes	126	49.2
	no	130	50.8
Do you use mosquito repellants?	yes	98	24.1
	no	308	75.9
Do you use protective clothing at night (long close cover hands and legs)?	yes	129	31.8
	no	277	68.2
Was there indoor residual spraying in the last 12 months?	yes	49	12.1
	no	357	87.9
If yes, how often? (n=49)	once	43	87.6
	twice	6	12.2

4.5. Prevalence of malaria among study participants

The overall prevalence of malaria among pregnant women in this study was 20.9% [95% CI (15.9%, 25.9%)] of whom 64(75.3%), 19(22.4%) and 2(2.4%) had plasmodium falciparum, plasmodium vivax and mixed infection respectively.

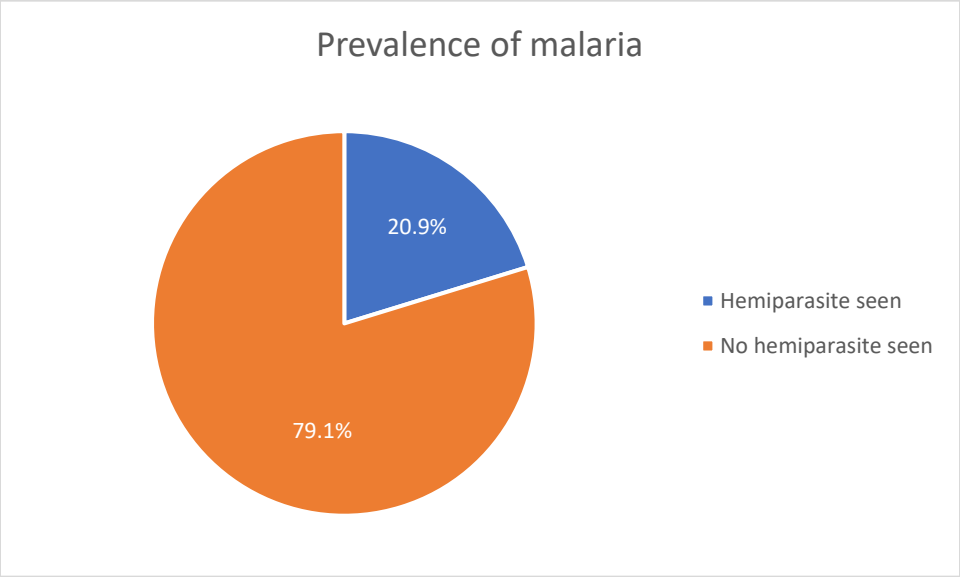

Figure 2: Prevalence of malaria among pregnant women attending BGH from Jun 7th – Sep 7th Bossaso, Somalia 2020 (n=406).

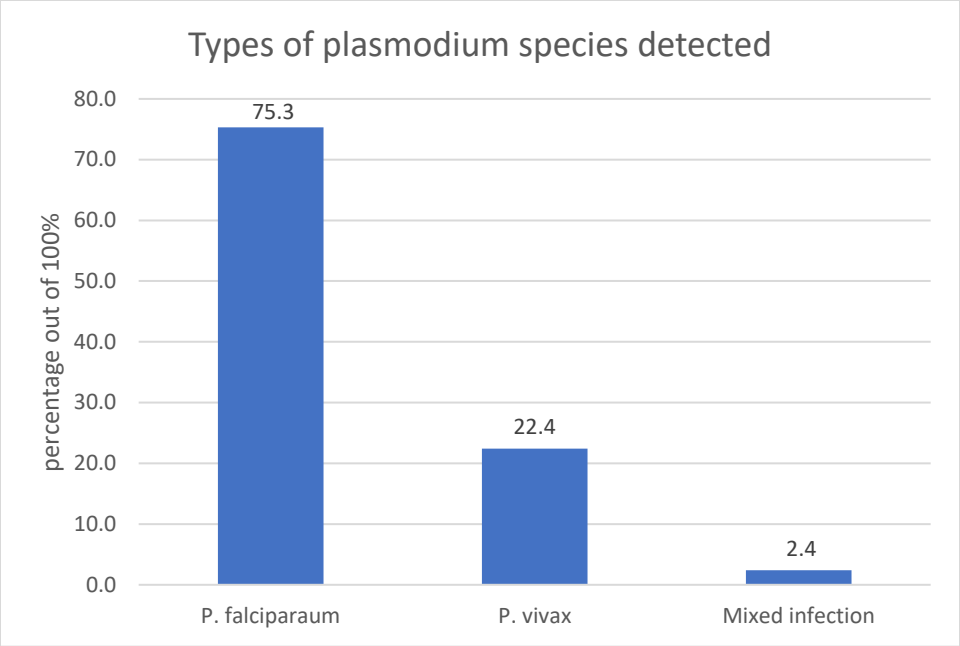

Figure 3. Types of malaria species among pregnant women attending BGH, Somalia 2020 (n=85).

4.6. Factors associated with malaria among pregnant women.

To determine the association between malaria and explanatory variables, bivariate and multivariable analyses were performed using binary logistic regression. As shown in (Table 5), there are 12 factors associated with malaria in the bivariate analysis at a p-value of <0.25, and these include age, gravidity, number of ANC visits, health education during ANC visits, how malaria is transmitted, presence of water pond sites around the house or vicinity, staying outside overnight after (6:00 pm), usually sleeping outside or inside the house, how often ITNS being used, utilization of mosquito repellants, usage of protective clothing at night (long close cover hands and legs), presence of indoor residual sprayed this year.

Then all of these factors listed above were further analyzed and entered into the final model for adjusting confounding factors. After adjusted in multivariable logistic regression, only two factors remained significantly associated with malaria.

Pregnant women who had water pond sites around their house or vicinity were 6.5 times increased odds of malaria infection compared to their counterparts [AOR= 6.5, 95% CI (1.6, 20.5)]. The odds of malaria infection among pregnant women were decreased by 90% for those who always used ITNs compared to those who used it less frequently [AOR=0.1, 95%CI (0.01, 0.88)].

Table 5: Factors associated with malaria among pregnant women at BGH - Bossaso, Somalia 2020 (n=406).

Covariant	**Category**	**Malaria status**		**COR (95%CL)**	**AOR (95%CL)**
		Positive N (%)	**Negative N (%)**		
Age	15 – 24	19 (16.1 %)	99 (83.9%)	1.04 (0.47, 2.3)	2.25 (0.14, 35.38)
	25 – 34	54 (25%)	162 (75%)	0.6 (0.3, 1.2)	2.67 (0.5, 14.32)
	≥ 35	12 (16.7%)	60 (83.3%)	1	1

Gravidity	Primigravida	21 (42.9%)	28 (57.1%)	0.31 (0.16, 0.58)	2.23 (0.14, 35.5)
	Secundigravida	13 (15.5%)	71 (84.5%)	1.26 (0.65, 2.44)	0.7 (0.1, 5.05)
	multigravida	51 (18.7%)	222 (81.3%)	1	1
Number of ANC visits	Never visited	33 (47.8%)	36 (52.2%)	0.2 (0.88, 0.43)	2.43 (0.42, 14.12)
	Once	30 (19%)	128 (81%)	0.8 (0.38, 1.73)	0.37 (0.08, 1.7)
	Twice	11 (10.0%)	99 (90.0%)	1.9 (0.76, 4.74)	0.19 (0.04, 1.01)
	Three times or more	11 (15.9%)	58 (84.1%)	1	1
Had health education during ANC visits (n=337)	Yes	6 (23.1%)	20 (76.9%)	0.56 (0.2, 1.48)	5.9 (0.7, 46.3)
	No	45 (14.5)	266 (85.5%)	1	1
How is malaria transmitted	Through mosquito bites	50 (22.4)	173 (77.6%)	0.58 (0.27, 1.25)	5.6 (0.94, 33.7)
	By eating tainted food	18 (22.8%)	61 (77.2%)	0.57 (0.23, 1.36)	3.8 (0.55, 26.9)
	By drinking contaminated water	8 (19.5%)	33 (80.5)	0.69 (0.24, 1.96)	3.9 (0.43, 36.0)
	Do not know	9 (14.3%)	54 (85.7)	1	1
Presence of water pond sites around your house or vicinity	yes	42 (35%)	78 (65%)	3.04 (0.2, 0.54)	6.5 (1.6, 20.53) *
	no	43 (15%)	243 (85%)	1	1

staying outside overnight after (6:00 pm)	yes	63 (25%)	189 (75%)	0.5 (0.29, 0.85)	1.8 (0.6, 5.35)
	no	22 (14.3%)	132 (85.7%)	1	1
Usually sleep	Inside the house	25 (16.8%)	124 (83.2%)	1	1
	Outside the house	60 (23.3%)	197 (76.7%)	0.66 (0.39, 1.11)	1.1 (0.33, 3.04)
How often ITNS being used (n=256)	Always	6 (13.3%)	39 (86.7%)	1.38 (0.53, 3.6)	0.1 (0.01, 0.88) *
	Sometimes	19 (27.9%)	49 (72.1)	0.55 (0.28, 1.08)	0.9 (0.2, 4.2)
	Never	25 (17.5%)	118 (82.5%)	1	1
Utilization of mosquito repellants	yes	12 (12.2%)	86 (87.8%)	1	1
	no	73 (23.7%)	235 (76.3%)	0.45 (0.23, 0.87)	2.6 (0.8, 8.42)
Usage of protective clothing at night (long close cover hands and legs)	yes	20 (15.5%)	199 (84.5%)	1	1
	no	65 (23.5%)	212 (76.9%)	0.6 (0.35, 1.04)	1.4 (0.4, 4.7)
Presence of IRS this year	yes	7 (14.3%)	42 (85.7%)	1.68 (0.73, 3.88)	0.2 (0.02, 1.7)
	no	78 (21.8)	279 (78.2%)	1	1

AOR= Adjusted Odd Ratio; CI= Confidence Interval; COR= Crude Odd Ratio; *= very Significant at p-value of < 0.05

5. DISCUSSION

This study assessed the prevalence of malaria infection and associated factors among pregnant women in Bossaso city, Somalia. This study resulted in a prevalence of 20.9%. In addition to these various potential factors assessed in this study, the factors like the presence of water bond sites around the house and always using ITNs were associated with malaria among pregnant women. However, different studies reported different factors that influence the rate of malaria infection among pregnant women.

The prevalence in this study (20.9%) was much closer to a prevalence of a study done in Benin (20.8%) (Accrombessi et al., 2018). However, this finding is greater from the studies conducted in western Ethiopia (10.2%) (Gontie et al., 2020), Salavan province, Laos (5.9 %) (Briand et al., 2016), Burkina Faso (18.1%) (Cisse et al., 2014) Nigeria (3.1%) (Isah, Amanabo, & Ekele, 2011) & in Nigeria as well 7.7% (Agomo, Oyibo, Anorlu, & Agomo, 2009). The reason for this discrepancy might be attributed to the difference in geographical location among the study areas. For instance, our study was conducted in a malaria-endemic area with a high rate of transmission. Therefore, individuals living in malaria-endemic areas have a greater chance of developing asymptomatic malaria. In contrast, those living in low transmission areas have a low probability of being infected, which can lead to a low prevalence of the diseases in such areas. Another reason for the difference could be methodology, including sampling techniques among these studies.

When this figure is compared with the results from Nigeria (41.6%) (Fana et al., 2015), Zambia 31.8 % (Chaponda et al., 2015), the findings were found to be lower. The difference in the prevalence might be due to, study period, study design and economic differences between the study areas as well as better implementation of improved malaria interventions including increased coverage in the distribution of ITNS, and IRS in our study area. Based on personal communication on of the regional health office, this difference might be due to better availability of ITNs in Bossaso, good health awareness of the community, and expanded health service coverage and utilization in Bossaso.

In this study, Plasmodium falciparum and vivax species caused the majority of the cases, 75.3%, and 22.4% respectively, while the remaining were caused by mixed infection (2.4%). This result

is in line with the 2016 screening survey conducted in the Bossaso regional hospital, which showed 73.7 %, 25.4% of malaria infections were caused by Plasmodium falciparum and vivax correspondingly (NMCPs/MoH, 2016). However, our result was lower than the WHO Somalia prevalence reports of the species, which was >95% of malaria species in the country was due to plasmodium falciparum (WHO, 2010a). On the other hand, the proportion of malaria cases caused by Plasmodium falciparum in our study was lower than the WHO malaria 2018 report, which revealed over 99% of malaria cases in Africa region were due to Plasmodium falciparum (WHO, 2019b). The possible reason for these variations might be due to marked seasonal, inter-annual, and spatial variability. It may also be due to large differences in climate (temperature, rainfall, and relative humidity), human settlement, and population movement patterns.

Our study also assessed socio-demographic factors, obstetric factors, environmental factors and ITN ownership and utilization factors. As a result, the presence of water pond sites around the house or vicinity, how often ITNs being used were significantly associated with malaria.

In this study, always using malaria preventive ITNS significantly associated decreased the odds of developing malaria infection during pregnancy [AOR=0.1, 95%CI (0.01, 0.88)]. A similar association was found in a study conducted in Lagos, Nigeria (Agomo & Oyibo, 2013). The possible explanation could be due to the UNICEF's recent provision of ITNS and community awareness campaigns by the MOH. The use of ITNs is shown to reduce malaria transmission, and it is one of the proven, cost-effective components of malaria prevention through the vector control approach.

In the present study, having water pond sites around the house or vicinity was significantly associated with the occurrence of malaria in pregnant women [AOR= 6.5, 95% CI (1.6, 20.5)]. This finding is in line with a study conducted in Uganda (Musoke et al., 2018) and other studies done in east India, which described it as a potential source of transmission (Sabin et al., 2018). This could be explained by the presence of stagnant water is an environmental risk factor that increases the breeding of mosquitoes near homes. The relatively inexpensive measures of removing pools of water have been shown to reduce mosquito abundance and malaria incidence significantly. Such interventions can be used with core malaria prevention methods such as the utilization of ITNs as a strategy to minimize the occurrence of the disease.

Overall, a timely intervention strategy is mandatory and should focus on the WHO recommended three-pronged approach for malaria in pregnancy, which includes ITNS, IPT and case management. In this study, although the majority of the pregnant women had ITNs, yet only few of them were regularly using it, so the health care providers in the region and stakeholders should create health awareness campaigns on the importance of using ITNs and specifically target pregnant women during routine care visits. In addition to this, a small portion of pregnant women had Sulfadoxine-pyrimethamine during ANC visits. This is also another area that the health care providers should work on since the administration of SP to the pregnant women has already demonstrated significant reductions in the morbidity and mortality of malaria in pregnancy.

5.1 Limitation of the study

- This study's limitation is that the time of data collection may affect the prevalence due to seasonal variation of malaria transmission.
- The causes and types of malaria in pregnant women are multi-factorial. As a result, we recognize this study's inability to identify the specific types and specific causes of malaria. It was done based on cross-sectional data, and we, therefore, could not establish a cause-effect relationship. Also, the stud y did not include qualitative method, particularly observation of housing conditions.
- The low prevalence of some of the associated factors created a wide confidence interval reducing the precision of the findings
- This study was conducted in COVID-19 era, where health systems have become overwhelmed with the efforts required to stop the transmission of the coronavirus, and hospitals have struggled to cope with increasing numbers of COVID-19 cases. This led to comprehensive concerns about the potential consequences of the pandemic, including disruptions of essential health services including malaria services.
- However, the strength of this study is, it has a 96.2% response rate, and the study finding may serve as a baseline data since no other related study was done in the country in general and in the study site in particular.

6. CONCLUSION AND RECOMMENDATIONS

6.1. Conclusion

The study found that the overall prevalence of malaria among pregnant women in the study area was found to be high (20.9%). The high proportion of this malaria species in our study is a clear implication that there is a need for aggressive prevention and control of the diseases, especially among pregnant women. Because Plasmodium falciparum causes the most severe form of the disease and it can cause devastating complications not only for the mother but also for the fetus. Factors significantly associated with malaria were only two factors; the presence of water pond sites and how often ITNs being used.

6.2. Recommendation

Based on the findings of this study, the following recommendations are forwarded.

- District health offices should provide broad-scale health education and awareness-building projects to the pregnant women communities regarding cleaning their surroundings and removing stagnant water pools as to prevent mosquito abundance and hence decrease malaria incidence.
- The health care providers should deliver health education sessions to the pregnant women during routine care visits and teach them different malaria prevention methods especially the importance of ITNs.
- Similarly, it would be better if concerned stakeholders increase the community's knowledge in general and the pregnant women in specific about malaria and its consequences as well as its preventive methods. This could help promote the healthcare-seeking behavior of individuals which might be a stepping stone to reduce the prevalence of malaria among pregnant mothers.
- Further studies on the specific types and other causes of malaria using more advanced equipment could motivate more focused clinical management of selected pregnant women and result in essential improvements in their overall health and survival.

7. REFERENCES

References

1. Aberese-Ako, M., Magnussen, P., Ampofo, G. D., & Tagbor, H. (2019). Health system, socio-cultural, economic, environmental and individual factors influencing bed net use in the prevention of malaria in pregnancy in two Ghanaian regions. *Malar J, 18*(1), 363. doi:10.1186/s12936-019-2994-5
2. Accrombessi, M., Fievet, N., Yovo, E., Cottrell, G., Agbota, G., Massougbodji, A., . . . Briand, V. (2018). Prevalence and Associated Risk Factors of Malaria in the First Trimester of Pregnancy: A Preconceptional Cohort Study in Benin. *J Infect Dis, 217*(8), 1309-1317. doi:10.1093/infdis/jiy009
3. Addai-Mensah, O., Annani-Akollor, M. E., Fondjo, L. A., Sarbeng, K., Anto, E. O., Owiredu, E. W., & Arthur, S. N. (2018). Regular Antenatal Attendance and Education Influence the Uptake of Intermittent Preventive Treatment of Malaria in Pregnancy: A Cross-Sectional Study at the University Hospital, Kumasi, Ghana. *J Trop Med, 2018*, 5019215. doi:10.1155/2018/5019215
4. Agomo, C. O., & Oyibo, W. A. (2013). Factors associated with risk of malaria infection among pregnant women in Lagos, Nigeria. *Infect Dis Poverty, 2*(1), 19. doi:10.1186/2049-9957-2-19
5. Amankwah, S., & Anto, F. (2019). Factors Associated with Uptake of Intermittent Preventive Treatment of Malaria in Pregnancy: A Cross-Sectional Study in Private Health Facilities in Tema Metropolis, Ghana. *J Trop Med, 2019*, 9278432. doi:10.1155/2019/9278432
6. Andrew, E. V., Pell, C., Angwin, A., Auwun, A., Daniels, J., Mueller, I., . . . Pool, R. (2015). Knowledge, attitudes, and practices concerning malaria in pregnancy: results from a qualitative study in Madang, Papua New Guinea. *PLoS One, 10*(4), e0119077. doi:10.1371/journal.pone.0119077
7. Briand, V., Le Hesran, J. Y., Mayxay, M., Newton, P. N., Bertin, G., Houze, S., . . . Fievet, N. (2016). Prevalence of malaria in pregnancy in southern Laos: a cross-sectional survey. *Malar J, 15*(1), 436. doi:10.1186/s12936-016-1492-2
8. CDC. (2019). Malaria. Retrieved from https://www.cdc.gov/dotw/malaria/index.html
9. Chaponda, E. B., Chandramohan, D., Michelo, C., Mharakurwa, S., Chipeta, J., & Chico, R. M. (2015). High burden of malaria infection in pregnant women in a rural district of Zambia: a cross-sectional study. *Malar J, 14*, 380. doi:10.1186/s12936-015-0866-1
10. Cisse, M., Sangare, I., Lougue, G., Bamba, S., Bayane, D., & Guiguemde, R. T. (2014). Prevalence and risk factors for Plasmodium falciparum malaria in pregnant women attending antenatal clinic in Bobo-Dioulasso (Burkina Faso). *BMC Infect Dis, 14*, 631. doi:10.1186/s12879-014-0631-z
11. Fana, S. A., Bunza, M. D., Anka, S. A., Imam, A. U., & Nataala, S. U. (2015). Prevalence and risk factors associated with malaria infection among pregnant women in a semi-urban community of north-western Nigeria. *Infect Dis Poverty, 4*, 24. doi:10.1186/s40249-015-0054-0
12. Fokam, E. B., Ngimuh, L., Anchang-Kimbi, J. K., & Wanji, S. (2016). Assessment of the usage and effectiveness of intermittent preventive treatment and insecticide-treated nets on

the indicators of malaria among pregnant women attending antenatal care in the Buea Health District, Cameroon. *Malar J, 15*, 172. doi:10.1186/s12936-016-1228-3
13. Fried, M., & Duffy, P. E. (2017). Malaria during Pregnancy. *Cold Spring Harb Perspect Med, 7*(6). doi:10.1101/cshperspect.a025551
14. Gontie, G. B., Wolde, H. F., & Baraki, A. G. (2020). Prevalence and associated factors of malaria among pregnant women in Sherkole district, Benishangul Gumuz regional state, West Ethiopia. *BMC Infect Dis, 20*(1), 573. doi:10.1186/s12879-020-05289-9
15. Hamer, D. H., Singh, M. P., Wylie, B. J., Yeboah-Antwi, K., Tuchman, J., Desai, M., . . . Shukla, M. M. (2009). Burden of malaria in pregnancy in Jharkhand State, India. *Malaria journal, 8*(1), 210.
16. Isah, A. Y., Amanabo, M. A., & Ekele, B. A. (2011). Prevalence of malaria parasitemia amongst asymptomatic pregnant women attending a Nigerian teaching hospital. *Ann Afr Med, 10*(2), 171-174. doi:10.4103/1596-3519.82070
17. Kimbi, H. K., Nkesa, S. B., Ndamukong-Nyanga, J. L., Sumbele, I. U., Atashili, J., & Atanga, M. B. (2014). Socio-demographic factors influencing the ownership and utilization of insecticide-treated bed nets among malaria vulnerable groups in the Buea Health District, Cameroon. *BMC Res Notes, 7*, 624. doi:10.1186/1756-0500-7-624
18. Muhumuza, E., Namuhani, N., Balugaba, B. E., Namata, J., & Ekirapa Kiracho, E. (2016). Factors associated with use of malaria control interventions by pregnant women in Buwunga subcounty, Bugiri District. *Malar J, 15*(1), 342. doi:10.1186/s12936-016-1407-2
19. Municipality, B. (2015). Districts | Bosaso Municipality. Retrieved from https://web.archive.org/web/20150202193210/http://bosasomunicipality.com/districts
20. Musoke, D., Miiro, G., Ndejjo, R., Karani, G., Morris, K., Kasasa, S., . . . Musoke, M. B. (2018). Malaria prevention practices and associated environmental risk factors in a rural community in Wakiso district, Uganda. *PLoS One, 13*(10), e0205210. doi:10.1371/journal.pone.0205210
21. NMCPs/MoH, Z. (2016). *Guidelines for the Diagnosis and Treatment of Malaria in Somalia* Retrieved from https://reliefweb.int/sites/reliefweb.int/files/resources/malaria_diagnosis_and_treatment_guidelines_180316.pdf
22. NMCPs/MOHs of the Fedral Government, P. a. S. (2014). Somalia Malaria Indicator Survey
23. Olukosi, A. Y., Olakiigbe, A., Ajibaye, O., Orok, B. A., Aina, O. O., Akindele, S. K., . . . Afolabi, B. M. (2020). Socio-economic behavioural indicators of falciparum malaria parasitaemia and moderate to severe anaemia among pregnant women attending antenatal clinics in Lagos, Nigeria. *Malar J, 19*(1), 393. doi:10.1186/s12936-020-03462-8
24. Ouedraogo, M., Kurji, J., Abebe, L., Labonte, R., Morankar, S., Bedru, K. H., . . . Kulkarni, M. A. (2019). Utilization of key preventive measures for pregnancy complications and malaria among women in Jimma Zone, Ethiopia. *BMC Public Health, 19*(1), 1443. doi:10.1186/s12889-019-7727-8
25. Sabin, L., Hecht, E. M. S., Brooks, M. I., Singh, M. P., Yeboah-Antwi, K., Rizal, A., . . . Hamer, D. H. (2018). Prevention and treatment of malaria in pregnancy: what do pregnant women and health care workers in East India know and do about it? *Malaria Journal, 17*(1), 207. doi:10.1186/s12936-018-2339-9

26. Singh, N., Singh, M. P., Wylie, B. J., Hussain, M., Kojo, Y. A., Shekhar, C., . . . Hamer, D. H. (2012). Malaria prevalence among pregnant women in two districts with differing endemicity in Chhattisgarh, India. *Malaria Journal*, *11*(1), 274.
27. SOMALIA, F. R. O. (2020). The Somali Health and Demographic Survey 2020.
28. somalia, U. (2015). UNICEF Somalia - Health - Child and Maternal Health. Retrieved from https://www.unicef.org/somalia/health.html
29. Tegegne, Y., Asmelash, D., Ambachew, S., Eshetie, S., Addisu, A., & Jejaw Zeleke, A. (2019). The Prevalence of Malaria among Pregnant Women in Ethiopia: A Systematic Review and Meta-Analysis. *J Parasitol Res*, *2019*, 8396091. doi:10.1155/2019/8396091
30. Tesfahunegn, A., Berhe, G., & Gebregziabher, E. (2019). Risk factors associated with malaria outbreak in Laelay Adyabo district northern Ethiopia, 2017: case-control study design. *BMC Public Health*, *19*(1), 484. doi:10.1186/s12889-019-6798-x
31. UNICEF. (2018). UNICEF Somalia - Media centre - World Malaria Day marked in Somalia with commitment to reduce infection rate further. Retrieved from https://www.unicef.org/somalia/media_18155.html
32. WHO. (2010a). malaria _Somalia. Retrieved from WHO. (2010b). Somalia malaia epidemiological profile.
33. WHO. (2011). WHO | Malaria. Retrieved from https://www.who.int/ith/diseases/malaria/en/
34. WHO. (2015). Microscopy for the detection, identification and quantification of malaria parasites on stained thick and thin blood films in research settings (version 1.0): procedure: methods manual. Retrieved from https://apps.who.int/iris/handle/10665/163782
35. WHO. (2018). Malaria in pregnant women. Retrieved from https://www.who.int/malaria/areas/high_risk_groups/pregnancy/en/
36. WHO. (2019a). Malaria. Retrieved from https://www.who.int/news-room/fact-sheets/detail/malaria
37. WHO. (2019b). *WORLD MALARIA REPORT*. Retrieved from Geneva:
38. WHO. (2020). WORLD MALARIA REPORT 2020. 20 - 25. Retrieved from https://www.who.int/docs/default-source/malaria/world-malaria-reports/9789240015791-eng.pdf?sfvrsn=d7a8ec53_3&download=true
39. WHO. (2020). WORLD MALARIA REPORT 2020. 20 - 25. Retrieved from https://www.who.int/docs/default-source/malaria/world-malaria-reports/9789240015791-eng.pdf?sfvrsn=d7a8ec53_3&download=true.

8. ANNEXES

8.1. ANNEX A: Information Sheet and Informed Voluntary Consent Form for Head of Institution.

Good morning/afternoon dear Sir/Madam! My name is _____. I am working as a data collector for the study being conducted in this hospital by Abdirahman Jama, who is studying for his master's degree at Haramaya University, Ethiopia. I kindly request you to lend me your attention to explain you about the study and your institution being selected as the study setting.

The study title: Malaria and associated factors among pregnant women Bossaso general hospital, Bossaso city, Somalia.

Purpose of the study: The findings of this study can be of paramount importance for the town health office to plan intervention programs to improve the preventive measures of women in your community and others. Moreover, the aim of this study is to write a thesis as a partial fulfilment of a master's program in master of public health in Nutrition for the principal investigator.

Procedure and duration: I will be interviewing the participants using questionnaire and investigate malaria parasite presence in blood by taking sample of blood to provide me with pertinent data that is helpful for the study. There are about 44 questions to answer where I will fill the questionnaire by interviewing you. The interview and the Laboratory examination will take about 20 minutes, so I kindly request you to spare me this time for the interview.

Risks and benefits: The risk of participating in this study is very minimal, but only taking 20 minutes from the participant's time, and taking a little bit of blood sample There would not be direct payment for participating in this study. But the findings from this research may reveal important information for the local health planners. During data collection any mother with severe malaria will be immediately reported to principal investigator by data collectors and try to help the mother to get medical care by financial supporting and linking to health facility that deliver best health care and rehabilitation center.

Confidentiality: The information Participants provide for us will be confidential. There will be no information that will identify the participant in particular. The findings of the study will be general for the study community and will not reflect anything particular of individual person. The

questionnaire will be coded to exclude showing names. No reference will be made in oral or written reports that could link participants to the study.

Rights: Participation for this study is fully voluntary. The participant has the right to declare to participate or not in the study. If participant decide to participate, she has the right to withdraw from the study at any time and this will not label her for any loss of benefits which she otherwise is entitled. In addition, the participant does not have to answer any question that she does not want to answer.

Contact address: If there are questions or enquires any time about the study or the procedure, please contact through the following address:

- Principal investigator: Mr. Abdirahman Jama. Cell phone: +252 90-483716 or +252 90-7927042. Email: iamabdure@gmail.com.
- Institutional Health Research Ethics Review Committee (IHRERC): Office phone: 025-466-20-11 or P.O.BOX: 235, Harar, Ethiopia.

7.1.1 Declaration of informed voluntary consent:

I have read the participant information sheet. I have clearly understood the purpose of the research, the procedures, the risks and benefits, issues of confidentiality, the rights of participating and the contact address for any queries. I have been given the opportunity to ask questions for things that may have been unclear. I was informed that participants have the right to withdraw from the study at any time or not to answer any question that they do not want. I am also informed that the Hospital has the right to stop this study from being conducted if any misdeeds and unethical procedures are observed during the data collection process in the Hospital's premises. Therefore, I declare on behalf of my hospital (Bossaso General Hospital) to allow this study to be conducted in the Hospital with my initials (signature).

Name and Signature of Head of the Hospital: _____ Date _____

Name and Signature of Data Collector: _____ Date _____

N.B: This is to be signed face to face in the presence of data collector and the copy is provided to the participant.

8.2. Annex B: Participant Information Sheet and Informed Consent Form for pregnant women

Good morning/afternoon!

My name is ……. I am working as a data collector for the study being conducted in the college of health and medical sciences research on "Assessment of malaria among pregnant women attending BGH, Bossaso City, Puntland State of Somalia' by Abdirahman jama who is studying for his master's degree at Haramaya University, College of Health and medical sciences, Department of General Public Health. I kindly requesting you to give me your attention to explain you about the study and being selected as the study participant.

The study title.

Assessment of Prevalence and associated factors of malaria among pregnant women attending BGH, Bossaso City, Puntland State of Somalia.

Purpose/ aim of the study

The finding of this study can be a paramount importance for the ministry of health or other intervention programs to prevent malaria transmission and reduce its impact in your community; thereby improve general health and survival of maternity and pregnant women in the community. Moreover, the aim of this study is to write a thesis as a partial requirement for the fulfillment of a Master's Program in public health for the principal investigator.

Procedures and duration

We will take a capillary blood specimen that will be collected using strictly disposable sterile blood lancet from finger under aseptic technique, and that will be investigated further in the laboratory and detected for malaria species, in addition this procedure won't cost you a money.

Then I will be interviewing you using a questionnaire to provide me with pertinent data that is helpful for the study. There are 40 questions to answer where I will fill the questionnaire by interviewing you. The interview will take about 20 to 30 minutes, so I kindly request you to spare me this time for the interview.

Risks and Benefits

The risk of participating in this study is very minimal, but only taking few minutes from your time. There would not be any direct payment for participating in this study. However, the findings from this research may reveal important information for stockholders or the local health planners.

Confidentiality and Rights

The information that you will provide during the study will be confidential. There will be no information that will identify you in particular. The findings of the study will be general for the study community and will not reflect anything particular to you. No individual names will be used for any purpose since each client will be assigned a number, not a name. No reference will be made in oral or written reports that could link particularly you to the research. Participation for this study is entirely voluntary. You have the right to either agree or disagree to take part in this study. You have the right to withdraw from participation. You do not have to answer any question that you do not want to answer. If you change your mind about participating during the course of the interview, you have the right to withdraw at any time, and it will not affect any aspects of your rights concerning health care.

Contact address

If there are any questions or enquires or any doubt about the study or procedure, please contact any time

- Principal investigator: Mr. Abdirahman Jama. Cell phone: +252 90-7483716 or +252 90-7927042. Email: iamabdure@gmail.com.
- Haramaya University, Institutional Health Research Ethics Review Committee (IHRERC): Office phone: 025-466-20-11 or P.O.BOX: 235, Harar, Ethiopia.

Declaration of informed voluntary consent

I have read/ was read to me the participant information sheet. I have clearly understood the purpose of the study, the procedures, the risk and benefits, issues of confidentiality, the rights of participating and the contact address for any queries. I have been given the opportunity to ask questions for things that may have been unclear. I was informed that I have the right to withdraw from the study at any time or not to answer any question that I do not want, and without in any way affecting my future life or medical care. Therefore, I declare my voluntary consent to participate in this study with my signature as indicated below.

Name of participant: _____ Signature of participant: _____.

Name of Data collector _____ Signature of Data collector_____.

N.B: This is to be signed face to face in the presence of data collector and the copy is provided to the participant.

8.3. Annex C: Participant Information Sheet and Informed Consent Form of pregnant women in Somali version

Warqada ka qayb qaadashada iyo ogolaanshaha qofka

Magacaygu waa …… waxan ka shaqaynayaa xog ururin cilmi baadhiseed laga samaynayo bulshada ku nool halkan, cilmi baadhistaan waxay ku saabsantahay xadiga iyo waxyaabaha la xariira xanuunka duumada/malaariyada ee hoyooyinka uurka leh, ee uu diyaarinayo cabdiraxman jaamac axmed isagoo uqabanaya mastertiisa jaamacada Haramaya, qaybteeda, caafimaadka iyo sayniska. Waxan si naxariis leh kaaga codsanayaa inad i siiso soo dhugtaada oo dhamaystiran si aan kuugu sharaxo wuxa uu ku saabsantahay cilmibaadhistan ka qayb qaate ahaan.

Ciwaanka

Xadiga iyo waxyaabaha la xariira xanuunka duumada/malaariyada ee hoyooyinka uurka leh kuwaas oo booqanaya xarunta cusbitalka guud e boosaaso, Somalia.

Ujeedada

Xogta cilmi baadhistani waxay tahay in xadiga uu leegyahay iyo waxyaabaha la xiriira e ku aadaan xanuunka duumada/malariyada ee hoyooyinka uurka leh e boosaaso, Somalia.. Garashada tani waxay naga caawindoontaa qorshaynta horumarineed ee caafimaadka bulshada taasoo anu ku eegi doono ka hortaga iyo daawada xanuunkan. Intaa waxa dheer ujeedo ah in aan qoro buuga jamaacada oo loo baahan yahay si aan u buuxiyo shuruudaha shahaadada labaad ee mastarta ee qaybta ka shaqaynta xanuunada caafimaadka guud ee bulshada.

Nidaamka iyo wakhtiga

Marka hore waxaan kaa qaadi doona dhiig si looga baaro xanuunka duumada taaso wax lacag ah aanan kugug weydiinayn, intaa wixii ka danbeeya waan ku waraysan doonaa anoo isticmaalaya shaxda su’aalaha si aad ii siiso xog sugan oo caawisa cilmi baadhistan. Waxa jira 40 su’aalood kuwaas oo ku saabsanaan doona shakhsiyadaada guud, caafimaadkaaga, qaab nololeedka guud ee qoyska iyo nadaafada guriga si aan u buuxiyo foomka markan ku warasyto. Waraysigu wuxu qaadan doonaa 7-15 daqiiqo. Markaa waxan si xushmad leh kaaga codsanayaa inaad ii ogalaato.

Khataraha iyo faa’iidooyinka

Khatarta ka qaybqaadashadaadu aad bay u yar tahay laakiin waxay kaa qaadan kartaa wakhtigaaga. Ma jiri doonto lacag si toos ah laguu siin doono si aad uga qayb qaadato. Laakiin xogta laga heli karo cilmi baadhistan waxay siin doonta warbixin muhiim ah qorsheeyaasha caafimaadka ka shaqeeya.

Sirhaynta

Xogta aad na siiso waxay ahaan doonta sir qarsoon. Ma jiri doonto xog adiga gaar kuu tilmaamidoonta. Waxii laga helo cilmi baadhistan waxay noqon doontaa mid guud mana jiri doonto wax gaar u ah qof iyo guri toona. lama samayn doono wax tixraac ah oo ku saabsan ka qayb qaataha qoraal ahaan iyo hadal ahaan midnaba.

Xuquuqda

Ka qayb qaadashada baadhistani waa tabaruc buuxa. Waxad xaq u leedahay inad ka qayb qaadato iyo inaad diidaba. Hadaad ogolaato inaad ka qayb qaadato hadana waxad xaq u leedahay inad joojiso wakhtiga aad doonto kugumana keeni doonto inad waydo faa'iidada. Ha ka jawaabin su'aasha ad doonto inanad ka jawaabin.

Ciwaanka d kala xidhiidhayso

Hadii ay jiraan wax su'aalo ah oo ku saabsan cilmi baadhista ama nidaamka wakhti kasta waxad la soo xidhiidhi kartaa ciwaandan soo socda

- Masuulka cilmi baadhista: (cabdiraxman jamac axmed) E-mail: iamabdure@gmail.com ama Taleefan namber: +252 90-7483716 ama +252 90-7927042
- Jaamacada Haramaya qaybta caafimaadka iyo sayniska iyo gudiga machadka cilmi baadhista iyo dib u eegista: Namberka xafiiska: 025-466-20-11 ama P.O.Box: 235, Harar, Itoobiya

Cadaynta in la wargaliyay damaanad qaadka tabaruca

Waa la ii akhriyay warqada xogsiinta ka qayb qaataha. Si cad baan u fahmay ujeedada baadhitaanka, nidaamka, khatarta iyo faa'idada, arimaha sirta , xuquuqda ka qaybqaadashada iyo ciwaanka lagala xidhiidhayo wixii su'aal ah.waxa la i siiyay fursada su'aal weydiinta wax kasta oo madaw ku jiro. Waxa la i wargaliyay in aan leeyahay xuquuqda in aan ka bixi karo baadhista wakhti kasta ama anan ka jawaabi Karin su'aal kasta oo aan doono. sidaas darted waxan cadaynayaa in aan si tabaruc ah uga qaybqaato baadhistan saxiixayguna xaga hoosuu ku sugan yahay.

Magaca iyo saxiixa ka qayb qaataha: ……..……..Taariikhda…….

saxiix xog ururiyaha……...…Taariikhda……..……

Tan waa in lagu saxeexo la joogitaanka xog ururiyaha si foolka fool ah.

8.4. Annex D Questionnaire in English version

Haramaya University, College of Health Sciences, School of Public Health,

Hello! My name is..... And I am working in _____ Bossaso general hospital and I am collecting data on the study conducted on the prevalence and associated factors of malaria among pregnant in Bossaso city, Somalia 2020. I would like to ask you about your aspects on factors associated to malaria. This information will help the district, region and country as well as other stakeholder to plan malaria prevention and control mechanisms. The questionnaire only takes between 15 to 20 minutes to complete. The information you provide will be kept strictly confidential and will not be shown to other persons and your participation is definitely important to identify the risk factors of malaria outbreak. There are no any incentives or direct benefits as well as risks in participating in this outbreak investigation project. Participation in this study is voluntary and you can choose not to answer any individual question or all of the questions. So, I am kindly requesting you to give us an appropriate information since your views are important for the study.

Consent (Verbal and written Consent): -

Respondent agrees to be interviewed Start interview..... 1

Respondent doesn't agree to be interviewed Terminate Interview..... 2

Name of interviewer: _____ Signature _____

Date: _____

Data collector mobile number _____

Part A: Socio-demographic characteristics

Q No.	Question	Response	Code	Skip to Q __
01	How old are you?	_____years		
02	Where is your place of residence?	1.urban 2.rural		
03	What is your religion?	1. Muslim		

		2. Christian 3. other (specify_____)		
04	What is your ethnicity?	1. Somalis 2. Somali Bantus 3. Arab 4. Oromo 5. Other (specify_____)		
05	How much is your family size?	_____		
06	What is your occupation?	1. Government employed 2. Private organization1 employee 3. Merchant 4. Daily laborer 5. Farmer 6. Pastoralist 7. Student 8. House wife 9. Other (specify_____)		
07	What is your educational level?	1. Had no formal education 2. Primary school (1-8th) 3. Secondary school (9-12th) and above		
08	If married what is your husband's educational level?	4. Had no formal education 5. Primary school (1-8th) 6. Secondary school (9-12th) and above		
09	How much is your monthly income in US dollar?	1._____ USD		

Part B: maternal characteristics

No	**Questions**	**Responses**	**Code**	**Skip to Q —**
10	What is your current marital status?	1. Single 2. Married 3. Widowed 4. Divorced 5. Separated		
11	How many times did you get pregnant including this one?	1. Once 2. Twice 3. Three times or more		
12	How old is your pregnancy?	1. 0 – 3 months (1st trimester) 2. 4 – 6 months (2nd trimester) 3. 7 – 9 months (3rd trimester)		
13	How many times did you attend antenatal care services during the current pregnancy?	1. Did not yet 2. Once 3. Twice 4. Three times or more		If not yet skip to Q
14	Have you been given health education about malaria during your ANC visit/s?	1. Yes 5. No		
15	During this pregnancy, did you take any drugs to keep you from getting malaria?	1. Yes 2. No		If no skip to Q
16	What drugs did you take?	1. SP (fansidar) 2. Chloroquine 3. Other (specify_____) 4. don't know		
17	How is malaria transmitted?	1. Through mosquito bites 2. By eating tainted food		

		3. By drinking contaminated water 4. Other (specify_____)		
18	How can malaria be prevented?	1. Washing fruit and vegetables before you eat them 2. Sleeping under an insecticide-treated bed net 3. Allowing the inside of your home to be sprayed with insecticides 4. Other (specify_____)		
19	If you think you have become infected with malaria, how soon should you get tested?	1. Within one week 2. Within 3 days 3. Within 24 hours 4. Other (specify_____)		

Part C: Environmental enquiry and other risk factors

N0	Questions	Responses	Code	Skip Q___
20	What is the type of your house?	1. Mud and thatch 2. cement 3. stone 4. emergency and transitional shelter 5. Somali traditional house 6. other (specify_____)		
21	Are there any water pond sites around the home or vicinity?	1. Yes 2. No		
22	Do you stay outside overnight (after 6:00 pm)?	1. Yes 2. No		

23	Where do you usually sleep?	1. Inside the house 2. Outside the house		
24	Does your household have any insect-side treated bed nets that can be used while sleeping?	1. Yes 2. No		If yes skip to Q38
25	If yes, how often do you use?	1. Always 2. sometimes 3. never		
26	If yes, do mothers and children given priority of using bed nets?	1. Yes 2. No		
27	Do you use mosquito repellants?	1. Yes 2. No		
28	Do you use protective clothing at night (long close cover hands and legs)?	1. Yes 2. No		
29	Was your house sprayed with indoor residual spraying in the last 12 months?	1. Yes 2. No		If no skip to Q31
30	If yes, how often?	1. Once 2. twice 3. three times 4. four times or more		

Part D: Laboratory Report Format

Bossaso General Hospital - Maternal and Child Health Center

I.D. ---------- Date ----------

Laboratory technician signature----------

Result

☐ Hemiparasite seen ☐ No Hemiparasite Seen

Type of hemiparasite seen

☐ Plasmodium vivax ------- ☐ Plasmodium falciparum----

☐ Mixed infections --------

Thank you for your great cooperation's.

8.5. Annex E Questionnaire in Somali version

Haramaya University, College of Health Sciences, School of Public Health,

Subax/galab wanagsan magacaygu waa_____ waxaan ka shaqeeyaa _____ waxaan ururinayaa xog cilmiyeed ku saabsan xadiga xanuunka duumada iyo waxyaabaha saameynta ee ku aadan hooyoyinka uurka leh kuwaas oo soo booqanaya cubitaalka guud ee sanadka 2020. Xogtaani waxay caawinaysaa degmada, gobolka iyo wadanka guud ahaan iyo dhamaan cidii ku shuqul leh xanuunka duumada iyo joojinteeda. Waxaa jiraya su'alo aan ku weydiin doono tasoo qaadanaysa wakhti gaaraya 15 ilaa 20. Xogtaad nasiiso waaxa loo xifdinayaa si sir ah cid kalena lama tusinayo aqoonsigaaga shakhsiyeed waxaa loo haynaa si qarsoon. Ma jirayaan wax abaalmarin ah iyo khataro toona kuwaasoo la xiriira ka qaybqaadashada cilmi baaristaan, sidaa awgeed ka qaadashadaadu waxay noqonaysaa tabaruc lakiin Khasab ma noqonayso inaad kawada jawaabto dhamaan su'aalaha lagu weydiiyo oo qaar waad ka jawaabi kartaa halka qaarna aad ka aamusi karto. Marka waxaan si naxariisle kaaga codsanayaa inaad isiiso xog sax ah laguna kalsoonan karo madaama cilmi baaristaani muhiim tahay.

Consent (Verbal and written Consent): -

Respondent agrees to be interviewed Start interview..... 1

Respondent doesn't agree to be interviewed Terminate Interview..... 2

Magaca waraysi qaadaha: _____ saxiixa _____

Maalinta: _____

Teleefan lambarka xog ururiyaha _____

Qaybta A: dabeecadaha bulshada

S No.	**weydiin**	**warcelin**	**kood**	**Ubood weydiinta**
01	Imisa sano ayaa jirtaa?	_____sano		
02	Xagee ayaa dagan-tahay?	1. Magaalo 2. Baadiye		
03	Waa maxay diintaada?	1. Muslim		

		2. Christian 3. Mid kale (magcow_____)		
04	Waa maxay qowmiyadaadu?	1. Somali 2. Somali jareer 3. carab 4. Oromo 5. Mid kale (magcow_____)		
05	Waa maxay shaqadaada?	1. Shaqaale dowladeed 2. Shaqaale gaar ah 3. Hooyo guri 4. ganacsato 5. maalin xoogsato 6. beeraley 7. xoolo dhaqato 8. arday 9. mid kale (magcow_____)		
06	Waa maxay heerkaaga waxbarasho?	1. Wax ma baran 2. Dugsi hoose/dhaxe 3. Dugsi sare ilaa heer jaamacadeed iyo wixii ka sareeya		
07	Hadad xaas noo sheeg heerka waxbarasho e ninkaaga	4. Wax ma baran 5. Dugsi hoose/dhaxe 6. Dugsi sare ilaa heer jaamacadeed iyo wixii ka sareeya		
08	Imisa ayu ka koobanyahay qoyskagu	_____		

09	Meeqa mushaar ah ama lacag ah ayaa ku soogasha bishii?	1._____ USD		

Part B: hooyada uurka leh

S No	**Questions**	**Responses**	**Code**	**Skip to Q _____**
10	Waa maxay xaaladaada Guur?	1. Doob 2. Xaas/laqabo 3. Laga-dhintay 4. Carmal 5. Kala-fogaansho		
11	Imisa jeer ayaad xaamilo noqotay tan imika marka lagu daro?	1. Hal jeer 2. Laba jeer 3. Sadex jeer iyo wixii ka badan		
12	Imisa billood ayad xamilo tahay	1. 0 – 3 billood (1st trimester) 2. 4 – 6 billood (2nd trimester) 3. 7 – 9 billood (3rd trimester)		
13	Imisa jeer ayaad booqatay xarunta hooyada iyo dhalaanka uurkii kan ka horeyay	1. Ma booqan 2. mar 3. labo 4. sadex iyo wixii ka badan		Mar haday ka badantahay u bood S15
14	Hadad booqatay ma lagu siiyay fariimo caafimaad o ku saabsan cudurka duumada ?	2. Yes No		
15	Hada intaad xaamilada ahayd ma qaadatay dawooyin kaa ilaasha xanuunka Duumada	1. Haa 2. Maya		Haday maya tiri u bood S19
16	Haday haa tiri, dawooyinkeed qaadatay	1. SP (fansidar) 2. CHLOROQUINE 3. Mid kale (_____)		

		4. Ma garanayo		
17	Cudurka duumada side la isugu gudbiyaa?	1. Qaniinyada kaneecada 2. Cunida cuno xumaatay 3. Cabida biyo wasakha 4. Mid kale (magcow_____)		
18	Side looga hortagaa cudurka duumada?	1. Mayrida khudaarta ka hor inta aan la cunin 2. Ku seexashada mara kanecada 3. In lagaaga buufiyo gurigaaga suntan cayayaanka 4. Mid kale (magcow_____)		
19	Hadii aad u malayso inay ku hayso xanuunka duumada, ilaa intee in leg wakhtiya aya tegi lahayd xarumaha caafimaadka?	1. Wiig kudihii 2. Kadib 3 cisho 3. Maalin kudaheed 4. Mid kale (magcow_____)		

qaybta C: Su'alaha bii'ada iyo waxyaabaha la xiriira

N0	Weydiin (su'al)	warcelin	Code	U bood Q___
20	Guri noocee ah weye kagu?	1. dhoobo 2. siminto 3. dhagax 4. mid kale (magcow_____)		
21	Ma jiraan meelo biyo fariistaan eek u dhow dhow gurigaaga?	1. Haa 2. Maya		

22	Habeenkii maku daahdaa guriga dibadiisa (kadib 6:00 pm)?	1. haa 2. No		
23	Xageed seexataa ?	1. Guriga gudihiisa 2. Guriga dibadiisa		
24	Ma leedahay mara kaneeco tasoo la isticmaali karo xiliga hurdada?	3. Haa 4. Maya		If no skip to Q30
25	Hadii haa tiri, ilaa intee in leeg isticmaashaa?	4. Markasta 5. Mararka qaar 6. marnaba		
26	Hadii haa tiri, hooyoyinka iyo ciyaalku maka qaybsadaan?	3. Haa 4. Maya		
27	Ma isticmaasha suntan kaneecada?	3. Haa 4. Maya		
28	Ma xirataa maryo dhaadheer (kuwaas oo qarinaya lugaha iyo gacmaha):	3. Haa 4. Maya		
39	Sanadkan ma la buufiyay cayayaanka iyadoo la isticmaalayo sunta cayayaanka?	3. Haa 4. Maya		
30	Hadii haa tiri, imisa jeer?	5. Mar 6. Labo 7. Sadex 8. Afar iyo wax ka badan		

Waad ku mahadsantahay inaad la shaqeeysay.

8.6 Annex F: Curriculum Vitae

Full name: Abdirahman Jama **Sex**: male **Addressl:** (Email: Abdiman.jama@gmail.com), (M: +251 944063882 / +252 636260102 / +252 907483716)

1: **Major qualification**

MPH in public health at Haramaya University

2. **Academic background: Educational Background**

MSc at Haramaya University –present

2014-2018 bachelor degree in Public health officer from Samara university

3. **Work experiences**

- **October 2020 to Now 2020:** work as Regional coordinator for Canadian Association of midwives at Hargeisa, Somalia.

Key responsibilities:

- Review and utilize the piloted MACAT 2.0 tool developed by ICM to assess the three Midwifery Associations remotely
- Review project documents and other relevant documentation related to Midwifery Association strengthening
- coordinate with ICM MACAT 2.0 team to learn about and validate the tool and provide information on the pilot exercise
- conduct virtual meetings and interviews with each of the Midwifery Associations with the support of the Technical Expert's team member in Somalia.
- Monitoring data collection results/ follow-up on nonresponses/Managing survey participants (Local partner coordination)
- Data cleaning and Reporting findings and facilitating dissemination workshops.

- **November 2019 to July 2020:** worked as District Health Management Information System Officer (DHMIS) at Dhahar, Sanaag region.

Key responsibilities:

- Conduct regular assessments and reviews of HMIS activities of the district;
- Monitoring and assessing different health centres in the district;
- Collecting monthly summary reports from health centres in the district;
- Compiling, correcting and submitting district health data to the ministry of health;
- Ensuring data completeness and accuracy by conducting regular data quality audits;
- Participate in the development of templates and guidelines for data gathering, collation and reporting in liaison with the central ministry of health.

➢ **October 2017 to April 2018:** Worked at Dubti Referral Hospital as an intern.

Key responsibilities:

- Community engagement on diseases prevention and other related Health problems.
- Counselling and educating outpatients and inpatients about diet, hygiene and risky behaviours.
- Monitoring and participation in the improvement of hospital sanitation and infection prevention.
- Supporting the day-to-day efficient work of the hospital including OPD, EPI, and MCH centres.
- Coordinating with external partners such as humanitarian NGO's and other stakeholders.

Language proficiency

✓ Somali: Native
✓ English: Fluent both Writing and Speaking
✓ Arabic: full professional.
✓ Amharic: Professional Working

References

1) Mr. Moti Tolera
Head of public health department
College of health and medical sciences
Haramaya University, Ethiopia
Phone: +251 922381559

2) Dr. Abdisalam Bahwal
Health Specialist
UNICEF Somalia, Hargeisa Office
Phone:+25207723267/+252633435866
email: abahwal@unicef.com