SCHOOL OF PUBLIC HEALTH

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FACTORS ASSOCIATED WITH MALARIA INFECTION AMONG HAWKERS IN THE GREATER ACCRA REGION

BY

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DECLARATION

I hereby declare that the presentation of this work is the result of my own effort, towards the attainment of MPH degree except the references which have been duly acknowledged. Neither the whole work nor part of it has been submitted for any other degree.

…… ……..

PATIENCE KWOFIE DATE

(STUDENT)

…… ……

DR. BISMARK SARFO DATE

(SUPERVISOR)

DEDICATION

This work is dedicated to my mother Mrs. Helena Lawoe, my daddy Mr. Tony Lawoe and my husband Mr. Reindorf-Elijah Akakpo for their encouragement and support during the difficult moment, and also to MPH first sandwich cohort for their assistant and support when things seemed tough.

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ABSTRACT

Background: Hawkers constitute mobile population who are at increasing risk of being infected with malaria. They move around the city to carry out their duties. Most of them have no accommodation. They sleep wherever they find themselves in the evening and do not benefit from most of the malaria intervention programs such as the use of long lasting insecticide net.

Objectives: The objective of this study was to determine factors associated with malaria infection among hawkers in the Greater Accra Region of Ghana.

Method: The study was conducted in the Accra Metropolis in the Greater Accra Region. Hawkers (head potters) were recruited from the Agbogbloshie market. Blood sample was collected from participants to test for malaria parasites infection and were interviewed using a closed-ended questionnaire. The data was statistically analyzed using STATA software version 15. Simple descriptive statistics, Pearson chi square and multiple **Logistic** Regression were performed. Significance was set at $p<0.05$

Result: The study revealed 12% and 9.8% prevalence of malaria using RDT and microscopy respectively. Plasmodium falciparum was the main parasite detected in all positive blood slide examinations (microscopy). Factors associated with malaria among head potters includes; age OR 0.11(CI 95%=0.01-0.98), marital status OR 3.52(CI 95%=1.13-10.92) and knowledge on preventive strategies with an OR 0.62(CI 95%=0.26-1.64).

Conclusion: The study revealed a high prevalence of malaria among hawkers (head potters). Factors associated were age, marital status and knowledge on preventive strategies. This research further recommends that more education should be carried out among these population to expand their knowledge on malaria especially on its preventive strategies and its practice.

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LIST OF ABBREVIATIONS

GHS	Ghana Health Service
HPM	Human Population Movement
IRS	Indoor Residual Spraying
ITN	Insecticide Treated Net
MOH	Ministry of Health
NGO	Non-Government Organization
NMCP	National Malaria Control Programme
OPD	Out Patients Department
RDT	Rapid Diagnostic Test
UNICEF	United Nations Children's Fund
WHO	World Health Organization

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Malaria still remains the most endemic disease globally, especially in the African sub-regions which account for over 1 million death yearly (WHO, 2015). According to WHO (2018), there was an estimated 219 million cases of malaria. Out of these estimated cases were 435,000 deaths in 2017 in 90 countries from which WHO African region is of no exception and accounted for 92% and 93% of malaria cases and deaths respectively.

Significant effort has been made in the fight against malaria. Between 2010-2016 malaria incidences and mortality rates fell by 18% and 37% respectively between population at risk of all age groups and 35% in children under five years (WHO, 2017). In Ghana this reduction was as a result of some strategies developed by the national malaria control programme (NMCP) in its fight against malaria, which are; multiple prevention strategies which includes the use of long lasting treated insecticide net, chemoprophylaxis in pregnant women as well as maintaining the environment properly, improved access to prompt and effective treatment and the maintenance of health systems at all levels (GHS, 2016) .

The substantial decrease in the prevalence of malaria in the country has led to a decreased dominance of the various *Plasmodium* species found in Ghana as evidenced by a work done by Owusu et al, (2017) which revealed that there is a 3.2% lower prevalence of cases with *Plasmodium, falciparum* and *ovale* compared to what was documented by the department for international development (DFID) (2014) with a range between 90-98% prevalence in *P.*

falciparum , *P. malariae* 2–9% and *P. ovale* 1%. In spite of this significant improvement, malaria continues to have a disturbing impact on people's health and livelihoods.

In 2015, Ghana recorded 10 million cases of malaria at the outpatient department (OPD). In the first quarter of 2016, about 2.2 million of malaria cases was recorded, representing a 3.5% increase over 2015 (GHS, 2016).

Human population movement (HPM) serves as a major challenge faced by malaria control and elimination programmes since they require an understanding of how the spatial distribution of malaria shifts through time and across multiple locations and become interconnected through population movements (Smith & Whittaker, 2014). Mobile populations from highly endemic malaria regions serve as a high risk in introducing malaria to the malaria free areas thereby compromising on the effort put in place to eradicate it (Cohen et al, 2012).

In settings where eliminating malaria seems impossible, understanding the patterns of parasite movements from local hotspots of transmission can provide valuable information (Pindolia, D. K. et al., 2013) for control by identifying both the regions where imported infections originate and where they may contribute substantially to transmission (Lynch & Roper, 2011). In a study done by Diallo et al., (2017) at Madina and Tema in the Greater Accra Region of Ghana, there was a 15.1% prevalence of malaria among hawkers and long distance truck and bus drivers. The high prevalence in this study could be as a result of these group of population not benefiting from most of the malaria interventions in Ghana.

1.2 Statement of the problem

Human population movement have been described as a major issue in malaria control and elimination programmes, because information on the spatial spread, the shifts through time and how it crosses multiple locations and become interconnected with the population displacement is limited(Smith & Whittaker, 2014), hence have been associated with an increase malaria transmission (Martens& Hall, 2000). The rise in mobility during the past decade has brought about a greater concern about the relationship that exists between mobility and malaria. Some of the reasons which account for the rise in mobility are rural urban migration in search of jobs and greener pastures, conflicts and natural disaster such as floods (Ramlogan, 1996)

It is crucial to consider the dynamics of movement of parasites from its local hotspot of transmission to develop a well-managed surveillance and response system through the identification of both regions where the infections originate and how they may add up more especially to its transmission in non-elimination areas (Lynch, 2011).

During the past decade, there has been a national effort to combat malaria which has led to the formation of many NGOs and other agencies putting in measures to help in it control.

In 2015, it was reported by the malaria surveillance systems that, 19% of the cases that occur globally were due to many factors including the fact that not all patient infected with malaria visit the health facility for health care, or if they do they may not seek care at a health facility that are covered by a country's surveillance system (WHO, world malaria report, 2016).

Urbanization and rapid population growth has been on the rise in many Sub Saharan African Region including Ghana with an increased rate of migration by people seeking menial jobs

such as hawkers (head potters) into the cities and towns without accommodation and residence resulting in unemployment and overcrowding (Yankson & Bertrand, 2012). Most of the hawkers (head potters) have no accommodation and therefore they sleep wherever they find themselves in the evening and do not benefit from protection against malaria such as the use of long lasting insecticide net and indoor residual spraying (Harris et al, 2013). This statement was evidenced by a survey carried out in 2015 by the national malaria control programme which revealed that National malaria programmes often target only selected population for Indoor Residual Spraying (IRS) hence the proportion covered by indoor residual spraying is generally lower (NMCP, 2016). This group of population are highly vulnerable to malaria because of barriers to access basic and quality health care services (Koen et al, 2015).

To this end they could be infected by the malaria parasite, making them a source of residual transmission which may thwart all the efforts put in place to control the disease. It is important to understand the factors associated with malaria transmission in this mobile population to help develop targeted interventions for the national malaria control programme. The inability to identify these factors means that malaria infection in this group can continue to drive the transmission even if malaria in the general population is controlled.

1.3 Justification

In situation where there is no baseline data and continuous assessment of the national malaria control programmes, there will be no effective planning, implementation and evaluation of the programmes. Mobile population is considered to be one of the at risk population of being infected with malaria (WHO, 2017). Very few research works have been done in the area of malaria among mobile populations in Ghana.

Information on the burden of malaria among mobile population is needed to help in the control programme. It is also important to furnish policy makers and other stakeholders with information regarding the factors associated with malaria infection among mobile population in the greater Accra region, for possible policy implementation and intervention and also to stimulate further research.

1.4 Conceptual framework

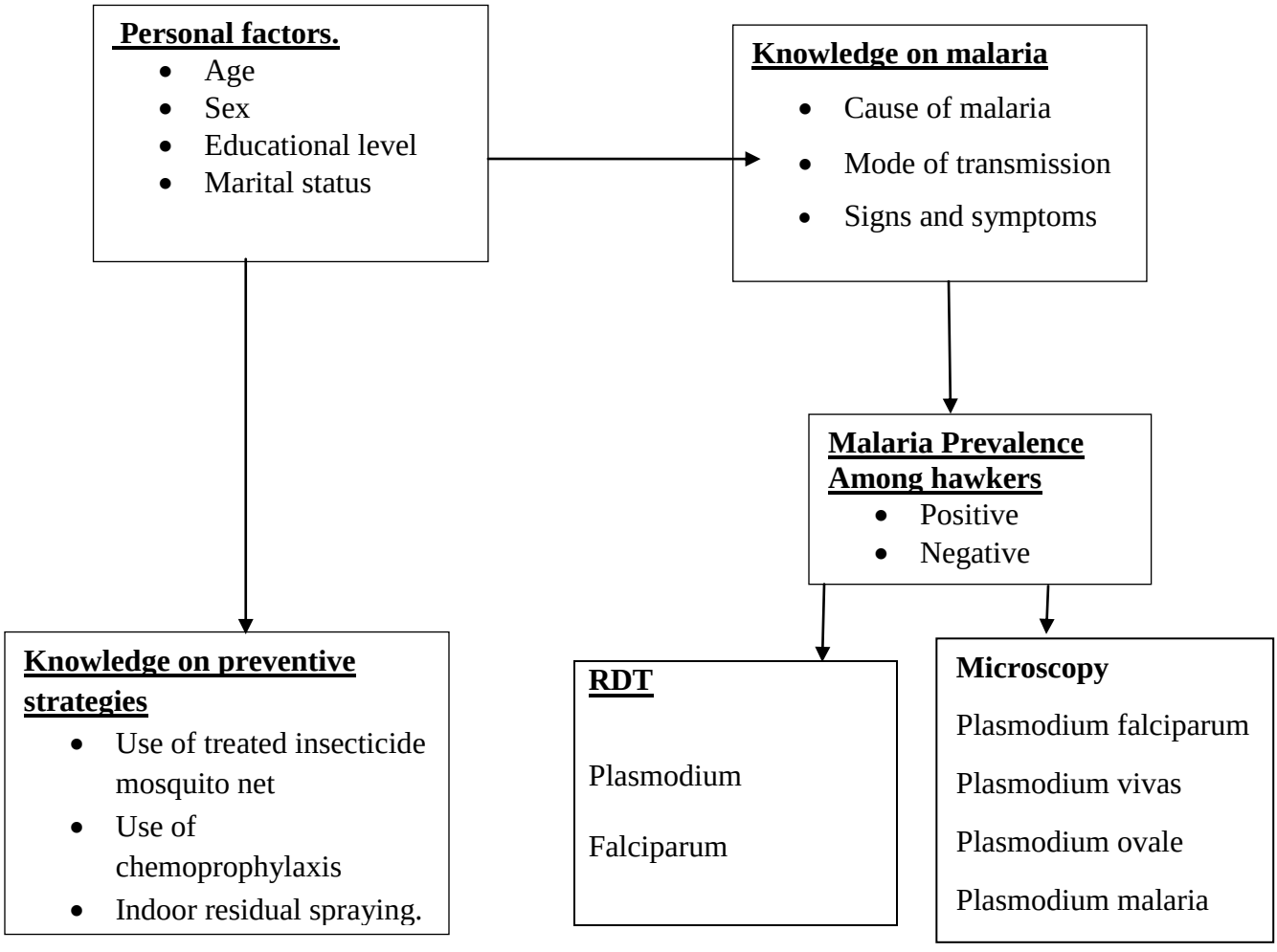

Figure 1: Conceptual framework of Malaria Prevalence among hawkers.

Narrative of conceptual framework

Factors that affect malaria burden in mobile populations can be classified into three categories: personal factors, knowledge on malaria and knowledge on preventive strategies. Personal factors such as educational level refer to one's ability to listen to radio, to read newspapers, to watch TV and understand and to acquire knowledge through information education and communication (IE&C) about malaria. Again factors such as occupation of people as hawkers staying outside all day have an impact on the transmission of the disease because of exposure to the bite of the infective mosquito (parasite).

Knowledge on Malaria factors refer to whether participants know what causes the disease, how malaria can be contracted, the signs and symptoms of the disease. Malaria prevention factors include education that individuals acquired on the measures to be taken to prevent being infected with malaria parasite. All these factors could influence the prevalence of malaria among hawkers. Malaria prevalence can be known by testing either with the RDT or blood film for microscopy, from which the particular species of malaria parasite can be identified.

1.5 Research questions

1. What is the prevalence of malaria among hawkers in the Greater Accra Region?
2. What are the malaria parasite species in the study participants?
3. What are the factors associated with malaria in this group of people?

1.6 Objective of the study

1.6.1 General and specific objectives

The objective of the study is to assess the factors associated with malaria infection among hawkers in the Accra Metropolitan Area.

1.6.2 Specific objectives

1. Determine the proportion of hawkers who have malaria during the study period
2. To identify the malaria parasite species in the study participants
3. To assess the factors associated with malaria infection among this population

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Prevalence of malaria associated with type of occupation

Exposure to mosquitoes causing malaria puts one at a high risk of malaria infection. Thus individuals engaged in hawking are at a greater risk of malaria infection since they are almost always exposed to the natural environment. Studies have indicated that the type of work mobile populations engage themselves in and the generally poor working conditions make them to be highly exposed to malaria vectors (Heggenhougen et al., 2007).

In Ghana, malaria is still hyper-endemic with incidence ranging from 11.2% to 40.0%. The occurrence of malaria is alleged to be higher among persons especially living in rural (37.7%) than in urban (15%) areas (Ghana Statistical Service (GSS), Ghana Health Service (GHS), ICF International, 2015). This may be attributed to the fact that most people in the rural areas engage in activities that exposes them to the mosquitoes carrying the malaria parasite.

A study by Tobgay et al., (2011), in Bhutan revealed that malaria cases are associated with occupational behaviours such as collecting firewood in forests, sleeping in fields overnight to protect crops, and crossing the border to India. These activities expose individuals to a variety of health hazards to which sedentary populations are not exposed and it is often harder for those individuals to cope with the consequences of the disease.

A study was conducted to assess the occurrence of malaria in settlement areas in Juruena district of Brazil (Ferreira et al., 2012). The study was undertaken in 2005 to find out how prevalent malaria is in the district. The results of this study indicated that in 2005 the

occurrence of malaria was 33%. The results of the study revealed that the ratio of incidence was higher (67%) among persons involved in gold mining activities or activities that expose one to the environment.

Similarly, Molla and Ayele, (2015) conducted an institution based, cross sectional survey in Dilla Town and the surrounding rural areas, Gedeo Zone, Southern Ethiopia with the main aim to explore the incidence of malaria and related factors. Data were gathered through questionnaire and blood film analysis format. The study found that largely exposure to adverse environmental conditions was a predisposing factors to the incident of malaria.

Anwar et al., (2015) conducted a study to determine the factors associated with malaria occurrence in the country. The study was carried out for over a year where malaria was screened using blood smear and/or RDT. Data on socio-demographic, clinical, and obstetrical were collected using pretested questionnaires. The study revealed that activities that expose individuals to the outside environment contributed greatly to malaria infection.

A study carried out by Diallo et al., (2017) to determine the burden of malaria among hawkers and long-distance truck drivers revealed the general burden of malaria to be 15.1%. Among hawkers and truck drivers, the occurrence of malaria was found to be 18.9% and 10.9% respectively. The study further indicated that the hawkers and long-distance truck drivers were more prone to malaria infection.

2.2 Factors associated with malaria infection in individuals

In sub-Saharan Africa, several factors have been reported to be associated with malaria infection in individuals. A study carried out in Accra and Tema by Diallo et al., (2017)

reported that sociodemographic characteristics, such as occupation, marital status, and educational level are associated with malaria infection in hawkers and long distance drivers.

Similarly, Ferreira. et al., (2012) undertook a research in Brazil to determine the associated factors with the prevalence of malaria in the country. The study findings revealed that the factors associated with malaria prevalence include insufficient knowledge about how malaria is transmitted, origin, occupation, insufficient information about the period the mosquito frequently bites and individual practices relative to the peak period of mosquito activity.

Also, a research conducted by Molla and Ayele, (2015) on the reasons for malaria infection reported that the absence of insecticide treated bed nets and living in houses with mud block walls were factors associated with malaria infection. The study also indicated that living in nearby stagnant water predispose individuals to malaria infection.

A cross sectional research was carried out by Fana et al., (2015) to establish how prone individuals are to malaria infection. The study was undertaken in the semi-urban area of Argungu, Kebbi State Nigeria. Results of this study indicated that factors associated with malaria infection were non-usage of ITNs and lack of education.

A study carried out by Agomo and Oyibo, (2013) in Lagos Nigeria to identify the factors responsible for malaria infection among individuals. The comparison of factors related to malaria infection among individuals was carried out using relative risk and multivariate logistic regression analysis. The study findings showed that the main factors responsible for malaria infection included non-usage of insecticidal spray.

Takramah, et al., (2017) studied the factors associated with malaria infection among persons in rural areas in the Volta region. The study focused on reporting the main factors related to

the infection of malaria in most rural areas in the region. It was then reported that age, fever, type of community and occupation are the main factors associated with malaria infection

2.3 The malaria parasite species in individuals

According to Matangila et al., (2014), some of the malaria parasite species that cause malaria in persons have been found to be widespread, from which researchers have reported substantial dominance of asymptomatic Plasmodium carriers. Again they reported an incidence of 21.6%, 27.4%, and 29.5% of asymptomatic *P. falciparum* infection in pregnant women in some areas in Africa respectively, by microscopy, Rapid Diagnostic Tests (R DTs), and PCR (Matangila, et al., 2014). Podmokła, et al., (2014) conducted a study to establish occurrence and intensity of infection with malaria parasites in the Blue Tit. The study findings showed that *Plasmodium* infections prevailed (incidence of 49.5 %), while Haemoproteus infection rate was much lower (frequency of 16.5 %).

Singh, Siwal, Pande and Das, (2017) studied in India to explore malaria parasite infections among persons. Based on PCR diagnostic assay, the researchers gathered published data on the differential infection prevalence of the five different malaria parasites. It was observed that approximately 11% of the overall cases examined were due to mixed species infection. Findings also showed that prevalence of *Plasmodium falciparum* mono-infection were considerably higher than *P. vivax* monoinfection. Moreover, *P. malariae* was observed to be emerging as a probable malaria menace in India.

A study was carried out in the Democratic Republic of the Congo to ascertain the high predominance of *Plasmodium falciparum* infection in asymptomatic individuals. The study revealed half of the samples collected from the respondents had *Plasmodium* infections.

Accordingly, the most species found was *P. falciparum* alone in combination with *P. malariae* 'Mvumbi et al., 2016'

Molla and Ayele, (2015) did a study to find out the malaria parasite species in persons in areas in Southern Ethiopia. The study was aimed at detecting the major species responsible for malaria in the areas. They reported that the leading Plasmodium species was *P. vivax*, which was 62.5% in individuals studied. It was followed by *P. falciparum*, which was at 26.8%, and mixed malaria infection of both species, 10.7%.

Agomo and Oyibo, (2013) did a study to find out the malaria parasite species in persons in Nigeria. Malaria infection, species identification and parasite density were done using microscopy. The study found *Plasmodium falciparum* in 95.2% of the cases examined. This was observed to be either mixed infection with *P. malariae* (3.6%) or as a mono infection (91.6%).

A study carried out by Diallo et al., (2017) aimed at reporting on the malaria parasite species responsible for the prevalence of malaria in persons in mobile population in Accra and Tema metropolis. The study findings revealed that malaria is prevalent in the population studied and *Plasmodium falciparum* was accountable for all infection.

2.4 The knowledge of individuals on the prevention of malaria

For decades now, malaria control and prevention still remains a major challenge in most parts of Africa. Forty (45) countries in Africa including Ghana, Cote d'ivoire, and Nigeria, are endemic for malaria. Approximately, 588 million individuals are at risk of being infected with malaria. Malaria prevention is usually characterised by the use of antimalarial chemoprophylaxis and insecticide treated nets (ITNs) (WHO, 2012).

Adebayo, Akinyemi and Cadmus, (2015) undertook a study on the knowledge and prevention of malaria at a rural community in Southwest Nigeria. The study was a descriptive cross-sectional survey which employed a semi-structured, interviewer-administered questionnaire to obtain data from the respondents. The study reported that in the rural community, the awareness of the prevention of malaria was poor. Similarly, Ojong, Iheanacho, Akpan and Nlumanze, (2013) conducted a study with the aimed of examining the knowledge of individuals on the prevention of malaria. The researchers reported that the participants who had good knowledge about the prevention of malaria were 83.9%. The study also reported that 69% of the respondents engaged in strategies to prevent the diseases. The study further indicated a relevant connection between knowledge and malaria prevention practices of the respondents.

Again, Abasiattai, Etukuma and Umoiyoho, (2009) studied in Uyo south Nigeria and examined the awareness and malaria preventive strategies. The study reported that 71% of the respondents studied had fair knowledge of the practices of malaria prevention strategies. They also indicated that the respondents were aware of the negative impact of malaria on them.

A study was conducted in Gboko metropolis, Benue State, Nigeria by Houmsou, Amuta and Sar (2010). The purpose of their study was to explore the awareness, the causes and the prevention of malaria. The study findings indicated poor awareness of the practices of malaria preventive strategies. It was observed that the usage of insecticide treated bed nets among the respondents was not satisfactory.

Sumari et al., (2016) conducted a research in Tanzania to explore the knowledge and comprehension of malaria transmission. The study also sought to assess the respondents'

recognition of symptoms, treatment seeking behaviour, preventive measures and practices of the disease. The study found 63.2% of the respondents to have good knowledge of the disease. On the prevention and control of malaria, 92.0% of the respondents indicated using bed nets as the main malaria prevention strategy. Other preventive measures indicated include the use of medicine, generally artemether lumefantrine, as prophylaxis. The study indicated that generally the respondents had fair knowledge of malaria prevention.

A study was undertaken in Uganda by Mwanje (2013) with the objective to examine the awareness, attitudes and practices on malaria prevention and control. The study was conducted in Nsaabwa Village, Mukono District. This study was undertaken in June 2012 and employed the cross-sectional design. Quantitative data for this study was obtained through structured questionnaires from 140 households while qualitative data were gathered through four Focus Group Discussions (FGDs) and 10 Key Informant Interviews (KIIs). The study findings showed that approximately 60% of the respondents had fair knowledge of the prevention and control of the malaria disease. The respondents further indicated that malaria is a threat to humans and could be control with malaria drugs.

In Ghana, a study was undertaken by Asante (2007) to investigate the frequency of malaria in the Bosomtwe-Atwima Kwawoma District in the Ashanti Region. The study randomly sampled respondents for the study and administered questionnaires to obtain data from them. The focus of the study was on unhygienic practices, lack of awareness and lack of protective devices. Knowledge of respondents concerning the prevention of malaria was not satisfactory. The study indicated that the prevention of malaria can be through taking essential precautions such as the use of repellents, treated mosquito nets, and taking malaria vaccines.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study design

A cross sectional study was conducted among hawkers (head potters) at Agbogbloshie in the Accra Metropolitan area in the Greater Accra region. Data on patient demographics, knowledge on the causes, transmission and the preventive strategies of malaria were collected and analysed to determine the factors associated with malaria infection in this population.

3.2 Study location

The study was conducted in the Accra metropolitan area in the Greater Accra region. Greater Accra region is the smallest region but the second highly populated after Ashanti Region in Ghana. Greater Accra region covers about 3,245square kilometre area representing 1.4 percent of the total land area in Ghana

Its population according to the 2010 population census was 4,010,054 accounting for 15.4 percent of Ghana's total population but have been estimated to be about 4,613,637 in 2016 by the Ghana statistical service. AMA has 42 percent of total population in Accra which was 1,665,085 in the 2010 population and housing census (Ghana statistical service, 2016).

Agbogbloshie

Agbogbloshie is a popular name of a commercial district on the Korle Lagoon of the Odaw River, near the centre of Accra, Ghana's capital city. Agbogbloshie is located in Ashiedu Keteke, a sub metro of the Accra Metropolis in the Greater Accra region. It has a population

size of about 40,000 with most of the populace migrating from the three northern regions in Ghana and from other rural areas, (Ghana statistical service, 2014). The main work carried out in Agbogbloshie is trading. It has been known as the most polluted area with E-waste within West Africa (Agyei-Mensah S, Oteng-Ababio M.2012), but has no health facility. The major health complaint of the people there are chest pains, headache, abdominal pains, fever and general body pains which is mostly related to the kind of work they are involved in as well as the nature of pollution that exist in the area. (Caravanos, J.et al., 2011)

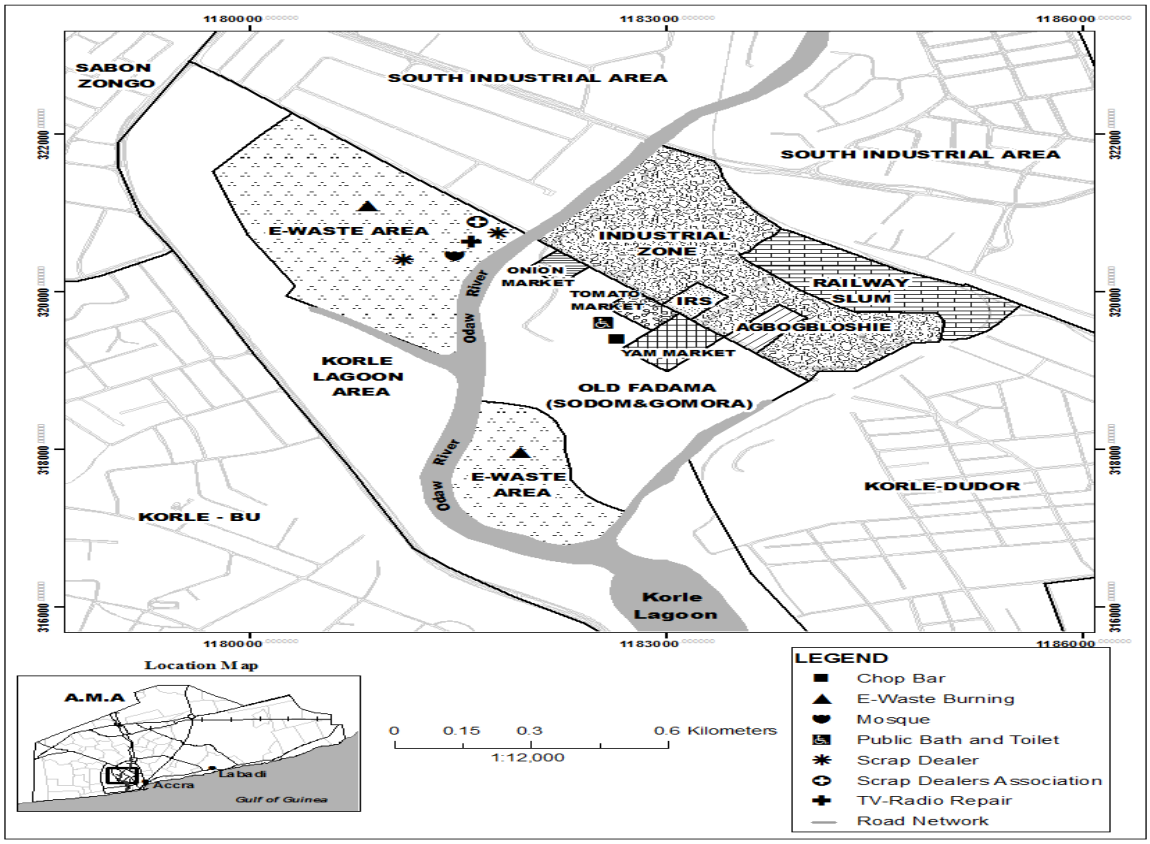

Figure 2: Map of study area; Agbogbloshie

Source: Oteng-Ababio M. 2010.

3.3 Study population

The study population was made up of hawkers (head potters) who reside at Agbogbloshie in the Accra Metropolitan Assemble. Most of these hawkers travelled from the three northern regions and other rural part of Ghana to the capital city Accra to seek for job (Ghana Statistical Service 2014). The main work that they do is to carry goods for shoppers who come to the market as a result they move a lot within the market and also move from one market to another. They charge a fee for providing such a service and that is how they earn their income. They sleep mostly in the open verandas in front of people's shops and in kiosk.

3.4 Inclusion and exclusion criteria

Inclusion criteria

All hawkers (head potter) above the age of 17years who consented to participate in the research work.

Exclusion criteria

Inability to provide consent as appropriate, which is being below the age 17years.

3.5 Study Variables

3.5.1 Dependent Variable

The main outcome variable for this study is Malaria infection

3.5.2 Independent variables

Demographic variables	**Knowledge on malaria**
Age	Awareness of malaria
Sex	Causes of malaria
Educational	Transmission process for malaria
Marital status	Preventives strategies against malaria

3.6 Sampling size

The sample size for the study was determined by adopting a sample size calculation for a cross sectional studies or surveys (Cochrane 2007). This formula is stated below:

$$Sample\ Size\ (n) = \frac{Z^2 p(1-p)}{d^2}$$

where:

Z = z statistic for a level of confidence

p = expected prevalence or proportion in the population based on previous studies

d = margin of error or precision

From review of literature, it was estimated that the prevalence of malaria was 15% among long distance truck drivers and hawkers in Greater Accra Region, Ghana. (Diallo et al., 2016)

Using the following formula;

$$\boldsymbol{n = \frac{1.96^2 x 0.15(1-0.15)}{0.05^2} = 195.9}$$

Accounting for 10% non-response rate, the total sample was 215

Therefore the minimum sample size that was used was 215.

3.7 Data collection technique and method

Ashiedu Keteke a sub district in the Accra Metropolitan Assembly was used for the study. Agbogbloshie was selected because of it highly populated numbers of head potters and also serve as a dwelling place and a national office for the association of head potters (Kayayee) in Ghana. Information regarding study population was taken from the President of the National Kayayee (head potter) association in Ghana to help identify the location and time from which the hawkers can be contacted. A durbar was organised by the President of the Association to assembly all hawkers available at that time for three conservative times. Consent was taken from the available hawkers (head potters) who were eligible for the study. Data was gathered through personal interview and assessment of blood samples.

Questions were designed in the areas of demographic data, knowledge on malaria: awareness, transmission process and preventive strategies such as the use of insecticide treated net and indoor residual spraying. Blood sample was taken from the respondents to test for the presence of malaria parasite. This was done in two ways. By using the rapid diagnostic test (RDT) and microscopy being thick blood smears of each participant stained with Giemsa.

3.7.1 Blood Analysis for malaria parasite using RDT

In performing the RDT, the fourth finger of the non-dominant hand was cleaned with alcohol swab, allowed to dry on its own and pricked with a sterile lancet. Pipette was used to collect the required amount of blood from the finger prick and dropped on the cassette through the sample hole (square hole). Two drops of a buffer was added to the blood sample via the round hole. The cassette was left to wait for 15minutes for the result. Those who tested

positive had two red lines on the cassette while those who were negative had one line, which is the control line. Each RDT cassette was coded with a unique number

Finger prick was used to access for blood sample from the respondents. In order to prevent fear, accidental pricks with used needles and infections the respondents were informed of the uneasiness or pain that may arise as a result of the needle prick. A sharp disposal container (box) was provided to dispose of the used needles as well as a new and sterile lancet (needle) was used for each respondents and disposed of after use. Pressure was applied to the pricked site to prevent unwanted bleeding. Disposable gloves was worn by the data collectors and discarded after attending to each respondents

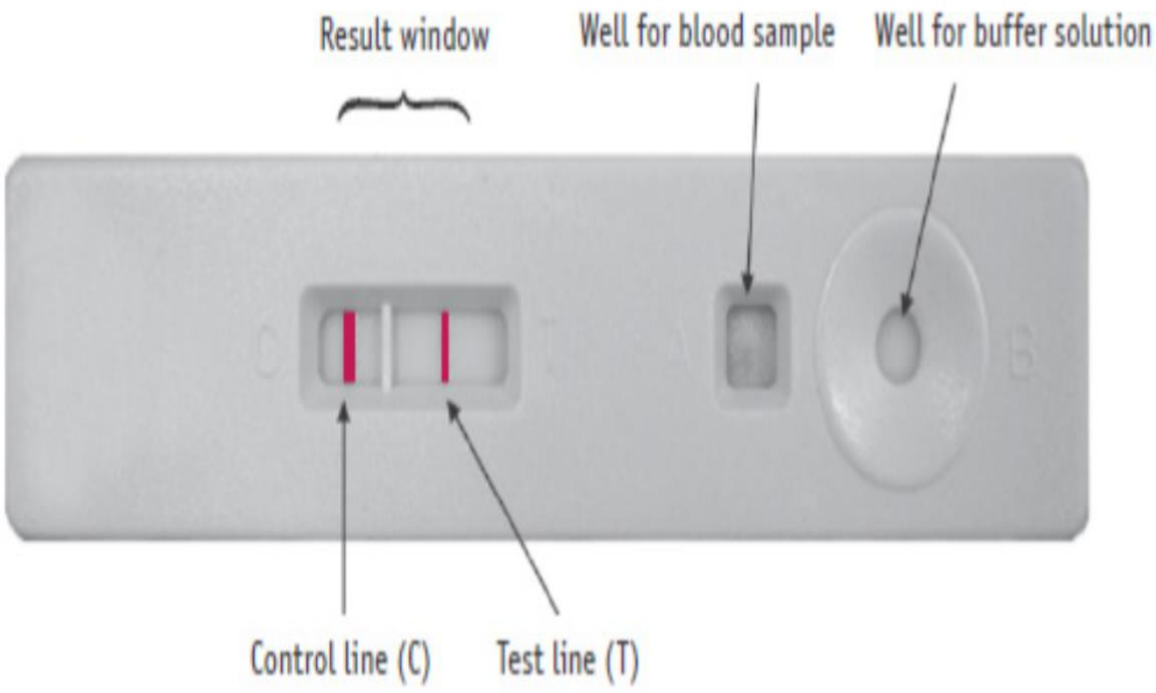

Figure 3: RDT test kit showing control and test line

3.7.2 Blood Analysis for malaria parasite, species identification and parasite density using Microscopy

Microscopy examination remains the gold standard for laboratory confirmation of malaria. In examining for malaria parasite under the microscopy, a drop of blood from the respondent's was spread out as a blood smear on a microscope slide. The specimen was stained with a Giemsa stain to give the parasites a distinct look. The Giemsa stained blood smear was put under a microscope and examined with a 100x oil immersion objective. Visual criteria was used to identify malaria parasite. Parasites found were scanned in additional 100 fields to increase the chance of identifying mixed infections. The shapes of the parasite were carefully examined to identify the type of species involved.

The parasite density approximate the percentage of red blood cells infected with malaria parasite, the severity of the infection and on the response to treatment.

To get the parasite density, the smear was cautiously scanned, a row at a time. The total number of white blood cells as well as infected white blood cells were counted and tabulated separately. The number of infected white cells was noted after a count of 2000 white blood cells, but was continued to 5000 white cell count where the infected white cells were less than 100ul.

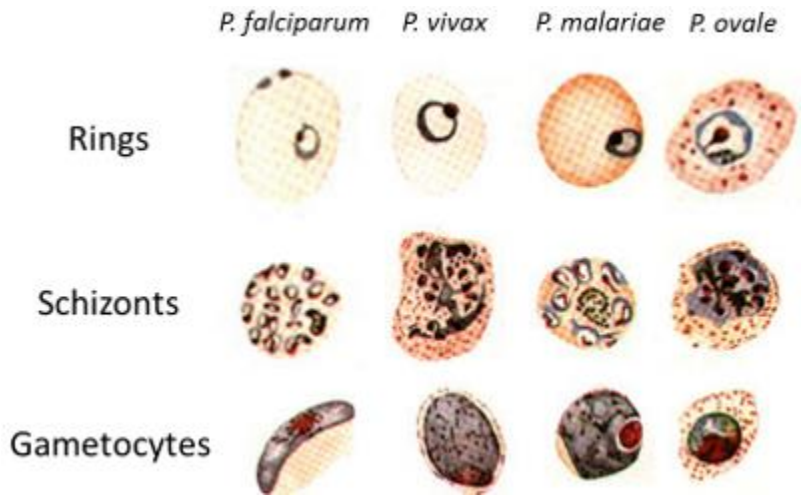

Figure 4: Microscopy differentiation of malaria parasite species

3.7.3 Training of interviewers

Data collectors were recruited and trained on ways of probing for questions, explanation of the questionnaire, seeking for consent from respondents and conforming to the ethics guidelines of the study and also to administer the questionnaires in a sociable and professional manner.

3.7.4 Pre-testing and review of instruments

The data collection tools and the techniques were pre-tested in a similar population. The questionnaire pre-testing was done at Kaneshie among the hawkers who reside at Kaneshie within Greater Accra Metropolis. A convenience selection of mobile population was interviewed and questionnaires filled. The format and comprehension of the questionnaires were assessed and revised accordingly where necessary

3.8 Data processes and analysis

Data was entered using Microsoft Excel spread sheet and exported to STATA 15.0 version. (Stata Corp LLC, 4905 Lakeway Drive, College Station, TX 77845, USA) for cleaning and

analysis. Descriptive statistics was done using two by two tables and frequencies. Univariate analysis of categorical variables was expressed in frequencies, proportions and percentages. Pearson Chi Square test was done for all the factors to determine an association between the factors and malaria and all variables with a p value of <0.05 were considered to be statistically significant. A binary logistic regression analysis was done to determine the strength of the association between the variables, and variables which were significant and were supported by the literature on the factors associated with malaria were put into a Multiple Logistic Regression analysis model. This analysis was done using odds ratio and their corresponding 95% CI to assess the association between the selected independent variables and malaria infection. The results were presented in a two by two tables to parade the frequencies, percentages, p value, 95% confidence interval, crude and adjusted odds ratio.

3.9 Ethical clearance

Ethical clearance was sought from the Ghana Health Service Ethics Review Committee and approval was given for the implementation of the study protocol (GHS-ERC164/412/17).

A letter was written to the president of the national head potters association in Ghana to seek for his permission. Study objectives, the benefits of the study and the assurance of confidentiality were explained to the president. Privacy and confidentiality was maintained as names of participants were not used but rather study materials were given a unique code for identification purposes. All study procedures were clearly explained to the participants to obtain their consent. All data collected was stored in a locked folder on the computer as well stored under lock and key and will be destroyed after five years.

3.10 Limitation

There was a limitation in the sampling method used in recruiting participants for the study. Consecutive method was used because hawkers were scarce to reach due to the nature of their job which involves hawking from one place to the other.

CHAPTER FOUR

4.0 RESULTS

A total of 218 respondents were interviewed and tested for malaria using RDT and microscopy during the study period. Participants were recruited at the Agbogbloshie market for the study between Septembers to October 2018. The age group ranged between 17years-65years with a mean (SD) of 29.5(10.32).

Table 1: Demographic characteristics of respondents

Variable	Frequency N=218	Percentage (%)
Sex		
male	2	0.9
Female	216	99.1
Age		
below 20	32	14.7
20-29	91	41.7
30-39	48	22
40-49	34	15.6
50and above	13	6.0
Mean(SD)	29.5(10.32)	
Marital Status		
Single	95	43.6
Married	113	51.8
Divorced	7	3.2
Widowed	3	1.4
Educational level		
No formal education	148	67.9
Primary school	26	11.9
Junior high school and above	44	20.2

Table 1 above shows the demographic characteristics of the respondents. From the table, majority of the respondents accounting for 216(99.1%) were females. Most of the hawkers

(head potters) accounting for 91(41.7%) were within the age group 20-29 years. Also the head potters who were married were more accounting for 113(51.8%), and those with no formal education were the most involved accounting for 148(67.9%).

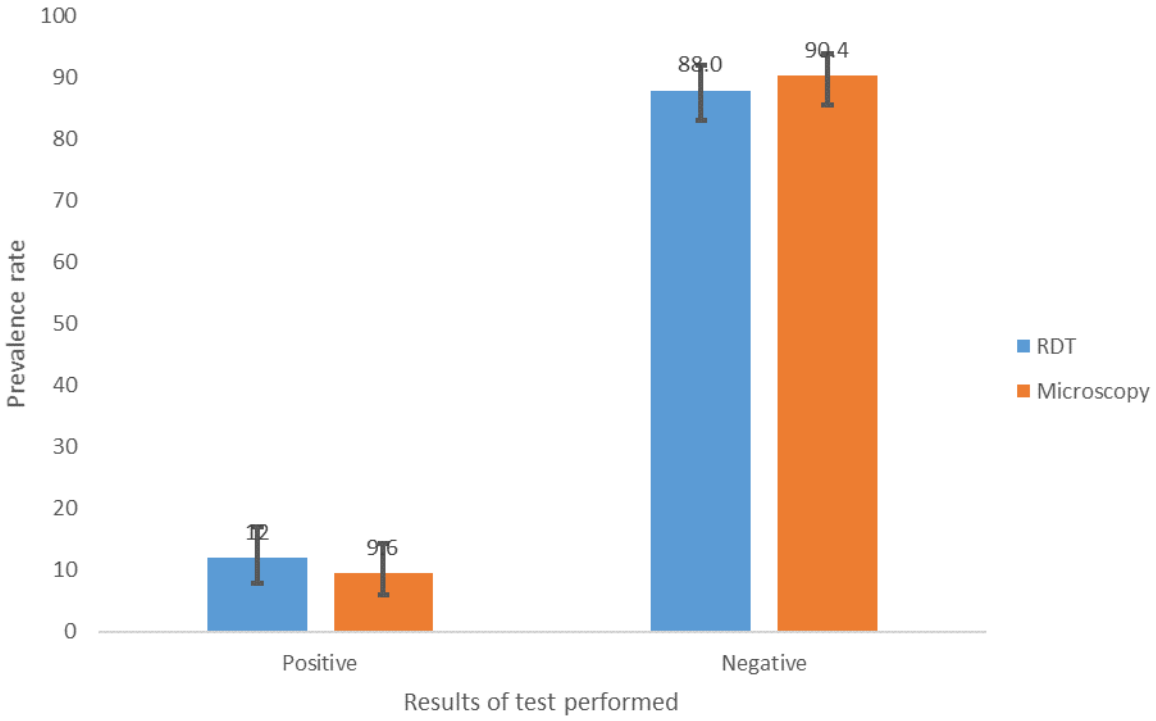

Figure 5: Prevalence of malaria using RDT and Microscopy showing 95% Confidence Interval

Figure 1 above represent the prevalence of malaria using RDT and microscopy. RDT recorded 12% prevalence whiles microscopy recorded 9.6%, however the difference between the RDT and microscopy is not statistically significant.

Table 2: Parasite density related to microscopy positive test

parasite density /ul	Frequency	Percentage
16-199	15	71.4
200-399	2	9.5
400 and above	4	19.1

Table 2 presented above depicts the parasite density revealed in blood positive examination using microscopy. Fifteen (15) out of twenty one (21) positive for malaria had a parasite density level between 16-199 microliter, two (2) had between 200-399microliter and four (4) had 400 and above. All the parasites identified among the respondents were *plasmodium falciparum.*

Table 3: Demographic characteristics associated with malaria and its prevalence

Demographic variable	**Malaria test results (RDT)**		**Pearson chi-square**	
	Negative=192	**Positive=26**	**Chi**	p-value
Age				
Below 20	22(11.46)	10(38.46)		
20-29	80(41.67)	11(42.31)	16.26	**0.001**
30-39	44(22.92)	4(15.38)		
40 and above	46(23.96)	13.85)		
Marital status				
Married	107(55.73)	6(23.08)	13.6	**0.004**
Single	85(44.27)	20(76.92)		
Educational level				
Junior high school above	39(20.94)	5(19.23)	2.52	**0.471**
No formal education	129(67.19)	19(73.08)		
Primary school	24(12.50)	2(7.69)		

Note: Negative: absence of malaria parasites in the blood analyzed; positive: presence of malaria parasites in the blood analyzed; p<0.05.

The table 3 above shows the demographic characteristics associated with malaria prevalence. Pearson chi square test showed that the prevalence of malaria among the hawkers (head potters) was statistically significant P<0.05 for age group (0.001) and marital status (0.004) while it had no significant difference in educational level (0.471).

Table 4: Factors associated with the prevalence of malaria

Variable	RDT test results		Pearson chi-square	
	Negative=192	**Positive=26**	**Chi**	p-value
Awareness of malaria				
Yes	170(88.54)	19(73.08)	4.75	**0.029**
No	22(11.46)	7(26.92)		
Total	192	26		
Cause of malaria				
Yes	136(70.83)	12(46.15)	6.4	**0.011**
No	56(29.17)	14(53.85)		
Total	192	26		
Knowledge on organism				
Mosquito	129(94.85)	12(100.00)	0.6	**0.441**
Others	7(5.15)	0(0.00)		
Total	136	12		
Transmission				
Mosquito bite	113(58.85)	10(38.46)	3.87	**0.049**
Other	79(41.15)	16(61.54)		
Total	192	26		
Signs &symptoms				
Yes	120(62.50)	12(46.15)	2.56	**0.109**
No	72(37.50)	14(53.85)		
Total	192	26		
Preventive knowledge				
Yes	130(67.71)	10(38.46)	8.52	**0.004**
No	62(32.29)	16(61.54)		
Total	192	26		
Specific prev. Measures				

ITN &IDRS	42(32.03)	5(50.0)		
ITN	65(50.78)	4(40.00)	1.4	**0.496**
IDRS	23(17.19)	1(10.00)		
Total	130	10		

The table 4 above shows the factors associated with malaria prevalence. Pearson chi square test showed that the prevalence of malaria among the hawkers(head potters) was statistically significant $P<0.05$ in awareness about malaria, causes, transmission and the preventive knowledge while it had no significant difference in knowledge on organism and the specific preventive measures against malaria.

Table 5: Risk factors associated with malaria RDT test showing logistic regression with Crude and Adjusted Odd ratio at 95% Confidence Interval

Variable	RDT Test Result		COR[95%CI]	AOR[95% CI]
	Negative=192	Positive=26		
Age				
Below 20	22(11.46)	10(38.46)	Ref	
20-29	80(41.67)	11(42.31)	0.30(0.11-0.80)*	0.40(0.14-1.15)
30-39	44(22.92)	4(15.38)	0.20(0.06-0.71) *	0.37(0.09-1.62)
40 and above	46(23.96)	1(3.85)	0.05(0.00-0.40)**	0.11(0.01-0.98)*
Marital status				
Married	107(55.73)	6(23.08)	Ref	
Single	85(44.27)	20(76.92)	4.20(1.6-10.9)**	3.52(1.13-10.92)*
Educational level				
Junior high school above	39(20.94)	5(19.23)	Ref	
No formal education	129(67.19)	19(73.08)	1.15(0.40-3.30)	
Primary school	24(12.50)	2(7.69)	0.65(0.12-3.62)	
Awareness of malaria				
Yes	170(88.54)	19(73.08)	Ref	
No	22(11.46)	7(26.92)	2.84(1.08-7.53)*	
Cause of malaria				
Yes	136(70.83)	12(46.15)	Ref	
No	56(29.17)	14(53.85)	2.83(1.23-6.51)**	
Knowledge on organism				
Mosquito	129(94.85)	11(100.00)	Ref	
Others	7(5.15)	0(0.00)	1	
Transmission				
Mosquito bite	113(58.85)	10(38.46)	Ref	
Other	79(41.15)	16(61.54)	2.29(0.99-5.31)	
Signs &symptoms				
Yes	120(62.50)	12(46.15)	Ref	
No	72(37.50)	14(53.85)	1.94(0.85-4.43)	
Preventive knowledge				
Yes	130(67.71)	10(38.46)	Ref	
No	62(32.29)	16(61.54)	3.35(1.44-7.82)**	0.62(0.26-1.64)*
Specific prev. Measures				
ITN &IDRS	41(32.03)	5(50.0)	Ref	
ITN	65(50.78)	4(40.00)	0.50(0.13-1.99)	
IDRS	22(17.19)	1(10.00)	0.37(0.04-3.39)	

Note COR= Crude Odds ratio, AOR=Adjusted Odds ratio, 95%CI=95% confidence interval other variables are * p<0.05, **p<0.01.

Inferential statistics predicts that, head porters within the age 40 years and above have 11% chance of getting malaria by using RDT test kit and statistically significant compared to head porters below the age of 20 years [AOR(95%CI)= 0.11(0.01-0.98)]. Interestingly, single head porters were 3.52 times to get malaria by using RDT test kit and statistically significant compared to head porters who were married [AOR (95%CI)= 3.52(1.13-10.92)].

Table 6: Factors associated with malaria using microscopy

Variables	**Microscopy test result**		**Pearson chi-square**	
	Negative	**Positive**	**Chi**	**p-value**
Age	N=197	N=21		
Below 20	28(14.21)	4(19.05)		
20-29	78(39.59)	13(61.05)	7.67	0.053
30-39	44(23.34)	4(19.05)		
40 and above	47(23.86)	0(0.0)		
Marital status				
Married	102(51.78)	11(52.38)	1.15	0.764
Single	95(48.22)	10(47.62)		
Educational level				
Junior high school above	41(20.81)	3(14.28)		
No formal education	132(67.01)	16(76.19)	1.01	0.799
Primary school	24(12.18)	2(9.52		
Awareness				
Yes	169(85.79)	20(95.24)	1.47	0.225
No	28(14.21)	1(4.76)		
Cause of malaria				
Yes	136(69.04)	12(57.14)	1.23	0.267
No	61(30.96)	9(42.86)		
Transmission				
Mosquito bite	110(55.84)	13(61.90)	0.28	0.594
Other	87(44.16)	8(38.10)		
Signs &symptoms				

Yes	120(60.91)	12(57.14)	0.11	0.737
No	77(39.09)	9(42.86)		
Preventive knowledge				
Yes	126(63.96)	14(66.67)	0.06	0.806
No	71(36.04)	7(33.33)		
Specific prev. Measures				
ITN &IDRS	41(33.06)	5(35.71)	0.4	0.82
ITN	6350.81)	6(42.86)		
IDRS	20(16.13)	3(21.43)		

Note negative =absence of malaria parasite in the blood analyzed, positive= presence of malaria parasites in the blood analyzed.

Table 6 shows the factors associated with malaria prevalence using microscopy. Pearson chi square analysis revealed no significant association between the prevalence of malaria among the hawkers (head potters) and all the listed factors ($p>0.05$).

Table 7: Patterns of malaria positive test results and association with demographic characteristics by RDT and Microscopy

Demographic variable	Malaria positive test result	
	RDT=26	**Microscopy=21**
Age		
Below 20	10(38.46)	4(19.05)
20-29	11(42.31)	13(61.05)
30-39	4(15.38)	4(19.05)
40 and above	1(3.85)	0(0.0)
Chi-square(p-value)	**16.26(0.001)**	**7.67(0.053)**
Marital status		
Married	6(23.08)	11(52.38)
Single	20(76.92)	10(47.62)
Chi-square(p-value)	**13.6(0.004)**	**1.15(0.764)**
Educational level		
Junior high school above	5(19.23)	3(14.28)
No formal education	19(73.08)	16(76.19)
Primary school	2(7.69)	2(9.52
Chi-square(p-value)	**2.52(0.471)**	**1.01(0.799)**

Pearson chi square test showed that, positive test results of malaria among head potters was statistically associated with age group and marital status using RDT test kit while no association was exhibited using microscopy.

CHAPTER FIVE

5.0 DISCUSSION

This was a cross sectional study carried out at the Agbogbloshie market in the Ashiedu Keteke sub metro of the Accra Metropolitan Assemble, Greater Accra Region. The purpose of the study was to determine the proportion of malaria infections among mobile hawkers (head potters), the species of *Plasmodium* parasite responsible for the infection as well as the factors that is associated with malaria infection among these population.

5.1 Proportion of hawkers who have malaria during the study period

Our study revealed malaria prevalence rate of 12% and 9.8% among head porters using RDT and microscopy respectively. This finding is in line with the National Malaria Control Programme 2016 report which indicated a high endemic rate of malaria 11.2% to 40%.

Our finding is relatively lower as compared to what was conducted in Bosomtwe-Atwima Kwawoma a decade ago by Asante B. (2007) and recently lower than a prevalence of 18.6% among hawkers in a study conducted in Greater Accra region by Diallo et al.,(2017). The less prevalence rate identified in this research as compared to previous studies proves the progress of malaria control programme intervention in Ghana implemented in all the 10 administrative regions across the country without any discrimination. Also, the differences could be as a result of the study area where respondents could access an enclosed area very easy to pass the night as well as the fact that majority of the respondents had knowledge on the strategies used in protecting themselves against the malaria parasites.

5.2 Malaria parasite species in the study participants

In all microscopy test results, *Plasmodium falciparum* was the main parasite detected in all positive blood slide examinations. This finding corroborate with Diallo et al., which also observed *Plasmodium falciparum* as the main parasite responsible for causing malaria in their study. This prevalence is slightly higher as compared to what was reported by WHO (2017) that, the main plasmodium species accounting for 99.7% of all malaria cases in the WHO African region and causing malaria morbidity and early mortality in Sub Saharan African regions is *falciparum*. Again, this study revealed a marginal difference between the RDT results and the microscopy which was not statistically significant, test of significance was done using a 95% confidence interval. Five plasmodium falciparum infections were missed by microscopy but was detected by the RDT. In relation to this Matangila et al.,(2014) also identified a similar result using RDT and microscopy as which detected a prevalence rate of 27.4% and 21.6% respectively. The disparity in this study could have been that respondents could have been treated within the past two weeks for malaria which the microscopy could not detect but the RDT was able to detect since it is able to detect low parasitemia in blood.

In line with this study Leslie et al., (2015) discovered that microscopy had a lower operational sensitivity for detection of *Plasmodium falciparum* than the RDT and these have been explained by WHO, (2014) that the difference between RDT and microscopy results is as a result of low parasitemia in the tested samples or the intake of drug to clear the parasites with persistent antigen.

5.3 Factors associated with malaria infection among this population

Age which is an unavoidable physiological process in a person's life has been identified to be statistically associated with RDT malaria prevalence. It has been established that, age and host genetics are important determinants of malaria prevalence Randall LM, et al., (2010) and many researches have showed that, age is significantly associated with the risk for developing malaria (Carneiro I. et al.,2010 & Choonara S, et al., 2015). Our findings further

reveal that, age group 40 years and above had 11% chances of getting infected with malaria compared to those below 40 years. This could be that the aged may have had more experience with the malaria infection thereby they put in place other measures to protect themselves against the malaria parasite.

Single head porters were more likely of being infected with malaria compared to married head porters. This study revealed that 76.92% of the malaria cases were recorded among the single. This high prevalence could be as a result of sole support by single head porters. Marriage in African society is seen as an incubator for social support where couples share together. For this instance, married couples can help and remind one another for the usage of malaria protectives as marital status has been identified to influence Intermittent Preventive Therapy usage (Choonara S, et al., 2015). This is consistent with study carried out by Diallo et al., (2017) which revealed that marital status and educational level were the demographic characteristics that affected malaria

Again 73.92% of malaria positive cases were recorded among the respondents with no formal education making them 1.2 times higher of being infected with malaria compared to the respondents with formal education. This could be attributed to the point that, those with some formal educational background were taught in school on the basic knowledge about malaria or their ability to read and understand messages communicated about malaria on the television and on banners or posters. This is consisten with study carried out by Kimbi et al., (2014) who reported that formal education was strongly associated with the knowledge that the people have on malaria.

factors such as knowledge on preventive strategies was observed to be statistically significant in this study. sixty four percent (64.2%) of the respondent had knowledge on the

preventive strategies while thirty five point eight percent (35.8%) had no knowledge on the strategies taken to prevent malaria which is consistent with a work done by Ojong et al., (2013) in Calabar River State in Nigeria to examine the knowledge of individuals on the prevention of malaria which revealed that participants had good knowledge about the prevention of malaria (83.9%). The respondents who had no knowledge on preventive strategies such as the use of insecticide treated net, Indoor Residual spraying and the use of chemoprophylaxis were more exposed and had 62% odds of being infected with malaria as 61.54% tested positive for malaria parasite. This could be as a result of them not practicing the preventive strategies to get protection against the malaria causing organism such as the use of insecticide treated net.

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATION

6.1 Conclusion

The study showed that hawkers (head potters) had a prevalence of 12% and 9.8% of malaria using RDT and Microscopy respectively. The socio demographic characteristics age and marital status and their knowledge on preventive strategies were significantly associated with malaria. There was no association between their knowledge on the causes of malaria as well as its transmission process and being infected with malaria.

6.2 Recommendation

Based on the research findings the following recommendations have been made:

1. Both microscopy and RDT could be used in testing for malaria parasite among hawkers (head potters) due to the insignificance difference observed in the result.
2. More education among these population to increase their knowledge on malaria especially on its preventive strategies and its practice.

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APPENDICES

Appendix I: Information Sheet

Research Title

Factors associated with malaria infection among hawkers and long distance drives in the Greater Accra Region.

Name and Address of Principal Investigator

Patience Kwofie, Department Epidemiology and disease control, School of Public Health, University of Ghana, Legon or post office box TD 806, Takoradi Western Region. Mobile: 0246288076. Email pat3030gh@yahoo.com.

Introduction

I am a master's student of the School of Public Health, University of Ghana conducting a research the factors associated with malaria infection among hawkers and long distance drivers. Please you would be required to kindly fill the questionnaire and test for the plasmodium parasite infection. All information provided would be treated as very confidential.

General Information about Study

Mobile population of which hawkers and long distance drivers fall under are known to be among the at risk group for malaria infection. In view of this, the research seeks to assess the factors associated with malaria infections among hawkers and long distance drivers in the Accra Metropolitan Area

Privacy and confidentiality

The principal investigator will ensure that all study records are managed in a secure and confidential manner. Study materials will be labeled and given a unique number just for identification purposes. The data would be entered into Stata version 15 with identification numbers and electronic formats will only be made available to research team.

The study materials (questionnaires and informed consent forms) and data would be stored under key by the principal investigator.

Electronic data will be encrypted with the pretty good privacy (pgp) software. All computers involved in the collection and saving of data will be password protected.

Disposal

The data will be stored for the maximum period of time (approximately 5 years) as required by local regulatory bodies. Study records will be destroyed by shredding papers, discarding microscopy slides and deleting data on hard drive by using the "sure delete" software.

Risk to participant.

Finger prick will be used to access blood sample from the respondents. Two drops of blood will be collected from the respondents. The potential risk from a finger prick is minimal and may include uneasiness or pain and a development of infection at the needle insertion site.

Protection against risk

The proposal for this study will be submitted for institutional review board from the Ghana Health Service ethics Committee for approval. Prior to the finger prick, respondents will be physically examined to make sure that no added risks are introduced to the respondents. New and sterile lancet will be used for each respondent. Disposable gloves will be wore by the data collectors and discarded after every respondent. Much care will be taken to prevent

accidental puncture of respondents with a contaminated lancets by dropping each used lancet immediately into a “sharp container”.

Benefits to respondents.

The likely benefit of the study to the respondents is substantial. The research would give the study participants the opportunity to check and know if they have been infected with the malaria parasite. Those with the infection will be treated with antimalarial drug and for possible referral for appropriate treatment. Indirectly, the study will also provide information to understand malaria transmission in these mobile populations. This information will be used by National Malaria Control Program to develop targeted interventions for malaria control and elimination.

Compensation

Qualified candidates who give their consent to participate in the survey will not be given any monetary compensation before, during or after the research work.

Voluntary participation and withdrawal

Study respondents would be made aware that participating in the research is entirely out of free will and one can opt out at any time of the study. Eligible participants declining to be involved in the study would bear no negative consequences.

Before taking the consent

Do you have any questions you wish to ask about the research? (If yes, please indicate the questions below)

Appendix II: Participant Informed Consent

I…….. declare that the purpose, procedures and all other information of the study have been read by me/ duly explained to me and all question (s) and clarifications have been answered and sought respectively. I therefore give my consent to participate in the study.

Signature of participant…….. Date ……../……./……

Appendix III: Questionnaire

QUESTIONNAIRE ON MALARIA PREVALENCE AMONG HAWKERS

Instructions for Interviewer:

Interview will concern hawkers who roam and sleep in the street of the major commercial cities. Circle all answers given; do not read out answers to respondents and write in answers if respond is not covered by checklist.

1. Participant ID…… 2. Date (dd/mm/yyyy) ……

3. Investigators name……

A- Respondent characteristics

1. Sex: Male ☐ Female ☐

2. Age (in completed years): …….....

3. Marital status: Single ☐ Married ☐ Divorced ☐ Widowed ☐

4. Educational level achieved: no formal education ☐ primary ☐ secondary school ☐

5. Do you know about malaria? Yes ☐ No ☐

6. What causes Malaria?

7. How is malaria transmitted from person to person?

8. Do you know about the signs and symptoms of malaria?

If yes name some

9. Do you know about the preventive measures against malaria? Yes ☐ No ☐

If yes how? Insecticide treated net ☐ Indoor Residual Spray ☐ Chemoprevention ☐

10. Confection of blood smear: Yes ☐ No ☐

11. RDT results: Positive ☐ Negative ☐