FACTORS ASSOCIATED WITH PERSISTENT MALARIA TRANSMISSION IN URBAN PERIPHERAL AREAS IN DAR ES SALAAM REGION, MAINLAND TANZANIA

Charles Dismas Mwalimu, BSc Gen (zoology)

MSc in Applied Epidemiology

Muhimbili University of Health and Allied Sciences

October, 2019

Muhimbili University of Health and Allied Sciences

Department of Epidemiology and Biostatistics



FACTORS ASSOCIATED WITH PERSISTENT MALARIA TRANSMISSION IN URBAN PERIPHERAL AREAS, DAR ES SALAAM – TANZANIA 2019

By,

Charles Dismas Mwalimu

A Dissertation Submitted in Partial Fulfilment of the Requirements for the Degree of Master of Science in Applied Epidemiology of

Muhimbili University of Health and Allied Sciences

October, 2019.

CERTIFICATION

The undersigned certifies that she has read and hereby recommends for acceptance by the Muhimbili University of Health and Allied Sciences a dissertation Titled **Factors Associated with Persistent Malaria Transmission in Urban Peripheral Areas of Dar es Salaam Region, Tanzania** in partial fulfilment of the requirements for the Degree of Master of Science in Applied Epidemiology of the Muhimbili University of Health and Allied Sciences.

Dr. Marycelina Mubi

(Supervisor)

Date _____

DECLARATION AND COPY RIGHT

I Charles Dismas Mwalimu declare that this dissertation is my own original work and that it has not been presented and will not be presented to any other University for a similar or any other award.

Signature_____ Date _____

This dissertation is copyright materials protected under the Berne Convention, the Copyright Act 1966 and other International and National enactments, in that behalf, on intellectual property. It may not be reproduced by any means, in full or in part, except for short extracts in fair dealing, for research or private study, critical scholarly review or discourse with an acknowledgement, with written permission of the Directorate of Postgraduate Studies, on behalf of both author and the Muhimbili University of Health and Allied Sciences.

ACKNOWLEDGEMENT

First and foremost, I thank the Almighty God whom without his grace this endeavour could not have been achieved.

Secondary, I am also grateful to my supervisor, Dr Marycelina Mubi who tirelessly supervised me throughout this study. Her door was always open for me despite her other many academic commitments.

Thirdly, I am very indebted to my employer, the Permanent Secretary Ministry of Health, Community Development, Gender, Elderly and Children, for sponsoring my studies and granting me permission to undertake the program.

Fourthly, I would like to thank the government authorities from the regional to the street (Mitaa) level for giving me the necessary assistance during the implementation of this study.

Special thanks should go to research participants in Chanika, Msongola and Zingiziwa wards who consented to participate in this study and research assistant, Mr. Ally Adinani (Council Malaria Focal Person- Ilala), Addo Tillya, Moses Mpeta, Ally Ndete and Doris Joseph. I feel much indebted to them for their indispensable help, which they offered me during the whole period of data collection.

Last but not least, I would like to convey my appreciation to Dr Ally Mohamed, Programme Manager, National Malaria Control Programme for his technical support and encouragements he offered to me during the whole period of my studies.

Finally yet importantly, special thanks should go to my fellow students, Cohort 10 who provided me constructive ideas all along the process from proposal development to dissertation write up that has enable this study to be in its present look.

DEDICATION

My father Dismas Mwalimu who passed away during the course of my studies, my mother Prisca Dismas Mwalimu, my beloved wife Monica Joseph Abdallah, my daughters Catherine, Dorothy and Prisca for their prayers and patience during the whole period of my studies.

ABSTRACT

Background: In 2018, there were an estimated 219 million cases and 435,000 deaths of malaria globally. Africa Region bear the highest burden with an estimated 3.5 million more malaria cases in 2017 compared 212 million cases reported in 2016. Data from 2015-2017, have shown no significant progress in reducing global malaria cases. In Mainland Tanzania however, malaria control interventions have significantly led to the reduction in malaria prevalence from 18.1% in 2008 to 7.3% in 2017. Despite of these achievements, malaria burden is still highly heterogonous in Tanzania with some regions including urban peripheral areas of Dar es Salaam, presenting persistent malaria over 2%.

Study objective: To investigate the factors associated with persistent malaria transmission in urban peripheral areas with a case study of Dar es Salaam.

Materials and Methods: This study employed cross – sectional survey to collect data from individual member of the households where 830 individuals were enrolled. A four stage multistage sampling was used to select the study population. Individuals in the households were tested for Malaria infection using malaria rapid diagnostic tests (mRDT), and responded to specific questions. Association between malaria infections and responses to specific questions was measured using Odds ratio. Variables indicated association were included in logistic regression model to determine independent risk factors for persistent malaria transmission in the study areas.

Results: Majority of the study participants (58.9%) were female, 55.3% were aged more than 18 years, 82.8% had primary or no education, and 77% were farmers or unemployed. Msongola ward contributed 48.9% of the study participants and the overall malaria prevalence in the study areas was (4.5%). Nets ownership was 17%, usage was 85.8%. The odds of malaria prevalence were 7.76 for individuals who do not own nets ($p = 0.001$), 5.08 for individuals residing in the households surrounded by mosquito breeding sites ($p = 0.006$) and 1.21 for individuals residing in houses with unscreened windows ($p = 0.001$).

Conclusion: Low nets ownership, residing in households surrounded by mosquito breeding sites and in households with unscreened windows were independent factors associated with risk of malaria in the areas. Promotion of ITNs coverage, application of biolarvicides through community engagement and house screening will reduce the risk of malaria infection in the areas.

TABLE OF CONTENTS

CERTIFICATION i
DECLARATION AND COPY RIGHT ii
ACKNOWLEDGEMENT iii
DEDICATION iv
ABSTRACT v
TABLE OF CONTENTS vi
LIST OF TABLES ix
LIST OF FIGURE x
LIST OF APPENDICES xi
ABBREVIATIONS xii
DEFINITION OF TERMS xiii

CHAPTER ONE 1
1.0. Background information 1
1.1 Problem Statement 4
1.2 Conceptual Framework 5
1.3 Rationale of the Study 6
1.4 Research questions 6
1.5 Broad Objective 6
1.5.1 Specific Objectives 6

CHAPTER TWO 7
2.0 Literature Review 7
2.1 Malaria as a Public Health Problem 7
2.2 Social and demographic risk factors associated with malaria transmission 8
2.3 Malaria burden from under five to school –age children 8
2.4 Factors determining individual exposure to malaria infection 9
2.5 Ownership, access to and use of Insecticide Treated Nets for malaria prevention and control 9

2.6 Assessment of presence of mosquito breeding sites and house characteristics associated with malaria infections at the household's level 10

CHAPTER THREE 12
3.0 Methodology 12
3.1 Research design 12
3.2 Study area 12
3.3 Study Sites 13
3.4 Study Population 13
3.5 Study unit 13
3.6 Sample size calculation 14
3.7 Sampling Procedure 14
3.7.1 First stage 14
3.7.2 Second stage 14
3.7.3 Third stage 14
3.7.4 Fourth stage 15
3.7.5 Fifth stage 15
3.8 Inclusion Criteria 15
3.9 Exclusion Criteria 15
3.10 Training of Research Assistants 15
3.11 Pre testing of the Tools 15
3.12 Data Collection 17
3.12.1 Specific objective 1: Determination of social and demographic risk factors associated with malaria transmission in the study areas 18
3.12.2 Specific objective 2: Identification of individual risk exposure to malaria infections in the study areas 18
3.12.2.1 Identification of asymptomatic malaria cases in the household level 18
3.12.3 Specific objective 3: Assessment of environmental risk factors sustaining persistent malaria transmission 18

CHAPTER FOUR 21
4.0 Results 21

4.1 Social demographic characteristics of the study population 21

4.2 Prevalence of malaria 22

4.3 Individual risk behaviours associated with malaria infection in the study areas..... 23

4.4 Relationship between malaria prevalence and presence of mosquito breeding sites . 25

4.5 House characteristics associated with malaria transmission in the study areas 26

4.6 Relationship between socio-demographic characteristics and malaria 27

4.7 Multivariate analysis..... 30

CHAPTER FIVE 32

5.0 Discussions 32

5.1 Prevalence of malaria by socio – demographic characteristics of study population ... 32

5.2 Prevalence of malaria by individual risk behaviour of the study population 33

5.3 Prevalence of malaria in relationship to the presence of mosquito breeding sites in the study areas 34

5.4 Prevalence of malaria in relationship with house characteristics in the study areas ... 35

CHAPTER SIX 36

6.0 Conclusion and Recommendations 36

6.1 Conclusion 36

6.2 Recommendations 36

6.2.1 Promote ITNs ownership..... 36

6.2.2 Residing in households with unscreened windows 36

6.2.3 Presence of mosquito breeding sites in the vicinity to households 36

6.3 Further studies 37

REFERENCES 38

APPENDICES 46

LIST OF TABLES

Table 1: Study variables 17

Table 2: Socio demographic characteristics of study participants 21

Table 3: Prevalence of malaria by Socio-demographic characteristics of the study population 22

Table 4: Prevalence of malaria by ownership and use of bed nets 23

Table 5: Prevalence of malaria by travel history, duration of stay, outdoor activities and time of going to bed/ sleep of the study subjects 24

Table 6: Presence of mosquito breeding sites around the households in relation to malaria prevalence 25

Table 7: Prevalence of malaria by characteristic of the houses where households resided 26

Table 8: Relationship between socio-demographic characteristics of the participants and malaria 27

Table 9: Relationship between ownership and use of nets and malaria 28

Table 10: Relationship between individual risk behaviours (travel history, duration of stay and outdoor activities after dusk) and malaria prevalence 29

Table 11: Relationship between house characteristics and malaria 30

Table 12: Multivariate analysis of individual risk factors shown to be associated with malaria infection 31

LIST OF FIGURE

Figure 1: Conceptual Framework for study variables 5

Figure 2: Map showing the study Sites in Ilala Municipality.....13

LIST OF APPENDICES

Appendix 1: Informed Consent Form- English Version 46
Appendix 2: Informed Consent Form- Kiswahili Version 49
Appendix 3: Interview Schedule – English version 51
Appendix 4: Questionnaires- Kiswahili 55
Appendix 5: Malaria mRDT test results form 59
Appendix 6: Form ya kipimo cha matokeo ya mRDT ya Kiswahili 60
Appendix 7: Ethical Clearance 61
Appendix 8: Introduction letter to Dar es Salaam Region authorities.....62
Appendix 9: Permission to conduct research in Ilala Municipality.....63
Appendix 10: Research permission from Medical Officer of Health Ilala- Municipal.....64
Appendix 11: Permission letter to conduct research in Ilala Municipal Council.....65

ABBREVIATIONS

AIDS	-	Acquired Immune Deficiency Syndrome
ACT	-	Artemisinin Combination Therapy
GPS	-	Global Positioning System
HIV	-	Human Immunodeficiency Virus
IPTp	-	Intermittent Preventive Treatment in Pregnancy
IRB	-	Institute Research Board
IRS	-	Indoor Residual Spray
ITNs	-	Insecticides Treated Nets
MUHAS	-	Muhimbili University of Health and Allied Sciences
mRDT	-	Malaria Rapid Diagnostic Test
RA	-	Research Assistant
SBCC	-	Social Behavioural Change Communication
PI	-	Principal Investigator
THMIS`	-	Tanzania HIV/AIDS and Malaria Indictor Survey
WHO/GMP	-	The WHO Global Malaria Programme

DEFINITION OF TERMS

Persistent Malaria	Presence of malaria prevalence above 2% despite deployment of recommended standard interventions
City	Population living within the administrative boundaries of the Municipality e.g. Ilala Municipality
Urban	Areas surrounded a city
Urban peripherals	Areas of the city/ Municipality council that join or create an interface between urban and rural areas
Household	Unit head by a male or female with his/her dependents and spouse and who share a cooking pot or eating in a same place.
Risk factor	Person behaviour, practice, lifestyle or an environmental exposure associated with contracting malaria infection
Malaria infected individual	An individual currently living in the study area who is mRDT positive with sign (symptomatic) or without signs asymptomatic.
Access to an ITN	Is measure by the proportion of the population that could sleep under an ITN if each ITN in the household were used by two people.
Ownership of ITN	Proportion of households that have at least one Net/ ITN
Use of ITN	Proportion of the population that slept under ITNs the night before the survey.
An ITN	Factory treated nets that do not require any further treatment.

CHAPTER ONE

1.0. Background information

Malaria is caused by parasites of the *Plasmodium* Species and transmitted by female *Anopheles* mosquitoes. Despite being preventable and treatable, malaria continues to have a devastating impact on people's health and livelihoods around the world. In 2017, there were 219 million reported cases of malaria world- wide. Africa continent, continues to bear the highest burden with an estimated 3.5 million more malaria cases reported in 2017 (1) compared to 212 million cases reported in 2016 (2). The disease continues to claim the lives of more than 435, 000 people, and majority are from Africa. Children under the age of 5 years are especially at high risk (1)

In most of the endemic countries, malaria is highly heterogeneous with great disparities between urban and rural areas. Urban malaria reported to account for 6-28% of the global malaria burden (3).

Several factors are attributed to persistent risk of malaria infection in urban areas, including, increasing urban agricultural activities, which is quite common in the African cities due to increasing need to feed the ever growing population (4) which in turn increases the mosquitoes vector breeding environment, hence risk of malaria.

A study conducted in the peri urban coast areas of Benin in West Africa, showed high parasite prevalence and spleen rates of between 40% to 60%, indicating high transmission levels of between meso- endemic to hyper- endemic (5). This reflects the heterogeneity of urban area in Africa and the highly focal nature of malaria transmission in cities. The transmission risk in urban areas is associated with proximity to breeding sites due to the presence of water bodies, urban agriculture and proximity to urban peripheries that are more likely to support mosquitoes vector breeding (6,7)**.**

The rapid rate of urban growth in Sub-Saharan Africa indicates, majority of the population in the continent will be living in urban by 2030 (8). Changes in urban population demography, environmental and socio- economic landscapes due to the process of urbanization will impact on the health of the urban residents (8). Malaria in Africa has for long been regarded as a rural disease with the process of urbanization reducing suitable

breeding environments for the dominant vectors species; *Anopheles gambiae s.l* and *Anopheles funestus* in urban (8,9).

However, in urban, the risk of malaria infection is likely within the densely populated urban setting of Africa. In particular, *Anophele gambiae s.l* is more likely to breed in urban aquatic habitats (9) than other vector species and has been found in domestic containers and highly organic polluted water in urban areas (10)

Huge investments and scaling up of effective malaria control interventions including Artemisinin Combination Therapy (ACT) to target the parasites, Indoor Residual spraying (IRS) and Insecticide Treated Nets (ITNs) targeting the malaria vectors that feeds and rest indoors, has resulted in the significant reduction in malaria morbidity and mortality worldwide (11). However, data from 2015 – 2017 indicates no significant progress in (12) reducing global malaria cases was made in this period (1). In Mainland Tanzania, such investment has resulted into significant reduction in malaria prevalence from 18.1% in 2008 to 7.3% in 2017 (13,14)

Despite the gain, new cases and people dying of malaria are still being reported across the country, with wide range of regional variations in transmission. For example, Lake and Southern zones have persistently been reported with considerably high malaria prevalence over 10% compared to Northern and Central zone less than 2% (15). Routine data collected from the health facilities from 2017 and 2018 have confirmed the transmission intensity pattern with extremely low malaria incidence per 1,000 populations. For example, in north-eastern zone, reported malaria incidence was < 15/1,000 population, while in central and south-western zones reported malaria incidence was 15 - < 50 /1,000 populations, and much high incidence of > 150/, 1000 population have been reported in the north–western and in south-eastern coastal zones (16). Malaria heterogeneity has also been consistently observed in different socio- economic strata: urban/rural, lower/higher wealth, and level of education. In 2017 data showed that people living in rural areas were 5 times more affected by malaria compared to those living in urban areas, while people within the poorest quintile were affected 10 times more than those in the richest wealth quintile (14).

In Dar es Salaam Region, although the regional average malaria prevalence is 1.1% (15), there is great heterogeneity in terms of geographical disparities of malaria prevalence where the urban peripheries seem to bear higher burden than urban centre. A study conducted in Dar es Salaam predicted increased risk of malaria infection in the administrative units in the urban peripheries than administrative units within the urban centre (17). The finding from this study is also supported by School Malaria Parasitological Survey conducted in Mainland Tanzania 2017 in which indicated malaria prevalence in peripheral areas above 2% compared to urban centres with less than 1% (12).

Although the overall low malaria prevalence in Dar es Salaam of 1.1%, malaria is still a major public health problem, particularly in urban peripheral areas of the city over 500,000 confirmed malaria cases are still reported annually by the health facilities (23). This is despite several control efforts implemented across the gradient of urbanization which included; environmental management (18), integrated vector management (19), initiation of Urban Malaria Control Project, mosquito surveillance and community based application of larviciding, malaria case management (20,21) using ACT, distribution of ITNs through mass campaigns and routinely to biologically vulnerable groups (pregnant and infants) when attending antenatal clinic (22). Understanding determinants associated with malaria risk in peripheral areas is important to allow targeted interventions (24).

A number of factors are attributed to variations in malaria risks among households and individuals (25). Some of these factors include access to health facilities (26), type of housing that people live in (27) proximity of human settlement to vector breeding sites (28), vector abundance (29), socio- economic status (30), gender, occupation, residential mobility, travel (31–34), presence of domestic animals near homesteads (33,35) and use of preventive methods such as mosquito nets (36). Information on how these factors interact to expose communities and individuals to malaria infection is important and need to be identified for spatial targeting of malaria interventions (37).

1.1 Problem Statement

Malaria is one of the top ten diseases in Dar es Salaam region. In recent years, there were over 500,000 confirmed malaria cases reported in the health facilities in 2015 and 2016 respectively (23). Majority of the cases were from the primary health facilities in urban peripheral areas. The percentage of malaria confirmed cases among Out Patients Department in primary health facilities ranged between 7- 20%.

The risk of malaria infection among primary school children also increased as one moved away from the city centre with prevalence of less than 1% compared to some urban peripheries with prevalence over 2% (12). The underlying reasons for such high percentage of malaria infected individuals and cases in the urban peripheries of Dar es Salaam are yet to be understood. However, identification of reasons for high percentage and persistent malaria transmission is important for targeted malaria control interventions (38).

This study therefore is designed to investigate factors associated with persistent malaria transmission in urban peripherals and recommend interventions to effectively reduce the malaria transmission.

1.2 Conceptual Framework

Several factors associated with persistent malaria transmission were studied. These include(i) Socio – economic and demographic factors (such as age, level of education., occupation, income, household size and possession of nets in the households) (ii) Individual risk factors to malaria infection (such as travel history, outdoor activities at night, time of going to bed and not using of ITNs and (iii) presence of mosquito breeding sites, asymptomatic individuals in households and distance of the houses from the mosquito breeding sites and house characteristics such as open eaves and unscreened windows in the study areas.

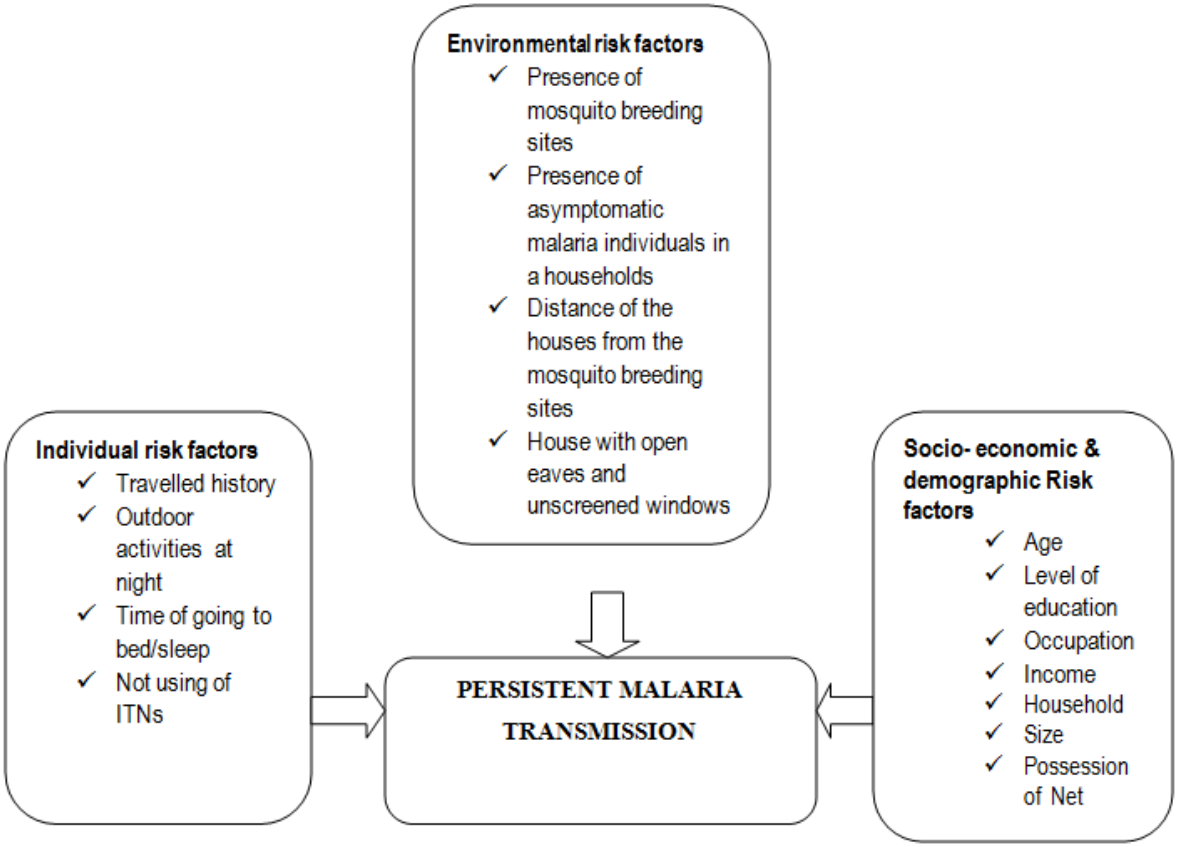


Figure 1: Conceptual Framework for study variables

1.3 Rationale of the Study

The study aimed to understanding factors responsible for persistent malaria transmission in urban- peripherals of Dar es Salaam despite deployment of recommended interventions (ITNs and availability of ACT in the health facilities). The results are expected to inform the relevant authorities (National Malaria Control Programme and Regional Health Management Team and Council Health Management Team) in Dar es Salaam and other stakeholders the prevailing factors responsible for persistent malaria transmission to assist in developing context specific control interventions to reduce malaria transmission and burden of disease, that shall lead to healthier and productive community.

1.4 Research questions

1. What are the Social demographic characteristics associated risk of malaria infection in the urban peripheral areas of Ilala Municipality in Dar Salaam?
2. What is the individual risks behaviour responsible for exposure to malaria infection in urban peripheral wards of Dar es Salaam region?
3. What are the environmental risk factors associated with persistent malaria transmission in urban- peripheral areas in Ilala Municipality, Dar es Salaam Region?

1.5 Broad Objective

To investigate factors associated with persistent malaria transmission in urban peripherals of Ilala Municipal Council in Dar es Salaam, Tanzania.

1.5.1 Specific Objectives

1.5.1.1 To determines social demographic characteristics associated with transmission of malaria in the peripheral wards of Ilala Municipal in Dar es Salaam region.

1.5.1.2 To identify individual risk behaviour associated with malaria infection in the peripheral wards of Ilala Municipal in Dar es Salaam region

1.5.1.3 To assess presence of mosquito breeding sites associated with malaria infections at the households level

1.5.1.4 To identify house characteristics associated with malaria transmission in the peripheral wards of Ilala Municipality in Dar es Salaam region

CHAPTER TWO

2.0 Literature Review

The perspective of review started by glanced malaria as public health problem then narrowed down to each specific objective of the study.

2.1 Malaria as a Public Health Problem

Malaria is the second most cause of infectious diseases related in the world after Tuberculosis (39). In 2017, there were 219 million cases of malaria. The 10 highest burden African countries saw an estimated 3.5 million more malaria cases in 2017 (1) compared to 212 million cases in 2016 (2). The disease continues to claim the lives of more than 435,000 people each year, largely in Africa and children under the age of five are especially vulnerable (1).

The WHO African Region continues to account for about 90% of malaria cases and deaths worldwide. (2). This is due to the fact that, majority of malaria infections in Africa are caused by *Plasmodium falciparum*, the most pathogenic species of human malaria parasites (40).

In Tanzania, malaria morbidity and mortality accounts for 26% and 17% for all age groups respectively. Malaria also accounts for 30% of morbidity and 25% mortality for all admission in the health facilities (41).

Studies have shown that process of urbanization reduces breeding sites for dominant malaria vector species, *Anopheles gambiae* and *Anopheles funestus*, with a positive impact on reducing malaria transmission in such settings (3,6,17). Dar es Salaam, particularly urban peripherals, is not highly urbanized, and is still favouring malaria transmission, making it one of the major public health problems. *Plasmodium falciparum* infections account for 90% of the cases treated within the city (19,42,43) with over 500,000 confirmed malaria cases reported annually by the health facilities (23).

2.2 Social and demographic risk factors associated with malaria transmission

Control and prevention of malaria requires in-depth understanding of the interactions of factors such as human behaviour, the environment, and the life cycles of vector and the parasites

(44). Human factors such as education, occupation, houses characteristics and location of the households from mosquito breeding sites have been associated with malaria transmission (26). Type of housing where people resides (27), proximity of human settlement to mosquito breeding sites (28) socio- economic status (30,45), gender, age, occupation, residential mobility, travel (31–34) and presence of domestic animal near homesteads (35) have been shown to associate with malaria transmission.

2.3 Malaria burden from under five to school –age children

In Africa, recent data on prevalence of malaria and incidence of clinical malaria showed that school–age children are mostly affected (46). This is because in most malaria endemic areas of sub-Saharan Africa control of malaria mostly focussed on the protection of young children and pregnant women (47). As a consequence children are acquiring immunity to malaria more gradually than in the past and clinical attacks, sometimes severe, are occurring in school-age children more frequently (48). In Malawi, a study has shown infection of *Plasmodium falciparum* of 60.0% among school-age children (46), and in Mainland Tanzania, a study showed overall malaria prevalence among the school-age children of 21.6 with regional and councils variation ranging from less than 1% to 53% and from 0- 76% respectively (12)**.** In Tanzania surveys have shown age shift in malaria burden from under five to school aged children(12,14). In Congo study findings indicated an association of malaria infection with age in low malaria transmission settings (53).

The shift in malaria prevalence from under-fives to older age groups is explained by increased success in lowering the level of malaria transmission in previously highly endemic areas, which has resulted in acquiring immunity to malaria later than has been in the past (49). Another explanation of the shift in the burden of malaria to school–age children, as revealed in findings from households surveys have shown school-aged children were the group least likely to sleep under an ITNs the previous night, with between 38% and 42% of school-aged children being unprotected (50).

Similar low ITN usage rates have been observed among school-age children in several studies conducted in Cameroon (51), Kenya(52), and Uganda (47). Education targeted directly at older children, for example through malaria education in schools, is likely to be the most effective way of increasing regular use of ITNs in this age group hence reducing the incidence of malaria in school –age children in previously high endemic areas.

Use of preventive measures such as bed nets have also been associated with malaria transmission (36). In Ghana, study conducted in 2011, on predictors of mosquito nets use, showed association in the level of education of mother/guardian's with ITNs use in a household (54). In South Asia, South East Asia and Western Asia Pacific Region, World Health Organization, 1996, showed an association of malaria incidence with working in low land irrigated rice production and Oil palm plantation (55). In Pacific Region, adults who worked on rubber tappers, forest, miners, military and farmers practicing shifting agriculture were more exposed to infectious mosquitoes (55). Understanding the association between malaria transmission and human related factors is important in developing appropriate interventions based on the local contexts.

2.4 Factors determining individual exposure to malaria infection

Individual behaviour has been associated with different outcomes in malaria infection. Factors such as poor households and poorest socio economic groups (44,48, 49), mobility, occupation and travel (37,56), access to health facilities (26), not using preventive measures like repellents, outdoor activities, spraying houses, sleeping under net and wearing protective clothing when outdoor (57), trading, fishing and labouring) (58) has been associated with malaria infection among individuals. Understanding individual risk factors associated with malaria transmission despite control efforts is useful to guide targeted interventions to high-risk areas and populations to reduce exposure to malaria infection.

2.5 Ownership, access to and use of Insecticide Treated Nets for malaria prevention and control

Wide scale use of ITNs has led to significant reduction in malaria morbidity and mortality globally (59). This is due to the fact that *Anopheles gambiae* and *Anopheles funestus* species complexes, the principal malaria vectors, primary feed indoor at night (60). However, in most high burden countries, access to and ITNs use is below the

recommended targets of above 80%). World Health Organization /Global Malaria Programme, recommends all people at risk of malaria to have universal access to and use of ITNs (61). ITNs when used by a majority of the target population, provide protection for all people in the community including those who do not sleep under the ITNs (62,63), reduce survival, frequency of bites, feeding success and density of vector mosquito population (64).

Studies on ITNs coverage conducted in different parts of the world have shown that coverage of about 60% of the targeted population (adults and children) achieve equitable community-wide benefit (22). In Rufiji and Ifakara, Tanzania, a study indicated positive relationship in increased coverage of ITNs and malaria burden, and that an increase of 10% ownership of mosquito nets at village level had an average of 5.4% to 10% decrease of malaria deaths in children under five years (65).

In Tanzania, Malaria Indicator Survey (2017) have indicated that, 78% of the households in Mainland Tanzania own at least one ITNs, 45% of the households had one ITN for every two people, 63% had access to ITNs, 22% owned non ITNs and 52% used the ITNs the night before the survey. However, in rural areas of Mainland Tanzania, ITNs usage was generally low 46% (41). In Dar es Salaam, the survey showed 79% of the households own at least one ITN, 66% use the ITNs and 71% had an access to ITNs (14).

Understanding nets ownership, access and use in the study areas is important to understand individual risk exposure to malaria infection.

2.6 Assessment of presence of mosquito breeding sites and house characteristics associated with malaria infections at the household's level

Active transmission of malaria depends on the suitability of the environmental to support mosquito breeding and proximity of the houses to mosquito breeding sites. Factors such as presence of mosquito breeding sites, house characteristics (66), and distance of the households from the breeding sites have been associated with episodes of malaria (33). In Botswana, study conducted in 2014, showed association between house structure, location of the households close to mosquito breeding sites with individuals risk to mosquito bites

(33). In Sri-Lanka and Gambia studies showed variation in malaria incidence as a results of small variation in risk factors (44,67).

In Madhya Pradesh, Central India, a study conducted in 2015 have shown that households with 4- 5 family members and households with 6 or more family members were 2.4 and 4.4 times more likely to have a malaria patient compared to households with 3 or less family members. The study also showed that, houses made of bricks (mainly mud bricks) walls had less chances to have a malaria case compared to houses with walls made up of dung and earth or thatch/ grass walls (68).

Since in Dar es Salaam region, majority of cases of malaria are reported from the peripheral health facilities despite deployment of standard recommended interventions, this appealed for systematic investigation to find out social and environmental determinants for malaria transmission for focal targeted malaria interventions (24).

CHAPTER THREE

3.0 Methodology

3.1 Research design

This study was a Cross - ssectional Study.

3.2 Study area

Ilala Municipal Council is one of the five Municipalities in Dar es Salaam Region; administratively it is divided into 4 divisions, 36 wards and 109 streets. It covers an area of 210 km^2 with an estimated population of 1,648,861 living in 256,357 households (2017 population projections).

Ilala Municipal Council is borded by Indian Ocean on the East, West by Coast Region, North by Kinondoni Municipal Council and on the South by Temeke Municipal Council.

Health services in the Municipal Council focus on reducing the burden of diseases to individuals and communities and interventions are essentially based on preventive, curative, rehabilitative and promotive services.

The services are provided at different levels of health Centres and dispensaries together with public and private health facilities. In order to ensure sustainability in delivery of quality health care services at all levels, the Office of Municipal Medical Officer (MOH) of Health is responsible for supervision, coordination and mentorship both in public and private health facilities.

Ilala Municipal Council, due to its proximity to the warm Indian Ocean, experiences tropical climate conditions characterized by hot and humid weather throughout the year. There are two rainy seasons in a year, long rain that start in April and May and short rains in November and December. The annual rainfall is approximately 1100mm, average annual temperature is 30.7^c, and average relative humidity is 79% per year.

3.3 Study Sites

This study was conducted in Chanika, Msongola and Zingiziwa wards in Ilala Municipality, Dar es Salaam Region.

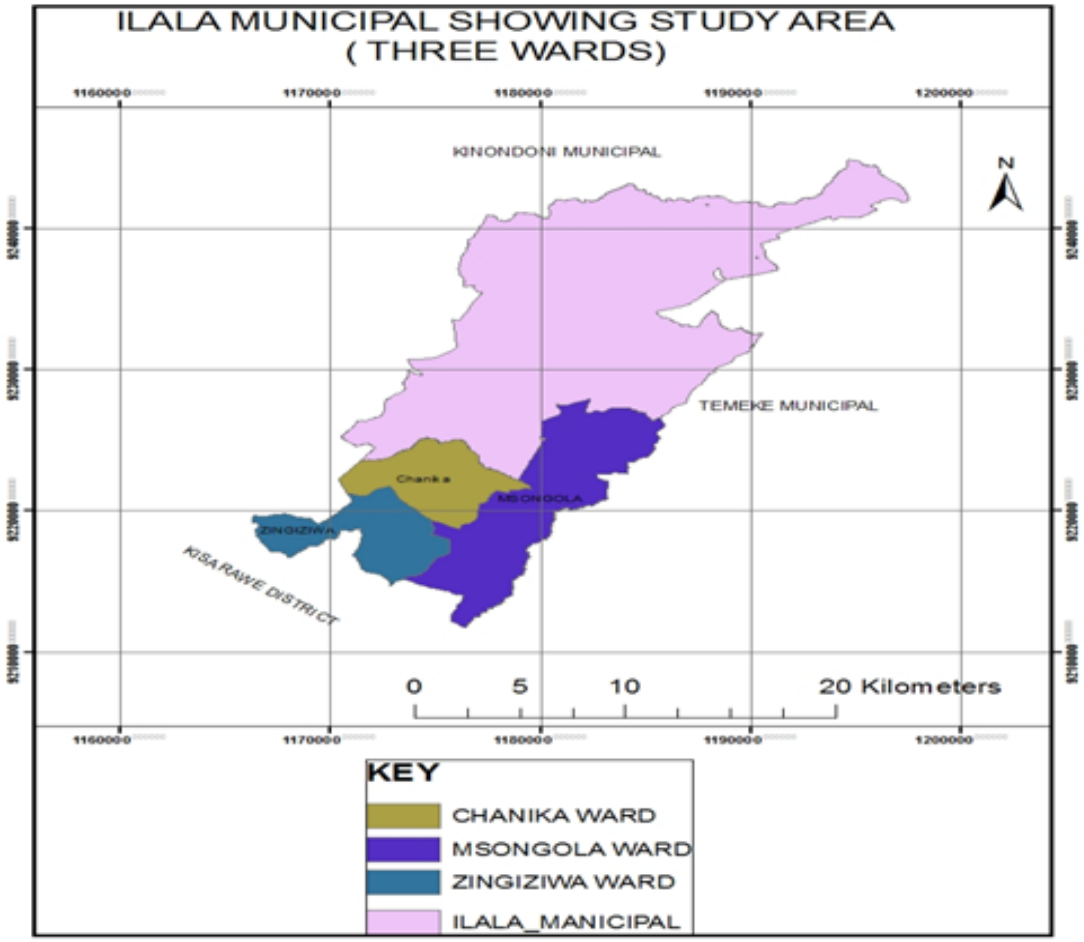


Figure 2: Map showing the study Sites in Ilala Municipality

3.4 Study Population

Households in the study areas

3.5 Study unit

Individual members of the household

3.6 Sample size calculation

$$N = g \times \frac{z^2 P(1-P)}{E^2}$$

Where

N = Sample size

g = Design effect = 1.5

P = Malaria prevalence is estimated to be 57% (43)

E = Margin of error = 5%

Z= Standard normal deviate = 1.96

The estimated sample size (N) = 565 and non response rate is assumed to be 10%,

Then $N = \frac{565}{1- 0.I}$ N = 628

The sample size is 628 individuals

3.7 Sampling Procedure

Multistage sampling using four stages cluster sampling method was used to select the households where individual members of the household aged 4 month to 1 years and above were enrolled for this study.

3.7.1 First stage

Ilala Municipal Council was selected purposively because it has division with wards in the urban peripheral with high malaria prevalence 2-57% in 2017 (43) and high percentage of malaria cases in 2015 and 2016 (22).

3.7.2 Second stage

Ukonga Division was also selected purposively because is one of the divisions in Ilala Municipal Council with wards in the peripheral urban with high percentage of malaria cases.

3.7.3 Third stage

Msongola, Chanika and Zingiziwa wards in Ukonga division were selected purposively because these wards had high percentage of malaria cases (22) and malaria prevalence above 2% (16).

3.7.4 Fourth stage

Twenty (20) streets with an average of 6 streets per ward were selected randomly in the three wards using rotary method.

3.7.5 Fifth stage

In each selected street, households were conveniently selected and individual members of the households aged 4 month to 1 year and above who were available and willing to participate in the interviews and agree to give a blood sample for testing of malaria parasite were enrolled in this study to collect information on Socio – economic and demographic factors (such as age, level of education., occupation, income, household size and possession of nets in the households) (ii) Individual risk behaviour (such as travel history, outdoor activities at night, time of going to bed and not using of ITNs and (iii) presence of mosquito breeding sites, presence of asymptomatic individuals in households, distance of the houses from the mosquito breeding sites and house characteristics such as open eaves and unscreened windows in the study areas.

3.8 Inclusion Criteria

Individuals in the household who have stayed in that household for a period of not less than 10 days prior to the day of data collection, to rule out imported malaria infection**.**

3.9 Exclusion Criteria

i Children aged 3 months or less due to immune responses

ii Individual members of the households who were unable to communicate e.g. mentally retarded individuals were excluded from the study.

3.10 Training of Research Assistants

For quality assurance of the collected data, all 4 researcher assistants were oriented on the data collection tools for one day before data collection to ensure their expertise, adherence on ethical issues and for consistent approach.

3.11 Pre testing of the Tools

The tools used for data collection were tested among 20 respondents at Kivule Street in Chanika ward. Kivule was selected for the pre-testing of the tools, because it has similar characteristics with other streets in the three wards where this study was conducted. The

results for the pre-test revealed that, the tools provide the required information and were reliable. Some of the questions were revised for clarity to suit the study objectives

Table 1: Study variables

No.	Specific objective	Variable	Operational Indicators
1.	To determine socio – economic and demographic risk factors associated with malaria transmission in the study area.	i Age ii Level of education. iii Occupation. iv Household size. v Possession of ITNs. vi Asymptomatic malaria individual in a households	i) Proportions of mRDT positive individuals for each variable.
2.	To establish factors determining individual exposure to malaria infection in the study area**.**	i Travel history ii Outdoor activities iii Time of going to bed/sleep iv ITNs use.	ii) Proportion of mRDT positive individuals for each variable.
3.	To assess presence of mosquito breeding sites and house characteristics associated with malaria infections at the household's level.	i) Presence of mosquitoes breeding sites in vicinity of the household ii) Distance of households to breeding sites iii) Housing characteristics	i) Proportion of mRDT positive for each variable.

3.12 Data Collection

Data was collected for a period of 4 weeks in April, 2019. Data were collected by Principal Investigator (PI) assisted by four (4) Research assistants.

3.12.1 Specific objective 1: Determination of social and demographic risk factors associated with malaria transmission in the study areas

Guided interview schedule with structured questions was used to collect socio-economic and demographic information such as sex, age, marital status, incomes, level of education, household size, and occupation for each study subjects and also number of ITNs available in the households. Each research subject was interviewed separate to ensure privacy and confidentiality.

3.12.2 Specific objective 2: Identification of individual risk exposure to malaria infections in the study areas

Interview using structured questions was used to collect individual risk factors for exposure to malaria infections which included travel history, days of stayed outside Dar es Salaam, outdoor activities after dusks, time of going to bed/sleep and possession and use of ITNs. All individual members of the household tested by mRDT (positive or negative) were interviewed to establish individual exposure to malaria infection in the study.

3.12.2.1 Identification of asymptomatic malaria cases in the household level

Malaria Rapid Diagnostic test (mRDT) was performed to provide evidence on the presence of asymptomatic individual cases of malaria at the household level. All individuals who tested positive to mRDT were treated using first line recommended ACT drugs. mRDT was preferred for this study because it is quick, user friendly and give results within 15 to 20 minutes as compared to microscopic diagnosis.

The mRDT test was performed by two trained Research assistants (laboratory technicians) assisted by two clinical officers whose main role was to prescribe the anti-malarial for positive confirmed cases. The role of the Principal Iinvestigator (PI) was to check the correctness of the procedure and coordinate the logistic issues.

3.12.3 Specific objective 3: Assessment of environmental risk factors sustaining persistent malaria transmission

Observation checklist with a list of all environmental risk factor variables was used to assess presence of breeding sites, distance of the households from the breeding sites and

house characteristics such as open eaves, windows, type of walls and roofing materials and hanged nets on the bed.

3. Data quality assurance

For data quality assurance, RA were oriented on the data collection tool to provide clarity and insight on variables proposed in the study. Explanations were also given to the RA on how to approach the community and the research subjects. To ensure data accuracy, consistency and completeness, filled questionnaires were checked daily by the PI for missing, incomplete or redundant entry, and also to ensure information collected do not conflict with each other, and ensure all variables specified in the questionnaire were consistently filled as required. Also, before actual data analysis commenced, data were cleaned to remove unintended error to ensure recorded data complied with required variables by this study.

4. Data Analysis

Epi data was used to enter the data and Stata version 14.2 was used to analyse social demographic risk factors, individual risk factors and environmental factors that sustain malaria transmission in the study areas. The association between exposure (Independent variable) and outcome (dependent variable) was determined using Odds ratio.

Social demographic variables were presented into simple frequency table and variables which indicated aassociations were included in a bivariate analysis. Environmental risk factors in univariate level was analysed using the Pearson chi-square test (x^2) where variables with p-value <0.05 were included in the bivariate analysis. Thereafter, all individual risk factors and individual risk behaviour with p-value ≤0.2 in bivariate level were further fitted into conditional multivariate logistic regression model, to identify the independent risk factors associated with malaria infection in the study areas. A p-value of 0.05 was used to determine level of significance at 95% confidence interval.

5. Ethical Consideration

Ethical clearance to conduct this study was granted by Muhimbili University of Health and Allied Sciences, Institute Research Board and permission to conduct the study in the

respective study areas was granted by Regional Medical Officer Dar es Salaam and Municipal Director **(Appendix 7- 11).**

Before data collection activities in the respective study area, a brief explanation about the study objectives was given to community leaders in the respective study areas including research subjects. Each research subjects who agreed to participate in the study was required to sign a consent form.

6. Study limitation and Mitigation

Time for data collection was limited: to meet the deadlines for data collection four Research Assistant were enrolled to assist in data collection and weekends were used to capture individual members of the households that were missed during the normal working days due to daily economic generating activities.

CHAPTER FOUR

4.0 Results

4.1 Social demographic characteristics of the study population

This study was done in Ilala Municipal council, in Dar es Salaam Region. It was designed to investigate factors associated with persistent malaria transmission in selected urban peripheral areas namely Chanika, Msongola and Zingiziwa wards in Ukonga division in Ilala Municipality.

A total of 830 individuals participated in this study. The majority of study participants (48.9%) were residing in Msongola ward, 55.3% of the participants was more that 18 years of age, 58.9% were female 82.8% were primary or no education, 77% were farmers or unemployed.

Table 2: Socio demographic characteristics of study participants

Variable	Number	%
Residence/Ward		
Chanika	206	24.8
Msongola	406	48.9
Zingiziwa	218	26.3
Age group		
<18 years	371	44.7
≥18 years	459	55.3
Sex		
Male	341	41.1
Female	489	58.9
Education		
Primary and below	687	82.8
Secondary and above	143	17.2
Occupation		
Farmer or unemployed	639	77.0
Employed or business man/woman	191	23.0

4.2 Prevalence of malaria

The overall prevalence of malaria infection in the study areas was 4.5%. The prevalence was higher among residents in Msongola (7.4%) than the other wards. It was also high among those <18 years of age (5.9%), those with secondary education and above (6.3%), and among farmers or unemployed (5.5%). The difference in prevalence of malaria by age, sex and education level was not significant ($p>0.05$). However, the difference in prevalence by occupation and residence was significant ($p<0.05$). Table 3 shows the prevalence of malaria by demographic characteristics of study participants.

Table 3: Prevalence of malaria by Socio-demographic characteristics of the study population (n= 830)

Variable	*mRDT results		Number
	Positive (%)	Negative (%)	
Residence/Ward			
Chanika	1 (0.5)	205 (99.5)	206
Msongola	30 (7.4)	379 (92.6)	406
Zingiziwa	6 (2.8)	212 (97.2)	218
Age group			
<18 years	22 (5.9)	349 (94.1)	371
≥18 years	15 (3.3)	444 (96.7)	459
Sex			
Male	17 (4.9%)	324 (40.9)	341
Female	20 (4.1%)	469(51.1%)	489
Education			
Primary and below	28 (4.1)	659 (95.9)	687
Secondary and above	9 (6.3)	134 (93.7)	143
Occupation			
Farmer or unemployed	35 (5.5)	604 (94.5)	639
Employed or business man/woman	2 (1.0)	189 (99.0)	191

*mRDT = Malaria Rapid Diagnostic Test

4.3 Individual risk behaviours associated with malaria infection in the study areas

Overall, 17% admitted to have nets, 83.0% did not have nets; and among those with nets 57.4% had ITNs, 19.9% had non-ITNs, and 22.7% didn't know if their nets were treated or not. Net use was 85.8% among those with nets. Majority of those who reported not to have nets reported their nets were torn beyond repair. The prevalence of malaria among those with nets was 2.8%, and among those without nets was 4.8%. The prevalence of malaria among these not using nets was 15.0%. The difference in prevalence of malaria by ownership and use of nets was not significant. Table 4 below shows the prevalence of malaria by ownership of nets.

Table 4: Prevalence of malaria by ownership and use of bed nets

Variable	mRDT Results		Number
	Positive (%)	Negative (%)	
Net (All types) n= 830			
Yes	4 (2.8)	137 (97.2)	141
No	33(4.8)	656 (95.2%)	689
Use Nets (All types) (n=141)			
Yes	1 (0.83)	120 (99.2)	121
No	3 (15.0)	17 (85.0)	20
Type of Net (n=141)			
ITN	2 (2.5)	79 (97.5)	81
Non-ITN	1 (3.8)	25 (96.2)	26
Don't know	1 (3.1)	31 (96.9)	32
Use ITN (n= 81)			
Yes	1 (1.7)	58 (98.3)	59
No	1 (4.5)	21 (95.5)	23

[1]ITNs = Insecticide Treated Nets

The prevalence of malaria was also assessed based on travel history outside Dar es Salaam, duration of stay outside Dar es Salaam, outdoor activities after dusks and time of going to bed/sleep. (Table 5). Only 6.2% of the study subjects had a history of travel outside Dar es Salaam, and prevalence of malaria among them, was 3.9%, while for those with no history of travel outside Dar es Salaam prevalence was 4.5%. The prevalence was high (6.5%)

among individuals with outdoors activities after dusk compared to 3.7% for individuals with no outdoor activities after dusks. The prevalence was high (5.4%) among individuals going to bed late (between 23.00 to mid-night), compared to 2.9% individuals who go to bed between 19:00 to 21:00 hours. The difference in prevalence of malaria among participants with history of travel outside Dar es Salaam was not statistically significant (p=0.825) and also the difference in prevalence of malaria by duration of stay outside Dar es Salaam was not statistically significant (p=0.87). Table 5 below shows the relationship between malaria prevalence with individual travel history, duration of stay, outdoor activities and time of going to bed/sleep.

Table 5: Prevalence of malaria by travel history, duration of stay, outdoor activities and time of going to bed/ sleep of the study subjects

Variable	mRDT results		Number
	Positive (%)	Negative (%)	
Travel out Dar es salaam (n= 830)			
Yes	2 (3.9)	50 (96.2)	52
No	35 (4.5)	778 (93.7)	778
Duration of stay out of Dar es salaam (n= 52)			
< 1 week	1 (3.5)	28 (96.6)	29
>2weeks	1(4.4)	22 (95.7)	23
Outdoor activities after dusk (n= 830)			
Social gathering and studies	14 (6.5)	200 (93.5)	214
No outdoor activities after dusk	23 (1.4)	593 (96.3)	616
Time of going to bed/ sleep (n= 830)			
19:00 – 21:00 hours	9 (2.9)	305 (97.2)	314
23:00 – mid night	28 (5.4)	488(94.6)	516

4.4 Relationship between malaria prevalence and presence of mosquito breeding sites

Table 6 below shows malaria prevalence in relations to the presence of mosquito breeding sites near the house and the distance of breeding site from the house. The majority (71.7%) of the study individuals reside in households surrounded by mosquito breeding sites and that 95.6% of households were located less than 5 kilometres from the mosquitoes breeding sites. The most common types of mosquito breeding sites present in the study areas were; terrace cultivation, small scale rice padding, mud brick holes, small streams, open bore holes and pools of stagnant water. Malaria prevalence among the individuals residing in households surrounded by mosquitoes breeding sites was 5.5%, and it was 4.4% for the individuals who stayed in the households located less than 5 kilometres from the mosquito breeding sites. The results showed statistically significant difference in malaria by presence of mosquito breeding sites around the house (p=0.001). There was no statistically significant difference by distance of the households from the mosquito breeding sites (p=0.833). The relationship between household and presence of mosquito breeding sites, the distance of the households and malaria is shown in Table 6 below.

Table 6: Presence of mosquito breeding sites around the households in relation to malaria prevalence

Variable	+mRDT results			
	Positive (%)	**Negative (%)**	**Total #**	**p-value**
Presence of breeding sites around the households				
Yes	4 (1.7)	231 (98.3)	235	0.001
No	33 (5.5)	562 (94.5)	595	
Distance of the breeding sites from the households				
<5[2]km	34 (4.4)	736 (95.6)	770	0.833
>5[2]km	3 (5.0)	57 (95.0)	60	

[2]Km = Kilometre
# = Number of observation

4.5 House characteristics associated with malaria transmission in the study areas

Table 7 below shows malaria prevalence by characteristics of the houses where households reside. These characteristics were open eaves on top of the wall, the type of building/roofing material and window screening. Results show that 45% of the individuals resided in households with open eaves on top of the walls and 26.1% of the individuals reside in the households with unscreened windows. Malaria prevalence among individuals resided in households with open eaves on top of the walls was 8.3% and was 14.7% for individuals residing in households with unscreened windows. Only twenty people (2.4%) resided in houses whose walls were made up of earth or thatches/grass, and prevalence of malaria among them was 30.0%. There was statistically significant difference in malaria prevalence by presence of open eaves on top of the walls (p= 0.001), presence of unscreened windows (p= 0.001), and type of building materials used for walls (earth or thatches/grass) (p=0.001). The relationship between household characteristics and malaria prevalence is shown in Table 7 below.

Table 7: Prevalence of malaria by characteristic of the houses where households resided

	+mRDT results			
Variable	**Positive (%)**	**Negative (%)**	**Total #**	**p-value**
House characteristics				
Open eaves on top of the walls				
Yes	31(8.3)	341 (91.7)	372	0.001
No	6(1.3)	452 (98.7)	458	
Type of walls and roofing materials				
Made up of bricks(blocks or burnt)	31 (3.8)	779 (96.2)	810	0.001
Made up of earth or thatch/ grass	6 (30.0)	14 (70.0)	20	
Screened windows				
Yes	5 (0.8)	608 (99.2)	623	
No	32 (14.8)	185 (85.3)	217	0.001

= Number of observation

4.6 Relationship between socio-demographic characteristics and malaria

The relationship between socio-demographic characteristics of study participants and malaria was explored in a bivariate analysis. Only occupation was found to have an association with malaria in bivariate analysis, with farmers and unemployed being at a higher risk than business and employed people (p=0.02). Table 8 below shows the relationship between socio-demographic characteristics of the study population and malaria prevalence.

Table 8: Relationship between socio-demographic characteristics of the participants and malaria

Variable	*COR (95% CI)	p- value
Age group		
> 18 yrs	Reference	Reference
4 month- 17 yrs	0.54 (0.27, 1.05)	0.069
Education level		
Secondary or college	Reference	Reference
No education or primary	1.58 (0.73, 3.43)	0.246
Occupation		
Businessman or employed	Reference	Reference
Farmers or unemployed	0.18 (0.044, 0.77)	0.020

[3]COR = Crude Odds Ratio

[4]CI = Confidence interval

The relationship between possession of nets and malaria prevalence as individual risk behaviour was also explored in a bivariate analysis. Low ownership of nets was associated with an increased risk of infection in bivariate analysis (p=0.031), as shown in table 9 below.

Table 9: Relationship between ownership and use of nets and malaria

Variable	COR (95% CI)	p- value
Have Net (All types)		
Yes	**Reference**	**Reference**
No	**1.72 (0.60, 4.94)**	**0.031**
Use Nets (All types		
Yes	Reference	Reference
No	2.76 (0.16,4.62)	0.48
Use ITNs		
Yes	Reference	Reference
No	0.76 (0.26, 2.22)	0.622

The relationship between malaria and travel histories, duration of stay outside, time of going to bed/ sleep and outdoors activities at night was explored in a bivariate analysis. All of these factors were not associated with malaria infection, as shown in the table 10 below.

Table 10: Relationship between individual risk behaviours (travel history, duration of stay and outdoor activities after dusk) and malaria prevalence

Variable	* COR (95% CI)	p- value
Travelled outside Dar es Salaam		
Yes	Reference	Reference
No	1.18 (0.28, 5.05)	0.825
Duration of stay outside Dar es Salaam		
>2weeks	Reference	Reference
<1week	1.27 (0.75, 21.51)	0.87
Time of going to bed/sleep		
19:00 – 21:00 hours	Reference	Reference
22:00 - midnight	1.05 (0.66,1.68)	0.84
Outdoor activities after dusk		
No outdoor activities after dusk	Reference	Reference
Social gathering and studies	0.99 (0.86, 1.15)	0.93

The relationship between malaria prevalence and presence of mosquito breeding sites, distance of the households from the breeding sites, and house characteristics (open eaves, screening of the windows and material used to build the house) were also explored in bivariate analysis as shown in table 10.

Presence of breeding sites around the house, open eaves on top of the wall, absence of window screen and type of wall/roofing material were all associated with an increased risk of malaria infection ($p<0.001$). However, distance of the house from the breeding site was not associated with malaria.

Table 11: Relationship between house characteristics and malaria

Variable	COR (95% CI)	p- value
Presence of mosquito breeding sites		
No	Reference	Reference
Yes	**20.07. (7.03, 57.29)**	**0.001**
Distance from the breeding sites		
>5km	Reference	Reference
<km	1.14 (0.34, 3.82)	0.833
House ccharacteristics		
Open eaves on top of the wall		
No	Reference	Reference
Yes	0.15 (0.06, 0.35)	0.001
House with screened windows		
Yes	Reference	Reference
No	21.0 (8.08, 54.76)	0.001
Type of wall and roofing materials		
Made up of bricks (block or burnt	Reference	Reference
Made up of earth or thatch/grass	10.8 (3.88, 29.91)	0.001

4.7 Multivariate analysis

Six variables shown to be associated with malaria prevalence in bivariate analysis were included in multivariate analysis. Only low ownership of nets (17%), absence of window screens and presence of mosquito breeding sites around the households were found to be associated with increased risk of malaria infection as shown in the table 11 below.

Table 12: Multivariate analysis of individual risk factors shown to be associated with malaria infection

Variable	COR (95% CI)	P- value	[4]A OR (95% CI)	p-value
Occupation				
Businessman or employed	Reference		Reference	
Farmer or unemployed	0.18 (0.044, 0.77)	0.020	0.31 (0.043, 2.32)	0.25
Have Nets				
Yes	Reference		Reference	
No	1.72 (0.60, 4.94)	0.031	7.76 (4.23, 24.6)	0.001
House characteristics				
Open eaves				
No	Reference		Reference	
Yes	0.15 (0.06- 0.35)	0.001	0.296 (0.065- 1.36)	0.118
Screened wwindows				
Yes	Reference		Reference	
No	0.048(0.018- 0.124)	0.001	1.21 (1.26 , 3.4)	0.001
Type of walls				
Made up of blocks or burnt bricks	Reference		Reference	
Made up of earth or thatch/grass	10.8 (3.88- 29.91)	0.001	2.06 (0.207, 20.61)	0.537
Presence of mosquito breeding sites				
No	Reference		Reference	
Yes	20.07(7.03, 57.29)	0.007	5.08 (3.20, 20.5)	0.005

[4]AOR= Adjusted Odds ratio

CHAPTER FIVE

5.0 Discussions

This cross-sectional study was done in Ilala Municipal council, in Dar es Salaam Region, to investigate factors associated with persistent malaria transmission in the selected three urban peripheral wards of Dar es Salaam, namely Chanika, Msongola and Zingiziwa in Ukonga in Ilala Municipality.

5.1 Prevalence of malaria by socio – demographic characteristics of study population

Our findings revealed overall malaria prevalence in the urban peripherals of 4.5%, higher than the average Dar es Salaam regional malaria prevalence of 1.1% (41). Msongola ward had the highest (7.4%) prevalence than the other study sites. This finding is consistent with a previous study conducted in Mainland Tanzania which revealed variations in malaria prevalence in urban peripherals of Dar es Salaam Region (12,43). A previous study conducted in Dar es Salaam showed increased risk of malaria infection in the administrative units of peri urban Dar es Salaam Region as compared to the urban centre (17). Low malaria prevalence observed in Chanika (0.5%) might be due to the fact that Chanika ward is characterized by more of urban setting than urban peripheral.

This study has also observed high malaria prevalence among participants aged <18 years (5.9%), which is consistent with the previous study conducted in Mainland Tanzania which also showed high malaria prevalence in the school going age group (43). Similarly, a study conducted in Congo showed a relationship between malaria infection and age, where high prevalence was observed in the age above 5 years (53). In Mainland Tanzania, Malaria Indicator Survey 2017 has shown an age shift of malaria burden from under five to school aged children (69), similar a study conducted in Rwanda highland showed a relationship between older age group with *Plasmodium* infection (70). The age groups used for this study and studies conducted in Mainland Tanzania (12) Congo (53) and Rwanda (70) ranged between 4 months to 19 years old.

The findings of this study have also shown malaria prevalence of 6.3% for individuals with secondary education and above. This finding is inconsistent with studies conducted in Burkina Faso and Rwanda where, in Burkina Faso the findings showed that households

with mother who had higher education, had low risk of malaria as compared to households with mother with primary education or no education (71). Similarly, in Rwanda, the findings showed reduced odds of malaria infections for the households with parents that had secondary or higher education level (70).

This study also observed a malaria prevalence of 5.5% among farmers or unemployed which was shown in bivariate analysis to be significantly higher than in business and employed group. This finding is consistent with studies conducted in South Asia, South East Asia and Western Asia Pacific region which shown relationship of occupations, such as low land irrigation rice production and Oil palm plantation with malaria incidence (55).

5.2 Prevalence of malaria by individual risk behaviour of the study population

Only a small number of individuals 141/830 (17%) admitted to own nets, and these included ITNs (54.7%), non-ITNs (19.9%) and 22.7% were not sure if their nets were treated or not. The prevalence of malaria was low among those with nets than among those without nets (2.8% vs. 4.8%), although the difference was not significant, but higher malaria prevalence was observed among non-users of nets (15.0%) and the difference was significant ($p = 0.01$)

This finding is consistent with study conducted in Morogoro Municipality in Tanzania which showed a low prevalence of asymptomatic malaria (5.4%) among 90.6% school children users of ITNs (72). Study conducted in Central India showed a reduction in overall prevalence of malaria to 1% for users of ITNs (73). A study conducted in Ifakara, Tanzania showed inverse relationship between increased coverage of ITNs and malaria burden, and indicated that an increases of 10% ownership of mosquito nets at village level had an average of 5.4% to 10% decrease of malaria deaths in children under five years (65).

This study showed no association between history of travel outside Dar es Salaam, duration of stay outside Dar es Salaam and malaria infection. The finding of this study is not consistent with, other previous studies. Study conducted in Mainland Tanzania (37) and report by World Health Organization (55), associated mobility, occupation and travel with malaria infection. Also study by Martens and Hall associated population movement

among individuals (trading, fishing and labouring) with malaria infections (58). Also previous study has revealed travels to rural areas as a risk for malaria in urban areas (32). The difference in our findings from other studies could be due to that fact that only a small proportion of individuals (6.3%) had a history of travel outside Dar es Salaam. This therefore implies that majority of individuals who tested positive for malaria, got malaria infection in their areas of domicile, not outside Dar es Salaam.

The findings of this study also indicated higher malaria prevalence among individuals with outdoor activities after dusk compared with those with no outdoor activities after dusk, although bivariate analysis revealed no association in malaria risk with outdoor activities after dusk. However, a study conducted in Dar es Salaam showed high risk of malaria infections among adults, and indicated that among 46.3% of adults who participated in outdoor activities after dusk, the risk of malaria infection was 1.8 times than among individuals who had not participated in outdoor activities (74).

The study also observed a higher malaria prevalence among individuals who go to bed/ sleep late, than among early sleepers. Bivariate analysis indicated no association between malaria prevalence and time of going to bed. A previous study conducted in Dar es Salaam, found high proportion of malaria infection for individuals who rested outdoor after dusk (9.7%) (74). The difference in the findings of the two studies could be due to the fact that our study included all age groups, while the other study was done among adults only.

5.3 Prevalence of malaria in relationship to the presence of mosquito breeding sites in the study areas

Findings from our study also revealed an association between malaria prevalence and residing in the households surrounded by mosquito breeding sites. This finding is consistent with the study conducted in Gambia (67) and Ifakara in Mainland Tanzania which revealed that distribution of malaria vectors, transmission rates and malaria incidence varies widely depending on the distance of the households from the mosquito breeding sites (75). Also, study conducted in Northern Botswana showed that households close to mosquito breeding sites were more exposed to mosquitoes bites (33). Also in Uganda, study showed households close to mosquito breeding sites were the risk factor for clinical malaria episodes (27). The findings of our study has also revealed that households

surrounded by mosquito breeding sites had 5.08 odds of malaria infection compared to households not surrounded by mosquito breeding sites.

5.4 Prevalence of malaria in relationship with house characteristics in the study areas

The findings of this study revealed higher malaria prevalence among individuals residing in the households with open eaves on top of the walls, and among individuals residing in the households with unscreened windows. While these two variables were shown to be significantly associated with malaria in bivariate analysis, only unscreened windows were still a significant factor in multivariate logistic regression models. Our findings is consistency with study conducted in Gambia which also showed that house screening substantially reduced the number of mosquitoes inside houses by 59% hence clinical episode of malaria infection (67), also in Uganda, study conducted showed reduced incidence of malaria episodes in children living in modern homes than in traditional homes (66)

Also, the findings have indicated no association between malaria infections and the type of building materials used for walls and roofs. This findings is inconsistent with the study conducted in Northern Batswana, which showed less chance of malaria cases in households residing in houses made up of bricks walls as compared to individuals member households residing in the houses, walls made up of dug and earth or thatch/ grass (33). The difference in the findings with our finding might be attributed by small proportion (2.4%) of houses in the study areas which their walls were made up of earth or thatch/grasses.

CHAPTER SIX

6.0 Conclusion and Recommendations

6.1 Conclusion

The study was conducted to identify factors associated with persistent malaria transmission in the urban peripheral wards of Dar es Salaam. Low nets ownership, residing in the households surrounded by mosquito breeding sites and in households with unscreened windows were independent factors associated with risk of malaria in the areas.

6.2 Recommendations

6.2.1 Promote ITNs ownership

The last campaign of ITNs distribution in Dar es Salaam was conducted in February, 2017. Since the median life span of the ITNs is 2.5 years, this then suggests most of the ITNs that are in the households are torn. Timely replacement is needed to increase access, ownership and ultimately use of nets, to prevent malaria transmission in the areas. A mini Mass Replacement Campaign is recommended in these areas to increase coverage and ITNs access by individual members of the households. Social Behavioural Change Communication should also be conducted to educate individuals on the importance of ITNs use, to prevent malaria even if the nets are torn, as some individuals reported not using nets because they are torn.

6.2.2 Residing in households with unscreened windows

Community should be educated on the importance of screened windows with mosquito gauze to prevent mosquitoes from entering the houses, hence reducing man - mosquito contact and potentially reduce malaria transmission in the areas. Alternatively, community in these areas should be educated on the alternative use of torn ITNs for screening the windows to reduce the chance of mosquitoes getting into the houses as this being one among the recommended alternative use of torn ITNs.

6.2.3 Presence of mosquito breeding sites in the vicinity to households

Since most of the households are surrounded by mosquitoes breeding sites (71.7%), larviciding for the permanent breeding sites such as terrace form of agriculture, mud bricks holes, small streams and open bore holes and abandon fish ponds through community engagement is recommended in the areas. This should take advantage of the availability of

bio-larvicides factory in country and government support of larviciding operations. Application of larviciding should go in line with environmental management and sanitation particularly for mud bricks holes and any accumulated stagnant water that can be dried or drained to prevent accumulation of water that in turn create new mosquito breeding sites.

6.3 Further studies

1. Assessment of Larval density and malaria vectors infection rate in households surrounded by mosquito breeding sites in urban peripherals of Dar es Salaam Region.
2. Microscopic estimation of malaria parasites density in urban peripheral areas of Dar es Salaam Region.

REFERENCES

1. WHO. World Malaria Report . World Malaria Report 2018. Who [Internet]. 2018;ISBN 978-92-4-156565-3. Available from: www.who.int/malaria.
2. World Health Organization. World Malaria Report 2016. [Internet]. 2016. Available from: www.who.int/malaria.
3. Hay, S.I., Guerra, C.A., Tatem, A.J., Atkinson, P.M. and Snow, R.W., 2005.Opinion - tropical infection diseases: Urbanization, malaria transmission and disease burden in Africa. *Nature Reviews Microbiol* 3 (1), p. 81–90.
4. Matthys, B., N'Goran, E.KN., Koné, M., Koudou, B.G., Vounatsou, P., Cissé, G., Tschannen,A.B., Tanner, M. and Utzinger, J., 2006. Urban agricultural land use and characterization of mosquito larval habitats in a medium-sized town of Côte d ' Ivoire. *Journal of Vector Ecology*, 31(2), pp. 319–33.
5. Siri, J.G., Lindblade, K.A., Rosen, D.H., Onyango, B., Vulule, J., Slutsker, L.and Wilson, M.L., 2008. Quantitative urban classification for malaria epidemiology in sub-Saharan Africa. *Malaria journal*, 8 (9),pp. 1–9.
6. Robert V, Macintyre K, Keating J, Trape J, Duchemin JB, Warren M & JCB. 2003 Malaria Transmission in Urban Sub-Saharan Africa. *American jounrnal of tropical medicine and Hygiene* 68(2), pp 169–176.
7. Machault, V., Vignolles, C., Pagès, F., Gadiaga, L., Gaye, A., Sokhna, C., Trape, J., and Lacaux ,J. R., 2010. Spatial heterogeneity and temporal evolution of malaria transmission risk in Dakar, Senegal, according to remotely sensed environmental data. Volume. 9, *Malaria journal*, p. 1–14.
8. Cohen, B., 2015 Urbanization , City Growth , and the New United Nations Development Agenda role in achieving the least cost path to a sustainable, 3(2).
9. Awolola, T.S., Oduola, A.O., Obansa, J.B., Chukwurar, N.J., Unyimadu, J.P.,2007. Anopheles gambiae s.s. breeding in polluted water bodies in urban Lagos, south western Nigeria. *Journal of vector borne disease*, 44 (4), pp. 241.
10. Kasili, S., Odemba, N., Ngere, F.G., Kamanza, J.B., Muema, A.M.and Kutima, H.L. 2009. Entomological assessment of the potential for malaria transmission in Kibera slum of Nairobi , Kenya.7(December),pp.273–9.
11. World Health Organization. 2015. Global technical strategy for malaria 2016-2030. World Health Organization. pp. 1–35.

12. Chacky, F., Runge, M., Rumisha, S.F., Machafuko, P., Chaki, P., Massaga, J.J.,Mohamed, A., Pothin, E., Molteni F., Snow, R.W. and Lengeler, C., 2018. Nationwide school malaria parasitaemia survey in public primary schools, the United Republic of Tanzania. *Malaria journal*,17(1),pp. 1–16.
13. Tanzania Commission for AIDS, Dar es Salaam Tanzania, Zanzibar AIDS Commission, Zanzibar, National Bureau of Statistics, office of the Chief Government statistician and ORC Macro. Tanzania Malaria Indicator Survey 2007-2008.
14. Ministry of Health, Community Development, Gender Elderly and Children, Tanzania, Mainland, Ministry of Health, Zanzibar, National Bureau of Statistics, Office of the Chief Government Statistician. Tanzania Malaria Indicator Survey 2017.
15. Ministry of Health, Community Development, Gender Elderly and Children, Dodoma, Ministry of Health Zanzibar National Bureau of Statistics, Zanzibar and Office of the Chief Government Statistician. Tanzania Malaria Indicator Survey 2018.
16. Ministry of Health, Community Development,Gender Elderly and Children. National Malaria Control Programme, Supplementary Malaria Midterm Strategic Plan (2018- 2020).
17. Kabaria, C.W., Molteni, F., Mandike, R., Chacky, F., Noor, A.M., Snow, R.W.,and Lengeler, C., 2016. Mapping intra-urban malaria risk using high resolution satellite imagery: A case study of Dar es Salaam. *Internation journal of health geographics*. ;15(1), pp. 1–12.
18. Castro, M.C., Tsuruta, A., Kanamori, S., Kannady,K. and Mkude, S.,2009. Community-based environmental management for malaria control: Evidence from a small-scale intervention in Dar es Salaam, Tanzania. *Malaria journal*, 8(1), pp. 57.
19. Castro, M.C., Yamagata, Y., Mtasiwa, D., Tanner, M., Utzinger, J., Keiser, J. and Singer,B.H., 2004. Integrated Urban Malaria Control: a Case Study in Dar Es Salaam, Tanzania. VolUME. 71, Amrican journal of tropical medicine and Hygiene, pp. 103–17.

20. Maheu-Giroux, M., Castro, M.C., 2013. Impact of Community-Based Larviciding on the Prevalence of Malaria Infection in Dar es Salaam, Tanzania. *PLoS One*, 8(8).
21. Msellemu, D., Namango, H.I., Mwakalinga, V.M., Ntamatungiro, A.J., Mlacha, Y., Mtema, Z.J., Kiware, S.1., Lobo, N.F., Majambere, S., Dongus, S., Drakeley, C.J., Govella, N.J.and Chaki, P.2016. The epidemiology of residual Plasmodium falciparum malaria transmission and infection burden in an African city with high coverage of multiple vector control measures. *Malaria Journal*,15(1), pp. 1–19.
22. Killeen, G.F., Smith, T.A., Ferguson, H.M., Mshinda, H., Abdulla, S., Lengeler, C., Kachur, S.P., 2007. Preventing childhood malaria in Africa by protecting adults from mosquitoes with insecticide-treated nets. *PLoS Medicine.* 3;4(7):e229.
23. National Malaria Control Programme,Tanzania; *Malaria Surveillance Bulletin* issued, June 2017.
24. Winskill, P., Rowland ,M., Mtove, G., Malima ,R.C.and Kirby M.J., 2011. Malaria risk factors in north-east Tanzania. Volume. 10, Malaria journal. *BioMed Central Ltd* 10(1), pp. 98.
25. Konradsen, F., Amerasinghe, P., Van Der Hoek, W.I.M., Amerasinghe, F., Perera, D and Piyaratne, M.,2003. Strong association between house characteristics and malaria vectors in Sri Lanka. T*he American journal of tropical medicine and Hygiene.*68(2),pp.177- 181.
26. Kreuels, B., Kobbe, R., Adjei, S., Kreuzberg, C., Reden, C., Bäter, K., Klug, S., Busch, W., Adjei, O., and May,J., 2008. Spatial Variation of Malaria Incidence in young children from a geographically homogeneous area with high endemicity.*The Journal of infectious disease,* 197(1), pp. 85–93.
27. Ghebreyes, T.A., Haile, M., Witten, K.H., Getachew, A., Yahannes, M., Lindsay, S.W. and BYASS, P., 2000. Household risk factors for malaria among children in the Ethiopian highlands. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 94(1), pp.17–21.
28. Staedke, S.G., Nottingham, E.W., Cox, J., Kamya, M.R., Rosenthal, P.J.and Dorsey, G., 2003. Proximity to mosquito breeding sites as a risk factor for clinical malaria episodes in an urban cohort of Ugandan children. *The American journal of tropical medicine and hygiene.* pp. 244–6.

29. Ondiba, I.M., Oyieke, F.A., Ong'amo, G.O., Olumula, M.M., Nyamongo, I.K., Estambale, B.B.,2018. Malaria vector abundance is associated with house structures in Baringo County, Kenya. *PLoS One*. 13(6), pp. 1–12.

30. Somi, M.F., Butler, J.G., Vahid, F., Njau, J., Kachur, S.P. and Abdulla S., 2007. Is There Evidence for Dual Causation Between Malaria and Socioeconomic Status ? Findings From Rural Tanzania. *The American journal of tropical medicine and hygiene*,77(6), 1020–1027.

31. Gender, Health and Malaria. Most. 2007;(3).

32. Siri, J.G., Wilson, M.L., Murray, S., Rosen, D.H., Vulule, J.M., Slutsker, L. and Lindblade, K.A., 2010. Significance of travel to rural areas as a risk factor for malarial anemia in an urban setting. T*he American journal of tropicla medicine and Hygiene*, 82(3), pp. 391–397.

33. Chirebvu, E., Chimbari, M.J., and Ngwenya B.N. 2014. Assessment of Risk Factors Associated with Malaria Transmission in Tubu Village, Northern Botswana. *Malaria Research and Treatment*, pp.1–10.

34. Caldas, M. S.C.,2003. Migration, Urbanization and Malaria: A Comparative Analysis of Dar es Salaam, Tanzania.

35. Bøgh, C., Clarke, S.E., Pinder, M. Sanyang, F and Lindsay S.W., 2001. Effect of Passive Zooprophylaxis on Malaria Transmission in the Gambia Effect of Passive Zooprophylaxis on Malaria Transmission in the Gambia. *Journal of medical entomology*, 38(6), pp. 822–828.

36. Agomo, C.O. and Oyibo, W.A., 2013. Factors associated with risk of malaria infection among pregnant women in lagos, Nigeria. *Infect disease of poverty*. 2(1), pp. 1–8.

37. Bousema, T., Drakeley, C., Gesase, S., Hashim, R., Magesa, S., Mosha, F., Otieno, S., Carneiro, I., Cox, J., Msuya, E., Kleimschmidt, I., 2010. Identification of Hot Spots of Malaria Transmission for Targeted Malaria Control. J*ournal of infectious diseases.* 201(11), pp. 1764-1774.

38. Bousema, T., Drakeley, C., Gesase, S., Hashim, R., Magesa, S., MF, Otieno S, Carneiro I, Cox J, Msuya, E., Kleinschmidt, I., Greenwood, B., Riley, E., Sauerwein, R., Chandramohan, 201(11),. Identification of Hot Spots of Malaria Transmission for Targeted Malaria Control. *J. of infec dise* pp 1764- 1774.

39. World Health Organization. World Malaria Report, 2017. 2017.
40. Liu, W., Li, Y., Learn, G.H., Rudicell, R.S., Robertson, J.D., Keele, B.F., Ndjango, J.N,, Sanz, C.M., Locatelli, S., Gonder, M.K,, Kranzusch, P.J., Walsh, P.D., Delaporte, E.1., Ngole, E.M., Georgiev, A.V., Muller, M.N., Shaw,1.G.M., Peeters, M. 2011. Origin of the human malaria parasite Plasmodium falciparum in gorillas. *Nature;* 467(7314), pp. 420–5.
41. Ministry of Health, Community Development, Gender Elderly and Children, Dodoma, Ministry of Health Zanzibar, National Buareau of Statistics , and Office of Chief Government Statistician; Malaria Indicator Survey 2017.
42. Dongus, S., Nyika, D., Kannady, K., Mtasiwa, D., Mshinda, H., Gosoniu, L., Drescher, A.W. , Fillinger, U., Tanner, M., Killeen, G.F., Castro M.C. 2009. Urban agriculture and Anopheles habitats in Dar es Salaam, Tanzania. G*eospat Health*. 3(2),pp. 189–210.
43. Ministry of Health, Community Development, Gender Elderly and Children 2014. School Malaria Parasitaemia Survey Report. A Study Conducted in Public Primary Schools, Tanzania Mainland.
44. Hoekl, W., Konradsen, F., Dijkstra1y, D. S. Risk factors for malaria, 1998: A microepidemiological study in a village in Sri Lanka. *Transaction Ryol Society of Tropical Medicine and Hygiene*. 192(3), pp. 265–9.
45. Somi, M.F., Butler, J.G., Vahid, F., Njau, J.D., Kachur S.P. and Abdulla, S., 2007. Economic burden of malaria in rural Tanzania: Variations by socioeconomic status and season. *Tropical medicine international health*, 12(10), pp. 1139–1147.
46. Mathanga, D.P., Halliday, K.E., Jawati, M., Verney, A., Bauleni, A., Sande, J., 2015. The High Burden of Malaria in Primary School Children in Southern Malawi. 93(4), pp. 779–789.
47. Pullan, R.L, Bukirwa, H., Staedke, S.G, Snow, RW., Brooker, S., 2010. Plasmodium infection and its risk factors in eastern Uganda, pp. 1–11.
48. Mathanga, D.P., Tembo, A.K., Mzilahowa, T., Bauleni, A., Mtimaukenena, K., Taylor, T.E., 2016. Patterns and determinants of malaria risk in urban and peri‐urban areas of Blantyre , Malawi. Malaria jourrnal, pp. 1–9.

49. Pinchoff, J., Chaponda, M., Shields, T.M., Sichivula, J., Muleba, M., Mulenga, M.,2012. Individual and Household Level Risk Factors Associated with Malaria in Nchelenge District , a Region with Perennial Transmission : A Serial Cross-Sectional Study from 2012 to 2015, pp. 1–12.
50. Noor, A.M., Kirui, V.C., Brooker, S.J., Snow, R.W., 2009. The use of insecticide treated nets by age: implications for universal coverage in Africa. *BMC Public Health*. 2009 Dec; 9 (1), pp. 369.
51. Bigoga, J.D, Nanfack, F.M., Awono-Ambene, P.H., Patchoké ,S., Atangana, J., Otia ,V.S., Fondjo, E., Moyou ,R.S., Leke, R.G., 2012. Seasonal prevalence of malaria vectors and entomological inoculation rates in the rubber cultivated area of Niete, South Region of Cameroon. *Parasites & vectors*,5(1):197.
52. Atieli, H.E, Zhou ,G., Afrane, Y., Lee, M., Mwanzo, I., Githeko, A.K., 2011 Insecticide-treated net (ITN) ownership , usage , and malaria transmission in the highlands of western Kenya. *Parasit Vectors,* 4(1), pp. 113.
53. Ferrari, G., Ntuku, H.M., Ross, A., Schmidlin, S., Kalemwa, D.M., Tshefu, A.K, Lengeler, C., 2016. Identifying risk factors for Plasmodium infection and anaemia in Kinshasa, Democratic Republic of Congo. *Malaria journal*. 15(1), pp. 362.
54. Baume, C.A., Franca-Koh, A.C., 2011. Predictors of mosquito net use in Ghana. *Malaria journal*, 10(1), pp. 265.
55. World Health Organization in collaboration with FAO, UNEP and U, PEEM Secretariat, World Health Organization.1996. Effects of agriculture an vector-borne diseases Topic E : Land use , vegetation and crops.
56. RMB Targets. The burden of malaria in Africa. 2010;17–23.
57. Mugwagwa, N., Mberikunashe, J., Gombe, N.T., Tshimanga, M., Bangure, D., 2015. Factors associated with malaria infection in Honde valley, Mutasa district, Zimbabwe, 2014: a case control study. *BMC research notes*. Dec;8(1), pp. 829.
58. Martens, P., and Hall, L., Malaria on the move: human population movement and malaria transmission. *Emerging Infectious Diseases*. 2000;6(2), pp. 103–9.
59. World Health Organization. World Malaria Report 2015 [Internet]. Annual Report World Health Organization. 2015. Available from: http://files/840/Malaria report 2015.pdf

60. White, G.B 1974. Anopheles gambiae complex and disease transmission in Africa. *Transaction of royal society of tropical medicine and hygiene* 68(4), pp. 278–98.

61. World Health Organization, 2015. Insecticide - Trated Mosquito nets: a WHO Position Statement. World Health Organization, p. 326–329.

62. Binka, F.N., Indome, F., Smith, T.,1998. Impact of spatial distribution of permethrin-impregnated bed nets on child mortality in rural northern Ghana. *American journal of tropical medicine and Hygiene*;59(1), pp. 80–85.

63. Hawley, W.A., Phillips-howard, P. A., Terkuile, F.O., Terlouw, D.J.J, Vulule, J.M., M J, Ombok, M., Nahlen BL, Gimnig, J.E., Kariuki, S.K., Kolczak, M. S., & Hightower AW. 2003. Community-Wide Effects of Permethrin-Treated Bed Nets on Child Mortality and Malaria Morbidity in Western Kenya. 68 *(Suppl 4)*, pp. 121–127.

64. Lengeler, C., 1996. Insecticide-treated bed nets and curtains for preventing malaria. *Cochrane Database of Systematic Reviews.*

65. Selemani, M. , Yeates, K., Msengwa, AS., Mrema, S., Shamte, A., Mahande MJ, Maurice, C.Y., Mbago, M.C., & Lutambi A. 2016. Assessing the effects of mosquito nets on malaria mortality using a space time model: A case study of Rufiji and Ifakara Health and Demographic Surveillance System sites in rural Tanzania. *Malaria journal.*15(1), pp. 1–14.

66. Wanzirah, H., Tusting, L.S., Arinaitwe, E., Katureebe, A., Maxwel,l K., Rek, J., Bottomley, C., Staedke, S.G., Kamya, M., Dorsey, G., Lindsay, S.W., 2015. Mind the gap: house structure and the risk of malaria in Uganda. *PLoS One*. Jan 30;10(1):e0117396.

67. Lindsay, S.W., Campbell, H., Adiamah, J.H., Greenwood, A.M., Bangali, J.E., Greenwood, B.M, 1990. Malaria in a peri-urban area of The Gambia. *Annals of tropical medicine & parasitology.* 1; 84(6):553-562.

68. Sharma, R.K., Singh, M.P., Saha, K.B, Bharti, P.K, Jain, V., Singh, P.P, Silawat, N., Patel, R., Hussain, M., Chand, SK., Pandey, A., 2015. Socio-economic & household risk factors of malaria in tribal areas of Madhya Pradesh, central India. T*he Indian journal of medical research. 141(5), pp. 567.*

69. Tanzania Commission for AIDS, Dar es Salaam T, Zanzibar AIDS Commission, Zanzibar NB of S, Dar es Salaam, Tanzania O of CGS, Zanzibar, Macro International Inc. Calverton MU. Tanzania Demographic and Health Survey and Malaria Indicator Survey 2015-2016 .

70. Sifft, K.C., Geus ,D., Mukampunga, C., Mugisha, J.C., Habarugira, F., Fraundorfer, K., Bayingana, C., Ndoli, J., Umulisa, I., Karema, C., von Samson-Himmelstjerna, G., 2016. Asymptomatic only at first sight: malaria infection among schoolchildren in highland Rwanda. *Malaria journal.* 15(1),pp. 553.

71. Samadoulougou, S., Maheu-Giroux, M., Kirakoya-Samadoulougou, F., De Keukeleire, M., Castro, M.C., Robert, A., 2014. Multilevel and geo-statistical modeling of malaria risk in children of Burkina Faso. *Parasites and Vectors*. 7(1), pp. 1–13.

72. Nzobo, BJ., Ngasala, BE., Kihamia, C.M., 2015. Prevalence of asymptomatic malaria infection and use of different malaria control measures among primary school children in Morogoro Municipality, Tanzania. *Malaria journal*. 14(1),pp. 1–7.

73. Chourasia, M.K, Kamaraju, R., Kleinschmidt, I., Bhatt, R.M., Swain, D.K., Knox, T.B., Valecha, N., 2017. Impact of long-lasting insecticidal nets on prevalence of subclinical malaria among children in the presence of pyrethroid resistance in Anopheles culicifacies in Central India. *International journal of infectious diseases*. 1; 57, pp. 123-129.

74. Namango, I., 2013. Malaria risk and the role of routine outdoor nocturnal activities and livelihoods among adults in Dar es Salaam, Tanzania (Doctoral dissertation, Thesis. University of Nairobi).

75. Drakeley, C., Schellenberg, D., Kihonda, J., Sousa, C.A, Arez, A.P., Lopes, D., Lines, J., Mshinda, H., Lengeler, C., Schellenberg, J.A., Tanner, M., 2003. An estimation of the entomological inoculation rate for Ifakara: a semi-urban area in a region of intense malaria transmission in Tanzania. *Tropical medicine and International Health*. 8(9), pp.767-774.

APPENDICES

Appendix 1: Informed Consent Form- English Version

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

ID S/# _____ DATE_____/_____/_____

Consent for participate in the study

Greetings. My name is _____, from Muhimbili University of Health and Allied Sciences, Dar es Salaam. We are conducting a research to determine factors associated with persistent malaria in peri- urban Dar es Salaam.

Purpose of the study

This study has the purpose of collecting information on factors associated with persistent malaria in the peri- urban in Dar es Salaam. You are requested to participate in this study because you have relevant information and experiences that possibly will be significant to the study.

Confidentiality

I reassure you all the information you provided will be confidential and not shared. Only people who are involved in this study will have access to the information of this study. We will be compiling a report which will contain responses from all research subject involved in this study. Your name will not appear in the report or other information that will identify you or the records you provided.

What participation involved

If you consent to participate in this study, you will be required to answer a series of questions that have been prepared for the study through interviewing and allow me to observe in order to obtain the intended information regarding factors associated with persistent malaria in this area. One drop of blood sample will be taken from the finger prick which has no major harm

Benefits

The information you are providing will help to understand the reasons for persistent malaria prevalence in the peri- urban areas of Dar es Salaam and disseminate the findings to relevant authority that will help in designing and optimization of malaria control strategies in peri- urban setting of Dar es Salaam.

Right to withdraw and alternatives

Your participation in this study is entirely your choice. If you choose not to participate in the study or if you decide to stop participating in the study you will not get any harm or punished. You can stop participating in this study at any time, even if you have already signed the consent form. If you refuse to participate or withdrawal from the study will not involve penalty or loss of any benefits to which you are entitled.

Risks

You will be asked questions about factors that are associated with malaria infection. You are free to answer the questions and ask questions where not clear and free to refuse to answer any specific question and stop the interview at any time. We do not anticipate any harm to occur to you because of your participation to this study.

Responsibility of Investigator

In the case where the individual will be found to have malaria infection, he/she will refer to nearby health facility for treatment as per National Guidelines for Malaria Diagnosis and Treatment of the Ministry of Health, community Development, Gender, Elderly and Children.

In case of injury

We do not expect any harm to occur to you or your family as a result of your participation to this study.

Who to contact

If you have questions regarding this study, please contact:

Charles Dismas Mwalimu, The Principal Investigator Muhimbili University of Health and Allied Sciences (MUHAS), P.O. Box 65001, Dar es Salaam (Tel. #. 0767269562.

If you ever have questions about your rights as a research participant, you may call Chairperson of the Senate Research and Publications Committee, Telephone No. 2150302-6 or 2152489.

P.O. Box 65001

DAR ES SALAAM.

Signature

Do you agree?

Participant agree_____, not agree _____

I _____ have read the content in this form, my questions have been answered, I agree to participate in this study

Signature of Participant_____

Signature of Research assistant_____

Date of signed consent_____

Appendix 2: Informed Consent Form- Kiswahili Version

CHUO KIKUU CHA AFYA NA SAYANSI SHIRIKISHI MUHIMBILI

Fomu ya ridhaa kushiriki kwenye utafiti juu ya sababu zinazo sababisha kuwepo kwa kiwango cha juu cha maambukizi ya malaria katika maeneo ya pembezoni mwa jiji la Dar es Salaam.

Na. ya Fomu _____

Ridhaa kushiriki kwenye utafiti

Habari za sahizi/ habari za leo? ---------- Shikamoo

Ninaitwa_____ Ninafanya utafiti juu ya sababu za kijamii na kiuchumi zinazosababisha mtu kupata kuugua/kupataa malaria.

Madhumuni ya utafiti

Lengo la utafiti huu ni kuchunguza sababu za kijamii na kiuchumi zinazosababisha mtu kupata kupata kuugua/kupata malaria, kwa kuwa kutokana na taarifa za kiutafiti zinaonesha kuwa eneo hili lina kiwango kikubwa cha maambukizi ya ugonjwa wa malaria.

Matokeo ya utafiti huu yatasaidia kutengeneza mkakati kwa ajili ya kudhibiti maambukizi ya malaria katika eneo hili. Hivyo, ushiriki wako katika utafiti hu ni muhimu sana katika kufikia lego hilo. Baada ya maelezo hayo, naomba uridhie kushiriki kwenye utafiti huu muhimu sana kwa mustakbali wa maendeleo ya wananchi wetu

Usiri

Taarifa zote utakazozitoa, kwa ajili ya utafiti huu kupitia mahojiano, zitakua ni siri na hakuna mtu mwingine ambaye hahusiki kwenye utafiti huu atakaziona.

Baada ya ukusanyaji wa taarifa zote, itaandaliwa ripoti ya utafiti huu, katika ripoti hiyo, jina la mtu aliyeshiriki kutoa taarifa halitatajwa wala utambulisho wowote mwingine hautaoeshwa kwenye ripoti hiyo. Namba iliyowekwa kwenye fomu ya dodoso ndio itatumika kama utambulisho wa taarifa utakayotoa.

Nini kinahitajika ili kushiriki

Ukiridhia kushiriki katika utafiti huu, utatakiwa kujibu maswahi kadhaa na kudhiria kuangalia baadhi ya vitu kwenye nyumba yako ili kupata taarifa zinazokusudiwa kwa ajili ya utafiti huu. Aidha, utaombwa kuchukuliwa damu kidong kwenye kidole kwa ajili ya kuangalia uwepo wa vimelea wa malaria kwenye mwili wako kwa ajili ya utafiti huu.

Faida

Taarifa unazotoa kwenye utafiti huu zitasaidia sana katika kujua sababu zinazochangia kuwepo kwa kiwango cha juu cha maambukizi ya ugonjwa wa malaria katika eneo hili. Matokeo ya utafiti huu yatawasilishwa kwa Uongozi wa Mkoa kwa ajili ya kupanga mikakati elekezi ya udhibiti wa malaria katika maeneo haya.

Haki ya kujitoa au vinginevyo

Kushiriki katika utafiti huu ni hiari na sio lazima. Hivyo unaweza kuamua kutoendelea kwenye utafiti huu wakati wowote na hakutakua na adhabu wala hutapoteza haki yako yoyote

Madhara

Utaulizwa maswali kuhusiana na sababu za kijamii na kiuchumi ambazo zinazochangia mtu kupata maambukizi ya malaria. Hakuna madhara yeyote yatakayojitokeza kwako au kwa familia yako kutokana na ushiriki wako/wenu katika utafiti huu.

Waajibu wa mtafiti mwanajamii aliyeridhia kushiriki katika utafiti huu

Mtafiti atawajibika kumuelekeza au kumpatia mwaja kaya aliyepimwa na kugundulika kuwa vimelea wa ugonjwa wa malaria dawa kama inavyoelekezwa kwenye Mwongozo wa Taifa wa uchunguzi na Tiba ya ugonjwa wa malaria wa Wizara ya Afya, Maendelea ya Jamii, Jinsia, Wazee na Watoto.

Nani wa kuwasiliana naye

Kama una swali lolote kuhusiana na utafiti huu tafadhali wasiliana na Mtafiti Mkuu anayeratibu utafiti huu Ndugu **Charles Dismas Mwalimu** (Simu; 0767269562).

Kwa maswali zaidi unaweza kuwasiliana Mwenyekiti wa Kamati ya Utafiti na Machapisho, simu Na. 2150302- 6 au 2152489.

S.L.P 65001

DAR ES SALAAM.

Je, Umekubali?

Mshiriki amekubali ( ), Mshiriki hajakubali ( )

Mimi_____nimesoma/nimeelezewa na kuridhia maelezo yote yaliyotolewa katika fomu hii, hivyo kwa ridhaa yangu mwenyewe nakubali kushiriki katika utafiti huu.

Saini ya Mshiriki_____

Sahihi ya mtafiti msaidizi_____

Tarehe _____

Appendix 3: Interview Schedule – English version

Consent Number _____Name of the Ward_____

Street_____

Interviewer name_____

Date of Interview _____/_____/_____

Introduction

We are researcher from Muhimbili University of Health and Allied Sciences (MUHAS). We are conducting research on **"Factors Associated with Persistent Malaria in selected Peri- urban areas in Dar es Salaam"**. The results of this study will be used by Region and District authorities in developing context specific control strategies to reduce malaria prevalence in these areas. You are allowed to ask questions where not clear. All information's you give will be confidential and will not share.

A) Socio- Economic and Demographic characteristics

1. Age _____ years
2. Education level (*Tick that apply*)
   - 2.1. No formal education ( )
   - 2.2. Primary educations ( )
   - 2.3. Secondary education ( )
   - 2.4. college ( )
3. Occupation (Tick that apply)
   - 3.1. Farmer ( )
   - 3.1. Unemployed ( )
   - 3.2. Employee ( )
   - 3.3. Businessman ( )
4. Average income earning in TSH per month *(Tick that apply)*
   - 4.1. Less than 200,000 ( )
   - 4.2. Between 210,000 and 300,000 ( )
   - 4.3. Between 301,000 and 400,000 ( )
   - 4.4. 400,000 and above ( )

5. Do you have nets? *(Tick that apply)*

   5.1. Yes ( )

   5.2. No ( )

6. If yes in question 5 above is the net you have treated? *(Tick that apply)*

   6.1. Yes ( )

   6.2. No ( )

   6.3. Don't know ( )

7. If the answer is yes in question 8 above, do you use the ITNs

   7.1. Yes ( )

   7.2. No ( )

8. If the answer is yes in question 7 above, how often do you use the ITNs

   8.1. Every night ( )

   8.2. Sometimes ( )

   8.3. Never ( )

9. If the answer is never in question 8 above, why did you not use the ITNs

   9.1. Fell hot when using ITN at night ( )

   9.2. The ITNs I have is torn ( )

   9.3. Any other reason_____

B) Individual Risk Behaviour

10. For the last two weeks, have you travelled outside Dar es Salaam? *(Tick that apply)*

    10.1. Yes ( )

    10.2. No ( )

11. If the answer is yes in question 11 above, how many days did you spent there? *(Tick that apply)*

    11.1. Less than 1 week ( )

    11.2. More than 2 weeks ( )

12. What outdoor activities most often makes you to sleep late *(Tick that apply)*

    12.1. Social gathering ( )

    12.2. Sell food during night ( )

    12.3. Religious convictions ( )

    12.4. Studying ( )

    12.5. Don't have outdoor activitiesnight ( )

13. Time of going to bed/sleep *(Tick that apply))*

    13.1. 19:00 to 20:00 hours

    13.2. 21:00 to 22:oo hours

    13.3. 23:00 hours to mid night

14. Do you use any preventive measures to prevent yourself from mosquito bites when your outdoor at night? *(Tick that apply)*

    14.1. Yes ( )

    14.2. No ( )

15. If yes in question 14 above, which among the following

    15.1. Use of mosquito repellent ( )

    15.2. Wearing of clothes with long sleeves ( )

    15.3. Any

    15.4. other specify_____

C) Environmental Factors (Observation Checklist)

16. Observe if there is presence of breeding sites around the house *(Tick that apply)*

    16.1. Yes ( )

    16.2. No ( )

17. Estimate ddistance of the house/household from the breeding sites

    17.1. Less that 5 kilometres ( )

    17.2. More than 5 kilometres ( )

18. Observe presence of the following in the house where households resides

18.1. Open eaves on top of the wall present ( )

18.2. Open eaves on top of the wall not present ( )

18.3. Screened window ( )

18.4. Unscreened window ( )

19. Observe type of material used for roofing the house *(Tick that apply)*

19.1. Corrugated iron sheets ( )

19.2. Thatch roof ( )

19.3. Any other type_____

20. Observe hanging of the Net on the sleeping bed (Tick that apply)

20.1. Hanged ( )

20.2. Not hanged ( )

Appendix 4: Questionnaires- Kiswahili

Namba ya Kuridhia Ushiriki _____

Jina la Kata_____

Mtaa_____

Jina la Mtafiti_____

Tarehe ya mahajiano_____/_____/_____

Utangulizi

Timu hii ni ya Watafiti kutoka Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili. Tunafanya utafiti juu ya sababu zinazosababisha kuendelea uwepo kwa kiwango cha juu cha maambukizi ya malaria katika maeneo haya. Matokea ya utafiti huu yatasaidia kutengeneza mikakati kwa ajili ya kudhibiti maambukizi ya malaria katika eneo hili. Unaweza kuuliza swali pale ambapo hapaeleweki. Taarifa zote utakazo toa kwa ajili ya utafiti huu zitakuwa ni siri na hakuna mtu mwingine ambaye hahusiki kwenye utafiti huu atakayeziona.

A) Sababu za Kijimii, Kiuchumi na Ki- demografia

1. Umri kwa miaka _____
2. Kiwango cha elimu (*Weka alama ya vema kwenye jibu sahihi*)
   - 2.1 Hajasoma ( )
   - 2.2 Elimu ya msingi ( )
   - 2.3 Elimu ya sekondari
   - 2.4 Elimu ya chuo
3. Kazi ya mhojiwa: (*Weka alama ya vema kwenye jibu sahihi*)
   - 3.1. Mkulima ( )
   - 3.2. Hana ajira ( )
   - 3.3. Ameajiriwa ( )
   - 3.4. Mfanya biashara ( )
4. Kipata kwa mwezi, fedha za Kitazania *(Weka alama ya vema kwenye jibu sahihi)*

   - 4.1. Kati ya 100,000 and 200,000 ( )
   - 4.2. Kati ya 201,000 and 300,000 ( )
   - 4.3. Kati ya 301,000 and 400,000 ( )
   - 4.4. Zaidi ya 410,000 ( )

5. Je una Chandarua chenye ? *(Weka alama ya vema kwenye jibu sahihi)*
   5.1. Ndio ( )
   5.2. Hapana ( )

6. Kama jibu lako ni ndio, kwenye swali Na. 5 hapo juu, Je chandarua/ vyandarua ulivyonavyo vimewekwa dawa ? (*(Weka alama ya vema kwenye jibu sahihi)*
   6.1. Ndio ( )
   6.2. Hapana ( )
   6.3. Sijui ( )

7. Kama jibu lako ni ndio kwenye swali Namba 6 hapo juu. Je unatumia chandarua chenye dawa. *(Weka alama ya vema kwenye jibu sahihi)*
   7.1. Ndiyo ( )
   7.2. Hapana ( )

8. Kama jibu lako ni ndio kwenye swali Na. 7 hapo juu. Je unatumia Chandarua hicho wakati ngani ? *(Weka alama ya vema kwenye jibu sahihi)*
   8.1. Kila ninapolala wakati wa usiku ( )
   8.2. Baadhi ya wakati ninapoona kuna mbu ( )
   8.3. Situmia kabisa ( )
9. Kama jibu lako kwenye swali 8 hapo juu hutumii kabisa, Je kuna sababu yoyote inayosababisha usitumie chandarua chenye dawa *(Weka alama ya vema kwenye jibu sahihi)*
   9.1. Ninapotumia Chandarua nasikia joto
   9.2. Chandarua /vyandarua nilivyonavyo vimechanika/vinamatundu

B) Tabia ya mtu mmoja mmoja

10. Katika kipindi cha wiki mbili zilizopita, je umewahi kusafiri nje ya Dar es Salaam? *(Weka alama ya vema kwenye jibu sahihi)*
    10.1. Ndiyo ( )
    10.2. Hapana ( )

11. Kama jibu ni ndiyo, kwenye swali Na. 10 hapo juu. Je ni idadi ya siku ngapi umekuwa nje ya Mkoa wa Dar es Salaam? *(Weka alama ya vema kwenye jibu sahihi)*
    - 11.1. Chini ya wiki 1 ( )
    - 11.2. Zaidi ya wiki 2 ( )

12. Ni shughuli ngani zinakufanya utumia muda mwingi ukiwa nje wakati wa usiku*(Weka alama ya vema kwenye jibu sahihi)*
    - 12.1. Vikao vya kijamii wakati wa usiku ( )
    - 12.2. Kupika na kuuza chakula wakati wa jioni ( )
    - 12.3. Mikutano ya kidini na maombezi ( )
    - 12.4. Kujisomea ( )
    - 12.5. Sina kazi yoyote wakati wa usiku ( )

13. Muda unaokwenda kulala wakati wa usiku *(Weka alama ya vema kwenye jibu sahihi)*
    - 13.1. Kati ya saa moja usiku hadi saa 2 Usiku ( )
    - 13.2. Kati ya saa 3 usiku hadi saa 4 Usiku ( )
    - 13.3. Zaidi ya saa 5 ya Usiku ( )

14. Je unatumia kinga yoyote ya kujizuia wewe mwenyewe usiumwe na mbu wakati unapokuwa nje wakati wa usiku? *(Weka alama ya vema kwenye jibu sahihi)*
    - 14.1. Ndio ( )
    - 14.2. Hapana ( )

15. Kama jibu ni ndiyo kwenye swali Na. 14 hapo juu.Je ni aina ngani ya kinga unayotumia kujinginga usiumwe na mbu? *(Weka alama ya vema kwenye jibu sahihi)*
    - 15.1. Natumia dawa za kupaka kufukuza mbu
    - 15.2. Navaa nguo zinazofunika mikono na miguu wakati wa usiku
    - 15.3. Njia nyingine yoyote unayotumia taja_____

C) Sababu za Ki- Mazingira (Orodha hakiki)

16. Angalia uwepo wa mazalia ya mbu kuzunguka eneo la nyumba/kaya (*(Weka alama ya vema kwenye jibu sahihi)*

    16.1. Kuna mazalia ya mbu ( )

    16.2. Hakuna mazalia ya mbu ( )

17. Wastani wa umbali kutoka kwenye eneo la nyumba/kaya na mazalia ya mbu

    17.1. Wastani wa chini ya kilomita 5 ( )

    17.2. Wastani wa zaidi ya kilometa 5 ( )

18. Nyamba wanamo kaa wanakaya. Angalia uwepo wa vipengele vifuatavyo *(Weka alama ya vema kwenye jibu sahihi)*

    18.1. Kuna uwazi sehemu ya juu ya nje ya ukuta ( )

    18.2. Hakuna uwezi sehemu ya juu ya nje ya ukuta ( )

    18.3. Madirisha hayana wavu wa kuzuia mbu ( )

    18.4. Madirisha yana wavu kuzuia mbu ( )

19. Angalia aina ya paa iliyowekwa kwenye nyumba *(Weka alama ya vema kwenye jibu sahihi)*

    26.1. Paa la bati ( )

    26.2. Paa la nyasi ( )

    26.3. Aina nyingine ya paa_____

20. Angalia kama chandarua kimetundikwa kwenye kitandani

    20.1. Kimetundikwa ( )

    20.2. Hakijatundikwa ( )

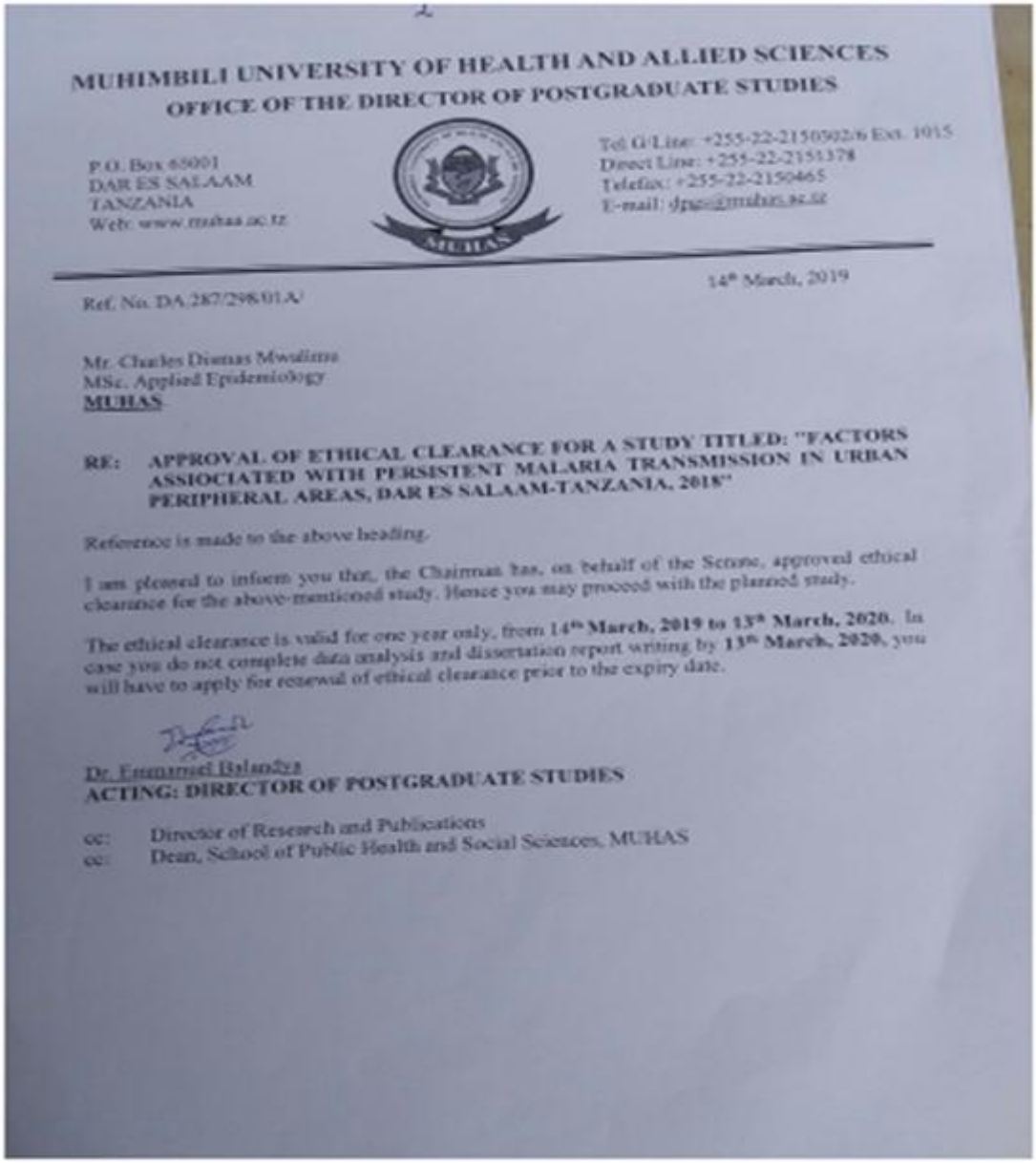
Appendix 5: Malaria mRDT test results form

S/#	CONSENT No.	SEX		Age	mRDT Results	
		Male	Female		Positive	Negative
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						
21.						
22.						
23.						
24.						
25.						

Appendix 6: Form ya kipimo cha matokeo ya mRDT ya Kiswahili

Na.	**Namba ya kuridhia kushiriki.**	**JINSIA**		**Umri**	**Matokeo ya Kipimo cha mRDT**	
		Mme	**Mke**		**Ana Vimelea wa malaria**	**Hana Vimelea wa malaria**
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						
13.						
14.						
15.						
16.						
17.						
18.						
19.						
20.						
21.						

Appendix 7: Ethical Clearance



MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR OF POSTGRADUATE STUDIES

P.O. Box 65001
DAR ES SALAAM
TANZANIA
Web: www.muhas.ac.tz

Tel G/Line: +255-22-2150302/6 Ext. 1015
Direct Line: +255-22-2151378
Telefax: +255-22-2150465
E-mail: dpgs@muhas.ac.tz

Ref. No. DA.287/298/01A/

14th March, 2019

Mr. Charles Dismas Mwalimu
MSc. Applied Epidemiology
MUHAS

RE: APPROVAL OF ETHICAL CLEARANCE FOR A STUDY TITLED: "FACTORS ASSIOCIATED WITH PERSISTENT MALARIA TRANSMISSION IN URBAN PERIPHERAL AREAS, DAR ES SALAAM-TANZANIA, 2018"

Reference is made to the above heading.

I am pleased to inform you that, the Chairman has, on behalf of the Senate, approved ethical clearance for the above-mentioned study. Hence you may proceed with the planned study.

The ethical clearance is valid for one year only, from 14th **March, 2019 to 13th March, 2020.** In case you do not complete data analysis and dissertation report writing by **13th March, 2020,** you will have to apply for renewal of ethical clearance prior to the expiry date.

Dr. Emmanuel Balandya
ACTING: DIRECTOR OF POSTGRADUATE STUDIES

cc: Director of Research and Publications
cc: Dean, School of Public Health and Social Sciences, MUHAS

Appendix 8: Introduction letter to Dar es Salaam Region authorities

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR OF POSTGRADUATE STUDIES

P.O. Box 65001
DAR ES SALAAM
TANZANIA
Web: www.muhas.ac.tz

Tel G/Line: +255-22-2150302/6 Ext. 1015
Direct Line: +255-22-2151378
Telefax: +255-22-2150465
E-mail: dpgs@muhas.ac.tz

Ref. No. HD/MUH/T.333/2017

15th March, 2019

Director
Ilala Municipal Council
DAR ES SALAAM.

Re: INTRODUCTION LETTER

The bearer of this letter Mr. Charles Dismas Mwalimu is a student at Muhimbili University of Health and Allied Sciences (MUHAS) pursuing MSc. Applied Epidemiology.

As part of his studies he intends to do a study titled: ***"Factors associated with persistent malaria transmission in urban periphreral areas, Dar es Salaam-Tanzania, 2018".***

The research has been approved by the Chairman of University Senate.

Kindly provide him the necessary assistance to facilitate the conduct of him research.

We thank you for your cooperation.

Ms. Sharifa Kamby
For: DIRECTOR, POSTGRADUATE STUDIES

cc: Dean, School of Public Health and Social Sciences, MUHAS

Appendix 9: Permission to conduct research in Ilala Municipality

THE UNITED REPUBLIC OF TANZANIA
President's Office
REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

DAR ES SALAAM REGION
Phone Number: 2203158
Fax number: 2203158
email: ras@dsm.go.tz
website: www.dsm.go.tz

In reply please quote:
Ref. No. .....

REGIONAL COMMISSIONER'S OFFICE,
3 RASHID KAWAWA ROAD,
P.O. BOX 5429,
12880 DAR ES SALAAM

20 MARCH 2019

District Administrative Secretary,
ILALA,
P. O. Box .....,
DAR ES SALAAM.

RE: RESEARCH PERMIT

Prof/Dr/Mrs/Ms/Miss CHARLES DISMAS MWALIMU is student/**Research** from MUHAS has been permitted to undertake research on FACTORS ASSOCIATED WITH PERSISTENT MALARIA TRANSMISSION IN URBAN PERIPHERAL AREA, ILALA DAR, TANZANIA

From MARCH 2019 to JUNE 2019.

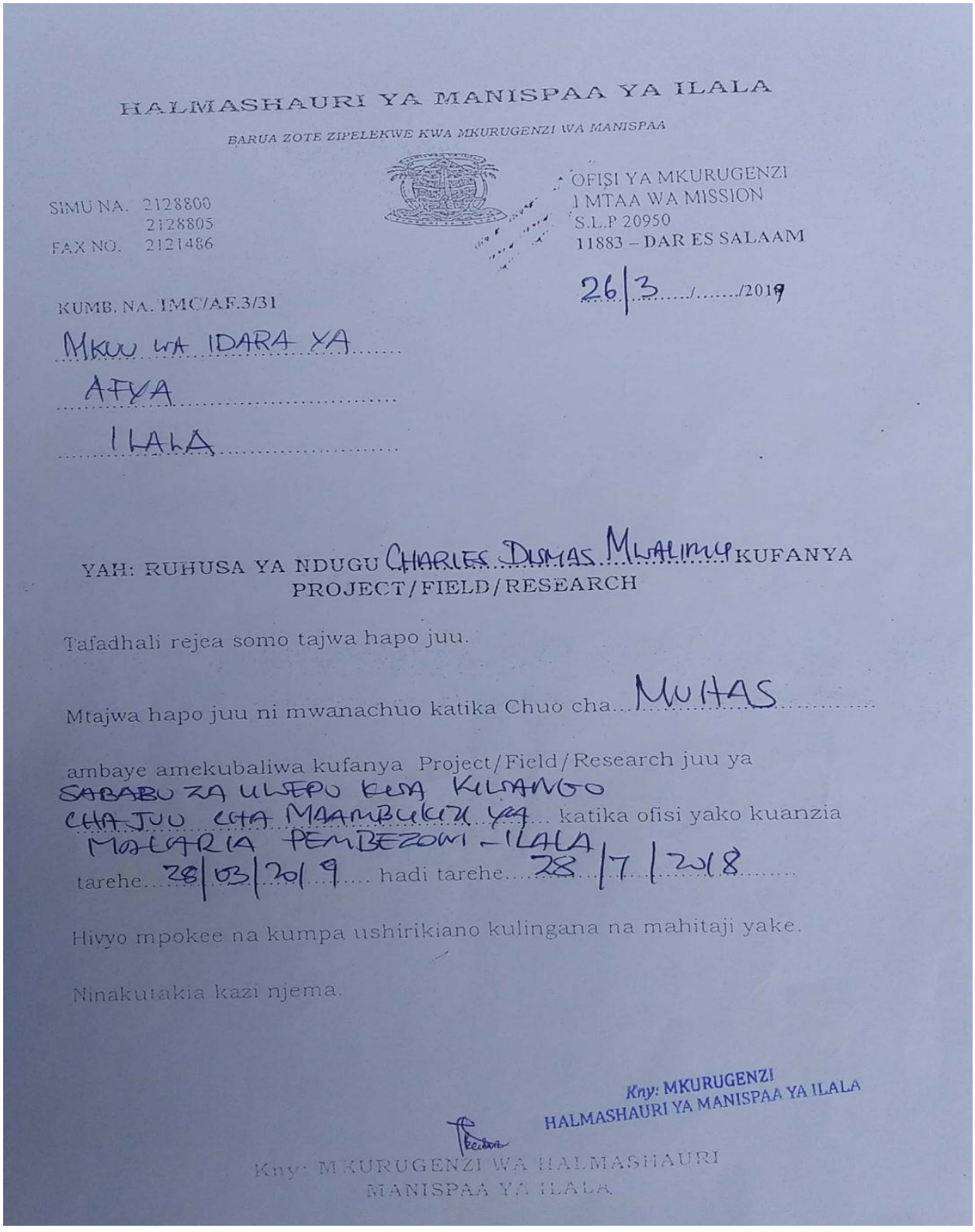
I Kindly request your good assistance to enable her/his research.

.....
For; **REGIONAL ADMINISTRATION SECRERTARY**
DAR ES SALAAM

Copy: Municipal Director,
ILALA
DAR ES SALAAM.

Principal/Vice Chancellor
MUHAS

Appendix 10: Research permission from Medical Officer of Health Ilala- Municipal



HALMASHAURI YA MANISPAA YA ILALA

BARUA ZOTE ZIPELEKWE KWA MKURUGENZI WA MANISPAA

OFISI YA MKURUGENZI
I MTAA WA MISSION
S.L.P 20950
11883 – DAR ES SALAAM

SIMU NA. 2128800
2128805
FAX NO. 2121486

26/3/2019

KUMB. NA. IMC/AF.3/31

MKUU WA IDARA YA
AFYA
ILALA

YAH: RUHUSA YA NDUGU CHARLES DISMAS MLALIMU KUFANYA PROJECT/FIELD/RESEARCH

Tafadhali rejea somo tajwa hapo juu.

Mtajwa hapo juu ni mwanachuo katika Chuo cha MUHAS

ambaye amekubaliwa kufanya Project/Field/Research juu ya SABABU ZA ULEPO KWA KILIANGO CHA JUU CHA MAAMBUKIZI YA MALARIA PEMBEZONI - ILALA katika ofisi yako kuanzia tarehe 28/03/2019 hadi tarehe 28/7/2018

Hivyo mpokee na kumpa ushirikiano kulingana na mahitaji yake.

Ninakutakia kazi njema.

Kny: MKURUGENZI
HALMASHAURI YA MANISPAA YA ILALA

Kny: MKURUGENZI WA HALMASHAURI
MANISPAA YA ILALA

Appendix 11: Permission letter to conduct research in Ilala Municipal Council



ILALA MUNICIPAL COUNCIL

ALL COMMUNICATIONS TO BE ADDRESSED TO THE MUNICIPAL DIRECTOR

PHONE NO: 2128000
2128005
FAX NO. 2121456

MUNICIPAL OFFICE
1 MISSION STREET
P.O. BOX 20950
11883 DAR ES SALAAM

Ref: IMC/DR.6/1V/87

29 March, 2019

TO WHOM IT MAY CONCERN

RE: PERMISSION TO CONDUCT A RESEARCH

Reference is made to the above heading

This is to introduce Charles O Mwalimu a students at MUHAS pursuing a MSc in applied Epidemiology who is requesting a permission to conduct a research at your facility

The Research Title is: **Factors associated with persistent malaria transmission in urban Peripheral areas in Ilala, dar es Salaam**

Permission has thus been granted to conduct the above mentioned study in our Municipal with a condition that she should bring a study results to the Municipal as a feedback.

I kindly request your assistance and support

Dr Willy Sanga
For: MMOH - ILALA MUNICIPAL COUNCIL