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Household Determinants of Malaria in Mutasa District of Zimbabwe

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Abstract

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MSc, University of Derby, 1999

BTech, Pretoria Technikon, 2001

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Dissertation Submitted in Partial Fulfillment

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Abstract

Malaria is a vector borne, acute febrile illness, caused by Plasmodium parasites. Malaria impacts the medical and socioeconomic development programs of affected communities, as it diverts both individual and national resources into managing the disease burden. The purpose of this study was to explore and evaluate household determinants of malaria in Mutasa District, Zimbabwe. The precede–proceed theoretical model guided the study. Secondary data from Demographic Health Survey and District Health Management Information System, and current data from household determinant questionnaires, were used to evaluate the influence and significance of identified household determinants. Multiple logistic regression models were used to examine the association between malaria prevalence and the identified household determinant factors. The study result showed the existence of household determinant factors that affected the prevalence of malaria in Mutasa District. The presence of livestock animals within a 50-meter radius of the household, ownership of animal drawn carts and low socioeconomic status significantly increased malaria risk, while availability of drinking water within a 50-meter radius of the household, significantly reduced malaria risk. Other variables, although not statistically significant, had varied levels of malaria infection risk. The study results may contribute to positive social change by providing an insight into innovative strategies that enhance existing interventions. The study results may also provide opportunities for upgrading malaria intervention policies and sustainable community participation, thus enhancing malaria elimination efforts.

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Dedication

I dedicate this dissertation to my late parents, Eric and Sithembeni Zinyengere. You inspired me throughout my life and gave me hope in everything I did. May your Saul’s rest in eternal peace.

Acknowledgments

This has been an incredible and invaluable journey. Ever since my enrolment as a Walden Student back in September 2013 the study program has been a major part of my life. I spent countless hours sifting through literature and discussing with relevant colleagues in the Malaria fraternity with regards my study subject. Up until then I did not realize how passionate I felt about the elimination of malaria, not only in Zimbabwe but throughout the world. Apart from the subject matter, I learnt a lot more about myself and my relationships with family, friends and pears.

My studies would not have been possible without the help, advice, support, and continuous prodding when necessary from a number of extraordinary people, and I am forever grateful to all of them. First, I would like to thank the Almighty God for making this endeavor possible for me. Next, I would like to extend my sincere gratitude to Professor Shingairai Feresu, my committee chairperson, for her invaluable guidance, advice, and for continuously challenging me to achieve more. I would also like to express my appreciation to all my associates and colleagues in my diverse work environment for their support and appropriate insights at relevant moments. I would also like to thank the Walden Academic advising team whenever I was experiencing technical challenges. I would also like to appreciate the support I received from colleagues in the Ministry of Health and Child Care. Lastly, but not the least, I would like to thank all my family members for their support, motivation, and having to endure some of my difficult moments and whom I deprived of the full attention and love whenever they so dearly needed it. To all I say I can never thank you enough.

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Chapter 1: Introduction to the Study

Malaria is an acute febrile illness caused by the Plasmodium parasites, transmitted from person to person by the bites of infected female *Anopheles* mosquitoes. (World Health Organization [WHO], 2016). Five parasite species are responsible for malaria infection in humans, with two of these (*P. falciparum* and *P. vivax*) posing the biggest threat. *P. falciparum* is most prevalent in Africa, while *P. vivax* is most prevalent outside the sub-Sahara Africa (WHO, 2016). According to WHO (2016), an estimated 212 million cases of malaria were reported worldwide in 2015, resulting in 429 000 deaths. The disease, which is preventable and curable, is endemic in 91 countries (WHO, 2016). As of year, 2015, the sub-Saharan Africa accounted for 90% of the global malaria cases and 92% of the deaths (WHO, 2016).

Current concerted global efforts, particularly in affected countries, have reduced the malaria burden in most countries (PMI, 2014). These intervention efforts include integrated vector management (IVM), use of long lasting insecticide treated nets (LLIN), intermittent presumptive treatments (IPTp), and passive case detection and treatment (WHO, 2014). These efforts resulted in malaria incidence of approximately 21 % during the period 2010 and 2015 (PMI, 2014; WHO, 2016). During the same period, mortality was reduced by 29% in all age groups; in children under 5 years of age, a 35% reduction was experienced. However, the malaria burden still remains a challenge for children under 5-years-old, with a child dying of malaria every 2 minutes (WHO, 2016).

Despite the intervention efforts and the use of resources to combat the disease, malaria remains a public health challenge (Benelli & Mehlhorn, 2016), particularly in the sub-Sahara African countries where most deaths continue to occur (WHO, 2015). Public health scholars have questioned whether current intervention measures and operational research activities are sufficiently exhaustive (Guyan et al., 2015; Hemingway, 2014; Hemingway et al., 2016; Zhou et al., 2014). There are other risk factors for malaria, particularly those related to socioeconomic factors (Gunathilaka, Abeyewickreme, Hapugoda, & Wickremasinghe, 2016; Yadav, Dhiman, Rabha, Saikia, & Veer, 2014). Scholars have investigated and evaluated the socioeconomic factors that are correlated with malaria, particularly the household determinants of malaria and their potential for influencing intervention policies to eliminating malaria (Guyan et al., 2015).

The results of this study may lead to positive social change by enhancing malaria intervention strategies within the communities living in malaria endemic areas. Because malaria incidence, in addition to the known biological and environmental factors, has been associated with poverty (Ricci, 2012; Yadav et al., 2014) and socioeconomic status (Tusting et al., 2016), social change is expected to result from eliminating malaria. Iproved health status and improved economic opportunities are expected to result from the reduction of malaria prevalence (Home, 2014; Tusting et al., 2016).

In Mutasa, Sande et al. (2016) examined a malaria endemic district in the North-Eastern part of Zimbabwe and found that Zimbabwe continues to experience a malaria burden. The malaria disease continues to tax the country's resources while causing both social and economic hardships to the affected communities and the country (MOH&CC, 2015). The target of malaria elimination can be obtained by addressing the elements that may influence or mediate the incidence of the disease. In this study, I evaluated established household determinants of malaria and their potential to enhance the current intervention strategies within the malaria endemic communities. The anticipated positive social changes would include the adoption of appropriate intervention strategies and the positive socioeconomic outcomes that derive from a malaria-free community.

In this chapter, I will highlight the malaria problem and the need for a paradigm shift for malaria elimination in Zimbabwe, in relation to the regional and global situation. I will explore the gap in malaria control and elimination knowledge and introduce the problem as determined by the knowledge gap. I will present the theoretical framework for the research, and the chapter will conclude with assumptions, scope, delimitations, and any limitations relevant to the study.

Background

Malaria has affected many communities in malaria-endemic countries (Guyan et al., 2015; Hemingway et al., 2016). Malaria impacts communities epidemiologically, economically or anthropologically (Center for Disease Control and Prevention [CDC], 2016; Maigemu & Hassan, 2015). In 2007, the Bill and Melinda Gates Foundation and the WHO led the fight to eradicate malaria. The Bill and Melinda Gates Foundation (2017) invested in the research and establishment of a diverse mix of innovative tools to reach the malaria elimination goal. However, the intervention tools have fallen short of achieving malaria elimination, and the disease continues to be a challenge.

There is a need for research into new tools and strategies to eliminate malaria (Guyan et al., 2015; Hemingway et al., 2016). The establishment of new tools would require resources to initiate and evaluate strategies to enable the achievement of an optimum synergistic effect (Guyan et al., 2015; Hemingway et al., 2016). It is imperative to establish more strategies to mitigate the disease and its transmission (Hemingway et al., 2016). Scholars must address the shortcomings of the strategies to eliminate malaria (Guyant et al., 2015). One such variable requiring evaluation is the household determinants or risk factors of malaria (Semakula, Song, Zhang, & Achuu, 2016). Semakula et al. (2016) examined household factors and their influence on malaria transmission in children, illustrating the need for further evaluation over the whole age group spectrum. Similarly, Kanyangarara et al. (2016) explored and evaluated identified, individual, and household malaria risk factors and noted their consideration in malaria control. Some households are more prone to malaria than others, with some households experiencing more malaria episodes; hence, the need for a micro epidemiology to isolate the reasons for malaria prevalence (Bannister-Tyrrell et al., 2017).

Few scholars have examined household determinants of malaria; therefore, there is a need to explore a multipronged approach to malaria control and elimination (Bannister-Tyrrell et al., 2017; Semakula et al., 2016). The household determinants are within the context of social, cultural, and economic factors of malaria epidemiology. Although reductions in malaria morbidity and mortality have been attained within Zimbabwe and even globally, there still remains a malaria incidence and prevalence (MOH&CC, 2015). Proactive strategies tantamount to preempting possible malaria hotspots could potentially enhance the malaria elimination efforts (Moonasar et al., 2013). Consequently, the study may assist global and regional stakeholders in their quest to eliminate malaria within this generation (Hemingway et al., 2016).

Household Determinants of Malaria to be Considered

In different locations throughout the sub-Saharan Africa, scholars have identified a number of household determinants for malaria prevalence, and these factors were considered as part of the formative background for the current study. These determinants included gender, range of household age, occupational/employment levels (farming and other income generating activities), type of housing and materials used in the construction (roof, walls, floors, openings), household hygiene, household lighting (electrified or not), type and location of sanitary facilities, household location and related distance to both water sources, (natural or other water bodies), and health facilities. Disposable income or the wealth index of household, educational levels of household, knowledge of malaria, religion, culture, household nutritional status, presence of other disease conditions within the household, and historical and existing malaria intervention strategies were examined (Ayele, Zewotir, & Mwambi, 2012; Chirebvu, Chimbari, & Ngwenya, 2014). The results of this study may enhance current intervention strategies and the goal of eliminating malaria. The results of this study may be of benefit to the affected communities through positive socioeconomic development and improved health of the communities.

Problem Statement

In Zimbabwe, malaria-related morbidity and mortality continue to impact on the country's socioeconomic developmental programs (MOH&CC, 2015). The current malaria control program is largely donor-funded, exposing the country to potential threat of donor fatigue and the possible challenges to the sustainability of ongoing malaria control and elimination intervention goals. Malaria incidence declined from 136/1,000 in 2000 to 22/1,000 in 2012 (PMI/Abt Associates, 2014; MOH&CC, 2015) as a result of multipronged approaches supported by both local and international partnerships (MOH &CC, 2015); however, the disease remains one of the top 10 leading causes of morbidity in the country (PMI, 2015) with 480,000 cases and 713 deaths being recorded in 2014 (PMI, 2016). As illustrated in Figure 1, malaria occurrence has been determined by biological and environmental factors (or factors that directly influence the malaria life cycle): the vector mosquito, the human being, the parasite, and the environmental factors (WHO, 2015). Consequently, scholars have placed more emphasis on these biological elements when considering the disease epidemiology.

Figure 1. Traditional determinants of malaria**.**

Determinants influencing the distribution of malaria in the world include life cycle/ parasite dynamics (Childs & Buckee, 2015; WHO, 2013) and environmental elements (Endo & Eltahir, 2016; Roux et al., 2013; Shimaponda-Mataa, Tembo-Mwase, Gebreslasie, Achia, & Mukaratirwa, 2017). Within environmental aspects, scholars have focused on determinants of transmission related to climate and its influence on vectorial and parasitological capacity (Afrane, Githeko, & Yan, 2012; Maharaj et al., 2013; Murdock et al., 2012; Murdock, Sternberg, & Thomas, 2016). The Malaria Eradication Agenda forum (MalERA) has focused on seven distinct themes that are not inclusive of household determinants. Their themes only included the following: drugs, vaccines, vector control, modeling, monitoring and evaluation/surveillance, integration strategies, and health systems/operations (Brown & Rogerson, 2016; Monitoring, 2011).

The variability of malaria within households in the same village or between villages has also been an issue of concern and one that has not received adequate attention (Bannister-Tyrrell et al., 2017). This has resulted in a poor understanding of the micro epidemiology of malaria and the continued sustenance of transmission (Bannister-Tyrrell et al., 2017). In this study, I aimed to understand these variations in malaria risk across the household settings. The study presented an opportunity to define intervention strategies for malaria micro epidemiology (Bannister-Tyrrell et al., 2017). Such a strategy may enhance the efforts to eliminate malaria in Mutasa District and the rest of the country.

David, Lauren, Ryan, and Lauren (2017) explained the importance of malaria household determinant studies at the community, or cluster household levels, to ensure appropriate intervention strategies. However, in malaria-endemic countries, particularly those moving into pre elimination like Zimbabwe, epidemiological considerations require elimination efforts to focus on risk mapping to improve available intervention strategies

(Alimi et al., 2015). Traditional malaria intervention strategies, such as the use of LLINs, indoor residual spraying, and treatment of cases with approved antimalaria drugs such as the artemisinin-based combination therapies (ACT) have reduced malaria but may not achieve elimination (Ingabire et al., 2015; Jobin, 2013). In this regard, understanding the risk determinants at the household level may enhance intervention policies and the attainment of malaria elimination goals (Alimi et al., 2015).

Purpose of Study

In this study, I quantitatively examined the levels of influence of identified household determinant variables to malaria morbidity and mortality in the Mutasa District of Zimbabwe. Mutasa District was selected due to its high levels of malaria morbidity within the country. The level of current support from various stakeholders in the Mutasa district, both material and financial, provides a motivation for establishing sustainable and innovative intervention strategies for malaria elimination.

Zimbabwe is among the eight Southern African countries (Malaria Elimination 8), sharing the goal of eliminating malaria within the region by 2030 (Elimination 8, 2016; Global Health Sciences, 2015; PMI, 2016). This initiative makes it necessary for the country to know which individuals are likely to be infected and the reasons for their infection (Elimination 8, 2016; WHO, 2017). However, the Ministry of Health and Child Care and WHO have indicated such knowledge does not exist (MOH&CC, 2015; WHO, 2016). Existing intervention tools will not achieve malaria elimination sooner (Guyan et al., 2015; Jobin, 2013; Tanner et al., 2015). The results of this study may address the continued challenges of residual transmission sustaining the continued prevalence of malaria (Njoroge et al., 2017)

Significance of Study

The study outcomes are expected to contribute to the existing body of knowledge regarding intervention policies and socioeconomic development within the affected malaria-endemic communities. At the individual, household, community, and the national level, the study outcomes are expected to lead to positive social change in relation to the identified influential household determinants. The household determinants are considered to be part of the micro epidemiology of malaria and are an element within the malaria elimination agenda (Bannister-Tyrrell et al., 2017). Some of the expected changes would be driven by appropriately targeted educational programs to foster social change in relation to malaria. Better household siting and construction could minimize vulnerability to vector entry and biting within the affected populations.

Families and communities could be proactively involved in malaria surveillance and control programs. Traditional cultures or religions could be better informed on ways to mitigate disease incidence. The cultures and religions that influence how their community, sect, or religious members should respond to disease and particularly malaria intervention programs are of upmost importance. According to Tanner et al. (2015), a mix of variables, such as the community in which a person lives, age spectrum, levels of nutritional being, and certain parameters of economic and socioeconomic levels may predispose individuals and their households to being infected with the malaria parasite and possibly even dying from it. The results of this study may assist in the control and elimination efforts of malaria by informing strategies for both current and future malaria intervention strategies.

Theoretical Framework

Research, practice, and theory have a complex, interlinked relationship (Hutchings & Jarvis, 2012). This relationship, which is influenced by various factors including political, economic and social concerns results in policy interventions and many other local and global factors (Hutchings, & Jarvis, 2012). Scholars have examined the biological causal relationships of malaria incidence. Appropriate theoretical models are needed to enhance understanding of the household determinants of malaria in the Mutasa District. After considering a number of possible theories, the precede-proceed model emerged as the most appropriate to use in this study.

This study was grounded on the precede-proceed model, as there have been numerous efforts to evaluate programs of malaria in the Mutasa District, Zimbabwe. In this study however, I used Phase 2 of the model, which embodies environmental assessment in terms of behavior and environment. In this study, I sought to establish the relationship of household determinant factors with malaria incidence and prevalence (Community Tool Box, 2016; McKenzie et al., 2016), which will assist with health programs on malaria assessment and evaluation. The model also enables an examination of malaria household determinants within the study population to enhance the success of current intervention strategies. Figure 2 shows the model.

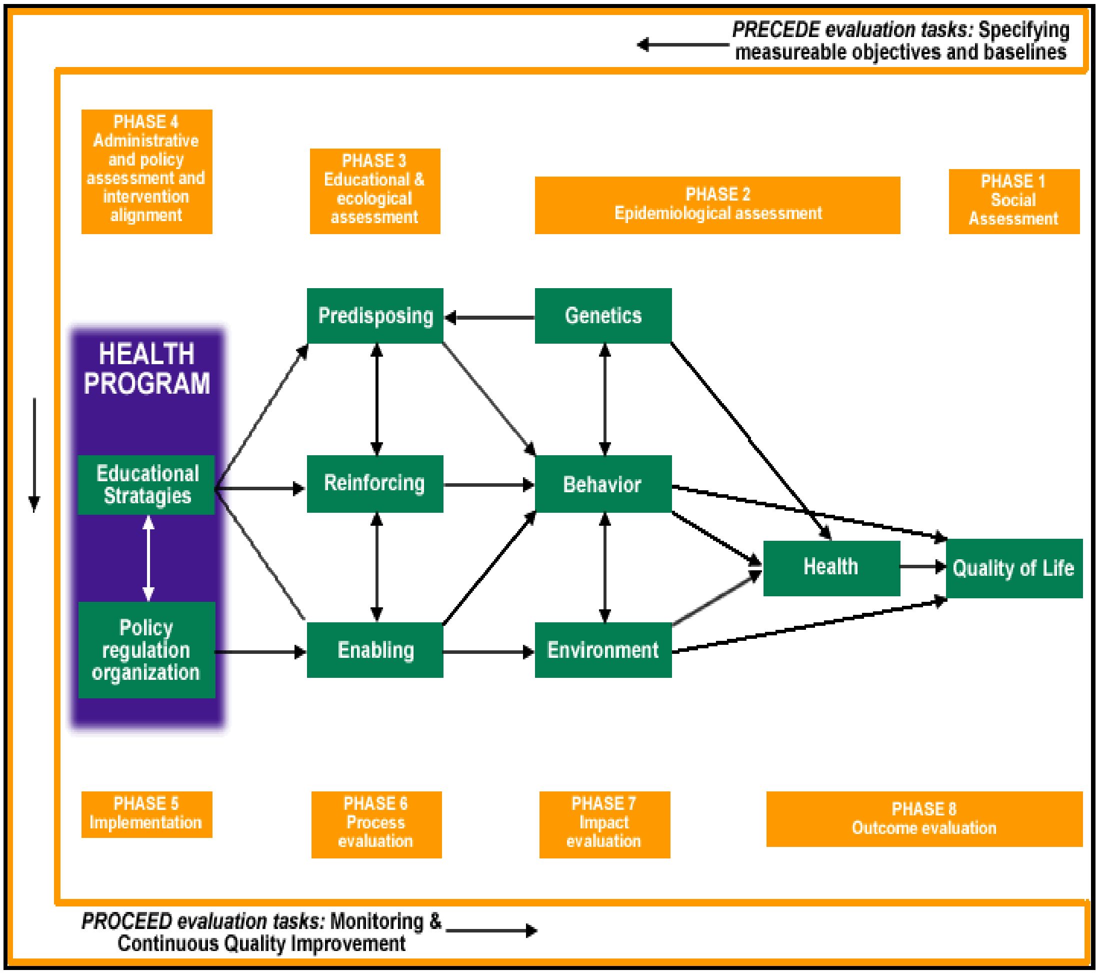

Figure 2. Generic representation of the precede-proceed model. Adapted from "Health promotion Planning: An Educational and Ecological Approach (4th Ed)" by L. Green and M. Kreuter, 2005, Copyright.

The diversity of the identified potential determinants, and any other determinants that may emerge during the household survey, requires a broader framework to ensure an evaluation that not only covers the household behavioral variable factors, but also considers the ecological and socioeconomic variable factors within the household context (Smith et al., 2014). The precede-proceed theoretical model enables examination of possible determinants, either as structural or intermediary determinants (Community Tool Box, 2016; McKenzie et al., 2016; Porter, 2016). All possible parameters were determined and analyzed for significance, and those determined to be significant may be used to enhance the policy determination of future malaria intervention programs.

Research Questions

The goal of this study was to establish if there were any household determinants (independent variables) that have an effect on malaria morbidity, considered to be the dependent outcomes, in Mutasa District, Zimbabwe. I wished to establish, at what level, the determinants influence malaria control and its subsequent elimination. In this regard, the following research questions and hypotheses were raised:

Research Question 1: Is there a relationship between household determinants and malaria diagnosis in Mutasa District, of Zimbabwe?

$H_0$1: There is no relationship between household determinants and malaria diagnosis in Mutasa District of Zimbabwe

H_a1: There is a relationship between household determinants and malaria diagnosis in Mutasa District of Zimbabwe.

Research Question 2: What is the relationship between environmental household factors including presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport, and malaria infection in Mutasa District of Zimbabwe?

H_o2: There is no relationship between the environmental household factors that include the presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport, and malaria infection in Mutasa District of Zimbabwe

H_a2: There is a relationship between the environmental household factors that include the presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport, and malaria infection in Mutasa District of Zimbabwe.

Research Question 3: What is the relationship between social and cultural factors and malaria infection in Mutasa District of Zimbabwe?

H_o3: There is no significant relationship between social and cultural factors and malaria infection in Mutasa District of Zimbabwe.

H_a3: There is a significant relationship between social and cultural factors and malaria infection in Mutasa District of Zimbabwe.

Research Question 4: What is the relationship between available malaria interventions including indoor residual spraying (IRS), use of long lasting, insecticide-treated nets, mosquito larviciding (insecticide spraying of breeding sites), use of intermittent preventive treatment of pregnant mothers, and malaria infection in the Mutasa District of Zimbabwe?

H_o4: There is no relationship between available malaria interventions including IRS; use of long lasting, insecticide-treated nets; mosquito larviciding (insecticide spraying of breeding sites); use of intermittent preventive treatment of pregnant mothers' and malaria infection in the Mutasa District of Zimbabwe.

H_a4: There is a relationship between malaria interventions including IRS spraying; use of long lasting; insecticide-treated nets; mosquito larviciding (insecticide spraying of breeding sites); use of intermittent preventive treatment of pregnant mothers; and malaria infection in the Mutasa District of Zimbabwe.

Nature of Study

I conducted a systematic exploration and evaluation of selected household determinants with the objective of enhancing the malaria elimination efforts. The study outcomes are expected to provide an understanding on the nature and level of determinants that challenge the malaria elimination efforts. The research design, which will be discussed in more detail in Chapter 3, was used to outline the strategy that was used to answer the research questions.

I used a quantitative, contextual, exploratory, evaluative, and descriptive methodological approach to examine the household determinants of malaria in the Mutasa District of Zimbabwe. The quantitative approach was justified, considering that the DHS data, and the questionnaire survey data, that were acquired during this study captured the variables in numerical format. The contextual approach was based on the outcomes of other studies within the same district and in similar settings in other endemic countries (Cotter et al., 2013; Gunathilaka et al., 2016; Sande et al., 2016; Semakula et al., 2015). I used the design to explore the nature of the relationship between the independent variables (household determinants) and the dependent variable (the malaria present yes/no) within the various households in the Mutasa district during the study period. Similarly, I highlighted the levels and nature of the determinants in relation to the malaria intervention strategies and the subsequent impact on the dependent outcomes. Last, I used statistical analytical tools to examine the quantification of the influence of the identified household variable determinants.

To achieve the study objectives, I used the precede-proceed model. The study was based on the epistemology of positivism (Creswell, 2013). The data were dependent on the historical and only rapid diagnostic tested (RDT) or laboratory-confirmed cases of malaria for the period January 2016-August 2017. The data, which were derived from DHS and Health Management Information Systems (HMIS) was used to identify the households appropriately (MOH&CC, 2015; Zimbabwe National Statistics Agency, 2013). Collected household data, both historical (ICF International, 2016; Zimbabwe National Statistics Agency, 2013) and current questionnaire survey data, were quantitatively evaluated and relevantly analyzed to determine significance.

Definitions

The following key terms were defined according to the WHO’s (2016) malaria terminology guide. However, where appropriately indicated, the definitions were adjusted in accordance with other relevant data collection protocols or established scholarly understanding.

Household: The household was defined as the ecosystem, including all persons (related and unrelated) and animals, occupying the same house or premises and the accompanying vectors, headed by an individual acknowledged as the responsible decision maker (Beaman & Dillon, 2012; WHO, 2016).

Household head/representative: Any adult person either male or female above the age of 18 years who is acknowledged as having the overall authority over the household and is preset during the time of the interview. However, in his or her absence, an alternate representative was eligible if they were above 18 years of age and responsible for the household in the absence of the substantive household head.

Malaria control: The reduction of disease incidence, prevalence, morbidity, or mortality to a locally acceptable level as a result of deliberate intervention efforts that are continuously sustained.

Malaria elimination: According to WHO (2016), malarial elimination is defined as the mitigation of local malaria transmission resulting in zero incidence of specified malaria parasites within a defined geographical area due to deliberate intervention activities. Similar to Malaria control, continued intervention measures to prevent transmission reestablishment must be in place.

Malaria eradication: The permanent reduction of the national, regional, or worldwide incidence of malaria infection caused by the human malaria parasites to zero. Once eradication is achieved, no further interventions are required.

Integrated vector management (IVM): According to WHO (2016), IVM is defined as carrying out a process, emanating from a national decision for strategic and optimal use of resources, to control malaria vectors, with the objective of improving the efficacy, cost-effectiveness, and ecological soundness in order to mitigate the incidence of malaria.

Intermittent presumptive treatment (IPTp): The full therapeutic course of antimalarial medicine given to pregnant women at routine prenatal visits, regardless of whether the woman is infected or not infected with malaria.

Malaria infection: The presence of Plasmodium parasites in the blood or tissues, confirmed by diagnostic testing that could consist of microscopy, RDT, or nucleic acid-based amplification (e.g., polymerase chain reaction assays to detect parasite DNA or RNA).

Malaria case: Any person with malaria infection, determined by diagnostic testing (parasitological testing using RDT or laboratory examination), confirming the presence of malaria parasites in the blood, with or without symptoms.

Malaria risk factors: Those attributes, characteristics, or individual exposure with potential to exacerbating the chances of developing malaria.

Susceptibility: The individual's propensity to be negatively affected by malaria as a result of all the variable risk factors (Hagenlocher & Castro, 2015). These factors included generic, biological, socioeconomic (including household), and environmental susceptibility factors. In addition, resilience shortcomings refer to the inability to withstand negative impacts of the malaria disease (Hagenlocher & Castro, 2015).

Limitations of the Study

There were four primary limitations to this study. The first limitation related to potential challenges that could be encountered with determining the household representative in child-headed households or where culture or tradition did not allow women to be interviewed as household representatives. The second limitation was concerned with the inability to determine parasetaemia levels within the household members to confirm the existence or nonexistence of malaria infection. However, the study period, coupled with the potential cost of carrying out the relevant parasetaemia tests, was considered limited for including this activity in the study protocol. The third limitation related to cases that may have been treated at private clinics or outside of the district health facilities; consequently, they may not have been reflected within the existing data sources. Although this information may have been discovered through the questionnaires surveys, its reliability would have been questionable. The fourth limitation related to imported cases that may have been erroneously recorded within the district health facility registers due to their being treated within the district health facilities but with infection having been acquired outside the district boundaries.

Assumptions

I assumed that the available historical data reflected the household status of malaria situation within the Mutasa District over the study period. The second assumption was that all households had an equal opportunity of receiving the same malaria control intervention strategies over the studied period. I assumed that all areas within the district encountered uniform geographic/climatic factors and that the health service delivery was equitable for all households within the district during the studied period. Lastly, I assumed that the random selection of the study sample was a true representation of the household population that was interviewed and that the questionnaires were truthfully answered. However, efforts to ensure truthfulness in answering questionnaires was obviated by preserving confidentiality and appropriately explaining the intended potential benefits of the study.

Study Delimitations

Due to time and cost constraints, the study was limited to one district, Mutasa District of Manicaland province of Zimbabwe. The country has a total of 67 districts. The district is also supported by various autonomous stakeholders in its efforts to eliminate malaria. It was anticipated that these stakeholders would welcome and cooperate in studies to enhance the existing efforts towards malaria elimination.

In selecting the study variables for consideration, I found that there were a range of determinants that influence malaria morbidity and mortality. However, those determinants related to households have not been explored. Current malaria intervention efforts are largely funded through external stakeholders; it is hoped that the results of the study will enhance efforts to sustain the current intervention successes while influencing future strategies. It is also hoped that the results will be used to influence future intervention policy formulation and elimination strategies and that they maybe generalizable to the rest of the Manicaland province or even the whole country.

Summary and Transition

In this chapter, I introduced the study subject, which was the household determinants of malaria in the Mutasa District of Zimbabwe. I also reiterated the need for multipronged strategies using both the current tools and innovative approaches in order to achieve elimination. I highlighted the problem and the importance and significance of the study in enhancing the current intervention policies and the expected social changes that the study outcomes would have in the malaria endemic community of Zimbabwe. I also outlined the methodology used to collect both secondary data and survey data. The study's theoretical framework was discussed, within a quantitative case control strategic approach. The anticipated assumptions, limitations, and delimitations to the study and how these may be minimized or mitigated were discussed.

In Chapter 2, I present a literature review that covers the various household determinant variables and their potential relationship with malaria morbidity and mortality. I will also highlight the search strategy and an indication on how the gaps identified were addressed within the study protocol. Within these parameters, I will further discuss the theoretical approach and how it was appropriately synthesized in carrying out the study. Chapter 2 is then followed by the research methodology in Chapter 3; presentation of the results in Chapter 4; and a summary, discussion, and conclusions in Chapter 5.

Chapter 2: Literature Review

Introduction

The negative effects of malaria on population health have been documented (WHO, 2016). Malaria is one of the most severe, worldwide public health problems, and it is a leading cause of death and disease in most developing countries, particularly Sub-Sahara Africa (CDC, 2016). Young children, pregnant women, and their fetuses or neonates bear the most brunt, with anemia and low birth weight accounting for most infant mortalities (CDC, 2016; Gunn et al., 2015; WHO, 2016, 2017). In 2010, it was estimated that 91% of malaria deaths were in the African region (CDC, 2016). At the household level, the impact of malaria is felt with the reduction in labor productivity while health expenditure increase, resulting in the diminished capacity of households to acquire assets (Diiro et al., 2016). Malaria has been prioritized as an urgent public health disease (UNICEF, 2017).

In this chapter, I will review relevant literature on malaria and its various determinants. Key areas reviewed include the malaria morbidity and mortality in Zimbabwe and Globally, the pathophysiology of malaria, implications of malaria to households and the community, current intervention strategies, and intervention successes and limitations. I review the determinants of malaria that include biological, environmental, and socioeconomic determinants. I focus on household determinants of malaria and the available knowledge of their influence and the potential for continued evaluation. Finally, the chapter culminates in outlining the precede-proceed theoretical model as the foundational model chosen for the study.

Literature Search Strategy

The literature search strategy was carried out using a diverse range of databases. The resources included the Walden University Library. I searched the following databases: ProQuest Dissertations, Theses-Full Text databases, Health Sciences, the CINAHL MEDLINE, Nursing, and Allied Health Source. The CDC library, WHO library, and the Google /Google Scholar search engines were also used. Publications and Literature from Ministry of Health and Child Care and other Zimbabwe Government publications were also used. The search terms used were *malaria determinants*, *malaria household determinants*, *malaria control and elimination*, *epidemiology of malaria*, *pathophysiology of malaria*, *public health and malaria*, *socioeconomic status and malaria*, and *education and malaria*. The most relevant studies from the search were reviewed. The literature reviewed was limited to the period between 2011 and 2017. However, I used sources pertaining to the theoretical framework that were much older to provide a historical foundation on the study foundational aspects.

Malaria Morbidity and Mortality

In this section, I review the global perspective and the Zimbabwe situation.

Global Malaria Morbidity and Mortality

Malaria is a parasitic disease with significant morbidity and mortality globally. It is one of the deadliest and most prevalent parasitic diseases, with most fatalities being attributed to the *Plasmodium falciparum* species (Bobenchik, et al., 2013). Children and pregnant women are the most vulnerable, particularly in Sub-Saharan Africa (Sumbele et al., 2016). According to the WHO (2016), 212 million new malaria cases were reported globally in 2015. Out of these cases, the WHO claimed that the African region accounted for 90% of the cases, with the South-East Asia region and the Eastern Mediterranean region accounting for 7% and 2%, respectively. Among these cases, there were significant mortalities, estimated to have been 429, 000 (WHO, 2016). The burden of mortalities was greater in the African region, accounting for 92% of the total deaths, while the South-East Asia region and the Eastern Mediterranean region accounted for 6% and 2% (WHO, 2016). Children's vulnerability to the disease, particularly within the under-5 year age group, is illustrated with 303,000 estimated deaths, of which 292,000 were in the WHO African region (WHO, 2016).

Despite these high morbidity and mortality statistics, there has been progress towards reducing the global malaria incidence rates. During the period between 2010 to 2015, global malaria incidence rates dropped by 21% while the mortality rates fell by 29% globally and by 31% in the African region (WHO, 2016). Similarly, mortality rates in the under-5 age group fell by approximately 35% globally within the same period (WHO, 2016). Albeit these achievements, globally there is still a child dying of malaria every 2 minutes (WHO, 2016). These developments have resulted creating the Malaria Millennium Development Goal (MDG) No 6 (UNICEF, 2017). The successful achievement of malaria elimination will depend on a multipronged approach that takes into consideration the influences of all possible determinants and is supported by adequate funding.

Zimbabwe-Malaria Morbidity and Mortality

The global morbidity and mortality trends have been reflected in Zimbabwe, with significant achievements being made towards the malaria elimination goal. However, the country, which experiences seasonal malaria transmission, continues to experience high malaria morbidity and mortality levels. It is estimated that approximately 50% of the population in Zimbabwe, equating to more than 6 million people, live in malaria-endemic areas and are at risk of being infected (Gunda et al., 2016). According to the Zimbabwe DHIS2 (2015) reports, a total of 391,772 incidences were confirmed as malaria cases, while 570 deaths were recorded for the same period (PMI, 2017). In 2015, three rural provinces (Manicaland, Mashonaland East, and Mashonaland Central) accounted for an estimated 83% of all malaria cases and 61% of all malaria deaths (PMI, 2017). Within the three provinces, Manicaland was the worst affected with 42% of all cases and 33% of all deaths.

The malaria morbidity and mortality has been showing a decline with incidence decreasing by 86% from 153/1,000 populations in 2004 to 22/1,000 in 2012 (PMI, 2017). However, the continuous decline from 2004 was interrupted by an upsurge in cases with an incidence being reported at 29 and 39 per 1,000 populations in 2013 and 2014 respectively; this was an increase of 77% over the 2012 rate (PMI, 2017). The upsurge, which was mainly in the Manicaland province and along the borders of Mozambique, was exacerbated by both the cross-border migration and the resistance of the *A, funestus* vector mosquito to the pyrethroid class of insecticides, which were being used for the IRS program (PMI, 2017). However, the introduction of various intervention measures in

2015 that included the introduction of the organophosphate insecticides and improved surveillance systems helped reduce the incidence levels by 26% from the 2014 levels of 39/1,000 populations to 29/1,000 populations in 2015 (PMI, 2017). The declining trends have continued into 2016 with a reported incidence of 20.5/1,000 populations (MOH& CC, 2017).

Malaria Pathophysiology

Malaria is a disease that develops after being infected with the malaria parasite, normally through the bite of an infected anopheline female mosquito. The causal pathway is dependent on the parasite species among the five possible parasites that infect humans. These single-celled parasite species, belonging to the genus *Plasmodium,* include *Plasmodium falciparum*, *P. vivax*, *P. ovale, P. malariae,* and *P. knowlesi* (CDC, 2015). The infection culminates in a range of symptoms, varying from unobserved or mild presentations, to a severe disease and even death (CDC, 2015). According to the CDC (2015), the disease pattern is usually categorized as uncomplicated or severe (complicated) malaria.

The infected mosquito injects into the human body the parasite life stage called the sporozoite. These initially pass through the liver, where they undergo the preliminary replication (termed exo-erythrocytic replication); developing into merozoites prior to their reentry into the blood system, they reinvade the red blood cells (termed erythrocytes) to complete the erythrocytic stage (CDC, 2015; Malaria.com, n.d.). Within the invaded red blood cells, the merozoites replicate again up to an appropriate level where they burst out, rupturing the host blood cells (CDC, 2015; Malaria.com, n.d.). It is during this rupturing phase that most infected persons experience malaria-associated symptoms, exacerbated by the body's immune system, as a response to the outcome waste products of the red blood cell bursting process (Malaria.com, n.d.). However, the bursting process and interval timings are different with each of the parasite species (CDC, 2015).

P. vivax has a tendency for 2-day cycles while *P. malaria* has 3-day cycles, all of which are characterized by fever (CDC, 2015). *P. falciparum* presents other pathological manifestations as a result of the way it manipulates the host's physiology. After infecting the red blood cells (erythrocytes), especially with the mature trophozoites, it adheres them to the vascular endothelium of the tiny blood vessel walls, restricting free blood circulation. The process is termed sequestration, and it reduces blood flow to key organs such as kidneys, lungs, heart, and brain, culminating in severe clinical symptoms such as cerebral malaria (CDC, 2015).

According to the CDC (2015), the period between infection and the onset of the first symptoms varies from 7 to 30 days, depending on the parasite species. Generally, *P. falciparum* exhibits shorter periods, while *P. malariae* exhibits longer periods (CDC, 2015). In the cases of *P. vivax* and *P. ovale*, these periods can further be affected by a person's immunological state, especially where prophylactic medication may have been taken prior to parasite infection. Both *P. vivax* and *P. ovale* can produce parasites that may lie dormant in the liver with the potential for reactivating months after being bitten by an infected mosquito (CDC, 2015). Such an understanding of the pathogenesis of malaria, while illustrating the intricacies of the parasite's life cycle, also enhances the appreciation of potential intervention strategies needed to mitigate the morbidity and mortality of the disease (Milner et al., 2012).

Implications of Malaria

The ramifications of malaria on the community or population are significant. These ramifications include the costs of treatment, suffering, and the consequent poverty of affected persons and the respective households. According to UNICEF (2017), the disease is costing the Sub-Saharan Africa up to 1.3% of gross domestic product; it also impacts income, particularly from agricultural activities and human capital (Adewale, Adebosin, & Oladoja, 2016; Mia et al., 2012; Nonvignon et al., 2016). Infection at pregnancy leads to long-term deficient in neurocognitive function, while childhood infection results in cognitive impairment, which leads to negative impacts on educational and labor outcomes (Kuecken, Thuilliez, & Valfort, 2014; Nonvignon et al., 2016). At the household, community, and national or global levels, the malaria burden can lead to a premature loss of life or disability, as measured by the Disability Adjusted Life Years (Gunda et al., 2016). The presence of malaria in the community or household adversely affects investments opportunities and available income, especially for children's education (Kuecken et al., 2014; Nonvignon et al., 2016). With these adverse implications of malaria, it becomes necessary to eliminate the disease. Elimination positively impact the population's health and improve its socioeconomic status (Nonvignon et al., 2016).

Proactive interventions that are specific to malaria control and its subsequent elimination not only impact malaria specific-morbidity and mortality, but will also positively impact the population’s wellbeing. Sachs (as cited in Okonofua, 2015) showed that the economic growth rate of *P. falciparum* malaria-endemic countries could be negatively impacted by as much as 1.3% compared to nonendemic malaria countries (Nonvignon et al., 2016; Okonofua, 2015). Scholars have highlighted the exacerbating factors to be medical costs; lost human hours due to employee illness or attending to ill family members; unprecedented infant mortalities; and lack of development in agriculture, tourism, and other relevant developments. These elements have a negative impact on fertility and population growth, investments potential. and socioeconomic achievements.

Malaria Prevention and Elimination

The control and management of malaria includes vector control interventions through IRS and larviciding, the distribution and use of NetLLINs, passive and active case detection and appropriate treatment, IPTp, surveillance and relevant community awareness, and education (Nkumama et al., 2016). However, there are challenges to appropriate malaria case diagnosis and management, particularly in underserved communities (Nkumama et al., 2016). These challenges include lack of adequate and appropriate diagnostic materials or tools and adequately trained human resources and availability of adequate and appropriate medication and its timeous consumption, assuming the correct diagnosis is given (Nkumama et al., 2016). Resistance to both the insecticides and treatment drugs has emerged. Malaria elimination strategies must include the dynamic factors that influence malaria prevalence. These factors include mosquitoes and people, land and its use, household determinants, and health systems (Nkumama et al., 2016; WHO, 2014). As a result of these factors, there has been a renewed global impetus on malaria prevention, focusing on its elimination.

Challenges to Malaria Elimination

With many countries scaling up malaria interventions from control towards elimination, a number of challenges are emerging with each country relevant to its malaria elimination strategies. Despite the global achievements in malaria control, particularly in Africa since year 2002, various challenges and complexities continue to emerge (Marsh, 2016; Nkumama et al., 2016). One of these challenges is the shift in the population at risk, coupled with the increase in imported malaria cases (Mogeni et al., 2016; Nkumama et al., 2016). The emergence of subpopulations of demographically determined clusters in small geographical areas and the shared social and behavioral risk determinants add to the emerging challenges (Nkumama et al., 2016). An appropriate knowledge and understanding of the emerging challenges would enhance the opportunity to achieve malaria elimination through strategically targeted interventions (Cotter et al., 2013; Nkumama et al., 2016). The present malaria intervention strategies may have reached a plateau. Such strategies would only emerge after a review of past and current malaria control and elimination dynamics to further reduce the malaria burden (Godfray, 2013; Nkumama et al., 2016).

Current Focus

The burden of malaria requires a paradigm shift, with concerted efforts towards the elimination of malaria. In addition to using established intervention tools, malaria elimination requires the development of a sustainable global framework that supports and prioritizes relevant elimination strategic policies (WHO, 2017). Such policies should be inclusive, evidence-based, and supported by existing appropriate data (Action Roll Back Malaria, 2015). According to Griffin (2016), *P falciparum* malaria can be eliminated, especially if the 2007 rates are reduced by 90%, thus achieving thresholds in which the disease cannot sustain itself, particularly if these levels are maintained for 10 to 15years. Griffin also reiterated the importance of maintaining *P. falciparum* reproductive thresholds to below 1 for a long enough period, as this would eliminate malaria from an area.

An appreciation of the intrinsic levels of malaria transmission, as determined by the environmental and socioeconomic factors, would be an invaluable asset (WHO, 2014). Such knowledge would allow for a holistic approach that would enable the provision of appropriate and adequate resources, materially and technically, to mitigate morbidity and mortality, with the long-term goal of achieving elimination (Action Roll Back Malaria, 2015). A factor in creating such a strategy is to reduce the transmission of the malaria parasite between the humans and the mosquito, rather than the management of the disease and the mortality outcomes thereof (Action Roll Back Malaria, 2015; WHO, 2017).

The objective of eliminating malaria globally, in particular for Zimbabwe, requires operational strategies to be defined in order to understand the differences between achieving control or low endemic status and achieving elimination (WHO, 2016). Control or low endemic status has been achieved through universal coverage using the traditional malaria prevention and treatment measures. However, doing more of the same may not achieve malaria elimination. Concerted focus on intrinsic factors and activities that identify and mitigate the foci of infection, in addition to existing intervention strategies, would enhance elimination efforts (Blas, 2013; Nkumama et al., 2016; WHO, 2017). Hagenlocher and Castro (2015) also reaffirmed the importance of integrative approaches that take into consideration the multiple factors influencing malaria incidence and prevalence. These strategic initiative approaches would be enhanced with the availability of political support for an enabling environment, an adequately functioning health system, a proactive community, sustainable financing, and an appropriate national and regional legal framework (Blas, 2013). The evolving mosquito and parasite bionomics, coupled with the multiple human factors (socioeconomic and environmental), will require a dynamic and resilient epidemiological approach that continuously evaluates all potential determinants.

Determinants of Malaria

Because the malaria disease was discovered, various determinants of malaria have been established. These determinants, which I will also consider as spatiotemporal drivers of malaria, according to Zhao et al. (2016), range from biological, environmental, socioeconomic, demographic, political, cultural, individual, and household determinants (Hagenlocher, & Castro, 2015). Some of these determinants (climatological, hydrological and biological), interact nonlinearly within the transmission cycle dynamics and thus require an appropriate appreciation (Endo & Eltahir, 2016). Zhao et al. (2016) noted some of these determinants were the key drivers to malaria elimination in Europe and thus requiring appropriate consideration by countries targeting malaria elimination.

Consequently, each of these determinants will be discussed culminating in the review of household determinants, considering that they derive various elements from the other key determinant factors.

Biological Determinants

From a biological point of view, three factors must be present to influence the incidence of malaria. These factors include the appropriate mosquito species, the parasite and the human being (CDC, 2015). The Anopheles mosquito species must be present and be in contact with the human being to either transmit or acquire the parasite. The parasite undergoes the invertebrate part of its life cycle in the mosquito and the vertebrate part in the human being (CDC, 2015). Consequently, malaria infection is normally preceded with the bite from an infected female Anopheles mosquito. However, in rare cases, malaria parasites can also be transmitted between persons, either, congenitally, through blood transfusion, organ transplantation or needle sharing (CDC, 2015).

In considering the three key biological factors, the timeous presence of the appropriate vector species in an area influences the level of malaria incidence and prevalence. There are many mosquito species, but only the Anopheles female mosquitoes that are anthropophilic (prefer biting humans), would be most relevant to the transmission of malaria parasites. Mosquito species have preferences of either biting indoors (endophagic), or biting outdoors (exophagic). The majority of malaria transmission is caused by anthropophilic and endophagic species (CDC, 2015). Humans, the second biological factor, may also have its unique characteristics that are either inborn or acquired and that may further be compounded by behavioral traits that influence the individual's malaria risk levels (CDC, 2015). The third biological factor, the parasite, plays an important role in influencing the occurrence and impact of malaria. According to WHO, (2017) there are five predominant parasites that cause malaria, with *P. falciparum,* and *P. vivax* pausing the greatest risk. Of these species *P. falciparum* which is predominant in Africa south of the Sahara is more severe and has accounted for more deaths globally while P. vivax is predominant in most countries outside sub-Saharan Africa. All these three, life cycle biological determinants can be influenced and sustained by climatic variables of the environment (CDC, 2015; Endo & Eltahir, 2016).

Environmental Determinants

The environment plays an important role in the geographic distribution and seasonality of malaria. An appropriate understanding of the influence of environmental dynamics may enhance the opportunity for sustainable malaria elimination as these impact on possible household determinants (Endo & Eltahir, 2016). Notable factors include the creation of breeding sites and their related location to households (Endo & Eltahir, 2016). The vector mosquitoes require water as part of the breeding environment to enable the female to deposit its eggs, and for the subsequent development of larvae and pupae to the adult stage (CDC, 2015). The most common source of water is rain, the intensity of which varies, dependent on seasonal weather characteristics. Incessant rains may flush the breeding sites while its absence may reduce the breeding sites (CDC, 2015). The full life cycle development process lasts a period of approximately 9-12 days in tropical areas depending on the appropriate ambient temperatures and humidity. Accordingly, 8-10º C and 14-19º C. are respectively the minimum temperatures for mosquito breeding and parasite development (Blanford et al., 2013). While the optimum temperatures for mosquito breeding are 25-27º C, at 28 º C breeding declines with 40º C being the maximum for both vectors and parasites development (Blanford et al., 2013; Mordecai et al., 2013).

The environmental factors also affect the extrinsic factors of parasite development within the mosquitoes. According to CDC, (2015), at 25° C the extrinsic life cycle takes 9-21 days whereas below 15° C for *P. vivax* and below 20° C for *P.* falciparum the cycle cannot be completed and hence there will be no malaria transmission. These factors, coupled with the various household human factors, in relation to climate have implications on the severity and intensity of malaria within a community. In this regard, elements such as agricultural activities, sleeping patens, and personal protection become relevant in sustaining malaria control and elimination (CDC, 2015).

Socioeconomic Determinants

The health of the individual and the community or population is considered complex and dependent on multiple factors. Consequently, various diseases including malaria have been influenced by socio-economic factors. These socioeconomic factors, sometimes referred to as social determinants of health include community safety, education, employment, income, family and social support (Senterfitt et al., 2013). For instance, in a study in Ghana, malaria incidence in children under 5 years was observed to be higher among mothers with lower education, (Nyarko & Cobblah, 2014). In addition, the type of house, the distance to a health facility, malaria awareness, number of mosquito bites per day, and the use of various intervention measures also influence the morbidity and mortality of malaria in an area (Yadav et al., 2014).

In this context, various scholars have reiterated the importance of combining the spatial risks of social drivers together with environmental, biological, and household factors to enable an integrated and appropriate determination of vulnerability to malaria (Bizimana et al., 2015). Despite the known effect of climate and environmental determinants on the distribution of mosquito vectors and malaria parasetaemia at any moment, it is also known that socioeconomic factors play an influential role as well (Yadav et al., 2014). However, some of these socioeconomic factors are relevant as household determinants, and will further be discussed in that context under the relevant section.

Sociodemographic Determinants

According to WHO (2017) sociodemographic determinants play an important role in the health of individuals and the community and require appropriate consideration in public health intervention strategies. Consequently, an appropriate appreciation of the influence of human population dynamics and their relevant activities on both the malaria parasite and vector enhances the opportunity for source reduction efforts (Vajda & Webb, 2017). The sociodemographics of a population include the evaluation of variables such as age, gender, race or ethnic population distribution within a region or country (WHO, 2017). In the context of malaria certain age groups or biological conditions have been observed to be more vulnerable than others. Nyarko and Cobblah (2014) and UNICEF (2017) observed that children less than a year were less vulnerable to malaria due to antibodies acquired while in their mothers' womb. Male children have been found to be more susceptible than females (Nyarko, & Cobblah, 2014). However, the important role of sociodemographic variables and its role in malaria will be discussed in more relevance as part of the household determinants.

Cultural Determinants

In the history of malaria epidemiology, particularly over the past 2 decades, it has become more apparent that malaria cannot be isolated from the behavioral and social elements of its control. The sociocultural environment is also emerging as a significant factor in the malaria epidemiology, and requiring appropriate consideration as there is a notable gap existing between biomedical knowledge and perceived or accepted practices and beliefs concerning malaria amongst the different communities or individuals within endemic areas (Ghosh et al., 2012). Similarly, according to Ricci, (2012), it is those same traditional convictions and practices that have the potential to influence the communities' response to malaria intervention measures (both treatment and control).

A critical component in discussing the culture factors in relation to malaria, not only for Zimbabwe but globally, is the need to agree on an appropriate definition of culture. Spencer-Oatey, and Franklin, (2012) reviewed various levels and forms of culture from which an appropriate definition for this study is derived. Consequently, in this study culture is defined as an accumulation of a multiple complex factors comprising, knowledge, beliefs, art, morals, laws, customs and any other capabilities and habits acquired by groups or individual members of a community, at a particular time, resulting in a defined way of life, and thus a defined way of responding to challenges as they present themselves (Spencer-Oatey & Franklin, 2012). Further to defining culture, I will also highlight the presence of cultural heterogeneity within the various communities. Cultural heterogeneity, which refers to a mix of different cultures in one place, may exist despite the community being viewed as one. Consequently, awareness of the different ethnic groups, traditions, political systems, languages, religions and social values must be appreciated.

Cultural and social factors can influence the effectiveness of malaria control and elimination interventions, impacting morbidity and mortality (CDC, 2012; Pell et al., 2011). In their Malaria in Pregnancy (MiP) studies, Pell et al. (2011) observed that culture and gender relations, among other determinants, affected the household decision making process in terms of the pregnant woman's response to MiP interventions. Despite the efficacies of the various interventions targeted at MiP the culture and behavior driven attitudes of pregnant women and the community has tended to dictate the course of events (Pell et al., 2011). Various studies have demonstrated the knowledge dichotomy between culture and causal biomedical interpretations of malaria (Franey, 2013). The dichotomy, is subsequently thought to influence the acceptance of malaria control interventions among affected or persons at risk, resulting in adverse outcomes. Apart from the influence of culture within MiP, other studies have similarly highlighted the impact of traditional beliefs and practices on the acceptance and adoption of relevant malaria control interventions and timeous malaria treatment seeking within their communities (Ricci, 2012). Differences, emanating from cultural factors and interpretations, have been observed, in the appreciation of certain malaria interventions such as use of mosquito nets, and perceived malaria treatment efficiencies (Ricci, 2012). The fundamental importance of culture in malaria control is also reiterated from a Social and Behavioral Change Communication (SBCC) perspective ensuring a holistic approach, that takes into consideration the bionomics of healthy behaviors (Kinshella, 2016). Proactive cultural endeavors have to be considered in the context of the Iceberg model, (Hanley, 2014).

The Iceberg model reiterates the importance of the bigger picture of culture which is not usually apparent, but needs to be extensively searched, to reveal the underlying values, beliefs, assumptions, and expectations of the communities, and thus, enhance the opportunity for successful malaria interventions and elimination (Kinshella, 2016). These observations indicated that an appropriate understanding of cultural contexts within a malaria endemic area must be part of the intervention strategy to reduce or eliminate the malaria burden (Hagenlocher & Castro, 2015).

Household Determinants

Despite the notable successes achieved in controlling and reducing the global malaria burden, most countries particularly in the sub-Saharan African region, continue to experience a significant burden due to the disease. Concerted, intervention efforts have been initiated and implemented at various levels and yet the disease continues to undermine the affected countries socioeconomic developments (Pellegrini & Tasciotti, 2016). Even with the continued efforts to find a magic bullet to eliminate malaria, such as a malaria vaccine, more deaths continue to occur in the sub-Sahara Africa region (WHO, 2016). The disease continues to challenge the research and intervention efforts, in the midst of the renewed and increased political and financial support (Alonso & Tanner, 2013).

From a local research perspective, various studies have been undertaken to evaluate the wide range of determinants or risk factors covering both the biological, environmental, socio-economic, individual and household factors. However, the most notable study in my literature review, and one that is of a similar nature to my intended study, is one carried out by Kanyangarara et al. (2016). In their evaluation of individual and household risk factors, they collected individual demographic data and household characteristics in a serial cross-sectional survey. While their study focused on both individuals and households, the proposed study will use a case control approach and intends to focus on mainly household determinant factors. In Kanyangarara et al., cases were not predetermined prior to sampling as in the proposed study.

The Kanyangarara et al. (2016) study set the pace for further evaluation in the various risk factors they explored, particularly by observing and bringing to the fore the importance of household determinants and the need for further evaluation (Kanyangarara et al., 2016). Inherently, this provided an opportunity to explore the complex scenario of why some households continue to experience malaria while other households hardly experience such malaria episodes. Consequently, I compared the two different household scenarios with the hope of establishing household determinants of malaria that exacerbate malaria morbidity and mortality.

Past and current efforts to control and subsequently eliminate malaria, have in the main, focused on intervention measures directly related to the biological, and environmental factors (CDC, 2015). However, according to Hagenlocher and Castro (2015), appropriate consideration should be given to approaches that are integrative, thus flexible to include a range of intervention strategies. Such approaches must be cognizant and inclusive of, biological, cultural, demographic, environmental, socioeconomic, and political factors, that contribute or enhance the malaria risk and vulnerability (Hagenlocher & Castro, 2015). In the light of this challenge, I hypothesized that because malaria occurs within households, there must be factors within this unit, that play a role to the sustenance of malaria risk and vulnerability.

Human behavior plays an important role in determining the level of malaria risk or vulnerability at the household level (CDC, 2012). However, such behavior which is often dictated by socioeconomic and environmental factors, also plays a crucial role in determining the success of malaria control interventions in endemic countries (CDC, 2012). Areas of particular note include poor housing construction, lack of appropriate knowledge on malaria, uninformed travelers to malaria endemic areas, environmental developments that exacerbate the breeding of malaria vectors, agricultural activities, raising of domestic animals, cultural norms, and values (CDC, 2016).

In this section, various household determinants will be considered for evaluation. A household is identified and verified according to the definition set out in Chapter 1. In addition to the indications of the definition, the household must be headed by a householder, who is defined as a person within the household recognized as the householder and in whose name the household or home is owned either as having bought or rented it. However, in the absence of such a person any other responsible household representative person above the age of 18 years would be eligible. In Zimbabwe, anyone above the age of 18 years is considered as having reached the age of majority and can qualify to be a designated householder.

Key identified household determinants considered for review include housing construction, electricity, household demographic make-up, culture, education, religious factors, socioeconomic status, employment (including agricultural activities), access to health (including health insurance and access to health facilities), intervention measures accessed, transport availability, distance to breeding sites, and animal breeding. These determinants, identified in various epidemiological settings, which are not in any order of importance will be reviewed**.**

Housing

Housing quality and the nature of its construction, design, material used, and location are considered to have an impact on the vulnerability of household residents to malaria (Tusting et al., 2017; Krech, 2013). In both their meta-analysis studies and analysis of 15 DHS and 14 Malaria Indicator Surveys (MIS) derived from the surveys conducted in 21 sub-Saharan African (SSA) countries, over a period of 8 years (2008 to 2015), Tusting et.al. (2015) and Tusting et al. (2017) observed that improved housing minimized the potential for malaria infection by as much as 47%, in the area they evaluated due to the decreased entry of vector mosquitoes into modern houses compared to traditional houses. However, they reiterated the need for specific determination of the various housing features that enhanced the protective effect (Tusting et al., 2015; Tusting et al., 2017). In their studies, housing quality was classified into two categories, one being the modern and improved housing while the other was the traditional (mud walls and thatch roofs). An important observation from their studies is that they noted a strength of association between housing and malaria, similar to that of Insecticide Treated Nets (ITNs) and malaria. Similarly, Dlamini et al. (2017) in their 3-year cross sectional population studies in Swaziland also found that low quality housing was associated with increased malaria infection risk. This could play a significant role in the formulation of sustainable malaria elimination intervention policies.

In similar studies carried out in the Bioko Islands, houses fitted with screen or with closed eaves were observed to have a protective effect for the occupants, against the threat of infected vector bites while indoors (Bradley et al., 2013). An important observation is that the strategy of improving housing, as a way of reducing the vulnerability to malaria infection, has the advantage of not being affected by vector or parasite resistance to insecticides or drugs respectively (Bradley et al., 2013; Tusting et al., 2015). While the improved housing strategy can be viewed as complimentary to all the other malaria control interventions, it may have initial negative financial implications, particularly for the low income at the household level. Despite the potential household financial constraints, I believe this would inculcate positive social change within the community as it motivates for improved housing to mitigate malaria transmission.

Electricity

Electrifying a household is considered as an important milestone in housing improvement. However, in this instance it will be considered differently, in order to adequately highlight its importance as influencing malaria infection. The nexus between malaria and electrification of households was first initiated in studies in Uganda, and further replicated in Malawi, where potential associations were observed (Pellegrini & Tasciotti, 2016; Tasciotti, 2017). Household members living in electrified houses had a greater risk of getting malaria infection than those in non-electrified households (Pellegrini & Tasciotti, 2016). Various interpretations have been advanced, to justify this observation. The first interpretation is that electric lights attract malaria vectors, hence their use even as mosquito light traps. Secondly, electrical or any artificial lighting including outdoor lighting has transformed the lifestyle of many people as they stay awake longer, active and unprotected, and thus exposing them to the vector mosquitoes (Pellegrini & Tasciotti, 2016; Tasciotti, 2017). These observations were also highlighted in earlier studies by Barghini and De Medeiros (2010) when they evaluated, what was considered to be ecological light pollution'=. The authors were able to observe the influence of artificial lighting on behavior change for both humans and the disease vectors, and its indirect influence on human health (Barghini & De Medeiros, 2010). The observed significance of electricity to malaria incidence and prevalence, reiterates the need for further evaluation and understanding of this variable. There is also a need to appropriately consider the socioeconomic challenges relevant to the importance of electricity and strategies that may be applied to adequately inform the affected population.

Demographic Makeup

According to WHO (2016), some population groups are considered to be at higher risk of getting infected with malaria parasites and consequently developing severe disease compared to others. Those considered to be at higher risk include infants, children aged under 5 years, pregnant women, patients with HIV/AIDS, nonimmune migrants, mobile populations, and travelers (WHO,2 016). On a global scale, children are particularly vulnerable, accounting for more than two thirds of the malaria mortalities (WHO,2016-2).

Another factor considered a demographic variable, is the household size. Huldén et al. (2014) established that household sizes with less than four persons had a lower probability of acquiring malaria. Their findings were independent of all commonly evaluated explanatory variables and globally valid across multiple climatic zones (Huldén et al., 2014).

Gender and Malaria

According to Ricci (2012) and Diiro et al. (2016), gender norms and values play a role in determining the vulnerability to malaria between males and females and requires an appropriate understanding in designing intervention measures. Within a household, certain daily activities put women at greater risk to malaria as their assigned roles result in them working up early to prepare for the household needs or cooking the evening meal late while outdoors (Ricci, 2012). Similarly, there are gender norms that also influence leisure activities, and even sleeping arrangements, resulting in different exposure patterns to mosquitoes between males and females. These gender dynamics have been observed to influence access to both treatment, care and prevention of malaria by women in particular, (Ricci, 2012). Consequently, the need to understand and appreciate the balance of power and the key decision-making process within the household and its influence on malaria intervention strategies, becomes important (Ricci, 2012; Roll Back Malaria, 2015).

In a UNDP sponsored discussion, Burns and Boyce (2015) further reiterated the exacerbating effect of culture, education, and economic necessities as a consequent of gender norms and values and their resultant impact to malaria vulnerability. However, they also observed that gender norms are not age specific as they impact both male and females differently (Burns & Boyce, 2015). Burns and Boyce recommended the need for developing a malaria tailored gender assessment tool, and a gender sensitive malaria service provision strategy.

Education Levels

The impact of education can be considered from various dimensions. One such dimension being the level of knowledge that the household may possess regarding malaria transmission dynamics, and the other dimension being the literacy levels of the household head (Sichande et al., 2014) and the household members, and its effect on understanding malaria intervention messages and the strategies thereof. The importance of education, coupled with socioeconomic status, has both a direct and indirect influence on malaria control, which can never be overemphasized (Chitunhu & Musenge, 2015). In some studies, observations made within the household have shown that, higher educational levels of the household head, both formal and informal result in positive malaria intervention uptake (Diiro, 2016). A knowledgeable household head has direct influence on the health behavior of the household members (Sichande et al., 2014).

Consequently, an educated household head would enhance the opportunity for an adequate understanding and appreciation of malaria, its simple etiological process, and the required intervention measures (Ghahremani et al., 2014). By the same token, increased awareness would increase the level of household cooperation and uptake of interventions against malaria, enhancing the opportunity for elimination (Ghahremani et al., 2014).

The importance of education on the perspective of health seeking behavior has been well reiterated by various scholars. Of particular importance is the use of long lasting mosquito nets (LLIN's), seeking treatment early, or giving vector control teams full support in their activities (Sichande et al., 2014). Education has an influence on the household knowledge, attitudes and practices, with regards malaria morbidity and mortality (Luyiga 2013). Chitunhu, and Musenge (2015) and Ma et al. (2017) observed that babies of mothers with better education were less likely to acquire malaria parasites compared to mothers with lower levels of education. These observations imply a better understanding and acceptance of the various intervention measures by the better educated mothers. Knowledge on malaria symptoms, for instance results in timeous treatment seeking, (Matsumoto-Takahashi et al., 2015), and the opportunity for reducing the disease burden.

Distance to Health Facilities

Availability of adequate and appropriately located health facilities is considered necessary for the treatment of malaria infected persons within an endemic area (Diiro et al., 2016). However, the availability of such facilities may not guarantee their timeous utilization. As observed in some studies various factors such as individual perceptions, socioeconomic factors, contextual constraints, and institutional systems may play an influencing role (Bizimana et al., 2015). I focused on the contextual constraints of distance to health facilities as a potential determinant that may also sustain the existence of malaria within a household and community. Distance to health facilities has also been shown to affect the ability of women to access the MiP intervention programs (Pell et al., 2011). The distribution of insecticide treated mosquito nets (ITNs) through health facilities has tended to disadvantage those living in more distant areas, and thus increasing their malaria vulnerability (Larson et al., 2012).

In some cases, the distance to health facilities is further exacerbated by travel times, inadequate and inability to access transportation, and the poor road infrastructure particularly during the malaria transmission seasons (Larson et al., 2012). Romay-Barja et al. (2016) highlighted the critical distance of three kilometers or more from the health facility exacerbating the malaria morbidity. Those living further from health facilities face the possibilities of missing the opportunities of other intervention strategies such as indoor residual spraying due to inaccessibility of their areas by vector control operational teams (Larson et al., 2012).

Distance to Breeding Sites

Distribution and particularly the distance of water bodies, irrespective of size and type, are a key and important factor that influences the occurrence and prevalence of malaria in an area (Chikodzi et al., 2013) due to their relevance in sustaining the mosquito larval breeding. Midega et al. (2012) observed that households built upwind of larval sites were at higher risk of malaria infection than those downwind. In another observation, Chikodzi et al. (2013) were able to narrow the risk to infection to critical distances from breeding sites. Their observations outlined distances of less than 1000m from any water bodies as high-risk areas, while those within1000m-3000m, were classified as moderate risk areas and those above 3000m, classified as low risk to malaria (Chikodzi et al., 2013). Similarly, in other studies on the impact of water bodies in sub-Saharan Africa by Kibret et al. (2015), Zhou et al. (2012), and Monteiro de Barros et al. (2011) noted that malaria incidence was higher in communities living closer or within the initial five-kilometer range of water bodies than those further than 5 km.

However, contrary to these findings, although Yewhalaw et al. (2013) found an abundance of mosquito's closer to water bodies, they did not find any effect of distance from the water bodies on incidence of malaria. Despite, this superfluous finding, the current studies will endeavor to maintain an open mindset and be influenced by the evidence obtained.

Socioeconomic Status at the Household Level

Within the history of malaria, the disease has generally been acknowledged as a double-edged sword, having an influence in either the presence or lack of development, or some might say the failure or success of development. These observations are reinforced by the fact that the burden of malaria is felt greater in underdeveloped and poor countries and with the least human development. Consequently, Blas (2013) observed, that lower socioeconomic status was associated with an elevated malaria parasetaemia risk when compared with higher socioeconomic levels. The situation is considered to be exacerbated by a multitude of other pathways such as the lack of employment, low wealth status, religion, education/knowledge, the composition of the household, age, gender, and nutritional status (Chitunhu & Musenge, 2015; Dickinson et al., 2012). The lower socioeconomic status negatively influences the nature of housing improvements and thus, impacting on the level of appropriate mosquito proofing within the households (Obaldia, 2015).

According to Dickinson et al. (2012), the relationship between the socioeconomic status and malaria can be considered both conceptually and empirically. In this regard, Dickinson et al. made use of a conceptual framework that takes into consideration both the proximal and fundamental causes of malaria. The proximal causes are defined as those intervention measures that are derived from the global malaria intervention strategic policies while the fundamental causes relate to upstream factors within the ambit of the socioeconomic context and other environmental and political contexts (Dickinson et al., 2012). Dickinson et al. reiterated the important association, of wealth, education, occupation, religion, age, and gender, and their determinant effect on malaria morbidity and mortality. They outlined three pathways in which socioeconomic status (SES) influences malaria morbidity as (a) affecting the access to malaria prevention, (b) pre exposing households and individuals to higher levels of vulnerability to malaria infection-(housing quality, education, psychological stress and the subsequent immune functionality, and (c) affecting accessibility to timeous and appropriate diagnosis, malaria treatment, and relevant mitigatory outcomes (Dickinson et al., 2012).

Existence and Distance of Animals to Households

The presence and distance of livestock to households has been observed as having both a positive and negative impact on malaria morbidity. Studies carried out in various settings to evaluate the diverse outcomes of the presence of different livestock within the household and the community environment have reported that livestock influences the rate of vectors within households (Homenauth, 2016). In studies carried out in the Zambezia, where *Anopheles arabiensis*, *An. gambiae ss*, and *An. funestus* were evaluated, they found that pigs and to a lesser extent sheep living in households had an influence on the increased risk of malaria infection among the household tenants (Temu et al., 2012). In another setting, the presence of cattle at the household level, was observed to alter the local vector species dynamics, in relation to composition, feeding and resting behavior (Mayagaya et al. 2015). Of particular note were the significant numbers of vectors resting within the cattle sheds rather than inside houses, supposedly indicating the utilization, at the household level, of alternative host species by the mosquito vectors (Mayagaya et al. 2015). However, in studies elsewhere within sub-Sahara Africa, keeping livestock, particularly cows, within the household compound increased the risk of malaria infection (Franco et al., 2014). Similar, diverse findings were also noted in other studies indicating both zooprophylaxis and zoopotentiation depending on distance to animal houses and host preference of vector species (Donnelly et al., 2015). Njoroge et al. (2017) explained that the lack of conclusive data on the potential for zooprophylaxis. Despite their reiteration of the potential of reduced but continuous malaria transmission, by both primary and secondary vectors, that have exophilic and zoophilic preferences and thus able to sustain themselves with alternative blood meal, they also noted the potential for using this element as part of an Integrated Vector Management Strategy (IVM) to treat animals within households with appropriate insecticides (Njoroge et al., 2017).

Albeit the varied observations, the full ecological impact on malaria morbidity, of the presence of livestock, in the reviewed study settings, although not quite clear, Mayagaya et al. (2015), recommended further studies. These suggestions, particularly when considering the global goal to eliminate malaria, require a multidimensional approach to establish appropriate intervention measures to control malaria mosquito vectors. This was echoed by Okumu et al. (2013) who noted that achieving malaria elimination, requires identifying and covering other appropriate domiciliary habitats and nonanthropological factors that enhance or sustain the survival of Anopheles mosquitoes.

Theoretical Framework

The importance of an integrated multipronged approach in efforts to achieve the goal of malaria elimination can never be over emphasized. This becomes apparent considering the continued existence of malaria and its incessant burden, particularly in the sub Saharan Africa region (WHO, 2016). With these views taken into consideration, I explored and evaluate all possible influencing factors utilizing the Precede-Proceed theoretical model as previously indicated in Chapter 1. This is intended to establish and evaluate the level of importance of the varied household determinant factors, impacting malaria incidence and prevalence (McKenzie et al., 2016; Porter, 2016).

Precede/Proceed Model

The Precede-Proceed model was first initiated by Green in 1974 as he developed the Precede component of the model and then later enhanced by Green and Kreuter with the addition of the Proceed component in 1991 (Porter, 2016). Since then, the model has provided invaluable guidance in the formulation of intervention programs in various health fields, due to its comprehensive nature (Porter, 2016). The model is also considered to be multidimensional, as its grounding incorporates varied elements of social/behavioral sciences, epidemiology, health administration and education sciences (Community Tool Box, 2016; McKenzie et al., 2016; Porter, 2016).

In this study emphasis was placed on two key fundamental propositions of the Precede Proceed model. These were (a) health and health risks are a result multiple factors, and (b) because health and health risks are a result of multiple determinant factors, efforts must be made to influence behavioral, environmental, and social change in a multidimensional or multisectoral, and participatory way (Binkley & Johnson, 2013; McKenzie et al., 2016). Within these parameters, it wasappreciated that the process of planning, designing and evaluating interventions to impact malaria elimination imposes notable challenges and requires allocation of adequate time.

The Application /Operationalization of the Model

The model is based on two key components the Precede and the Proceed components (Green & Kreuter, 2005). Both names are acronyms derived from their key operational/application components. The acronym Precede representing predisposing, reinforcing and enabling constructs in educational/ecological, diagnosis, and evaluation, while the acronym Proceed represents, policy, regulatory and organizational, constructs in educational, and environmental development.

The Precede Phase deals mainly with planning and involves diagnosis at five levels which include, social diagnosis, epidemiological diagnosis, behavioral and environmental diagnosis, administrative and policy diagnosis (Green & Kreuter, 2005). The Proceed Phase deals with four key areas, that include implementation, process evaluation, impact evaluation and outcome evaluation (Green, & Kreuter, 2005).

Within the context of the study, which is based on the dependent outcome of malaria infection (morbidity and mortality), the framework will be translated into a set up that will enable the exhaustive exploration and evaluation of the household determinant factors beginning with the precede component.

Precede Phase

- Stage 1-Social Assessment

During this stage, the disease burden will be noted and the status of households that were either affected or not affected with malaria during the period January 2016 up to August 2017 noted. The outcome emphasis is reemphasized as that of malaria elimination and a healthy population.

- Stage 2-Epidemiological Assessment

During this stage issues related to genetics and human biology were not covered as they fall outside the scope of the study since they are not considered to be household determinants. However, issues related to the household environment were explored. These included distance to health facilities, distance to breeding sits, distance to source of drinking water, and keeping animals within the household area. Behavioral and cultural factors that include household culture, beliefs and religion were explored as part of the study focus.

- Stage 3–Educational and Ecological Assessment

This stage is interlinked with Stage 2 and 4 and will also reinforce some of the determinants highlighted in both stages. The stage will explore the predisposing, reinforcing and enabling factors.

Predisposing factors included knowledge, attitudes, beliefs, cultural values and perception at the household level.

Reinforcing factors included educational levels of the householder and the adult women within the household, distance to health facilities, and access to community health workers.

Enabling factors included the socioeconomic status of the household as determined by the wealth index variables.

- Stage 4 and 5 - Intervention Alignment, Administration and Policy Assessment

These two stages were dealt with in combination and they included accessibility to health education and advocacy programs, interventions accessible to the households as a result of malaria control and elimination strategies within the district of Mutasa, any other notable resources to combat malaria, and household access to socioeconomic activities that enhance the livelihood of the households.

Proceed Phase

Within the context of this study, the evaluation as mainly that of determining the household factors and their levels of influence on the morbidity and mortality of malaria within the Mutasa District. The actual implementation is considered to have been carried out already since the study is retrospectively considering the period January 2016 up to August 2017. The impact and outcome levels may be implied from the statistical significance of the evaluated determinant factors.

Beginning with the Precede or formative component of the model, four key elements were highlighted. Malaria is considered to be a life-threatening, but preventable and curable disease (WHO, 2016). However, due to its burden, causing 212 million cases of malaria and 429 000 deaths in 2015, malaria has been targeted for elimination (WHO, 2017). The elimination strategy is ultimately the desired outcome in accordance with the first element of the Precede model. The model, as can be observed begins by identifying the desired outcome and moving logically backwards to mapping of appropriate intervention measures, necessary for achieving the elimination outcome (Community Tool Box, 2016). The model will assist in designing an appropriate structure for the study while enhancing the basis for critical analysis of all potential malaria household factors (Community Tool Box, 2016).

The next element will involve the identification of existing priorities or potential priorities needed, to enhance the opportunities for achieving the desired outcome. This process will involve evaluating the household behavioral and environmental determinants that have an impact on achieving the intended outcome. The third element involves identification of predisposing, enabling, and reinforcing factors that can impact the household behaviors, attitudes, and environmental factors noted while the last element, focuses on identifying administrative and policy issues at the household level that influence the implementation process (Community Tool Box, 2016).

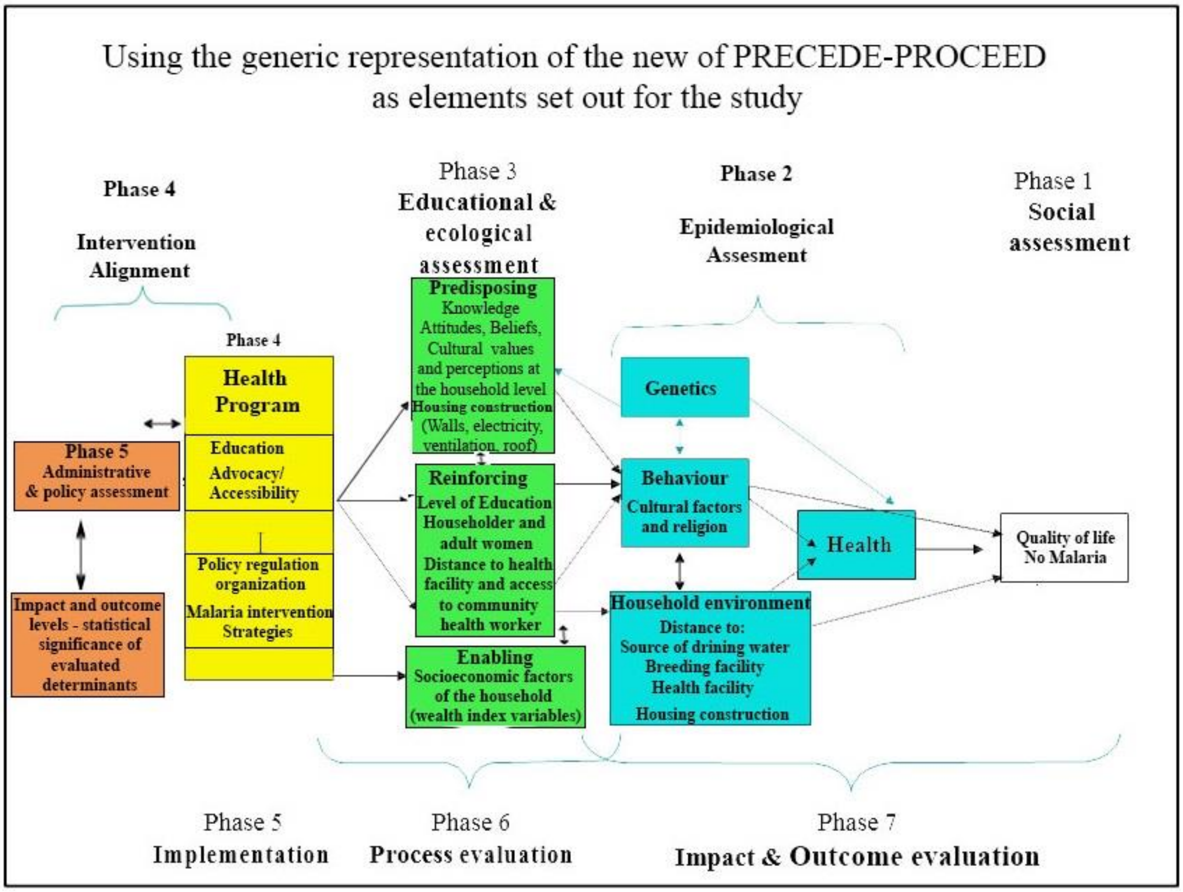

Figure 3. Operationalizing the Precede –Proceed Model to explore and evaluate determinants enhancing appropriate epidemiological assessment.

While the Precede component is considered formative the Proceed component is considered as the operational component (Community Tool Box, 2016). Similar to the Precede, the Proceed component has four elements as well beginning with the implementation of the interventions. However, the nature of this study did not involve the implementation nor the process evaluation but mostly the impact and partly the outcome evaluation. All of these highlighted four processes complete the elements of the Proceed component (Community Tool Box, 2016).

Summary and Transition

The literature review was a synthesis of the information on the malaria burden and its epidemiology globally and at the Zimbabwe country level. The disease pathophysiology, its uniqueness, and consequent ramifications at both the individual, household, community and population levels were reviewed and noted. The need for malaria control and elimination and the apparent challenges encountered over the decades of program implementation were highlighted. Achievements on reducing malaria morbidity and mortality and the subsequent impact on the affected population were extensively reiterated. Various determinant variables that influence malaria were explored.

A review of the historical path of malaria control enabled the opportunity to explore widely the underlying determinants of malaria ranging from the biological, environmental, socioeconomic, sociodemographic, individual, and household levels. Despite the broad exploration the emphasis was on the household level factors. At this level, housing, electrical lighting, household demographic make-up, gender, education, household location in relation to breeding sites and health facilities, socioeconomic status, and agricultural activity including animal husbandry within the household context, were all explored and reviewed. I was able to explain the relevant associations of the various determinants with malaria prevalence.

There is limited knowledge on the impact of household determinants on malaria morbidity and mortality. The current literature is not exhaustive and conclusive on the subject. There is a need for further studies to enhance the malaria mitigatory efforts currently underway. This study will endeavor to assess these relationships, through the use of a the Precede-Proceed theoretical model while evaluating both secondary DHS and District Health Information System (DHIS 2) data and data from confirmatory survey questionnaires interviews to be carried out. Chapter 3 is an outline of the quantitative study rationale and methodological approach that was undertaken.

Chapter 3: Research Method

Introduction

The purpose of the study was to investigate and establish potential household determinant variables and their levels of influence on malaria morbidity and mortality within the district of Mutasa. Appropriate statistical analyses were carried out to establish the influence and level of importance of each of the identified household determinants to the continued malaria infection. The study provided an opportunity to enhance the local, regional, and global efforts to eliminate malaria by 2030, which are being undertaken through various strategic partnerships, such as the Elimination 8, the Global Fund, the Roll Back Malaria Initiative, the private sector, and the individual country level initiatives (Global Health Sciences, 2015; PMI, 2016). I wished to enhance these malaria elimination initiatives by exposing relevant household determinants and their relevant mitigatory opportunities. The lack of such knowledge, despite recent efforts in other studies (Kanyangarara et al., 2016), has been reiterated by both the Ministry of Health and Child Care and the WHO (MOH & CC, 2015; WHO; 2016). In Chapter 3 of this study, I address the research design and the associated methodology that was implemented.

Research Design and Rationale

This study was based on the epistemology of positivism and I used a quantitative, descriptive, case control methodological approach, using both historical data and data from survey questionnaires (Creswell, 2013). The historical data were obtained from the DHS and the DHIS2 that captured confirmed cases of malaria for the period from January 2016 up to August 2017. The DHIS 2, which is used to monitor health interventions, is an open-source health management information platform that endeavors to enhance malaria surveillance, as it enables timeous data access. The accessible data enables the opportunity for facilitating strategic, evidence-based decisions and to enhance appropriate and efficacious service delivery.

The Zimbabwe national health data relies on a consolidated National Health Information System of data collection and validation that emanates from a Weekly Disease Surveillance System (WDSS; Gunda et al., 2016). The data are gathered at all of the health facilities, which are then reported and recorded in the WDSS, evaluated and consolidated at the district level, and then transmitted to the provincial and central level. At the central level, weekly and monthly reviews of received data are undertaken to verify their quality and were analyzed prior to final approval and recording for public consumption in the DHIS 2 platform. The DHIS 2 includes all of the relevant information, such as the number of parasitological confirmed malaria cases and the number of mortalities (France, n. d.; Gunda et al., 2016). However, the DHIS2 does not indicate the identity nor the physical address of the recorded cases; it aggregates the cases per health facility and district.

The simplified data interface, which is available to district health staff and collated through dashboards, consolidates data at both the provincial and district levels. The evaluation process ensures that the data rendered are appropriate, timely, and of high quality, thus enhancing the opportunity for achieving the malaria elimination goal (France, n. d.). DHIS 2 is not only used in Zimbabwe but has become the preferred health management information system across four continents, spreading over 47 countries and 23 organizations, and enabling National Malaria Control Programs and other health organizations to manage, monitor, and improve operational communications (HISP, 2017).

Case Identification

The identification of households that experienced malaria (malaria present yes) and those that did not experience malaria (malaria present -no) over the study period followed the following process:

The DHIS2/HMIS data were inspected to extract the malaria incidence numbers for the Mutasa district. These numbers, which did not identify the names nor the household location, were disaggregated for each health facility within the district. Each of the health facilities were visited to verify the cases through the relevant health facility register (this information is kept in what is called the T12 register) to identify the relevant malaria case households (malaria present -yes households). Initially, it was anticipated that there would be available a ward/village household listing to isolate non affected households separately as control households; however, this was not available. Consequently, non case households (malaria present –no) were identified and sampled as the identified, and sampled case households were surveyed.

Available household enumeration data for the Mutasa district (MOH & CC, 2015; ZIMSTATS, 2013) were used for the sampling framework. Collected household data, both historical (DHIS2, 2016; Zimbabwe National Statistics Agency and ICF International, 2016) and current (obtained from survey questionnaires) were quantitatively evaluated and analyzed to determine potential significance of the identified household determinants to the continued prevalence of malaria and the consequent impact to ongoing elimination strategies (WHO, 2015).

The research design was chosen to determine and evaluate the relationship and the influence of the household determinant variables identified during the questionnaire survey on malaria morbidity and mortality within the Mutasa District. Household malaria infection was considered as the dichotomous dependent variable in the study. The covariates of interest were obtained from the DHS, DHIS2, ZIMSTATS files, and the survey questionnaire.

The study's findings may be generalizable to a broader population or other relevant malaria endemic settings, giving an opportunity to enhance the malaria control and elimination efforts, resulting in positive social change within the affected communities. In choosing the case control design, I was motivated by its use in the public health field. It allows for ease of data collection procedures and obviates the potential for a long follow-up period (Sedgwick, 2014). The design involved descriptive means of (a) assessing the frequency and distribution of households that had experienced malaria infection during the period January, 2016 to August, 2017, and (b) assessing the frequency and distribution of malaria in the defined study population during the same period. The analytical aspect of the design involved the investigation and evaluation of the association between the recognized household characteristics, household environment socioeconomics, and demographic and cultural risk factors in the study population households.

I was not able to alter the independent variables in order to compare pre and post malaria infection situations because investigations were for a particular point in time. It becomes a challenge to have controls that may be considered necessary to establish causality (Frankfort-Nachmias & Chava, 2014). The collection of information about risk factors through survey questionnaires was retrospective, and this had the potential risk of recall bias. However, the use of secondary data from the DHIS 2, HMIS, and ZIMSTATS within this case-control design was an advantage in terms of time and cost.

Methodology

Population

The study was undertaken in the Mutasa district, which is one of the seven districts of the Manicaland province in Zimbabwe. The district is approximately 30 kilometers from the city of Mutare, and it stretches up to Honde Valley, which is 100 kilometers northeast of Mutare (Figure 4). The district is made up of 31 wards. It has 41 clinics and three main referral hospitals (Hauna, Bonda Mission, and Mutare District Hospitals) providing primary health care to the district population (Jaravaza 2013; Mharakurwa et al., 2012). The district area is approximately 2547km^2.

The study population included all households of the Mutasa District with a population estimated at approximately 180,000 people residing within these households. The population estimates were based on the base rate of the 2012 census (168,747) and projected to the year 2017 by a growth rate of approximately 2% per year (ZIMSTATS, 2013, 2015). Based on the average number of 4.1 persons per household, the study population was approximately 43,900 households (ZIMSTATS, 2013). The sampling unit was the household unit represented by the household head or their representative. Two household groups were randomly selected from the household population. One group represented households that experienced one or more confirmed malaria cases over the study period January, 2016 to August ,2017. Malaria cases were defined as those infections confirmed through the use of rapid diagnostic testing (RDT) or laboratory diagnosis during the period January, 2016 to August, 2017. In comparison to previous studies (Kanyangarara et al., 2016), in this study, the actual malaria testing (either RDT or laboratory) was not undertaken because these were historically confirmed cases as derived from the DHIS2.

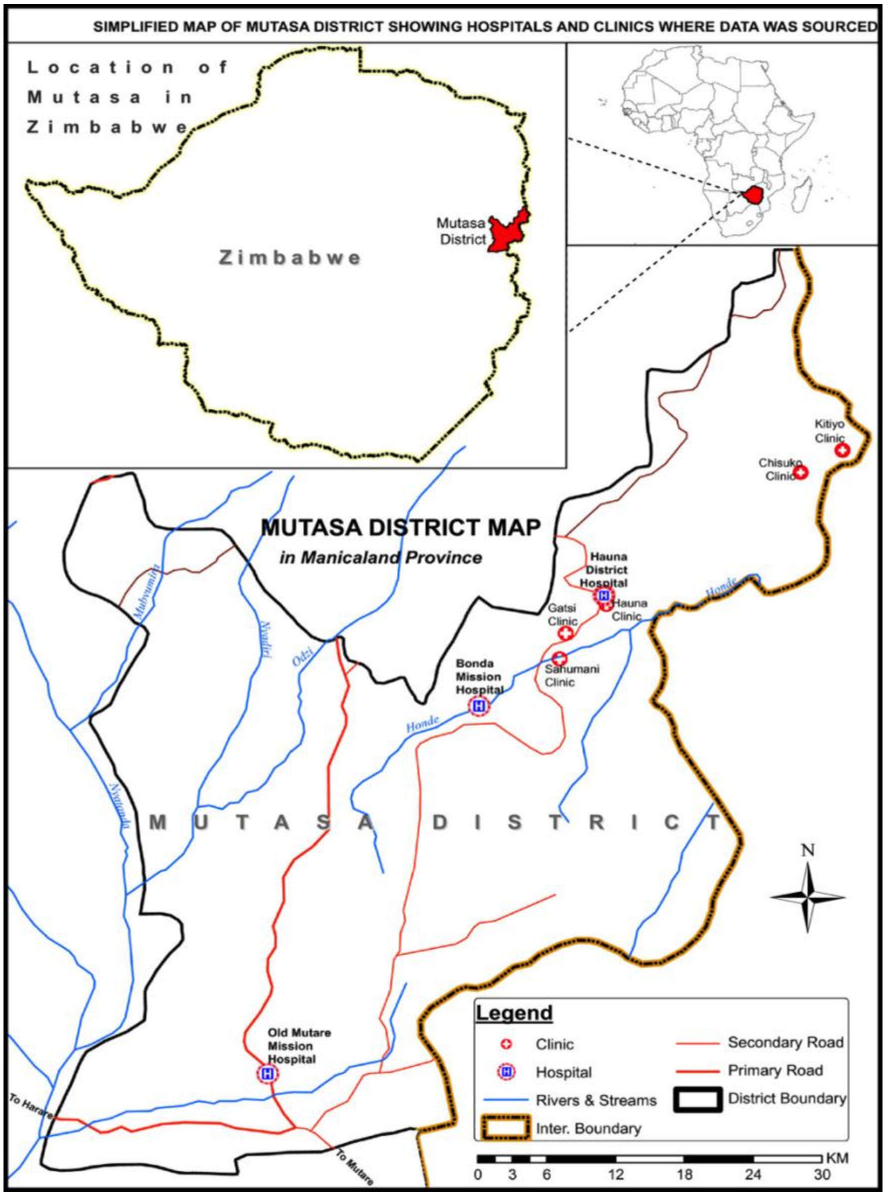

Figure 4. Mutasa District map location. Adapted from Mharakurwa et al., 2013.

The demographic features of the district as at 2012 are reflected in the table below (ZIMSTATS, 2013)

Table 1

Mutasa District Demographic Indicators

Demographic Indicators	
Total Population	168 747
Household Population (based on extrapolation)	41158
Proportion of Urban (%)	1.7
Proportion of Child Population (%)	49.5
Proportion of children below five (<5) (%)	15.1
Proportion of Women in Child Bearing Age,15 49 (%)	44.9
Proportion of Youth, 15–24 (%)	19.1
Sex Ratio of Youth, 15–24 (male/female)	96
Average Household Size	4.1

Sampling and Sampling Procedures

Sampling Strategy

The sampling for malaria-affected households was based on all malaria cases within the district during the period January, 2016-August, 2017. The sampling was structured in stages with initially a random selection of 15 wards out of the 31 Mutasa districts wards, followed by selecting the determined sample size of 172 households for the case households and 343 for the control households. These numbers were consistent with previous malaria studies within the same districts. It was hoped that the numbers would allow for sufficient power and effect size. In selecting the sample size, I was guided by the following formula as explained by Charan and Biswas (2013).

Equation 1

$$\text{Sample size} = \frac{Z_{1-\alpha/2}{}^{2} SD^{2}}{d^{2}}$$

$Z_{1-\alpha/2}$ =Is the standard normal variate (at 5% type 1 error (*P<0.05)* is 1.96 and at 1% type 1 error (P<0.01) is 2.58).

SD = Standard deviation of variable (note this could be derived from previous studies)

d = Absolute error of precision as anticipated

Note – 25.5 is the average incidence derived from combined average of national malaria incidence 2012 and 2013 (Presidential Malaria Initiative, 2017).

In this study, I calculated the sample size using EPINFO version 7.1. 3. The estimated odds ratios of being diagnosed with malaria based on rare household determinates, was set at 2.00. The resident population for the study area was 180,000, translating into approximately 43 900 households, and assuming a two-sided 95% confidence interval, an expected 20% of control to be exposed while the percentage of those exposed to malaria expected to be 33.3%, the estimated total sample size was 411. In related malaria case-control studies, Grigg et al. (2014) similarly established these sampling parameters. However, in this study I considered additional safeguards with the inclusion of a contingency of 25% for potential missing data, and also to minimize the potential for confounders, thus making the sample size of 515 study participating households. These were to be represented as; 172 (137+35) households with cases and 343(274+69) control households.

Unmatched Case-Control Study (Comparison of ILL and NOT ILL)

Two-sided confidence level: 95%

Power: 80 %

Ratio of controls to cases: 2

Percent of controls exposed: 20 %

Odds ratio: 2

Percent of cases with exposure: 33.3 %

	Kelsey	Fleiss	Fleiss w/ CC
Cases	123	126	137
Controls	245	252	274
Total	368	378	411

Figure 5. Sample size calculation using EPINFO version 7.1.3.

A multistage sampling strategy was adopted to ensure coverage and appropriate representation in all the 15 Wards. Mutasa District has a total of 31 Wards. The first stage was the collection of malaria incidence and mortality data from the DHIS 2 and verifying the data with National Malaria Information Records. The second stage was the disaggregating of the data into Wards. The third stage involved ascertaining the eligibility of the identified households prior to sampling. This strategy has the advantage providing the opportunity for generalizability to the target population and amenable for use in such a geographically clustered area (Bornstein et al., 2013)

Sampling Procedure

Secondary data set as derived from DHS, DHIS2 and the National Malaria Health Information System was used to conduct a stratified multistage probability design. This predetermines the framework for sampling the household. The initial stage commenced with extracting the malaria incidence information for the period, January, 2016 to August, 2017, for Mutasa District per each sampled ward or health facility from the DHIS2. The recorded malaria incidence (cases including mortalities) was then divided into relevant cluster ward/health facility sampling ratios. Within these ward clusters, probability sampling was carried out. This was achieved through randomized sampling to ensure all members within the determined target population had an equal chance of being selected within their relevant strata or cluster (Creswell, 2013).

The next stage involved visiting each health facility to inspect the T12 case registers to verify the numbers and the relevant household identities and carry out the appropriate sample size allocation for the ward or health facility catchment area. The process was to enable the separation of cases from control households using the household listing within each ward (where available). Physical address details of the sampled household were then tabulated to enable identification during questionnaire interview visiting process. The T12 registers enabled the isolation of households affected with malaria during the study delimitations and thus provide an opportunity for the equivalent control household identification and consequent random selection.

Sampling Frame

The sampling frame enables the opportunity to operationalize the population. The population was all the households in Mutasa District of Manicaland Province of Zimbabwe. However, the sampling frame was based on the National Malaria Incidence and Mortality Register for the period January, 2016 to August, 201n7. The list was subdivided according to Wards and further into Villages or Headman. However, special note was made of those units that belong to the Population, but not the sampling frame. Examples of these would-be institutions such as boarding schools, military barracks, hospitals, prisons, elderly homes, and the homeless. The probability of these being selected can be zero if not appropriately accounted for. The quality of data from the DHS, DHIS2 and National Malaria Control Directorate is considered very high and reliable as there are intricate and deliberate measures through various stakeholders such as the Global Fund, WHO and Monitoring and Evaluation Department within the Ministry of Health and Child Care that provide appropriate oversight on operational activities and data quality.

Power Analysis

The importance of an appropriate sample size can never be overemphasized, (Kumar et al., 2014) and hence the need for power analysis. Power outlines the probability erroneously rejecting the null hypothesis when the alternative is true. Consequently, power analysis was carried out to ensure that the sample size was appropriate while minimizing the potential for type II error. Determining an appropriate sample size would enhance timeous and efficient usage of the limited resources for the study. Consequently, the use of Epi Info software program enhances the determination of the appropriate sample size. This process anticipates any other relevant parameters that may emerge and hence requiring appropriate consideration.

Recruitment of Participant Households and Data Collection

As indicated in the preceding sections recruitment of participant households and consequently the relevant householder to be interviewed was preceded by the sampling strategy protocol. The strategy began with listing confirmed malaria cases during the period January, 2016 to August 2017, followed by clustering these cases into wards/health facility and institutions (Figure 6). Recruitment was proportionally done in relation to the cases within the ward/health facility.

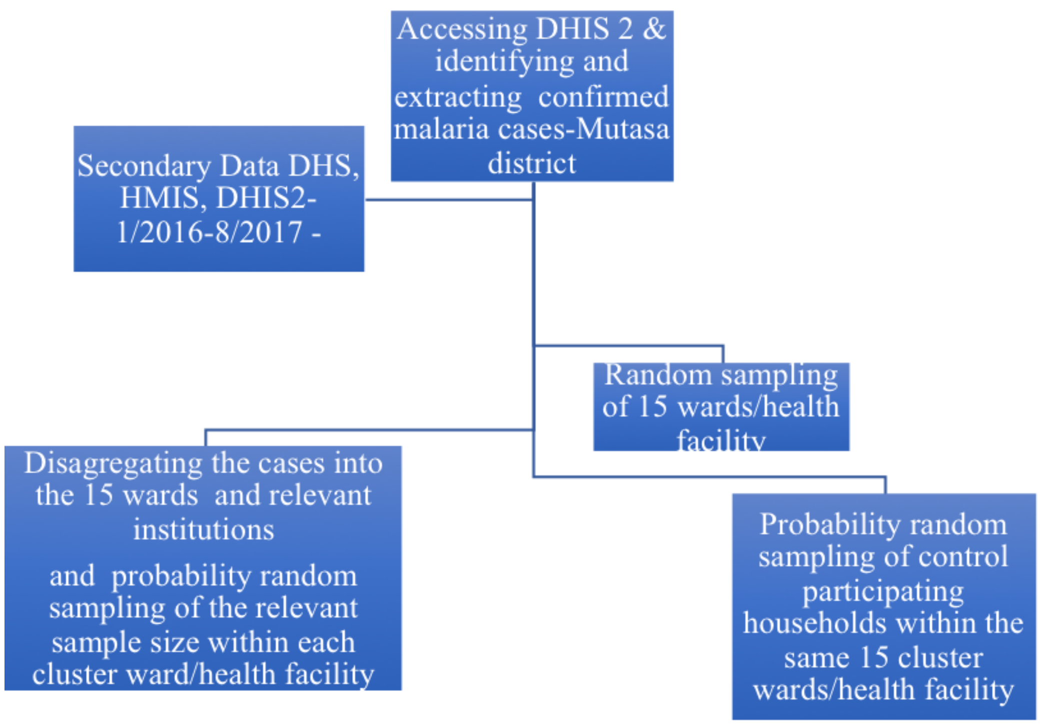

Figure 6. Recruitment of participant households.

HMI, DHS, DHIS2, and incidence records of malaria as recorded in the local health facility (T 12 Registers) and the district hospital formed the basis of the data collection. All data originates from weekly reports that are initiated at clinics or health facility, then verified and reconciled at the district hospitals before being entered into the provincial and National HMI, and DHIS2 platforms. The data are appropriately verified with the relevant authority within the Ministry of Health and Child Care and was reaffirmed during interview/ questionnaire completion with sampled households. Additional secondary data were also obtained from

- Zimbabwe National Statistics Agency (ZIMSTATS)- for population demographics
- Zimbabwe National Statistics Agency (ZIMSTATS) and ICF International, (2016) –Historical survey data.
- DHS for variable determinant data, such as household characteristics, socioeconomic status and environmental determinants.

In addition to secondary data, current data were obtained through survey questionnaires administered on sampled households, represented by the household head.

The Population of Mutasa District, which was estimated at 180 000 people (ZIMSTATS, 2013), translating into 43, 900 households, was the study population. Determination of households that experienced or did not experience malaria incidence was based on identified, confirmed malaria persons within those households. Malaria incidence records within the Ministry of Health and Child Care's, Health Management Information records (HMIS) and DHIS2 were used to obtain the initial incidence data (MOH & CC, 2015; 2017). Confirmed malaria cases were defined according to the

WHO’s criteria, as those persons confirmed to having had malaria parasite in their blood by either microscopical determination or through RDT (WHO, 2013; 2015). The other group (control households) comprised any of those households that had not experienced any malaria incidence during the study period.

Data Collection Instruments

Data were collected using a household questionnaire, completed during an interview with the household head or any other defined representative (Sichande et al., 2014). The questionnaires appropriately captured information on the identified household determinant variables. The questionnaires and interviews were limited to the household head/representative and intended to establish or reaffirm household data and not personal or individual data (Sichande et al., 2014).

Operationalization of Variables

The existing DHIS2 and HMIS data contains a number of variables both dependent variables (malaria cases) and independent variables that include household characteristics, household income, employment status, use of intervention strategies (LLINs, IRS, Repellants etc.), household education/literacy levels, culture, religion, household population demographics, decision making (women and men), accessibility to health facilities, malaria knowledge, access to media communication, and school going children. Other, relevant variables were identified from previous related studies and included on the questionnaire together with information obtained from available data sets. Appropriately framed questions were designed to gain insight into the consolidated household determinants (Appendix B).

Dependent Variables

The dependent variables were households that experienced confirmed malaria cases during the study period. The factor was considered as a binary dependent variable (yes/no). This information, initially obtained from the HMIS and DHIS2 was also confirmed through questionnaires.

Two questions were asked:

1. Has any member of the household had malaria since January 2016? (Yes/No).

If the answer to the question was “yes” a follow up question to determine when was asked to verify that it occurred during the study period.

2. When did the infection/illness occur?

Appropriately defining a malaria case or incidence can pause a challenge as there are varied views amongst health personnel (CDC, 2014; WHO, 2015). In this study, my understanding was derived from the definitions of both CDC and WHO. For the purposes of this study a malaria case shall be synonymous with malaria infection (WHO, 2015) and the terms shall be used interchangeably. Consequently, a malaria case or infection shall be a person in whom, malaria specific parasites or species-specific parasite DNA, have been detected in their blood and appropriately confirmed through the use of RDT, microscopic examination or Polymerase Chain Reaction (PCR). This shall be regardless of the existence or absence of clinical symptoms. This is the Ministry of Health and Child Care’s guideline recommendation, which is carried out at all health facility levels, culminating in the recorded cases in DHIS2.

Independent Variables and Covariates

The independent variables which includes covariates such as age and sex consist of the socioeconomic factors (household wealth, household/family income housing construction, employment levels, education levels of household head/representative, knowledge of malaria, household agro/economic activity), demographic factors (household make up/size) behavioral factors (culture, religion, beliefs), environmental factors (climate, geographical features), and services (current malaria interventions, electricity, transport, health facilities, communication)

Household wealth. This was determined through answers to questions about the ownership of items such as radio, television, telephone, refrigerator, bicycle, motorcycle, or a a car. The availability of household electricity (conventional or solar) and the type of fuel used for cooking was also noted. The number of rooms used for sleeping, ownership of agricultural land and livestock and possession of a bank account or other cash serving mechanisms were used for computing the wealth and socioeconomic status index. This information would add appropriate value to the household source of income question (ICF International, 2016).

Household dwelling characteristics. Key or main materials used in the construction of the walls, floor, and roof, (Kanyangarara et al., 2016), which are additional components of the wealth index, are also important in relation to the insecticide residuality and the potential biological implications on the malaria vector. These characteristics were observed during interviewers and appropriately noted.

Education and literacy. It has been observed that malaria morbidity, mortality and the appropriate health care-seeking behavior, and health-related preventive behavior may be influenced by levels of education and literacy and thus the importance of recording the status within the household. In this regard and in accordance with the ICF International (2016), householders who have attained at least secondary education were presumed to be literate (Sichande et al., 2014: ICF International, 2016).

Religion. Zimbabwe is considered to be a country with religious diversity. In this regard, I believe, it is necessary to record the nature and levels of diversity within Mutasa District and its subsequent influence on health behavior related to malaria prevalence. Considerable evidence has been reported of the normative attitudes associated with religious values resulting in defined health-related behavior (ICF International, 2016). Such behaviors may impact malaria intervention strategies.

Knowledge of Malaria. The effect of malaria messages in a community and the subsequent impact on malaria morbidity and mortality can never be underestimated. The evaluation strategy within this study endeavors to establish the level of malaria knowledge within the household particularly that of the householder. Furthermore, the questionnaire also aimed to establish if the household were exposed to any relevant malaria media messages and any other relevant sources.

Independent Variables Definition

Independent variables in this study are defined as those identified household determinants as described in Table 2 and any other factor that may be identified during the questionnaire survey.

Table 2

Dependent and Independent Variables

Variable Type	Variable Name	Variable Source	Level of Measurement
VARIABLES FROM DATA FILES			
Dependent	Malaria diagnosis status	DHS and HMIS Data	Categorical
Independent	Interventions	DHS and HMIS Data	dichotomous
	LLIN		dichotomous
	IRS		dichotomous
	Repellents		dichotomous
	Other		
	Wealth Index (Household Possessions) *	DHS and HMIS Data Files	categorical
	Household Income		ordinal
	Household assets*		ordinal
	Electricity(Yes/No)		dichotomous
VARIABLES FROM THE QUESTIONNAIRE DATA			
Independent	Education Level	Questionnaire data file	Continuous
	Household head, education	Questionnaire data file	
	Mother's Education	Questionnaire data file	
	Knowledge of Malaria	Questionnaire data file	Categorical
	Housing Characteristics (Modern/traditional/Mixed)	Questionnaire data file	Categorical(C)
	Wall Type	Questionnaire data file	ordinal
	Roof type	Questionnaire data file	ordinal
	Interventions		
	LLIN	Questionnaire data file	dichotomous
	IRS	Questionnaire data file	dichotomous
	Repellents	Questionnaire data file	dichotomous
	Other	Questionnaire data file	dichotomous
	Wealth Index (Household	Questionnaire data file	categorical
	Possessions) *	Questionnaire data file	
	Household Income	Questionnaire data file	ordinal
	Household assets*	Questionnaire data file	ordinal
	Electricity(Yes/No)		dichotomous
	Household Demographics	Questionnaire data file	
	Household size	Questionnaire data file	ordinal
	Males	Questionnaire data file	ordinal
	Females	Questionnaire data file	ordinal
	Under fives		ordinal
	Environmental Variables		
	Distance to health Centre	Questionnaire data file	continuous
	Distance to breading sites	Questionnaire data file	continuous
	Distance to CHW	Questionnaire data file	continuous
	Distance to transport	Questionnaire data file	ordinal
	network	Questionnaire data file	ordinal
	Distance to source of	Questionnaire data file	dichotomous
	potable water	Questionnaire data file	dichotomous
	Sanitation (toilet/bath		

	facilities)		
	Existence of Animals		
	Socio-conomic Factors		
	Agricultural Activity	Questionnaire data file	ordinal
	Household Main Source of		ordinal
	Income (employment)		ordinal
	Communication Channels		ordinal
	Entertainment (tv. etc)		ordinal
	Cultural Factors		ordinal
	Religion		ordinal
	(Christianity/Muslin/traditional/other)		
Covariate	Age (Household head)	Questionnaire data file	continuous
Covariate	Sex (Household head)	Questionnaire data file	dichotomous

Notes –Wealth Index was based on the ownership of household assets, and estimated annual household income, used as a proxy for socio-economic status (SES)and categorized as low SES and high SES (Samadoulougou et al., 2014).

Data Analysis Plan

Data Analysis

Binary logistic analysis was carried out to determine the level and significance of the variables (Forthofer, & Lee, 2014; Kanyangarara et al., 2016; Sichande et al., 2014). The multivariate logistic analysis was considered appropriate, since the study outcome was dichotomous and there were multiple independent variables being considered (Hidalgo & Goodman, 2013). These analyses were anticipated to enhance the potential for minimizing possible case-control study limitations (Frankfort-Nachmias &Chava, 2014). Considering the potential for case-control study limitations of possible confounding, variable stratification methods were employed as necessary. The multivariate models according to Pourhoseingholi (2012) can handle multiple covariates simultaneously.

International Business Machines Corp (IBM) SPSS Statistics version 23 was used to conduct analysis for all data. SPSS provides appropriate data management, that encompasses, coding, recoding, transformation, and missing value thus enabling the analysis of variables as obtained from the survey data sets. Collected data files were organized and recorded prior to appending to the secondary data sets in accordance with the methodological approach. A review and analysis of missing data was carried out to preserve the integrity of the results. This analysis also includes descriptive statistics for demographic factors, socio-economic factors, education levels and wealth index. Furthermore, any other relevant variables additionally identified were also adequately described.

Research Question 1. Is there a relationship between household determinants and malaria diagnosis in Mutasa district, of Zimbabwe?

$H_0 1$: There is no relationship between household determinants and malaria diagnosis in Mutasa district.

$H_a 1$: There is a relationship between household determinants and malaria diagnosis in Mutasa district .

In addressing research question 1 a frequency distribution for the identified household determinants was used to represent the study period comparing the two household groups; those that were diagnosed with malaria (cases), and those that did not suffer from malaria (the controls). Logistic regression was used to determine the relationship within the households (malaria present yes/no), and the independent variables (household determinants of malaria). An alpha level, p-value of 0.05 determined if there was a significant difference between those households that encountered confirmed malaria cases, and those households that did not have any malaria cases during the study period. Comparisons were made between control households (those that had no malaria incidence) and case households (households that had confirmed malaria cases), consequent upon the identified and evaluated household determinants. If the trend was the same, data were pooled to give summary measures for affected and nonaffected households, otherwise the results were reported separately for these groups.

Research Question 2. What is the relationship between environmental household factors including presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport and malaria infection in Mutasa district of Zimbabwe?

H_o2: There is no relationship between the environmental household factors that include presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport and malaria infection in Mutasa district of Zimbabwe.

H_a2: There is a relationship between the environmental household factors that include presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport and malaria infection in Mutasa district of Zimbabwe.

Research Question 3. What is the relationship between social and cultural factors and infection in Mutasa district of Zimbabwe?

H_o3: There is no significant relationship between social and cultural factors and malaria infection in Mutasa district of Zimbabwe.

H_a3: There is a significant relationship between social and cultural factors and malaria infection in Mutasa district of Zimbabwe.

Research Question 4. What is the relationship between available malaria interventions including indoor residual spraying, use of long lasting insecticide treated nets, mosquito larviciding (insecticide spraying of breeding sites),use of intermittent preventive treatment of pregnant mothers, and malaria infection I Mutasa District of Zimbabwe

H_o4: There is no relationship between available malaria interventions including indoor residual spraying (IRS), use of long lasting insecticide treated nets, mosquito larviciding (insecticide spraying of breeding sites),use of intermittent preventive treatment of pregnant mothers, and malaria infection in Mutasa district of Zimbabwe.

H_a4: There is a relationship available malaria interventions including indoor residual spraying, use of long lasting insecticide treated nets, mosquito larviciding (insecticide spraying of breeding sites), use of intermittent preventive treatment of pregnant mothers, and malaria infection in Mutasa district of Zimbabwe,

In addressing Research Questions 2, 3, and 4, logistic regression models were fitted to establish the relationship between the different grouping categories of the household determinants and Malaria infection. Examination was for nonaffected households, compared to the malaria affected households, where the trend was the same, the results were pooled and reported per each variable group. Analysis also examined severity, through analyzing for those households which had episodes of malaria, and those that had no episodes of malaria, between January 2016 and August 2017. Crude odds ratios and 95% confidence intervals were reported in crude analysis for each household determinant. Multivariate logistic regression models were fitted to control for potential confounders (covariates), such as age, gender, socioeconomic status, education, and others.

Validity and Reliability

Validity and reliability are important concepts to be considered and ensured as this reflects the measurement properties of a survey, questionnaire or any other type of study measure. Lack of appropriate consideration may enhance opportunities for potential threats to the study.

Threats to Validity

The threats to validity may either be internal or external or both. Internal validity may compromise the confidence that is necessary in the established relationship between independent and dependent variables.

According to Frankfort-Nachmias and Chava (2014) internal validity must be ensured through answering the question, of whether any changes or timeous existence in any of the independent variables does affect or influence, any outcomes in the dependent variable. Consequently, in this study the design and methodology have been the guiding principles intended to ensure attainment of internal validity (Frankfort-Nachmias & Chava, 2014). Despite these efforts, the threat to internal validity, may be anticipated due to both extrinsic and intrinsic factors. However, the use of randomization in sample selection is anticipated to have mitigated or offset the effect of unforeseen intrinsic and extrinsic factors. The inclusion of a control group (non-malaria affected households) will be expected to have enhanced or counteracted the potential effects of intrinsic factors (Frankfort-Nachmias & Chava, 2014).

While internal validity is important, the need to generalize study findings to the general populace and possibly different social or political settings, is equally very important (Frankfort-Nachmias & Chava, 2014). Such concern reflects the external validity of the study. In this regard, two critical issues noted were sample representativeness and reactions during the research procedures. External validity can be divided into population validity and ecological validity (Yu, 2017; Michael, 2014).

In this study threats to external validity may present themselves through potential limitations resulting from possibly incomplete data. The types of incompleteness in this study survey may thus include households with which no interview is realized, or explicit refusals or unreachability of sampled households. Despite these observations, the threat to external validity, which was anticipated to compromise the study findings' generalizability was mitigated by having an appropriate sample size as indicated earlier enhanced by the 25% increase in the calculated sample size.

Construct Validity

Construct validity relates to the quality of chosen independent and dependent variables and the appropriateness of the measurements instruments as it pertains to the adopted theoretical concepts and their operationalization (Wittwer, & Hubrich, (2015).

In this study, the only anticipated threat to construct validity was the probability of household representative respondents anticipating the hypotheses and hence responding accordingly. This was particularly pertinent with regards the behavioral, cultural and religious aspects within the household. The other anticipated threat was related to evaluation apprehension, which is also related to ecological external validity, with potential to affect the generalization process (Wittwer & Hubrich, 2015).

Ethical Considerations

Prior to data collection, the appropriate IRB Walden approval and the approval of National Medical Research Council of Zimbabwe and the local district community leadership were obtained. When one is carrying out research on humans in Zimbabwe, it is required to get approval from, and register the project with the Medical Research Council of Zimbabwe, which in turn gets the Research Council of Zimbabwe's approval. This process involved seeking permission from the Permanent Secretary of Health, and from the departmental heads of the relevant institutions defined in the proposal. As the principal investigator, I was responsible for processing this approval. A consent form (both Walden and MRCZ formats), also translated into Shona, was signed by each individual study participant (Appendix A and Appendix C). The necessary participant consent was sought prior to enrolling the respondent households into the study (Creswell, 2013). The study was carried out in collaboration with the Zimbabwe National Malaria Control Program Director and relevant National Institute of Health Research officials

Secondary data were acquired from the DHS platform. According to Health Information Systems Program (HISP) this data were collected with all necessary and appropriate ethical considerations being upheld. This pertained to upholding all the required and relevant legal issues of individual privacy with regards the collection, communication and disclosure of personal information., In carrying out this study, informed consent was obtained from the appropriate household representative.

The use of the Household Questionnaire commenced with the appropriate introduction, relevant explanations and the subsequent respondent's consent (household head or representative) to participate in the survey (Appendix A). The study endeavors to uphold the principles of respect for all sampled household representative respondents, beneficence and justice as outlined in the 1979 Belmont Report (Friesen et al., 2017).

All information was acquired lawfully, fairly and solely used for the evaluation and determination of the influence of the established household determinants on malaria morbidity and mortality. All information acquired will be kept in confidence with all possible security measures ensured to safeguard against loss or theft by unauthorized persons in any way.

Definitions

Key Respondent (Household Head/Representative)

A key respondent in this study is the household representative determined as the household head. In this study, the household head is defined as a person acknowledged as such by members of the household and responsible for the upkeep of the household (Radhakrishnan et al., 2015)**.**

Exposure

A term used to describe the potential of an individual, household, or community to possible infection to malaria parasites or what may also be described as potential risk to malaria infection (WHO, 2013). It can also be stated that the threat of malaria depends on the level of exposure to one or more of the available risks associated with malaria. Inherently exposure is relative to a number of variable situations, that derive from socio-economic status., environmental, biological, and demographic dynamics (Blas, 2013). According to WHO (2013), measuring the level of exposure is a somewhat complicated with one of the processes usually involving the determination of the spleen rates. This, however, is beyond the scope of this study.

Malaria Case

A malaria case is defined as a person in whom the malaria disease or illness (symptomatic or asymptomatic) has manifested itself and in whom the presence of malaria parasites were found in his or her blood and confirmed by parasitological testing (diagnostic testing).

Summary and Transition

The focus in Chapter 3 was on describing the relevant research strategy and methodology applicable to the study. The study population, sampling framework and sample size, instrumentation, operational definitions of variables, research questions and hypotheses relevant to the anticipated independent and dependent variables were also outlined. The data analysis plan and its relevant strategy in relation to the research questions and hypotheses was also outlined.

Chapter 4: Results

Introduction

The purpose of this study was to explore the relationship between the identified household determinant variables to malaria morbidity in the Mutasa District of Zimbabwe by analyzing the secondary data (DHS, DHIS2) and questionnaire survey dataset. In this chapter, I report the data collection process and the results of the study. Descriptive statistics on the dependent variable, and the identified independent variables and covariates, are reported and presented as frequencies and percentages for all variables, as summarized in tables and figures. Bivariate analysis between the dependent variable and each of the independent variables was conducted, and the crude odds ratio (*OR*), adjusted odds ratio (*AOR*), and *CI* results are reported. Multivariable logistic regression models were conducted for each research question, and these results are reported and summarized in tables. The statistical findings are organized and presented in relation to each research questions and hypotheses.

This study included four research questions, which are presented below with the corresponding hypotheses.

Research Question 1: Is there a relationship between household determinants and malaria diagnosis in Mutasa district, of Zimbabwe?

$H_0$1: There is no relationship between household determinants and malaria diagnosis in Mutasa District of Zimbabwe

H_a1: There is a relationship between household determinants and malaria diagnosis in Mutasa District of Zimbabwe.

Research Question 2: What is the relationship between environmental household factors including presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport, and malaria infection in Mutasa district of Zimbabwe?

H_o2: There is no relationship between the environmental household factors that include the presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport, and malaria infection in Mutasa district of Zimbabwe

H_a2: There is a relationship between the environmental household factors that include the presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport, and malaria infection in Mutasa district of Zimbabwe.

Research Question 3: What is the relationship between social and cultural factors and malaria infection in Mutasa district of Zimbabwe?

H_o3: There is no significant relationship between social and cultural factors and malaria infection in Mutasa district of Zimbabwe.

H_a3: There is a significant relationship between social and cultural factors and malaria infection in Mutasa district of Zimbabwe.

Research Question 4: What is the relationship between available malaria interventions including indoor residual spraying (IRS), use of long lasting, insecticide-treated nets, mosquito larviciding (insecticide spraying of breeding sites), use of intermittent preventive treatment of pregnant mothers, and malaria infection in the Mutasa District of Zimbabwe?

H_o4: There is no relationship between available malaria interventions including IRS; use of long lasting, insecticide-treated nets; mosquito larviciding (insecticide spraying of breeding sites); use of intermittent preventive treatment of pregnant mothers' and malaria infection in the Mutasa district of Zimbabwe.

H_a4: There is a relationship between malaria interventions including IRS spraying; use of long lasting; insecticide-treated nets; mosquito larviciding (insecticide spraying of breeding sites); use of intermittent preventive treatment of pregnant mothers; and malaria infection in the Mutasa district of Zimbabwe.

Data Analysis

To test these hypotheses, I adopted a case control methodological approach, using both historical data and data from survey questionnaires. The historical data were obtained from the DHS, the DHIS2, and the district health facilities' T12 patient registers, where all confirmed cases of malaria for the period from January 2016 up to August 2017 were recorded. A total of 529 households were randomly selected from 15 wards out of the 31 Mutasa District wards, using a multistage random sample selection strategy (Table 3, Figure 7). Sampling of cases was carried out using the confirmed cases listed in the T12 registers of the health facilities in the sampled wards. Sampling of controls was dependent on the sampled cases. Control households were also randomly selected by first choosing the nearest eligible non case household to the sampled case household and then every third household visited, thereafter up to the required numbers in relation to each case household sampled.

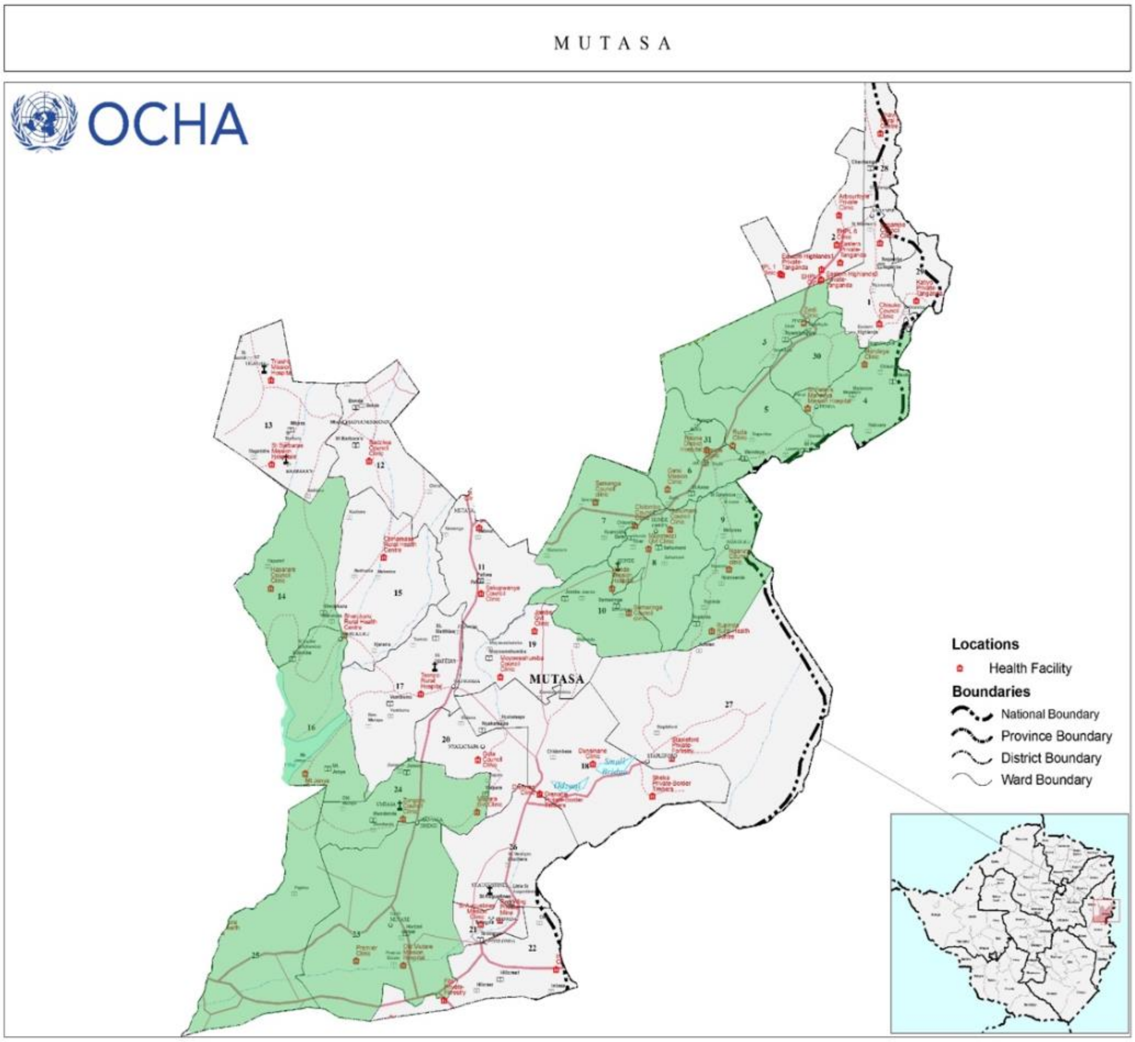

Figure 7. Mutasa district map –highlighting selected wards and health facilities. Adapted from-UN Office for the Coordination of Humanitarian Affairs (OCHA).

Table 3

Manicaland Province –Mutasa District Population Demographics Year 2012

Ward	Population Males No	%	Females No	%	Total No	%	Sex Ratio	Households Total No/Hds	Av House/Hd Size
Ward01	4227	45.3	5114	54.7	9341	100	82.7	2172	4.3
Ward 02	1346	52.1	1239	47.9	2585	100	108.6	855	3.0
Ward 03	4282	45.7	5087	54.3	9369	100	84.2	2207	4.2
Ward 04	2791	46.7	3186	53.3	5977	100	87.6	1439	4.2
Ward 05	3368	45.8	3979	54.2	7347	100	84.6	1795	4.1
Ward 06	2929	44.9	3599	55.1	6528	100	81.4	1537	4.2
Ward 07	3945	46.1	4604	53.9	8549	100	85.7	2085	4.1
Ward 08	2912	45.5	3487	54.5	6399	100	83.5	1585	4.0
Ward 09	2390	44.9	2932	55.1	5322	100	81.5	1284	4.1
Ward 10	1721	45.8	2034	54.2	3755	100	84.6	963	3.9
Ward 11	5047	46.1	5896	53.9	10943	100	85.6	2653	4.1
Ward 12	2724	45.1	3320	54.9	6044	100	82.0	1457	4.1
Ward 13	1889	46.6	2163	53.4	4052	100	87.3	1015	4.0
Ward 14	1169	45.7	1389	54.3	2558	100	84.2	707	3.6
Ward 15	1536	46.4	1776	53.6	3312	100	86.5	879	3.8
Ward 16	1413	46.4	1632	53.6	3045	100	86.6	763	4.0
Ward 17	4835	47.2	5405	52.8	10240	100	89.5	2449	4.2
Ward 18	1493	55.9	1180	44.1	2673	100	126.5	858	3.1
Ward 19	3113	45.9	3672	54.1	6785	100	84.8	1650	4.1
Ward 20	2034	46.9	2306	53.1	4340	100	88.2	1053	4.1

Ward21	4687	50.5	4594	49.5	9281	100	102.0	2355	3.9
Ward 22	1695	52.0	1562	48.0	3257	100	108.5	902	3.6
Ward 23	3497	51.0	3361	49.1	6858	100	104.0	1549	4.4
Ward 24	2048	46.2	2388	53.8	4436	100	85.8	1078	4.1
Ward 25	2297	53.0	2031	46.9	4328	100	113.1	1248	3.5
Ward 26	2768	49.3	2842	50.7	5610	100	97.4	1312	4.3
Ward 27	846	56.3	657	43.7	1503	100	128.8	427	3.5
Ward28	1657	44.4	2075	55.6	3732	100	79.9	930	4.0
Ward 29	947	47.3	1057	52.7	2004	100	89.6	518	3.9
Ward30	2338	46.2	2728	53.8	5066	100	85.7	1235	4.1
Ward31	1604	45.7	1904	54.3	3508	100	84.2	924	3.8
Total	79548	471.0	89199	52.0	168747	100	89.4	41894	4.0

In this chapter, I present the results of the study based on the descriptive overview, demographic data characteristics, and the binary and multivariate logistic regression analysis that were carried out. The identified variables, as set out in the questionnaire, were grouped into four categories: household characteristics, household environment, household socio/cultural, and malaria interventions at the household level. Survey data were first entered into a Microsoft Excel spreadsheet for the initial review and data cleaning process. The required sample size was 515 households, with 172 of these being case households and 343 being control households. However, in the process of carrying out the survey, I ended up sampling 529 households with 189 of these being case households and 340 being control households. It was during the process of data verification when I discovered that seven of the control households had experienced cases of malaria during the study period, and I moved them to the household case group.

Demographic Characteristics of the Sample

Table 4 reports the demographic characteristics of the sampled wards in terms of total numbers of males and females within the sampled wards and the number of case and control households related to each ward. The table also highlights the health facilities related to each of the sampled wards. Some health facilities were shared between wards. In total, there were 13 health facilities serving the 15 sampled wards.

Table 4

Mutasa District – Sampled Wards Demographics

	Population				Households			
Ward	Males No	Females No	Total No	Health Facility	Total H/Hds	T/No Sample Cases	Control	Average H/Hd Size
Ward 03	4282	5087	9369	Zindi	2207	21	37	4.2
Ward 04	2791	3186	5977	St Peters	1439	14	27	4.2
Ward 05	3368	3979	7347	St Peters	1795	19	31	4.1
Ward 06	2929	3599	6528	Gatsi	1537	16	23	4.2
Ward 07	3945	4604	8549	Chitombo	2085	13	32	4.1
Ward 08	2912	3487	6399	Mpotedzi	1585	14	23	4.0
Ward 09	2390	2932	5322	Ngaruwa	1284	18	35	4.1
Ward 10	1721	2034	3755	Samaringa	963	7	16	3.9
Ward 14	1169	1389	2558	Sherukuru	707	7	17	3.6
Ward 16	1413	1632	3045	Sherukuru	763	7	12	4.0
Ward 23	3497	3361	6858	Mandeya	1549	12	20	4.4
Ward 24	2048	2388	4436	Premier	1078	8	15	4.1
Ward 25	2297	2031	4328	Manica Bg	1248	8	14	3.5
Ward 30	2338	2728	5066	Premier	1235	13	22	4.1
Ward31	1604	1904	3508	Hauna	924	10	18	3.8
Total	38704	44341	83045		20399	189	340	4.02

Study Results

The independent determinant variables of malaria included household characteristics (gender of household head, presence of children both 0-5years and 6-18 years, type of roof cover, type of wall cover, availability of electricity, and type of ventilation construction), household environment (presence and proximity of livestock, availability of toilets, distance to drinking water, existence and proximity of potential breeding sites, distance to health facility, distance to village health worker, type of cooking fuel, and accessibility to transport), household socio/economic and cultural status (presence/ownership of television, radio, stove, refrigerator, animal drawn cart, telephone, livestock), type of occupation (formal employment, seasonal farming, horticulture, or mining), level of education and religion, and type and level of malaria interventions at the household level (indoor residual Spraying, LLINs, IPTp, Larviciding). All of the independent variables data were obtained using the survey questionnaire.

To analyze the survey data, I used the SPSS Version 23 statistical analysis software. An evaluation of the association of the recognized household characteristics, household environment, socio/cultural, and malaria intervention risk factors was done. I compared the risk factors between the case households and the control households within the study population households.

Tables 5 and 6 report the results of the analysis, frequencies of cases, and of the crude and AORs for the household characteristic factors. I rejected the null hypothesis at the 95% level of significance and accept the alternate hypothesis as there are household determinants that influence malaria incidence in the Mutasa District.

Table 5

Distribution of Household Characteristic Factors

Independent Variables	Total (*n*=529)	%	Cases (*n*=189)	%	Control (*n=340)*	%
Sex of Head of HH						
Male	390	73.7	137	35.1	253	64.9
Female	139	26.3	53	38.1	86	61.9
Presence of under 5 children in HH(chn_HH)						
No- under 5 children in HH	223	42.2	75	39.5	148	43.7
Under 5 children present in HH	306	57.8	115	60.5	191	56.3
Roof Type						
-Traditional (thatch)	119	22.5	42	35.3	77	64.7
-Both (T&M)	339	64.1	127	37.5	212	62.5
-Modern (iron /asbestos/tiles)	71	13.4	21	29.6	50	70.4
Walls						
-Mud	82	15.5	25	30.5	57	69.5
-Mud & Cement	185	35.0	63	34.1	122	65.9
- Mud & Other -Comb	44	8.3	17	38.6	27	61.4
-Cement Plaster	218	41.2	85	39.0	133	61.0
Electricity						
-Yes	13	2.5	7	53.8	6	46.2
- No	516	97.5	183	35.5	333	64.5
Ventilation						
- Traditional	145	27.4	53	36.6	92	63.4
- Traditional & Modern	288	54.4	101	35.1	187	64.9
- Modern	96	18.1	36	37.5	60	62.5

A number of key observations were noted, as reported in Table 5. In the association of gender in relation to malaria frequency, I noted that the frequency of malaria was higher in female-headed households at 38.1% compared to 35.1% in male-headed households. On the other hand, households with children under 5 years had a higher frequency of malaria at 60.5% compared to those with no children under 5 years at 39.5%.

On the variable of housing construction features; households with a combination of both traditional and modern roofing had a slightly higher frequency of malaria cases at 37.5 % compared to traditional roofing alone (35.3%) and modern roofing alone (29.6%). Cement plastered walls (39.0%) and mud and other combinations (38.6%), had higher malaria case frequency than mud and cement walls (34.1%) and only mud plastered walls (30.5%). Households with electricity even though these were quite few (only 13), had a higher frequency of malaria cases at 53.8% compared to households without electricity at 35.5%. However, when considering the type of ventilation there were minor differences between the three types; traditional ventilation (36.6%), combination of traditional and modern (35.1%) and modern ventilation (37.5%).

Table 6

Crude and Adjusted Odds Rations for Household Characteristics

Independent Variables	Crude Odds Ratio	95%CI	Adjusted Odds Ratio	95% CI
Gender of Household Head(H/head)				
Males	0.88	0.59-1.31	0.87	0.57-1.30
Females	Reference	Reference	Reference	Reference
Presence of under 5 children in HH (chn_HH)				
No under 5 children in HH	0.84	0.59-1.21	0.84	0.58-1.21
Under 5 children present in HH	Reference	Reference	Reference	Reference
Roof Type(Roof2)				
-Traditional (thatch)	1.30	0.69-2.45	1.54	0.75-3.13
-Both (T&M)	1.43	0.82-2.49	**1.64**	0.91-2.94
-Modern (iron /asbestos/tiles)	Reference	Reference	Reference	Reference
Wall type (Walls2)				
-Mud	0.69	0.40-1.18	0.60	0.32-1.11
-Mud & Cement	0.81	0.54-1.22	0.72	0.47-1.11
-Mud & Other Combs	0.99	0.51-1.92	0.91	0.45-1.84

-Cement Plaster	Reference	Reference	Reference	Reference
Electricity				
-Yes	2.12	0.70-6.41	2.26	0.74-6.95
-No	Reference	Reference	Reference	Reference
Ventilation type (ventil3)				
- Traditional	0.96	0.56-1.64	0.82	0.46-1.46
- Traditional & Modern	0.90	0.56-1.45	0.83	0.48-1.44
- Modern	Reference	Reference	Reference	Reference

Table 7 reports the crude odds ratios (*OR*) and adjusted odds ratios (*AOR*) of the household characteristics. I used binary logistic regression for both cases (crude and adjusted odds ratios). The crude odds ratios (*OR*) and confidence intervals (*CI*) were initially computed to separately compare the malaria prevalence between the reference group and other groups within each predictor variable. The adjusted odds ratios (*OR*) and CIs were computed to adjust for confounding. In this respect, I adjusted for socio-demographic variables, which included gender of household head, and age, in assessing the relationship of risk factors on the outcome variable of malaria prevalence simultaneously.

In this regard, all the predictor variables within the Household Characteristics cluster were included in the model. Household determinant variables were considered on the basis of comparing households that had experienced malaria (malaria present–yes) and those that had not experienced malaria, (malaria present-no) during the study period. All the household characteristic variables were not significant at the 95% CI. However, households that had a combination of traditional and modern roof types (reference modern roofing) and availability of electricity (reference no electricity), had a higher risk of malaria infection (A*OR* =1.64) and (*AOR*=2,26) respectively, compared to all the other household characteristic factors. Although not statistically significant, the risk of malaria infection was reduced in male headed households, compared to female headed households (*AOR*=0.87, *CI* 0.57,1.30) and in households without under five years children in comparison to households with under five years children, *AOR*=0.84, *CI* (0.58,1.21).

Research Question 2

What is the association between household environmental factors including presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport and malaria infection in Mutasa district of Zimbabwe?

H_o2: There is no association between the environmental household factors that include presence of livestock, drinking water, breeding household factors that include presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport and malaria infection in Mutasa district of Zimbabwe.

H_a2 There is an association between the household environmental factors that include presence of livestock, drinking water, breeding sites, distance to health facilities, distance to village health worker, type of fuel used for cooking, accessibility to transport and malaria infection in Mutasa district of Zimbabwe.

RSQ 2: Household Environment Factors

Tables 7 and 8, report the results of the analysis frequencies of cases and of the crude and adjusted odds ratios for the household environment factors

Table 7

Distribution of Household Environment –Variable Frequencies of Cases and Control

Independent Variables	Total n=529	%	Cases n=190	%	Control n=339	%
Animals (Livestock)						
< 50 Meters	213	40.3	86	40.4	127	59.6
>50 Meters	316	59.7	104	32.9	212	67.1
Toilet						
Yes	457	86.4	161	35.2	296	64.8
No	72	13.6	29	40.3	43	59.7
Drinking water Distance						
< 50 Meters	243	45.9	75	30.9	168	69.1
>50 Meters	286	54.1	115	40.2	171	59.8
Nearest Breeding sites						
<100 Meters	129	24.4	46	35.7	83	64.3
>100 Meters	400	75.6	144	36.0	256	64.0
Distance to Health Facility						
<1Km	108	20.4	36	33.3	72	66.7
>1Km	421	79.6	154	36.6	267	63.4
Distance to Village Health Worker						

<1Km	215	40.6	67	31.2	148	68.8
>1Km	314	59.4	123	39.2	191	60.8
Cooking Fuel						
Electricity	21	4.0	4	19.0	17	81.0
Firewood	508	96.0	186	36.6	322	63.4
Accessibility to transport						
Yes	414	78.3	145	35.0	269	65.0
No	115	21.7	45	39.1	70	60.9

Table 8 reported the distribution of the independent Household Environment variables within the households, (malaria present yes/no). The table shows that the frequency of malaria cases is higher in households with livestock animals kept within 50 meters of the household (*n*=213; 40.4%), compared to households with animals kept more than 50 meters away (*n*=316; 32.9%). Households without toilet facilities had a higher frequency of malaria cases (*n*=72; 40.3%) compared to those with toilet facilities (*n*=457; 35.2%). On availability and distance to drinking water the table reports a higher frequency on households with drinking water further than 50 meters (*n*=286; 40.2%), compared to those households with water available within 50 meters (*n*=243; 30.9%). However, when considering the element of distance to breeding sites there seems to be minor difference between households with potential breeding sites situated less or more than 100 meters away (35.7% and 36.0% respectively).

On the element of distance to the health facility, the table indicates a higher frequency of malaria cases on households that are more than 1kilometer away from the health facility (*n*=421; 36.6%), compared to (*n*=108; 33.3%) for households that are less than one kilometer away from the health facility. Similarly, households that were further than one kilometer away from the village health worker had a higher frequency of malaria cases (*n*=314; 39.2%) compared to those less than one kilometer away (*n*=215; 31.2%).

On the element of cooking fuel used, households using firewood for cooking had a higher frequency of malaria cases (*n*=508; 36.6%) than those using electricity for cooking (*n*=21; 19.0%). Households that had difficulties in accessing transport had a higher frequency of malaria cases (*n*=115; 39.1%) compared to households that had easy accessibility to transport (*n*=414; 35.0%).

Table 8 outlines the results of the analysis of the crude and adjusted odds ratios for the household environment variables including, livestock animals, toilets, distance to available drinking water, distance to nearest vector breeding sites, distance to health facility, distance to village health worker, availability, type of cooking fuel used, and accessibility to transport. I used binary logistic regression for both cases (crude and adjusted odds ratios). The crude odds ratios (*OR*) and confidence Intervals *CI*s were computed separately to compare the malaria prevalence between the reference group and other groups within each predictor variable. The adjusted odds ratios (*AOR*) and *CIs* were computed, to control for confounding in assessing the relationship of risk factors on the outcome variable of malaria prevalence simultaneously. All the predictor variables within the Household Environmental Factors cluster were included in the model

The adjusted odds ratios were computed using logistic regression with the subset of explanatory variables in the category for Household Environment which included; the presence of livestock animals, toilet, drinking water, nearest breeding sites, distance to health facilities, distance to village health worker, cooking fuel and accessibility to transport. In addition, the binary logistic regression analyses were also used to compute Confidence Intervals (CIs). The crude ORs and CIs enabled comparison of the frequency of malaria cases between the reference group and other groups in each variable.

Table 8

Crude and Adjusted Odds Rations for Household Environment Factors

Independent Variables	Crude Odds Ratio	95%CI	Adjusted Odds Ratio	95% CI
Animals				
< 50 Meters	1.38	0.96-1.98	1.57	1.07-2.31
>50 Meters	Reference	Reference	Reference	Reference
Toilet				
Yes	0.81	0.49-1.34	0.86	0.51-1.46
No	Reference	Reference	Reference	Reference
Drinking water Distance				
< 50 Meters	0.644	0.46-0.95	0.64	0.43-0.96
>50 Meters	Reference	Reference	Reference	Reference
Nearest Breeding sites				
<100 Meters	0.99	0.65-1.49	1.15	0.72-1.83
>100 Meters	Reference	Reference	Reference	Reference
Distance to Health Facility				
<1Km	1.15	0.74-1.80	1.01	0.61-1.68
>1Km	Reference	Reference	Reference	Reference
Distance to Village H/ W				
<1Km	1.42	1.99-2.05	0.77	0.51-1.16
>1Km	Reference	Reference	Reference	Reference
Cooking Fuel				
Electricity	2.46	0.81-7.40	0.45	0.15-1.40
Firewood	Reference	Reference	Reference	Reference
Accessibility to transport				
Yes	1.19	0.78-1.83	0.86	0.85-1.32
No	Reference	Reference	Reference	Reference

Research Question 3

What is the association between social and cultural factors and malaria infection in Mutasa District of Zimbabwe?

H_o3: There is no significant association between social and cultural factors and malaria infection in Mutasa district of Zimbabwe.

H_a3: There is a significant association between social and cultural factors and malaria infection in Mutasa district of Zimbabwe.

Social/Cultural Factors

Table 9 reports the distribution of the independent Household Socio/Cultural variables in relation to household status (malaria present yes/no). The frequency of malaria cases is higher in households with TV (*n*=73; 37.0%), Stove (*n*=24; 45.0%) and refrigerator (*n*=18; 38.9%) than in households without these items. Households without cars had a higher frequency of malaria cases (*n*=503; 36.0%) compared to households with cars (*n*=26; 34.6%). Households with radios had a lower frequency of malaria cases (*n*=292; 32.96%) compared to (*n*=237; 39.7%) in households without radios. Similarly, households without telephones (mobile or fixed) had a higher frequency of malaria cases (*n*=52; 38.5%) than households with telephones (*n*=477; 35.6%).

On the variable of animal drawn carts, households with these carts had a much higher frequency of malaria cases (*n*=55; 47.3%) than those without (*n*=474; 34.6%). Similarly, households owning livestock animals had a higher frequency of malaria cases (*n*=266; 36.8%) compared to those without livestock animals (*n*=263; 35.0%).

Four types of employment where considered as a household source of income and their influence on malaria incidence. Households which relied on seasonal agriculture (field) had a slightly higher frequency of malaria cases (*n*=458; 36.0%) than households which did not engage in seasonal farming (*n*=71; 35.2%). Similarly, households that engaged in garden/horticultural activities had a much higher frequency of malaria cases (*n*=364; 38.7%) compared to those that did not (*n*=165; 29.7%). Households that relied on formal employment as a source of income had a higher frequency of malaria cases (*n*=63; 41.3%) compared to households that did not (*n*=466; 35.2%). Similarly, households that relied on mining (artisanal) activities had a higher frequency of malaria cases (*n*=12; 41.7%) than those that did not (*n*=517; 35.8%).

In considering the level of education of the householder, Table 9 indicates that households headed by someone with only up to primary(low) level of education had a higher frequency of malaria cases (*n*=192; 41.1%), compared to households headed by someone whose education was at the secondary (high) level (*n*=337; 32.9%). On the factor of religion households that belonged to the Apostolic (*n*=231) and Pentecostal (*n*=97) Churches had a higher frequency of malaria cases (both 38.1%) compared to Traditional beliefs (*n*=24; 33.3%) and Main Line Churches (*n*=177; 32.2%).

On the Socioeconomic Status (SES), the last variable in this model, households classified as Low ES (*n*=364) had a higher frequency of malaria cases (38.2%) compared to those classified as High ES (*n*=165; 30.9%).

Table 9

Distribution of Household Socio/Cultural Factors- Variable Frequencies of Cases and Control

Independent Variables	Total *N*=529	%	Cases *n*=190	%	Control *n*=339	%
Wealth						
TV						
Yes	73	13.8	27	37.0	46	63.0
No	456	86.2	163	35.7	293	64.3
Radio						
Yes	292	55.2	96	32.96	196	67.1
No	237	44.8	94	39.7	143	60.3
Stove						
Yes	24	4.5	11	45.8	13	54.2
No	505	95.5	179	35.4	326	64.1
Refrigerator						
Yes	18	3.4	7	38.9	11	61.1
No	511	96.6	183	35.8	328	64.2
Car						
Yes	26	4.9	9	34.6	17	65.4
No	503	95.1	181	36.0	322	64.0
Animal-drawn cart						

Yes	55	10.4	26	47.3	29	52.7
No	474	89.6	164	34.6	310	65.4
Telephone						
Yes	477	90.2	170	35.6	307	64.4
No	52	9.8	20	38.5	32	61.5
Livestock						
Yes	266	50.3	98	36.8	168	63.2
No	263	49.7	92	35.0	171	65.0
Employment -						
Agriculture Field						
Yes	458	86.6	165	36.0	293	64.0
No	71	13.4	25	35.2	46	64.8
Agriculture Garden						
/Horticulture						
Yes	364	68.8	141	38.7	223	61.3
No	165	31.2	49	29.7	116	70.3
Formal						
Employment						
No	466	88.1	164	35.2	302	64.8
Yes	63	11.9	26	41.3	37	58.7
Mining						
No	517	97.7	185	35.8	332	64.2

Yes	12	2.3	5	41.7	7	58.3
Education						
-Primary	192	36.3	79	41.1	113	58.9
-Secondary	337	63.7	111	32.9	226	67.1
Cultural/Religion						
Traditional Beliefs	24	4.5	8	33.3	16	66.7
Apostolic Church	231	43.7	88	38.1	143	61.9
Pentecostal Church	97	18.3	37	38.1	60	61.9
Main Line Church	177	33.5	57	32.2	120	67.8
SES						
Low ES	364	68.8	139	38.2	225	61.8
High ES	165	31.2	51	30.9	114	69.1

Logistic regression was performed to ascertain the effects of household socio/cultural variables including, ownership of television, radio, refrigerator, telephone (mobile or fixed), car, and animal drawn cart, source of income either as seasonal farming, horticultural/garden farming, formal employment, or mining, level of education, religion, and SES, on the likelihood of malaria incidence. Table 10 reports the results of the analysis of the crude and adjusted odds ratios for the household socio/cultural variables. Both the crude and adjusted odds ratios were calculated using the binary logistic regression. The crude odds ratios and *CI*s were computed separately to compare the malaria prevalence between the reference group and other groups within each predictor variable. The adjusted odds ratios (*AOR*) and *CIs* were computed to adjust for confounding of socio-demographic factors including religion of households, education of household head, and employment (source of income) of household head in assessing the relationship of risk factors on the outcome variable of malaria prevalence, simultaneously. In this regard, all the predictor variables within the Household socio/cultural cluster were included in the model. The adjusted odds ratios were computed using logistic regression with the subset of explanatory variables in the category for Household Socio/Cultural factors. These variables included; ownership of animal drawn cart, telephone, TV, radio, stove, refrigerator, car, livestock, and Type of employment (seasonal agriculture, horticulture, formal employment, and mining), educational level of householder, culture /religion, and SES.

Table 10

Crude and Adjusted Odds Ratios for Household Socio/Cultural Factors

Independent Variables	Crude Odds Ratio	95%CI	Adjusted Odds Ratio	95% CI
Wealth				
TV				
Yes	1.05	0.63-1.76	1.43	0.73-2.84
No	Reference	Reference	Reference	Reference
Radio				
Yes	0.75	0.52-1.07	0.874	0.57-1.35
No	Reference	Reference	Reference	Reference
Stove				
Yes	1.54	0.68-3.51	1.71	0.61-4.84
No	Reference	Reference	Reference	Reference
Refrigerator				
Yes	1.14	0.44-3.00	0.83	0.22-3.14
No	Reference	Reference	Reference	Reference
Car				
Yes	0.94	0.41-2.16	0.86	0.32-2.32
No	Reference	Reference	Reference	Reference
Animal-drawn cart				
Yes	1.70	0.97-2.97	2.21	1.17-4.17

No	Reference	Reference	Reference	Reference
Telephone (mobile)				
Yes	0.89	0.50-1.60	0.93	0.50-1.72
No	Reference	Reference	Reference	Reference
Livestock animals				
Yes	1.08	0.76-1.55	1.23	0.82-1.85
No	Reference	Reference	Reference	Reference
Source of Income				
Agriculture Field				
Yes	1.04	0.61-1.75	0.88	0.47-1.65
No	Reference	Reference	Reference	Reference
Garden /Horticulture				
Yes	1.22	1.01-1.49	1.24	0.99-1.54
No	Reference	Reference	Reference	Reference
Formal Employment				
No	1.29	0.76-2.21	1.18	0.63-2.21
Yes	Reference	Reference	Reference	Reference
Mining				
Yes	1.28	0.40-4.09	1.53	0.45-5.21
No	Reference	Reference	Reference	Reference
Education				
Primary	1.42	0.99-2.05	1.26	0.83-1.92

Secondary	Reference	Reference	Reference	Reference
Cultural /Religion				
- Traditional Beliefs	1.05	0.43-2.60	1.003	0.39-2.55
- Apostolic Churches	1.30	0.86-1.96	1.228	0.80-1.89
- Pentecostal Churches	1.30	0.77-2.18	1.39	0.82-2.37
--Main Line Churches	Reference	Reference	Reference	Reference
Socio Economic Status				
Low ES	1.38	0.93-2.04	1.94	1.08-3.47
High ES	Reference	Reference	Reference	Reference

Of the 15 predictor variables two were statistically significant; ownership of animal drawn cart and lower SES (as shown in Table 10). The adjusted odds ratio (AOR) for households with animal drawn carts is, *AOR*= 2.21, 95% *CI* (1.17-4.17). The adjusted odds ratio for lower social economic status is *AOR*=1.94, 95% *CI* (1.08-3.47). The associations between availability of a cart and that of lower SES with malaria infection are statistically significant.

Primary education *AOR*=1.42, 95% *CI* (0.98-2.08), and horticulture/gardening *AOR*= 1.24, 95% *CI* (0.99-1.54) are not significant at the 5% level, but they could be significant at the 10% level. These two variable factors had relatively high-risk potential to influence malaria incidence and will also be discussed further in Chapter 5.

Consequently, in answer to Research Question 3, I reject the null hypotheses and accept the alternate hypotheses that there is a significant association between socio/cultural factors and malaria infection in Mutasa District of Zimbabwe.

Research Question 4

What is the association between available malaria interventions including indoor residual spraying, use of long lasting insecticide treated nets, mosquito larviciding (insecticide spraying of breeding sites), use of intermittent malaria prevention of pregnant women, and malaria infection in Mutasa district of Zimbabwe?

H_o4: There is no association between available malaria interventions that include indoor residual spraying (IRS), use of long lasting insecticide treated nets, mosquito larviciding (insecticide spraying of breeding sites), use of intermittent malaria prevention of pregnant women, and malaria infection in Mutasa district of Zimbabwe.

H_a4: There is an association between available malaria interventions that include indoor residual spraying (IRS), use of long lasting insecticide treated nets, mosquito larviciding (insecticide spraying of breeding sites), use of intermittent malaria prevention of pregnant women, and malaria infection in Mutasa district of Zimbabwe

Results of Malaria Intervention Factors

Table 11 reports the distribution of the independent malaria intervention variables at the household level, in relation to the incidence of malaria. The frequency of malaria cases is slightly higher in households that did not receive IRS (*n*=69; 36.2%), compared to households that received IRS (*n*=460; 35.9%). Similarly, households that had LLINs (*n*=90; 34.4%), had less frequency of malaria cases compared with households that did not have LLINs (*n*=439; 36.2%). On the element of larviciding only3 households reported having carried out larviciding compared to 526 households that never experienced this intervention. However, despite this fact those households that experienced larviciding had a lower frequency of malaria cases at 33.3 % compared with 35.9%. Households that had pregnant women who received IPTp treatment had a higher frequency of malaria cases (*n*=105; 38.1%) compared to households that did not experience the intervention (*n*=424; 35.4%). Lastly households that made use of a variety of other interventions had a lower frequency of malaria cases (*n*=36; 30.6%) compared to households that never implemented any other interventions (*n*=493; 36.3%).

Table 11

Distribution of Malaria Interventions at the Household Level-Variable Frequencies of Cases and Controls

Independent Variables	Total *n*=529	%	Cases *n*=190	%	Control *n*=339	%
IRS						
No	69	13.0	25	36.2	44	63.8
Yes	460	87.0	165	35.9	295	64.1
LLINs						
Yes	90	17.0	31	34.4	59	65.6
No	439	83.0	159	36.2	280	63.8
Larviciding						
No	526	99.4	189	35.9	337	64.1
Yes	3	0.6	1	33.3	2	66.7
IPTp						
No	424	80.2	150	35.4	274	64.6
Yes	105	19.8	40	38.1	65	61.9
Other						
No	493	93.2	179	36.3	314	63.7
Yes	36	6.8	11	30.6	25	69.4
LLINs Ratio						
# LLIN for every 2	85	16.1	26	30.6	59	69.4
# No LLINs	444	83.9	164	36.9	280	63.1

Table 12 reports the results of the analysis of the crude and adjusted odds ratios for the malaria interventions at the household level that include Indoor Residual Spraying

(IRS), Larviciding, LLINs, IPTp, and ant other measures implemented. Binary and multivariate logistic regression analyses were used to compute the crude (*OR*) and adjusted odds ratios (*AOR*) and Confidence Intervals (*CI*). Similarly, as indicated in the preceding model categories, I calculated the odds ratios using the binary logistic regression. The crude odds ratios and *CI*s were computed separately to compare the malaria prevalence between the reference group and other groups within each predictor variable. The adjusted *OR* and *CI*s were computed to al in assessing the relationship of risk factors on the outcome variable of malaria prevalence, simultaneously. In this regard, all the predictor variables within the Malaria Interventions cluster were included in the model. The adjusted odds ratios were computed using logistic regression with the subset of explanatory variables in the category for Malaria intervention factors. These variables included, indoor residual spraying, LLINs, Larviciding, IPTp, any other interventions, and LLIN Ratio.

Table 12

Crude and Adjusted Odds Rations for Interventions

Independent Variables	Crude Odds Ratio	95%*CI*	Adjusted Odds Ratio	95% *CI*
IRS				
Yes	0.98	0.58-1.67	0.90	0.50-1.64
No	Reference	Reference	Reference	Reference
LLINs				
Yes	0.93	0.58-1.49	1.25	0.64-2.46
No	Reference	Reference	Reference	Reference
Larviciding				
Yes	0.89	0.08-9.90	0.85	0.07-9.72
No	Reference	Reference	Reference	Reference
IPTp				
Yes	1.12	0.72-1.75	1.09	0.69-1.71
No	Reference	Reference	Reference	Reference
Other				
Yes	0.77	0.37-1.61	0.72	0.32-1.61
No	Reference	Reference	Reference	Reference
LLINs Ratio				
# 1 LLIN for 2	0.75	0.46-1.24	0.64	0.32-1.30
# No LLINs	Reference	Reference	Reference	Reference

After evaluating the results of the analyses, I found no significant variables in this model. However, the odds of getting malaria were reduced through the use of IRS, (*OR*=0.90), or Larviciding (*OR* =0.85) or other various interventions (*OR*=0.72). Consequently, from the analysis results of Tables 12 and 13, I accept the null hypothesis that there is no association between the available household malaria interventions and the malaria infection in Mutasa District.

Results of the Overall Model

Table 13

Parameter Estimates for Each of the Final Selected Variables

Independent Variables	Adjusted Odds Ratio	95% *CI*
Roof Type(Roof2)		
-Traditional (thatch)	0.91	0.47-1.79
-Both (T&M)	1.06	0.60-1.90
-Modern (iron /asbestos/tiles)	Reference	Reference
Animals (Livestock)		
< 50 Meters	1.60	1.09-2.36
>50 Meters	Reference	Reference
Drinking water Distance		
< 50 Meters	0.67	0.45-0.99
>50 Meters	Reference	Reference
Distance to Village Health Worker		

<1Km	0.77	0.52-1.15
>1Km	Reference	Reference
Animal-drawn cart		
Yes	2.24	1.20-4.20
No	Reference	Reference
Agriculture Garden /Horticulture		
Yes	0.75	0.50-1.14
No	Reference	Reference
Education		
Primary	1.23	0.81-1.86
Secondary	Reference	Reference
Socio Economic Status (SES)		
Low ES	1.54	0.95-2.49
High ES	Reference	Reference

Table 14 is the logistic regression showing likelihood of malaria infection based on presence of animals, drinking water within 50 meters, distance to VHW, Garden/horticulture, education, ownership of animal drawn cart, roof type, and SES.

Table 14

Logistic Regression

	B	SE	Wald	*df*	*p*	Odds Ratio	95%CI for Odds Ratio Lower	Upper
Roof2			.432	2	.806			
Roof2(1)	-.091	.344	.069	1	.792	.913	.465	1.793
Roof2(2)	.061	.296	.043	1	.836	1.063	.595	1.899
Animals (1)	.472	.196	5.772	1	.016	1.603	1.091	2.356
DWater (1)	-.406	.204	3.963	1	.047	.666	.447	.994
DVHW (1)	-.263	.204	1.655	1	.198	.769	.515	1.148
Animal/D/Cart (1)	.807	.320	6.360	1	.012	2.241	1.197	4.196
G/Horticulture (1)	-.287	.213	1.823	1	.177	.750	.495	1.138
Education (1)	.206	.212	.948	1	.330	1.229	.812	1.860
SES (1)	.432	.245	3.119	1	.077	1.541	.954	2.489
Constant	-.892	.341	6.817	1	.009	.410		

Further to carrying out the logistic regression analyses in all the four category models, all variables with a *p*-value < 0.1 were selected into a final model. The decision to choose these variables was motivated by their p-values being within the 10% significance range and the possibility of further refining their effects while obviating any confounding issues. A logistic regression model was computed with household malarial status as the dependent variable and the eight selected explanatory variables. Table15 and 16 give parameter estimates for each of the variables.

The logistic regression model was statistically significant, $\chi^2(9) = 25.524$ $p < .002$. The model explained 6,5% (Nagelkerke R^2) variance in malaria incidence and correctly classified 65,6% of cases. Sensitivity was 14.7%, specificity was 94.1%, positive predictive value was 58.33%, and negative predictive value was 66.32%. Of the eight predictor variables only three were statistically significant at 5%; the presence of animals within 50m radius of the household, distance to drinking water, and ownership/possession of an animal drawn cart while SES was significant at 10%. As reported, (Tables 15 and 16), the odds of acquiring malaria infection with the significant variables were; the presence of animals within 50m radius of the household (*AOR*=1.60, 95%*CI*[1.09-2.36]), distance to drinking water (*AOR*=0.67 95%*CI* [0.45-0.99]), and ownership/possession of an animal drawn cart (*AOR*=2.24, 95%*CI* [1.20-4.20]).

Summary and Transition

Collected survey questionnaire data were used to evaluate whether household determinant factors were associated with the frequency of malaria cases in Mutasa District of the province of Manicaland in Zimbabwe. The household determinants included; Household Characteristics factors (gender of household head, presence of children up to years old-0-5years), presence of children 6-18 years old, type of roof construction, type of wall cover, electricity, and type of ventilation construction); Household Environment factors (presence of livestock animals within the household, availability of a toilet, distance to drinking water, distance to nearest breeding sites, distance to health facility, distance to village health worker, type of cooking fuel used, accessibility to transport); Household Socioeconomic and Cultural factors (availability of TV, radio, stove, refrigerator, car, animal drawn cart, telephone, and livestock animals, Source of income either as seasonal farming, horticulture farming, formal employment, or mining, level of education of household head, religion and socio-economic status of household); Household Interventions (Indoor Residual spraying, use of LLINs, larviciding, and any other type of interventions).

Chapter 4 was a presentation of the data analysis and the results of the research study. In the data collected and analyzed, I reported the results of the variable frequencies in relation to the malaria cases. Binary and multivariate logistic regression analyses were carried out in order to appropriately analyze the data. Both the crude and adjusted odds ratios of all the independent household determinants were reported. I also reported the levels of association of the independent variables with the incidence of malaria.

After evaluating the analyses within each of the four categories, I chose those variables with a p-value <0.1 for inclusion into a final model. In a further analysis, I found three independent household determinant variables to be significant at 5%. These were; presence of animals within 50meter radius of households, ownership and presence of animal drawn cart, and availability of drinking water within 50meter radius of household. However, a fourth independent variable, socio-economic status could also be considered significant at 10%.

Chapter 5 is a presentation of the interpretation of the findings, limitations and strengths of the study. In addition, the chapter will also include concussions and recommendations for further study. The chapter includes an explanation of the implications of the findings and study’s potential impact on positive social change.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this study was to examine the association between identified household determinants of malaria and their level of contribution to the prevalence of malaria cases within the Mutasa District of Manicaland Province in, Zimbabwe. I addressed a research gap concerning the continued incidence of malaria despite the concentered intervention efforts to eliminate malaria.

The case control quantitative study included a representative study sample of the Mutasa District household population to determine whether the identified household factors had any influence on the prevalence of malaria within the malaria endemic district. The household determinants were grouped into four categories: household characteristics, household environment, household socioeconomic and cultural factors, and household malaria interventions. The household characteristic factors included gender of the household head, presence of children (0-5 and 6-to 18-years-old), type of roof construction, type of wall cover, availability of electricity, and type of ventilation construction. The household environment factors included presence and distance of livestock animals from the household, availability of toilets, availability and distance to drinking water source, distance to nearest mosquito breeding site, distance to nearest health facility, distance to nearest village health worker, type of cooking fuel used, and accessibility to transport. The household socio/cultural group included household wealth (availability of TV, radio, car, telephone, animal drawn cart, stove, refrigerator, livestock), source of income (seasonal agriculture, horticulture, formal employment, artisanal mining), level of education of the householder (primary or secondary), religion of household (traditional, main line churches, Pentecostal churches, and apostolic churches) and socioeconomic status. The household malaria intervention group included IRS, use of LLIN, use of larviciding for mosquitoes, use of IPTp, and any other intervention method.

Scholars have not addressed the association between the identified household determinant factors with malaria prevalence. In this case control quantitative study, I used survey questionnaire data to answer the research questions. I reported the overall demographic characteristics of the study population including the district wards household population and the available health facilities. I conducted the univariate statistical analysis to determine the descriptive statistics of variables. I also conducted binary logistics regression analyses to examine the association between the malaria status and the household determinants using SPSS statistical analysis package.

Interpretation of Findings

Malaria continues to occur in the Mutasa District, with the incidence rate fluctuating from 23.35% in 2015, to 17.5% in 2016, and to 28.04% in 2017 (MOH&CC, 2018). At the national level, 50% of the population in Zimbabwe live in malaria-endemic areas (Gunda et al., 2016). In this study, I focused on households in the Mutasa District that had experienced malaria cases over the study period (January, 2016-August, 2017) compared to control households (households that had not had any malaria cases over the study period January, 2016-August, 2017) within the same district. Households that had experienced malaria cases were established through the appropriate ward health facilities'

T12 registers with household identification and further verification carried out through the local village health worker and the survey questionnaire. All of the household visits were carried out under the supervision of the district environmental health staff.

In my literature review, I noted a number of household determinant factors of malaria, and these will be reviewed in the context of the research findings and results of analysis. A review within each determinants category will be done followed by a much more focused interpretation of identified significant determinant variables.

Household Characteristics

In this category of household characteristics, no significant variables were established at the 5% level. However, female-headed households had a higher frequency of malaria cases (38.1%) compared to male-headed households (35.1%). These results are consistent with the findings of Diiro et al. (2016) in a study of households in rural Kenya, who noted that male-headed households adopted more malaria prevention strategies than female-headed households. Ricci (2012) noted the negative effects of gender discrimination on disease incidence. Male-headed households were amenable to timeous implementation of appropriate malaria prevention strategies. Within the same category, households with children under 5 years were found to have a higher frequency of malaria at 60.5 % compared to those with no children under 5 years (39.5%). These observations are synonymous with the indications of the WHO (2016). The WHO that child dies every 2 minutes from malaria.

With regards the nature of housing construction features, I found that households with a combination of both traditional and modern roofing (*AOR*=1.64) and those with thatching alone (*AOR* =1.54) had an increased risk of malaria infection compared to modern roofing alone, which was used as reference. These observations are consistent with the findings of Dlamini et al. (2017), where they found an increased risk of malaria infection to be associated with low quality housing. However, contrary to Dlamini et al., walls plastered with cement or plastered with mud and other combinations were at a higher risk of malaria infection than other wall surface configurations.

Households with access to electricity (*OR*=2.26) were also at a higher risk of malaria infection than those without access to electricity. These observations are synonymous with the findings of Pellegrini and Tasciotti, (2016) and Tasciotti (2017), in studies carried out in both Uganda and Malawi. Electric lights may attract malaria vectors, while also transforming the behavior of the household occupants as they stayed awake longer, active and unprotected, particularly during the peak biting times of malaria vectors (Pellegrini & Tasciotti, 2016; Tasciotti, 2017). All of the variables in this model had an association with malaria infection, although at a nonsignificant level statistically (p >.05). A larger sample size, however, may have been able to produce significant findings in some or all of the considered predictor variables within this category.

Household Environmental Factors

In examining the results of the household environment factors, a number of key observations were noted. Amongst the eight predictor variables in the model, two were significant. These included presence of livestock animals within 50 meters of the household (*AOR*=1.57, p< 0.05, 95% *CI*[1.07-2.31]) and availability of drinking water within the 50-meter radius (*OR*=0.64, p< 0.05, 95% *CI*[0.43-0.96]).

In considering the presence of livestock animals within the 50-meter radius, I noted that the predictor variable increased the risk of malaria infection (*AOR*=1.57). The frequency of malaria cases was also higher in households with the presence of animals within the 50-meter radius at 40.4% compared to 32.9% in households with livestock animals outside the 50-meter radius. These findings are consistent with Temu et al. (2012), when they established the negative influence of the presence of livestock animals within households. Similar findings were also reported in studies carried out in Sub-Sahara Africa by Franco et al. (2014). The presence of livestock animals close to households may be attracting malaria vectors to the households and increasing the risk of being bitten by infected mosquitoes.

The predictor variable, distance to drinking water, was significant with households that were within the 50-meter radius having a reduced risk of malaria infection (*AOR*=0.64). Relative to this observation was the lower frequency of malaria cases in households with drinking water available within 50-meter radius (30.9%) compared to (40.2%) in households that fetched their water outside the 50 meters radius from their homesteads. This variable has not been researched in the past, but the results are consistent with the findings of Ayele et al. (2012) and Sharma et al. (2015) in studies carried out in Ethiopia and central India respectively.

In analyzing the predictor variable, distance to nearest breeding site, I found that households that were less than 100 meters from breeding sites had a slightly increased risk of malaria infection (*AOR*=1.15) with the reference being households that were more than 100 meters from the nearest breeding site. These findings are consistent with the findings of Chikodzi et al. (2013), who observed that distances of less than 1,000 meters to breeding sites had a higher risk of malaria infection. Similarly, Kibret et al. (2015), Zhou et al. (2012), and Monteiro de Barros et al. (2011), also noted increased incidence of malaria in communities living closer or within the 5 kilometer range of water bodies.

In considering availability of toilets, those households with toilet facilities within their homesteads had a lower risk of malaria infection (*AOR*=0.86). Although these results were not significant at the 5% level, I noted that the frequency of malaria cases was lower at 35.2% compared to 40.3% in households without toilets. These observations are consistent with studies carried out in Ethiopia by Ayele et al. (2012).

In evaluating the effect of distance to health services (either health facility or village health worker), I observed that households further away from health services had a higher frequency of malaria cases than those that were closer to health services. Of particular note, after taking into consideration of confounding variables, was that households within a kilometer range of the village health worker were at a significantly reduced risk of malaria infection (*AOR*= 0.77). However, in this instance I also noted that the risk of malaria infection for households closer to a village health worker was much lower than that of households closer to a health facility. Inherently, the frequency of malaria cases in households that were less than 1kilometer from the health facility and the village health worker (33.3% and 31.2%) respectively, compared to households that were further than 1kilometer from both the health facility and the village health worker (36.6% and 39.2%) respectively. By the same token, the findings were consistent with previous studies by Romay-Barja et al. (2016) and Schoeps et al. (2011), who in their observations from studies in Equatorial Guinea and Burkina Faso respectively, found that increased distance from health facilities negatively impacted the health of children. Linked to the issue of distance to health services is the predictor variable of accessibility to transport. In this regard, I noted households with easy accessibility to transport had a reduced malaria risk factor (*AOR*=0.86) and a lower frequency of malaria cases (35.0%) compared to those that indicated difficulties in accessing transport (39.1%). Invariably I would hypothesize that where transport was easily accessible the challenges of greater distances to health facilities were minimized resulting in timeous attention to malaria treatment facilities.

Household Socio/Cultural Variables

In this category model, which I subdivided into household wealth (ownership of TV radio, stove, refrigerator, car, animal drawn cart, telephone, and livestock), source of household income (seasonal agriculture-field, horticulture, formal employment, and artisanal mining), educational level of householder (primary or secondary), culture/religion (main line churches, pentecostal churches, apostolic churches and, traditional beliefs) SES, only the ownership of an animal drawn cart was significantly associated with malaria prevalence *AOR*=2.07, *p*=0.029, 95% *CI* (1.08-3.95). These results are plausible considering that earlier on I noted the statistical significance of households with livestock animals kept within 50-meter radius and the respective influence of the predictor variable to the prevalence of malaria infection in Mutasa District. The observations are consistent with the findings of Temu et al. (2012) in studies in Zambezia, Mozambique; Franco et al. (2014) in their malaria modelling, and in the systematic review of previous studies carried out by Donnelly et al. (2015) also confirming increased malaria risk due to presence of livestock in close proximity to households, particularly to the sleeping quarters.

However, despite that only one variable factor in this category was significant at the 5% level, I noted that households with televisions (*AOR*=1.43), stove (*AOR*=1.71), engaging in artisanal mining (*AOR*=1.53), household head with lower education (primary level; *AOR*=1.26), and lower SES (*AOR*=1.80), had increased risks of malaria infection. The frequency of malaria cases in these noted households was reported to be comparatively higher than in households in the inverse situation. Similarly, in considering religion/culture and using main line churches as reference, households that followed Apostolic (*AOR*=1.22) and Pentecostal (*AOR*=1.39) beliefs had a higher risk of malaria infection compared to households that followed traditional beliefs (AOR=1.00). From another perspective, I also noted that households engaged in seasonal farming (AOR=0.88), and horticulture (AOR=0.65), had a lower risk of malaria infection.

Malaria Intervention Variables

In this category model, there were no significant variables noted at the 5% level. However, the risk of malaria infection was reduced in households that had IRS carried out (*AOR*=0.90), and in households that implemented any other malaria interventions (*AOR*=0.72), apart from the normally provided interventions. In households that used LLINs, I noted that the risk of malaria infection was slightly increased (*AOR*=1.25). This is contrary to the position statement of the WHO (2011) and the findings of Kweku et al. (2017) and Fokam et al. (2016). However, this may have been due to the fact that most of the nets still in use were old, insufficient or in a poor state of repair (having been in use for more than three years). Invariably, however, interpretations derived from the WHO position statement, also reiterate the possibility of achieving the observed results due to various factors related to inadequate coverage, inappropriate maintenance and use or the use of aged and damaged LLINs. These assumed interpretations were not evaluated in this study.

Overall Model

In Chapter 4, I indicated that an overall model was created consisting of all the variables that had a *p*-value of <0.1 for further analysis. The analysis confirmed the significant findings as reported in the primary categories. These significant variables included; presence of animals within 50meter radius of household, drinking water within a 50meter radius, and ownership/possession of an animal drawn cart. These findings will be discussed further.

Discussion – Overall Findings

In this section I will discuss the three predictor variables that were found to be statistically significant as highlighted earlier. However, before I delve into the discussion of the significant variables, I would like to explain some minor changes made in the analytical approach. Initially in the proposal I had intended to use the Pearson's Chi – Square test of association, but after the data collection process, I felt that the results would be more meaningful if I also establish the magnitude of the association between the independent and dependent variables. This could not be achieved with the Chi-Square test alone, hence the change to the use of the Odds Ratios which gives both measures.

In considering the association of malaria incidence and presence of animals within 50meter radius of the household I concluded that the presence of the predictor variable increased the risk of malaria infection. The presence of animals within the 50meter radius of households could be having a zoopotentiation effect, consistent with previous studies by Hiscox et al. (2013) in Lao PDR and Iwashita et al. (2014) in the Lake Victoria area of Western Kenya and in a systematic review of previous studies by Donnelly et al. (2015).

Similarly, the ownership of animal drawn carts had the same effect. However, in addition animal drawn carts have the added exacerbating effect resulting from their use during some of the pick vector biting times. These are the early morning hours and the late evening hours for various household chores that may include fetching water from far distances or transporting household members from place to place. In addition to the combined effect of both the humans and animals attracting the vectors the cart also serves as an ideal environment for vector harborage while parked outside the household, waiting to access their preferred blood meal.

On the association of malaria infection with the predictor variable of distance to drinking water I noted that the risk to malaria infection was significantly reduced when drinking water was located within the 50 meter radius of the household. These findings are consistent with the findings of Sharma et al. (2015) in studies in the tribal areas of Madhya Pradesh central India where drinking water available within the household area reduced the risk to malaria infection. The risk reduction to malaria infection maybe explained by some observations, though not documented, made during the survey.

Notable observations were that residents in the study took less time to fetch their drinking water. Sources of most of the drinking water in the study area, were situated within the 50meter radius. Water was either piped tap water or obtained from protected deep well/borehole water. The protected drinking water sources may not be easily accessible for malaria vector breeding Pickering and Davis (2012) also noted that reduced time to drinking water and availability of fresh water, were significant factors in reducing the mortality of children less than 5 years old.

Limitations of the Study

There are some limitations to this study that could affect the generalization of the study findings. The study relied on both secondary and survey data. Some of the secondary data was based on the 2012 population census data with relevant extrapolations being made to reflect the current demographic situation. Consequently, some of the extrapolations may not have been very accurate. To limit this limitation the calculated sample size was increased by 25%. Similarly, the responses to the survey questions may have been incorrect or biased in some way. Areas of particular note included; the household size, the educational level of householder, the SES of household, the ages of household members, the distances calculated within some of the various variables (distance to health facility or village health worker, and distance to nearest breeding site). To mitigate some of this limitation, I moved with one or more of the local health staff. These were either the local Village Health Worker or the Environmental Health Technician of the area to enhance reliability and validity of data.

The third limitation relates to cases that may have been treated at private clinics or outside the district health facilities and consequently, were not reflected within the existing district data sources. Since the sampling frame for cases was based on the health facilities T12 patient registers there could have been bias in the sampling. This limitation was addressed through the appropriate explanations during the administration and completion of questionnaire. The village health worker consultations enhanced the opportunity to minimize the exclusion of such cases from the sampling. The fourth limitation relates to imported cases that are erroneously recorded in the district health facility registers due to their being treated within the district health facilities but with infection having been acquired elsewhere outside the district boundaries. Mutasa District borders with other provincial districts and with Mozambique as well. However, most of the imported cases come from Mozambique. This limitation, was, however, mitigated by the appropriate recording of case addresses in the T 12 case registers. Relevant indications were noted and the identified cases were excluded from the sampling frame.

Recommendations

This study resulted in many interesting findings that can contribute to the current body of knowledge regarding the determinant factors of malaria infection. However, on the significance of, presence of livestock within the household environment, further research needs to be carried out with regards the mosquito species characteristics in relation to their behavior and feeding habits. This will enable an appropriate understanding of the relationship of the existing mosquito vectors with both humans and animals and thus determine the potential for both zooprophylaxis or zoopotentiation.

Livestock animals are an important asset within a household and in view of these findings, there is need to establish an appropriate threshold distance for keeping animals to reduce zoopotentiation and the subsequent risk of malaria infection.

The benefits of having drinking water accessible within 50meter radius of households was noted. Households with availability of drinking water within a 50meter radius had a reduced risk of malaria infection. This observation has been well reiterated by Ayele et al. (2012) and Sharma et al. (2015). However, there is need to carry out further research to establish the various factors influencing the risk reduction due to the availability of drinking water close to households.

In addition to the noted significant factors I also recommend that further studies be carried out to get a clearer understanding of the association and effect of these factors: roof types, wall surfaces, availability of electricity, distance to village health worker, possession of radio and television, horticultural activities, educational status of household head, religion and socio-economic status. I hypothesize that if the sample size had been larger, the analysis may have been able to reveal a much clearer picture. However, despite my sample size being consistent with previous similar studies both in Zimbabwe and within the sub Sahara Africa context (Grigg et al., 2014; Kanyangarara et al., 2016), increasing the sample size could have increased the likelihood of some of the borderline variables, particularly those that were included in the overall model, showing a significant relationship with malaria infection. In this regard, I also recommend that future studies consider the possibility of carrying out an evaluation in a smaller area but taking into consideration the possibility of total population sampling. Furthermore, I would also recommend the use of geographic information systems to improve the reliability of household location in relation to distances to certain variable considerations.

Implications for Social Change

The findings of this study have the potential to influence positive social change at the individual, household, and community levels as well as policy determination to mitigate and improve the malaria endemic situation of Mutasa District and the country as a whole. The findings suggest that the keeping of livestock animals within homesteads may have a negative effect on malaria incidence. Consequently, appropriate strategies to keep livestock animals at a secure and reasonable distance away from households may need to be adopted. Alternatively, where this may not be possible adequate malaria intervention measures including personal protection and malaria awareness need to be enhanced at both the household and community levels. The community needs to be educated on the increased risk of malaria infection resulting from livestock animals being kept closer to homesteads and the related impact of animal drawn carts.

Availability of drinking water in close proximity to households minimized the risk of malaria infection. In this instance, strategies for provision of potable drinking water in close proximity to households should be part of a comprehensive approach involving community members to engage in an integrated approach to malaria prevention and control. Availability and easy accessibility of potable water, not only reduces the risk of malaria infection but also enhances the overall health of the community. These indications are also reiterated by Sharma et al., (2015).

Benefits of improved housing characteristics such as wall surface type, roofing material, and type of ventilation had a positive effect in reducing the risk of malaria infection. Strategies to promote improved houses within the community will be enhanced with reference to the study findings, consequently inculcating positive social change. In addition to improved houses, robust strategies to improve the socio-economic status of the community must also be crafted as part of the integrated approach to eliminating malaria within the district. The strategies should take into cognizance the need and importance of transport availability and accessibility, adequate and accessible health facilities and village health workers. These factors were notable in impacting on the reduction of risk to malaria infection.

On a broader outlook, these results may enhance the promotion of social change by assisting the Zimbabwe Policy Makers and the Ministry of Health and Child Care health officials to engage in robust and sustainable malaria elimination programs. Programs that take into consideration the household determinants that were found to be associated with malaria prevalence. Furthermore, the study findings help to understand or appreciate why some households are prone to frequent malaria episodes than others within the same community and hence enable the formulating of appropriate positive social change messages.

Conclusions

In this study, I explored the association of selected household determinants with malaria infection in the Mutasa District of Manicaland, Zimbabwe. The determinants were grouped into four models that included household characteristics, household environmental factors, household socio/cultural factors, and household malaria intervention factors. The findings of the study supported the hypothesis that there were household determinants that were associated with malaria incidence in Mutasa District.

The study provided an understanding of some of the household risk factors associated with malaria prevalence in Mutasa District. Although most of the covariates were associated with malaria prevalence only three; livestock animals kept within 50 meter radius of household, ownership and use of an animal drawn cart, and availability of drinking water within 50 meters of the household, were statistically significant. The results, however, underline the need for an all-inclusive integrated approach to malaria control and its subsequent elimination. The findings underscore the need to include new innovative approaches in addition to existing intervention strategies to increase the pace towards malaria elimination. These approaches would have to proactively involve the community particularly on the issue of observed influential household determinant factors.

Mutasa District is fortunate to have a diverse range of stakeholders involved in malaria control. Consequently, it is important for program implementers to create strategic partnerships with the community. All the implementing malaria control stakeholders in Mutasa district should consolidate their efforts. This would enable the opportunity of mitigating the challenges of malaria and the achievement of the malaria elimination goal.

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Appendix A: Introduction and Consent (Walden Format)

Hello. My name is_______________________. I am a student at WALDEN UNIVERSITY and working together with Ministry of Health and Child Care. We are conducting a survey about malaria all over MUTASA DISTRICT. The information we collect will help the Ministry of Health & Child Care to plan Malaria control services. Your household was selected for the survey. I would like to ask you some questions about your household. The questions usually take about 15 to 20 minutes. All of the answers you give will be confidential and will not be shared with anyone other than members of our survey team. You don't have to be in the survey, but we hope you will agree to answer the questions since your views are important. If I ask you any question you do not want to answer, just let me know and I will go on to the next question or you can stop the interview at any time. In case you need more information about the survey, you may contact the person listed on this card.

GIVE CARD WITH CONTACT INFORMATION

Do you have any questions?

May I begin the interview now?

Signature of Interviewer______________________________ DATE __________

RESPONDENT AGREES TO BE INTERVIEWED - 1 - BEGIN

RESPONDENT DOES NOT AGREE TO BE INTERVIEWED- 2- END

Appendix B: Household Determinants Questionnaire

COUNTRY –ZIMBABWE

DISTRICT –MUTASA **WARD/EA –**

Health Facility-

Household Details
VILLAGE_____________ NAME OF HOUSEHOLD HEAD/REPRESENTATIVE . . . .

VISIT DETAILS				
DATE				
INTERVIEWER'S NAME				
CODING 23. MALE HEADED HOUSEHOLD 24. FEMALE HEADED HOUSEHOLD 25. CHILD HEADED HOUSEHOLD (UNDER 18YEARS) 26. POSTPONED 27. REFUSED 28. HOUSEHOLD VACANT OR ADDRESS NOT				TOTAL NO OF PERSONS IN HOUSEHOLD 6+ (=1) 1-5(=2)

1	**HOUSEHOLD DEMOGRAPHICS**	**NO OF ADULTS**	Male	Female	No in Age groups

					0-5 | 6-18 | +18
			SCORE		COMMENTS
2	a.) Has any member of the household had malaria in the last three years? b.) If so how many) c.) If so, when? (last 12months=1 last 24 months =2 last 36 months =3		(Yes=1/ No=2)		
3	HOUSEHOLD CHARACTERISTICS				
	ROOF	THATCH		1	
		IRON SHEETS		2	
		TILES		3	
		CEILING		4	
	WALLS	MUDPLASTER		1	
		CEMENT		2	
		WOOD		3	
		OTHER		4	
	ELECTRICITY (Y/N) 1-Y 2= N			1	
				2	
	VENTILATION modern=1			1	

	traditional=2			2	
4	HOUSEHOLD ENVIRONMENT				
	Animals	< 50 Meters (1) >50 Meters (2)			
	Toilet	(Y=1; N=2)			
	Drinking water Distance	<50 Meters (1) >50 Meters (2)			
	Nearest Breeding sites	<100 Meters (1) >100 Meters (2)			
	Distance to Health Facility	<1Km (1) >1Km (2)			
	Distance to Village Health Worker	<1Km (1) >1Km (2)			
	Cooking Fuel	Electricity=1 Firewood =2			
	Accessibility to transport	(Y=1; N=2)			
5	SOCIO-ECONOMIC STATUS				
			Yes .)	No (2)	

	Does any member of this household own a				
	TV				
	Radio				
	Stove				
	Refrigerator				
	Car				
	Animal-drawn cart				
	Telephone (mobile)				
	Cattle/sheep/goats				
6	EMPLOYMENT				
	Agriculture				
	Field =1		1		
	Garden/Horticulture=2		2		
	Formal=3		3		
	Mining=4		4		
7	EDUCATION				
	Below secondary =1		1		
	Above secondary =2		2		
8	CULTURAL				
	Religion				

	Christianity Main Line =1 Pentecostal=2 Apostolic Faith =3 Traditional =4 Other=5		 1 2 3 4 5	
9	INTERVENTIONS	At any time in the past 3 years, has anyone come into your dwelling to carry out the following against mosquitoes? (Y=1 N=2)		
	IRS=1 LLIN=2 Larviciding=3 IPTp=4 Other=5		1 2 3 4 5	
10	How many LLINs in the household?	Ratio 1 for everyone =1 1 for every two =2 1 for every three=3 1 for every four =4	 1 2 3 4	

*Format adopted from the DHS survey instruments

End of Questions-Signature of Interviewee (Household Head)________________________

-Interviewer (Principal Investigator)______________________________

Appendix C: Consent Form (MRCZ Format)

MRCZ No. -MRCZ/A/2251_

Consent Form

Research Tittle-*Household Determinants of Malaria In Mutasa District of Zimbabwe*

Principal Investigator-**David Zinyengere**

Phone number(s)__ - 0773253102________________

What you should know about this research study:

- We give you this consent so that you may read about the purpose, risks, and benefits of this research study.
- Routine intervention is based upon the best known intervention strategies and is provided with the main goal of helping the individual or community within a target area. The main goal of these research studies is to gain knowledge that may help future intervention strategies.
- We cannot promise that this research will benefit you.
- You have the right to refuse to take part, or agree to take part now and change your mind later.
- Whatever you decide, it will not affect your regular care.
- Please review this consent form carefully. Ask any questions before you make a decision.
- Your participation is voluntary.

PURPOSE

You are being asked to participate in a research study of ***Malaria in Mutasa District.*** The purpose of the study is ***To Investigate and Evaluate Household Determinants of Malaria in Mutasa District.*** Your household was selected as a possible participating household in this study. Consequently, because you are the householder or head of the household were also selected as the representative of the household to participate in the study. The total number of household selected and expected to participate throughout the District of Mutasa is 515.

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MRCZ/A/2251

PROCEDURES AND DURATION

If you decide to participate, you will undergo an interview during which a list of questions will be asked concerning your household and its environment. The questions are listed in a questionnaire which will be completed during the interview. In addition to the interview an overall observation of the household inspection to observe the nature of the household construction and siting will also be carried out and relevant findings recorded on the questionnaire. The Interview and household observational inspection is expected to last approximately 40 minutes.

RISKS AND DISCOMFORTS

There are no known or expected risks or discomforts expected with this study.

BENEFITS AND/OR COMPENSATION

We cannot and do not guarantee or promise that you will receive any benefits from this study.

CONFIDENTIALITY

If you indicate your willingness to participate in this study by signing this document, we plan to disclose the information obtained to Walden University -College of Health Sciences, Ministry of Health and Child Care, and Medical Research Council of Zimbabwe (MRCZ). Any information that is obtained in connection with this study that can be identified with you will remain confidential and will be disclosed only with your permission. Under some circumstances, the MRCZ may need to review records for compliance audits.

ADDITIONAL COSTS

There are no known additional costs to be borne by the participant.

VOLUNTARY PARTICIPATION

Participation in this study is voluntary. If you decide not to participate in this study, your decision will not affect your future relations with Walden University and its personnel. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time without penalty.

SIGNATURE PAGE

PROJECT TITLE- Household Determinants of Malaria in Mutasa District

OFFER TO ANSWER QUESTIONS

Before you sign this form, please ask any questions on any aspect of this study that is unclear to you. You may take as much time as necessary to think it over.

AUTHORIZATION

You are making a decision whether or not to participate in this study. Your signature indicates that you have read and understood the information provided above, have had all your questions answered, and have decided to participate.

____ _____________

Name of Research Participant (please print) Date____________________________

Signature of Participant or legally authorized representative Time

____

Relationship to the Participant ____

Name of Staff Obtaining Consent Signature Date

______________________________ ______________ _____________

Name of Witness (*if required)* Signature Date

YOU WILL BE OFFERED A COPY OF THIS CONSENT FORM TO KEEP.

If you have any questions concerning this study or consent form beyond those answered by the investigator, including questions about the research, your rights as a research participant or research-related injuries; or if you feel that you have been treated unfairly and would like to talk to someone other than a member of the research team, please feel free to contact the Medical Research Council of Zimbabwe (MRCZ) on telephone (04)791792 or (04) 791193 and cell phone lines 0784 956 128. The MRCZ Offices are located at the National Institute of Health Research premises at Corner Josiah Tongogara and Mazowe Avenue in Harare.