RISK FACTORS ASSOCIATED WITH MALARIA INFECTION AMONG ADULT POPULATIONS IN SELECTED INTERNALLY DISPLACED CAMPS IN GOMA, NORTH KIVU PROVINCE, DRCONGO.

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DECLARATION AND APPROVAL

Declaration

This thesis is my original work and has never been presented for any academic award in any institution.

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DEDICATION

To the memory of my late father Floribert Mbalikada Momoti and all the people who succumbed to malaria.

May their souls rest in peace.

ACKNOWLEDGMENTS

First of all, I would like to express my deep gratitude to God, whose grace and mercy gave me life and the opportunity to continue this study. My deepest gratitude goes to my uncle Willy Mbalikada, my mother Veronica Makanzala, and my siblings for their unwavering support throughout this journey. Their encouragement and belief in me were a constant source of strength.

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ABSTRACT

Malaria remains a significant public health concern in many parts of the world, particularly in Africa. The Democratic Republic of the Congo (DRC) is one of the countries most heavily affected by malaria, with millions of cases reported annually. In the Eastern region of the DRC, ongoing conflict has resulted in large numbers of people living in precarious conditions within IDP camps, where the risk of malaria transmission is heightened due to improper housing conditions, a lack of bed nets, crowded, unhygienic conditions, and restricted access to basic healthcare services. This study aims to assess the risk factors associated with malaria infection among adult populations in the Kashaka and Shabindu IDP camps in Goma, North Kivu Province. The study employed a cross-sectional design using a mixed-method approach. Multistage sampling was used to select 371 households and data were collected through interviews and medical record reviews. Chi-square tests were performed for bivariate analysis, and then logistic regression to evaluate the impact of multiple variables simultaneously. All participants pointed to mosquitoes as the causal agent. Around 97.8% confirmed that fever is the main symptom followed by chills (75.2%), headache (54.5%), and sweating (10.2%). Bed net was identified as a preventive measure at (100%), mosquito repellents (71.7%), and Indoor residual spraying (68;2%). Approximately 43.9% of households had at least one case of malaria with an increasing incidence in April (26.7%) and October (35.9%). The most significant factors affecting the spread of malaria were gender (OR: 1.73; p-value < 0.001), lack of bed net (OR: 5.231; p-value < 0.001), outdoor activities at night (OR: 0.661; p-value = 0.0364), and being close to sanitation facilities (OR: 2.458; p-value = 0.0013). In conclusion, high malaria knowledge exists, but practice gaps persist. Nearly half of households reported recent cases, with environmental factors like sanitation proximity also influencing malaria infection, beyond individual behaviors.

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LIST OF ABBREVIATIONS AND ACRONYMS

CDC	Centers for Disease Control and Prevention
DRC	Democratic Republic of the Congo
DHS	Demographic Health Survey
GTS	Global Technical Strategy
IDP	Internally Displaced Person/people
IRS	Indoor Residual Spraying
REC	Research Ethics and Review committee
ITNs	Insecticide-Treated bed Nets
HBHI	High Burden to High Impact
HIV/SIDA	Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome
M23	Movement of 23rd May
MKU	Mount Kenya University
NGO	Non-Governmental Organization
NPM	National Program of Malaria
PMI	President's Malaria Initiative
SDGs	Sustainable Development Goals
SEM	Socio-Ecological Model
UNICEF	United Nations Children Education Fund
WHO	World Health Organization
WS	Water and Sanitation condition

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter includes an overview of the research, a statement of the issue being researched, objectives of the study, both broad and specific, research questions, rationale, as well as the constraints and boundaries of the research.

1.1 Background

Malaria is a potentially fatal infectious disease caused by microscopic organisms called Plasmodium. Five recognized species affect humans: P. falciparum, P. malaria, P. ovale, P. vivax and P. knowlesi. The disease is transmitted by Anopheles mosquitoes, which carry the parasite responsible for its spread (WHO: Guidelines for Malaria 2023).

In 2022, approximately 249 million cases of malaria were reported in 85 countries and regions worldwide, an increase of 5 million from the previous year. The WHO African region reported the highest value (94%), while a significant proportion (2%) was also reported from the WHO Southeast Asia region. Four African countries, including Nigeria (26.8%), the Democratic Republic of Congo (12.3%), Uganda (5.1%) and Mozambique (4.2%), accounted for almost half of all global malaria cases (World Malaria Report)., 2023).

Inadequate resources for malaria prevention and treatment services are the biggest hurdle for malaria-affected African countries. This lack of resources means that some communities do not have access to necessary prevention and treatment options. In addition, some areas in sub-Saharan Africa face mosquito populations that have developed resistance to commonly used insecticides.

The prevalence of malaria varies significantly in different regions of the world. Malaria mainly affects countries in the intertropical zone such as sub-Saharan Africa, Southeast Asia, and South America (Sadie J. Ryan et al., 2023). The spread of malaria is influenced by a mix of environmental, socioeconomic, and health-related factors. Climate, particularly temperature and precipitation, have a major impact on the life cycle of the vector that transmits the parasite. Factors such as poverty, having a bed net and unsuitable housing conditions contribute to the vulnerability of certain population groups (Gething et al., 2016).

In East Africa, the incidence of malaria varied across countries and regions. At the beginning of 2019, it was estimated that more than 12.7 million people lived in areas with a predicted parasite prevalence of about 30%. This included 6.4% of Kenya's population, 12.1% of Tanzanians, and 6.3% of Ugandans. On the other hand, there were regions with a very low proportion of the parasite (>1%), but still favored transmission, affecting approximately 46.2 million people in the region. This included 52.2% of people living in Kenya, 26.7% of people living in mainland Tanzania, and 10.4% of people living in Uganda. While no Department of Health Administration was considered completely inadequate for malaria transmission, Nairobi County in Kenya recorded a very low prevalence of 0.1% in the same year (Victor A. Alegana et al., 2021).

According to the Democratic Republic of Congo's National Strategic Plan 2020-2023, every individual in the Democratic Republic of Congo is at risk of contracting malaria. In 2022, the Dem. The Republic of Congo, one of the original eleven high-burden, high-impact (HBHI) countries, reported more than 30 million cases of malaria. Of particular concern was the prevalence of malaria in children <5 years, which reached 39% using rapid tests (PMI report, 2022).

1.2 Statement of the problem

Despite advances and numerous attempts to control and prevent malaria infections using various methods, malaria continues to represent a significant global health problem, particularly in tropical and subtropical areas. The Democratic Republic of Congo, one of the most malaria-affected countries in Africa, is actively fighting malaria by taking various measures, including the distribution of insecticide-treated bed nets, promotion of their use, targeted indoor spraying of residues, early diagnosis and treatment and rearing Raise awareness of malaria prevention and the importance of prompt treatment.

For more than two decades, the eastern region of the Democratic Republic of Congo has witnessed some of the largest internal displacement in the world. Due to violence, natural disasters, and violent conflict, 5.7 million people from Masisi, Rushuru, Beni, and the outskirts of Goma were forced to relocate to various IDP sites in Goma (IDMC: GRID, 2023). Internal displacement poses significant public health challenges. Internally displaced people in Goma live in overcrowded, unsanitary conditions and have limited access to basic health services, food, and clean water.

In addition, they are particularly vulnerable to malaria and there is a very real risk of epidemics occurring in the camp due to the large number of people at risk. Lack of access to malaria prevention measures such as treated nets (ITNs) could further exacerbate this risk (Malaria Consortium, 2019).

In Goma, internally displaced people are up to three times more likely to develop malaria than the general population. A study conducted to compare the prevalence of malaria among children in a refugee camp with that of a nearby village in Goma, in the Democratic Republic of Congo noted the higher percentage of malaria infections among children in the refugee camp (17%) compared to those in the control village (7.5%) (Rhianna C., et al., 2016).

Malaria infection during pregnancy can have serious consequences for mother and child, such as: B. maternal anemia, miscarriage, stillbirth, premature birth and low birth weight. In Africa, approximately 10,000 maternal deaths per year are due to severe maternal anemia caused by malaria infection.

Certain people are more susceptible to malaria than others, with some groups at higher risk due to factors that affect their immune system or exposure to infected mosquitoes. These high-risk groups include children under five years of age, pregnant women, people with HIV/AIDS, newborns, immigrants or displaced persons, people with chronic diseases, and people living in regions with high mosquito populations or seasonal malaria transmission. With repeated exposure, immunity to malaria can develop over time. (CDC: Malaria & WHO: Malaria and HIV/AIDS).

1.3 Objectives of the study

1.3.1 Broad Objective

The general objective of this study is to assess the risk factors associated with malaria infection among adult populations in IDP camps in Goma, North Kivu Province, Democratic Republic of the Congo.

1.3.2 Specific Objectives

The objectives arising from the general objective included:

1. To assess the level of awareness and knowledge about malaria infection among the adult populations in IDP camps in Goma, North Kivu Province, Democratic Republic of the Congo.
2. To assess the prevalence of households that reported at least one case of malaria in the last 12 months in IDP camps in Goma, North Kivu Province, Democratic Republic of the Congo.

3. To identify behaviors and practices associated with increased risk of malaria infection among adult populations in IDP camps in Goma, North Kivu Province, Democratic Republic of the Congo.
4. To investigate environmental factors associated with malaria infection among adult populations in IDP camps in Goma, North Kivu Province, Democratic Republic of the Congo.

1.4 Research questions

To achieve these specific objectives, the research addresses the following questions:

1. What is the level of awareness and knowledge about malaria infection among the adult populations in IDP camps in Goma, North Kivu Province, Democratic Republic of the Congo?
2. What is the prevalence of households that reported at least one case of malaria in the last 12 months in IDP camps in Goma, North Kivu Province, Democratic Republic of the Congo?
3. What common behaviors and practices are associated with an increased risk of malaria infection among adult populations in IDP camps in Goma, North Kivu Province, Democratic Republic of the Congo?
4. What environmental conditions are associated with malaria infection among the adult populations in IDP camps in Goma, North Kivu Province, Democratic Republic of the Congo?

1.5.0 Significance of the study

The significance of this study spans multiple stakeholders, providing actionable insights for policymakers, empowering the community, advancing research, guiding NGO interventions, and aligning with the missions of faith-based organizations.

1.5.1 For the Government of the Democratic Republic of the Congo

This study empowers the government to make informed decisions regarding malaria control in IDPs by pinpointing specific risk factors contributing to malaria prevalence. The government can tailor healthcare strategies to mitigate challenges faced by internally displaced persons, guide targeted interventions, improve resource allocation, and address residents' specific needs, ultimately contributing to a more equitable healthcare system and reducing the national malaria burden.

1.5.2 For the Local Community

The study's importance for the displaced communities lies in its potential to improve health outcomes. By identifying malaria risk factors, the community benefits from specific interventions such as increased access to healthcare, mosquito bed net distribution, and educational campaigns. Tailored interventions that consider the community's specific needs and cultural context ensure effectiveness and cultural sensitivity, thereby building stronger and more resilient communities.

1.5.3 For Researchers

This study provides significant insights into malaria epidemiology in displacement settings, enhancing current knowledge. The results serve as a foundation for future research, enabling researchers to explore the complexities of malaria transmission in similar contexts. The study's methodology and findings contribute to methodological advancements and the development of effective strategies to combat malaria in IDPs.

1.5.4 For Non-Governmental Organizations

This research supports NGOs in providing healthcare services and interventions in humanitarian situations. The findings enable NGOs to make informed decisions, improve resource allocation, and tailor malaria prevention and treatment programs to the specific needs of IDPs, thereby maximizing the impact of their efforts.

1.5.5 For Faith-Based Organizations

Faith-based groups play a crucial role in community outreach and assistance. This study informs community-based health initiatives that align with their values. Faith-based organizations can use the study's results to design and implement health education programs, distribute preventive measures, and engage the community in promoting health-seeking behaviors.

1.6.0 Scope of the Study

1.6.1 Geographical area

This study took place in Kashaka and Shabindu IDP camps in Goma. Concentrating on this specific geographical area allowed for a detailed understanding of malaria dynamics within a defined population, ensuring the findings are directly applicable to interventions in this setting and enabling a thorough examination of local risk factors.

1.6.2 Content scope

The study assessed confirmed malaria cases, investigated potential contributors such as level of awareness, and environmental conditions, and analyzed demographic patterns based on age, gender, and duration in the camp. It also assessed behaviors related to malaria and considered seasonal variations in malaria prevalence. Data collection methods included semi-structured interviews and medical records providing a comprehensive understanding of malaria within displaced populations.

1.6.3 Time scope

The study's data collection and analysis commenced in July 2024, after the introduction letter. It examined historical data and trends over twelve months, covering both dry and rainy seasons to ensure comprehensive data collection.

1.7 Study Limitations

This study encountered several limitations that may have influenced the findings. Recognizing these, we implemented specific strategies to mitigate their impact where possible

Firstly, participants may have exhibited social desirability bias, providing answers they believed were more acceptable or aligned with perceived researcher expectations rather than their true experiences. Additionally, inaccurate recall or memory biases could have affected the precision of self-reported information regarding past experiences or behaviors. While the researcher cannot definitively quantify the extent of these biases, the researcher addressed them by ensuring participant anonymity and confidentiality, clearly communicating the study's purpose, and employing neutral, non-leading question phrasing during data collection.

Secondly, ongoing conflicts and insecurity in the study area significantly hindered data collection. These volatile conditions restricted researchers' access to certain blocs and households, potentially limiting the representativeness of our sample. This also led to unforeseen disruptions in data collection schedules. Although these external factors were largely beyond our control, the researcher worked closely with local community leaders and organizations to gain access to as many safe areas as possible. The researcher also prioritized the safety of the research team by strictly adhering to security protocols and

adapting our fieldwork schedule to prevailing conditions, which meant some data collection took longer than anticipated.

Finally, limited time and resources presented considerable operational challenges. These constraints impacted the depth and breadth of data we could collect and the duration of our engagement in the field. To overcome this, the researcher meticulously planned the research activities, prioritizing essential data points and utilizing efficient data collection tools (KoboCollect). The researcher also focused on training a highly skilled local research team to maximize productivity within the available timeframe and resources.

1.8 Delimitations

This study was delimited to assess malaria infection among adult populations in the Kashaka and Shabindu IDP camps in Goma, excluding other infectious diseases. The focus was on malaria awareness, testing, related behaviors and practices, and potential environmental factors. Data collection methods included semi-structured interviews and medical records review. These delimitations ensured a concentrated examination of malaria dynamics and risk factors, making the findings directly applicable to targeted interventions in this setting.

1.9. Operational definition of key terms

a. **Malaria**: a sudden feverish illness caused by Plasmodium parasites transmitted to humans through bites from infected female Anopheles mosquitoes.

b. **Prevalence of Malaria**: refers to the number of confirmed malaria cases within a specific timeframe. Malaria cases are confirmed using laboratory tests like microscopy or rapid diagnostic tests (RDTs).

c. **Risk Factors**: are variables or conditions that increase the chances of getting malaria. Common risk factors include age, gender, travel history to endemic areas, bed net usage, housing conditions, and presence of standing water.

d. **Internally Displaced People**: individuals or groups of individuals who have been compelled to flee their homes or usual living areas because of violence, armed conflicts, or natural disasters but they have not crossed an international border to seek refuge.

e. **Internally displaced persons (IDPs) camp**: is a temporary settlement established to house individuals who have been forced to flee their homes but remain within the borders of their own country.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter consists of a literature review that includes theoretical, empirical, and critical reviews, along with a conceptual framework and a summary of the conceptual framework.

2.1.0 Theoretical framework

Numerous theories exist that seek to elucidate the risk factors and the occurrence of infectious diseases like malaria and other communicable illnesses. This research will be guided by two models, namely the Triad Model and the Social-Ecological Model.

2.1.1 The Triad Model or Epidemiological Triad

The epidemiological triad is a key concept in epidemiology that helps us understand and study the factors that lead to infectious diseases. This triad includes three essential elements that work together to influence the occurrence and transmission of disease within a population. The idea of representing the three elements (also called vertices) in a love triangle originated in the early 20th century. However, the modern depiction of the epidemiological triad is often attributed to the work of the American epidemiologist C.E. Winslow from 1940. The epidemiological triad serves as a tool for locating risk factors and illustrating how the pathogen, the host, and the environment interact with each other.

2.1.1.1 Host

The malaria parasite has a life cycle that involves two hosts. When a mosquito infected with the parasite bites a person, it injects sporozoites into the bloodstream. These sporozoites then migrate to the liver, where they multiply into schizonts and then release merozoites. Some species, such as Plasmodium ovale and Plasmodium vivax, can have a dormant stage in the liver, leading to future recurrent infections. After multiplying in liver cells, the parasites reproduce asexually in red blood cells (erythrocytes).

Certain parasites go through a process of developing sexual stages (gametocytes) in the blood before they can be transmitted. The symptoms of the disease appear in the blood stage. When an Anopheles mosquito feeds on blood, it consumes both male (micro-gametocytes) and female (macro-gametocytes) gametocytes. Inside the mosquito, the

parasites multiply during the sporogonal cycle. In the mosquito's stomach, male and female gametes fuse to form zygotes, which then develop into motile ookinetes that penetrate the mosquito's midgut wall. The ookinetes mature into oocysts, which release sporozoites when they burst. These sporozoites migrate into the mosquito's salivary glands and are passed on to a new human host when the mosquito bites again.

2.1.1.2 Agent

The best-known pathogen that causes malaria is the parasite of the genus Plasmodium. Plasmodium falciparum and vivax are the most common species that infect humans, with P. falciparum causing the most severe cases. Malaria parasites, which are zoophilic, feed on humans as their population increases. During the day they rest in human houses and animal shelters. They proliferate in various water sources such as rainwater basins and riverbed basins, especially after the monsoon season. The biting time of these parasites is influenced by their species and the environment. Anopheles culicifacies and other vectors begin biting shortly after dark, with peak times varying depending on the species. Malaria progresses through cyclic infections in humans and female Anopheles mosquitoes. The parasites first develop in liver cells and then migrate to red blood cells, where they multiply

and destroy. This releases merozoites that repeat the process in other red blood cells (Sharma, V. P. & Dev, V. 2017).

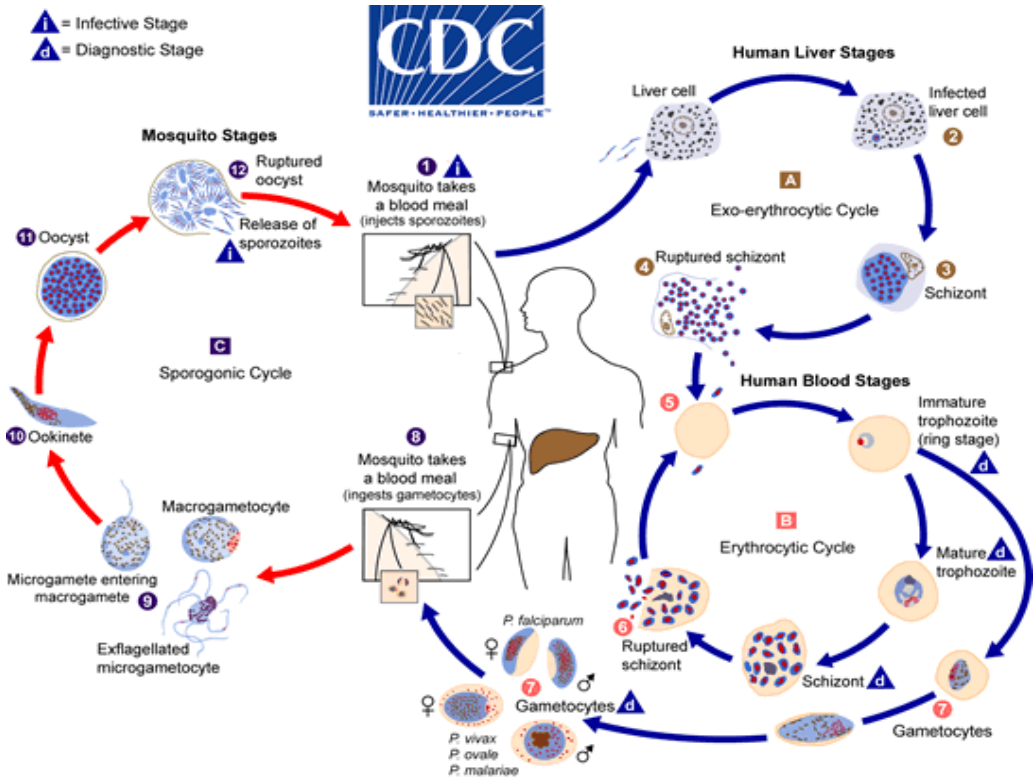


Figure 2.1. Life Cycle of Malaria Parasites

Source: Centers for Disease Control and Prevention (2020).

2.1.1.3 Environmental

The environment includes external elements that impact the active ingredient and the likelihood of exposure. These factors can be physical (such as geology and climate), biological (such as disease-carrying insects), and socioeconomic, including factors such as population density, hygiene, and availability of health services (Szklo, M. & Nieto, F. J., 2014). In this theory, they argue against the idea that disease is caused by the smell of decaying organic material. This theory has its roots in the belief that disease is linked to climate change. Unlike other theories, the cause of the disease is separated from the person suffering from the disease. The early scientific theories about malaria suggested that

miasma, or bad air, was not directly related to the disease, but this belief was eventually abandoned. In the late 19th century, the germ theory of disease emerged, revolutionizing our understanding of disease. When Charles revealed that malaria was caused by a microscopic parasite, belief in the miasma theory began to wane (Charles E. Johnson, 1851).

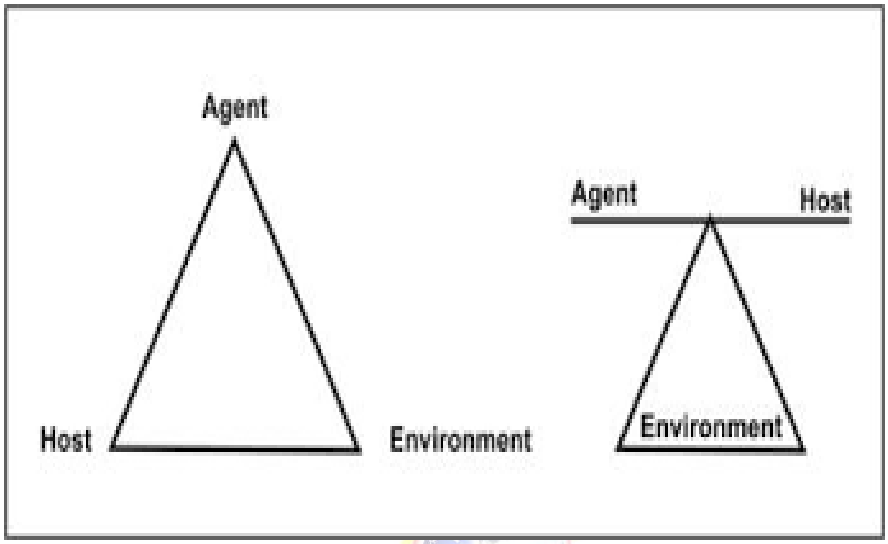


Figure 2.2. Epidemiological Triad of Causative Environmental

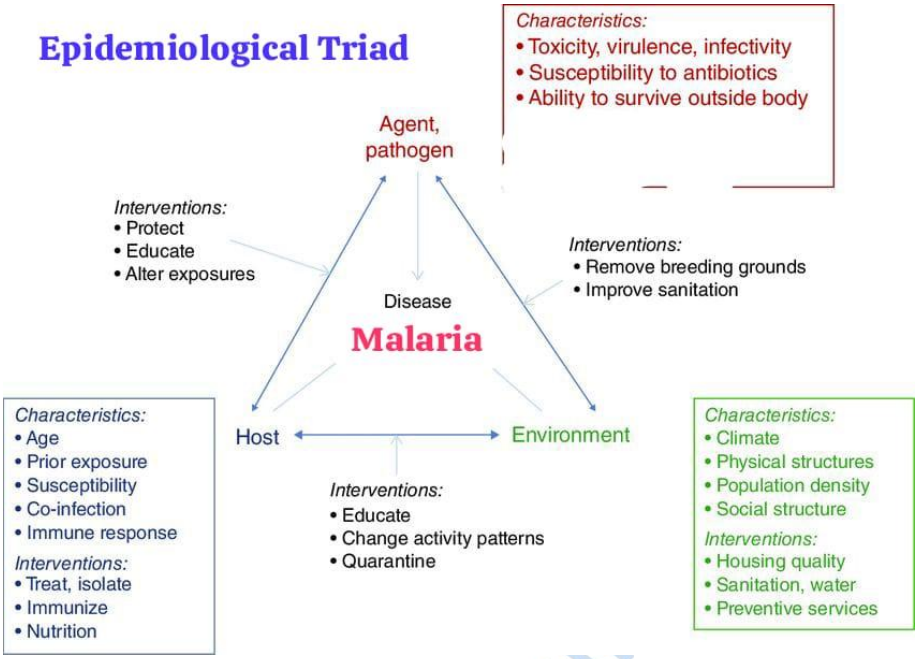
Source: Gandhi, Kishor (1986).

2.1.1.4 Time

Time plays a central role in the Epidemiological Triad. It encompasses the incubation period of most infectious diseases, which is the time between when a person gets infected by infected mosquitoes and when they show symptoms of malaria. Time also refers to the duration of the illness, the time it takes for a person to recover or succumb from malaria, and the time it takes for malaria infection to reach epidemic levels in a population (CDC Web site).

The adapted Malaria Epidemiological Triad below provides a holistic view of what contributes to malaria occurrence. This avoids focusing solely on the biological agent and neglecting the influence of host susceptibility and environmental factors that facilitate

malaria transmission. Each component of the triad offers insights into potential risk factors



(David D. Celentano & Moyses S., 2018).

Figure 2.3. The Adapted Epidemiological Triad for Malaria

Source: A literature review by the researcher, (2024).

2.1.2 The Socio-Ecological Model (SEM)

The "Socioecological Model" developed by Urie Bronfenbrenner in the late 1970s, acknowledges that individuals affect and are affected by a variety of factors. This model recognizes that factors can move across different levels and impact individuals in varied ways based on the combination of their experiences.

The Socioecological Model emphasizes the importance of an individual's affiliation with others, organizations, and their community at large to be effective. This model consists of four key stages as proposed by the CDC – Individual, Interpersonal, Community, and

societal. The Socioecological Model offers a holistic approach that considers individual, relational, community and societal factors shaping health outcomes.

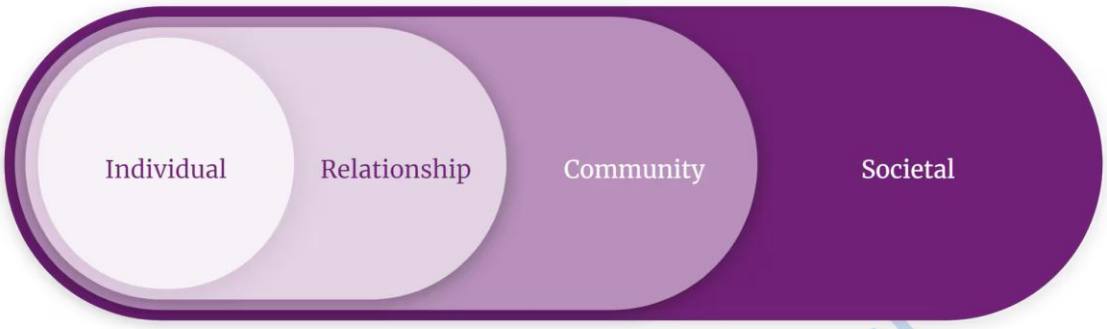


Figure 2.4. The Socioecological Model

Source: CDC - The Social-Ecological Model: A Framework for Prevention (2022).

i) Individual

Various biological and personal factors can influence malaria prevalence. These include factors such as age, sex with females more susceptible during pregnancy, immune status (previous exposure provides some protection), pre-existing health conditions, and genetic predispositions to malaria susceptibility (sickle cell trait offers some resistance). Additionally, personal behaviors such as not using insecticide-treated bed nets, awareness of malaria transmission and preventive measures, failure to seek timely medical care, and lack of adherence to prescribed antimalarial medication regimens can increase the risk of malaria infection (Okello, 2019).

ii) Relationship

The close relationships within displaced camps, including family members, peers, neighbors, and partners can significantly impact malaria risk. Shared living spaces and proximity facilitate the transmission of malaria parasites between individuals. Moreover, family dynamics and social networks may influence health-seeking behaviors related to malaria prevention and treatment.

iii) Community

The conditions within displaced camps, such as overcrowding, inadequate sanitation infrastructure, and limited access to healthcare services, contribute to the heightened risk of malaria transmission. Environmental factors, such as stagnant water bodies providing breeding sites for mosquitoes, exacerbate the situation (WHO, 2019).

iv) Societal

The broader societal factors, including political instability, economic disparities, social marginalization, and environmental policies such as national and regional policies on deforestation and land use changes that might affect mosquito breeding habitats near camps. These factors can affect access to healthcare services, availability of preventive measures, and overall living conditions (UNHCR, 2020).

2.2.0 Empirical Literature Review

2.2.1 Global Burden Of Malaria

In 2022, there were around 249 million malaria cases worldwide in 85 countries and regions where malaria is prevalent, including French Guiana, which represented an increase of 5 million cases from the previous year. Between 2000 and 2014, the number of cases varied but ultimately decreased from 243M to 230M across countries affected by malaria in 2000. However, since 2015, there has been a resurgence in malaria cases, with the most significant annual surge estimated between 2019 and 2020, mainly affecting countries in the WHO African Region. Noteworthy increases in cases between 2021 and 2022 were observed in Pakistan 2.1M, Ethiopia and Nigeria 1.3M each, and Uganda 597,000. Nigeria's rise was primarily due to population growth, while the other four countries experienced a substantial increase in incidence rates compared to 2021.

The number of malaria new cases decreased from 81/1000 population at risk in 2000 to around 56.8 in 2019, and then a slight increase of three percent in 2020. Over the past three years, the incidence rates of 58.4 per 1000 have stayed stable. Similarly, malaria deaths dropped from 864,000 in 2000 to 576,000 in 2019, then increased to an estimated 631,000 in 2020, largely due to COVID-19 disruptions in accessing prevention and treatment tools. However, there was a slight decrease in deaths in 2021 and 2022 to 610,000 and 608,000, respectively (World Malaria Report, WHO, 2023).

Falciparum malaria leads to over 1 million deaths annually, with young children being the most vulnerable to indirect mortality, often due to the combination of other infections and illnesses.

Between 2019 and 2022, the number of malaria cases in the original 11 high burden high impact (HBHI) countries gradually increased from 157M cases reported in 2019 to 167M in 2022. The rise in cases was primarily attributed to the impact of the COVID-19 pandemic, with subsequent small increases in 2021 and 2022 partly due to population growth. India, despite its minimal overall contribution to the total cases among HBHI countries, saw the highest percentage reduction in cases (around 30%). Collectively, these 11 countries represented 67% of malaria cases worldwide in 2022 (World Malaria Report, WHO, 2023).

2.2.2 Malaria in Africa

Africa still holds the greatest number of malaria cases and deaths worldwide. In 2000, malaria caused around 18% of deaths in children under five in sub-region, resulting in approximately 803,000 deaths. The mortality rate due to malaria rose significantly in rural Africa in the 1980s and early 1990s, potentially due to resistance to chloroquine. Malaria also indirectly contributes to a high number of deaths, with complications like maternal anemia, low birth weight, and premature delivery causing an estimated 75,000-200,000

deaths yearly in the sub-region. Malaria outbreaks lead to about 12 million cases and nearly 310,000 deaths each year in Africa. Egypt and Morocco have low malaria transmission compared to other sub-Saharan African countries, with sporadic imported cases. In endemic African countries, malaria accounts for a significant percentage of outpatient (25-35%), hospitalization (20-45%), and hospital deaths (15-35%), placing significant strain on already overwhelmed healthcare systems (World Malaria Report, WHO, 2005).

Plasmodium species like P. Falciparum are the most common, responsible for 93% of malaria cases, while P. Vivax or mixed infections account for 7% of cases with A. gambiae and A. funestus being the main vectors of the disease.

The region contributes significantly to the global burden of clinical malaria cases, with an estimated 59% share, and specifically to clinical falciparum malaria cases with 74%. Additionally, Africa bears a substantial burden of global malaria mortality, accounting for an estimated 89% (The World Health Report, WHO, 2003).

In 2022, the region accounted for nearly all of the world's malaria cases (93.6%) and deaths (95.4%). In the same year, 78% of deaths occurred in children under the age of 5, a decrease from 90.7% in 2000. From 2019 to 2020 the number of malaria cases rose from 218M to 230M. Despite minimal fluctuations in cases between 2020 and 2022, the number of deaths in the region dropped to 580,000.

Travelers and tourists visiting these endemic areas including South America and Asia are at increased risk of contracting the disease. Similarly, individuals exposed to malaria in these regions and then return to their home countries to visit family are also at risk due to weakening immunity. While some immunity may develop with repeated exposure, it is impossible to achieve complete immunity to malaria.

2.2.3 Malaria In East-Africa

Malaria is a significant threat to children under the age of five in East Africa, with approximately 285,000 children in the region dying from the disease in 2016. In areas where malaria is prevalent, children under five are most vulnerable to the disease.

Research shows that P. falciparum populations in Africa increased about 6,000 years ago, spreading alongside human populations due to agricultural practices. The parasite has caused a significant number of deaths in Africa, leading to the development of various human survival mechanisms like genetic changes in red blood cells (Riley and Steward, 2013).

While malaria infection is common in Sub-Saharan Africa, deaths specifically caused by P. falciparum are uncommon due to acquired immunity. In contrast to diseases like HIV/AIDS or tuberculosis, nearly everyone in a population gets infected with malaria, but not all develop the disease. Those who succumb to malaria show the public health consequences of needing to build immunity in the population.

2.2.4 Malaria in Somalia

The World Malaria Report (2005) indicates that in Somalia, there were 23,349 reported malaria cases in 2003, with 7,571 confirmed through lab testing. The incidence rate was 2.36 per 1,000 per year. About 17% of kids had a fever in the previous two weeks, with similar rates among genders and urban/rural areas based on the MICS 1999 survey. Around 18% of children under five with fevers received anti-malarial treatment, with higher rates in rural (24%) versus (11%) in urban areas (MICS 1999). However, due to limited health facility usage and incomplete reporting, the actual malaria burden in

Somalia may be higher than reported figures because many cases are diagnosed based on symptoms, not through proper testing.

Research on malaria in Somalia has been scarce due to the civil war, and prior studies have primarily focused on the northern regions. Transmission rates vary across regions, with P. Falciparum being the most prevalent parasite. Donor funding supports disease control in Somalia due to economic, political, and security challenges. The main program combating malaria in the country is funded by GFATM, targeting children, pregnant women, and adults. The aim is to reduce malaria-related illness and death and enhance the country's health system. The strategy involves various interventions, including disease management and prevention, vector control, and strengthening health capacities.

The program aligns with global initiatives like the Rollback Malaria Initiative and UN development goals. However, Somalia's healthcare system is fragmented, with different ministries overseeing health in various regions. Strengthening the health system is crucial for effective malaria control. Financial gaps remain a challenge due to the country's political instability and inadequate data, making it difficult to estimate the total financial needs accurately. Ongoing initiatives guide the current budget estimates for the next five years.

2.2.5 Democratic Republic of the Congo Malaria Situation

Although teenagers have a higher prevalence of malaria in the Democratic Republic of Congo, most large surveys are focused on children under the age of five. To bridge this gap, researchers analyzed data from both young children and adults in the country. The study revealed that teenagers between the ages of 10 and 14 had the highest prevalence of malaria. Despite evidence showing higher malaria rates among older children and adolescents, they are frequently overlooked in national malaria surveys. It's crucial to

include all age groups in surveillance to accurately inform malaria control policies, especially in countries like the DRC where the prevalence among older children remains unknown (Sultana et al., 2017).

By analyzing data from the Demographic and Health Survey (DHS 2013-2014) and a long-term study, researchers were able to assess the impact of malaria infection on various age groups in the country. The DHS included over 8000 children under 5 and more than 17,000 children of 15 and above, while the longitudinal study involved 1591 individuals at seven locations in Kinshasa, each with different levels of endemicity. Combining these datasets allowed for a better estimation of malaria rates in all age groups, leading to more targeted interventions to control the disease.

The research has been taking place in Kinshasa Province since 2015, with data collected from 7 distinct locations. In 2015, a specific time frame, a random selection of households was made from 7 different locations, and a total of 1591 participants, varying in age from 6 months to 98 years, were included from 6 rural villages and 1 urban neighborhood. The blood samples were placed on spots from all participants, and DNA extraction was performed using Chelex resin and saponin, followed by PCR focusing on the P. falciparum. The PCR test results indicated different levels of malaria prevalence, with urban areas reporting 3% and certain rural villages showing 42% prevalence (Coalson et al., 2018).

The DHS Program conducts surveys in the DRC using a random sampling scheme to ensure representation of the entire population. The latest survey occurred from November 2013 to March 2014, with participants or their guardians granting informed consent. A PCA method was applied to determine urban or rural status accurately. A sensitivity analysis compared results using PCA versus the standard DHS classification to identify any discrepancies.

The study utilized age-specific population data from the WorldPop Project to validate the urban/rural classifications derived from PCA and DHS categories. The population figures for different provinces were calculated using province borders to predict the total number of cases in the country. It was noted that interventions targeting this age group could significantly impact malaria control efforts in the country.

Moreover, future studies must take into account the precise age distribution, as indicated by recent research findings. In urban settings, the impact of malaria on teenagers surpasses that of younger children. This aligns with previous studies showing that in sub-Saharan Africa teens are most affected by malaria. However, there may be an underestimation of infection rates by current surveys, as they might not adequately capture this highly impacted age group (Deutsch-Feldman al., 2020).

The research, conducted using PCR for detecting infections, found a higher prevalence rate compared to existing estimates, possibly due to differences in testing methods. The study was based on data from a large national health survey in the DRC, focusing on children under 5 and adults aged 15 and above. Despite limitations such as site-specific data and outdated census information, the research provides valuable insights into malaria prevalence, especially among adolescents. It underscores the need for future surveys to pay closer attention to this age group in countries with high malaria endemicity like the DRC.

To sum up, this research indicates that a significant number of malaria cases in the DRC are found among children aged 5-14. It is suggested that future studies focusing on malaria prevalence in countries with high endemicity, such as the DRC, should specifically consider this age group.

2.2.6 Level of Awareness

Studies have explored the complex interplay of knowledge, attitudes, and practices (KAP) related to malaria within communities across various regions. A crucial barrier to its eradication lies in the knowledge gaps and misconceptions surrounding the disease. Studies from various regions, including Tanzania, India, and Zambia, reveal a concerning lack of understanding about transmission modes, risk factors, and preventive measures.

Research conducted in Ethiopia by Belaynesh and Abaineh (2021) found that a high percentage of respondents had good knowledge with 63.1% and positive attitudes towards malaria with 62.6%. However, only half of the respondents (50.8%) had good practices regarding malaria (Belaynesh and Abaineh, 2021). On the other hand, studies conducted in Tanzania by Njau et al. (2019) and in Kenya by Onyango et al. (2021) identified significant knowledge gaps, particularly concerning mosquito breeding sites and the importance of insecticide-treated bed nets (ITNs). Misconceptions about causes and transmission routes, often deeply rooted in cultural beliefs, further complicate prevention efforts (Njau et al., 2019) and (Onyango et al., 2021).

Attitudes towards preventive measures, including bed nets (ITNs) and prompt healthcare seeking are generally positive, but inconsistent use and delays in treatment remain challenges. Malaria and attitudes present a complex dance between fear and complacency.

Studies by Onyango et al. (2021) and Killian et al. (2019) highlight the co-existence of these emotions, fear of malaria can motivate preventive actions, but can also lead to stigma and discrimination. Conversely, complacency due to perceived low risk or inadequate knowledge can hinder adherence to prevention measures like bed net use.

The gap between knowledge and action is often evident in malaria prevention practices. A study by (Mboera et al., 2016) highlights that even with adequate knowledge and positive

attitudes, barriers like cost, accessibility, and perceived discomfort can hinder the usage of preventive measures like bed nets. Additionally, sociocultural norms and beliefs can influence practices related to seeking healthcare or mosquito avoidance behaviors.

2.2.7 Prevalence of Malaria

Determining the prevalence of malaria involves utilizing different techniques and considering various factors. In the past, microscopic examination of blood samples has been the preferred method for diagnosing malaria because it enables the identification and counting of parasites. In 2019 study by Killian et al. emphasizes the importance of confirming positive results from rapid diagnostic tests using microscopy, especially in regions with low malaria rates where false positives are common. However, accessing microscopy can be challenging in certain areas due to the requirement for skilled personnel and laboratory facilities.

A recent study by Tiono et al. in 2021 highlights the effectiveness of Rapid Diagnostic Tests (RDTs) in swiftly detecting malaria parasites in blood samples for large-scale surveys, providing insights into the geographic spread and intensity of transmission. Nevertheless, results should be interpreted cautiously due to the potential for false results, necessitating confirmation through microscopy in specific cases.

Malaria rates in displacement camps vary across regions. In the Democratic Republic of Congo, approximately 60.2% of people were affected, primarily by the P. falciparum parasite, with seasonal spikes during the monsoon season. Conversely, in Somalia's Bad-bado Refugee Camp, a study indicated a 39.3% prevalence among women of childbearing age (Kayiba K., et al., 2022).

2.2.8 Environmental Factors

Malaria transmission is highly dependent on environmental factors including, rainfall, housing conditions, sanitation and hygiene, temperature, humidity, and other factors that influence the mosquito's survival, the lifecycle of the parasite, and the breeding and feeding habits of the vector (Texier et al., 2013).

Many studies have investigated the correlation between temperature and the spread of malaria in tropical and subtropical areas. Climate plays a crucial role in the spread of malaria, influencing both mosquito development and parasite replication in a complex manner. Parasites cannot develop below 18°C or above 48°C, impacting the survival of the mosquitoes that carry them. The most favorable temperature range for the transmission of malaria is typically between 20 and 30°C (WHO: Fight against malaria, 2019). Warmer temperatures can accelerate mosquito breeding cycles and shorten parasite development within the mosquito, potentially increasing transmission risk. However, excessively high temperatures can also stress and kill mosquitoes, leading to a non-linear relationship between temperature and transmission. Additionally, temperature influences human behavior, affecting the use of bed nets and outdoor activity, further impacting transmission dynamics (Sinka et al., 2010).

For years, it has been understood that there is a connection between rainfall and outbreaks of malaria. Rainfall typically leads to more water and suitable conditions for mosquito breeding, the primary vector for transmitting the disease. Nonetheless, too much rain can have a different impact by washing away small breeding habitats like puddles or ditches and lowering temperatures, particularly in elevated areas, which can halt the spread of malaria transmission (Krefis et al., 2021).

Substandard housing conditions significantly amplify malaria transmission risk, creating a breeding haven for mosquitoes and facilitating their contact with humans. Lack of walls,

proper roofing, or screens in dwellings expose residents to mosquito bites, particularly in areas with high mosquito densities. Factors like gaps in walls, thatched roofs, and open eaves provide easy access for mosquitoes, while improper ventilation and lighting can create favorable breeding sites within the house itself. This combination increases the risk of mosquito-human interaction, especially at night when people are most susceptible to bites (Amani et al., 2019).

Living close to mosquito breeding sites significantly amplifies malaria risk, creating a geographical proximity problem with dire health consequences. Communities residing near swamps, marshes, poorly drained areas, or stagnant water bodies face heightened exposure to malaria vectors. This proximity translates to increased mosquito biting rates, leading to a higher chance of infection, especially for individuals with limited protective measures. The impact is particularly concerning for young children, who often play outdoors and are more susceptible to mosquito bites (Bejon et al., 2012).

2.2.9 Groups at Risk

Malaria is an infection that affects people of all ages but its severity differs from one individual to another depending on the age, immunity, gender, proximity to the vector breeding sites, and health status. Young children below the age of 5 are particularly vulnerable to severe cases and death from malaria as their immune systems are not fully developed and they have limited exposure to the disease. As they get older, their immunity strengthens, offering some level of protection. Nevertheless, teenagers transitioning into adulthood may face an elevated risk of contracting malaria due to changes in behavior and increased exposure.

The likelihood of susceptibility to malaria is significantly influenced by genetics, with variants in hemoglobin such as sickle cell trait and hemoglobin C (HbC) playing crucial

roles. People with sickle cell trait (HbAS) are more resistant to malaria because the altered hemoglobin disrupts the parasite's ability to thrive in red blood cells (Keri H., et al., 2020).

While biological factors contribute to differences in susceptibility, gender roles, and responsibilities often expose females to higher mosquito bite risks. Females often disproportionately bear the burden of household chores like fetching water, outdoor activities, collecting firewood, and other activities that might coincide with peak mosquito activity, putting them at greater risk compared to males who might engage in different activities (Mbonye et al., 2021).

Malaria has a major effect on different health aspects, especially for people with underlying medical conditions. Pregnant women are more vulnerable to malaria due to bodily changes and weakened immune systems. Malaria in pregnancy can lead to serious consequences for both the mother and the baby. Likewise, individuals with HIV are at high risk of contracting malaria because of their weakened immune systems. Malaria infection can exacerbate the progression of HIV and raise the likelihood of treatment failure (Seyedeh-Tarlan, et al., 2023).

Displaced populations face challenging living conditions and health issues, making them more vulnerable to malaria. The length of time spent in displacement camps plays an essential role in increasing the risk of exposure and susceptibility to the disease. Prolonged stays in these camps with poor sanitation, inadequate housing, and increased mosquito breeding areas heighten the likelihood of malaria infection. Factors such as insufficient nutrition, stress, and uncertainty linked to displacement can also contribute to malnutrition, weakening the immune system and making individuals more prone to malaria.

2.3 Critical Review (Find Gaps)

2.3.1 Malaria Gap Worldwide

The connection between malaria and poverty is well known, but the specific ways in which they are linked and the reasons behind it are not fully understood. Different research methods offer varying perspectives on the disease's impact. While some large economic studies indicate that countries with high malaria levels could see a reduction in economic growth of over one percentage point annually, microeconomic studies show a smaller impact, usually less than one percent of the country's annual GDP per capita.

In 2022, the total funding allocated for malaria management and eradication in 91 countries - comprising 84 endemic countries and 7 non-endemic countries - reached $4.1 billion, an increase from $3.5 billion in 2021, $3.3 billion in 2020, and $3.0 billion in 2019. However, despite this rise, the funding is still less than $7.8 billion needed globally to achieve the Global Technical Strategy (GTS) goals, with only 52% of the required amount secured in 2022. The funding deficit has grown notably over the past five years, escalating from $2.3 billion in 2018 to $3.7 billion in 2022. Personal expenses on malaria are excluded from the GTS targets and the funding analysis (Global Fund, NMP report, 2023).

The significant variance in these estimates suggests that malaria may have economic externalities that amplify the burden beyond the costs of individual cases. To comprehend

the scale of this impact and how malaria affects income, policymakers need to understand how the disease can impede long-term economic growth.

2.3.2 Malaria Gap in Africa

Malaria has a significant economic impact in Africa as it leads to high healthcare costs and decreased productivity. Each year, the direct healthcare costs associated with malaria in Africa are estimated to be around $2 billion, covering treatment, prevention, and public health initiatives, with 34% of these costs being funded by the governments of endemic countries and 36% by the USA agencies. The disease also lowers economic productivity, especially in the agricultural sector, where infected farmers may experience a 60% decrease in crop yields due to illness (Global Fund, NMP report, 2023).

Understanding the economic costs imposed by malaria and how these impact health policy is crucial. Investing in preventing and treating malaria is mainly driven by the significant human cost it incurs. When deciding where to allocate resources for health and development, it is important to consider the economic effects of investing in anti-malaria measures, especially when faced with other pressing needs. If severe malaria hampers economic progress, reducing this burden could lead to a positive cycle of improved health and wealth, ultimately raising living standards.

The discrepancy between estimates of economic burden from different studies sheds light on how malaria hinders development. If the costs of malaria extend beyond individual households, relying solely on private spending for combating it will be insufficient. Public support for anti-malaria efforts becomes even more crucial in such cases.

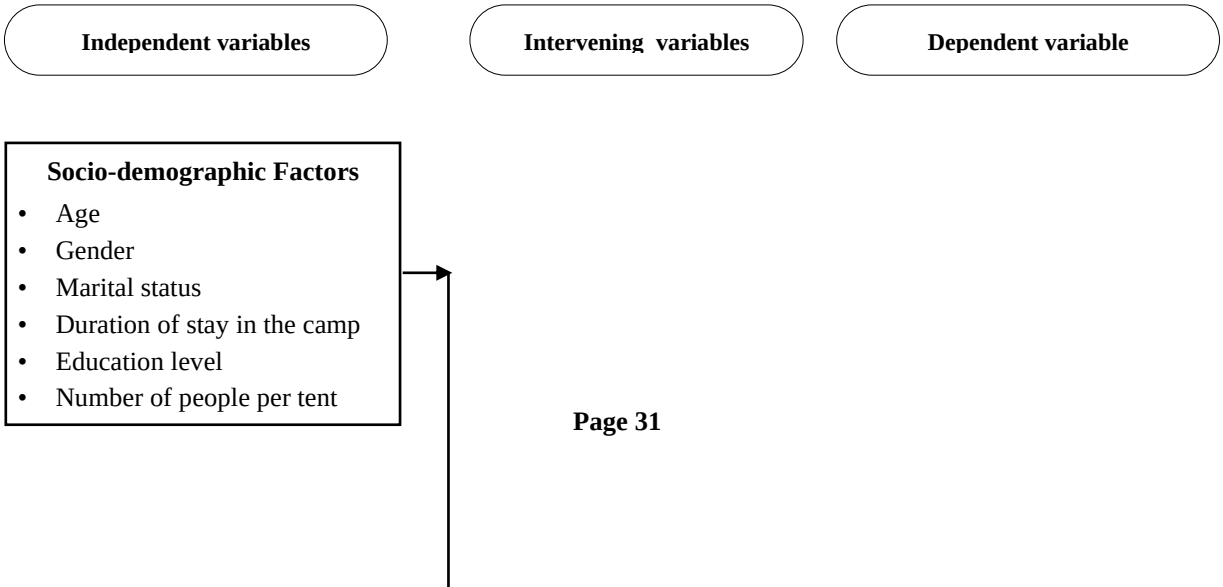
2.3.3 Malaria Gap In East Africa

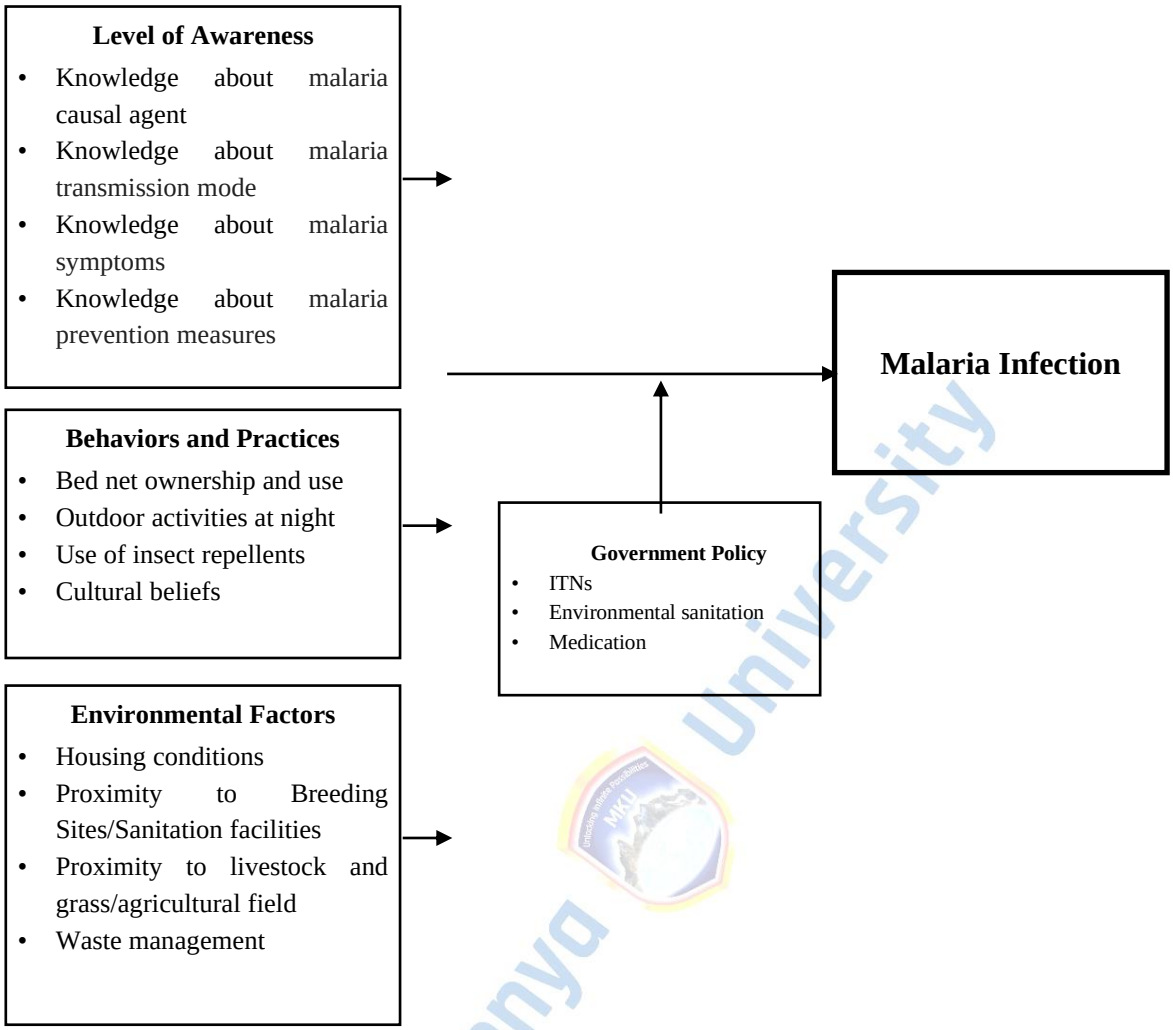
Malaria has a major impact in East Africa, specifically in nations like Kenya, Tanzania, and Uganda where it is a major health and socio-economic concern. These nations report

some of the highest rates of malaria in the region, with millions of cases each year. For instance, Uganda had more than 13 million malaria cases in 2020 alone. The disease is a major cause of death, particularly among children under five who make up around 70% of all malaria-related deaths in this region.

This is further exacerbated by school absenteeism, as children miss an average of 8-10 school days per year because of malaria, impacting the development of future human capital. Additionally, the burden of malaria can reduce GDP growth by up to 1.3% annually in heavily affected regions, perpetuating a cycle of poverty and impeding economic progress. It represents a significant portion of public health spending, inpatient admissions, and outpatient visits, especially in countries heavily burdened by the disease like Kenya and Tanzania. This heavy burden of malaria hinders economic progress, reduces agricultural output, and reinforces poverty, making it a crucial challenge both in public health and economic terms for East Africa.

2.4 The Conceptual Framework





Source: A literature review by researcher

2.5.0 Summary of Conceptual Framework

2.5.1 Independent variables

The conceptual framework uses various indicators to investigate how common malaria infection is among the population in the displaced camp, as well as the factors that might increase the risk.

In the socio-demographic section, demographic factors that increase vulnerability to malaria, including age, gender, marital status, education level, size of people in the tent, and length of stay in the displaced camp were explored. Indicators under the level of

awareness encompass the educational background of participants, their access to information about malaria, understanding of what causes malaria, how it spreads, the symptoms it presents, and ways to prevent it. Participants 'behaviors and practices will be identified by analyzing indicators such as bed net ownership and use, use of insect repellents, outdoor activities at night, healthcare-seeking behavior, and Cultural beliefs. Finally, environmental conditions contributing to malaria risk will be assessed by considering housing conditions, proximity to breeding Sites (stagnant water), proximity to livestock, presence of grass around the tent, existence of agricultural field, sanitation facilities, waste management, and environmental sanitation.

This comprehensive conceptual framework provides a structured approach to understanding the complex interplay of factors influencing malaria infection among populations in internally displaced camps.

2.5.2 Intervening variables

In the context of our research, government policy, NGO interventions/support, and politics of malaria control in the Democratic Republic of the Congo play the intermediary. Government policies related to healthcare, refugee/displacement management, and malaria control can directly impact malaria prevalence among displaced populations. Policies governing access to healthcare services, distribution of mosquito nets, funding for malaria prevention programs, and infrastructure development within camps can significantly influence the prevalence and management of malaria.

Non-governmental organizations (NGOs) often play a key role in providing healthcare services, distributing aid, and implementing malaria control programs in displaced settings. NGO interventions may include providing medical supplies, conducting health

education campaigns, distributing insecticide-treated bed nets, and supporting healthcare infrastructure development. The presence and nature of NGO interventions can directly affect malaria prevalence by improving access to prevention measures and treatment services.

2.5.3 Control variables

In the context of this research on malaria in the displaced camps, controlling variables such as camp size, duration of displacement, conflict intensity, camp infrastructure, and population mobility are very important.

Camp size: Camp size can impact the spread of malaria within the camp. Larger camps may have higher population densities, which could increase the risk of transmission due to closer proximity among individuals. By controlling and maintaining camp size, we can account for variations in population density and better assess the true impact of other factors on malaria.

Duration of displacement: The length of time individuals have been displaced can affect various aspects of health, including immunity, access to healthcare, and adaptation to the environment. Longer durations of displacement may lead to increased vulnerability to diseases like malaria. By controlling for this variable, we can account for differences in health outcomes that may be related to the duration of displacement rather than other factors under investigation.

Conflict intensity: Conflict intensity can disrupt healthcare systems, infrastructure, and access to resources, all of which can influence the prevalence of malaria. Higher levels of conflict may lead to reduced access to healthcare services, increased population displacement, and deteriorating living conditions, all of which can contribute to higher malaria infection. Controlling for conflict intensity allows us to isolate the impact of other factors on malaria risk, independent of the effects of conflict.

Population mobility: Mobility within the displaced population, including movements within the camp or between camps, can influence malaria transmission dynamics. Increased mobility may introduce parasites from different regions or disrupt control measures. Controlling for population mobility can allow us to evaluate the impact of other factors on malaria risk while accounting for variations in population movement.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

This chapter outlined the methodology and techniques utilized in this study. It highlighted the research design, approach, target population, sample size, sampling method, data collection tools, measures of validity and reliability, analysis techniques, data presentation methods, and ethical considerations. An explanation is given as to why a particular method has been chosen over others.

3.1 Study design

A descriptive cross-sectional study design was utilized to provide a snapshot of malaria testing, assess participant awareness levels, and identify potential risk factors at a specific point in time. This design is effective in capturing the current malaria burden within the Kashaka and Shabindu IDP camps, enabling the simultaneous examination of multiple variables. It is particularly important for assessing malaria in IDPs as it facilitates timely and accurate data collection, essential for informing targeted interventions and guiding effective public health responses.

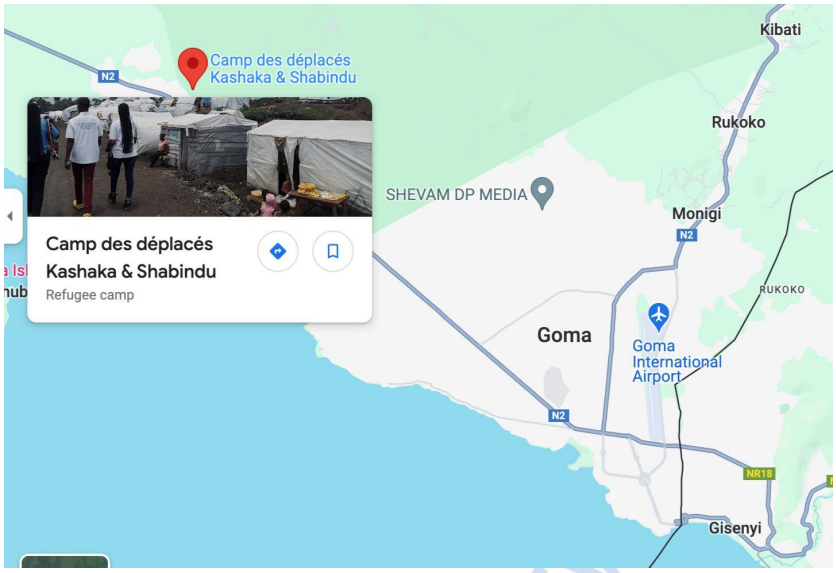
3.2 Study Approach

The study adopted a mixed-method study approach combining quantitative and qualitative data collection techniques to obtain a thorough understanding of malaria and its associated risk factors among the adult population in IDP camps. Semi-structured interviews and medical record reviews were conducted, providing comprehensive historical data. This combined approach addressed the community's immediate health needs by capturing both numerical data and contextual insights, ensuring a detailed examination of trends and distribution of malaria in the IDP camps.

3.3 Location of the study

The research was conducted in the Democratic Republic of the Congo focusing on Kashaka and Shabindu camp, one of the largest internally displaced camps in Goma, North Kivu province. Situated on the city's edge, less than 5 kilometers away, the Kashaka and Shabindu camp boasts a scenic backdrop of mountains and green landscapes, surrounded by agricultural fields growing crops such as maize and rice. This juxtaposition placed the camp at the intersection of potential malaria risk factors, including its proximity to Lake

Kivu, which serves as a breeding ground for mosquitoes, and potential limitations on



access to preventative measures compared to urban areas.

Figure 3.1. Kashaka & Shabindu

Source: Google map

3.4.0 Target population

The target population for this study was the heads of households residing in the Kashaka and Shabindu IDP camps in Goma, North Kivu Province, Democratic Republic of the Congo. While the camp accommodates large numbers of people including children, adolescents, and adults, the study specifically focused on the 11,110 heads of households. This focus was chosen to gather detailed historical information on malaria and its risk factors from those responsible for household-level decisions and management within the camp.

3.4.1 Inclusion Criteria

The inclusion criteria were based on the participant's age, residency, household role, and willingness to participate. Adults aged 18 years and above, who were permanently residing in the Kashaka and Shabindu IDPs camp in Goma were included in the study. Participants

had to be recognized as the heads of their households within the camp and had to voluntarily agree to participate in the interview process. Additionally, participants needed to be available during the data collection process.

3.4.2 Exclusion Criteria

The exclusion criteria were based on recent arrivals, non-availability, health status, and multiple locations. Participants who had recently arrived in Kashaka and Shabindu IDP camps and had not yet been permanently residing there were excluded. Additionally, heads of households who were frequently absent or unavailable during the data collection period, despite initially agreeing to participate, as well as those who sometimes lived in Goma town with their family, were not included. Furthermore, participants who were sick or had mental health problems were excluded from the study.

3.5 Sampling procedures and techniques

The study utilized a multistage random sampling to efficiently select samples within the camp. According to Lohr (2019), multistage sampling is particularly useful in large-scale surveys where the population is widely dispersed or organized into hierarchical structures. The complex and layered structure of Kashaka and Shabindu IDP camps necessitated a sampling method that could systematically address different levels of the population hierarchy. Multistage sampling allowed for a step-by-step approach to select samples at each level, accommodating this complexity. It was effective in providing a balance between precision and practicality. By breaking down the sampling process into three stages, the researcher was able to organize and manage the selection process.

The sample selection process at each stage

Stage 1: Camp

There are more than seven camps for internally displaced people around Goma city, some of which are extremely dangerous due to their proximity to the conflict areas of the M23 and the DRC armed forces. The selection of the camp for this study was prioritized based on factors such as camp size, resource availability, accessibility, distance, and security. These criteria were critical to ensure the safety of researchers and research assistants and the feasibility of data collection. Taking these factors into account, Kashaka and Shabindu camps were chosen over five secure and accessible IDP camps using simple random sampling.

Stage 2: Blocs

After selecting Kashaka and Shabindu IDP camps, 50 out of 202 blocks were randomly selected using simple random techniques in Excel. This approach ensured an unbiased selection process and enabled a representative sample of blocks.

Stage 3: heads of households

Due to the varying size of the heads of households within blocks, a stratified simple random sampling technique was employed within each selected block. A comprehensive list of the heads of households within each block was prepared in Excel and the random function was applied to proportionally select a certain number of the heads of households for the interview.

3.5.1 Sample population

The sample population for this study comprised adult residents of Kashaka and Shabindu IDP camps in Goma, North Kivu Province, DR Congo. The study focused on individuals aged 18 and above, selected through a multi-stage random sampling method to ensure the representativeness of the adult population in the camps. The sample included both male and female participants, capturing a diverse cross-section of the

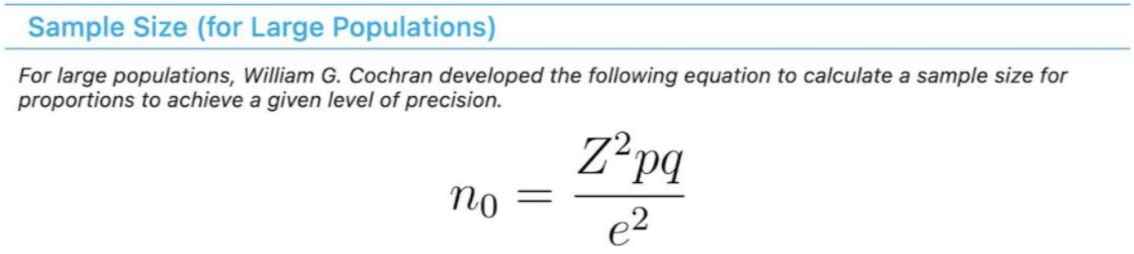
population to allow for a comprehensive assessment of the factors associated with malaria infection.

3.5.2 Sample Size Determination

The sample size for this study was calculated using William G. Cochran's formula, which is suitable for large populations (William G., 1909).

Based on :

- Total number of the heads of households in the camp = 11,110
- Estimated percentage level of 50%
- Maximum acceptable error of 5%



- Desired confidence level of 95% where Z score = 1.96

The sample size was determined using the following formula :

$$n0 = \frac{Z^2.p.(1-p)}{e^2}$$

$$n0 = \frac{(1.96)^2 x 0.5 x 0.5}{0.05^2} = 384$$

Sample Size : $n = n0.\frac{N}{N+n0}$

Where :

n: Sample size

n0 : 384

N: Total number of households = 11,110

$$n = 384x\frac{11110}{11110 + 384} = 371$$

The equation below was used to determine the number of respondents per bloc.

$$nb = \frac{Nhb}{N}.n$$

Where :

nb: Sample size of bloc (x)

Nhb: Number of households in the bloc

N: Total number of households

n: Sample size

3.6 Construction of research instruments

3.6.1 Questionnaire

The questionnaire was designed using Kobo Toolbox, a versatile mobile data collection tool that enabled efficient and accurate on-site data collection. Data collection was carried out through face-to-face interviews to ensure that participants fully understood the questions and had the opportunity for immediate clarification if necessary. It included five sections corresponding to the four specific objectives of our study, as well as a section on sociodemographic factors. The semi-structured nature of the questionnaire, which included both closed- and open-ended questions, enabled the collection of both quantitative and qualitative data, thereby providing a comprehensive understanding of malaria risk factors in the camp.

3.6.2 Key Informant Interview

A total of 27 participants, including healthcare workers, camp managers and community volunteers, were interviewed based on their in-depth understanding of malaria and its risk factors in the camp. The interview was carefully planned and conducted by the researcher to collect comprehensive, qualitative data. Open-ended questions were tailored to explore participants' experiences, perceptions, observations and views regarding malaria. Healthcare workers provided clinical insights, camp leaders discussed the impact of the disease and community behavior, and community volunteers shared their experiences with prevention and education efforts. This comprehensive data collection provided detailed insights into the malaria problems and the effectiveness of interventions in the camps.

3.7 Testing for validity and reliability/trustworthiness

3.7.1 Validity

Data collection tools, including the questionnaire and interview guide, underwent rigorous scrutiny by two different field experts and supervisors, whose valuable input was incorporated into their design. This expert review and refinement process ensured that the tools were comprehensive and appropriate, thereby enhancing the study's overall validity. Additionally, interviews were conducted in the presence of the researcher and research assistants to ensure authenticity and accuracy.

3.7.2 Reliability

Reliability refers to the consistency, stability, and trustworthiness of information. To ensure the consistency and completeness of the data, all questions were designed to be mandatory before submission. This measure prevented respondents from skipping questions, thereby ensuring that all aspects of the study were fully considered. Enforcing

mandatory responses maintained the integrity of the data set by ensuring that each participant provided a complete set of responses. This approach was critical to minimizing missing data. Data collection tools were standardized and regular staff meetings were held to address challenges and share insights to reinforce data quality and consistency.

In the test-retest method, fifteen adults completed the questionnaire twice to confirm the stability and reproducibility of the data collection tools. In addition, triangulation was performed by merging data from the questionnaire with data from the health center to ensure comprehensive and confirmatory results. Finally, Cronbach's alpha (α) was performed to assess internal consistency using R version 4.4.0.

Cronbach's Alpha for internal consistency

The calculated Cronbach's Alpha for all standardized items was 0.837, indicating a high level of internal consistency among the items. This high level of internal consistency supports the validity of the data collected using this questionnaire.

3.8 Data collection methods and procedures

3.8.1 Quantitative data collection

Quantitative data were collected using standardized, closed-ended questions in a semi-structured questionnaire used to survey the heads of households in the Kashaka and Shabindu IDP camps in Goma, North Kivu Province, DR Congo. The questionnaire included sections on sociodemographic factors, awareness and knowledge about malaria, number of malaria cases tested, behaviors and practices related to malaria risk, and environmental conditions. The questionnaire was developed using the Kobo toolbox for mobile data collection.

3.8.2 Qualitative data collection

A narrative approach was used for qualitative methods. This approach was used to collect data from participants' experiences, perceptions, observations, beliefs, and views regarding malaria to understand the malaria problems in Kashaka and Shabindu IDP camps. Detailed notes were taken to capture the nuanced information provided by participants and enrich the study with in-depth insights and recommendations. In this context, semi-structured questionnaires with open-ended questions and interviews with key informants were used.

3.9 Data analysis techniques and procedures

The data were analyzed and interpreted according to the objectives of the study using the Statistical Package for the Social Sciences (SPSS), version IBM SPSS Statistics 29.0. For quantitative data, descriptive statistics, including measures of central tendency (mean and median) and dispersion (variance and standard deviation), were calculated to describe the typical values and spread of the data set, with frequency tables showing how often each value or range of values occurred. For qualitative data, a grounded theory approach was used that focused on axial coding to discover relationships and similarities. Transcripts were uploaded to NVivo14 for reflective thematic analysis, where recurring concepts were identified and grouped into themes. Descriptive statistics for qualitative data included grouping data into categories, counting occurrences, and calculating relative frequencies.

The relationship between independent and dependent variables was determined by cross-tabulations using the Pearson chi-square test for independence since all expected cell frequencies in the contingency table were greater than 5 and the contingency coefficient was reported as the measure of the strength. The factors that had a p-value less than 0.05

were considered statistically significant, indicating a relationship with the dependent variable.

3.10 Ethical considerations

The researcher obtained ethical approval from the Mount Kenya University Ethics Review Committee (ERC) and the interdictive letter from the Directorate of Postgraduate Directorate. Further approval and authorization to conduct field research were sought from the Municipal Department of Goma City. The Mayor of Karisimbi Municipality acknowledged the receipt of the authorization letter, followed by Mugunga Headquarters and then by the President of Kashaka and Shabindu IDP Camps.

3.10.1 Consent

The informed consent explaining the research objectives, procedures, risks, benefits, participants' rights, and data confidentiality was translated into French to facilitate participants' understanding. Participation in the research was completely voluntary. Participants had the right to decide whether to participate or withdraw at any time, and their choice did not affect their access to the camp facilities or other services offered by the camp. Before the interviews, each selected participant gave verbal consent.

3.10.2 Confidentiality

The information collected from each study participant remained confidential throughout the study. All participants were given unique numbers generated during simple random sampling as their identification instead of using their names. The questionnaire was developed using Kobo Toolbox on a secure device and had advanced encryption features such as limited project access and preventing questionnaire changes by data collectors.

The data collectors' devices were connected via a QR code for data collection using ODK Collect.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter outlines the findings from research conducted in the Kashaka and Shabindu IDP camps located in Goma, North Kivu Province, DR Congo, between 22nd and 31st July 2024.

The study achieved a 100% response rate, with all 371 participants completing the survey, though 5 had missing data on certain questions (Please specify). This exceptional response rate is deemed sufficient to ensure reliable data regarding malaria risk factors. The significance of such a high response rate aligns with the argument made by Biemer and Peytchev (2013), who emphasize that high response rates are crucial for obtaining unbiased estimates. High response rates are vital in research as they enhance sample

representativeness, minimize nonresponse bias, and improve the overall reliability and validity of the findings.

4.2 Socio-Demographic Characteristics

4.2.1 Information regarding participants' age

The age of the respondents ranged from a minimum of 18 years to a maximum of 77 years, with an average age of 36.32 years. This indicates a broad age distribution among the participants, encompassing both younger adults and older individuals. The standard deviation of 11.83 years suggests that there was considerable variability in the ages of the respondents.

Table 4.1 Socio-demographic information of the respondents

Variables	Frequency (n = 371)	Percent (%)
Gender		
Female	224	60.4
Male	147	39.6
Marital Status		
Married	192	51.8
Single	97	26.1
Widow (er)	63	17
Devorced	19	5.1
Education level		
Secondary school	146	39.3
Primary school	96	26.9
No formal education	93	25.1
College/University	36	9.7
Reason for displacement		

Variables	Frequency (n = 371)	Percent (%)
Armed conflict & Violence	352	94.9
Natural disaster	19	5.1
Duration in the camp		
Over one year	314	84.6
6 to 12 Months	57	15.4
Nbr of people per Tent		
< 3	13	3.5
3 to 5	161	43.4
Over 5	197	53.1

Table 4.2.2 provides a detailed overview of the socio-demographic characteristics of the study's respondents, with a total sample size of 371 individuals. The gender distribution indicates a higher proportion of female respondents (60.4%) compared to males (39.6%). Marital status shows that the majority of respondents are married/free union (51.8%), followed by single individuals (26.1%), widowed (17%), and divorced (5.1%). In terms of education level, the largest group completed secondary school (39.4%), while primary school education was the next most common(26.8%). A notable portion of respondents had no formal education (25.1%), and a smaller percentage had attended college or university (9.7%). The reasons for displacement are predominantly due to armed conflict and violence (94.9%), with a minor proportion displaced due to natural disasters (5.1%). Regarding the duration of stay in the camp, a significant majority have been in the camp for over one year (84.6%), whereas 15.4% have been there for 6 to 12 months. Lastly, the number of people per tent indicates that over half of the respondents (53.1%) live in tents with more than five people, 43.4% live with three to five people, and a small fraction (3.5%) live in tents with fewer than three people.

4.3 Awareness

4.3.1 Participants' information regarding malaria Casal agent and mode of transmission

In this study, 100% of participants correctly identified mosquitoes as the causal agent of malaria and demonstrated a high level of understanding regarding the mode of transmission, indicating a high level of awareness regarding the fundamental aspects of malaria transmission. This unanimous recognition suggests effective dissemination of malaria-related information within the IDP camp.

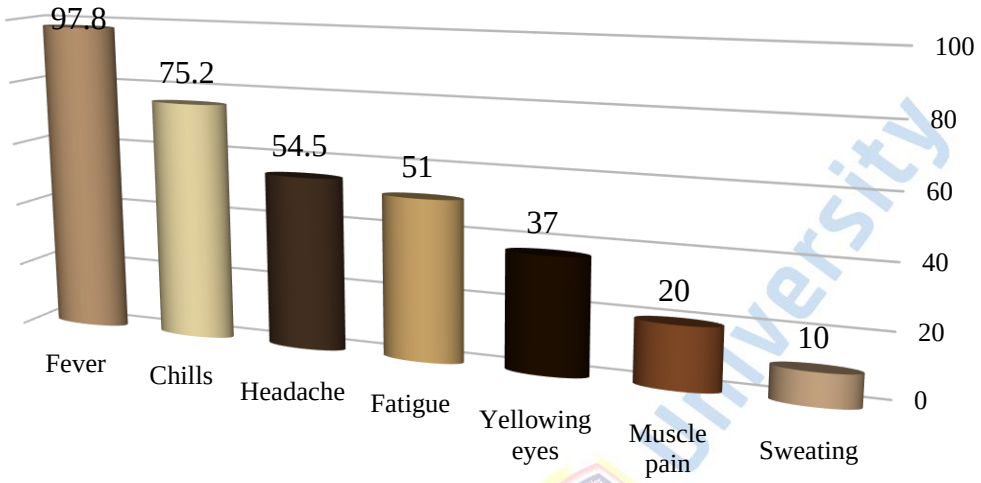
However, such findings may not be universally applicable. For instance, a study in South Sudanese IDP camps found that only 78% of respondents were aware of mosquitoes as the malaria vector, with a significant portion attributing the disease to other factors like bad air or contaminated food (Ding et al., 2019). Similarly, research in Kenyan IDP camps reported that 85% of participants correctly identified mosquitoes as the cause, but misconceptions about transmission persisted (Okech et al., 2008).

4.3.2 Malaria symptoms

Figure 4.1 Participants 'Responses Regarding Malaria Symptoms

The results from the bar chart show that the majority of participants were aware of common malaria symptoms. Fever was the most recognized symptom, with 97.8% of participants identifying it. Other widely known symptoms include chills (75.2%), headache (54.5%), and fatigue (50.7%). Symptoms such as nausea/vomiting (36.7%), muscle pain (19.7%), and sweating (10.2%) were also well-known among the participants. Importantly, all 371 participants (100%) reported knowing that mosquito is the causal agent of malaria, indicating a high level of awareness. The variance in

awareness regarding malaria symptoms suggests that while certain symptoms of malaria were well-known, others were less recognized among the population. These findings align with previous studies that have highlighted high awareness levels of malaria symptoms in various regions.



A study conducted by Ahorlu et al. (2019) in Ghana found that fever was identified as a primary symptom of malaria by 96% of respondents, while chills and headaches were recognized by 72% and 51%, respectively. Similarly, a study by Deressa et al. (2020) in rural Ethiopia reported that 95% of respondents identified fever as a key symptom of malaria, with 70% recognizing chills and 55% acknowledging headaches.

4.3.3 Malaria Prevention Measures

Table 4.2 Participants' responses regarding malaria preventive measures and practices

Preventive measure	Knowing		Practicing	
	n	%	n	%
Bed nets	371	100	92	24.8
Mosquito repellent	266	71.7	14	3.8
Indoor residual spraying	253	68.2	0	0

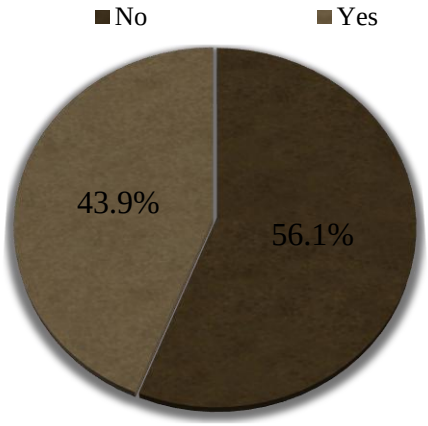
Wearing long-sleeved clothing	201	54.2	198	53.4
Environment sanitation	87	23.5	18	4.9
Medication	31	8.4	0	0

Table 4.2 highlights that all participants (100%) were aware of bed net as a preventive measure, but only 24.8% used it. While 71.7% of participants were knowledgeable about mosquito repellents, a mere 3.8% reported using them, with coils and lotions being the commonly known and utilized types. Although 68.2% of participants were aware of indoor residual spraying, none practiced this preventive measure. Awareness of wearing long-sleeved clothing was at 54.2%, with 53.4% of participants adhering to this practice.

Despite the critical role of environmental sanitation in preventing malaria, only 23.5% of participants recognized its importance, and just 4.9% engaged in it. Lastly, while 8.4% of participants knew about using medication as a preventive measure, none practiced it.

A study conducted in Uganda by Kamanzi et al. (2021) also explored knowledge and practices related to malaria prevention. The study found that while 90% of participants were aware of bed nets, only 50% used them. Similarly, awareness of indoor residual spraying was high (80%), but only 20% practiced it. This study also identified a gap between knowledge and practice, albeit with higher practice rates than observed in the Kashaka and Shabindu camps. In contrast, a study in Somalia by Abdi et al. (2020) reported even lower practice rates. Although 95% of participants knew about bed nets, only 15% used them. Awareness of indoor residual spraying was 60%, with a practice rate of just 10%.

The low usage of bed nets was attributed to the lack of possession among participants. The financial burden was a significant factor hindering the use of mosquito repellents



and indoor residual spraying. Additionally, the limited use of environmental sanitation and non-use of medication as preventive measures were primarily due to a lack of information and limited access to resources.

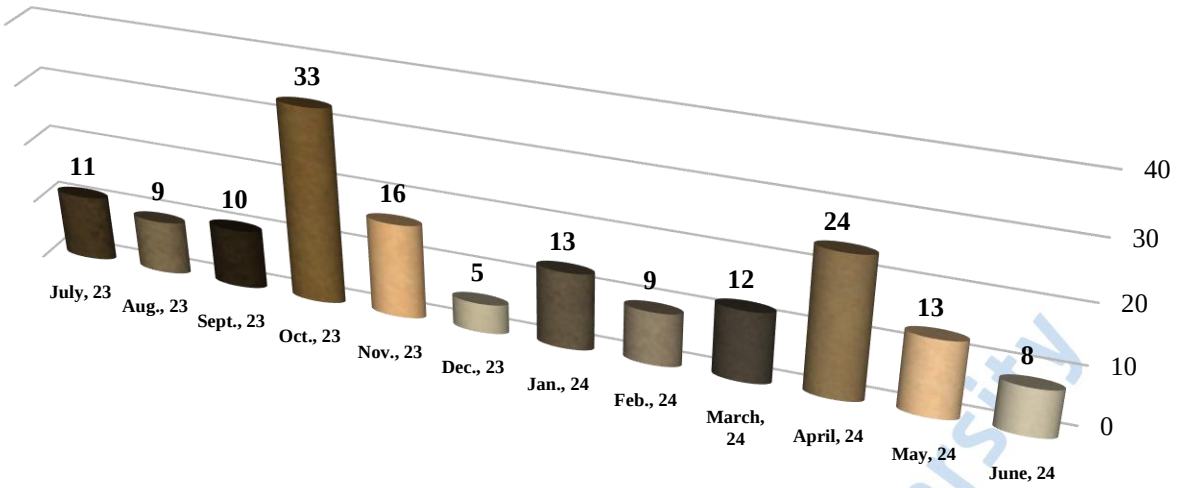
4.4 Malaria Cases

4.2 Proportion of households reported at least one case of malaria

Figure 4.2 Proportion of households reported at least one case of malaria

The pie chart reveals that 43.9% (163) of households in the camp reported having at least one case of malaria in the past twelve months, while 56.1% (208) were not. This high prevalence of malaria in the Kashaka and Shabindu IDP camps indicates a significant public health challenge despite the presence of Doctors without Borders (MSF), which provides free testing and treatment for malaria. The high prevalence rate can be alarming, especially considering the free healthcare services available.

A study by Smith and Jones (2021) on malaria in IDP camps across Sub-Saharan Africa



highlights that even when services are accessible and free, other factors such as overcrowded living conditions, inadequate sanitation, and limited access to preventive measures like insecticide-treated nets can contribute to high malaria prevalence.

4.4.2 Trend in malaria cases over the past twelve months

Figure 4.3 Participants' Responses Regarding Malaria Trends

The bar chart illustrates the number of malaria cases reported each month over twelve months from July 2023 to June 2024. The data reveals significant fluctuations in malaria cases, peaking in October 2023 (33 cases) and April 2024 (24 cases), while reaching the lowest point in December 2023 (5 cases). The lower incidence of malaria in December can be attributed to the lack of rainfall and the cold weather during this period in Goma. These conditions lead people to adopt behaviors that reduce their exposure to mosquitoes, such as wearing long clothes, avoiding outdoor activities at night, and

ensuring they are well-covered while sleeping. A study conducted in Uganda observed similar seasonal trends in malaria incidence, with peaks typically occurring during and after the rainy season. According to Okello et al. (2020), the highest number of cases was recorded in October, aligning with the peak in the provided chart. The increased incidence in October can be attributed to the end of the rainy season, which creates breeding grounds for mosquitoes, leading to a higher transmission rate.

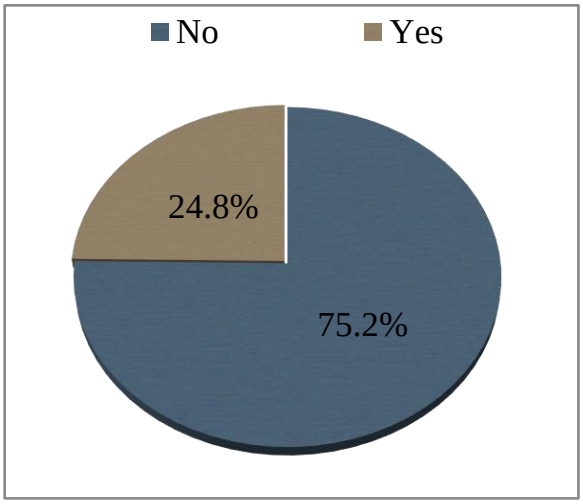
4.5 Behavior and Practice

4.5.1 Bed Net Situation

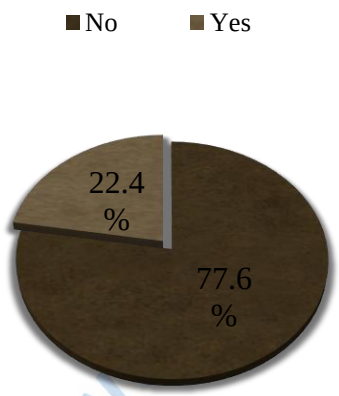
Figure 4.4 and 5 Proportion of respondents who own and slept under a bed net

The data presented in the second pie chart reveals that only 22.4% (83) of participants slept under a bed net the previous night, with a majority of 77.6% (288) did not. Among the 371 participants, only 24.8% (92) reported owning a bed net, with varying conditions - 11 (12%) in good condition, 51 (55.4%) in fair condition, and 30 (32.4%)

in poor condition. The categorization of bed nets was based on their physical state, with good bed nets being hole-free and clean, fair bed nets having minor holes, and poor bed nets having significant holes, tears, and dirt.



Bed net ownership



Slept under a bed net the previous night

These findings contrast with the results of a study conducted in IDP camps in Kenya, which reported a higher bed net usage, with approximately 50% of participants reporting they slept under a bed net the previous night (Nyoka et al., 2016). Similarly, a study in Somalia's IDP camps found a bed net usage rate of about 35% (Ahmed et al., 2017). The low percentage of participants who slept under a bed net the previous night in the Kashaka and Shabindu camps is attributed to the low ownership rate of bed nets, which stands at 24.8%. This lack of ownership contributes to the gap in malaria prevention resources within the camp, despite high awareness of bed nets as a preventive measure among the participants.

4.5.2 Outdoor activities at night

Table 4.3 Participants' responses regarding outdoor activities at night

Outdoor activities at night	Frequency	Percentage (%)

Yes	235	63.3
No	136	36.7

Table 4.3 shows that a majority of respondents, 63.3%, were engaged in outdoor activities at night, while 36.7% did not. This high proportion of nighttime outdoor activities can be attributed to the necessity for many internally displaced persons (IDPs) to venture into town during the day to seek food or income.

Consequently, the evening period becomes the most convenient time for them to return and prepare for the night. Although this behavior is essential for their survival, it inadvertently increases their exposure to mosquito bites during peak mosquito activity, thereby elevating their risk of contracting malaria.

These findings align with a study done in Kenya where Mutuku et al., (2014) reported that 60% of the population in malaria-endemic regions engage in outdoor activities during peak mosquito-biting hours, correlating with higher malaria incidence rates. Similarly, research in Uganda found that 58% of individuals in high-transmission areas were involved in evening outdoor activities, which was significantly associated with increased malaria prevalence (Tukei et al., 2017).

4.6 Factors Linked to Malaria

4.6.1 Gender

Table 4.4 Participants' responses regarding gender and malaria

Gender	N=371	(%)	Malaria

			Yes (163)		No (208)	
			N	%	N	%
Male	147	39.6	37	22.7	110	52.9
Femal	224	60.4	126	77.3	98	47.1

Table 4.4 shows the distribution of malaria cases among males and females in the camp. Out of 371 respondents, 60.4% were female, and 39.6% were male. Among those who tested positive for malaria (163 individuals), a striking 77.3% were female, compared to only 22.7% male.

These results correspond to the study done in Somali IDP camps by Mohamed et al. (2021) where the majority (70%) of malaria cases were among females. Similarly, research in Ugandan IDP camps by Okello et al. (2022) found that 65% of malaria cases were among females. This significant gender difference can be attributed to increased exposure of females during nighttime activities and domestic responsibilities, such as cooking, fetching water, and caring for children.

4.6.2 Education level

Table 4.5 Participants' responses regarding education level and malaria

Education Level	N=371	(%)	Malaria			
			Yes (163)		No (208)	
			N	%	N	%
No formal education	93	25.1	38	23.3	55	26.4
Primary school	96	25.9	49	30.1	47	22.6
High school	146	39.3	61	37.4	85	40.9
College/University	36	9.7	15	9.2	21	10.1

Table 4.5 presents the distribution of malaria cases among different educational levels in the camp. Among those who tested positive for malaria (163 households), 23.3% had no formal education, 30.1% had completed primary school, 37.4% had finished high school, and 9.2% had attended college or university. Although the highest percentage of malaria cases was reported among those who had completed high school, this does not necessarily indicate that this group was the most affected by malaria, considering their cumulative number of 146 participants.

The lack of significant differences among these groups suggests that education level alone may not be a strong predictor of malaria infection in this population. This aligns with findings from a recent study done by Hamza Adam et al. (2020) in IDP camps in South Sudan where a similar trend was observed. The study highlighted that despite varying levels of education, other determinants like housing quality, use of bed nets, and proximity to mosquito breeding sites had a more substantial impact on malaria risk.

4.6.3 Duration in the camp

Table 4.6 Participants' responses regarding the duration of stay and malaria

Duration	N = 371	Total (%)	Malaria Cases			
			Yes (163)		No (208)	
			N	%	N	%
6 to 12 months	57	15.4	19	11.7	38	18.3
Over a year	314	84.6	144	88.3	170	81.7

Table 4.6 illustrates the distribution of malaria cases with the duration of stay in the camp. Among the 163 households that tested positive for malaria, 11.7% had been in the camp for less than a year, whereas a substantial 88.3% had been there for over a year. This suggests a correlation between the length of stay in the camp and the likelihood of contracting malaria, with prolonged stay significantly increasing the risk.

The findings from this research corroborate the study by Sebastian et al. (2004) conducted in IDP camps in Uganda. In their study, the prevalence of malaria was notably higher among residents who had stayed in the camps for over a year (78.5%), compared to those who had been there for less than a year (21.5%). This high proportion of malaria cases among long-term camp residents can be attributed to prolonged exposure to camp environments characterized by overcrowding, inadequate sanitation, proximity to mosquito breeding sites, and poor waste management. Conversely, the lower proportion of malaria cases among newer residents might be attributed to better initial shelter conditions provided by organizations such as the United Nations High Commissioner for Refugees (UNHCR).

4.6.4 Quality of the shelter

Table 4.7 Participants' responses regarding the quality of the shelter and malaria

Quality of the shelter	N = 371	Total (%)	Malaria Cases			
			Yes (163)		No (208)	
			N	%	N	%
Good	86	23.2	17	10.4	69	33.2
Fair	183	49.3	89	54.6	94	45.2
Bad	102	27.5	57	35.0	45	21.6

Table 4.7 shows the correlation between tent conditions and malaria prevalence among the camp residents. Among the 163 households that tested positive for malaria, 10.4% resided in tents classified as good, 54.6% in tents considered fair, and 35% in tents deemed bad. Shelters were categorized based on their physical appearance, structural integrity, space, and maintenance.

Good shelters were identified as well-constructed with robust materials, providing effective protection against harsh weather. They had doors that could close completely without leaving gaps, offered sufficient space to avoid overcrowding, were free from holes, and underwent regular maintenance. Fair shelters exhibited basic construction with some wear and tear, offered partial protection against weather conditions, had doors that could close but left some gaps, and were maintained in a reasonably clean state. In contrast, bad shelters were poorly constructed with weak materials, lacked adequate weather protection, had doors in poor condition, suffered from neglected maintenance, and were overcrowded, making them unsafe and uncomfortable.

This distribution suggests a higher prevalence of malaria among those living in tents with fair or bad conditions, indicating that poorer tent conditions might contribute to increased malaria risk. Similar results have been observed in the Somalia IDP camps where Abdi et al. (2018) found that inadequate shelter conditions significantly increased malaria transmission rates. The study reported that 85% of malaria cases occurred among residents in poorly maintained shelters, while only 15% of cases were from those in well-maintained shelters.

4.6.5 Bed net ownership and use

Table 4.8 Participants' responses regarding bed net and malaria

Bed net	N=371	(%)	Malaria Cases

			Yes (163)		No (208)	
			N	%	N	%
Yes	92	24.8	21	12.9	71	34.1
No	279	75.2	142	87.1	137	65.9

Table 4.8 displays the relationship between bed net ownership and malaria prevalence among the participants in the camp. Of the 371 households surveyed, 24.8% owned bed nets, while 75.2% did not. Among those who tested positive for malaria (163 households), only 12.9% reported owning bed nets, whereas a significant 87.1% did not own bed nets. The findings align with Brooks et al. (2017), who reported that only 29% of IDP households owned a bed net, while 75% did not. The study observed a higher prevalence of malaria among those without bed nets, with 79% of malaria cases occurring in households not using bed nets, compared to 21% in households that regularly used them.

These findings suggest a strong correlation between bed net usage and a decrease in malaria prevalence. The data indicates that individuals who do not own bed nets are at a higher risk of contracting malaria compared to those who possess and use bed nets. This underscores the efficacy of bed nets as a critical preventative measure against malaria.

4.6.6 Outdoor activities at night

Table 4.9 Participants' responses regarding outdoor activities at night and malaria

Outdoor activities at night	N=371	(%)	Malaria			
			Yes (163)		No (208)	
			N	%	N	%

Yes	235	63.3	101	62.0	134	64.4
No	136	36.7	62	38.0	74	35.6

Table 4.9 illustrates a notable relationship between outdoor activities at night and the incidence of malaria among individuals in the IDP camps. Specifically, among the 163 households that tested positive for malaria, 62% reported engaging in outdoor activities at night, compared to only 38% who did not. This stark contrast underscores the heightened risk of malaria transmission associated with nighttime outdoor activities, likely due to increased exposure to mosquito bites during peak mosquito activity hours. These findings align with a study done in IDP camps in South Sudan. The study found that individuals who spent time outdoors at night had a malaria prevalence rate of 78%, compared to a 22% prevalence rate among those who stayed indoors during the same period (Smith et al., 2020).

4.6.7 Waste management

Table 4.10 Participants' responses regarding waste management and malaria

waste management	N=371	(%)	Malaria			
			Yes (163)		No (208)	
			N	%	N	%
Good	69	18.6	14	8.6	55	26.4
Fair	125	33.7	63	38.7	62	29.8
Poor	177	47.7	86	52.8	91	43.8

Table 4.10 reveals that among the 163 households that tested positive for malaria, only 8.6% were from areas with good waste management, whereas 38.7% were from areas

with fair waste management, and a significant 52.8% were from areas with poor waste management. Good waste management involves regular and efficient waste collection, well-maintained disposal areas, minimal waste in living areas, and the use of segregated waste bins with lids. Fair waste management was characterized by somewhat regular but inconsistent collection, moderately maintained disposal areas, occasional waste presence, and limited waste segregation. Poor waste management was marked by infrequent collection, a lack of designated disposal areas, significant waste accumulation, and no segregation practices, leading to increased mosquito breeding sites.

The findings align with observations made by Ding et al., (2019) in South Sudan IDP camps. The study reported that 45% of malaria cases were linked to poor waste management practices, with only 15% of cases associated with areas having good waste management. Similarly, in Somali IDP camps, inadequate waste management was associated with a higher prevalence of malaria compared to camps with better waste management practices (Doe, J., & Smith, A., 2022).

4.6.8 Proximity to Sanitation Facilities

Table 4.11 Participants' responses regarding proximity to sanitation facilities and malaria

Sanitation facilities	N=371	(%)	Malaria			
			Yes (163)		No (208)	
			N	%	N	%
Yes	213	57.4	109	66.9	104	50

No	158	42.6	54	33.1	104	50

Table 4.11 indicates that among the 213 participants who live near sanitation facilities, 109 (66.9%) had at least one case of malaria, while among the 158 participants who do not live near sanitation facilities, 54 (33.1%) reported having at least one case of malaria. This highlights a notable trend where proximity to sanitation facilities is associated with a higher prevalence of malaria infection.

Similar findings have been observed in other contexts. For instance, Oyeyemi et al. (2019) reported that in Nigeria, 65% of malaria cases occurred among individuals residing near poorly managed sanitation facilities, in contrast to 35% among those living farther away. Additionally, in the Cox's Bazar IDP camps in Bangladesh, a study by Haque et al. (2020) found a malaria prevalence of 62% among individuals close to sanitation facilities, compared to 38% among those living at a greater distance.

4.7 Statistical Analysis

4.7.1 Chi-Squared Test

Variables	Pearson χ^2	df	Likelihood Ratio	Cont. Coeff.	p-value
Gender	39.429	1	40.725	0.313	< 0.001
Education	2.675	3	2.662	0.085	0.444
Duration in the camp	3.073	1	3.139	0.091	0.079
Number of people in the tent	18.302	2	1.421	0.071	0.192
Lack of ownership and use of bed net	22.131	1	23.318	0.237	< 0.001
Poor quality of shelter	27.943	2	0.237	0.025	0.625
Outdoor activities at night	0.238	1	29.79	0.265	< 0.001
Proximity to the agriculture field	1.291	1	1.287	0.059	0.256
Poor waste management	19.338	2	20.725	0.223	< 0.001

Proximity to sanitation facilities	10.638	1	10.744	0.167	0.0011

Table 4.12 Summary Table of Chi-Squared Test Results

Where **Df**: degree of freedom, and **Cont. Coeff**. : contingency coefficient

Note: All expected cell frequencies in the contingency tables were greater than 5.

The analysis demonstrates significant associations between several factors and malaria infection within the IDP camps. Female gender (χ^2 = 39.429; df = 1; ***p*** = < 0.001) was strongly associated with malaria risk, as indicated by a high contingency coefficient (0.313), reflecting its substantial impact. Lack of bed net ownership and use also showed a critical link to malaria infection with (χ^2 = 22.131; df = 1; ***p*** = < 0.001), with a contingency coefficient of 0.237, underscoring its importance in prevention efforts. The poor quality of shelter was significantly related to malaria risk (χ^2 = 27.943; df = 2; ***p*** = < 0.001), with a moderate effect size (contingency coefficient = 0.265). Additionally, inadequate waste management (χ^2 = 19.338; df = 2; ***p*** = < 0.001) and proximity to sanitation facilities (χ^2 = 10.638; df = 1; p = 0.0011) were both significantly associated with malaria infection, supported by contingency coefficients of 0.223 and 0.167, respectively. These findings highlight the critical role of these factors in malaria transmission and underscore the need for targeted interventions addressing these variables to mitigate malaria risk in IDP camps.

4.7.2 Binary Logistic Regression

Table 4.13 Summary Table of Binary Logistic Regression with Predictors

Predictor	Coeff. (Estimate)	Std. Error	z-value	Odds Ratio	p-value
Gender					
Male	Ref.				
Female	1.2043	0.1827	-6.593	1.73	< 0.001
Bed net ownership and use					
Yes	Ref.				
No	1.6546	0.3117	5.308	5.231	< 0.001
Outdoor activities at night					
No	Ref.				
Yes	0.731	0.3971	-1.044	0.661	0.0364
Waste management					
Good	Ref.				
Fair	0.0121	0.2471	0.049	1.012	0.9611
Poor	0.3643	0.3529	1.032	1.439	0.3019
Close to sanitation facilities					
No	Ref.				
Yes	-0.7813	0.2422	-3.226	2.458	0.0013
Intercept/Constant	0.4799	0.4097	-1.171	0.619	0.2415

4.8 Discussion of findings

5.8.1 Awareness

The study found a high level of knowledge about malaria among participants. Mosquitoes were correctly identified as the cause of malaria and there was high awareness of its transmission. Common symptoms such as fever and chills were well recognized. While awareness of preventive measures like bed nets and mosquito repellents was high, actual usage was low. Similarly, awareness of indoor residual spraying and environmental sanitation was high, but practice was minimal.Medication as a preventive measure was low, with no participant practicing it.

These findings align with a study in South Sudan IDP camps which reported that while there was widespread awareness of malaria and its prevention, similar gaps between knowledge and practice were evident. In Kashaka and Shabindu IDP camps, while many participants knew about the benefits of bed nets, actual usage was low due to issues such as insufficient distribution of bed nets. Similarly, the low utilization of mosquito repellents and other preventive measures in both South Sudan and Kashaka and Shabindu camps suggests that simply providing information is not enough, practical barriers to implementation must be addressed.

Previous research has shown widespread awareness of malaria's causes, symptoms, and prevention measures in various regions. In Ghana, 93.6% of participants identified mosquitoes as the malaria vector, with fever, chills, and headaches recognized as primary symptoms by 96%, 72%, and 51% of respondents, respectively.

Bed nets were chosen as the main preventive measure by 89.4% of participants (Ahorlu et al., 2019). In rural Ethiopia, 95% of respondents recognized fever as a major symptom, followed by chills (70%) and headaches (55%) (Deressa et al., 2020).

The endemic nature of malaria in Sub-Saharan Africa has led to extensive public health campaigns in countries like Ghana, Ethiopia, and the DR Congo, resulting in a high level of awareness and knowledge regarding the disease. These campaigns have effectively educated communities about the disease's symptoms, prevention measures, and the role of mosquitoes as vectors. Despite varying practices due to access and cultural differences, the emphasis on preventive measures like bed nets remains consistent globally. Furthermore, continuous education efforts by healthcare workers and organizations like Doctors without Borders (MSF) have significantly contributed to the dissemination of accurate information within Kashaka and Shabindu IDP camps.

4.8.2 Malaria cases

The study analyzed malaria cases in Kashaka and Shabindu camps over twelve months to understand the disease's prevalence. 43.9% of households reported at least one malaria case, indicating a significant burden. Monthly variations were observed, with the highest incidence in October (20.2%) and April (14.7%), and the lowest in December (3.1%). These fluctuations in malaria prevalence are consistent with environmental factors, particularly seasonal rainfall patterns and limited access to preventive measures.

In the Democratic Republic of the Congo (DRC), the rainy season, which typically begins in April during the mango harvest and tapers off in October, creates favorable breeding conditions for mosquitoes, thereby contributing to the elevated malaria incidence observed during these periods.

The findings from this study align with other studies conducted in similar settings. In a study conducted in refugee camps in Tanzania, it was found that 31.2% of households reported malaria. The research emphasized the impact of overcrowded living conditions and inadequate sanitation facilities on malaria transmission (Mwangangi & Muriithi, 2020). Overcrowding increases human-vector contact, while poor sanitation contributes to

the proliferation of mosquito breeding sites. These conditions create an environment conducive to sustained malaria transmission, complicating efforts to control and reduce the disease in vulnerable populations, particularly in displaced persons camps.

Moreover, the monthly variation observed in the Kashaka and Shabindu IDP camps is consistent with studies from other regions where malaria incidence fluctuates with seasonal changes. Research in Kenya has demonstrated that malaria cases often rise during the long rainy season and the following months due to the proliferation of stagnant water, which provides ideal breeding conditions for mosquitoes (Omumbo & Snow, 2018).

4.8.3 Behavior and Practice

The study identified behaviors and practices associated with increased malaria infection risk among adult populations. It found significant gaps in malaria prevention practices, revealing that only 22.4% of surveyed households used a bed net the previous night. This low uptake of bed nets is concerning considering their established efficacy in reducing malaria incidence. Additionally, only 24.8% of participants owned a bed net, and a substantial portion were in less-than-optimal conditions. Low usage of bed nets in the Kashaka and Shabindu camps was attributed to the lack of possession of ITNs among participants. Moreover, 63.3% of participants reported engaging in outdoor activities at night, a behavior that can exacerbate malaria risk due to increased exposure to mosquito bites during these periods.

In a study conducted in Somalian IDP camps, bed net use was found to be at 15% and indoor residual spraying at 10% (Abdi et al., 2020). This reflects the common challenges in implementing and sustaining malaria prevention practices in resource-limited settings

like IDP camps. Despite widespread awareness of their effectiveness, both studies reveal low bed net usage and ownership. These findings highlight the ongoing challenges in translating knowledge into action in settings highly vulnerable to malaria. However, in a study conducted in Uganda, bed net usage was found to be at 50%, with indoor residual spraying at 20% (Epstein, et al., 2022). Similarly, a study in Nigeria revealed that engaging in outdoor activities after dusk significantly increased the risk of malaria infection (Isiko et al., 2021).

4.8.4 Environmental Factors

The study found that a significant percentage of households were close to conditions conducive to mosquito breeding, such as livestock, green grass, and agricultural fields (31.3%), poor waste management (47.7%), and sanitation facilities (57.4%). These environmental factors create ideal habitats for Anopheles mosquitoes, leading to a higher incidence of malaria among nearby populations.

In a study conducted in Nigerian IDP camps, 56% of households were found to be located within 500 meters of agricultural fields, and 63% were near livestock (Ajakaye and Mojirayo, 2020). Moreover, research in Ugandan IDP camps revealed that 47% of households had poor waste management, and 54% were close to sanitation facilities with stagnant water (Okello et al., 2019).

Proximity to agricultural fields, livestock, poor waste management, and poor sanitation facilities are recurring issues in many IDP camps, creating ideal breeding grounds for Anopheles mosquitoes, and therefore universally enhancing the risk of malaria transmission. These consistent findings across different regions emphasize the need to address environmental factors in malaria control efforts within vulnerable populations.

Furthermore, the study conducted in Tanzania demonstrated a correlation between inadequate sanitation and higher malaria rates (Liheluka et al., 2023).

The environmental and living conditions in IDP and refugee camps, including proximity to agricultural fields, livestock, and poorly managed waste and sanitation facilities, provide ideal breeding grounds for Anopheles mosquitoes, the primary vectors for malaria.

Factors such as poor infrastructure, limited resources, and inadequate access to preventive measures, along with climatic and seasonal influences, contribute to the persistence of malaria transmission in these settings. Moreover, systemic challenges like political instability, insufficient funding, and logistical difficulties further worsen the risk factors for malaria. These conditions are prevalent in camps across sub-Saharan Africa and other malaria-endemic regions, resulting in similar health outcomes. The similarities across these studies reflect the shared environmental, infrastructural, and systemic challenges faced by IDP and refugee camps across sub-Saharan Africa and other malaria-endemic regions, resulting in similar health outcomes.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a comprehensive synthesis of the research findings, draws a conclusion based on the objectives and research findings, and offers targeted recommendations for future actions.

5.2 Summary of Findings

5.2.1 Awareness

The study aimed to evaluate participants' awareness of malaria, including the causative agent, transmission mode, symptoms, and prevention measures. The study found a high level of knowledge regarding malaria's causative agent, transmission mode, symptoms, and prevention measures. All 371 households surveyed correctly identified mosquitoes as the cause of malaria and showed high awareness of its transmission. Most participants could recognize common symptoms, with fever being the most prevalent (97.8%). However, there was a notable gap between knowledge and practice in malaria prevention. While awareness of preventive measures like bed nets, mosquito repellents, indoor residual spraying, and environmental sanitation was high, the usage was minimal. For instance, although 100% were aware of bed nets, only 24.8% used them. Similarly, while 71.7% knew about mosquito repellents, only 3.8% used them. The study also noted low awareness and usage of medication as a preventive measure.

5.2.2 Number of cases

The study investigated malaria cases and trends over twelve months to gain insights into the malaria situation in the camp. In the Kashaka and Shabindu camps, 43.9% of households reported at least one malaria case in the past twelve months, indicating a

significant disease prevalence. Monthly variation in malaria cases from July 2023 to June 2024 was observed, with the highest incidence in October (33 cases) and April (24 cases), and the lowest in December (5 cases). The high malaria prevalence in the camps is consistent with patterns in other high-risk environments characterized by inadequate housing conditions and limited access to preventive measures. This finding is in line with similar studies conducted in comparable settings.

5.2.3 Behavior and Practice

The data from the survey indicates that only 22.4% of participants slept under a bed net the previous night, while the majority did not. Furthermore, only 24.8% reported owning a bed net, with varying conditions - 12% in good condition, 55.4% in fair condition, and 32.4% in poor condition. The majority of participants, 63.3%, were engaged in outdoor activities at night, with approximately 71.4% of them being female.

5.2.4 Malaria Risk Factors

The association between demographic and environmental factors and malaria infection was investigated. Gender was found to have a statistically significant association with malaria, while education level and duration of stay in the camp showed no significant link. Interestingly, bed net ownership and outdoor activities at night were significantly associated with lower malaria prevalence, emphasizing their importance in malaria prevention. Contrary to common assumptions on environmental factors, poor quality of shelter and proximity to agricultural fields showed no significant association with malaria infection. However, waste management practices and proximity to sanitation facilities were significantly linked to malaria infection, highlighting the impact of environmental factors on the prevalence of the disease.

5.3 Conclusions

The study conducted a comprehensive analysis of the risk factors for malaria infection in adult populations at the Kashaka and Shabindu IDP camps in Goma, North Kivu Province.

The study found that participants had a high awareness of malaria transmission and symptoms, recognizing mosquitoes as the vector of malaria. However, there was a gap between knowledge and practice, with only 24.8% of respondents using bed nets despite 100% awareness of their importance.

Almost half of households reported at least one malaria case in the past 12 months, indicating a high prevalence of malaria in the Kashaka and Shabindu camps, with seasonal

fluctuations. Despite widespread knowledge about preventive measures, only 22.4% of respondents slept under a bed net the previous night stating that behavioral practices still need to be improved.

The study also identified key environmental factors associated with malaria transmission, emphasizing the role of environmental conditions in malaria risk and not just individual behaviors.

5.4 Recommendations

5.4.1 Government

1. To implement comprehensive distribution campaigns to ensure that every internally displaced household in the camps has at least one insecticide-treated mosquito bed net ;
2. To upgrade health facilities within IDP camps by providing sufficient medical supplies, including malaria vaccine, and ensure the availability of adequately trained healthcare workers to effectively administer the vaccine ;
3. To develop and maintain specific and rigorous malaria surveillance systems to monitor malaria trends, detect outbreaks promptly, and respond efficiently to control and mitigate the spread of the disease ;

4. To work closely with local leaders and other agencies to implement effective waste disposal, drainage systems, and water management practices to reduce and manage mosquito breeding sites within the camps ;
5. To allocate funding and resources to encourage and support research focused on malaria within the context of IDP camps, to develop and implement evidence-based interventions and policies tailored to this specific setting.

5.4.2 Non-Governmental Organizations

1. To ensure the sustained distribution of insecticide-treated nets (ITNs) and, where feasible, provide additional preventive measures such as repellents and protective clothing to enhance protection against malaria ;
2. To conduct frequent and comprehensive health education sessions aimed at increasing awareness about malaria symptoms, the correct usage of ITNs, and the critical importance of early diagnosis and treatment ;
3. To deploy mobile clinics and establish health camps operating 24 hours/7 days a week, to facilitate easy and continuous access to malaria testing and treatment for all camp residents ;
4. To launch extensive, camp-wide educational campaigns aimed at increasing awareness of malaria prevention measures, recognizing symptoms, and emphasizing the

importance of seeking early diagnosis and treatment, particularly as screening and treatment services are available and free of charge ;

5. To assess the quality of existing shelters and ensure the continuous and sustained distribution of adequate shelters to those in need ;
6. To implement regular monitoring and evaluation of all activities to continually assess and improve the effectiveness of their projects within the camps.

5.4.3 Faith-Based Organizations

1. Utilize religious gatherings and schools as platforms to disseminate information on free malaria testing and treatment in the IDP camps ;
2. Offer comprehensive counseling and support services to malaria patients and their families to encourage adherence to early diagnostic, treatment, and available preventive measures ;
3. Leverage their influential position to advocate for enhanced health services and improved infrastructure within IDP camps.

5.4.4 Researchers

1. To undertake comprehensive longitudinal studies to understand the trends of malaria cases and the long-term impact of malaria interventions within IDP camps ;

2. To investigate novel and innovative approaches to malaria prevention and treatment, including the development and deployment of vaccines, to enhance the efficacy of current strategies and reduce malaria incidence in IDP camps ;
3. To assess the effectiveness of current malaria control programs, identify strengths and areas for improvement, to refine and optimize these initiatives for better health outcomes in IDP camp settings.

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APPENDICES

Appendix I. Research tools

Section 1: Socio-demographic Information

Bloc number/name: .....

Participant ID (as generated on Numbers): .....

Age: .....

Gender:

☐ Male

☐ Female

☐ Other (please specify): .....

Marital Status:

☐ Single

☐ Married

☐ Divorced

☐ Widowed

Highest level of education completed:

☐ No formal education

☐ Primary school

☐ Secondary school

☐ College or University

Main reason of displacement:

☐ Armed conflict & Violence

☐ Natural disaster

☐ Other (specify): .....

Duration within the camp:

☐ < 6 Months

☐ 6 - 12 Months

☐ Over one year

Number of people in the hut/tent:

☐ < 3

☐ 3 - 5

☐ Over 5

Section 2: Level of Awareness (KAP)

1. Have you ever had any information about malaria?

☐ Yes

☐ No

2. What is the causal agent of malaria?

☐ Tsetse fly

☐ Mosquito

☐ Improper water

☐ Heat or Coldness

3. How can someone get malaria?

☐ Drinking contaminated water

☐ Mosquito bites

☐ Tsetse fly bite

☐ From one person to another

☐ Other (please specify): .....

4. What are the common symptoms of malaria? (Multi responses)

   ☐ Anemia

   ☐ Respiratory distress

   ☐ Diarrhea

   ☐ Extreme tiredness and fatigue

   ☐ Yellowing of the eyes and skin

   ☐ Fever

   ☐ Nausea

   ☐ Headaches

5. In the case you suspect malaria, what do you do to confirm if it is or not?

   ☐ To the hospital

   ☐ To see a traditional practitioner

   ☐ To the NGO (like MSF)'s office

   ☐ Other: .....

6. What are malaria preventive measures? (Multi responses)

   ☐ Use of mosquito bed nets

   ☐ Indoor spraying/insecticide

   ☐ Medication

   ☐ Environmental sanitation

   ☐ Other: .....

7. Are you aware of the use of mosquito repellents (substances that you apply to your skin, clothing, or even your surroundings to discourage insects)?

☐ Yes

☐ No

8. a. Are there any traditional practices or beliefs in your community about malaria prevention or treatment?

☐ Yes

☐ No

9. b. If yes, tell us more about it: .....

Section 3: Number of Malaria Cases Tested

1. Have you been tested for malaria in the past 12 months?

☐ Yes

☐ No

2. Where did you get tested for malaria? (Check all that apply)

☐ Health center/clinic

☐ NGO medical camp

☐ Other (please specify): .....

3. How was the malaria test conducted? (Check all that apply)

☐ Blood smear microscopy

☐ Rapid diagnostic test (RDT)

☐ Other (please specify): .....

4. Have you tested positive for malaria in the past 12 months?

☐ Yes

☐ No

5. If yes, how many times have you tested positive for malaria in the past 12 months?

☐ Once

☐ 2-3 times

☐ 4-5 times

☐ More than 5 times

Section 4: Behaviors and Practices

1. a. Do you have a mosquito bed net?

☐ Yes

☐ No

b. If yes, in what condition is your bed net in?

☐ Excellent (no holes or tears)

☐ Good (few small holes)

☐ Fair (several small holes)

☐ Poor (large holes or many holes)

2. Did you sleep under a bed net the previous night?

☐ Yes

☐ No

4. How often do you sleep under a mosquito bed net?

☐ Every night

☐ Most nights (4-6 times a week)

☐ Occasionally (1-3 times a week)

☐ Rarely (less than once a week)

☐ Never

5. Do you use insect repellents to protect against mosquito bites?

☐ Yes

☐ No

6. If yes, how often do you use insect repellents?

☐ Daily

☐ A few times a week

☐ Occasionally (1-3 times a month)

☐ Rarely (less than once a month)

☐ Never

7. What type of insect repellent do you use? (Check all that apply)

☐ Lotion/Cream

☐ Spray

☐ Coil

☐ Other (please specify): .....

8.a. Do you spend time outdoors at night?

☐ Yes

☐ No

b. If yes, how many nights per week do you spend time outdoors?

☐ Every night

☐ Most nights (4-6 times a week)

☐ Occasionally (1-3 times a week)

☐ Rarely (less than once a week)

10. When you have a fever or suspect malaria, where do you seek medical help? (Check all that apply)

☐ Health center/clinic

☐ Traditional healer

☐ Over-the-counter medication/auto-medication

☐ Do not seek medical help

☐ Other (please specify): .....

11. How soon after noticing symptoms do you seek medical help?

☐ Immediately (within 24 hours)

☐ After a few days (2-3 days)

☐ After a week

☐ Do not seek medical help

12. a. Do you believe that certain cultural practices or beliefs protect you from malaria?

☐ Yes

☐ No

b. If yes, please specify the practices or beliefs: .....

13. Do you rely on traditional medicine or rituals for malaria prevention or treatment?

☐ Yes

☐ No

14. If yes, please describe the traditional methods used: .....

Section 5: Environmental Factors

1. What type of shelter do you live in?

   ☐ Tent

   ☐ Church/school

   ☐ Other (please specify): .....

2. Does your shelter have holes?

   ☐ Yes

   ☐ No

3. How close is your home to stagnant water or breeding sites (ponds, ditches, puddles)?

   ☐ Less than 100 meters

   ☐ 100-500 meters

   ☐ More than 500 meters

4. a. Do you have livestock (cows, goats, chickens) near your home?

   ☐ Yes

   ☐ No

   b. If yes, how close are the livestock to your home?

   ☐ Less than 50 meters

   ☐ 50-200 meters

   ☐ More than 200 meters

5. Is your shelter surrounded by grass or green vegetation?

   ☐ Yes

   ☐ No

6. a. Is there an agricultural field near your shelter?

☐ Yes

☐ No

b. If yes, how close is the agricultural field to your home?

☐ Less than 100 meters

☐ 100-500 meters

☐ More than 500 meters

7. What type of sanitation facilities do you use?

☐ Private toilet

☐ Shared toilet

☐ Public toilet

☐ Open defecation

10. How often are the sanitation facilities cleaned?

☐ Daily

☐ Weekly

☐ Monthly

☐ Rarely

11. How is waste disposed of in your area? (Check all that apply)

☐ Burned

☐ Buried

☐ Left in open areas

☐ Other (please specify): .....

12. How far is the place where you throw away your household waste?

☐ Just here around the tent

☐ < 20m

☐ 20-50m

☐ Over 50m

13. After the rain, is there stagnant water near the shelter?

☐ Yes

☐ No

Additional Comments (Open-ended)

Is there anything else you would like to share about malaria within the IDP camp?

……

……

……

……

Thank you for your participation. Your input is valuable in helping us understand and combat malaria in the displacement camps. Your responses will remain confidential, and your cooperation is greatly appreciated.

Appendix II. Key Informant Interview Guide (Health workers and community leaders)

1. In your experience, what are the main challenges faced by the displaced community in this camp regarding malaria prevention and control?
2. Can you describe the availability and accessibility of healthcare services for malaria diagnosis and treatment within the camp?
3. Are there any specific barriers adults in the camp face in accessing malaria diagnosis and treatment services?
4. From your perspective, what are the main factors linked to the spread of malaria within the camp?
5. Are there any specific groups within the camp who are particularly vulnerable to malaria infection? If so, thy?
6. Have there been any previous initiatives aimed at addressing malaria within the camp? If so, what were their successes and limitations?
7. What are the existing community practices and beliefs related to malaria prevention and treatment among adults in the camp?
8. Do you have any recommendations for improving malaria prevention and control strategies in this camp?
9. Is there any additional information you would like to share related to malaria and the displaced community?

Mount Kenya University

REF: **MKU/ISERC/3934** Date: 17 July 2024
TO: **MBALIKADA KOTEBEDA William**

REG: **MPH/2023/39517**

Dear Sir/Madam,

RE: ASSESSMENT OF RISK FACTORS ASSOCIATED WITH MALARIA INFECTION AMONG ADULT POPULATIONS IN SELECTED INTERNALLY DISPLACED CAMP IN GOMA, NORTH KIVU PROVINCE, DRCONGO.

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **2916.** The approval period is **17/07/2024 - 16/07/2025.**

This approval is subject to compliance with the following requirements;

i. Only approved documents including informed consents, study instruments, MTA will be used
ii. All changes including amendments, deviations and violations are submitted for review and approval by **Mount Kenya University**
iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to **Mount Kenya University**

Yours sincerely,

MOUNT KENYA UNIVERSITY
ETHICS REVIEW COMMITTEE
P. O. Box 342 - 01000,
THIKA

Dr. Alfred Owino, PhD
Chairman, Mount Kenya University ISERC

Appendix III. ERC Certificate

Appendix IV. Introduction Letter

Mount Kenya University

MKU

DIRECTORATE OF GRADUATE STUDIES

MPH/2023/39517

18th July, 2024

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

RE: MBALIKADA KOTEBEDA WILLIAM– REGISTRATION NO. MPH/2023/39517

The purpose of this letter is to introduce the above named student who is pursuing **Master of Public Health** in the department of **Community Health, Epidemiology and Biostatistics in the school of Public Health.**

The title of the research is **"Assessment of Risk Factors Associated with Malaria Infection Among Adult Populations in Selected Internally Displaced Camp in Goma, North Kivu Province, DR Congo."** It has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data between **July, 2024 and September, 2024.**

Any assistance accorded to the student will be highly appreciated.

Thank you.

Mount Kenya University
P.O. Box 342-01000, THIKA
Office of the Director,
Graduate Studies

Dr. Samuel M. Karenga, Ph.D
Director, Graduate Studies
Enc.

Main Campus, General Kago Road, P.O. Box 342-01000 Thika.
Cell: +254 709 153 000 / +254 709 153 200
Email: info@mku.ac.ke, Web: www.mku.ac.ke
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Unlocking Infinite Possibilities

REPUBLIQUE DEMOCRATIQUE DU CONGO
PROVINCE DU NORD KIVU

MAIRIE DE GOMA
www.villedegoma.gouv.cd
Le Maire

MBALIKADA KOTEBEDA William
MOUNT KENYA UNIVERSITY
Tel: +254758250640

Objet :
Autorisation de collecte de données

Monsieur/Madame,

Nous faisons suite à votre lettre du 20 Juillet 2024 par lequel vous sollicitiez l'autorisation de mener une recherche sur la « ÉVALUATION DES FACTEURS DE RISQUE ASSOCIÉS À L'INFECTION PAR LE PALUDISME CHEZ LES POPULATIONS ADULTES DANS CERTAINS CAMP DE DÉPLACÉS INTERNES À GOMA, PROVINCE DU NORD-KIVU, RDCONGO »; Cas du camp de Kashaka et Shabindu.

Après examen de votre demande, nous avons le plaisir de vous informer que vous êtes autorisé à mener votre recherche dans le camp.

Le Chef de Division Urbain

Alexis NDALIHORANYE UZ...
Chef de Division urbain

ACCUSE DE RECEPTION
GOMA, LE 20/07/2024
COMMUNE DE KARISIMBI

Vu pour arrivée au Bureau du Quartier Muyunga le 22/07/2024
MAKELELE-MYAMUSICI Georges
CHEF DE C. ADJOINT

Adresse physique: Av. Karisimbi N° 23, Quartier Mikeno, Commune et Ville de Goma
E-mail : info@villedegoma.org / www.villedegoma.org
Tel. (+243) 977354659, (+243) 810342790. (+243) 992589947, (+243) 942099606

Appendix V. Field entry / Research Authorization

KOTEBEDA MBALIKADA

ASSESSMENT OF RISK FACTORS ASSOCIATED WITH MALARIA INFECTION AMONG ADULT POPULATIONS IN SELECTED INT...

THESIS
STUDENT THESIS
Mount Kenya University

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Appendix VI. Turnitin report

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Appendix VII. Research site map