



**COLLEGE OF MEDECINE AND HEALTH SCIENCES**

**Prevalence of malaria and associated factors among febrile patients aged five years and adults attending Ngoma district Health facilities**

**A thesis submitted to the University of Rwanda in partial fulfillment for the requirements for the degree of Master of Science in Field Epidemiology and Laboratory Management in the school of Public Health, College of Medicine and Health Sciences**

**By**

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## **Declaration**

I, NIYOYITA Jean Claude, do hereby declare that this dissertation submitted for the degree of Master of Science in Field Epidemiology and Laboratory management at University of Rwanda /college of Medicine and Health Sciences is my unique work and has not previously been submitted somewhere else. Also, I do declare that a complete list of references is provided including all the sources of information quoted or cited.

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## **Dedication**

To my lovely partner MUKANDAYISABA Delphine and my daughter IRAKOZE Eduine and HIRWA Yvan who laid a foundation for my academic career and success in my life.

To my lovely family and friends

To all who actively participated in this study;

I dedicated this work.

## **Acknowledgment**

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## **Abbreviation and acronyms**

**ACT:** Artemisinin –based combination therapy

**AIDS:** Acquired immune deficiency syndrome

**AQ:** Amodiaquine

**CDC:** Centers for Disease Control and Prevention

**CI:** Confidence Interval

**HIV:** Human Immune deficiency Virus

**ICCM:** Integrated community case management

**IRB:** Institution review board

**IRS:** Indoor residual spraying

**ITN:** Insecticide treated Net

**Km:** Kilometer

**LLITNs:** Long lasting insecticide treated Nets

**MDG:** Millennium Development Goal

**RDHS:** Rwanda Demographic Health survey

**RHIMS:** Rwanda Health information management system

**RSSB:** Rwanda Social Security Board

**SP:** Sulphadoxine -pyrimethamine

**WHO:** World health organization



## **Abstract**

### **Background**

Malaria is a public health problem among febrile patients aged from five years. More malaria studies have been done for under five children while little information is known for persons aged five and above. We assessed the prevalence and factors associated with malaria among febrile patients aged from five years in Ngoma district.

### **Method**

Cross-sectional study was conducted from November to December, 2018. Systematic sampling method was used for participants selection. Data collection questionnaires were completed after informed or assent forms were signed by the participants. Thick blood smears were collected and tested for malaria parasites by laboratory personnel. Data entry was done through Microsoft Excel while STATA Version 13.0 was used for analysis. Bivariate and multivariate logistic regression was computed to determine the association between dependent and independent variables at 95%CI,  $p < 0.05$ .

### **Results:**

Overall, 420 febrile patients aged from five years were recruited and 257(61.2%) were confirmed malaria positive. Malaria microscopic positive results were significantly associated with being male (aOR=1.69,95%CI=1.07,2.68; $p=0.02$ ) with sixty-nine percent more likely to get infection than females. Living in Mutenderi Sector (aOR=7.04;95%CI=1.19-41.39; $p=0.03$ ) compared to living elsewhere in Ngoma district.

In reference to 5-14 years age group, being in the age group of 15-24 years (aOR=0.30;95%CI=0.10-0.89); $p=0.03$ ),25-34years (aOR=0.25;95%CI=0.08,0.83, $p=0.01$ )and $\geq 35$ years (aOR=0.24;95%CI=0.08,0.679); $p=0.00$ ) were less likely to get malaria. Knowledge on malaria causes was found protective

**Conclusion:** Malaria parasitaemia was found high in aged five and above in the study area thus its prevention and control measures should be enhanced in this particular aged group as well. Moreover, particular attention is needed to male, Mutenderi residents and those in the 5-14 age group as they are more likely to get the malaria infection.

## Chapter1: Introduction

Malaria is an infection caused by plasmodium parasite that affect human's red blood cells where it causes fever and red blood cells destruction. The people are affected when they became in contact with infected female anopheles mosquito. Its life cycle engages insect vector and vertebrate human as hosts. The major plasmodium species include *Plasmodium falciparum*, *malariae*, *Vivax*, *Ovale* with almost similar life cycle. The Human is infected during mosquito bite where it injects sporozoites in the human body. It is the major cause of morbidity and mortality in Africa region. The interventions were increasingly implemented in the last decade. Despite the effort in its prevention and control, malaria remains a public challenge in Africa and accounts 445,000 deaths globally with 91% occurred in African region in 2016 and an estimated of 216 million cases occurred globally in 2016 of which 90% occurred in Africa. Its incidence stood at 63 cases per 1000 population at risk in 2016(1,2). Globally, an estimated 8.9 billion US Dollar was used for malaria intervention programs between 2006 and 2010 with most of this funding to Africa. However, the burden still emerging thus the funding is still needed to fight against malaria and carry out more research about this burden(3). The malaria has shown to cost the households with malaria case around 2.67 US Dollar per day. It leads to around 3 days of fruitless situation, with additional indirect cost of 10.85 US Dollar among productive individuals. The care givers may lose 2-4 days when the family member is infected with malaria(4). Since 2000, the malaria cost was reached 300 million US Dollar per year for malaria case management in Sub-Saharan Africa. This huge money could be used to boost the population's economic and infrastructure, if the malaria transmission had been averted in the area(5).

The malaria transmission in African countries is facilitated by the poor environmental management including deforestation which led to the rise in temperature hence spread of larval habitats, survival of malaria vectors and development of malaria parasites(6). Malaria is also a public health concern in Rwanda bordering countries. Malaria in Democratic Republic of Congo reported to affected about 14 million. It is noted that around 26% of the diseases are due to malaria in Uganda and the malaria prevalence in Uganda between 2006-2011 were 14.6% while the usual monthly malaria incidence was almost 473 cases per 10,000 people. The malaria also affect badly the Republic of Burundi (7-10).

Malaria control in Rwanda is integrated in the entire health system from community level to referral Hospitals. Prior to 2005, preventive interventions were limited to offering of Insecticide treated net(ITN) to pregnant women and children with less than five years. In 2006, Rwanda replaced Amodiaquine plus Sulphadoxine - Pyrimethamine (AQ+SP) with Artemisinin-based combination therapy (ACT) (11). Since 2010, Indoor residual spraying was initiated in some district with the highest malaria cases except in Ngoma district which is among the highest malaria burden district in Rwanda(12–15). Despite the malaria control interventions put in place since 2012, malaria incidence is yearly increased in Rwanda from 48 per 1000 in 2012 to 403 per 1000 in 2016. The malaria cases increased from 460,460 in 2013-2014 to 1.4 million in 2015-2016 in Eastern province. The enormous majority of increase was observed among person over five years of age. The malaria deaths was increased from 419 in 2013 to 715 in 2016(16). Most of the patients presenting at health facilities with fever had malaria referring to the study done in Rwanda(17). Malaria prevalence among health facilities attendees in Eastern Province of Rwanda accounted 22.8% in 2013(18,19). Malaria has benefited from several and important funding over the last years but Rwanda is still experiencing the resurgence of malaria but there are few studies on malaria among people aged five years and above.

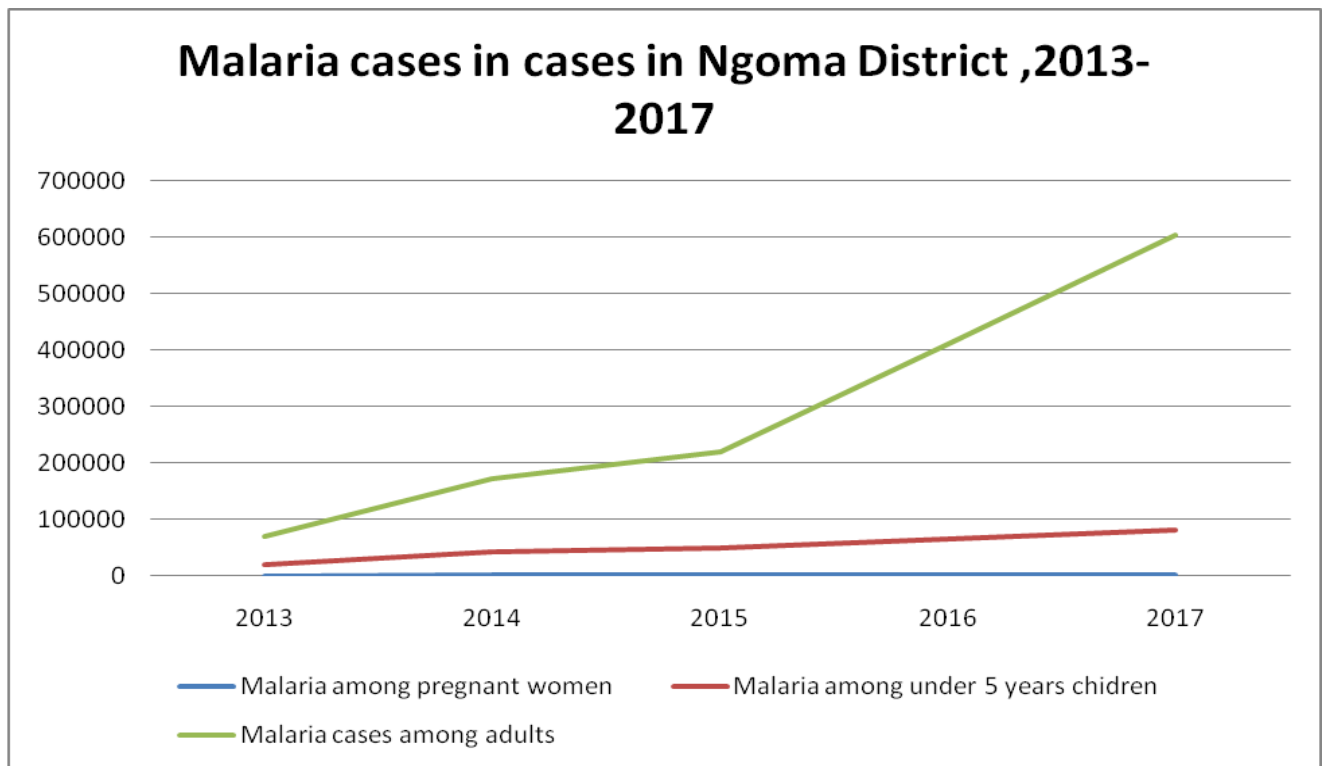
The Millennium Development Goals (MDGs) for reducing poverty and upgrading the health, welfare of people living in limited resources settings were set in 2000 by the United Nations with the eight goals. Malaria was targeted under MDG-6. Rwanda has attained its most MDGs targets for health. Despite this achievement, Rwanda is still facing malaria challenge(20,21). The Community health workers (CHWs) were introduced in Rwanda health system to expand the malaria prevention and control at community level since 2007 and they were found to be useful(22). The primary interventions were mass distribution of insecticide treat net (ITN) and antimalarial drugs to vulnerable people(23).

WHO recommendation was implemented for integrated community case management (ICCM) using community health workers to increase access to health services in Rwanda. To achieve MDG targets and universal health coverage, community based health insurance (CBHI) with around 78% of participation in 2010 and other health insurances were established in order to promote health service seeking through cost effective (24). The ICCM was introduced in 2003 and by 2011, ICCM was established in all 30 districts with the aim of health promotion, diagnostic and curative service including malaria diagnosis and treatment (22,25).

The Home based management (HBM) of malaria was introduced in Rwanda in 2004 with the aim to assist access to care and facilitate early diagnosis and treatment. Nyanza district was the first one to host the HBM as the pilot district. Malaria morbidity was reduced among children less than five after implementing HBM from 44.9% in 2004 to 28.7% in 2007 (23,26). The Community health worker scope services were extended from children under five to sick adult in 2016 for better management and control of malaria (27).

### **1.1 Problem statement**

Malaria interventions have been boosted in Rwanda including free malaria services at community level for those in the poorest group. In reference to the recent Rwanda Demographic survey 64 % of the population has access to mosquito nets as the primary preventive measures against malaria. Despite of all of these interventions and effort made to control malaria in Rwanda, the malaria was increased since 2012 with 4.5 million cases and 600 deaths reported in 2017. Ngoma district was among the most affected district in Rwanda (16,28,29). Malaria attention and studies in under five children was scrutinized not only in the country but also in other African region. The review of Health Management Information system (HMIS) in Ngoma district shows the malaria increment in febrile patients aged five and above than in under five children and pregnant women between 2013-2017 as illustrated further down. However little information is documented in the study area about malaria prevalence and associated factors in this particular group.



**Figure 1. Ngoma district HMIS malaria cases review report (2013-2017)**

## 1.2 Justification of the study

Ngoma district was among the most affected districts with the highest malaria cases despite the national malaria contingency plan implemented since 2012 up to 2016. The main malaria interventions included in the Malaria Contingency Plan were: (i) initiation of home based treatment of fever in adults, (ii) delivering mosquito nets to the general population through different distribution channels, (iii) follow up and assessment , and (iv) the community sensitization (30). During my training in Ngoma district, malaria upsurge was observed in febrile patients aged five and adults however little information was documented in regard to its prevalence and associated factors in this particular group. Therefore, new ideas about malaria situation in this particular group, is of great scientific interest(31). In fact, we needed to document malaria prevalence and underlying factors among febrile patients with five years and above. Understanding the magnitude of malaria among febrile patients aged five and above provides new ideas and approach that guide on the appropriate malaria preventive and control measures in this particular group. Thus we carried out this study to highlight malaria situation including its prevalence and associated factors in Ngoma district and propose recommendations which should be the foundation to defeat malaria in the area.

### **1.3 Study objectives**

**(i) General objective**

To find out the magnitude of malaria and its associated factors among febrile patients aged five years and above in Ngoma district

**(ii) The specific objectives are:**

- 1) To find out the prevalence of malaria parasite among febrile patients aged five years and above attending Ngoma district health facilities
- 2) To determine the factors associated with malaria among people aged five years and above in Ngoma district

### **1.4 Research questions**

- i. What is the prevalence of malaria among febrile patients with five years old and above in Ngoma District?
- ii. What are the associated factors of malaria in the study area?

## Chapter 2: Literature Review

Globally, the malaria incidence was reduced from 76 to 63 cases per 1,000 populations at risk. The malaria incidence rate in WHO African region was shifted from 256 to 206 cases per 1,000 populations at risk from 2010 to 2016. Despite the effort to halt malaria infection, 216 million occurred worldwide, in 2016. Almost 445,000 deaths were caused by malaria and 91% of them occurred in WHO African region(1). The study conducted in Kenya, 2015, reported malaria prevalence to be about 28%. The malaria positivity rate varied also by season where it accounted 60% in the peak of malaria period to about 10 percent in other season (32). The study in Southern Ethiopia in 2015, reported malaria to be higher in children aged five than in under five children and 5-14 to be the most affected(33). The study carried out in Mozambique, reported 14.4 % prevalence of malaria in adults where all cases were due to *Plasmodium falciparum* (34). The study done in Nigeria in 2016, reported the prevalence of malaria of 51% among people attending Dutse General Hospital. The 30-39 age group had the higher prevalence of 73.3% followed by 50-59% with 60%, 20-29 age group had 50% of malaria prevalence while 40-49 age group had the least prevalence(35). The prevalence was found to be 35.7% in patients attending the Hospital Markarfi in Nigeria. The study reported also that adults accounted 4.8% of the total positive cases and males had higher parasitaemia (19.4%) than female with 16.4%. The study also pointed out that the adults with 40 years and above living in malaria endemic area had developed certain immunity against malaria as no malaria case reported in the area. Malaria in Ethiopia was reported to be 25% and was associated to age(36). The malaria prevalence of 43% was reported among children aged 5-17 years compared to 24% malaria prevalence among children under five in northern Zambia in 2016 (37).

As stated by WHO, the malaria incidence rate was reduced by 31% between 2000 to 2012 in WHO African region however it was reduced to 18% globally between 2010 to 2016. This was due to adoption of ACT therapy and use of long lasting insecticide treated nets (LLITNs), preventive mechanisms and increased financial support (1,38). According to Bhatt report the malaria incidence due *Plasmodium falciparum* in Africa slowed down to 40% from 321 per 1,000 population at risk in 2,000 to 192 per 1,000 population at risk in 2015 though the international targets for universal coverage is not yet achieved (39).

The utilization of Insecticide mosquito nets occasionally was linked with the higher malaria prevalence of 65%. The indoor residual spraying (IRS) was found to be effective as the lowest malaria prevalence (38.9%) was recorded after IRS intervention.

Surprisingly, the malaria was not associated with socio-economic status(35). In Sub Sahara Africa some malaria risk factors highlighted include socioeconomic status, agricultural practices, poor monitoring of land use, housing with poor quality, age group, lack of education, scarce of malaria drug, increased rainfall, altitude, climatic factors, and improperly use of bed net, malnutrition, inadequate vector control. In addition to that, people living in close proximity to irrigated farmlands are more exposed to malaria (1,17,40,41). The constructed dam around household was found to be risk fact for malaria transmission in Africa. The incidence of malaria in the communities living around the dam was high than those living farther away. People living within 1-5 km from reservoirs(dam) are at high risk than those living in 5 km and above (42). The study done in Ethiopia in 2012, malaria prevalence was 8% and the most malaria risk factor were materials which constructed the walls, the house' s structure, the drinking water source , time used to fetch water, the absence of toilets facilities and the absence of electricity. It has been noted also that the presence of clean water was associated to a greater chance of being malaria negative(43). The government of Rwanda and its partners distributed insecticide mosquito net which were increased from almost zero in 2005 to 38% in 2006, and 76% in 2010. About six million nets were delivered between 2009 and 2011 and from 2006. The community Health workers (CHWs) were taught and authorized to test and treat confirmed malaria cases. In 2007, Rwanda initiated indoor residual spraying (IRS) in three districts of Kigali and in other selected districts including Nyagatare, Bugesera, Nyanza, Gisagara and Kirehe (11).

## **2.1 Human related behavior factors**

The human attitude and economic status can facilitate or hinder the malaria transmission and the poor are the most affected.. In addition to their weakened immunity, they are more exposed. The cultural beliefs may results in traditional medicine use. In addition, the night shift work may influence the exposure to mosquito bites(44). The pregnant women may be more harmed by malaria parasite than men as their immunity is weakened(45).



## **2.2 Malaria Status in Africa**

The plasmodium parasite infection in Africa is a critical public health issue where about 90% of the malaria cases worldwide occur in WHO African area. The malaria prevention and control measures are not yet completely satisfactory in the African continent.

The number of households with adequate insecticide treated nets were 43% in 2016 though utilization of ITN increased from 30% to 54% in 2016 in African region(1).

The research conducted in Kenya in 2015, reported the prevalence of 28% with gender associated to malaria(31). Females were more affected in study done in Nigeria and Kenya (31,46). The prevalence in the study done in Ethiopia in 2017, was reported at 25% though 97% were aware that the infection is public issue in the area. The highlighted malaria symptoms were being cold, sweating, fevering, headache, vomiting and lack of appetite. The origin of malaria stated included hunger cited by 34%, eating maize stalk by 25%, eating juvenile sugar cane by 196 (24%) participants. Majority of the participants (99%) reported that malaria is an avertable disease(36,43). Knowledge about malaria causes was found adequate among aged <40 years while 86% of the respondents stated mosquito vector to be responsible for malaria transmission in the study done by Dlamini in Swaziland. However, 3% reported malaria to be transmitted by snail and food they ate. Overall, 84 % highlighted that mosquito breeding habitats is stagnant or slow moving water. Indeed, participants aged <20 years had good knowledge on malaria prevention mechanism while those with 20-39, 40-49 and >50 years old had poor understanding on malaria prevention mechanisms in the same study. Moreover, 97% reported that malaria could be averted and draining swamps and stagnant water was reported to prevent malaria by 36 % of the participants(47). As for socio-economic considerations, the poor are highly distorted by malaria than the others; consequently fifty-eight percent of deaths occur in the poorest individuals in the world. The living condition in the poor are so challenging with poor housing and congestion which could be the risk for malaria infection (48).

### **2.3 ITNs Availability and its efficacy**

According to the study done in Ethiopia about the malaria in adults reported that among the malaria suspected cases; 57% had mosquito nets to be used while sleeping. Among those with mosquito nets 48% had two, 36 % had only one, and 13% had above two mosquito nets. Around 52% reported to sleep under mosquito nets all the nights, 30% sometimes, 16% did not sleep under mosquito nets while 59% reported to use mosquito nets prior to seek care (36). The malaria infection and fatality is reduced by the use of mosquito bed nets in Africa as well as worldwide. However, the ITNs are ineffective for population who used to be outside their home in the early evening and sleep later. This suggest that adults are more exposed than children as the children benefit more from ITN as they go to bed earlier and sleep long time than adults. In addition, children do not move far from dwelling which averts the exposure. Malaria control in Rwanda was improved since 2005 with the distribution of mosquito treated nets and accessibility of ACT(49).

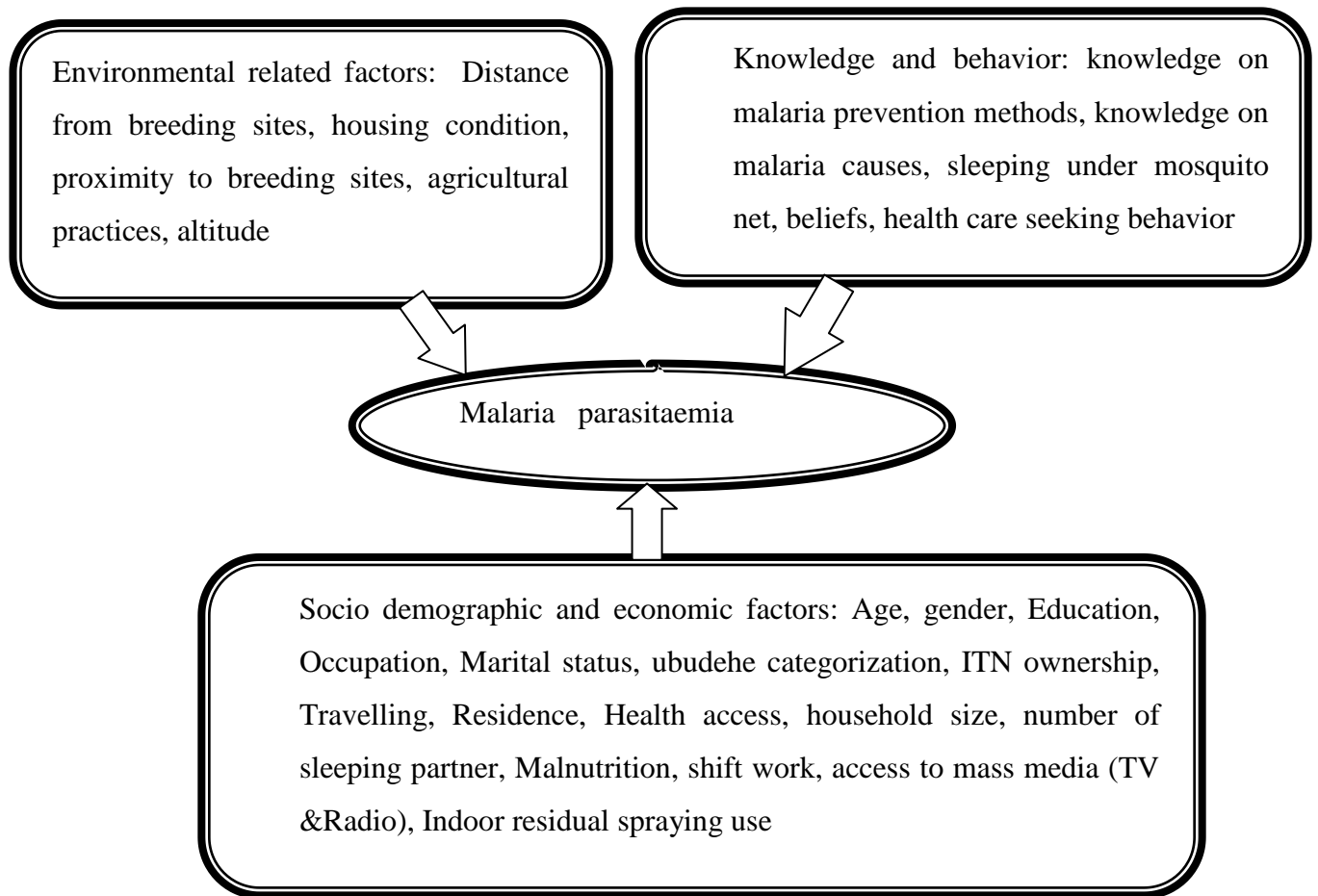
### **2.4 Physical environment /housing condition and environment**

A multi country analysis survey conducted in Sub-Saharan Africa about housing improvement to control malaria transmission reported that participants residing in modern, improved home were unlikely to be infected with malaria than those living in unimproved housing. The poor housing quality in Sub-Sahara Africa was mentioned as the cause of malaria transmission(50). The people living in modern homes showed to be having less malaria infection than those in traditional. The studies in Tanzania, Ethiopia and Uganda reported the malaria infection to be halved by modern housing (51). The Southern Ethiopia study reported the malaria prevalence of 16% with 15-24 age group most affected with participants living in houses with rudimentary houses, living near stagnant water and unavailability of ITNs mostly significantly associated with malaria infection (52). The study carried out in Kenya reported high prevalence in children with 11-14 age years old with malaria cases increase among children living in rural area than (10.16%) those leaving in urban area (2.93%). The poor children (11.05%) were the most affected than rich children (3.23%). The absence of hanging mosquito nets, electrical energy and poor access to mass media such as radio and television were linked with higher malaria incidence (53).

## **2.5 Prevalence of Malaria**

The prevalence is the proportion of persons with malaria parasite positive among total number of individual tested. The malaria prevalence is valuable indicator that shows the level of malaria endemicity (54). Malaria prevalence varied region by region but more malaria cases are documented in Africa than elsewhere (55). The proportion of malaria positive was found at 25% among adults attending Oromia state, Ethiopia in 2012(36). In Uganda community survey carried out in 2011-2013 reported malaria prevalence to be between 3 to 5.1% while average of 30% of malaria prevalence was reported in under five in the survey done between 2014-2015. The reported malaria prevalence in Kenya was 28% in 2015(31). The recent Rwanda demographic survey reported malaria prevalence of 2% and 1% among under five children and pregnant women respectively(56). The prevalence of malaria infection in the general population from 6 months of age and above was estimated to be 17% in Eastern Province(57). Notably, most studies about malaria prevalence and associated factors have been done for under five and pregnant women than in other age group categories hence few published research of malaria parasitaemia in aged five and above are remarkable.

## 2.6 Conceptual framework



**Figure 2: Conceptual framework (Author's model)**

Factors that can affect malaria magnitude in Ngoma district was categorized into three categories which are: Environmental factors, Socio-demographic and economic factors, knowledge and behavior factors. Environmental factors refer to the surrounding of the participants that can facilitate or hinder the mosquitoes breeding and bites. Socio demographic factors refer to the attributes that characterize participants that can favor or hinder malaria transmission. Knowledge factors refer to whether the participants know how malaria can be contracted and prevented while behavior factors refer to their attitude towards malaria prevention and control measures. All the arrows indicate that the factors mentioned in each category of the conceptual framework may contribute to the malaria parasitaemia either negatively or positively.

## **Chapter 3: Methodology**

### **3.1 Study Design**

The study used cross sectional design

### **3.2 Research Setting**

This study was carried out in Kibungo Hospital catchment area located in Ngoma district. The Hospital is approximately 100 Km from Kigali. It is a Referral Hospital with a catchment area which supervises 12 health centres, 9 Health Post and Prison Central de Kibungo (PCK). Eastern Province is malaria endemic area zone and it contains different lakes (58). Ngoma district is closet to Bugesera in the west, Kirehe in the east and Burundi republic in the south. Both bordering districts used indoor residual spraying. In 2014, Ngoma district came on the second rank in Eastern province with high malaria cases and the third district with high cases of malaria in 2016 in Rwanda. Referring to Rwanda Malaria bulletin issued March, 2017; Ngoma district was the third district among top ten malaria with high malaria incidence (30).

### **3.3 Study population**

Febrile patients aged from five years old residing and attending Ngoma district Health facilities were the main population of interest. The participants living and attending Kibungo study Health facilities during the study period and able to sign consent or assent were included in the study. Moreover, the individuals living outside Ngoma district, under five years old and those in detained center were not part of the study.

### **3.4 Sample size and sampling techniques**

Kish Leslie's formula was used to calculate the sample size with an assumption of 95% confidence level with 5% of degree of precision and proportion of malaria of 50% among aged five years old and above in the study area. Thus a total sample size was 384 participants aged from 5 years old and above of Ngoma district. However a sample size of 420 malaria suspected cases participated in the study to manage the possibility of non- respondents. Here bellow is the formula used (69).

The sample size was calculated using.

$$n = \frac{(z_{1-\alpha/2})^2 p(1-p)}{d^2}$$

$$= \frac{1.96^2 0.50(0.50)}{0.05^2} = 384$$

Participants were recruited from public health centers and at the hospital level in Ngoma district. To ensure the representative of each health facilities, a systematic sampling strategy was used to recruit participants in each facility. The sampling interval was established in reference to the malaria suspected cases in the previous month over the total number of the sample size required at each health facility. The sample size was equally allocated in all health facilities. Therefore 420 participants were interviewed after consent or assent for participation in this study is obtained.

### **3.5 Data collection procedures**

Structured questionnaire designed in English and translated into Kinyarwanda version was used for data collection. To ensure the instrument validity and reliability; the questionnaire was constructed using concepts from literature and under supervisor guidance. In this study 10% of participants were used in the pilot study thereafter the findings were tested for reliability. The Cronbach alpha was used to test questionnaire's reliability and validity. The Cronbach alpha was found at 0.717 which is acceptable due to the fact that the acceptable Cronbach alpha should be between 0.70-0.95 (60). Each participant signed informed consent however assent form was signed by under 18 years to participate in the study. For participants who cannot write; their guardians or parent helped them to complete the form and to sign the assent form. Data collection was done between November to December, 2018. The lab technicians from each facility were trained on the study instrument to facilitate data collection. The Giemsa 1/10 dilution was used for thick blood smears staining. Microscopes with 100 x oil objectives were used for malaria testing. The blood smear for malaria were scanned by laboratory technicians routinely performing this activity at each study health facility. The tested blood slides were sent to experienced laboratory personnel at Hospital Laboratory for crosschecking. The 10% of the blood smear were crosschecked by an experienced WHO Certified Malaria microscopist.

### 3.6 Study variables

#### Dependent variable

- Malaria parasitaemia a dichotomous variable: Positive or Negative

#### Independent variables

- Age:** Age of the participants was categorized in four age group categories: 5-14 , 15-24, 25-34 and  $\geq 35$  years old. The age category of 5-14 years old was considered as reference.
- Sex :**Sex of the participants ,a dichotomous variable: female or male
- Education:** Education was grouped into 3 categories :None, primary and secondary and above
- Occupation:** Occupation was grouped into employed and non employed or farmer
- Marital status:** civil status categorized into married and not married
- Ubudehe category:** Generally known as wealth quintile and locally named ubudehe category where the poorest are in ubudehe category 1, Second in ubudehe category 2 , middle in ubudehe category 3 and fourth in ubudehe category 4 (61–63).
- ITN:** Insecticide treated net ownership ,a dichotomous variable (Yes or No)
- Sleeping under an ITN last night ,** a dichotomous variable with Yes or No
- Traveling :**Traveling ,a dichotomous variable ,(Yes or No)
- Owning Health insurance:** Owning Health insurance, a dichotomous variable (Yes or No)
- Sector of residence:** All 14 sectors of residence in Ngoma district were presented
- Distance from breeding site:** We categorized a breeding site into less than 1 kilometer (km, 1 to 4 Kilometer and Equal to 5 Kilometer or more.
- Knowledge of malaria causes:** Four choices were established which were Being bitten by mosquito, Eating immature sugar cane, Eating maize stalk and Hunger
- Knowledge of malaria prevention methods:** a dichotomous variable with Yes or No

### **3.7 Data analysis**

Data entry into Microsoft excel was done and STATA *version 13.0* was used for data analysis. Descriptive statistics were computed to summarize, organize sample characteristics, describe research variables and e frequency tables were presented for response rate. The univariate data such as socio demographic variables were presented using frequency distribution. A bivariate analysis was computed for independent variables, performing the odds ratio at  $p\text{-value} < 0.05$  to determine the association of malaria with identified risk factors. The significance of the findings was determined at 95 % confidence interval (CI) and below 0.05 of p.value. Multivariate analysis was used to determine factors statistically associated to malaria infection.

### **3.8 Ethical considerations**

The proposal was submitted to ethical review committee of University of Rwanda for review and the approval was obtained before commencement of the study. Permission was sought from the Hospital Ethical committee and Hospital administration. The permission letter was presented to each health facility before commencement data collection. The study did not use any additional invasive procedure thus no risk caused by the study. Study procedures were clearly explained to participants before obtaining informed consent or assent form. Confidentiality was assured by using codes instead of names. The findings should be used to develop the appropriate interventions for malaria prevention in the area hence participant's protection against malaria infection. Hard copies were stored in locked file cabinet while electronic data were stored in computer with password that can be accessed by principal investigator and supervisor upon request.



## **Chapter 4: Results**

### **4.1 Background characteristics of the study participants**

A total of 420 febrile patients attending study health facilities in Kibungo Hospital catchment area, Ngoma district in Rwanda, from November to December, 2018 were interviewed. The high proportion of participants were females (60.71%), the largest group 151(35.95%) had 35 years or above. In regard to the marital status, 221 (52.62%) were married while 199 were not married. In all, 252(60%) participants had only primary education level and about 409 (97.38%) were unemployed or farmer. It also shows that 199(47.38%) participants were in Ubudehe category 2 followed by those 150(35.71%) in Ubudehe Category 3 (Table1).

**Table 1: Social Demographic characteristics (N=420)**

<b>Variables</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Demographic factors</b>		
<b>Gender</b>		
Female	255	60.71
Male	165	39.29
<b>Age (years)</b>		
5-14	125	29.76
15-24	40	9.52
25-34	104	24.76
>=35	151	35.95
<b>Marital status</b>		
Married	221	52.62
Not married	199	47.38
<b>Education level</b>		
None	69	16.43
Primary	252	60.00
Secondary and above	99	23.57
<b>Occupation</b>		
Employed	11	2.62
Not employed or farmer	409	97.38
<b>Sector</b>		
Gashanda	8	1.90
Jarama	33	7.86
Karembo	3	0.71
Kazo	15	3.57
Kibungo	27	6.43
Mugesera	33	7.86
Murama	17	4.05
Mutenderi	34	8.10
Remera	41	9.76
Rukira	48	11.43
Rukumberi	36	8.57
Rurenge	37	8.81
Sake	34	8.10
Zaza	54	12.86
<b>Ubudehe categorization</b>		
Category 1	71	16.90
Category 2	199	47.38
Category 3	150	35.71

## 4.2 Behavior , knowledge and Environmental characteristics

Overall, 324 (77.14%) had mosquito treated nets and majority of the participants 411 (97.86%) did not travel to neighbouring countries one month before the study. A total of 282 (67.14%) of the participants slept under mosquito nets one day before the interview and 408 (97.145%) were aware that malaria can be caused by mosquito bite while only 12 (2.86%) knew that malaria can be caused by hunger, eating immature sugar cane and maize stalk. Fortunately, 417 (99.29%) knew about the malaria prevention methods. Almost half of the participants 207 (49.29%) lived in less than 1 km from the breeding sites while only 43(10.24%) lived in 5 km or above away from the breeding sites (Table 2).

**Table 2: Behavior and knowledge and environmental characteristics**

<b>Notion of travelling</b>		
No	411	97.86
Yes	9	2.14
<b>ITN ownership</b>		
No	96	22.86
Yes	324	77.14
<b>Sleeping under an ITN last night</b>		
No	138	32.86
Yes	282	67.14
<b>Knowledge of malaria causes</b>		
Being bitten by mosquito	408	97.14
Eating immature sugar cane	5	1.19
Eating maize stalk	5	1.19
Hunger	2	0.48
<b>Knowledge of malaria prevention methods</b>		
No	3	0.71
Yes	417	99.29
<b>Distance from breeding sites</b>		
Less than 1 km	207	49.29
1 to 4 km	170	40.48
Equal to 5 km or more	43	10.24

## 4.3 Malaria prevalence among febrile patients(N=420)

Of the 420 febrile participants aged from five years old attending Ngoma health facilities, 257 (61.2%) were microscopically confirmed malaria positive.

#### **4.4 Bivariate analysis :Malaria and and characteristics factors of respondents**

Overall, 257 blood smears were malaria positive. Males (OR=1.71;95%CI=1.05,2.77);p=0.02) were seventy one percent times more likely to get malaria infection than females. In reference to 5-14 age group, being in 15-24 age group (OR=0.27;95%CI= 0.08-0.89;p=0.03) were seventy three percent less likely to get malaria infection , 24-34 age group (OR=0.19;0.06-0.63;p=0.00) were eighty one percent less likely to get malaria and  $\geq 35$  years (OR=0.19; 95%CI= 0.58-0.61;p=0.00) were eighty one percent less likely to get malaria infection as well. Knowledge on malaria causes was related to protective characteristic. Eating immature cane (OR=0.06,95%CI=0.04,1.00,p=0.05) was ninety four percent protective. Living in Mutenderi sector (OR=7.35;95%CI=1.08-49.97;p=0.04) were around seven times more likely to get the malaria in reference to Gashanda sector . Some variables like marital status, education, occupation, ubudehe category, notion of travelling, ITN ownership, sleeping under ITN last night, knowledge of malaria causes, preventive measures, distance from the breeding site had p-value higher than 0.05 consequently they were not associated with malaria infection(appendix 4).

#### **4.5 Factors associated with malaria among febrile patients aged from five years in Ngoma district**

Multivariate analysis shows that males (aOR=1.69;95%CI=1.07,2.68;p=0.02)were sixty-nine percent more likely to get the malaria than females.

In reference to 5-14 years, participants in the age group of 15-24 (aOR=0.30,95%CI=0.10,0.89;p=0.03), 25-24 (aOR=0.25;95%CI=0.08,0.83;p=0.01) and  $\geq 35$ (aOR=0.24;95%CI=0.08,0.69;p=0.00) were 70%,75% and 74% respectively less likely to get malaria infection. Living in Mutenderi sector (aOR=7.04;95%CI=1.19,41.39;p=0.03) seven times more likely to get the malaria infection in reference to Gashanda Sector. Knowledge on malaria causes was associated to malaria and eating immature cane was ninety percent less likely to get infection in reference to being bitten by mosquito. The other variables were not statistically significant in multivariate analysis (Table 3).

**Table 3. Factors associated with malaria among febrile patients aged from five years**

<b>Variables</b>	<b>AOR</b>	<b>95% CI</b>		<b>p-value</b>
<b>Gender</b>				
Female	Ref			
Male	1.69	1.07	2.68	<b>0.02</b>
<b>Age(years)</b>				
5-14	Ref			
15-24	0.30	0.10	0.89	<b>0.03</b>
25-34	0.25	0.08	0.83	<b>0.01</b>
>=35	0.24	0.08	0.69	<b>0.00</b>
<b>Residence (sector)</b>				
Gashanda	Ref			
Jarama	3.91	0.73	20.72	0.10
Karembo	0.65	0.04	10.79	0.76
Kazo	0.93	0.15	5.52	0.94
Kibungo	2.38	0.46	12.37	0.29
Mugesera	1.27	0.26	6.14	0.76
Murama	1.15	0.20	6.50	0.87
Mutenderi	7.04	1.19	41.39	<b>0.03</b>
Remera	2.71	0.55	13.18	0.21
Rukira	1.03	0.22	4.73	0.96
Rukumberi	2.69	0.55	13.13	0.21
Rurenge	0.93	0.19	4.38	0.92
Sake	2.82	0.55	14.44	0.21
Zaza	0.71	0.15	3.26	0.66
<b>Knowledge of malaria causes</b>				
Bitten by mosquito	Ref			
Eating immature cane	0.56	0.04	0.72	<b>0.02</b>
Eating maize stalk	0.16	0.01	1.87	0.14
Hunger	0.99	0.05	19.72	0.99

## Chapter 5: Discussion

### 5.1 General discussions

The objective of this study was to document the prevalence of malaria and associated factors in febrile patients aged from five years old in Ngoma district. In regard to this study findings, living in Mutenderi sector (aOR=7.04;95%CI=1.19,41.39,p=0.03), being male (aOR=1.69,95%CI=1.07-2.68);p=0.03) and age group and knowledge on malaria causes were statistically significant. Moreover, in reference to 5-14 years age group category, being between 15-24 age group (aOR=0.30;95%CI=0.10-0.89);p=0.03) and with  $\geq 35$  age (aOR=0.24;95%CI:0.08-0.69;0.01) decreased the probability of getting malaria infection. The findings are in contrast the study done in Ethiopia where participants aged between 16-24 ,25-34 and 35 to 44 years were more likely to get malaria (64). Men were found highly likely to get the malaria infection than females which was in conformity with the study done in Ethiopia (65). This similarity is related to the fact that males usually perform outdoor night shift work compared to females in both sides. Living in Mutenderi sector was found statistically associated to malaria which is in conformity with the study done in Ethiopia where living in Meki zone, Ethiopia was also associated with Malaria positivity(64). The Mutenderi sector association to malaria infection could be attributed to the high portion of forest in the area and to the factor that it is closest to Akagera river and Burundi Republic compared to the other part of the district (66). The ubudehe category 1 as the poorest in the study area were not associated with malaria and malaria prevalence in this category was quite low compared to other categories which is contrary to the study done in Kenya where higher prevalence was reported among the poor than in rich people(67). The difference could be attributed to the factor that people in Ubudehe category 1 receive free malaria medical service in the study area while in Kenya the poor people were more likely found to use non recommended medicine during that study period. Moreover, the study done in Kenya, data collection was done in 2012 when free malaria medical service was not yet fully implemented. The study findings revealed that 97.18% had knowledge about malaria causes comparing to the level of knowledge in the study done in Nigeria where they found more participants with low knowledge about malaria causes (68). The difference in knowledge could be attributed to the difference in the malaria prevention sensitization to the public in study settings. More than half of the participants' behavior about malaria prevention by sleeping under mosquito nets was appreciable in this study.

The study findings was in agreement with the study done in Ethiopia (69) and also in agreement with the study done in Nigeria Tertiary Hospital (70). However the study findings are in contrast with the study done in Uganda where participants with knowledge about malaria prevention were few (71). Distance from the breeding site was not found to be statistically associated with malaria in the area which in contract with the study done in Southern Ethiopia (52). The difference should be attributed the difference in the research settings and study design where in South Ethiopia they focused only in living nearby by the stagnant water while in our study we focused on living nearby any mosquito breeding sites including stagnant water. Overall, 420 thick blood smears were tested for malaria parasites, of which 257(61.2%) blood smear were malaria positive among the study participants attended the heath facilities between November and December, 2018 in Ngoma district. This study shows that malaria prevalence in febrile patients was less than the prevalence of 80.40% obtained in Nigeria. The difference is attributed to the factor that Nigeria study area was most likely experiencing flood with poor water drainage hence water body formation which favored mosquito breeding. The prevalence in the study area was high compared to what has been reported by Tadesse in Ethiopia however the study findings was in agreement with the factor that age group was associated with malaria(36). Travel history was not significant which is contrast with the study done in Zambia (37) and this was due to the factor that ,participants in this study area are not used to travel compared to the study done Zambia.

## **5.2 Study strengths and limitations**

The information used in this study was obtained from the appropriate source (interviewers), data collectors were trained on data collection tool before the activity and blood smears microscopy testing was done by the laboratory technicians routinely used to do Malaria microscopy testing in the study area; indeed WHO Malaria Certified microscopist supported in the Quality control; which are the strength of the present study. Nevertheless, this present study had limitations. We have not been able to observe directly some practices about behavior on mosquito nets use, presence or absence of mosquito nets. Moreover, the present study used data from public health facility attendees thus some information from private sector and community level was not captured. Despite all these limitations the present study provide important information as data obtained was from reliable source and testing was done in the same context as the clinical patient samples. Therefore, the information provided in this present study reflects the real picture in the study area which validates our findings.

## **Chapter 6: Conclusion and recommendations**

### **6.1 Conclusion**

We aimed to document the prevalence of malaria and its associated factors among febrile patients living and attending health facilities in Ngoma district. We found that being male, living in Mutenderi sector, age and knowledge on malaria causes were associated to malaria infection. Moreover, being male and residing in Mutenderi sector were more likely to get the malaria infection. However, referring to 5-14 age group, being in 15-24, 25-34 and  $\geq 35$  age categories were unlikely to get malaria disease. The prevalence of malaria among febrile patients aged from five years old was found high. The malaria positivity was not associated with variables such as education category, travelling etc. In reference to the participant's responses, some of them do not have insecticide treated net. Luckily, most of the participants in the area have good knowledge on malaria causes and preventive methods. Referring to the malaria parasitaemia obtained in this study we can state malaria is a public health concern in the area in the febrile patients aged five and above thus public authorities and stakeholders should work hand in hand to intensify malaria prevention and control measures in this particular group as well. Moreover, particular attention should be taken to people living in Mutenderi sector, male resident and people aged 5-14 years as they are highly likely to get malaria infection.

### **6.2 Recommendation**

#### **-To the public**

Malaria is a public health issue in the study area thus malaria interventions must be continuously established and owned by the community. The community must seek at all cost the mosquito nets and use them while sleeping. Community, mostly men are encouraged to use mosquito repellent body lotion while performing night shift work to prevent mosquito bites. Continuously, monitor the use of mosquito nets among children aged 5-14 years while they are sleeping.

#### **-The District authority**

The district authority is recommended to continue to reinforce existing mechanisms about malaria prevention and control. To work closely with Mutenderi sector, male residents and 5-14 years old category on malaria prevention and control as these were associated with malaria infection in the area.



**-Mutenderi sector**

-Ensure mosquito breeding sites are avoided or minimized at community level

**-To MOH**

In reference to the fact that, Indoor residual spraying was found effective in fighting malaria. We recommended Ministry of Health to sustain the Indoor residual spraying mechanism already introduced in the area since 2019. Mosquito treated nets should be made available and accessible to the community at affordable cost either at pharmacy or health facilities.

**-To the Researchers**

Additional research is required to understand better what are the underlying factors of malaria among Mutenderi sector residents, male and 5-14 years age group.

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## Appendices

### Appendix 1: Informed consent documents (english)

#### Information sheet

My name is NIYOYITA Jean Claude; I am a student in Masters Program, Field epidemiology and Laboratory Management at the University of Rwanda carrying out a study entitled : ‘Prevalence of malaria and associated risk factors among febrile patients aged five years from five attending Ngoma district health facilities .I am asking for your participation

In fact this study might not benefit you immediately but the findings may help to improve the malaria interventions in this area. There are no obvious physical risks foreseen or emotional risks anticipated. The information will be gathered from the participants by filling the questionnaire. The information will include demographical data, knowledge about Malaria, associated factors ;s so you are free to ask any questions. It is voluntary, mean that you are free to leave from the research any time without any penalty. The service you receive at the health center/Hospital and the relationship with the health care provider will not be affected in any way. All information will be confidential and your name will be anonymous. For any queries or questions, contact me or contact the supervisor of this research on **0788683209** or use my cell phone **0783242350**.

Will you please sign to your willingness to participate?

#### Participant’s Statement:

The study described above has been explained to me to my full understanding and I voluntarily take part in this study.

Participant / Witness’s Signature.....Date.....

Investigator’s Signature.....Date.....

**Note: Children under 18 will sign assent form. Illiterate will be helped to complete the questionnaire by their parent/guardian.**

## **UMUGEREKA 1:Kwemera kwinjira mubushakashatsi(mu kinyarwanda)**

Amazina yanjye nitwa NIYOYITA Jean Claude; umunyeshuri muri Kaminuza y'Urwanda, agashami ko kurwanya indwara z'ibyorezo no gukurikirana imikorere yaza Loborawari nkaba ndigukora ubushakashatsi kuburwayi bwa Malariya nibituma yakwiyongera muri aka gace kubantu baje kwa muganga bafite umuriro.

Ubu bushakashatsi nta gihembo buri bungenere, ahubwo buzafasha mukongera serivisi nziza itangwa irebana na gahunda yo kurinda indwara ya malariya , kandi ku wemera gufatanya muri ubu bushakashatsi ntangaruka mbi bizamutera. Amakuru atangwa uwemeye gufatanya mu bushakashatsi asubiza urutonde rw'ibibazo rukubiyemo; amakuru ku irangamimerere, ku ikoreshwa rya gahunda yo kurinda indwara ya malaria, ibiyitera ndetse n'ubumenyi kuri malariya kandi ufite uburenganzira bwo kubaza ikibazo waba ufite.

Gufatanya mu bushakashatsi ni ubushake kandi ufite uburenganzira bwo guhagarika ubu bushakashatsi igihe cyose ushatse ntazindi nkurikizi zibayeho. Serivisi muhabwa kukigo nderabuzima ndetse n'imibanire hagati yabayibaha ntabwo izahungabana nagato.Amakuru yose azabikwa mu ibanga kandi nta zina rizajyaho. Uramutse ugize ikibazo kubijyanye n'ubu bushakashatsi wahamagara ni mero zikurikira: ukurikirana ubu bushakashatsi **(0788 683209)** cyangwa uri gukora ubushakashatsi **(0783242350)**.

Nimwemera ko dufatanya muri ubu bushakashatsi, murasinya ku rupapuro ahabugenewe.

### **Kwemera gufatanya mu bushakashatsi**

Numvise neza igikorwa cy'ubushakashatsi nasobanuriwe, nka ba nemeye kubushake gufatanya muri ubu bushakashatsi

Umukono w'umubyeyi / umuhagarariye .....itariki.....

Umukono wuri gukora ubushakashatsi.....itariki.....

Icyitonderwa:Ufite imyaka iri muni ya 18 asinya aurupapuro rwagenewe abana.Utazi kwandika azabifashwa n'umubyeyi we cg umurera .

**Appandix 2: Children under 18 years old assent form**

**Project Title:** Malaria prevalence of and associated risk factors among febrile patients aged from five years attending Ngoma district health facilities

**Investigator:** NIYOYITA Jean Claude(0783242350)

A research study is a way to learn more about malaria risks factors thus we want you to be part of this study. To be part of this study you have to have malaria sign and symptoms .Therefore after giving blood smear for malaria testing while waiting the results you will have a short interview with the researcher/researcher assistant where you will be asked some questions about yourself and the environment . No discomfort will be caused by this study. The study findings will be used by decision makers to avert malaria in this area that is your indirect benefit. The participation is voluntary and confidential and you can stop anytime .

Note:Next of kin/Guardian will sign for illiterate children.

I, \_\_\_\_\_ , want to be in this research study.

Your signature: \_\_\_\_\_Date .....

Guardian 's name and Signature for children unable to write/read :.....Date:

Signature of consented/assented participant: \_\_\_\_\_ Date \_\_\_\_\_



**Umugereka 2: Kwemera kugira uruhare mubushakashatsi ku ufite muni y’imyaka 18 (kinyarwanda)**

**Izina ry’ubushakashatsi:**Kumenya ubwandu bushya bwa malariya nikibutera kubana bafite imyaka itanu ndetse n’abantu bakuru batuye mu karere ka Ngoma baje kuwivuzza bafite umuriro

**Umushakashatsi:** NIYOYITA Jean Claude

Turimo turakora ubushakashatsi kubwandu bushya bwa malaria nikibutera kubana bafite imyaka itanu ndetse nabantu bakuru batuye mu karerere ka Ngoma.Ubushakashatsi nibwo bwonyine bufasha kubona amakuru kuri iyindwara.Niwemera kugira uruhare muri ububushakashatsi turakubaza ibibazo byerekeranye nubushakashatsi.

Hari ibyo ushobora kuba uzi kuri ububushakashatsi:Kwemera kugira uruhare muribwo bisabako uba ufite ibimenyetso bya Malariya kandi watanze ikizami cyo kuyipima.Mugihe ugitegerejeko muganga aguha igisubizo urabazwa ibibazo byerekeranye nububushakashatsi ; numushakashatsi cyangwa umuhagarariye.Ntandaruka buzakugiraho..

Ibizava mubushakashatsi bizakoreshwa nabafata ibyemezo mukurinda ko abantu batuye muri akakarerere barware malariya.Inyungu kuri wowe nuko amakuru uzatanga azifashishwa mukurinda ibitera malariya aho utuye.Niba udashaka kugira uruhare muri ububushakashatsi ntandaruka bizakugiraho kdi igihe cyose wemerewe guhagarika gukorerwaho ubushakashatsi.Ntaho amazina yawe azagaragara mugihe cyogutanga ibyavuye mubisubizo mwaduhaye. Ababyeyi bawe /abakurera nabo bemeye ko ugira uruhare mubushakashatsi.

Gusinya ururupapuro bivuzeko wemeye kugira uruhare mubushakashatsi.

Njyewe, \_\_\_\_\_ , ndemera kugira uruhare muri ububushakashatsi.

Umukono wawe: \_\_\_\_\_itariki\_\_\_\_\_

Umukono w’umubyeyi /umurezi mugihe umwana atazi gusoma no kwandika :  
\_\_\_\_\_ Itariki \_\_\_\_\_

**Ikitonderwa:**Umwana utazi gusinya azasinyirwa nabamuhagarariye

**Appendix3: English version Questionnaire**

Topic: Prevalence malaria and associated risk factors among aged five years and above living in Kibungo Hospital Catchment area, Ngoma District, Eastern province -Rwanda

- a) DISTRICT OF RESIDENCE:.....
- b) SECTOR:.....
- c) CELL:.....
- d) VILLAGE:.....
- e) LABORATORY CODE:.....
- f) HEALTH CENTER NAME:...

**INSTRUCTIONS**

- Read carefully before responding
- Respond all questions
- Answer truthfully by: circle or filling in the provided space the correct answer

**Part1:IDENTIFICATION**

- 1. District of residence: .....
- 2. Sector:.....
- 3. Cellule:.....
- 4. Village:.....

**Part2:SOCIO-DEMOGRAPHIC FACTORS**

**5.Sex**

- 1.Male
- 2.Female

**6.Age:.....**

**7.Martal Status**

- 1.Single
- 2.Married
- 3.Separated/Divorce
- 4.Widow
- 5.Live with parent/guardian

**8.Level of Education:.....**

- 1. None
- 2.Primary
- 3.Secondary
- 4.University

**9.Profession**

- 1.Public servant
- 2.Self-employed
- 3.Private sector
- 4.Farmer
- 5.Fisher

- 6.Wetland farmer
- 7.Upland farmer

8.Rice farmer

9.Other

(specify):.....

**10. Religion**

- 2. Catholic
- 3. Moslem

1. Protestant

9 Other( specify):.....

**11. Do you do night duty?**

- 1. Always
- 2. Occasionally
- 3. No

**17. Did you travelled in neighboring country during the last month**

- 1. Yes
- 2. No

**12. Number of children:.....**

**18. If yes in which country did you visited?**

**13. What is your ubudehe category level**

- 1. Ubudehe1
- 2. Ubudehe2
- 3. Ubudehe3
- 4. Ubudehe4

1. DRC

2. Uganda

3. Burundi

4. Kenya

5. Tanzania

**14. Do you have health insurance**

- 1. Yes
- 2. No

9. Other

(Specify):.....

**15. What is your health insurance?**

- 1. Mutuelle
- 2. RSSB(RAMA)
- 9. Other (specify):.....

**19. If yes, did you use LLINs there?**

- 1. Yes
- 2. No

**20. How many bedrooms do you have.....?**

**16. Number of sleeping space:.....**

**PART3. INSECTICIDE TREATED NET (ITN)**

**21. Have you ever seen or heard an insecticide treated nets?**

- 1. Yes
- 2. No

**22. Do you own any ?**

- 1. Yes
- 2. No

**If no skip to 31 Question**

**23. How many ITN do you have in the household?**

- 1. One
- 2. Two
- 3. Three and above

**24.a ITN number 1**

- 1. New
- 2. Torned

**24.b**

- 1. New
- 2. Torned

**24.c**

- 1. New
- 2. Torned

**24.d**

- 1. New
- 2. Torned

**25. How long have you been with the current ITN(s)(in Years)**

**25.a**

- 1. One
- 2. Two
- 3. Three

- 4. Four
- 5. Five and above
- 6. Don't know

**25.b**

- 1. One
- 2. Two
- 3. Three
- 4. Four
- 5. Five and above
- 6. Don't know

**25.c**

- 1. One
- 2. Two
- 3. Three
- 4. Four

- 5. Five and above

**25.d**

- 1. One
- 2. Two
- 3. Three
- 4. Four
- 5. Five and above

**25.e**

- 1. One
- 2. Two
- 3. Three
- 4. Four
- 5. Five and above

**26. Do you sleep under ITN?**

- 1. Yes
- 2. No

**If Q22 is no, please go to the question 29**

**27.Frequency of sleeping under ITN**

- 1.Always
- 2. Not always

**28.Did you use it last night ?**

- 1. Yes
- 2. No

**29.Reasons for not using the available ITNs**

- 1. Housing structure not favorable to ITNs use
- 2. Absence of bed
- 3. Causes allergy/itching
- 4. Make me uncomfortable
- 5. Nets do not prevent malaria
- 6. Afraid of its toxicity
- 7. Increase bed-heat
- 8. Bed bugs
- 9. Other  
(specify):.....  
.....

**30.Where do you get ITN?**

- 1.ANC
- 2.EPI
- 3.Mass campaign

**9.Other (specify):.....**

**31.What are the reasons for unavailability of ITNs/not owning ITNs**

- 1. Fear to use
- 2. Cost not affordable
- 3. Lost then thrown away
- 4. Old then thrown away
- 5. Used for other purpose
- 9.Other(specify):.....

**32.Do you think is it important to sleep under mosquito net**

- 1.Yes
- 2.No

**33.What do you think is the benefit of sleeping under mosquito nets**

- 1. Prevent malaria infection
- 2. Help save money for other purpose by averting malaria
- 3. Fill comfortable
- 4. Saves time for visiting health facility to seek care due to malaria
- 5. Don't know
- 9.Other(specify):.....

**34.In case you did not get ITN from the health facility can you afford to purchase them yourself**

- 1.Yes
- 2.No

**35.If no why?:.....**

**36.In which season you use mosquito nets ?**

- 1. Always
- 2. Rain season
- 3. Dry season
- 4. Don't know
- 5. None
- 9.Other  
(specify):.....

**37.What are the reason for using the nets in such above cited seasons?.....**

**38:What are the malaria sign and symptoms do you know?**

- 1. Chills
- 2. Lose of appetite
- 3. Headache
- 4. Abdominal pain
- 5. Don't know
- 9.Other  
(specify):.....

**39:What are the malaria sign and symptoms did you come with at health facility**

- 1.Fever
- 2.Loss of appetite
- 3.Headache
- 4.Vomiting

5.Abdominal pain

6.Diarhea

7.Don't know

9.Other(specify):.....

**40.What do you do if you have an episode fever?:**

- 1. Go to health facilities
- 2. Go to the CHWS
- 3. Seek traditional medicine
- 4. Seek medicine from shopping pharmacy
- 9.Other( specify):

**41.Is the blood smear taken:**

- 1.yes
- 2.No

**42.What was the result:**

- 1. Malaria positive
- 2.Malaria negative

**43. What are malaria drugs used to treat malaria in Rwanda?:.....**

- 1. Coartem
- 2. Paracetamol
- 3. Aspirin
- 9.Other(  
specify):.....

**44.What are the causes of malaria?:**

- 1. Hunger
- 2. Eating maize stalk
- 3. Eating immature sugar cane
- 4. Being bitten by mosquito

9.Other  
(specify):.....

**45.Is malaria preventable**

- 1.Yes
- 2.No

**46.If yes: What are the main measures do you use to prevent malaria?**

- 1. Use of insecticides treated nets
- 2. Destroying breeding sites
- 3. Use of antimalarial drugs
- 4. Use of traditional medicines
- 5. Using repellents
- 6. Using mosquito electric killer
- 9.Other(  
specify):.....

**PART 4: TYPE OF HOUSING AND ENVIRONMENT**

**47.At what time do you go home?**

- 1. Before 5.00 PM
- 2. 6.00 PM
- 3. 7.00 PM
- 4. 8.00 PM
- 5. 9.00 PM or above

**48. At what time do you go to bed?:**

- 1.At 6.00 PM
- 2.7.00 PM

- 3.8.00 PM
- 4.9.00 PM or above
- 5.10.00
- 6.11.00
- 7.12.00 a.m
- 8.Above 12.00 a.m

**49. At what time do you go to work?:**

- 1. 4.00 AM
- 2. 5.00 PM
- 3. 6.00 PM

**50. Did you wear long sleeves clothes during the last night?:**

- 1.Yes
- 2.No

**51.Is your house and surrounding environment clean?:**

- 1. Yes
- 2. No

**52.Is your house nearest to breeding sites like:**

- 1. River
- 2. Stagnant water
- 3. Bush
- 4. Ponds
- 5. Water dam
- 6. Farming activities
- 7. Rice farming

9. Other  
(specify):.....

**53. How far is your house from the breeding sites?:(in Kilometer)**

1. Less than 1
2. 1
3. 2
4. 3
5. 4
6. 5km and above

**54. Is your house have windows?**

1. Yes
2. No

**55. Number of windows available**

1. One

**59. Is there an opening in the wall**

1. Yes
2. No

**60. Is your house made up of modern materials(such as metal roofs and brick or concrete walls)?:**

1. Yes
2. No

**61. Is your house made with traditional/rudimentary materials(thatch like staw, reeds, palm leaves or similar material)?:**

2. Two
3. Three
4. Four
5. Five and above

**56. Do your house's window have mosquito wire gauze?:**

1. Yes
2. No

**57. Does your house have separate rooms?:**

1. Yes
2. No

**58. What is the structure of your room?:**

1. Has the place where to hung mosquito net
  2. No space to hung mosquito net
1. Yes
  2. No

**62. Is your house have windows/door where they have been designed to be?**

1. Yes
2. No

**THANK YOU**



**Umugereka 3: Ibibazo mu rurimi  
rw'ikinyarwanda**

b.HEALTH CENTER  
NAME:.....  
.....

**IZINA RY'UBUSHAKASHATSI:**

Ubushakashatsi ku ndwara ya malariya  
kubantu bafite imyaka itanu kuzamura  
batuye mukarere ka ngoma

**AMABWIRIZA**

- Soma neza mbere yo gusubiza
- Subiza ibibazo byose
- Subizanyukuri: Ushyira akaziga cyangwa wuzuzababugenewe

a.NOMERO YA  
LABORATWARI:.....  
.....

**IGICE 1: UMWIRONDORO**

1.AKARERE UTUYEMO:

.....

2.

UMURENGE:.....

.....

3.AKAGARI:.....

.....

4.UMUDUGUDU:.....

.....

**IGICE CYA II: IBYOROHEREZA  
MALARIYA**

**5. Igitsina**

1. Gabo
2. Gore

**6. Imyaka: .....**

**7. Irangamimerere**

1. Ndibana
2. Ndubatse
3. Twaratandukanye
4. Umupfakazi/re
5. Mbana n' ababyeyi/Abandera

**8. Amashuri wize**

1. Nta mashuri mfite
2. Abanza
3. Ayisumbuye
4. Kaminuza

**9. icyo ukora**

1. Umukozi wa Leta
2. Ndikorera
3. Nkorer' abigenga

4. Umuhinzi
5. Umurobyi
6. UHINGAIBISHANGA
7. UHINGAIMUSOZI
8. UHINGAUMUCELI
9. Umunyeshuri

**10. Idini**

1. Umukristo
2. Umusiramu
3. Irindi(Waritubwira):

**11. Ukora akazi k' ijoro?**

1. Buri gihe
2. Rimwe narimwe
3. Nta narimwe

**12. Umubare w' abana: ...**

**13. Uri mu cyiciro cya kangahe cy' ubudehe?**

1. Ubudehe 1
2. Ubudehe 2
3. Ubudehe 3
4. Ubudehe 4

**14. Ufit'ubwishingizi bwo kwivuzza:**

1. yego
2. Hoya

**15. Ukoresh'ubuhebushingizi bwo kwivuzza?**

1. Mutuelle(MUSA)
2. RSSB(RAMA)
3. MMI
9. Ubundi(Wabutubwira):

**16. Umubare w' uburyamo: .....**

**17. Wabwarigeze ujya mu bihugu duturanye mu kwezi gushize?**

1. Yego
2. Hoya

**18. Niba ari yego ni ikihe gihugu wagiye?**

1. RDC
2. Uganda
3. Burundi
4. Kenya
5. Tanzaniya
9. Ahandi(havuge): .....

**19. Niba ari yego, waba warakoresheje inzitiramubu iteye umuti?**

1. Yego
2. Hoya

**20. Mufite uburyamo bungaha?:...**

**IGICE CYA III. INZITIRAMUBU ITEYE UMUTI**

**21. Waba warabonyeho cg warumvise Inzitiramubu iteye umuti?**

1. Yego
2. Hoya

**22. Mwaba mufite Inzitiramubu iteye umuti?**

1. Yego
2. Hoya

**Niba ari ntayo ufite komeza kukibazo cya 31**

**23. Mufite inzitiramubu zingaha mu rugo?**

1. Imwe
2. Ebyiri
3. Eshatu kuzamura
4. Nta nimwe dufite

**24. Inzitiramubu ufite ubu imeze ite?**

**24.a)**

1. Ni nshya
2. Yarashaje

**24.b)**

1. Ni nshya
2. Yarashaje

**24.c)**

1. Ni nshya
2. Yarashaje

**24.d)**

1. Ni nshya
2. Yarashaje

**25. Inzitiramubu muyimaranye igihe kingana iki?(Imyaka)**

**25.a) Inzitiramubu ya mbere**

1. Umwe cg munsi yawo
2. Ibiri
3. Itatu
4. Ine
5. Itanukuzamura

6. Simbizi

**25.) Inzitiramubu ya kabiri**

1. Umwe cg munsi yawo
2. Ibiri
3. Itatu
4. Ine
5. Itanu kuzamura
6. Simbizi

**25.c) Inzitiramubu ya gatatu**

1. Umwe cg munsi yawo
2. Ibiri
3. Itatu
4. Ine
5. Itanu kuzamura
6. Simbizi

**24.d) Inzitiramubu ya kane**

1. Umwe cg munsi yawo
2. Ibiri
3. Itatu
4. Ine
5. Itanukuzamura

6. Simbizi

**24.e) Inzitiramubu ya gatanu**

1. Umwe cg munsiyawo

2. Ibiri

3. Itatu

4. Ine

5. Itanukuzamura

6. Simbizi

**26. Uryama mu nzitiramubu?**

1. Yego

2. Hoya

**Niba ari oya jya ku kibazo cya 29**

**27. Ukoresh'inzitiramubu kangahe?**

1. Buri gihe

2. Si buri gihe

3. Ntanarimwe

**28. Waba waraye mu nzitiramubu mu ijoro ryakeye?**

1. Yego

2. Hoya

**29. Impamvu utakoresheje Inzitiramubu**

1. Uburyamo budafite aho kuyimanika

2. Itera uburyaryate

3. Ituma ntaryama neza

4. Ntabwo irinda Malariya

5. Gutinya ko yanyanduza

6. Yongera ubushyuhe mu buriri

7. Itera ibihari mu buriri

8. Kutagira inzitiramubu

9. Indi mpamvu (Yivuge):...

**30. Inzitiramubu mufite mwayikuye he?**

1. Kwa muganga igih'umugore atwite

2. Igihe cyogukingira / gukingirwa

3. Mu gikorwa rusange cyo kuzitanga

9. Ahandi (havuge): ...

5. Simbizi

**31. Impamvu udafite inzitiramubu**

1. Gutinya kuyikoresha

2. Irahenze

3. Barayibye/Yaratakaye

4. Yarashaje turayijugunya

5. Tuyikoresha ibindi

9. Indi mpamvu (Yivuge): ...

**32. Kuryama mu nzitiramubu iteye umuti wumva bifite umumaro**

1. Yego

2. Hoya

**33. Kuki wumva byaba ari ingirakamaro kuryama mu nzitiramubuiteye umuti?**

1. Irinda Malariya

2. Kwirinda Malariya bituma twizigama amafaranga adufasha mu bindi

3. Kurara mu nzitiramubu bitera akanyamuneza

4. Biturindagutaumwanya wo kujyakwivuzamalariya

5. Simbizi

6. Ikindi (Kivuge): .....

**34. Utabonye Inzitira mubu ku kigo nderabuzima cg mugiko rwa rusange cyo kuzitanga washobora kuyigurira?**

1. Yego

2. Hoya

**35. Niba ari Hoya sobanura impamvu: ...**

**36. Ni mu kihe gihe ukoresha inzitiramubu**

1. Burigihe

2. Igihe cy' imvura

3. Igihe cy' izuba

4. Simbizi

5. Ntanarimwe

9. Ikindi (Kivuge): ...

**37. Ni izihe mpamvu zituma ukoresha cg udakoresha inzitiramubu muri kiriya gihe uvuze hejuru?.....**

**38. Ni ibihe bimenyetsobya Malariya uzi?**

1. Gutitira

2. Kumva udashaka kurya

3. Kubabara umutwe

4. Kuruka

5. Kubabara munda

6. Kwituma ibyoroshye

7. Kugiraumuriro

8. Simbizi

9. Ikindi (Kivuge): .....

**39. Ni ibihe bimenyetso bya Malariya waje kwa muganga ufite**

1. Umuriro
2. Kumvaudashakakurya
3. Kubabaraumutwe
4. Kuruka
5. Kubabaramunda
6. Kwitumaibyoroshye
7. Simbizi
8. Ikindi (Kivuge): .....

**40. Ukora iki iyo ugize umuriro?**

- 1.Njyakwamuganga
- 2.Njyakumujyanama w' ubuzima
- 3.Njyakumuvuziwagakondo
- 4.NguraimitimuriFarumasi
- 5.Ikindi(Kivuge): ...

**41. Bagufashe amaraso yo gupima Malariya:**

1. Yego
2. Hoya

**42. Basanze ufite malariya?**

1. Yego
2. Hoya

**43. Ni uwuhe muti ukoreshe mu Rwanda kuvura Malariya?**

1. Coartem
2. Paracetamol
3. Aspirin
9. Undi (Wuvuge): ..

**44. Ni ibiki bitera Malariya?**

1. Inzara
2. Kurya imisigati
3. Kurya ibisheke biteze
4. Kurumwa n' umubu
9. Ikindi (Kivuge): ...

**45. Malariya ishobora kwirindwa?**

1. Yego
2. Hoya

**46.Niba ari yego, Mwaba mukoresha ubuheburyo mu kwirinda malaria?**

1. Gukoresha Inzitiramubuiteye umuti
2. Gutema ibihuru no gusiba ibizenga aho dutuye
3. Gukoresha imiti ivura Malariya
4. Gukoresha imiti ya Kinyarwanda

5.Gukoresha ibikoresho byirukana imibu (urugero:amavuta yirukana imibu,akuma k,amashanyarazi,Boygon,)

6.Ntabwo

9. Ikindi (Kivuge): ...

**IGICECYA 4:IMITERERE  
YAHOTUBA N'IBIDUKIKIJE**

**47. Utaha ryari?**

1.Mbere ya saa kumi nimwe z'umugoroba

2.Saa kumi nimwe z' umugoroba

3.Saa kumi nebyiri z'umugoroba

4.Saamoyaz'ijoro

5.Saambiriz'umugoroba

6.Saatatuz'ijorokuzamura

**48. Uryama ryari?**

1.Saakumin'ebviriz'umugoroba

2. Saa moya z'ijoro

3.Saa mbiri z'ijoro

4.Saa tatu z'ijoro

5.Saa yine z'ijoro

6.Saa tanu z'ijoro

**49. Ubyuka ryari?**

1.Saa kumi za mugitondo

2.Saa kumi nimwe za mu gitondo

3.Saa kumi n'ebvyiri za mu gitondo

9.Ikindigihe(kivuge):...

**50.Waba warambaye imyenda  
y'amaboko maremare mw'ijoro ryakeye?**

1.Yego

2. Hoya

**51.Aho utuye hari aho imibu ya  
kororokera(urugero:Ibihuru,amazi  
adatamba?**

1.Yego

2. Hoya

**52.Waba utuyehafi yaho imibu  
yororokera nki:**

1.Imigezi

2.Amazi adatamba

3.Ibihuru

4.Ibishanga

5.Ibidamu

6.Ahakorerwa ubuhinzi

7.Ahahingwa umuceri



8.Ntabyo

9.Ibindi(bivuge):.....

**53. Hari urugendo rungana iki kuva aho imibu yororokera kugera aho utuye (urugero:igishanga,Ibihuru)**

1.Munsiya 1km

2.Kirometeroimwe

3.Kirometeroebyiri

4.Kirometeroeshatu

5.Kirometeroenye

6.Kirometero 5 kuzamura

**54. Inzu yawe ifite amadirishya**

1.Yego

2. Hoya

**55. Inzu yawe ifite amadirishya angahe?**

1.Rimwe

2.Abiri

**59. Inzu uraramo ifite imyenge yanyuramo imibu?**

1.Yego

2. Hoya

**60. Inzu yawe ikozwe nibikoresho bigezweho (urugero:amabatikugisenge,.)**

1.Yego

2. Hoya

3.Atatu

4.Ane

9. Undi mubare wuvuge:...

**56. Amadirishya yinzu yawe afite utuyunguruzo tubuza imibu kwinjira?**

1.Yego

2. Hoya

**57. Inzu yawe ifite ibyumba bitandukanye?**

1.Yego

2. Hoya

**58. icyumba uraramo gifite aho wa manika inzitiramubu?**

1.Yego

2.Hoya

**61. Inzu yawe yubatswe n'ibikoresho byoroheje/ (ibyatsi, ibirere, imigano cg ibindi nkabyo)**

1.Yego

2. Hoya

**62. Inzuyawe ifite amadirishya/inzugi aho byagenewe kujya?**

1.Yego

2. Hoya

**Appendix 4. Relationship between socio-economic, geographic environmental characteristics and malaria infection among febrile patients in Ngoma District**

Variables	n(%)	OR (unadjusted)	95%		P-Value
			Lower	Upper	
<b>Gender</b>					
Female	144(56.03)	Ref			
Male	113(43.97)	1.71	1.05	2.77	<b>0.02</b>
<b>Age(Years)</b>					
5-14	34(13.23)	Ref			
15-24	63(24.51)	0.27	0.86	0.89	<b>0.03</b>
25-34	75(29.18)	0.19	0.06	0.63	<b>0.00</b>
≥35	85(33.07)	0.19	0.05	0.05	<b>0.00</b>
<b>Marital status</b>					
Married	128(49.81)	Ref			
Not married	129(50.19)	0.91	0.52	1.60	0.76
<b>Level of education</b>					
None	41(15.95)	Ref			
Primary	153(59.53)	0.77	0.39	1.49	0.44
Secondary or above	63(24.51)	0.79	0.34	1.85	0.60
<b>Occupation</b>					
Employed	9(3.50)	Ref			
Not employed or farmer	248(96.50)	0.51	0.09	2.92	0.45
<b>Residence</b>					
Gashanda	4(1.56)	Ref			
Jarama	26(10.12)	4.01	0.61	26.41	0.14
Karembo	1(0.39)	1.20	0.62	23.26	0.90
Kazo	7(2.72)	1.03	0.15	6.88	0.97
Kibungo	19(7.39)	2.64	0.44	15.64	0.28
Mugesera	17(6.61)	1.54	0.26	9.01	0.62
Murama	8(3.11)	1.07	0.16	7.22	0.93
Mutenderi	30(11.67)	7.35	1.08	49.97	<b>0.04</b>
Remera	30(11.67)	3.03	0.54	16.76	0.20
Rukira	25(9.73)	1.09	0.20	5.83	0.91
Rukumberi	25(9.73)	2.87	0.50	16.43	0.23
Rurenge	17(6.61)	0.92	0.16	5.05	0.92
Sake	26(10.12)	3.86	0.62	23.91	0.14
Zaza	26(8.56)	0.87	0.169	4.55	0.87

<b>Ubudehe category</b>					
Category 1	35(13.62)	Ref			
Category 2	122(47.47)	1.61	0.80	3.22	0.17
Category 3	100(38.91)	1.45	0.66	3.19	0.35
<b>Notion of traveling</b>					
No	250(97.28)	Ref			
Yes	7(2.72)	2.22	0.39	12.62	0.36
<b>ITN Ownership</b>					
No	62(24.12)	Ref			
Yes	195(75.88)	0.83	0.33	2.10	0.70
<b>Sleeping under ITN last night</b>					
No	86(33.46)	Ref			
Yes	171(66.54)	1.17	0.53	2.58	0.68
<b>Knowledge of malaria causes</b>					
Bitten by mosquito	254(98.83)	Ref			
Eating immature cane	1(0.39)	0.06	0.04	1.00	0.05
Eating maize stalk	1(0.39)	0.21	0.01	2.57	0.22
Hunger	1(0.39)	1.27	0.06	26.03	0.87
<b>Knowledge of malaria prevention methods</b>					
No	1(0.39)	Ref			
Yes	256(99.61)	2.40	0.16	0.29	4.59
<b>Distance from breeding sites</b>					
Less than 1 km	123(47.86)	Ref			
1to 4 km	110(42.80)	1.10	0.61	2.00	0.73
Equal to 5 km o more	24(9.34)	0.64	0.26	1.61	0.35