



## INFLUENCE OF SOCIODEMOGRAPHIC CHARACTERISTICS AND LEVEL OF AWARENESS ON MALARIA DISEASE RESURGENCE AMONG THE ADULT RESIDENTS OF ISIOLO SUB-COUNTY IN KENYA

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### Abstract:

**Background:** This study evaluated the determinants of malaria disease resurgence among the adult residents of Isiolo Sub-county in Kenya. The following specific objectives guided this research; to establish the influence of the level of awareness on malaria disease resurgence among the adult residents of Isiolo Sub-county in Kenya and to evaluate demographic characteristics influencing malaria disease resurgence among the adult residents of Isiolo Sub-county in Kenya. **Methods:** This was a descriptive study, employing a cross-sectional study design. The researcher used mixed research methodology in this study which employed both qualitative and quantitative methods. Stratified sampling techniques were used for sampling the study respondents. The residents of Isiolo Sub-county, key informant interviewers and NGOs/CBO based focus group discussion constituted the target population. The study respondents were selected from five different wards of Isiolo Sub-county with a Sample size of 392 comprised of 385 respondents randomly selected for quantitative data and 7 key informants and focus group discussion for qualitative data. The study used interview guides to collect data from key informants. Quantitative data were collected using self-administered questionnaires. SPSS version 25.0 was used in quantitative data analysis while qualitative data was analyzed thematically. **Results:** Respondents experienced malaria resurgence in the study as evidenced by knowledge of malaria disease symptoms, causative agents of malaria disease, mode of transmission, treatment and intervention strategies among others. The study established that all the characteristics considered in this study had some level of influence on the resurgence of malaria disease in the study site. Further, Regression analysis model had a R<sup>2</sup> of +0.700, p=0.000 for awareness, and standardized beta co-efficient of +0.593, p=0.000 for demographic, showing statistically significant positive influence on malaria resurgence in Isiolo sub-county. The study Policy makers

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in Isiolo Sub-county should consider formulating policies that support education for the residents since a big percentage 58% had not attended any form of schooling. The researcher recommended that Policy makers and NGOs/CBOs sought to allocate additional resources in support of educating residents about malaria disease and how to control it.

**Keywords:** malaria, awareness, demographic characteristics, Isiolo County

## 1. Introduction

Infection with *Plasmodium* species causes a life-threatening disease known as malaria. Anopheles mosquitoes carry parasites through the female Anopheles mosquito from one human to another. According to the World Health Organization, there were 241 million illnesses and 627,000 fatalities due to malaria infections in 2020. Children and pregnant women account for more than two-thirds of all malaria-related deaths. The World Health Assembly's worldwide plan, which seeks to maintain malaria-free countries by 2030, reduced malaria mortality and burden in 35 countries by at least 90% in 2015; WHO (2015) approved the broad use in endemic areas in October 2021 of the world's first human parasitic disease immunization for young children to accomplish this goal. On World Malaria Day 2022, the infectious disease team at Nature Communications has gathered a compilation of scientific publications to highlight recent advances in malaria research.

Malaria is the most widespread parasitic disease that may affect people, and it can be found in more than one hundred countries that are located in tropical and subtropical regions. Around 500 million people are infected by it every year, and between one and three million people are killed by it annually; the majority of those killed are youngsters younger than five years old. There are four different protozoa species that are responsible for the illness. They belong to the class Haematozoa and the order Haemosporida, and their genus name for them is *Plasmodium* (Maraka et al., 2020). *Plasmodium falciparum* is responsible for tropical malaria; *Plasmodium vivax* is responsible for tertian malaria; *Plasmodium malariae* is responsible for quartan malaria and *Plasmodium ovale* is responsible for tertian malaria are the major infectious species in sub-Saharan Africa and globally. According to analyses of the core and mitochondrial nucleic acid sequences, *Plasmodium falciparum* is the parasite that is most closely associated with *Plasmodium gallinaceum*. This parasite is made up of types that are genetically unique from one another. On the basis of the mutations that have been found, it is believed that the age of *P. falciparum* is between 10,000 and 100,000 years, which corresponds to the evolution of hominids. This belief is based on the fact that no indicators of malaria selection pressure have been detected in Central or North Europe (Maraka et al., 2020). These four species of *Plasmodium* that cause disease in humans do not infect any other animals. In extremely rare cases, the malaria parasites carried by other primates can cause sickness in humans (e.g., *Plasmodium simium*, *Plasmodium cynomolgie*, and *Plasmodium knowlesi*).

Nearly 405,000 people lost their lives to malaria in 2018, according to the World Health Organization. This number represents a decrease from 416 000 in 2017 and 585,000 in 2010. Malaria cases were estimated to number 228 million worldwide in 2018 (95 percent confidence interval [CI]: 206–258 million). This is a decrease from 231 million cases in 2017 (95 percent confidence interval [CI]: 211–259 million) and 251 million cases in 2010 (95 percent confidence interval [CI]: 231–278 million). Nasir with his fellow workers (Nasir et al., 2020). The WHO region that had the second-fewest cases of malaria in 2018 was the WHO South-East Asia Region (2.1 percent), followed by the WHO Eastern Mediterranean Region (2.1 percent) (3.4 percent). The WHO African Region had the highest number of reported cases of malaria (93 percent, or 213 million). In all, over 85 percent of the world's malaria burden was carried by 19 countries in India and sub-Saharan Africa. More than half of all cases of malaria in the world were accounted for by just six countries in Africa and they are; Niger (4 percent), Mozambique (4 percent), Côte d'Ivoire (4 percent), Uganda (5 percent), and the Democratic Republic of the Congo (12 percent) and Nigeria accounted for 25 percent of all malaria cases worldwide.

The worldwide malaria incidence rate decreased from 71% to 57% incidents per 1000 individuals at risk between 2010 and 2018. Nevertheless, between the years 2014 and 2018, the rate of change slowed significantly falling to 57% in 2014 and remaining at comparable rates until 2018. The incidence rate in the WHO South-East Asia Region continues to fall, going from 17 cases per 1000 individuals at risk in 2010 to five cases per 1000 individuals in 2018. This is a significant decrease. (a 70 percent reduction) (Abdelsattar & Hassan, 2021). The number of cases reported in the WHO African Region has similarly declined, going from 293 in 2010 to 228 in 2018, which represents a fall of 22 percent. In all of the other WHO areas, the incidence rate went up, which suggests that there has been either no improvement or an increase. The Americas Region of the WHO saw a rise primarily as a result of an increase in the transmission of malaria in the Bolivarian Republic of Venezuela.

Only 31 of the major nations that are prone to malaria experienced significant drops in the number of cases reported between 2015 and 2018. By the year 2020, the countries were on target to accomplish a reduction in case incidence of at least 40 percent. If the transition is not sped up, the Worldwide Technological Plan for Malaria 2016–2030 (GTS) will not be able to meet its objectives for morbidity in 2025 to 2030. *Plasmodium falciparum* is perhaps the most common form of the malaria parasite and it accounts for 99.7 percent of all cases of malaria that are diagnosed in 2018 (WHO,2018). Its prevalence is highest in the WHO Eastern Mediterranean areas (71 percent), WHO South-East Asian Region (50 percent), and Also WHO African areas (50 percent). India is the most affected country in the WHO Asia; the Pacific area is responsible for 53 percent of the global *P. vivax* load. *P. vivax* is the most common type of malaria parasite and it is responsible for 75 percent of all cases of malaria disease in the WHO Americas Region.

An estimated 3.5 million new cases and 10,700 deaths due to malaria occur each year in western Kenya. As in many other countries, the CDC has worked for hand in hand with the Ministry of Health in Kenya to tackle malaria. As part of its commitment

to public health, CDC works with worldwide health ministries to build their capacity and offer technical assistance. The CDC provides on-site service and financial support to Kenyan researchers studying malaria. Kenyan field workers, laboratory technicians, physicians, and scientists have all benefited from the CDC's involvement in Kenya over the last three decades. Many of Kenya's degree-seeking students can now rely on the subject matter experts at CDC for regular support as they work toward their academic goals. Additionally, the CDC's technology transfer to KEMRI has had a substantial impact. To carry out its activities at the local level, CDC provided it with vital technology resources previously unavailable. KEMRI and the CDC work together to monitor health facilities. Routine surveillance in hospitals and health centers records these infections.

According to estimates, as many as 80% of persons infected with malaria in western Kenya are asymptomatic. They avoid going to hospitals to prevent getting malaria because of the risk of obtaining the disease. They have come up with an innovative way to track the spread of malaria by testing community members in their homes every working day of the year. Malaria control efforts may be monitored thanks to the Kenyan health ministry's two surveillance methods. Vector and pesticide resistance surveillance are carried out to understand better how mosquitoes and malaria parasites interact and assess the effectiveness of indoor residual spray and long-lasting insecticide-treated nets. Lastly, the Child Health and Mortality Prevention Surveillance (CHAMPS) Network study and our HDSS support the surveillance of deaths using minimally invasive tissue sampling (MITS) and verbal autopsy to assess the long-term impact of scaling up malaria interventions on mortality associated with malaria.

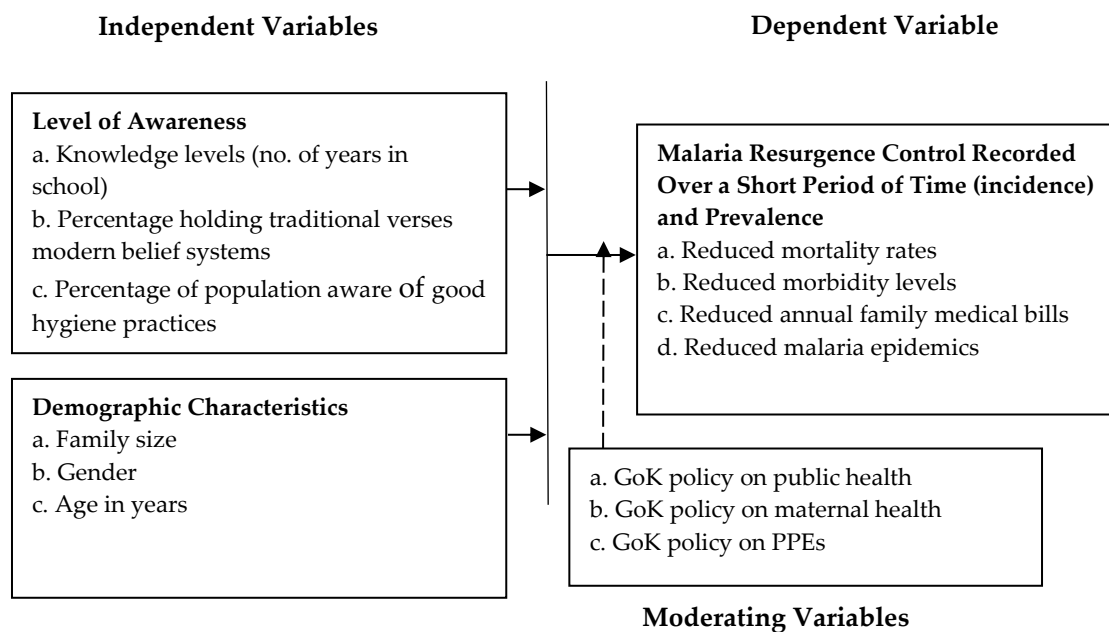
Resurgence will happen after MDA unless the conduction potential is extremely low or the post-MDA occurrence falls below the verge that is reliant on both instability induction and transmission potential, according to the conceptual models. Introduction rates are only relevant if this verge is exceedingly low. The steady state attained at the conclusion of most Open Malaria imitations was autonomous of the presence of MDA. The ultimate state was untouched by the reasonable introduction of diseases. To eradicate the illness, high-intensity test-and-treat, low prevalence and extremely effective case organization were all required. Test-and-treat-induced instability has no effect on case management. As transmission capacity increased, revival became more rapid (not treatment rates). Resurgence is anticipated to follow a brief period of high-impact MDA. To prevent comeback, concurrent therapy must either be more successful in clearing or preventing illnesses at low prevalence or dramatically lower average transmission potential. Case management with high effective coverage has this differential impact, and it should be sufficient to avoid revival caused by imported cases at realistic importation rates. In the event of a revival, the rate of spread is mostly determined by the transmission potential rather than by therapeutic methods. his study, therefore, seeks to evaluate malaria disease resurgence determinants among the adult residents of Sub-county of Isiolo in Kenya.

The primary goal of this study was to evaluate the determinants of malaria disease resurgence among the adult residents of Isiolo Sub-county in Kenya. The following specific objectives guided this study:

- 1) To establish the influence of the level of awareness on malaria disease resurgence among the adult residents of Isiolo Sub-county in Kenya.
- 2) To evaluate demographic characteristics influencing malaria disease resurgence among the adult residents of Isiolo Sub-county in Kenya.

## 2. Conceptual Framework

In the conceptual framework, the study was guided by dependent variables, independent variables and moderating variables. The independent variables are the specific objective of the study and these are determinants that influence malaria resurgence while the dependent variables are malaria disease resurgence and moderating variables or intervening are extrinsic factors that influence moderating variables as described in the figure below.



**Figure 1: Conceptual Framework**

## 3. Methods

The study design defines the kind of research for instance as correlational, descriptive, semi-experimental, and experimental, meta-analytic, analysis, as well as sub-types for example descriptive-longitudinal case study. It also describes the problem of research, hypothesis, independent and dependent variables and where it applies, and the procedures for data gathering and analysis. The design of the study is thus a framework that is used to help answer the research questions. This study employed a cross-sectional

design where both quantitative and qualitative data were used for collection and analysis.

Summarily the design used mixed approach methodology and also referred to as mixed method research designs that encompass data collection by use of surveys, interviews and focus group discussion and this is also referred to as qualitative and quantitative research.

### **3.1 Settings, Population and Study Design**

The research took place in Isiolo Sub-county, which is part of the greater Isiolo County. The sub-county covers an area of 3269 sq.km as well as five political administrative units that include Wabera, Bulla Pesa, Burat, Ngaremara and Oldonyiro.

The populace targeted was residents of Isiolo Sub-county which were composed of local residents, Key Informants {health managers and CEC/CCO and NGOs/CBO in support of health programs. The study respondents were selected from five different wards in Isiolo Sub-county.

### **3.2 Inclusion Criteria**

- 1) All the adults with sound mind randomly selected formed the basis of study respondents;
- 2) Only the relevant heads of the county health department were selected as key informant interviewers;
- 3) The study respondents must be above 18 years old;
- 4) Only sane respondents were considered to participate in the study.

### **3.3 Exclusion Criteria**

- 1) Insane respondents randomly selected were not allowed to participate in this study;
- 2) Visitors to the sub-county who will not have stayed in the region for more than one year were excluded from the study;
- 3) Minors were not allowed to participate in this study.

### **3.4 Sample Size**

This study focused on a population of fewer than 10000 people and hence targets 385 respondents in addition to 7 key informants' interviewers hence totaling 392 respondents and two sessions of focus group discussion of 10 people who are mainly health professionals working in the disease surveillance in the 5 mentioned wards, Local influential leaders, business community and religious leaders.

The study respondents were selected from five different wards and which are done by simple random sampling after stratification, therefore it is clear that the study's total target population was  $N = 385$ . Therefore, the sample size will be calculated with the help of Yamane formula of 1968 as shown below from a population of less than 10000 statistically.

Below is the mathematical illustration for the Taro Yamane method:

$$n = N / (1 + N(e)^2)$$

Where:

n signifies the sample size;

N signifies the population under study;

e signifies the margin error;

$$n = 1 + 10,00 \times (0.005)(0.005)^2$$

$$n = 385$$

The sample size was then proportionately shared with the population of the wards as per the latest literature review on the census by the researcher. The sample size of 385 and 7 key informant interviews totalled 392 as total respondents in this research.

### 3.5 Data Analysis

The reliability of the study instruments will be checked through the test-re-test method. This method involves administering the instruments to the respondents and after some period of time re-administering the same instruments to see the consistency with which the questions are answered. The researcher administered the questionnaires to 20 members of the public at the neighbouring Meru County and after a two-week period, the researcher administered the same instruments once more to the actual respondents. The reliability of the instruments was based on the consistency of the responses given. Computation of the alpha reliability coefficient between the scores of the two sets of questionnaires was carried out using Pearson's Product Moment Correlation Formula. If a value of  $r > 0.70$  is obtained, then this will indicate high internal reliability (Kothari, 2009), for our case 15 respondents gave a similar reading that corresponds to 75% of that total measure hence this index of the coefficient was greater than 0.75 which indicated that our tool was valid.

In this study, the researcher used both SPSS and Info Software. The SPSS is for quantitative data analysis and hence deals with numbers only while Info Software is like SPSS but doesn't deal with numbers but deals with attitudes, and beliefs and therefore mainly for themes and subthemes also called thematic analysis and it is purely for qualitative data. Lastly, the study findings were presented in form of tables, figures and pie charts etc.

The study used the multiple regression model to find the link between the dependent variable and independent variables (2 or more). This analysis technique is vital since it allows and promotes theory building and explanation as well as prediction of certain characters. One dependent variable (criterion), as well as 2 or more independent variables (predictor variables), are crucial for the effective utilization of the multiple regression models. For this research, malaria resurgence and its outcomes are

represented as the response (criterion) variable (Y), while the independent (predictor) variables are the determinants of malaria resurgence, (X1) Level of awareness factors, (X2) socio-demographic factors. The following model will be used in this research:

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \Sigma$$

Where:

Y is the dependent variable (Malaria disease resurgence and its outcomes);

X represents the set of 2 independent variables;

X1 – Level of awareness factors;

X2 – Socio-demographic factors.

### 3.6 Ethical Considerations

Bryman and Bell (2007) sum up the following points to give the most crucial principles concerning ethical considerations in studies:

- 1) No harm should be subjected to the respondents and the community in general
- 2) The research should prioritize the dignity of participants.
- 3) The participants should sign the full consent before the study starts.
- 4) The research participant's privacy should be protected.
- 5) The research should ensure adequate confidentiality levels of the research data.
- 6) The individuals and organizations engaged in the research should remain anonymous.

## 4. Findings

This implies the respondents were interested in the research and willing to provide research information attested by a 100% response rate. Respondents to research questions were of different gender including male and female. None of the respondents was transgender or neither male or female. A total of 213 (55.3%) male and 172 (44.7) females responded to research questions as shown in Table 1.

**Table 1:** Distribution of Respondents by Gender

| Gender of respondents | Frequency  | Percentage (%) |
|-----------------------|------------|----------------|
| Males                 | 213        | 55.3           |
| Females               | 172        | 44.7           |
| <b>Total</b>          | <b>385</b> | <b>100.0</b>   |

Source: Researcher (2022).

### 4.1 Distribution of Respondents by Age

Data on the age of research respondents were analyzed and presented in Table 2. Data indicated that the majority of respondents 52.1% were aged between 18 to 20 years of age followed by respondents aged between 30 and 39 years at 25.3%. The lowest percentage



of respondents (2.5%) were aged 60 years and above. The data shows that majority of respondents were aged 39 years and below at 84.8%.

**Table 2: Distribution of Respondents by Age**

| Age of respondents in years | Frequency  | Percentage (%) |
|-----------------------------|------------|----------------|
| 18-20                       | 194        | 50.4           |
| 21-29                       | 30         | 7.8            |
| 30-39                       | 102        | 26.5           |
| 40-49                       | 30         | 7.8            |
| 50-59                       | 20         | 5.2            |
| 60 years or older           | 9          | 2.3            |
| <b>Total</b>                | <b>385</b> | <b>100.0</b>   |

Source: Researcher (2022).

#### 4.2 Distribution of Respondent by Education

The respondents were of different levels of education as shown in Table 3.

**Table 3: Distribution of Respondents by Education**

| Education level of respondents | Frequency  | Percentage (%) |
|--------------------------------|------------|----------------|
| No education                   | 223        | 57.9           |
| Primary level                  | 42         | 10.9           |
| Secondary level                | 69         | 17.9           |
| Tertiary level                 | 51         | 13.2           |
| <b>Total</b>                   | <b>385</b> | <b>100.0</b>   |

Source: Researcher, 2022.

Data indicated that respondents who had no formal education were the majority (57.9%) while those who had attained primary school level were a minority at 10.9%. Respondents who had attained at least a secondary school level of education were 31.1%. It was noted that at least 42% of respondents had some level of formal education.

#### 4.3 Analysis of Malaria Resurgence in Isiolo Sub-county

Malaria resurgence was the dependent variable in this study. The researcher set out to investigate the level of awareness and understanding of the respondents in identifying malaria resurgence in the research area. To achieve the goal of determining the level of awareness amongst the respondent, the researcher posed specific questions which elicited the respondent's reactions including knowledge of cardinal symptoms of malaria, tests for malaria, and causative agents for malaria and transmission mode. Additionally, the researcher determined respondents understanding in terms of treatment for malaria disease, management of malaria during febrile illness, prevention and knowledge or identification of health workers.

To understand the respondents' cardinal awareness of indicators of malaria in the research area, the researcher asked respondents to identify malaria symptoms and responses shown in Table 4.

**Table 4:** Distribution of Respondents Based on the Identification of Malaria Disease Symptoms

| Symptoms of Malaria                   | Frequency  | Valid Percentage (%) |
|---------------------------------------|------------|----------------------|
| Fever                                 | 180        | 46.8                 |
| Rigors                                | 54         | 14.0                 |
| Fever + rigors                        | 33         | 8.6                  |
| Fever + rigors + headache             | 19         | 4.9                  |
| Fever + rigors + headache + confusion | 99         | 25.7                 |
| <b>Total</b>                          | <b>385</b> | <b>100.0</b>         |

**Source:** Researcher (2022).

Data indicated that the highest percentage of respondents (46.8%) identified fever only as a symptom of malaria and 14% only identified rigors as a symptom. A total of 60% of the respondents could only identify one symptom of malaria. However, at least 39% of respondents could identify multiple signs of malaria. Despite the fact that respondents identified different signs of malaria it was possible that they failed to express themselves adequately that malaria had more than one symptom because of the low formal education levels.

To determine the respondents' understanding of the causative agents of malaria the researcher requested them to identify the one responsible for causing malaria from a list of different insects, bacteria and viruses. The results were presented in Table 5.

**Table 5:** Distribution of Respondents by Identification of Malaria Causative Agent

| Causative agents    | Frequency  | Percentage (%) |
|---------------------|------------|----------------|
| Mosquito            | 189        | 49.1           |
| Bacteria            | 46         | 11.9           |
| Virus               | 17         | 4.4            |
| Mosquito + Bacteria | 18         | 4.7            |
| Plasmodium          | 115        | 29.9           |
| <b>Total</b>        | <b>385</b> | <b>100.0</b>   |

**Source:** Researcher (2022).

Data shows the highest percentage of respondents (49.1%) identified mosquito as the insect related to malaria resurgence in the research site. However, only 29.9% of respondents correctly identified *Plasmodium* as the causative agent for malaria. *Plasmodium* is transmitted by mosquito hence the association of mosquito to malaria by many respondents. The data indicate that malaria resurgence in the research site is a real problem evidenced by respondents' ability to associate it with mosquito (the vector) and *plasmodium* (the causative agent).

To gauge respondents' understanding of malaria treatment, the researcher asked about its treatment by providing respondents with a list of different drugs to select from and responses presented in Table 6.

**Table 6:** Distribution of Respondents by Identification of Treatment for Malaria Disease

| Treatment drug         | Frequency  | Percentage (%) |
|------------------------|------------|----------------|
| Coartem alone          | 169        | 43.9           |
| Other anti Malarials   | 60         | 15.6           |
| Paracetamol            | 29         | 7.5            |
| Coartem + Others (ACT) | 17         | 4.4            |
| Antibiotics            | 110        | 28.6           |
| <b>Total</b>           | <b>385</b> | <b>100.0</b>   |

**Source:** Researcher (2022).

Respondents correctly identified Coartem as a drug for the treatment of malaria as shown by 44% of the respondents which implies that malaria resurgence in the research site happens to force respondents to learn and know what drugs to use when such resurgence occurs. There was an indication that other anti-malaria treatments were available in the research site that is used to treat the disease as indicated by 28.6% of respondents. The availability of several options for the treatment of malaria disease in the research area attests to the fact that malaria resurgence is a common problem in Isiolo Sub-county.

To understand different prevention strategies for malaria disease, the researcher enquired how it was done in the research area and the responses presented in Table 7.

**Table 7:** Distribution of Respondents by an Understanding of Prevention Strategies for Malaria

| Strategy used                | Frequency  | Percentage (%) |
|------------------------------|------------|----------------|
| Doing nothing                | 157        | 40.8           |
| Drain stagnant water         | 66         | 17.1           |
| Use of nets                  | 23         | 6.0            |
| Burn vegetation outdoors     | 25         | 6.5            |
| Put screens on windows       | 112        | 29.1           |
| Drain stagnant water + coils | 2          | .5             |
| <b>Total</b>                 | <b>385</b> | <b>100.0</b>   |

**Source:** Researcher (2022).

Data shows that residents of Isiolo Sub-county understand different strategies for preventing malaria resurgence as shown by 60% of respondents who listed different strategies that are appropriate. However, there was 40.8% of respondents indicated that they do nothing which implies that there is a need for awareness creation amongst that group of respondents to forestall the resurgence of malaria. The huge knowledge base (60% of respondents) on the prevention of malaria strategies points to the fact that malaria disease resurgence in the research area is a problem that continually affects the population of the region.

#### **4.4 Influence of Levels of Awareness on Malaria Resurgence among Residents of Isiolo Sub-county**

The first objective of this research was aimed at establishing the relationship between the level of awareness and malaria disease resurgence among the residents of Isiolo Sub-county in Kenya. The researcher asked the question “How do the levels of awareness

influence malaria resurgence among residents of Isiolo Sub-county, Kenya?" Quantitative data from the field was analyzed descriptively and inferentially. Table 8 shows the descriptive data.

**Table 8:** Distribution of Respondents Based on Levels of Awareness of Malaria Resurgence in Isiolo Sub-county

| Type of response  | Frequency  | Percentage (%) |
|-------------------|------------|----------------|
| Strongly agree    | 157        | 40.8           |
| Agree             | 66         | 17.1           |
| Neutral           | 23         | 6.0            |
| Disagree          | 27         | 7.0            |
| Strongly disagree | 112        | 29.1           |
| <b>Total</b>      | <b>385</b> | <b>100.0</b>   |

**Source:** Researcher (2022).

Data indicates that a total of 385 respondents were involved in determining the level of awareness of malaria resurgence in Isiolo Sub-county. Out of the total sampled respondents, 157 respondents representing 40.8% strongly agreed that malaria resurgence was witnessed in Isiolo Sub-county while 17.1% agreed. Those who strongly disagreed and disagreed were 29% and 7% respectively. A total of 23 respondents (6%) were neutral. It meant that at least 58% of respondents agreed malaria resurgence was witnessed in Isiolo Sub-county while at least 36% disagreed.

Regression analysis was conducted to understand the influence of awareness on malaria resurgence in Isiolo Sub-county. The results of linear regression were presented in three tables namely Table 9 (Model summary), Table 10 (Statistical significance) and Table 11 (estimated regression coefficients).

**Table 9:** Regression Model Summary of the Influence of Levels of Awareness on Malaria Resurgence Among Residents of Isiolo Sub-county

| Model | R     | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-------|----------|-------------------|----------------------------|
| 1     | .700a | .491     | .489              | 5.91355                    |

**Source:** Researcher (2022).

The R-value of +0.700 obtained in this regression model summary shows that there is a strong positive linear correlation between the level of awareness and the resurgence of malaria disease. The coefficient of determination R<sup>2</sup> value of +0.491 was interpreted to mean that level of awareness explained or accounted for at least 49.1% of variations in the regression model. This implied that apart from awareness, there were other factors that accounted for at least 50.9% of malaria resurgence in the study site.

Table 10 shows the appropriateness of the regression model in the analysis of the data on the influence of awareness on malaria resurgence.

**Table 10:** Statistical Significance of the Regression Model  
 on the Influence of Awareness on Malaria Resurgence

| Model        | Sum of Squares   | df         | Mean Square | F       | Sig.  |
|--------------|------------------|------------|-------------|---------|-------|
| Regression   | 12898.456        | 1          | 12898.456   | 368.842 | .000b |
| Residual     | 13393.559        | 383        | 34.970      |         |       |
| <b>Total</b> | <b>26292.016</b> | <b>384</b> |             |         |       |

a. Dependent Variable: Malaria resurgence  
 b. Predictors: (Constant), awareness

**Source:** Researcher (2022).

The output indicates the F-ratio values of  $F(1,385) = 368.842$ ;  $p < 0.05$ . The P-value obtained was 0.000 which is less than the alpha value of 0.05. This implies that the result obtained in this regression model was appropriate and the likelihood of similar results through other methods such as comparison of means would not suffice. The regression model shows that level of awareness could be used to predict malaria resurgence in the study area.

The coefficients of the regression model were examined and fitted into the regression model/equation:

$$Y = a + \beta X_1 + e.$$

Where:

y = malaria resurgence;

a = 11.822;  $\beta = 3.335$ ;

e = error term.

The regression coefficients obtained were presented on Table 11.

**Table 11:** Estimated Regression Coefficients of the Influence  
 of Awareness on Malaria Resurgence in Isiolo Sub-county

| Model | Unstandardized Coefficients |            | Standardized Coefficients | T      | Sig. |
|-------|-----------------------------|------------|---------------------------|--------|------|
|       | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant)                  | 11.822     | .555                      | 21.318 | .000 |
|       | Awareness                   | 3.335      | .174                      | .700   | .000 |

a. Dependent Variable: Malaria Resurgence

**Source:** Researcher (2022).

The researcher observed that standardized B coefficients obtained of +0.700 were for awareness with a statistical significance of 0.000. The result was deduced to mean that awareness was statistically significantly different from zero (0).

The outcome showed that awareness can be used to predict the outcome of malaria resurgence using the regression line:

$$(y) = 11.822 + 3.335X_1 + e$$

The findings indicated that awareness could be used to predict malaria resurgence in Isiolo Sub-county. The findings are in line with the literature reviewed which observed that by improving the public's awareness of malaria, the general population could understand how to protect themselves, while infected can be encouraged to seek medication as early as possible (Das et al. 2013). On his part, Tyagi et al. (2005) argued that enhancing health literacy and awareness is the proper technique to prevent malaria diseases. The observations by these scholars indicate that awareness is a determinant in preventing malaria resurgence as observed in this study.

Musuva (2017) noted that people's awareness of malaria prevention in Uganda at Mbarara, suggested that people should be enlightened on the malaria-mosquito connection, and why they should seek biomedical treatment for convulsions or similar challenges related to malaria disease. Qualitative data obtained from focused group discussions indicated that the community considered awareness as key to managing all challenges in the area including diseases such as malaria. One elder said,

*"When people are made aware of the challenge of malaria, they are able to consider best ways for controlling and managing the disease when it strikes the region".*

This shows that the local community considered awareness and information about the disease as key to controlling the resurgence of the disease. This observation was echoed by the local administrator, who said,

*"Awareness is the key to all challenges. Here when the community was made aware of the malaria disease threats and its transmission mode, there has been voluntary action towards curbing the disease. The actions by the local community have been instrumental in making our administrative work easy".*

#### **4.5 Influence of Demographic Characteristics on Malaria Resurgence among Residents of Isiolo Sub-County**

The second objective of this research was to determine the influence of demographic characteristics on the resurgence of malaria in Isiolo Sub-county, Kenya. The researcher set out to answer the question "How do demographic characteristics influence malaria resurgence among residents of Isiolo Sub-county in Kenya?". In analyzing the research question, the researcher considered different aspects of demographic characteristics and assessed them accordingly.

Respondents were asked to indicate how they rated demographic characteristics to contribute to malaria resurgence and their responses are shown in Table 12.

**Table 2:** Distribution of Respondents Based on the Influence of Demographic Characteristics on Malaria Resurgence in Isiolo Sub-county

| Type of response  | Frequency  | Percentage (%) |
|-------------------|------------|----------------|
| Strongly agree    | 165        | 43.3           |
| Agree             | 66         | 18.1           |
| Neutral           | 23         | 6.0            |
| Disagree          | 21         | 5.5            |
| Strongly disagree | 104        | 27.1           |
| <b>Total</b>      | <b>385</b> | <b>100.0</b>   |

Source: Researcher (2022).

Results showed that the highest frequency of 165 (43.3%) of respondents strongly agreed that demographic characteristics influence malaria resurgence in Isiolo Sub-county. A total of 23 respondents representing about 6% were neutral while 104 respondents representing 27% strongly disagreed that demographic characteristics influence malaria resurgence in Isiolo Sub-county. Overall, it was clear that at least 61.4% of respondents agreed that demographic characteristics influenced malaria resurgence while at least 32.6% did not agree. The results show that residents considered demographic characteristics to have quite some level of influence on malaria disease resurgence in the study site. It appears that demographic characteristics were considered to have a high influence on the resurgence of malaria disease in the study area owing to the results of data analysis shown.

Regression analysis was conducted to understand the influence of demographic characteristics on malaria resurgence in Isiolo Sub-county. The results of linear regression were presented in three tables namely Table 13 (Model summary), Table 14 (statistical significance) and Table 15 (estimated regression coefficients).

**Table 33:** Regression Model Summary of the Influence of Demographic Characteristics on Malaria Resurgence in Isiolo Sub-county

| Model | R     | R Square | Adjusted R Square | Std. Error of the Estimate |
|-------|-------|----------|-------------------|----------------------------|
| 1     | .593a | .352     | .350              | 6.66955                    |

a. Predictors: (Constant), Demographic factors

Source: Researcher 2022

The R-value of +0.593 obtained in this regression model summary shows that there is a moderate positive linear correlation between the level of demographic factors and the resurgence of malaria disease. The coefficient of determination R<sup>2</sup> value of +0.352 was interpreted to mean that demographic factors accounted for at least 35.2% of variations in the regression model. This implied that apart from demographic factors identified in the research, there were other factors that accounted for at least 64.8% of malaria resurgence in the research area.

Table 14 is a presentation of the appropriateness of the regression model in the analysis of the data on the influence of demographic factors on the malaria resurgence in the study site.

**Table 44:** Statistical Significance of the Influence of Demographic Factors on Malaria Resurgence in Isiolo Sub-county

| Model  |              | Sum of Squares   | Df         | Mean Square | F       | Sig.  |
|--|--------------|------------------|------------|-------------|---------|-------|
| 1  | Regression   | 9255.062         | 1          | 9255.062    | 208.059 | .000b |
|  | Residual     | 17036.954        | 383        | 44.483      |         |       |
|  | <b>Total</b> | <b>26292.016</b> | <b>384</b> |             |         |       |
| a. Dependent Variable: Malaria resurgence      |              |                  |            |             |         |       |
| b. Predictors: (Constant), Demographic factors |              |                  |            |             |         |       |

Source: Researcher, 2022.

The output indicates the F-ratio values of  $F(1,385) = 208.059$ ;  $p < 0.05$ . The P-value obtained was 0.000 which is less than the alpha value of 0.05. This suggests that the result obtained in this regression model was appropriate and that the result could not possibly be obtained through other methods such as the comparison of means. The regression model indicates that demographic factors could be used to predict malaria resurgence in Isiolo Sub-county.

The coefficients of the regression model were studied and fitted into the regression model/equation:

$$Y = a + \beta X + e$$

Where:

y = malaria resurgence;

a = 13.698;

$\beta = 2.778$ ;

e = error term.

The regression coefficients obtained were presented in Table 15.

**Table 5:** Estimated Regression Coefficients of the Influence of Demographic Factors on Malaria Resurgence in Isiolo Sub-county

| Model                                     |                     | Unstandardized Coefficients |            | Standardized Coefficients | t      | Sig. |
|---|---------------------|-----------------------------|------------|---------------------------|--------|------|
|   |                     | B                           | Std. Error | Beta                      |        |      |
| 1   | (Constant)          | 13.698                      | .596       |                           | 22.979 | .000 |
|   | Demographic factors | 2.778                       | .193       | .593                      | 14.424 | .000 |
| a. Dependent Variable: Malaria resurgence |                     |                             |            |                           |        |      |

Source: Researcher 2022.

The researcher observed that standardised B coefficients obtained of +0.593 for demographic factors with a statistical significance of 0.000 indicated that demographic factors were statistically significantly different from zero (0).

The outcome showed that demographic factors can be used to predict the outcome of malaria resurgence using the regression line:



$$(y) = 13.698 + 2.778 X_2 + e$$

The findings indicated that demographic characteristics could be used to predict malaria resurgence in Isiolo Sub-county. The findings are in line with findings by WHO (2015) which observed that children and pregnant women are the groups at high risks for malaria disease since they are often severely affected by the disease, and prevention efforts should target such vulnerable populations in the nation. It was also observed that school-going children (between the ages of 5–15 years) had the highest malaria prevalence rates in the nation (Kepha, Nikolay and Nuwaha, 2016). The literature and study findings are in agreement regarding demographic characteristics and the resurgence of malaria in the study area where it was observed to have some level of influence.

## 5. Conclusion and Recommendation

The first objective was to establish the influence of levels of awareness on malaria resurgence among residents of Isiolo Sub-county. The first objective of this research was aimed at establishing the relationship between the level of awareness and malaria disease resurgence among the residents of Isiolo Sub-county in Kenya. The researcher asked the question “How do the levels of awareness influence malaria resurgence among residents of Isiolo Sub County, Kenya?” The researcher noted that at least 58% of respondents agreed malaria resurgence was witnessed in Isiolo Sub-county while at least 36% disagreed. The researcher concluded that more respondents agreed that levels of awareness had an influence on malaria resurgence in Isiolo Sub-county.

The second objective of this research was to determine the influence of demographic characteristics on the resurgence of malaria in Isiolo Sub-county, Kenya. The researcher set out to answer the question “How do demographic characteristics influence malaria resurgence among residents of Isiolo Sub-county in Kenya?”. Descriptive analysis showed that at least 61.4% of respondents agreed that demographic characteristics influenced malaria resurgence while at least 32.6% did not agree. The researcher concluded that residents considered demographic characteristics had some level of influence on malaria disease resurgence in the study site. The R-value of +0.593 obtained in the regression model summary shows that there is a moderate positive linear correlation between the level of demographic factors and the resurgence of malaria disease. The coefficient of determination R<sup>2</sup> value of +0.352 was interpreted to mean that demographic factors accounted for at least 35.2% of variations in the regression model.

### 5.1 Recommendations for Residents of Isiolo Sub-county

- 1) The study observed that approximately 58% of Isiolo residents had not attended formal school. It is therefore recommended that Isiolo residents prioritise education for both boys and girls to improve success rates in curbing malaria resurgence in the county

- 2) Residents should put more effort into understanding the mode of transmission of malaria disease as currently, the understanding is relatively low as indicated 61.5% of residents did not understand how malaria disease is transmitted.

## 5.2 Recommendations for Policymakers in Isiolo Sub-county

- 1) Policymakers in Isiolo Sub-county should consider formulating policies that support education for the residents since a big percentage 58% had not attended any form of schooling.
- 2) Policymakers should allocate additional resources in support of educating residents about malaria disease and how to control it since prevention is usually cheaper than treatment.
- 3) Training for health workers to enhance health education and promotion programs as part of the intervention strategy.

## Conflict of Interest Statement

The authors declare no conflicts of interest.

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