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Examining the Causes of Mosquito Bites to Human Life: A Look at Kampala from 2018-2019

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ABSTRACT

The purpose of the study was to examine the causes of mosquito bites to human life: a look at Kampala metropolitan from 2018-2019. This study looked at causes of mosquito bites, symptoms, treatment, effects and interventions made by the Uganda government to decrease the overall number of mosquito bites that result in increased Malaria incidence rate, conclusions and recommendations. The study findings indicate that 90% of mosquito bites in Kampala metropolitan was attributed to stagnant water around homesteads, uncovered septic tanks, dirty and dumpy latrines floors that become breeding grounds for mosquitoes, bushes surrounding homesteads for instance the grass that acts as resting places and leaving house window screens open throughout the night. Most numbers of malaria cases occur during the period of June-July due to the rainy season, climate change, prolonged intermittent rains in various parts of the country that have lasted till to date (August 2019), and reduced net ownership and use due to the aging of nets distributed in 2017/18 mass Long Lasting Insecticide-treated Mosquito Nets (LLINs) campaign. Mosquitoes are important vectors of diseases such as malaria fever, chikungunya, dengue and other arboviruses by transmitting diseases. Mosquitoes cause the deaths of more people.

Keywords: Cause, Mosquito bites, Human Life, Kampala metropolitan, Uganda

INTRODUCTION

Mosquitoes are vector agents that carry disease-causing viruses and parasites from person to person without catching the disease themselves. Epidemics of mosquito-borne disease are nowadays a major health problem in Uganda. Historically before mosquito-transmitted diseases were brought under control, they caused tens of thousands of deaths in most countries. Mosquitoes were shown to be the cause by which yellow fever and malaria were transmitted from person to person (Gubler and Clark, 1995)

A mosquito bite is a small, round, puffy bump that appears soon after you have been bitten. Mosquito bite causes Malaria which is transmitted by the female Anopheles mosquitoes which normally bite at night. An infected female Anopheles mosquito bites a human being and transmits the plasmodium parasite into the blood of the person. Mosquitoes are the vectors that carry viruses and parasites causing disease from person to person without causing the disease for themselves. Mosquitoes suck blood from people and other animals as part of their eating and breeding habits. When mosquitoes bite, they also inject saliva and anticoagulants into the blood which may contain disease-carrying viruses and other parasites. This cycle can be interrupted by killing mosquitoes while they are infectious or by educating the exposable population to protect themselves from mosquito bites (Nagaraj, 2003).

The mosquito undergoes a complete life cycle which consists of egg, larva, pupa, and adult stages. Eggs are laid on the water surface; they hatch into motile larvae that feed on aquatic algae and organic material. The adult females of most species have tube-like mouth parts called proboscis that can pierce the skin of a host and feed on blood, which contains protein and iron needed to produce eggs. Thousands of mosquitoes species feed on the blood of various hosts-verb rates, including mammals, birds, reptiles, amphibians and some fish; along with some invertebrates primarily other arthropods. This loss of blood is seldom of any importance to the host (Wikipedia, 2021).

The mosquito's saliva is transferred to the host during the bite and can cause an itchy rash. In addition, many species can ingest pathogens while biting, and transmit

them to future hosts. In this way, mosquitoes are important vectors of diseases such as malaria fever, Chikungunya, West Nile dengue fever, filariasis, Zika and other arboviruses. By transmitting diseases, mosquitoes cause the deaths of more people than any other animal taxon: over 700,000 each year and as many as half of the people who have ever lived (Ahmed et al., 2019).

Malaria remains one of the world's leading killers, claiming the life of one child every two minutes. Most of these deaths are in Africa, where more than 250,000 children die from the disease every year. Children under 5 years are at the greatest risk of its life-threatening complications. Worldwide, malaria kills 435,000 people a year, most of them children (Liverpool School of Tropical Medicine (LSTM), 2019).

According to World Health Organisation (WHO) 2019 world malaria report, no significant gains were made in reducing malaria cases in the period of 2015 to 2017. The World malaria report 2018 draws on data from 87 countries and areas with ongoing malaria transmission. The information is supplemented by data from national household surveys and databases held by other organizations. In addition, urgent action is needed to get the global response to malaria back on track and ownership of the challenge lies in the hands of countries most affected by malaria. On World Malaria Day 2019, WHO joined the partnership to end malaria with the African Union Commission and other partner organizations in promoting Zero malaria starts with me, a grassroots campaign that aims to keep malaria high on the political agenda, mobilize additional resources, and empower communities to take ownership of malaria prevention and care (WHO, 2019)

Uganda has the sixth-highest number of annual deaths from malaria in Africa, as well as some of the highest reported malaria transmission rates in the world, with approximately 16 million cases reported in 2013 and over 10,500 deaths annually. The cases of Malaria have continued to attack the population as the result of mosquito bites by over 400,000 cases when compared with 2018 and 2019 from about 1 million cases in June 2018 to 1.4 million in June 2019 (40% increase). However, it is worth noting that cases are still low compared to 2017 and 2016 in the same period with all the efforts of government (MoH, 2014; Ruth, 2019).

The Malaria upsurge has affected half of the country with approximately 65 districts involved. The affected areas include; West Nile region, Acholi region, Lango except where Indoor Residual Spraying is ongoing (Dokolo, Alebtong, Lira, Otuke) Busoga Region, Bunyoro Region, Buganda Region: Kyotera, Butambala, Kalangala, Luweero, Kampala, Kayunga, Buyikwe, Rakai, Kyankwanzi, Mubende, Nakasongola, Karamoja Region, Teso Region: Soroti, Kumi, Amuria, Eastern Region: Namissindwa, Busia, Bulabuli, Mbale, Sironko, Manafwa, Western Uganda; Kamwenge, Kisoro, Kanungu. (Ruth, 2019)

Kampala is the capital and largest city of Uganda. The city has a population of 1,680,000 and is divided into the five divisions of Kampala Central Division, Kawempe Division, Makindye Division, Nakawa Division and Rubaga Division. Kampala's metropolitan area consists of the city proper and the neighboring Wakiso District, Mukono District, Mpigi District Bwuikwe District and Luweero District. It has a rapidly growing population that is estimated at 6,709,900 people in 2019 by the Uganda Bureau of Statistics in an area of 8,451.9 km^2 (3,263.3 square miles) (Wikipedia, Kampala, 2019)

In 2015, this metropolitan area generated an estimated nominal GDP of $13.80221 billion (constant US dollars of 2011). This was more than half of Uganda's GDP for that year, indicating the importance of Kampala to Uganda's economy. Kampala is reported to be among the fastest-growing cities in Africa, with an annual population growth rate of 4.03 percent, by City Mayors. (Wikipedia, Kampala, 2019). Mercer (New-York-based consulting firm) has regularly ranked Kampala as East Africa's best city to live in ahead of Nairobi and Kigali (UBOS, 2019).

Kampala originally referred to only the present-day Old Kampala hill, on whose summit Fort Lugard was located and the initial headquarters of the British colonial authorities in the soon-to-be Uganda Protectorate. Before the British construction of Fort Lugard, the hill was a hunting reserve of the Kabaka (King) of Buganda and had several species of antelope, especially the impala. As a result, when the British colonial officials were allocated this hill by the then Kabaka (King) of Buganda, they referred to it as "The Hill of the Impala". The Baganda, in whose territory this British settlement was located, then translated "Hill of the Impala" as Akasozi ke'Empala. This was then shortened to K'empala and finally Kampala. Kasozi means "hill", ke "of", and empala the plural of "impala". Hence the name "Kampala" came to refer to this initial British colonial settlement that would, later on, spread out from the occupied old Kampala hill near the pre-existing Kibuga (capital) of the Buganda Kingdom (Brujulea, 2021).

Kampala has about 23 percent of its area as fully urbanized, a significant portion (60 percent) semi-urbanized and the rest is considered as rural settlements. Under the Köppen-Geiger climate classification system, Kampala is said to have a tropical rainforest climate. Kampala's weather features two annual wet seasons. There is a long rainy season from August to December and a short rainy season from February to June. However, the shorter rainy season sees substantially heavier rainfall per month, with April typically seeing the heaviest amount of precipitation at an average of around 169 millimeters (6.7 in) of rain. This context presents favorable conditions for mosquito breeding (UBOS, 2019).

Statement of the problem

Despite the interventions put in place for example emergency supplies of Artemisinin-based Combination Therapy (ACTs) and Rapid Diagnostic, the Ministry of Health is networking with the private sector to ensure they have adequate stocks of subsidized anti-malarial medication and monitoring malaria cases. In Kampala,

the state of mosquito bites that cause malaria is still on increase as compared to previous months, this is similar to what was registered in the same period last year (for example; in the month of June, there were 27,159 in 2019, 28,086 in 2018 and 36,391 in 2017). However, the number of severe forms of Malaria requiring admission (severe malaria) has increased by 60% compared to the same period last year (920 severe cases in June 2019, a total of 570 in 2018 and 540 in 2017). This is due to the seasonal variations and lack of herd immunity among Kampala residents. The total number of malaria deaths in Kampala has remained unchanged at an average of 6 deaths per month. Therefore this study aims to examine the causes of mosquito bites to human life in Kampal district from 2018-2019.

Research Objectives

i. To analyse the factors for increased mosquitoes in Kampala district from 2018-2019
ii. To establish the people's knowledge and attitude towards mosquito bites in Kampala district
iii. To identify the effects of mosquito bites on human life in Kampala district
iv. To suggest possible measures to the mosquito bites in Kampala district

Research Questions

i. What are the factors responsible for the increased presence of mosquitoes in Kampala district from 2018-2019?
ii. What are the people's knowledge and attitude towards mosquito bites in Kampala district?
iii. What are the effects of mosquito bites on human life in Kampala district?
iv. What are the possible measures to the mosquito bites in Kampala district?

Scope of the study

With regards to the geographical scope, the research focused on the Kampala district because there was easy accessibility of the respondents who were willing to be interviewed after seeking permission from the concerned authorities. The study considered the period from 2018-2019 and the study established the causes of mosquito bites to human life.

Significance of the study

Since the beginning of human life on earth, mosquitoes have been an important part of the environment. However human beings are always found in a context to combat the diseases transmitted by mosquitoes. Despite various measures in the form of national health programmes that have been taken to control and eradicate mosquito-borne diseases, the war which is still ongoing on mosquitoes constitutes the most important single family of human health. There might be hardly any place on earth, where mosquitoes are not found. The four important groups of mosquitoes contributing to disease transmission are Anopheles, Culex, Aedes and Monsoia. Mosquitoes play an important role in the transmission of many human diseases. They act as vector of many diseases like Malaria, Filaria, Chikungunya and Dengue fever. In Uganda, nearly 95 percent of the population is exposed to the epidemics such as malaria, with friendly conditions for mosquito breeding. Therefore an examination of the cause of mosquito bites on human life will be significant to the populations in Kampala districts and the rest of the areas in Uganda.
Significant numbers of children die each year in Uganda and Kampala district inclusive and the entire country at large before they reach the fifth birthday, more than any other country in the world. Half of these deaths occur in the very first month of life. What's even more shocking is that most of these deaths are preventable. Children's lives could easily be saved by simple, low-cost solutions which will be captured in this study.

LITERATURE REVIEW

Joshi and Banjara (2008) in their descriptive study conducted to assess the knowledge of cost-effective methods of preventing mosquito bites among the mothers of under-five children in the rural and slum areas of Delhi, they suggested that prevention of mosquito-borne diseases must start in the locality to ensure that people are receptive to the methods to prevent mosquito bites and to make desired behavioral changes easier to adopt. The epidemic of Chikungunya has to be seen as a resurgent viral illness in the context of other epidemics of mosquito-borne illness. Mangalore of Karnataka state, India has been hit by Chikungunya infections. More than 20,000 children with suspected cases of Chikungunya have been reported in a month and half of them were from various rural parts of Dakshina Kannada district according to the district health officer.
Lacey and Lacey (1990) assert that there are many methods used for mosquito control, some target the larval stage, while others are used to kill or repel the adult. Modern mosquito control is no longer dependant on pesticides but specialized organisms that eat mosquitoes or infect them with a disease that kills them. Such methods can even be used in Conservation Areas, like " forsyth refuge", where some major mosquito control is performed and monitored using killi fish and juvenile eels. The success is documented with the most advanced underwater microscopes like the eco SCOPE. However, the outbreaks of human mosquito-borne diseases may still result in fogging with products that are less toxic than those used in the past.
Mosquito-borne diseases can be reduced through mosquito control and personal protection. To reduce the number of mosquito bites; one should wear clothing that covers most of the body, if the temperature permits and by the use of mosquito repellent that contains NN

Table 1: Showing the Sample Size.

Category of respondents	Target population	Sample size	Sampling strategy
Officials from ministry of Health	10	10	Purposive sampling
Health workers from KCCA	10	10	Purposive sampling
Participants from the public (other authorised persons)	80	60	Simple random sampling
Total	**100**	**80**	

diethyl/meta Talumide (DEET) at a concentration of 7.5% - 100%. Lower concentrations are sufficient for the most outdoor protection and 15% concentration is recommended for children. Permethrin is an effective mosquito repellent and pesticide (Park, 2009).

Yasuoka et al. (2006) posited that one of the main non-chemical ways to prevent mosquito bites is to use a mosquito net. If properly used and maintained, it provides the maximum possible personal protection against biting insects. In many areas of the world, mosquitoes are not only a nuisance, but also pose a serious health threat. Until such time in the foreseeable future when an efficient, affordable, safe and long-lasting vaccine becomes available, the best prevention is control of vector mosquitoes especially during the inter epidemic period which can reduce transmission of the virus and reduce the incidence and spread of the diseases. Preventive strategies tailored for specific locations are needed to reduce breeding places and the consequent risk of future outbreaks of mosquito-borne diseases.

Joshi and Banjara (2008) urged that no study has been conducted in Bangalore District regarding cost-effective methods of preventing mosquito bites. Therefore from literature review, it was revealed that education on cost-effective methods of prevention of mosquito bites is important to develop awareness regarding preventive measures of mosquito-borne diseases. Therefore this study becomes very important, designed to identify the need for accurate information required by mothers about cost-effective methods for preventing mosquito bites through pre and post-test planned teaching programmes.

METHODOLOGY

Research Design

The study employed both qualitative and quantitative methods. The descriptive research design was used to obtain information concerning the current status of phenomena to describe what exists, with respect to variables in a situation.

Target population

The target population of this study was officials from the Ministry of Health, Health workers from KCCA and participants from the divisions of Kampala. The target population of this study was 100 respondents.

Sample Size and selection

The sample size was determined using Slovene's formula:

$$n = \frac{N}{1+N(\alpha)^2}$$

Where n=sample size, N=sample unit, $\alpha = 0.05$ level of significance

$$n = \frac{100}{1+100\,(0.05)^2}$$

$$\boldsymbol{n = 80}$$

Therefore sample size is 80 as shown in Table 1.

Sampling Techniques

This study used purposive and simple random sampling to select the respondents. Simple random sampling was used because it was not biased; it gave each respondent equal chance of participating in the study. Purposive sampling was used because the categories of respondents were chosen purposely due to their work rationale in Kampala district.

Sources of data

Both primary and secondary data were collected to achieve the study objectives. The primary data used were telephone interviews, questionnaires, experiments, direct observation in physical sciences among others. While secondary data used consists of readily available documents, compiled statistical statements, reports such as books, journals, newspapers, national gazette, records and reports.

Data analysis and interpretation

The data collected were analyzed using the descriptive statistical method. SPSS was used to analyze various responses. Tables and pie charts were also used.

Ethical Consideration

Personal confidentiality and privacy were very important since the report was public. Participation was voluntary; participants are free to refuse to answer any question and may withdraw at any time. Another important

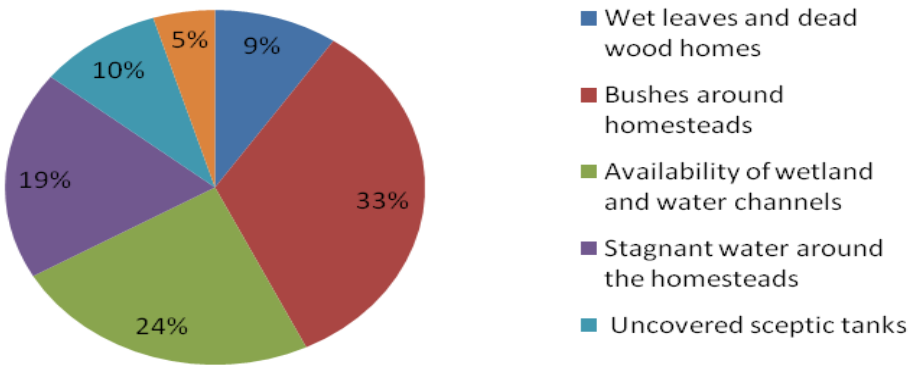

Figure 1: Factors responsible for increased presence of mosquitoes in Kampala district. Source: Primary data (2019).

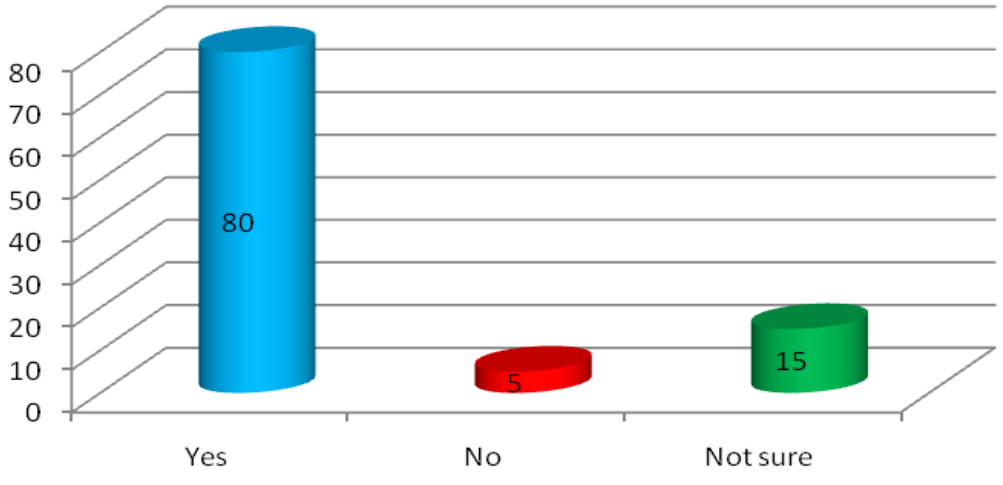

Figure 2: Showing People's knowledge and attitude towards mosquito bites. Source: Primary data (2019).

consideration involved getting the informed consent of those to be interviewed during the research process, which involved interviews and observations.

RESULTS

Factors for increased mosquitoes in Kampala district

Numerous responses were put forward when participants were asked of the factors responsible for increased mosquitoes in Kampala district and they included among others bushes around homesteads which were represented with 33% of the participants, followed by 24% of respondents who revealed the availability of wetland and water channels, 19% of respondents revealed stagnant water around the homesteads was among the factors for the increased mosquitoes in Kampala, 10% of respondents said uncovered septic tanks constructed near homesteads, 9% of the participants revealed wet leaves and dead wood around homesteads were also among the factors for increased mosquitoes presence. These findings are as shown in Figure 1.

People's knowledge and attitude towards mosquito bites

From figure 2, the biggest percentage of the participants with 80% revealed that they are aware of the mosquito bites' experience and went on to reveal how they have suffered from malaria disease which is a result of mosquito bites. Respondents further confirmed the causes of the increase of mosquitoes in their surroundings to be bushes around homesteads, stagnant water around the homesteads, uncovered sceptic tanks constructed near homesteads among other factors whereas surprisingly, 5% of respondents revealed that they did not have any knowledge about mosquito bites and 15% of respondents were not sure what is the cause of increased mosquitoes presence in their areas.

Effects of mosquito bites on human life in Kampala district

From Table 2, the majority of the participants represented with 50% revealed that malaria cause by mosquito bite is the cause of increased numbers of deaths mostly among children under the age of five

Table 2: Showing the effects of mosquito bites to human life in Kampala district.

Responses	Frequency	Percentage (%)
Slowed socio-economic development and poverty	10	12.5
Increased deaths mostly among children under five years of age are due to malaria	40	50
Increased expenditure for consultation fees, drugs, transport and subsistence at a distant health facility	30	37.5
Total	**80**	**100**

Source: Primary data, (2019).

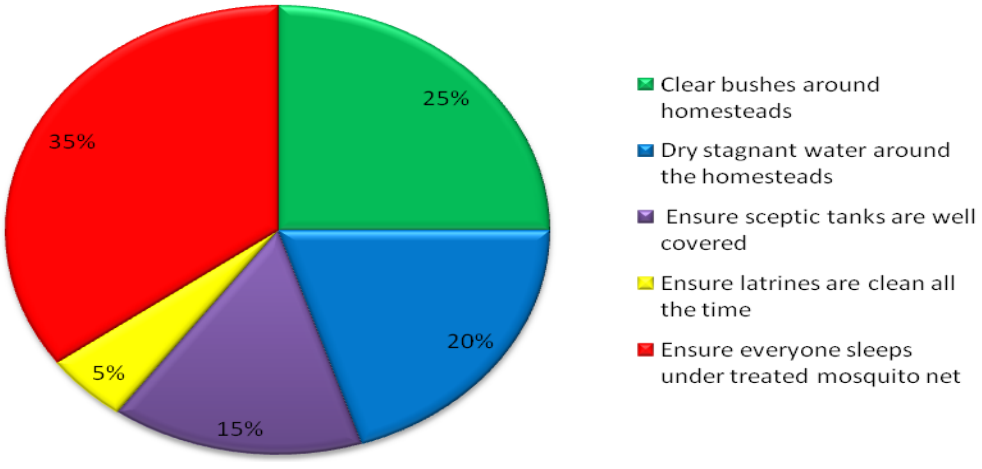

Figure 3: Showing the possible measures to the public on mosquito bites. Source: Primary data, (2019).

Table 3: Possible measures to by taken by the government and other stakeholders on mosquito bites.

Responses	Frequency	Percentage (%)
Subsidization of anti-malarial medication and monitoring malaria cases	20	25
Supply of free mosquito nets to the public	30	37.5
Increase extension of health services	10	12.5
Mass sensitisation drive against Malaria	5	6.2
Government Support in terms of emergency supplies (Artemisinin-based Combination Therapy (ACTs) and Rapid Diagnostic Tests (RDTs)	15	18.7
Total	**80**	**100**

Source: Primary data, (2019).

followed by 30% of participants who said that the increase in consultation fees, drugs, transport and subsistence at a distant health facility. And lastly, 12.5% of participants revealed that there is slow socio-economic development and poverty among communities due to malaria disease caused by mosquito bites.

Possible measures taken by the public on mosquito bites

Figure 3 shows an assessment of the possible measures adopted by the public towards mosquito bites. 35% of the participants' suggested that everybody should sleep under a treated mosquito net, this was followed by 25% of the participants who suggested that bushes around homesteads should be cleared, 20% of participants said stagnant waters around homes should be dried, septic tanks around homes should be covered and latrines should be kept clean always.

Possible measures the government and other stakeholders should take on mosquito bites

Results in Table 3 shows the possible measures the government and other stakeholders should take on mosquito. 25% of the participants recommended subsidization of anti-malarial medication and monitoring malaria cases, 37.5% suggested that there should be free supply of mosquito nets to the public, 12.5% suggested there should be an increase in extension of health services, 6.2% of participants revealed that there should be mass sensitisation drive against Malaria and lastly there should be government support in terms of

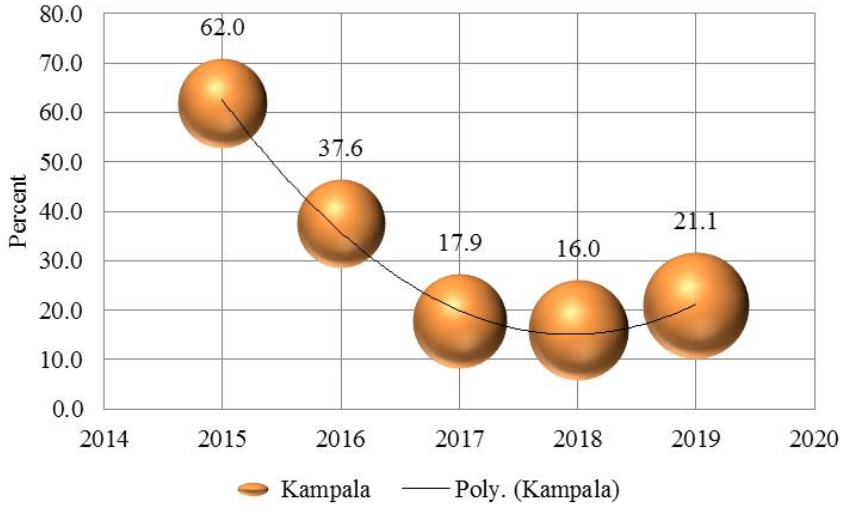

Figure 4: Showing distribution of proportions of reported malaria cases in Kampala district (2015-2019). Source: Secondary data – Malaria Indicator Survey (MIS).

emergency supplies such as Artemisinin-based Combination Therapy (ACTs) and Rapid Diagnostic Tests (RDTs).

Temporal analysis of malaria cases in Kampala district (2015-2019)

Results from Figure 4 indicate that malaria cases in Kampala district steadily declined from 2015 to 2018 (62% to 16%) and thereafter, there was an annual increase in cases from 2018 to 2019 (16% to 21.1%). This is as shown by the polynomial trend above. The sudden increase in the number of cases between 2018 and 2019 (the study period) might be attributed to laxity on the part of residents of Kampala residents having experienced a historical reduction in the number of reported cases from 2015 to 2018. Due to limited access to Health Management Information Systems (HMIS) data in the country, annual data was used instead of the preferred monthly data.

DISCUSSION

Factors responsible for the increased presence of mosquitoes in Kampala district

Results of the study show that bushes around homesteads, availability of wetland and water channels, stagnant water around the homesteads, uncovered septic tanks constructed near homesteads, and wet leaves and dead wood around homesteads are the factors responsible for the increased presence of mosquitoes and hence mosquito bites. According to Uganda National Malaria Control Division (NMCD), Uganda Bureau of Statistics (UBOS) and Inner City Fund (ICF) (2020) the presence of stagnant water which act as breeding environment for mosquito is a significant cause of increased mosquitoes. Also, the sixth goal of the Sustainable Development Goals (SDGs) 2016–2030 aims at reducing the burden of malaria. It promotes clean water and sanitation and suggests that drainage of standing water leads to decreased mosquito breeding and reduction in the rate of malaria transmission (WHO, 2019 and World malaria report ,2019).

Also, according to Carrasco-Escobar et al. (2017); the high malaria-risk clusters, observed in a highly deforested area with substantial surrounding vertical vegetation since such deforested areas are preferred breeding sites. In some communities, the high malaria-risk clusters were located near lagoons, where the stagnant water ecosystem are likely suitable breeding sites.

Knowledge and attitude towards mosquito bites in Kampala district

80% of study participants revealed that they were aware of the mosquito bites and went on to share their experience of how they had suffered from malaria disease as a result of mosquito bites. These findings are consistent with results from the most recent Malaria Indicator Survey (MIS) of 2018/2019 where 78% of women between the ages of 15-49 were reported to understand that malaria is caused by mosquitoes or mosquito bites (NMCD, UBOS and ICF, 2020). It has been shown that as the knowledge and attitudes toward malaria behaviors, products, and services improve, the practice of healthy malaria behaviors increases. This is why one of the core objectives of the Uganda Malaria Reduction Strategic Plan 2014-2020 (UMRSP) was that by 2020, at least 85% of the population would practice correct malaria prevention and measurement measures (MoH, 2014).

There is a relationship between educational attainment and knowledge about mosquitoes and mosquito bites as education increases access to information. High levels of education are associated with increased mosquito bites knowledge which in turn reduces

malaria prevalence. A decreasing trend of malaria prevalence was observed with mother's highest level of education. Malaria prevalence was 15% and 43% lower in children whose mothers had attained primary and post-primary education compared to children whose mothers had no education respectively (Ssempiira et al., 2017). Also, according to (NMCD, UBOS and ICF, 2020), among children in the age brackets of 0-59 months, malaria prevalence according to microscopy decreases with increases in mother's education from 17% among children whose mothers have no formal education to less than 1% among those whose mothers have more than secondary education.

Effects of mosquito bites on human life in Kampala district

50% of the study participant revealed that mosquito bites in Kampala district have increased deaths mostly among children under five years of age. These findings are in agreement with results from the World Malaria report of 2019 where children aged under 5 years old were reported to be the most vulnerable group affected by malaria. In 2018, they accounted for 67% (272,000) of all malaria deaths worldwide (WHO, 2019). Further, the Ministry of Health in Uganda reported that clinically diagnosed malaria is the leading cause of morbidity and mortality, accounting for 30-50% of outpatient visits at health facilities, 15-20% of all hospital admissions and up to 20% of all hospital deaths. About 27% of inpatient deaths among children under five years of age are due to malaria. A significant percentage of deaths occur at home and are not reported by the facility-based Health Management Information System (HMIS) (MoH, 2021).

Thirty percent (30%) of participants said that there was increased expenditure for consultation fees, drugs, transport and subsistence at a distant health facility as a result of Malaria. Similar findings were revealed by Orem et al. (2012) who discovered that Malaria poses a heavy economic burden on households, which may expose them to financial catastrophe and impoverishment. In their study, the total malaria treatment-related spending was US$46,134,999; out of which 90% was incurred by households or individuals; only US$2,987,351 was spent on malaria prevention; out of which 81% was borne by Ministry of Health and development partners. The researchers recommended upholding of the no-user fees policy as well as increased investments in improving access to quality health services in order to further reduce the cost of illness borne by patients and their families.

According to Ssempiira et al. (2017), socio-economic development is significantly associated with Malaria in Uganda. This is in line with findings from this study where 12.5% of participants revealed that there was slowed socio-economic development and poverty among communities due to Malaria disease that is caused by mosquito bites. Also, according to Uganda Malaria Reduction Strategic Plan 2014-2020 (2014), Malaria has an indirect impact on the economy and development in general. The socio-economic impact of Malaria includes out-of-pocket expenditure for consultation fees, drugs, transport and subsistence at a distant health facility. These costs are estimated to be between US$0.41 and US$3.88 per person per month (equivalent to US$1.88 and US$26 per household). Household expenditure for Malaria treatment is also a high burden to the Ugandan population, consuming a larger proportion of the incomes in the poorest households. Industries and agriculture also suffer due to loss of person-hours and decreased worker productivity. Investors are generally wary of investing in countries where malaria rates are high, leading to a loss in investment opportunities. Furthermore, severe malaria impairs children's learning and cognitive ability by as much as 60%, consequently affecting the performance of Uganda's universal primary and secondary education programs.

Malaria has a significant negative impact on the economy of Uganda due to loss of workdays because of sickness, decreased productivity, and decreased school attendance. A single episode of malaria costs a family an average of 9 US dollars or 3% of their annual income. Workers suffering from malaria may be unable to work for an estimated 5-20 days per episode. Given that many people are infected multiple times a year, this has substantial financial consequences on families. A poor family in a malaria-endemic area may spend up to 25% of the household income on malaria prevention and treatment (MoH, Uganda Malaria Reduction Strategic Plan 2014-2020, 2014).

Measures taken by the public on mosquito bites

35% of the study participants revealed that everybody should sleep under mosquito-treated net as a measure against mosquito bites. This is in agreement with findings by the World Health Organisation (WHO) which discovered that sleeping under an insecticide-treated net (ITN) can reduce contact between mosquitoes and humans by providing both a physical barrier and an insecticidal effect. Population-wide protection can result from the killing of mosquitoes on a large scale where there is high access and usage of such nets within a community. In 2019, an estimated 46% of all people at risk of malaria in Africa were protected by an insecticide-treated net (WHO and Malaria, 2021).

These findings are related with the results of Stone et al. (2018) who discovered that applying invasive-plant interventions can suppress malaria transmission, or even interrupt it altogether in some instances. Nkuo-Akenji et al. (2006) reported that inhabitants of houses surrounded by bushes or garbage heaps and swamps or stagnant water showed higher malaria parasite prevalence and densities compared with those from cleaner surroundings.

Interventions suggested to the government and other stakeholders on mosquito bites

37.5% of the study participant suggested that there should be a free supply of mosquito nets to the public and 12.5% suggested there should be an increase in extension of health services. According to United

Nations Children's Fund (UNICEF), since Malaria is transmitted through the bites of mosquitoes, sleeping under an insecticide-treated mosquito net is the best way to prevent mosquito bites. Sleeping under insecticide-treated nets every night helps to control Malaria and Anaemia in children and adults, as well as reducing the household expense on treatment and funeral expenses (UNICEF, 2021).

Also, 25% of the participants recommended subsidization of anti-malarial medication and monitoring malaria cases, 6.2% of participants suggested that there should be mass sensitization drive against Malaria and the government's support in terms of emergency supplies of Artemisinin-based Combination Therapy (ACTs) and Rapid Diagnostic Tests (RDTs). According to the WHO, for rapid and effective case management of the disease, both early diagnosis and treatment of malaria are essential. The best available treatment, particularly for *P. falciparum* is artemisinin-based combination therapy. The primary objective of treatment is to ensure the rapid and full elimination of Plasmodium parasites from a patient's bloodstream in order to prevent an uncomplicated case of malaria from progressing to severe disease or death. From a public health perspective, the effective treatment also reduces transmission of the infection to others by reducing the infectious reservoir and by preventing the emergence and spread of resistance to antimalarial medicines (WHO, 2021; Treating Malaria, 2021).

Uganda government-supported Kampala metropolitan and other districts with increased cases of Malaria in order to get emergency supplies (Artemisinin-based Combination Therapy (ACTs) and Rapid Diagnostic Tests (RDTs) to ensure facilities are well stocked. The government has also revised the quantification of ACTs for this financial year to take into account this increase in cases. There is also redistribution of Malaria commodities from facilities and districts with overstocks to those with in adequate stock of malaria commodities every time. The Ministry of health is also networking with the private sector to ensure they have adequate stocks of subsidized anti-malarial medication and monitoring malaria cases, admissions and deaths in all districts on a dashboard and using the data to guide decisions at all levels, this has helped identify and curtail many outbreaks (Ruth, 2019).

In addition, the Uganda government is extending the management of malaria by village health teams at the community level through training, providing adequate stock and continuing the routine distribution of Long-lasting insecticidal nets (LLINs) to pregnant women in Antenatal care clinics and to Children in immunization clinic, fast-tracking the implementation of the 2020 LLIN Mass Campaign and introducing new channels of LLIN distribution such as school distribution in selected districts with high malaria burden. The president of Uganda, Yoweri Museveni also launched the Mass Action Against Malaria (MAAM) drive in 2018 for every individual to actively take on malaria preventive services and ensure they are malaria-free. In this regard, the government is working with leaders to intensify education and prevention.

Mobilization and community outreaches in high burden areas to conduct testing and treatment and tracking have also been done. Mobilization drive for resources to scale up interventions such as Indoor Residual Spraying and routine LLIN distribution (increase IRS beyond the current 15 districts) has also been implemented by the government of Uganda.

CONCLUSION

A mosquito bite is a small, round, puffy bump that appears soon after you've been bitten by a mosquito. Mosquito bites cause Malaria which is transmitted by the female Anopheles mosquitoes which normally bite at night. The factors that cause mosquitoes are attributed to stagnant water around homesteads, uncovered sceptic tanks, dirty latrines that become breeding grounds for mosquitoes and bushes surrounding homesteads. Malaria still remains one of the leading causes of death in Africa that has also been attributed to slow socio-economic development and poverty, and decline of Industries and agriculture which also suffer due to loss of person-hours and decreased worker productivity. Despite the interventions put in place by Uganda government like mass drive campaigns (Mass action drive against Malaria), early treatment and networking with private sector to eradicate the disease and copying up with prevention methods used by other different states of the world, malaria is still a challenge. Unless other new strategies are developed and successfully implemented, malaria will continue to exact a heavy toll on human life and health around the world.

RECOMMENDATIONS

Do not allow stagnant water: Mosquitoes breed by laying eggs in stagnant water. You can keep them off your property by covering or clearing out any stagnant water from your home. Buckets, coolers, and other containers must be regularly checked for stagnant water. A handy tip for the rainy season is to drop a little oil in puddles around your home. This can hamper the life cycle of mosquitoes by not allowing eggs to hatch.

Clear all litter: Do not allow any debris to collect around your house, especially in gardens, compounds or yards. Litter is often a great hiding place for mosquitoes. Remove waste from your house regularly and make sure your neighborhood stays clean as well. If you see trash lying around for more than a couple of days, ensure that it is picked up and disposed of properly.

Use a suitable mosquito repellent: Insect repellents often contain harmful chemicals that can cause allergies and affect babies. But you can be rest assured with good mosquito repellents which eliminate mosquitoes effectively from every corner of your home and have been proven to be safe around toddlers and children.

Use physical barriers: As evening approaches, you

might see mosquitoes swarming towards your home. An effective method to keep them from entering your home is by using mosquito screens on doors and windows. This, along with a good insect repellent, will effectively mosquito-proof your home. If you have already prepared your baby's crib, covering it with netting is a good idea for an extra layer of protection.

Awareness programs: Health authorities in Kampala Metropolitan that is Divisions, Parishes, Villages and Zones should call on individuals, families and communities to join the battle to reduce mosquito breeding sites in and around homes, the campaign should focus on increasing community participation in the elimination of breeding sites. The mosquitoes that transmit dengue, chikungunya, Zika and urban yellow fever can easily be controlled through awareness programs.

Other recommendations

- Every family member should sleep under a mosquito net every night to avoid been bitten by mosquitoes.
- Drain off all the stagnant water around your homes and ensure all wastewater from any sanitary provisions including bathroom, shelters, kitchen, and others are properly drained off to a soak pit or septic tank.
- It's also important to keep the grass and vegetation near your home well-trimmed.
- Install screens in your windows to keep mosquitoes out and ensure that the windows are closed early enough and avoid staying outdoors in the late hours.
- Whenever you're outside in wooded or grassy areas, wear long sleeves and pants.
- Make sure your vaccinations are up to date before you travel to foreign countries. Your doctor may also prescribe oral medications to help prevent malaria or other illnesses.
- Always seek early treatment from the nearest Health Facility within 24 hours of the onset of symptoms and take a complete dosage of Malaria medication as advised by a health worker. Encourage Use of mosquito repellents for those who can afford.
- All pregnant women must attend all antenatal care visits and take intermittent preventive therapy and avoid self-medication and sharing of medication.
- Remove wet leaves and dead wood from shady areas of the yard. Gardens overgrown with weeds and debris that attract these pests. Also, keep the grass low by mowing at regular intervals throughout the warm weather seasons to avoid hiding spots
- Avoid overwatering plants that can cause excess water to pool within the flowerbeds and check automatic sprinkler systems to maintain proper irrigation practices to prevent the occurrence of stagnant water.

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