FACTORS INFLUENCING VACCINATION OF DOGS AGAINST RABIES WITHIN HOUSEHOLDS IN SOUTH MUGIRANGO SUB-COUNTY-KISII COUNTY, KENYA

OBARA FANICE KERUBO

BSc. Public Health (Jaramogi Oginga Odinga University of Science and Technology)

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Obara Fanice Kerubo

MHS16/40084/15

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This thesis has been submitted for examination with our approval as University Supervisors

Signature ..... Date 19/08/2025

Dr. Japheth Mativo Nzioki, PhD.

School of Nursing,

Andrews University, Michigan.

Signature ..... Date 19.08.25

Dr. Eric. O. Omwenga PhD.

Department of Medical Microbiology & Parasitology

Kisii University, Kenya

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DEDICATION

This work is dedicated to my beloved parents, Mr. and Mrs. Obara, whose unwavering love, prayers, sacrifices, and support have been a constant source of strength and inspiration throughout my academic journey. I also dedicate this work to my dear siblings, Harriet, Edwin, and Evans, for their encouragement, love, and support. May God bless them abundantly for their invaluable contribution to my life and education.

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ABSTRACT

Rabies is a zoonotic viral disease that affects all warm-blooded mammals, including humans. Approximately 99% of human rabies cases result from bites by infected dogs, making dog vaccination the most effective strategy for preventing transmission. In Kenya, rabies remains endemic and is recognized among the country's priority zoonotic diseases. This study assessed factors influencing vaccination of dogs against rabies within households in South Mugirango Sub-County, Kisii County, Kenya. The study was guided by the following four objectives: to assess the level of awareness of rabies within households, to establish the socio-demographic factors influencing vaccination of dogs, to establish the factors influencing level of adherence to vaccination of dogs against rabies, to assess the practices of households in regard to control of dog mediated rabies in South Mugirango Sub-County. A descriptive cross-sectional survey was conducted among 422 household heads using structured questionnaires, while 22 key informants from the health, veterinary, livestock, and administrative sectors were interviewed. Quantitative data were analysed using SPSS version 26, with logistic regression applied to determine relationships between variables at a significance level of $\alpha = 0.05$. Qualitative data were analysed thematically. Quantitative data was presented using frequency tables and figures. The findings showed a high level of rabies awareness (96.3%) within households. However, only 59.2% correctly identified a virus as the cause of rabies, while 83.8% recognized animal bites as the primary mode of transmission. Awareness was significantly associated with marital status, occupation, and household breadwinner status ($p < 0.05$). Despite high awareness, adherence to dog vaccination was low, with only 14.5% of respondents reporting regular vaccination of their dogs. Most respondents (84.7%) could not recall the last time their dogs were vaccinated. Adherence to vaccination was significantly associated with age, education level, occupation, household income, household size, and breadwinner status ($p < 0.05$). Regarding rabies control practices, 79.3% of households sought medical care following dog bites, and 89.2% reported referring bite victims to health facilities. The study concludes that although awareness of rabies is high, vaccination uptake remains inadequate. Strengthening community sensitization, expanding vaccination campaigns, providing mobile vaccination services, and improving access to affordable vaccines are essential to enhance rabies prevention and control in South Mugirango Sub-County.

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LIST OF ACRONYMS AND ABBREVIATIONS

ARV	Anti-Rabies Vaccine
CI	Confidence Interval
DRIT	Direct Rapid Immunohistochemistry Test
DMS	Degree Minutes Second
DFAT	Direct Fluorescent Antibody Test
DUVV	Duvenhage Virus
ERIG	Equine Rabies Immunoglobulin
ELISA	Enzyme-linked Immunosorbent Assay
FAT	Fluorescent Antibody Test
FRD	Free Roaming Dogs
GARC	Global Alliance for Rabies Control
HH	Households
HHS	Householeads
KAP	Knowledge, Attitudes and Practices
KNZU	Kenya National Zoonotic Disease Unit
KII	Key informant interviews
KNBS	Kenya National Bureau of Statistics
LBV	Lagos Bat Virus
MIT	Mouse Innoculent Test
MoA	Ministry of Agriculture
MoKV	Mokola Virus
MoH	Ministry of Health

NACOSTI	National Commission for Science, Technology and Innovation
PCR	Polymerase Chain Reactions
PIC	Point Infection Control
PEP	Post Exposure Prophylaxis
PreP	Pre-exposure prophylaxis
RIG	Rabies Immunoglobulins
RABV	Rabies Virus
RNA	Ribonucleic-acid
WHO	World Health Organization

DEFINITION OF TERMS

Dog Ownership: refers to responsible possession of a dog by consistently providing at a minimum food, shelter and medical attention

Dog keeping and Husbandry: refers to the methods employed in keeping a dog in such a way that guarantees no abuse and ensures provision of protection, companionship and shepherding.

Household dog: is fully dependent on a household and semi-restricted;

Restricted dog: is fully dependent and fully restricted or supervised;

Free roaming dog: is independent and unrestricted (it may need to forage around households but nobody will take responsibility for it).

Household: individuals living under one roof and who share one cooking pot.

Dog vaccination status: a dog is considered vaccinated if the last vaccination date to current date is not greater than I year. This can be verified from the vaccination certificates. If the vaccination certificate is not available, verification can be obtained from concerned veterinary officer; otherwise, the dog is considered unvaccinated

CHAPTER ONE

INTRODUCTION

1.1. Background Information

Rabies is a viral infectious disease that is transmitted from animals to humans (a zoonotic disease) and is often overlooked in public health. It is caused by the rabies virus, which belongs to the Rhabdoviridae family (Yousaf et al., 2012). The rabies virus is an enveloped virus with a non-segmented, negative-sense single-stranded RNA genome. It belongs to the Rhabdoviridae family, which is known for its distinctive bullet-shaped structure and comprises at least three genera of animal viruses: Lyssavirus, Ephemerovirus, and Vesiculovirus. The Lyssavirus genus includes several viruses such as the rabies virus, Lagos bat virus, Mokola virus, Duvenhage virus, European bat viruses 1 and 2, and the Australian bat virus (World Health Organization [WHO], 2017). The genome of this virus codes for five distinct genes: nucleoprotein (N), phosphoprotein (P), glycoprotein (G), matrix protein (M), and viral RNA polymerase (L) (Yousaf et al., 2012).

Following inoculation, the virus begins to replicate within the connective tissues at the site of entry. It then gains access to the peripheral nerves through the neuromuscular junction and subsequently spreads to the central nervous system (Yousaf et al., 2012). At this stage, the virus begins to affect the nervous system, progressing to the spinal cord and eventually the brain. The time it takes to reach the brain varies depending on the location of the bite, typically ranging from 10 days to as long as 30 to 50 days. Once in the brain, the virus replicates and then spreads through other nerves to the salivary glands, from which it is

secreted in the saliva (WHO, 2024). The symptoms of rabies arise from the activity of specific viral genes; nucleoprotein (N), phosphoprotein (P), glycoprotein (G), matrix protein (M), and viral RNA polymerase. The disease is marked by the onset of serious neurological symptoms that eventually result in paralysis and death (Kessels et al., 2017).

The control and prevention of rabies is increasingly framed within the One Health approach, which recognizes that human health is closely linked to the health of animals and the environment. This approach promotes multisectoral collaboration between human health, veterinary, and environmental sectors to effectively prevent and control zoonotic diseases such as rabies (WHO et al., 2019). Under this framework, interventions such as mass dog vaccination, surveillance systems, community awareness, and access to post-exposure prophylaxis are implemented in a coordinated manner to interrupt transmission at its animal source and protect human populations (Food and Agriculture Organization of the United Nations [FAO], 2023; World Organisation for Animal Health [WOAH], 2022).

Approximately 99% of human rabies cases are caused by bites from infected dogs. Once clinical symptoms appear, the disease is almost always fatal. Rabies is primarily spread through the saliva of infected animals such as dogs, raccoons, skunks, bats, and foxes, usually via bites that introduce the virus into the central nervous system (Kessels et al., 2017; Yousaf et al., 2012). The global impact of rabies remains substantial, with the disease found in over 150 countries and territories across all continents except Antarctica (Ministry of Health and Ministry of Agriculture, 2014). Each year, rabies claims the lives of up to 59,000 people globally, with 95% of these deaths occurring in Africa and Asia. In Kenya alone, an estimated 2,000 people die from rabies annually (Spargo et al., 2021). However, official figures

reported to the World Health Organization (WHO) from African countries significantly underrepresent the true extent of the disease (Kessels et al., 2017). This underreporting is largely due to several factors: many victims are too sick to reach healthcare facilities or die before arriving, families often see little benefit in seeking medical help due to the lack of effective treatment for rabies, and clinical misdiagnosis and difficulty in laboratory confirmation of suspected cases are common (Ministry of Health and Ministry of Agriculture, 2014). The situation is further compounded by widespread poverty in many African households, which makes it challenging for individuals to afford the high cost of medical care (Kenya National Bureau of Statistics [KNBS], 2019).

Over 95% of global rabies-related fatalities occur in Asia and Africa, equating to approximately one death every 10 minutes across the two continents (Hampson et al., 2015). South Asia accounts for more than half of the worldwide rabies burden, with India alone responsible for an estimated 17,000–20,000 of the 59,000 global deaths each year (Kakkar et al., 2012). However, the highest per capita death rates are recorded in some of the poorest sub-Saharan African nations, including Kenya (Hampson et al., 2015). While dog vaccination efforts exist in parts of East and West Africa, rabies transmission remains uncontrolled (Yousaf et al., 2012)**.** Despite their proven effectiveness in preventing rabies and reducing rabies-related deaths, rabies vaccines remain underutilized, particularly in resource-limited settings, due to high costs and limited accessibility (World Health Organization, 2017). Consequently, rabies (particularly when spread by dogs) continues to pose a significant global health threat, causing physical injuries, psychological trauma, post-traumatic stress, and often death. The World Health Organization (WHO) classifies rabies as a neglected tropical disease (World Health Organization, 2017).

In Kenya, rabies in animals is categorized as a notifiable condition under the Disease Control Act and Rabies Act. The country is endemic to five lyssavirus genotypes known to cause rabies. The predominant strain is genotype 1, known as the Rabies virus (RABV), while the others include genotype 2 (Lagos bat virus, LBV), genotype 3 (Mokola virus, MOKV), genotype 4 (Duvenhage virus, DUVV), and the Shimoni bat lyssavirus (WHO, 2017). Human rabies cases in Kenya are primarily linked to the canine variant of RABV (World Health Organization, 2021). In 2014, the Kenya National Zoonotic Disease Unit estimated that the country records slightly over 2000 deaths annually caused by Rabies (Ministry of Health and Ministry of Agriculture, 2014). As a result, rabies has been identified as one of Kenya's top five priority zoonotic diseases (Ministry of Health and Ministry of Agriculture, 2014).

Dog vaccination remains the most effective and sustainable strategy for controlling rabies transmission at the source. In rabies-endemic settings, successful elimination depends not only on vaccine availability but also on household preference and willingness to vaccinate dogs consistently (WHO, 2018). Studies conducted in rabies-endemic regions of sub-Saharan Africa indicate that although awareness of rabies is often high, actual preference for dog vaccination varies widely due to socio-economic and cultural factors. Households with higher levels of education and income are more likely to prioritize routine vaccination of dogs, while those in lower-income settings often delay or forego vaccination due to cost, limited access to veterinary services, and competing household needs (Hampson et al., 2015).

In rural Kenyan settings, dog vaccination uptake is also influenced by perceptions of risk and the perceived value of dogs. Where dogs are primarily kept for security or herding, owners may prioritize feeding and functional use over preventive veterinary care, including

vaccination. In some cases, vaccination is only sought after a dog bite incident occurs, reflecting a reactive rather than preventive approach to rabies control (Ministry of Health & Ministry of Agriculture, 2014). Accessibility of veterinary services further shapes vaccination preferences. Long distances to vaccination points, limited outreach campaigns, and irregular availability of free or subsidized vaccination services reduce uptake, particularly in remote areas. Community-based and mobile vaccination campaigns have been shown to improve acceptance and coverage by reducing logistical and financial barriers (WHO, 2018). Cultural beliefs and misinformation also influence decision-making. Some households perceive vaccination as unnecessary for healthy-looking dogs or believe that traditional remedies can prevent rabies. These perceptions contribute to inconsistent vaccination practices and undermine herd immunity within dog populations.

In 2015, the World Health Organization (WHO), in collaboration with the Food and Agriculture Organization (FAO) and the World Organisation for Animal Health (WOAH), launched the global strategic framework "Zero by 30," aiming to eliminate human deaths from dog-mediated rabies by 2030 (WOAH, 2022). This goal is grounded in the One Health approach, which emphasizes coordinated action across human, animal, and environmental health systems. The elimination of rabies is achievable through mass dog vaccination, which is considered the most cost-effective strategy for interrupting transmission and reducing the need for post-exposure prophylaxis (PEP) (WHO, 2018). Kenya has adopted a national rabies elimination strategy aligned with the One Health framework, focusing on mass vaccination, improved surveillance, access to PEP, and community awareness (Ministry of Health and Ministry of Agriculture, 2014). This coordinated approach is designed to systematically

reduce the risk of rabies until the country is free of dog-mediated human rabies (Ministry of Health and Ministry of Agriculture, 2014).

Despite these efforts, little is known about the level of public awareness of dog mediated rabies in communities living in rural Kenya and in particular South Mugirango sub county in Kisii County. Additionally, little is also known on the level of adherence to vaccination of dogs against rabies as well as the factors influencing the level of awareness of dog mediated rabies and adherence to vaccination of dogs against rabies. Based on this background, this study was conducted to assess community awareness of dog-mediated human rabies and to identify the factors that influence both awareness and adherence to dog vaccination efforts among households in South Mugirango Sub-County.

1.2. Problem Statement

Rabies is a frequently overlooked zoonotic disease that is almost always fatal to humans, domestic animals, and other mammals (WHO, 2017). Globally, dog-mediated rabies causes an estimated 59,000 human deaths annually, with the vast majority occurring in Asia (56%) and Africa (43.6%), predominantly in rural communities (Ministry of Health and Ministry of Agriculture, 2014; WHO, 2017). In Kenya, rabies is responsible for approximately 2,000 human deaths annually, with more than 95% of these resulting from bites by infected dogs (World Health Organization, 2017). However, the figures reported to WHO from Africa significantly underestimate the actual disease burden (Ministry of Health and Ministry of Agriculture, 2014). Contributing factors include patients being too sick to reach medical facilities, lack of faith in treatment effectiveness, challenges in rabies diagnosis, and

difficulties in confirming suspected cases through laboratory testing (Ministry of Health and Ministry of Agriculture, 2014).

In addition to human mortality, the high expense of post-exposure prophylaxis (PEP) places a significant financial strain on both public health systems and families (Ministry of Health and Ministry of Agriculture, 2014). For households, PEP-related costs include not only the price of vaccines but also expenses related to travel, medical consultations, and lost income (Ministry of Health and Ministry of Agriculture, 2014). In Kenya, a full PEP course costs approximately $85 per person (Ministry of Health and Ministry of Agriculture, 2014). This cost can be prohibitive for low-income households, often leading to financial distress and delays in receiving or even complete omission of necessary treatment. In many rural areas of Africa, PEP shortages are common, forcing victims to travel long distances for care, which increases costs and adds to the burden. Additionally, families of rabies victims endure severe emotional distress, largely due to the fear and inevitability of the disease's outcome (Ministry of Health and Ministry of Agriculture, 2014).

Rabies remains one of Kenya's five priority zoonotic diseases and is endemic in all counties (Ministry of Health and Ministry of Agriculture, 2014; Muriuki et al., 2015). In Kisii County, 975 dog bites were reported in 2016, 898 in 2017, and 835 in 2018. South Mugirango Sub-County accounted for 14% of reported dog bites in both 2016 and 2017, rising to 21% in 2018 (Ogugu et al., 2024). The financial implications are substantial, with Kisii County spending approximately Kshs. 3.5 million per month on human anti-rabies vaccines, of which South Mugirango accounts for about Kshs. 640,000 (Ogugu et al., 2024). It is postulated that little is known on the level of public awareness and factors influencing level of awareness of

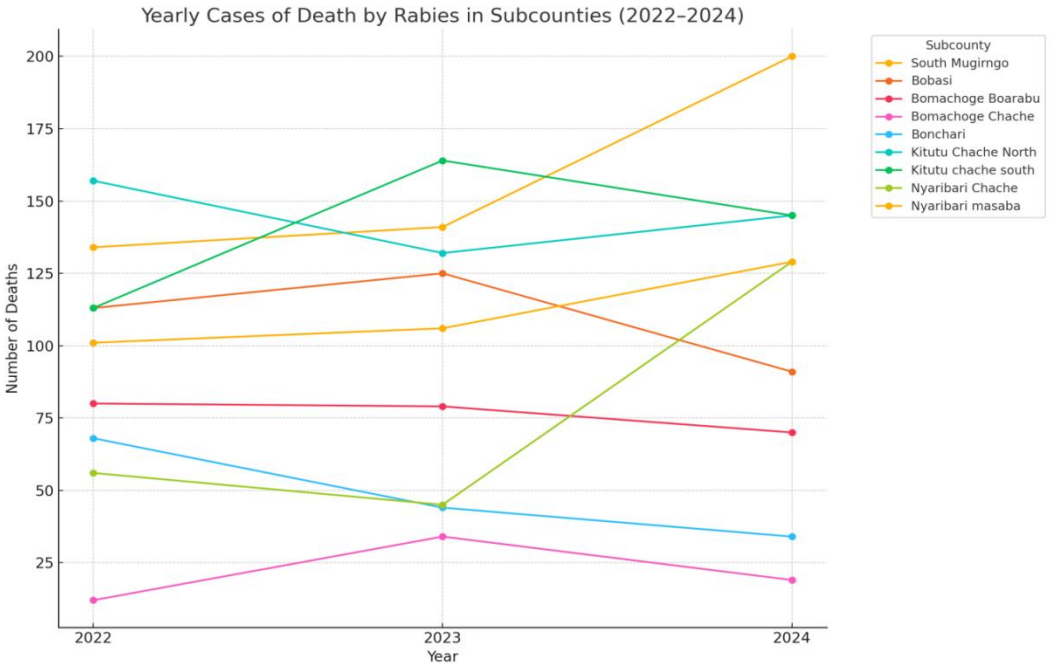
dog mediated rabies in communities living in rural Kenya and in South Mugirango in particular as less or no current documentation is present to the best of our knowledge. On the other hand, little is known about the level of adherence and factors influencing vaccination of dogs against rabies in most parts of rural Kenya and in South Mugirango in particular. Therefore, this study seeks to fill this gap.

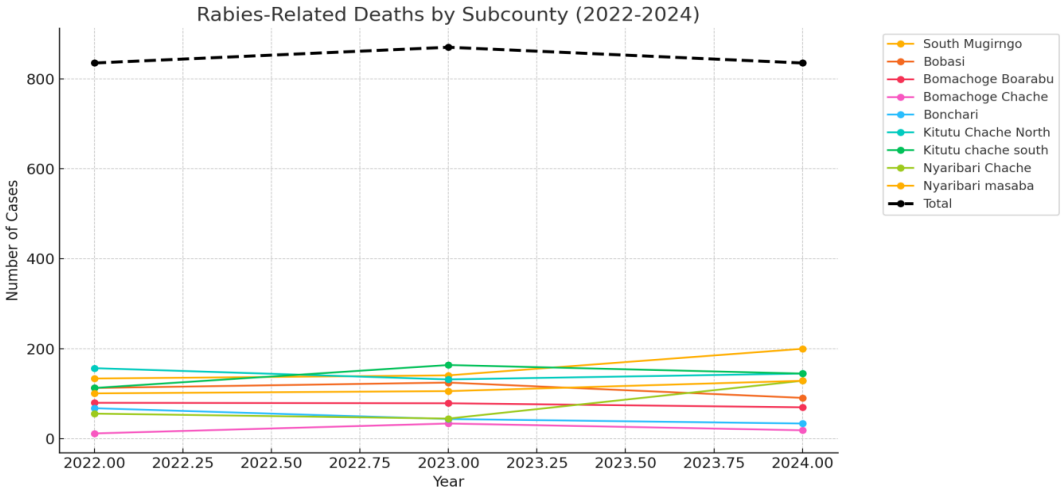
1.3. Justification

Rabies is classified as a neglected tropical disease (Vigilato et al., 2018), largely because approximately 99% of cases occur in developing countries, where it receives limited public health attention. Despite being entirely preventable through vaccination, the disease continues to impose a significant public health and economic burden, particularly in rural communities where access to healthcare and veterinary services is limited (Hampson et al., 2015).

Effective rabies control depends on locally generated evidence on community awareness, prevention practices, and vaccination uptake. Such evidence is essential for informing targeted interventions that improve knowledge, increase dog vaccination coverage, and reduce human exposure. However, studies on public awareness of rabies and the determinants of dog vaccination remain limited in many rural settings in sub-Saharan Africa, including Kenya (WHO, 2018). Similarly, evidence on adherence to dog vaccination and the factors influencing uptake is insufficient at the community level. This gap limits the development of effective, context-specific rabies control strategies and weakens the implementation of national elimination programmes. Strengthening the evidence base is therefore necessary to support policy formulation and improve programme effectiveness.

In Kisii County, rabies continues to pose a significant public health challenge. Reported dog bite cases and associated rabies control costs indicate sustained transmission risk, with South Mugirango Sub-County contributing a substantial proportion of cases (Ogugu et al., 2024). However, limited empirical data exist on community awareness and dog vaccination practices in this area.





The trend data for rabies deaths in Kisii County between 2022 and 2024 shows fluctuations at both county and sub-county levels. Overall, deaths increased from 835 in 2022 to 870 in 2023, before declining to 835 in 2024. This pattern suggests a temporary rise in 2023 followed by stabilization, possibly reflecting improved control efforts or fluctuating exposure risks.

At sub-county level, South Mugirango consistently recorded the highest number of deaths, rising from 134 in 2022 to 200 in 2024. This sustained increase identifies the area as a potential rabies hotspot requiring urgent public health intervention. Kitutu Chache South also showed a notable rise from 113 deaths in 2022 to 164 in 2023, before declining slightly to 145 in 2024, although levels remain high. Nyaribari Masaba displayed a steady upward trend from 101 deaths in 2022 to 129 in 2024, indicating persistent transmission. In contrast, Bobasi showed a decline from 113 deaths in 2022 to 91 in 2024, suggesting possible improvement in control measures. Kitutu Chache North showed minor fluctuations with no clear trend, while Bonchari and Bomachoge Borabu maintained relatively low and stable figures. Bomachoge Chache recorded a temporary increase from 12 deaths in 2022 to 34 in 2023, warranting closer monitoring.

The observed differences across sub-counties indicate uneven rabies risk distribution within Kisii County. These disparities may reflect variations in dog vaccination coverage, dog population density, access to post-exposure prophylaxis (PEP), and differences in surveillance and reporting capacity. Areas with consistently lower figures, such as Bonchari and Bomachoge Chache, may reflect stronger control measures or lower exposure risk, although underreporting cannot be ruled out. This study therefore seeks to generate evidence

on community awareness of dog-mediated rabies and to identify factors influencing awareness and adherence to dog vaccination among households in South Mugirango Sub-County. The findings are expected to support evidence-based planning and strengthen rabies prevention and control strategies at the local level.

1.4. Study Objectives

1.4.1 General Objectives

To assess factors influencing vaccination of dogs against rabies within household in South Mugirango Sub-County-Kisii County, Kenya.

1.4.2 Specific Objectives

i. To assess the level of awareness of rabies within household in South Mugirango Sub-County.
ii. To establish the socio-demographic factors influencing vaccination of dogs within household in South Mugirango Sub-County.
iii. To establish the factors influencing level of adherence to vaccination of dogs against rabies within household in South Mugirango Sub-County.
iv. To assess the practices of household in regard to control of dog mediated rabies in South Mugirango Sub-County.

1.5. Study Research Questions

i. What is the level of awareness of human dog mediated rabies within household in South Mugirango Sub-County?

ii. What socio-demographic factors that influence level of awareness of human dog mediated rabies within household in South Mugirango Sub-County?
iii. What factors influence the level of adherence to vaccination of dogs against rabies within household in South Mugirango Sub-County?
iv. What are the practices of households in regard to control of dog mediated rabies?

1.6. Significance of Study

This study will be valuable in several ways:

The study findings will inform health promotion, health education, and other prevention measures. It shall support the health care providers in charge of health promotion to understand reason behind non adherence to be able to modify messages communicated and support strategies to address specific needs and concerns. More so it will assist the Sub-County public health and Veterinary officers in designing effective interventions for control and elimination of rabies in South Mugirango sub-county and other rural communities in Kenya. This will accelerate the progress towards achieving a rabies free country by the year 2030.

The study shall inform the allocation of resources to address vaccination of dogs, health promotion information, subsidization of purchases of anti-rabies at an affordable cost, this will optimize resource utilization and maximize the impact of rabies prevention efforts.

The study shall give precise detailed recommendations to key stakeholders involved in rabies mitigation and management.

The study shall provide crucial epidemiological data that can be used to influence policy makers to allocate resources during planning to address factors contributing to non-adherence to vaccination such as, lack of awareness of vaccination dates, inadequate human power to conduct the activity and transportation challenges. This can optimize resource usage and boost the impact of rabies prevention efforts.

The findings of this study will also add into the existing body of knowledge in regard to the prevention and control of human dog mediated rabies. This contributes valuable data on the prevalence of non-adherence, its determinants, and potential intervention strategies. The study provides opportunities for researchers and academicians to join forces with local stakeholders in Kisii County South Mugirango, fostering knowledge exchange and capacity building. The study also inspires and informs future research on rabies prevention and control, particularly in low- and middle-income countries.

CHAPTER TWO

LITERATURE REVIEW

2.1 History of Rabies

Rabies is one of the oldest known diseases, with records dating back to around 2000 BC (Adamson, 1977). Historical accounts from ancient Middle Eastern civilizations such as Egypt and Mesopotamia reference the disease, including its mention in the Code of Eshunna from approximately 2300 BC. In literary texts like Homer's Iliad, the term "rabid" is used metaphorically to describe Hector. Greek philosophers such as Demosthenes and Epicormics referred to the disease as "lyssa," a term meaning "worm" in Greek. They believed it was caused by worms located beneath the tongue that attacked the brain—an idea that persisted until the 18th century. Today, rabies is understood to be caused by a bullet-shaped virus from the Lyssavirus genus, primarily transmitted through the saliva of infected animals (Fooks et al., 2014).

The disease does not present symptoms immediately; instead, signs appear following an incubation period that can last anywhere from 10 days to six months. During this time, the virus multiplies and spreads throughout the nervous system, ultimately causing inflammation in the brain and spinal cord, which can be fatal. Rabies typically presents in one of two forms: the furious form, characterized by agitation, restlessness, and hydrophobia (fear of water); or the paralytic form, where muscle paralysis gradually progresses from the site of infection. According to the World Health Organization (WHO), approximately 99% of human rabies cases are the result of bites from infected dogs. The potential for dogs to transmit this disease

was already recognized in ancient times; for instance, Aristotle noted their role in spreading rabies (Tarantola, 2017).

In the early 1880s, Louis Pasteur undertook research on several infectious diseases, including rabies. By 1885, he successfully protected a 9-year-old boy named Joseph Meister—who had been bitten by a rabid dog—through a ground-breaking procedure involving the injection of an attenuated form of the rabies virus (Tarantola, 2017). This method marked a significant milestone in medical science during the 19th century. Despite this achievement, there has been little advancement in developing an effective treatment for individuals who exhibit symptoms of rabies. To this day, rabies remains one of the deadliest infectious diseases affecting humans. In honour of efforts to combat the disease, World Rabies Day is observed annually on September 28th, the anniversary of Pasteur's death.

To prevent rabies, many countries have adopted large-scale vaccination strategies. These include designated rabies awareness days, during which ministries of health often run free vaccination campaigns targeting dogs and cats, distributing millions of vaccine doses (Gongal & Wright, 2011).

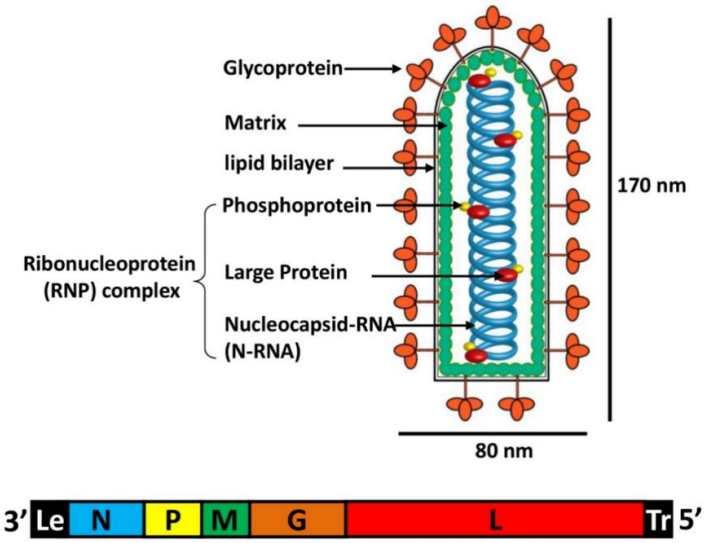
2.2 The Biology and Life Cycle of Rabies

There are fourteen identified Lyssaviruses related to rabies, such as the Mokola virus and Australian bat Lyssavirus. Unlike the rabies virus (RABV), however, these viruses are confined to specific geographic areas and account for only a small proportion of human rabies cases. Nonetheless, their significance may increase as human activity expands into regions where these viruses naturally occur (Francis et al., 2014). The primary cause of rabies, RABV, is a single-stranded, negative-sense RNA virus and the most well-known member of

the Lyssavirus genus. It belongs to the Rhabdoviridae family – named after the Greek word "rhabdos," meaning rod – due to the characteristic rod- or bullet-shaped appearance of the virion under an electron microscope. Like other negative-stranded RNA viruses, RABV virions consist of a tightly organized and stable complex of genomic RNA and nucleoprotein, surrounded by a lipid envelope derived from the host cell membrane (Dietzgen & Kuzmin, 2012).

Figure 2.1

Structure of Rabies virus (Horwitz et al., 2020)

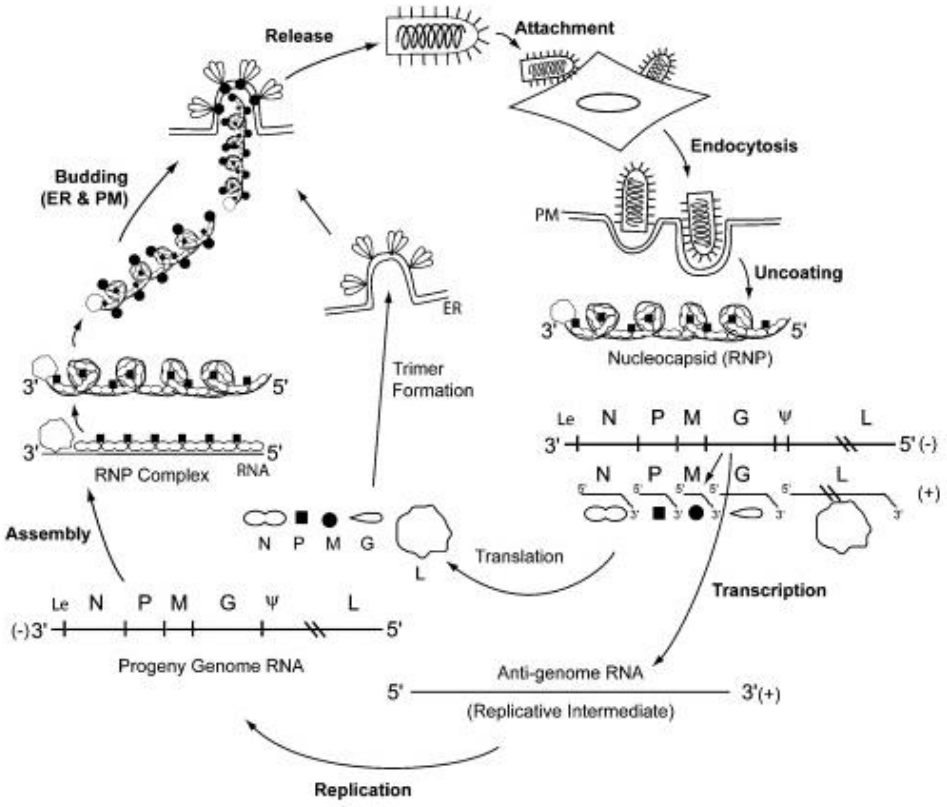


Lyssaviruses share numerous biological and physicochemical traits with other members of the Rhabdoviridae family, including similar strategies for cell entry, genome replication, gene expression, and viral egress via budding from the plasma membrane of infected cells (Wunner, 2007). Structurally, lyssaviruses consist primarily of protein (64–74%), lipid (20–26%), carbohydrate (3%), and RNA (2–3%). The replication cycle of the rabies virus (RABV) in animal hosts proceeds through three key stages. In the initial phase, the virus binds to specific receptors on susceptible host cells, such as the nicotinic acetylcholine

receptor (nAChR), the neuronal cell adhesion molecule (NCAM), and the p75 neurotrophin receptor (p75NTR). Entry into the cell occurs via direct fusion with the plasma membrane or through fusion with internal endosomal membranes. Once inside, the viral particles are uncoated and released into the cytoplasm. The second phase involves transcription of the viral genome, replication of RNA, and synthesis of viral proteins. The final stage includes the assembly of new viral particles and their release from the host cell. These newly formed viruses then propagate by infecting adjacent cells (Wunner, 2007). This life cycle is summarised in figure 2.2 below.

Figure 2.2

Lifecycle of Rabies virus (NPTEL) (Hudacek et al., 2014)



2.3 Rabies: Clinical Features and Diagnosis

The rabies infection incubation period in animals can vary considerably due to variations in their carriers. For instance, in dogs and cats, it typically ranges from 2 to 12 weeks, although longer durations have occasionally been observed (Frymus et al., 2009). Rabies presents in two primary forms in animals: the furious and the dumb (paralytic) forms (Dutta, 2016) and many furious form, often referred to as the "mad-dog syndrome," has been noted across various species. Affected animals display extreme irritability and may attack humans or other animals using their teeth, claws, horns, or hooves without provocation. They often lose their natural fear of humans and other creatures (Rupprecht, 2023). In contrast, the dumb form of rabies is characterized by a lack of coordination (ataxia) and paralysis, particularly of the throat and jaw muscles. This can result in excessive salivation and difficulty swallowing, though affected animals are not typically aggressive. Dogs and cats infected with rabies usually die within 10 days after symptoms begin (Ministry of Health and Ministry of Agriculture, 2014).

In humans, the incubation period for rabies usually spans from 1 to 3 months but can range from less than a week to over a year (Ministry of Health and Ministry of Agriculture, 2014). Early symptoms often include fever and pain, as well as unusual sensations—such as tingling or burning—at the site of the bite (WHO, 2020). As the virus advances through the central nervous system, it causes fatal inflammation of the brain and spinal cord. The disease may manifest as either the furious (encephalitic) or the paralytic form (Belete et al., 2015). Furious rabies in humans is marked by hyperactivity, agitation, fear of water (hydrophobia), and fear of drafts or fresh air (aerophobia). Neurological symptoms can include aggression,

restlessness, difficulty swallowing, and death within days. Paralytic rabies, accounting for about 30% of human cases, progresses more slowly and is less dramatic than the furious form (Ministry of Health and Ministry of Agriculture, 2014; World Health Organization, 2020). This variant begins with muscle paralysis near the bite site and eventually leads to coma and death. Due to its subtle presentation, it is often misdiagnosed, which contributes to underreporting. Once symptoms emerge, rabies is nearly always fatal (Belete et al., 2015; Hemachudha et al., 2005). Paralytic symptoms include muscle weakness, flaccid paralysis, myalgia, excessive drooling, and even hearing loss. In humans, non-specific signs may include fever, general malaise, loss of appetite, anxiety, headaches, and numbness or tingling at the bite site. In animals, early signs include lethargy, fever, vomiting, and anorexia. These may escalate over a few days to neurological symptoms such as cranial nerve dysfunction, seizures, difficulty breathing and swallowing, abnormal behaviour, self-mutilation, aggression, paralysis, and excessive salivation (Mucheru, 2015).

2.4 Rabies Virus Diagnostic Techniques

Rabies diagnosis in both animals and humans relies primarily on the clinical presentation of central nervous system symptoms. In Kenya, diagnostic testing for rabies is conducted at two specialized facilities: Kabete and Mariakani Veterinary Investigation Laboratories (Mucheru, 2015). Various methods have been used to diagnose for presence of rabies virus with rapid diagnosis methods being the most commonly used techniques in both humans and animals. In animals, they include;

2.4.1 Direct Fluorescent Antibody Test (DFAT)

This test identifies rabies antigens in brain tissue, which must be collected post-mortem. Animals submitted for testing should be humanely euthanized, ensuring the brain remains intact to allow laboratory staff to distinguish its anatomical structures. For efficient testing, samples should be refrigerated during storage and transportation. The Fluorescent Antibody Test (FAT) is the definitive method used globally in public health labs, offering 98–100% accuracy for all rabies strains when a strong conjugate is applied. Standard diagnostic procedures can be performed in biosafety level 2 laboratories, and personnel handling the virus are advised to receive pre-exposure vaccinations. FAT can yield results within two hours, whereas inoculation in mice may take up to 28 days. This test typically becomes positive when brain tissue, saliva, or cerebrospinal fluid is cultured in cells or injected intracerebrally into mice or suckling mice. The Direct Fluorescent Antibody (DFA) test is a fast microscopic method that uses fluorescently tagged monoclonal antibodies to detect specific antigens, such as those on viral or bacterial surfaces. These antibodies are chemically linked to fluorescent dyes like fluorescein isothiocyanate. If the antigen is present, the antibody binds to it and unbound antibodies are washed away. The antigen-antibody complexes emit a green fluorescence under a microscope. Absence of the antigen results in no fluorescence (McElhinney et al., 2020).

2.4.2 Mouse Inoculation Test (MIT)

All collected samples undergo the Fluorescent Antibody Test (FAT) as the initial diagnostic procedure. If a case is deemed suspicious or there is a history of human exposure, the samples are then inoculated into mice. This method is performed using only fresh tissue samples such

as the brain, salivary glands, liver, spleen, pancreas, and nuchal skin. When FAT results are inconclusive, the intracerebral inoculation of brain material from suspected rabies cases into new-born mice is used as a confirmatory test. If the rabies virus is present, a significant viral load can typically be harvested from a single mouse brain, allowing for strain identification. This process is time-consuming, often requiring up to 28 days. To expedite results, the World Health Organization's Expert Committee on Rabies advises using enough mice to enable the sequential euthanasia of one or two animals per day for earlier detection (Mucheru, 2015).

2.4.3 Tissue Culture Inoculation

Tissue culture inoculation involves introducing fresh tissue samples into a controlled laboratory cell culture to detect the presence of infection. In this procedure, specimens—especially brain tissue, which provides the most reliable diagnostic yield—together with salivary glands, liver, pancreas, and nuchal skin, are processed and inoculated into susceptible cell systems. If the pathogen is present, it infects the cultured cells and produces observable changes that confirm infection (Yousaf et al., 2012). The rabies tissue culture infection test (RTCIT) is a recommended method for detecting the presence of rabies virus in tissue suspensions (such as those derived from brain tissue) or body fluids (like saliva) by employing highly sensitive cell lines, notably neuroblastoma cells. This approach is suggested as a preferable alternative to animal testing, especially the mouse inoculation test (MIT), wherever feasible. RTCIT is relatively straightforward to perform, cost-effective, and yields quick and dependable results. It is also employed when the fluorescent antibody test (FAT) results are inconclusive. The process involves introducing the suspect animal's brain

tissue into a culture of mouse neuroblastoma cells. Despite its faster turnaround time, RTCIT maintains a sensitivity level comparable to that of MIT (Yousaf et al., 2012).

2.4.4 Enzyme-Linked Immunosorbent Assay (ELISA)

According to (Mucheru, 2015), ELISA tests that identify rabies antigens are effective tools for conducting large-scale surveys and represent a variation of immunochemical assays. The Rapid Rabies Enzyme Immunodiagnostic (RREID) test operates on principles similar to those of the Fluorescent Antibody Test (FAT). In this method, rabies antiserum is linked to an enzyme that produces a colour change upon interaction with its specific substrate. However, its accuracy and reliability must be thoroughly assessed prior to use, and the test should be used alongside confirmatory methods such as FAT.

2.4.5 Polymerase Chain Reaction (PCR)

In studies involving large sample sizes, such as epidemiological surveys, polymerase chain reaction (PCR) offers rapid results when conducted in specialized laboratories. The samples analysed can include saliva, urine, or cerebrospinal fluid. PCR is effective for identifying different types of rabies virus isolates and for assessing their variation across and within regions. Despite its high cost and the need for skilled technicians, this method can process tissue samples regardless of their condition (Yousaf et al., 2012). Additional diagnostic methods include the Direct Rapid Immunohistochemistry Test (DRIT) and various serological assays, such as the fluorescent antibody neutralization test and the rapid fluorescent focus inhibition test. For human cases, the recommended diagnostic procedure is

the Direct Fluorescent Antibody Test (DFAT) performed on brain tissue (Ministry of Health and Ministry of Agriculture, 2014)

2.5 Epidemiology of Dog Mediated Rabies

2.5.1 Global rabies epidemiology Overview

Rabies remains a significant global public health concern, although recent evidence indicates a gradual decline in incidence and mortality over time. Predictive burden models estimate that the disease still causes over 59,000 human deaths annually worldwide (Spargo et al., 2021). However, more recent global analyses suggest a lower but still substantial burden. For instance, a comprehensive assessment of 204 countries and territories between 1990 and 2019 estimated approximately 13,743 deaths annually (95% uncertainty interval: 6,019–17,938), alongside declining incidence trends over the study period (Gan et al., 2023). These findings are consistent with reports from the Centres for Disease Control and Prevention (CDC), which indicate an overall reduction in global rabies cases and deaths, although transmission remains persistent in endemic regions, particularly in Africa and Asia. Despite this general downward trend, rabies continues to disproportionately affect vulnerable populations, especially children under 15 years living in rural and low-income settings where access to post-exposure prophylaxis and dog vaccination is limited. Country-level data illustrate this burden more clearly; for example, India alone is estimated to contribute approximately 35% of global rabies deaths, with an annual incidence of about 17,137 cases (95% CI: 14,109–20,165) (Radhakrishnan et al., 2020). Additionally, a study conducted in Lucknow, India, evaluated rabies awareness among staff nurses at a medical institute. The findings revealed varied levels of knowledge; strong in certain areas but lacking in others.

Factors such as gender, religion, and marital status influenced awareness levels. Cultural norms, such as women being less likely to own dogs and having lower educational attainment compared to men, were cited as contributing factors (Chopra et al., 2017).

An epidemiological study conducted in Northern Iran revealed that the annual number of animal bite cases in Mazandaran Province ranged between 3,174 and 4,670. This translates to an incidence rate of 160 bites per 100,000 people each year. The financial burden associated with these bites—including healthcare expenses and income loss—was estimated at around US $0.5 million. From 2001 to 2005, approximately 20,000 bite incidents were recorded. The research indicated that dogs, particularly strays, were responsible for the majority of these bites (84.87%), with men (79.62%) and individuals aged 10–19 (28.5%) in rural areas being most frequently affected. Their increased risk was linked to a lower fear of dogs and greater involvement in caring for them (Najafi & Ghasemian, 2009). In the Philippines, 1,176 animal bite cases were reported between January 1, 2014, and June 30, 2018 (Republic of the Philippines Department of Health, 2018). To address the issue, the Ilocos Norte Communities Against Rabies Exposure (CARE) initiative was launched in April 2012. The program focused on mass dog vaccination and raising awareness about the importance of post-exposure prophylaxis (PEP), with the goal of eradicating human and animal rabies in the province by 2015. An assessment of the initiative confirmed that it led to a sustained reduction in rabies cases among both dogs and humans. This outcome underscored the feasibility of eliminating rabies within a short time frame through coordinated multi-sectoral efforts (Valenzuela et al., 2017).

In many developed countries such as the United States, human rabies cases are extremely uncommon, with only 1 to 3 incidents reported each year (Centers for Disease Control and Prevention, 2020). Between 2009 and 2018, the U.S. recorded just 25 human rabies cases, 7 of which were contracted outside the country. Strategies aimed at progressively eliminating rabies in wildlife have been implemented, including methods such as Trap-Vaccine-Release (TVR), Point Infection Control (PIC), and Oral Rabies Vaccination (ORV) (Sterner et al., 2009). These techniques have played a vital role in eradicating raccoon rabies in Canada and in establishing buffer zones to prevent its spread. One of the earliest successful large-scale dog vaccination initiatives took place in 1948 in Memphis city and Shelby County, Tennessee. This campaign led to the complete elimination of rabies cases in both animals and humans (Aga et al., 2016). Japan has remained rabies-free for over five decades, having successfully eliminated both human and animal cases by 1971 (Aga et al., 2016). This success was achieved through compulsory dog registration, confinement, vaccination, and elimination of stray dogs. Since then, only imported cases have occurred—two in 2006 involving individuals returning from the Philippines, and one in 1970 involving a student infected in Nepal (Inoue, 2007).

In Europe, rabies has been largely eliminated through the oral vaccination of red foxes, which are the main wildlife reservoir (Aga et al., 2016). Human rabies is now rare, and significant progress has been made since the first international rabies conference in Europe (Meslin & Briggs, 2013). Interestingly, some areas have managed to eradicate rabies despite having vaccination coverage below 70% (Aga et al., 2016; Okonko et al., 2010). Many countries in Central and Eastern Europe are now rabies-free or close to it. For instance, Switzerland's last endemic rabies case was in 1996 following a sustained vaccination effort (Zanoni et al.,

2000). Poland saw a dramatic drop in rabies cases—from 3,084 in 1992 to just 82 by 2006—after 13 years of oral vaccination (Smreczak et al., 2008). In Germany, the vaccination program expanded in 1995 to cover 215,000 km² in the western part of the country, significantly reducing rabies incidence (Müller et al., 2005)

According to the WHO (2021), Australia and many Pacific Island nations have remained free of dog-mediated rabies. Nevertheless, they still face the risk of imported cases and bear the cost of surveillance and maintaining rabies-free status. In Australia, dog rabies is considered exotic, with only one possible incursion noted in 1867. This is despite the presence of free-ranging and feral dogs, including dingo hybrids. The country upholds strict quarantine regulations to prevent the introduction of rabid animals (Sparkes et al., 2015).

The global perspective demonstrate that rabies remains a preventable yet persistent public health challenge. While substantial progress has been achieved in many developed countries through sustained dog vaccination, effective surveillance systems, public awareness campaigns, and accessible post-exposure prophylaxis, the disease continues to impose a significant burden in many low- and middle-income countries, particularly in rural communities where human–dog interactions are common and access to preventive services is limited. The reviewed literature further highlights that community knowledge, attitudes, and practices play a critical role in rabies prevention and control. Understanding local perceptions and factors influencing participation in dog vaccination programmes is therefore essential for designing effective interventions.

2.5.2 Epidemiology of Dog Mediated rabies in Africa

Rabies continues to be a major public health concern across most African countries, with the majority of human infections stemming from dog bites (Jibat et al., 2015). Globally, rabies is responsible for an estimated 59,000 deaths annually, with 99% of cases occurring in low-income countries, particularly in Africa and Asia. According to a study by Nyasulu et al. (2021), Africa alone accounts for between 21,000 and 25,000 of these deaths, largely linked to animal bites. Children under the age of fifteen are disproportionately affected, as they are often unaware of the dangers posed by rabid dogs (World Health Organization [WHO], 2024). Mass vaccination of dogs is recognized as the most effective strategy to prevent rabies transmission to humans. The same study reported that in 2011, 33 African nations documented 1,607 rabies outbreaks, resulting in 2,779 cases and 1,524 deaths. Rabies accounted for 7.2% of all reported animal disease outbreaks that year—making it the most frequently reported zoonotic disease on the continent. Countries including Algeria, Namibia, Eswatini (formerly Swaziland), Tunisia, Uganda, Zambia, and Zimbabwe reported significant case fatality rates: 563 cases (33.9% deaths), 269 cases (94%), 62 cases (88.7%), 91 cases (90%), 466 cases (40.9%), 207 cases (32.8%), and 114 cases (80.7%), respectively. A review by Jeon et al. (2019) found that in African countries, the coverage of dog rabies vaccination under free-of-charge campaigns reached 68%, nearly meeting the WHO-recommended threshold of 70%. In contrast, programs where dog owners bear the vaccination costs achieved only 18% coverage. This suggests that most dogs in Africa are owned and can be accessed for vaccination if financial barriers are removed (Jibat et al., 2015). This could offer an easy way of reducing incidences of rabies in Africa continent.

Several studies conducted across Africa on rabies control have revealed concerning findings. For instance, a study in Lilongwe, Malawi, aimed at assessing public awareness, rabies incidence, and vaccination coverage, found that while 98% of participants had heard of rabies and 88% would seek medical attention after a dog bite, the actual vaccination coverage was only 59% (Jonasson, 2014). Morters et al. (2014) further demonstrated that high vaccination rates can be achieved through strategies such as community involvement and door-to-door vaccine delivery—even in challenging circumstances where most dogs had to be net-captured for vaccination. In 2012, hospital data in Lilongwe reported 2,992 cases of dog bites. Given the 2008 population of Lilongwe District was 1,230,834 (Malawi National Statistical Office, 2012), this equates to an annual incidence of approximately 243 dog bites per 100,000 people. This figure marked a slight increase compared to previous years, where the average annual number of bites in 2008, 2010, and 2011 was 2,774 (data for 2009 was unavailable). By the end of September 2013, 1,973 dog bites had been recorded, averaging 219 bites per month—a decrease from 249 per month in 2012 and 231 per month during 2008, 2010, and 2011.

Lyssavirus infections in the Democratic Republic of Congo (DRC) remain largely undocumented. Nevertheless, a study examining 218 bats found no presence of lyssavirus antigens. Interestingly, neutralizing antibodies against Lagos bat virus (LBV) were identified in two bat species, *Eidolon helvum* and *Myonycteris torquata*. Additionally, four LBV-positive samples also showed reactivity to Shimoni bat virus (Niezgoda et al., 2016), suggesting the potential presence of rabies-related viruses in the DRC. The same study recorded a total of 5,053 animal attacks involving six species: dogs, cats, monkeys, rabbits, rats, and pigs. Clinical assessments identified rabies cases in dogs and cats, while laboratory

confirmations extended this to include a goat. From 2009 to 2011, there was a marked decline in reported rabies cases, followed by a rise through 2013. Seasonal variation was not statistically significant ($p = 0.721$). Rabies incidence was found to be significantly higher in peri-urban areas compared to urban settings, with an odds ratio of 3.4 (95% CI: 2.3–5.1). Based on clinical diagnosis, 2.6% (95% CI: 2.1–3.0) of cases were positive, whereas laboratory confirmation showed a higher rate of 65.9% (95% CI: 50.0 –79.5). The findings underline the endemic nature of rabies in Kinshasa, where its occurrence is closely linked to population density and lifestyle factors. The study recommends establishing a robust surveillance system and implementing widespread vaccination programs for susceptible animals.

A study conducted in Morocco revealed that rabies is endemic and has been classified as a notifiable disease in the country for over a decade (El Bazi et al., 2023). The disease is prevalent across all regions except the southern desert areas. The dominant lyssavirus identified is genotype 1, or the Rabies virus (RABV), with most human infections linked to the canine strain (El Bazi et al., 2023). Since 1986, an average of 22 human deaths due to rabies have been reported annually. Specifically, Morocco recorded 18 human cases in 2011 and 19 in (El Bazi et al., 2023). According to a recent global rabies burden report, the annual death toll in Morocco is estimated at around 50 people, primarily caused by domestic dogs (El Bazi et al., 2023). The same report states that in 2011, there were 64 reported rabies cases in dogs, and 62,851 dogs were vaccinated. In 2012, 91 rabid dog deaths were recorded, with 114,790 animals vaccinated. By mid-2013, 44 dog rabies cases had been confirmed. Additionally, the disease affects a considerable number of livestock, particularly cattle. In 2011, 187 cases were noted, increasing to 255 in 2012, then declining to 133 in 2013. This

data underscores that rabies remains a significant public health concern in Morocco and continues to be officially monitored (El Bazi et al., 2023).

In Tunisia, a 2014 WHO rabies status report also confirmed that the disease is endemic, particularly in the northern provinces. Genotype 1 (RABV) is the most common lyssavirus found, with most human cases linked to the canine strain, primarily transmitted through bites from infected domestic dogs. Data from the World Animal Health Information System showed that Tunisia recorded one human rabies case in 2011, three in 2012, and six in 2013. In 2011, dog vaccination coverage was estimated at 48% (Bastiaensen, 2018).

As of 2014, Swaziland reported that four genotypes of lyssaviruses responsible for rabies are endemic in the country. The predominant type is genotype 1, known as the Rabies virus (RABV). Other genotypes present include genotype 2 (Lagos bat virus, LBV), genotype 3 (Mokola virus, MOKV), and genotype 4 (Duvenhage virus, DUVV) (Bastiaensen, 2019). Human rabies cases are primarily caused by the canine variant of RABV, typically resulting from bites by infected domestic dogs (Bastiaensen, 2019). According to the World Animal Health Information System, 38 human rabies cases were reported in 2011, although no specific data was recorded for 2012 (Bastiaensen, 2019).

The detection rate of rabies virus antigen in Nigeria varied between 3% and 28%, with most research focused in the northern areas of the country. The majority of dog bite incidents were unprovoked (ranging from 36.4% to 97%) and typically involved dogs with low vaccination coverage (12%–38%). Although many of the biting dogs were owned (31%–90%), only a small number of studies (6%; 2 out of 32) included laboratory confirmation of rabies. Indigenous dogs, mainly kept for security purposes (52%–98%), made up the bulk of

surveyed animals, with vaccination rates across most states falling between 15% and 38%. Studies conducted in areas far from rabies diagnostic centres reported more cases of human rabies than dog rabies (Adebayo et al., 2019).

Recent research on rabies in Namibia has provided valuable findings related to public awareness and the disease's epidemiology. A study carried out in two northern towns showed that most participants were aware that rabies is a viral illness and that dog bites are its primary mode of transmission. However, only 38% could accurately identify its key symptoms. Many respondents also recognized wild animals, particularly dogs and jackals, as common reservoirs of the virus. Education level and gender were significantly linked to knowledge about rabies: individuals with primary or secondary education (OR 10.9, 95% CI: 1.4–84.6, $p \leq 0.022$) and those with tertiary education (OR 30.5, 95% CI: 3.7–250.9, $p \leq 0.001$) were more likely to understand that a virus causes rabies. Additionally, men (OR 7.25, 95% CI: 1.65–31.9, $p < 0.009$) and people aged 25–32 (OR 4.29, 95% CI: 1.6–15.9, $p \leq 0.03$) demonstrated a greater likelihood of correctly identifying dog bites as the main transmission pathway (Haimbodi et al., 2014).

From 2011 to 2017, Namibia reported 113 human rabies cases, with an incidence ranging from 1.0 to 2.4 deaths per 100,000 inhabitants annually. Most cases were reported in the Northern Communal Areas (NCAs), where the highest incidence of human rabies was found in Kavango, a region with notably low animal rabies surveillance. The majority of rabies-positive dog samples originated from communal farmland (77%), while wildlife samples, including kudu and eland, were mostly collected from freehold farms and urban areas. The high positivity rate in wildlife species, particularly kudus (89%) and jackals (87%), suggests

two distinct rabies transmission cycles: one in domestic dogs primarily in the NCAs, and another in wildlife on central Namibian farmland. This geographic separation indicates that targeted control measures in dogs and wildlife could effectively manage rabies in Namibia (Hikufe et al., 2019). Despite high awareness of free vaccine availability, with 83% of respondents acknowledging it, only 37% had vaccinated their pets, and just 6% had received vaccination themselves (Haimbodi et al., 2014). This gap highlights the urgent need for intensified public education and vaccination initiatives to strengthen rabies prevention efforts.

Similarly, a study in Debark Woreda, North Gondar, Ethiopia, found that nearly all participants were familiar with rabies. The research also revealed a strong correlation between rabies knowledge and factors such as education level, occupation, and gender (Yalemebrat et al., 2016).

In Blantyre, Malawi, a combination of static point and door-to-door vaccination strategies successfully vaccinated 35,000 dogs over a 20-day period. Follow-up surveys indicated a vaccine coverage rate of 79.3% (95% CI: 78.6–80.1). This study illustrates the practicality of conducting mass dog vaccinations—exceeding 35,000 animals in under a month—in an urban African setting where rabies remains a significant public health concern (Gibson et al., 2016). Such findings, alongside other studies conducted across the continent, underscore the urgent need for intensified efforts to combat the persistent threat of rabies in Africa.

2.5.3 Epidemiology of Dog Mediated rabies in Kenya

Rabies remains a widespread endemic disease throughout most parts of Kenya, with domestic dogs serving as the principal reservoir and source of infection for humans (Bitek et al., 2019). National estimates indicate that the country experiences approximately 2,000 human rabies deaths annually, although modelling studies suggest a lower but still substantial burden of about 523 deaths per year (95% CI: 134 –1,100), reflecting uncertainty due to underreporting and limited diagnostic confirmation (Chuchu et al., 2022; Ministry of Health and Ministry of Agriculture, Livestock and Fisheries, 2014). Rabies exposure is primarily driven by dog bites, which remain common across the country; surveillance data from selected counties between 2011 and 2016 recorded an incidence of 289 animal-bite injuries per 100,000 population, with the majority of bites attributed to owned and free-roaming dogs. Children, particularly those under 15 years of age, constitute a disproportionately affected group due to their frequent contact with dogs and increased vulnerability to severe bite injuries (Mwatondo et al., 2018).

The persistence of rabies in Kenya is largely attributed to low dog vaccination coverage, widespread free-roaming dog populations, inadequate public awareness, and delayed access to post-exposure prophylaxis in some rural settings. In response, Kenya adopted the National Rabies Elimination Strategy (2014–2030), which outlines a One Health approach aimed at eliminating dog-mediated human rabies deaths through mass dog vaccination, improved access to post-exposure prophylaxis, strengthened surveillance systems, and community education (Bitek et al., 2019; Ministry of Health and Ministry of Agriculture, Livestock and Fisheries, 2014).

Rabies remains a widespread endemic disease across all counties in Kenya (Muriuki et al., 2015). The earliest documentation of a rabies-like illness in the country dates back to 1902 in the South Nyanza District of Nyanza Province—just a year after the Department of Veterinary Services was established (Muriuki et al., 2015). Over the past decade, rabies has continued to pose a significant public health threat, with domestic dogs being the primary source of infection, followed by livestock, cats, wildlife, and then humans. Wildlife-related rabies cases have been confirmed in five of Kenya's eight former provinces, affecting thirteen districts. Among the wild species most commonly infected are jackals, mongooses, wildcats, squirrels, honey badgers, and foxes (Muriuki et al., 2015).

A study conducted in Kisumu revealed critical findings about rabies exposure and control measures. The annual estimated number of human rabies cases was 17,137 (95% CI: 14,109—20,165), illustrating the disease's substantial burden in the region (Muriuki et al., 2015). The study also found that a majority of owned dogs in Kisumu and Siaya counties were allowed to roam freely and scavenge, potentially heightening their exposure to rabies (Muriuki et al., 2015). Moreover, over 90% of respondents demonstrated awareness of rabies as a zoonotic disease transmitted by dogs and acknowledged the pivotal role of domestic dogs in its transmission. However, concerning healthcare-seeking behaviours were noted, with 16.6% of respondents in Kisumu preferring traditional treatment as their initial response to an animal bite, indicating gaps in appropriate medical practices (Muriuki et al., 2015). Additionally, another study assessing rabies occurrence and control in Kisumu municipality emphasized the veterinary and public health departments' role in managing rabies, the incidence rate varied Males (59%) were at higher risk of bites than females (41%) (Kagira & Kanyari, 2012). Control efforts encompassed integrated strategies such as pre- and post-

exposure prophylaxis, mass vaccination of owned dogs, and culling of stray dogs. Challenges identified included poor coordination in rabies control initiatives, staffing shortages, and limited resources (Kagira & Kangari, 2012).

The incidence of animal bites in Kenya between the year 2002-2012 stood at 336 per 100000 people and 858 confirmed human rabies cases from uncontrolled free-roaming dogs (ZDU, 2014). In Kenya, between 1000 and 2000 cases of animal-human bites are reported (Ngugi et al., 2018). The human rabies in Kenya is considered to be under-reported due to various factors such as erratic supply of ARVs, lack of proper diagnostic and lack of information and management of cases of animal bites injuries (Obonyo et al., 2016).

A retrospective study carried out in Laikipia North Sub County between January 2013 and February 2014 reviewed animal bite incidents and subsequent treatment at six government health facilities, documenting a total of 106 bite cases. The median monthly bite incidence was 24 per 100,000 people, ranging from 6 to 45 per 100,000. The typical age of bite victims was 13 years old, with ages spanning from 1 to 81 years; males accounted for 58% (61) of the bites. Dogs were responsible for 88% (94) of all recorded bites (Obonyo et al., 2016). The investigation linked this cluster to at least three suspected human rabies fatalities and four domestic animal deaths. The cost of post-bite care, including post-exposure prophylaxis (PEP), places a significant financial strain on the community, worsened by the inconsistent local availability of rabies vaccines. Furthermore, dog vaccination coverage is low in the area, and confirmed diagnoses of rabies in suspected animals are rare, which heightens the risk of human exposure to rabies and adds to the economic burden of PEP treatment (Obonyo et al., 2016).

A study carried out in Kakamega County to evaluate knowledge and practices regarding rabies, as well as factors influencing dog rabies vaccination in households, found that 35% of households had vaccinated their dogs within the previous 12 months (Mucheru et al., 2014). Additionally, the study identified a significant association between awareness of the importance of dog vaccination and actual vaccination of dogs during the past year (Mucheru et al., 2014). These and similar studies demonstrate that rabies remains a persistent public health concern in Kenya, underscoring the need for strengthened control and prevention strategies. Despite ongoing national efforts, there is limited locally generated evidence on factors influencing dog vaccination and rabies prevention practices in South Mugirango Sub-County. This study therefore addresses this knowledge gap by generating context-specific evidence to inform more effective rabies control interventions in the study area.

2.6 Prevention and Management of Rabies

Once clinical symptoms of rabies appear, the outlook is generally poor, often resulting in death within 5 to 11 days. However, some patients receiving intensive care may survive for an additional 1 to 3 months (Hemachudha et al., 2013; Mani et al., 2016). The most effective way to combat rabies is through primary prevention. This includes eradicating rabies in animal populations by vaccinating them, raising public awareness about the disease and its prevention, and encouraging responsible dog ownership and vaccination, particularly in endemic regions where cultural practices should be considered in intervention strategies (Banyard et al., 2013). Vaccination of animals, mainly dogs, has significantly lowered human and animal rabies cases in various countries, especially in Latin America (Vigilato et al., 2018). However, a recent rise in human rabies fatalities in parts of Africa, Asia, and Latin

America indicates that rabies is re-emerging as a major public health concern. Controlling rabies in domestic dogs to prevent human cases is an achievable goal in many areas of Africa and Asia, and this is economically justified by the future reduction in the need for post-exposure prophylaxis (WHO, 2010). The World Health Organization has developed comprehensive dog rabies control guidelines, which include reporting suspected cases to authorities, euthanasia of symptomatic dogs or those bitten by suspected rabid animals, reducing contact between susceptible dogs via leash laws, controlling dog movement and quarantine, mass vaccination campaigns targeting young dogs, managing stray dog populations, and registering dogs (WHO, 2018). In Kenya, efforts such as dog vaccination, culling of stray dogs using baiting, and restricting dog movements have been attempted but have largely failed due to insufficient funding causing vaccine shortages, high dog population turnover, and inadequate public education about rabies (Mucheru et al., 2014).

Several rabies vaccines are available for both humans and domestic animals. Where feasible, rabies pre-exposure prophylaxis (PrEP) through vaccination is recommended for individuals at risk. This includes children in rabies-endemic regions of developing countries, laboratory personnel, veterinarians, animal handlers, wildlife officers, and travellers to high-risk areas. The vaccination schedule involves intramuscular injections of 1 ml or 0.5 ml of rabies vaccine, depending on the vaccine type, administered on days 0, 7, and 28 in the deltoid muscle of the arm or the anterolateral thigh in children under two years old (Fooks et al., 2003).

When infrastructure for primary prevention is lacking, secondary prevention plays a vital role in stopping the progression to clinical disease through post-exposure prophylaxis (PEP).

Without PEP, a person bitten by a rabid dog has a 5% chance of developing rabies if the bite is on the hand, and up to a 70% chance if the bite is on the face (Cleaveland et al., 2002). Human rabies immunoglobulin (HRIG) should be injected into the wound at a dosage of 20 IU/kg, or alternatively, equine rabies immunoglobulin (ERIG) at 40 IU/kg, both administered on day 0. Follow-up vaccinations should be administered on days 0, 3, 7, 14, and 28. In addition, tetanus toxoid and antibiotics are recommended (WHO, 2010). Combining pre-exposure prophylaxis (PrEP) with PEP can nearly eliminate the risk of infection. Regardless of whether PrEP has been given, proper wound care along with timely PEP administration remains the most effective strategy to prevent rabies-related deaths (WHO, 2013).

The treatment approach for both paralytic and furious rabies is generally similar (WHO, 2018). Dog bite wounds should not be sutured initially; instead, they should be managed as open wounds. Immediate cleansing with ample soap and water, followed by the application of iodine, is critical. Physically or chemically eliminating the virus at the entry site is a key defence against infection. Thus, rapid local care of all bite or scratch wounds suspected of rabies exposure is essential. First-aid recommendations include washing and flushing the wound thoroughly for at least 15 minutes using soap and water, detergent, povidone-iodine, or other virucidal agents (WHO, 2013).

2.7 The level of awareness about rabies

Awareness of rabies is shaped by various factors such as gender, age, education, socioeconomic status, cultural beliefs, and religious affiliation (Bouaddi et al., 2020).

2.7.1 Gender

Various researchers have significantly associated gender with rabies awareness. In a study conducted in Tanzania, it was established that men were more knowledgeable compared to women in matters rabies (Sambo et al., 2014). Similar findings were reported by Awuni et al. (2019) who documented that men were 1.5 times more likely than women to be informed about rabies and the transmission of selected zoonotic diseases. This trend contradicts the general notion that women tend to acquire more knowledge under equal socio-environmental conditions. Specifically, in Ghana's Bolgatanga Municipality, women were found to have lower awareness of zoonotic diseases like rabies. This was largely attributed to the low levels of dog ownership among women in the Upper East Region, which may reduce their interest in learning about dogs and related diseases.

Conversely, Palamar et al. (2013) demonstrated that women tended to have more knowledge about rabies in North Carolina, likely due to higher rates of dog ownership among American women—a trend not mirrored in many African contexts. Similarly, another study conducted in India demonstrated that men had less awareness about rabies than women, potentially because men are more frequently exposed to animal bites as compared to women (Herbert et al., 2012). However, findings from a study in Nyimba District, Zambia, showed that the gender of the household decision-maker did not influence awareness or vaccination practices for household dogs (Mulipukwa et al., 2017).

Collectively, these studies suggest that gender plays a significant role in rabies awareness, with males often demonstrating higher levels of awareness than females in many community settings (Awuni et al., 2019; Sambo et al., 2014). However, responses vary across different

communities and societies, underscoring the role of cultural norms and practices. This highlights the importance of collecting localized data to inform effective and context-specific policy development.

2.7.2 Age

Bouaddi et al. (2020) reported that younger people were more knowledgeable about rabies and this was attributed to the higher level of education among young people compared to older ones. Another study in India concluded that the proportion of people with acceptable knowledge about rabies diminished with increasing age, lower education level and was less among women (Krishnamoorthy et al., 2018). Herbert et al. (2012) observed that older individuals were generally less informed about rabies compared to younger respondents, possibly due to higher literacy rates among the younger population. However, contrasting results were found in a study from Ethiopia, where older dog owners demonstrated greater awareness of rabies (Beyene et al., 2018). The study found a positive correlation between dog owners' knowledge of rabies and their willingness to vaccinate their pets. Older owners were more inclined to vaccinate their dogs than their younger counterparts, likely because they had more exposure to information about rabies through media or community interactions (Beyene et al., 2018).

2.7.3 Education Level

Education level has been identified as a key factor influencing rabies awareness and knowledge. Individuals with at least a primary school education demonstrated greater awareness of rabies compared to those who were completely illiterate (Herbert et al., 2012).

In another study in Ghana, it was found that dog owners with tertiary education were significantly more likely to possess good knowledge of rabies and to vaccinate their dogs, being 76 times more likely than those without any formal education (Awuni et al., 2019). Similarly, Sambo et al., (2014) and Wasay et al. (2012) reported that respondents with secondary and tertiary education respectively (in Tanzania and Pakistan) were associated with better awareness and knowledge of rabies.

2.7.4 Occupation/ Social Status

Studies have reported different findings on the association of occupation with the level of awareness and knowledge about rabies. For example, Nejash et al. (2017) found no significant relationship between occupation and knowledge about rabies. In a study carried out in Ethiopia examining the factors that influence dog owners' intentions to vaccinate against rabies, it was found that those who had health professionals or veterinarians among their relatives, friends, or family members were more likely to be aware of rabies and showed a greater likelihood of intending to vaccinate their dogs (Beyene et al., 2018). Also, in the same country, Hagos et al. (2020) found a significant association between occupation and knowledge whereby government employee household heads were almost two times more likely than unemployed ones to have good knowledge about rabies, with greater odds of intending to vaccinate their dogs. This was attributed to the employed respondents having better education than unemployed people. It was also noted that unemployed individuals might not vaccinate their dogs against the disease due to a lack of awareness or because they cannot afford the cost of the vaccine (Hagos et al., 2020).

Furthermore, another study done in Zimbabwe found healthcare professionals had greater odds of rabies awareness compared to other respondents who fall in other occupation groups (Spargo et al., 2021). Another study done in Nigeria, it was observed that farmers and hunters had good knowledge of rabies compared to respondents in other occupations (Abdulsalam et al., 2018). These findings corroborate with another study findings done in India, which revealed that livestock owners were less inclined to feed stray dogs compared to those without livestock. This attitude was linked to the economic losses caused by injuries, deaths, or rabies infections in livestock due to attacks by free-roaming dogs (FRDs) (Tiwari et al., 2019). Overall, these studies indicate that occupation significantly influences rabies awareness and related behaviours, with knowledge levels and preventive attitudes varying across professional groups due to differences in exposure, experience, and perceived economic risks.

With regards to socio-economic status, a study conducted in India reported that individuals from lower socio-economic backgrounds were less likely to view FRDs as beneficial, provide them with food, or seek veterinary care for injured dogs, in contrast to those from higher or middle socio-economic groups. Those in the higher/middle classes were more likely to feed stray dogs, possibly due to having greater disposable income. Furthermore, they exhibited more compassionate and favourable views towards FRDs. These positive attitudes could be leveraged to encourage responsible dog ownership, including the adoption of FRDs (Tiwari et al., 2019).

2.7.5 Cultural Beliefs and Religion

A study conducted in Ghana's Upper East Region examined dog owners' awareness of rabies and the factors influencing the vaccination of dogs against the disease. It found that Muslim dog owners were 2.6 times more likely to vaccinate their dogs against rabies compared to Christian dog owners. This increased likelihood among Muslims is attributed to Islamic teachings that emphasize the importance of health, viewing self-care as a religious obligation. Consequently, Muslim owners, guided by their faith and the knowledge of rabies' fatal nature, are more inclined to vaccinate their dogs as a preventive health measure in line with their spiritual responsibilities (Awuni et al., 2019). In contrast, traditionalist dog owners—who adhere to indigenous African spiritual beliefs involving a supernatural world—were found to be 4% less likely to vaccinate their dogs than Christians. According to the World Health Organization, despite the availability of modern medicine in Africa, many individuals continue to rely on traditional healing practices (WHO, 2019). Traditionalists often distrust Western medicine, believing instead that illness is the result of curses or spiritual punishment (Awuni et al., 2019). Consequently, they may not associate rabies with dogs directly but rather see it as a form of supernatural misfortune, which reduces their likelihood of vaccinating dogs (Awuni et al., 2019). Additionally, research from Shirsuphal village in western India explored knowledge, attitudes, and practices (KAP) related to rabies and free-roaming dogs. It found that families consisting mainly of older adults, who often hold stronger religious values, were more likely to feed and care for dogs than younger individuals in larger households, reflecting a compassionate approach rooted in religious or cultural beliefs (Tiwari et al., 2019).

2.8 Drawbacks in Handling Rabies Condition in Third World Countries

In low and middle income countries, rabies is one of the most neglected infectious diseases (Nejash et al., 2017). Africa and Asia are the most affected regions by rabies disease where it constitutes a serious public and animal health problem. Despite the development of vaccines for both pre-exposure and post-exposure prophylaxis over a century ago, rabies continues to present serious challenges in these regions. In Ethiopia for instance, the lack of comprehensive health education initiatives has resulted in limited public awareness about the disease and how to prevent or manage it (Aga et al., 2016). A study done in Morocco revealed that respondents believed that rabies does not affect humans. In the same study, it was observed that although people knew that vaccination could prevent rabies, they did not adhere to that practice, allowing dogs to roam freely in search of food (Bouaddi et al., 2020). These drawbacks were associated with low education level. Sambo et al. (2014) noted that responsible dog ownership is generally poor across many African communities. In a Tanzanian study, numerous dog owners admitted to not restraining their dogs, highlighting a lack of enforcement of existing rabies control laws. Moreover, there was limited interaction between communities and veterinary services, with villagers indicating that they would prefer to kill potentially rabid animals rather than report the incidents to veterinary authorities (Sambo et al., 2014). In Zambia, similar barriers to dog vaccination were identified (Mulipukwa et al., 2017). While participants understood the importance of vaccinating dogs against rabies, several obstacles hindered their compliance. Over half (56%) of respondents cited the cost of vaccination as a barrier, suggesting that free vaccination services could improve coverage. Dogs were often acquired informally through friends or relatives, leading to low perceived value and reluctance to spend money on them. Additionally, the shortage

of veterinary staff hindered both the delivery of vaccination services and the dissemination of campaign information. Many respondents were unaware of vaccination schedules, and veterinary teams themselves reported resource limitations due to inconsistent government funding. Dog behaviour was also a major challenge—approximately 92% of owners struggled to control their dogs, often impeding vaccination efforts. In Bishoftu, Central Ethiopia, key factors influencing dog owners' willingness to vaccinate included the distance to clinics, cost, ease of transporting and handling dogs, and trust in the vaccine (Beyene et al., 2018).

Costa et al. (2018) asserted that rabies surveillance remains inadequate in most parts of Africa and Asia, despite widespread recognition of the disease. In many low- and middle-income countries, enforcement of case reporting laws is weak, and data collection systems are underdeveloped. Taylor et al. (2017) further emphasized that limited laboratory capacity, lack of trained personnel, restricted access to diagnostic tools, and challenges in obtaining post-mortem samples contribute to the ongoing difficulties in managing rabies in endemic regions.

2.9 Summary and Identification of Gaps

Previous studies indicate that Rabies kills close to 60 000 people every year with domestic dogs being the main vectors (El-Sayed, 2018; Ministry of Health and Ministry of Agriculture, 2014; Singh et al., 2017). Consequently, the spread of rabies is strongly affected by the concentration of unvaccinated dogs. Studies have established that achieving a 70% vaccination coverage is adequate in prevention of rabies (Jeon et al., 2019). It is also clear that rabies control and its elimination from the human race can only be visible through

carrying out effective vaccination of dogs population, pre-exposure prophylaxis for people at risk of rabies infection, post exposure prophylaxis for those who have already been exposed to the rabies virus, and control of dog population (Morters et al., 2015; Ngugi et al., 2018; World Health Organization, 2020)

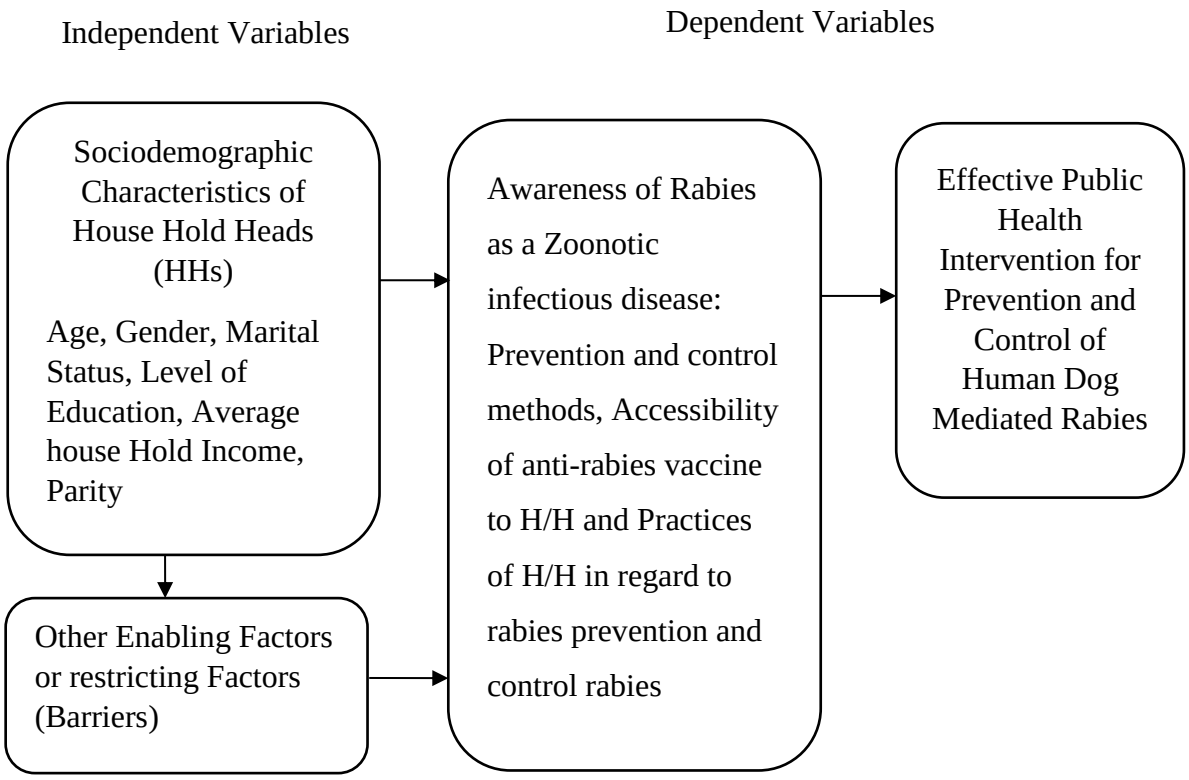
In order to achieve this in Kenya, there is need to develop an innovative public health intervention. This intervention should be informed by among other things; the level of public awareness on rabies as zoonotic diseases, the level of public awareness on methods used in prevention and control of rabies which include vaccination of dogs against rabies (found to be most effective as it controls rabies from source), the level of adherence to vaccination of dogs against rabies, the factors influencing both level of awareness of rabies as a zoonotic disease and its prevention and control, and the factors influencing adherence to vaccination of dogs. Such data will help in the identification of the priority public health activities, which should guide the focus of a public health intervention. This data is however not available in South Mugirango Sub County of Kisii County. This is the knowledge gap this study seeks to fill.

2.10 Conceptual Framework

The conceptual framework for this study was developed by the researcher. The framework identifies both the independent variables such as socio-demographic characteristics (Age, gender, marital status, level of education, average household income) and dependent variable that is awareness of rabies, accessibility of anti-rabies vaccine and household practices in regards to rabies prevention.

Figure 2.3

Study Conceptual Framework



CHAPTER THREE

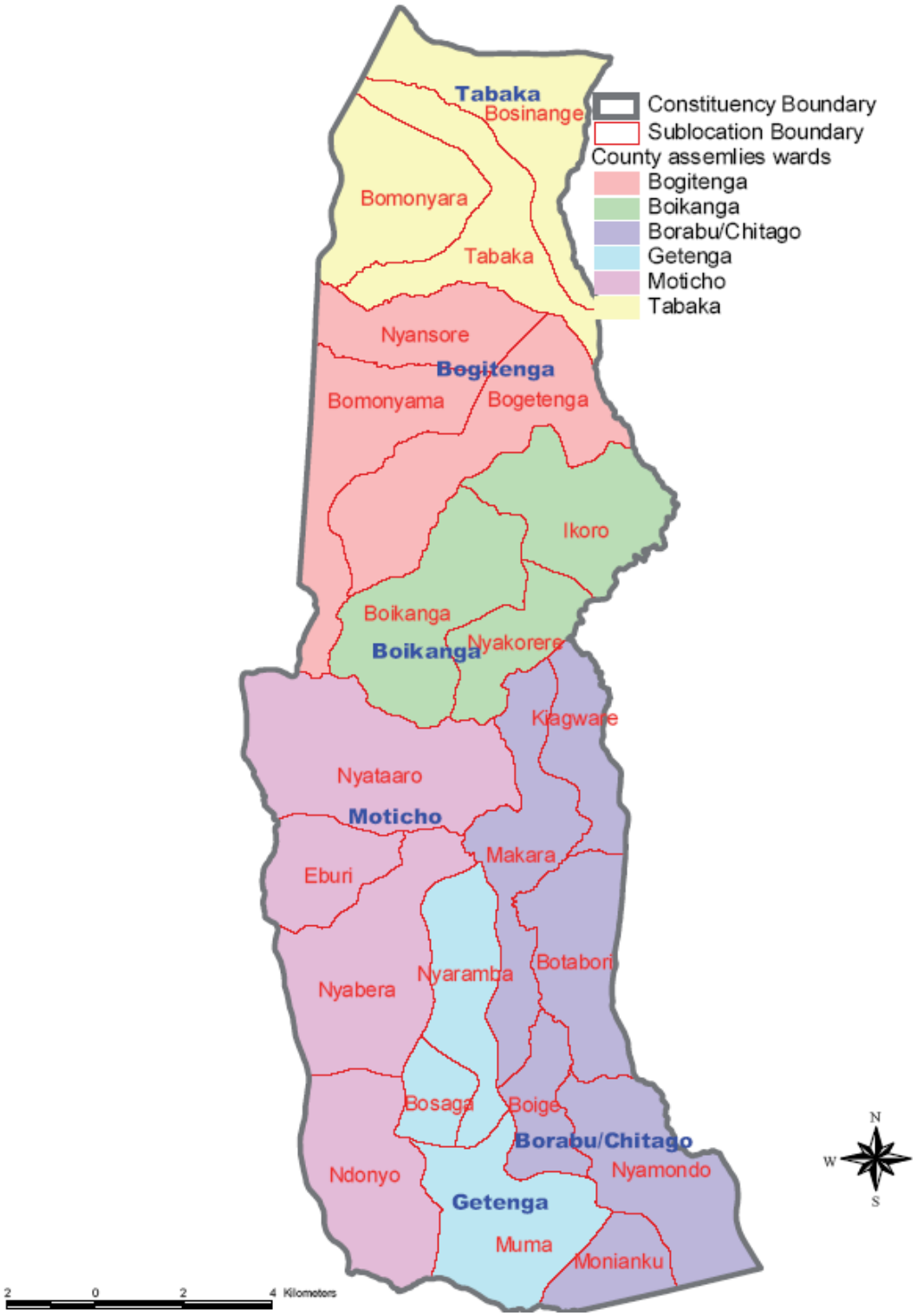
METHODOLOGY

3.1 Study Area

This study was done in South Mugirango Sub County [0°49'60" S and 34°39'0" E in DMS (Degrees Minutes Seconds) or -0.833333 and 34.65 (in decimal degrees)] in Kisii County as shown in figure 3.1 below. South Mugirango subcounty is divided into 6 administrative wards namely; Tabaka Ward, Boikanga Ward, Borabu/Chitago Ward, Moticho Ward, Getenga Ward, and Bogetenga Ward (KNBS, 2010); Kisii County Government, 2013). It borders Migori to the South, Trans Mara to the North, Bomachoge Borabu and Chache to East and Bonchari to the West and has an estimated population of 196,768 as per 2015 census. South Mugirango sub-county is divided into 6 administrative wards namely; Tabaka Ward, Boikanga Ward, Borabu/Chitago Ward, Moticho Ward, Getenga Ward, and Bogetenga. Ward (KNBS, 2010). The study region receives about 1608mm of rainfall annually and average temperature ranges from 19.9ºC - 20.3ºC annually. It lies in an altitude of 1598M above sea level. The most common economic activities by the inhabitants are the mining of Tabaka soap stones and small-scale farming of maize, beans etc (KNBS, 2010).

Figure 3.1

Map of South Mugirango (IEBC, Kenya)



3.2 Study Design

This study employed a mixed-methods approach, collecting both quantitative and qualitative data, in line with methodologies used in previous research (Nyumba et al., 2018). A cross-sectional survey design was employed in the quantitative method by use of questionnaire (Appendix IV) whereby 400 household heads were interviewed. In the qualitative method, key informant interviews (with key informants in the Ministry of Health and Ministry of Agriculture and Livestock Development and marketing) were done.

3.3 Target Population

The targeted study population for the quantitative cross-sectional survey were household heads. On the other hand, the targeted study population for the qualitative method were key informants with specific information on human dog-mediated rabies prevention and control. They included public health officers and veterinary officers working in South Mugirango Sub County.

3.3.1 Inclusion Criteria

In the quantitative survey, participants who were included in the study were household heads with at least 1 dog and had consented to participate in the study (Appendix VI). In the qualitative survey, key informants were selected from employees working in the sub-county, Ministry of Health and Sub County Veterinary Department. They were perceived to have specialized knowledge on prevention and control of human dog-mediated rabies. However, their participation was also voluntary.

3.3.2 Exclusion Criteria

Household heads who declined to provide informed consent were excluded from the study. Additionally, household heads who were unavailable at the time of data collection after reasonable follow-up visits were excluded. Officers from the Ministry of Health and the Veterinary Department who were not directly involved in rabies prevention and control activities within South Mugirango Sub-County, as well as those who declined to participate or provide informed consent, were excluded from the study.

3.4 Sample Size Determination

3.4.1 Sample Size Determination for the Quantitative Study

The total number of HHs in South Mugirango Sub County is 42,576. The total number of households with dogs are 29,300 and the total number of people living in the sub county is indicated as approximately 196,067 (Kisii County Government, 2013). The formula developed by Fisher et al. (1998) was utilized to determine the sample size for populations exceeding 10,000 individuals and was therefore applied in this study (Fisher et al., 1998). The formula was as follows:

$$n = \frac{Z^2 pq}{d^2}$$

Where;

n represents the required sample size (applicable when the study population exceeds 10,000).

Z denotes the standard normal deviate, which is 1.96 for a 95% confidence level.

p is the estimated proportion of the population with the specific attribute of interest.

q is calculated as 1.0 minus p (q = 1 − p).

d refers to the margin of error, typically set at 0.05.

In South Mugirango Sub County, the number of households with dogs is 29,300. When no reliable estimate of p is available, Fisher et al. (1998) suggest using a value of 50% (0.50) as a conservative estimate. Thus:

p = 0.50
q = 1 − 0.50 = 0.50

Therefore, the required sample size (n) was calculated as follows.

$$n = \frac{Z^2pq}{d^2} = \frac{1.96^2 \times 0.50 \times 0.50}{(0.05)^2}$$

$$n = \frac{0.9604}{0.0025}$$

n= 384.16 which is approximately 384 HHs.

10% of 384 HHs will be added to increase representativeness and cater for participants who may not be available for responses.

Thus 10% of 384 = **38.4** subjects

Thus ***n***= 384+38.4= **422 HHs.** Therefore, 422 household heads participated in this study.

3.4.2 Sample Size Determination for the Qualitative Study

In the qualitative survey, 22 key informants were purposively selected from the Ministry of Health, the Ministry of Agriculture, Livestock Development and Marketing, veterinary

services, and local administration. The sample size was determined by the principle of data saturation, whereby interviews continued until no new information, perspectives, or themes emerged from subsequent participants. This approach is widely recommended in qualitative research as it ensures sufficient depth and completeness of data while maintaining methodological rigor (Baker et al., 2014).

3.5 Sampling Procedures

The area has 6 administrative wards and their households formed the sampling frame. Sampling was done in two stages whereby proportionate sampling was initially used to obtain the number of study subjects per ward. Simple random sampling of the households was done to get to the actual study subjects. Purpose sampling of key informants was used in the qualitative survey.

3.6 Data Collection Tools

A pretested questionnaire (Appendix IV) was used to collect quantitative data. The questionnaire collected information on socio-demographic characteristics, levels of awareness of rabies within households, level of adherence to dog vaccination and practices within households in regard to control of dog mediated rabies. Qualitative data was collected using a key informant interview question guide as shown in Appendix V.

The independent variables in this study consisted of the socio-demographic attributes of the participants. These attributes included age, gender, marital status, level of education, occupation, household size, average household income, and the primary income earner in the household. The dependent variables included awareness on rabies, accessibility of anti-rabies

vaccine to household heads, and practices of household heads regarding control of dog mediated rabies. In the qualitative study, themes were developed from the data collected.

3.6.1 Data Collection Process

In the Quantitative survey, the village elders served as guides to identify and enumerate all households with dogs in their villages. The recruited and trained research assistants were then deployed to the selected households where they administered the structured questionnaires to collect data from the household heads.

In the qualitative survey, key informants were purposively identified and enumerated from relevant sectors, including the Ministry of Health, veterinary services, the Ministry of Agriculture, Livestock Development and Marketing, and local administration. Trained research assistants then conducted key informant interviews to obtain in-depth information. Interviews continued until data saturation was achieved, that is, when no new themes or insights emerged from subsequent interviews.

3.6.2 Quality control

3.6.2.1 Pretesting of the Questionnaire

Before actual data collection, the tools were pretested in Bobasi Sub County which had similar socio-demographic characteristics like the study area. The pretest was conducted to assess the clarity, relevance, and consistency of the questionnaire items, as well as to determine the average time required to complete an interview. Based on feedback from respondents and observations made during the exercise, minor revisions were made to

improve the wording, sequencing, and clarity of some questions. The pretest also enabled the assessment of the instrument's reliability. Internal consistency was evaluated using Cronbach's alpha coefficient, as recommended by Tavakol and Dennick (2011), and the questionnaire achieved a Cronbach's alpha coefficient of 8.2, indicating an acceptable level of reliability for data collection.

3.7 Ethical Considerations

Ethical approval for the study was secured from the University of Eastern Africa, Baraton (Ref. No. UEAB/09/01/2019, see Appendix 2) and from the National Commission for Science, Technology, and Innovation (NACOSTI) (Ref. No. NACOSTI/P/19/86707/29063, see Appendix 3) prior to commencing data collection. Village elders in the designated enumeration areas were also engaged to assist as guides during the household interviews. Additionally, informed consent was obtained from the heads of households before conducting the interviews. To maintain the integrity of the findings, participants were assured that all information provided would be kept confidential.

3.8 Data Management, Analysis, and Presentation

For the quantitative survey, completed questionnaires were checked for completeness and consistency before data entry. The data were then coded by assigning numerical values to the responses in order to facilitate entry and analysis using the Statistical Package for Social Sciences (SPSS) version 20.0. To maintain confidentiality, completed questionnaires were collected from research assistants and securely stored in locked cabinets until data collection was complete. Access to computer files was protected with passwords. Each questionnaire was assigned a unique identifier for validation purposes. Descriptive statistics, including

frequency distributions, were used to summarize the socio-demographic and economic characteristics, awareness levels of rabies among households, adherence to dog vaccination, and rabies control practices.

Prior to inferential analysis, the data were assessed for compliance with logistic regression assumptions. These included testing for multicollinearity among independent variables using Variance Inflation Factor (VIF), with variables exceeding acceptable thresholds considered for exclusion or adjustment. Model fit was evaluated using the Hosmer–Lemeshow goodness-of-fit test. A non-significant value ($p > 0.05$) was considered indicative of an adequately fitting model. Potential confounding variables were identified from literature and bivariate analysis and controlled for during multivariable logistic regression. Variable selection for the final model was guided by statistical significance at bivariate level ($p < 0.05$). Logistic regression analysis was then conducted to assess the relationship between socio-demographic factors, awareness of dog-mediated rabies, and access to anti-rabies vaccines among households in South Mugirango Sub-County. Adjusted odds ratios (AORs) with 95% confidence intervals were reported, and statistical significance was set at $p < 0.05$.

Qualitative data were analysed thematically through systematic coding and categorization into emerging themes related to rabies awareness, vaccination practices, and control measures. Quantitative findings are presented using tables and figures, while qualitative findings are presented as synthesized narratives supported by participants' views as recommended by Sutton and Austin (2015).

CHAPTER FOUR

RESULTS

4.1 Introduction

This chapter presents results on a comprehensive exploration of rabies awareness, dog vaccination practices, adherence factors, and control practices within households in South Mugirango Sub-County. The study aimed to assess these aspects through four main objectives: first, to evaluate the level of rabies awareness within households; second, to identify socio-demographic factors influencing dog vaccination; third, to uncover factors impacting adherence to dog vaccination; and fourth, to examine the practices employed by household heads for controlling rabies transmission through dogs. The findings shed light on the complex interplay of socio-demographic variables and local practices that affect rabies management in this community, providing insights crucial for targeted interventions and public health strategies.

4.2 Level of Awareness of Rabies within Households

This section presents the findings on the level of rabies awareness among households in South Mugirango Sub-County. The analysis focuses on respondents' knowledge of the disease, including its causes, modes of transmission, and spread, in order to assess the extent of community awareness and understanding of dog-mediated rabies.

4.2.1 Basic Awareness on Rabies

To determine the level of rabies awareness among households in South Mugirango Sub-County, respondents were asked if they have ever heard of the rabies disease so as to assess their general understanding of the disease. The results are presented in Table 4.1.

Table 4.1

Frequency distribution of whether they have heard of rabies disease/condition

I have heard of rabies disease/condition	Frequency (Number)	Percentage (%)
Yes	400	94.8
No	22	5.2
Total	422	100

The results on Table 4.1 show that 94.8% (400/422) of respondents reported that they have heard of rabies disease or condition, while 5.2% (22/422) indicated they have not. This suggests a high level of awareness about rabies among the surveyed population. The substantial majority being aware of rabies is positive from a public health perspective, as awareness is crucial for prevention and timely treatment, especially in regions where rabies is endemic.

4.2.2 Awareness on the Modes of Spread of Rabies

To assess awareness of rabies transmission, respondents were asked to identify the common ways through which the disease spreads from infected animals to humans. The findings presented in Table 4.2 provide an indication of the respondents' level of knowledge regarding rabies transmission and help identify areas that may require targeted public health education and awareness interventions.

Table 4.2

Frequency distribution of Awareness on the Modes of Spread of Rabies

knowledge on the modes by which rabies spread	Frequency	Percentage
Bite from an infected animal	350	82.9
Scratches from infected animals	65	15.4
Infected saliva	7	1.7
Total	422	100

Table 4.2 shows that a significant majority of respondents 82.9% (350/422) are aware that rabies can spread through bites from infected animals. However, awareness levels are notably lower for other modes of transmission, with 15.4% (65/422) aware of transmission through scratches from infected animals and only 1.7% (7/422) aware of transmission via infected saliva.

4.2.3 Knowledge on Causative Agent and Mode of Transmission

The survey investigated respondents' understanding of the cause of rabies and its modes of transmission. This information is fundamental to the prevention of dog-mediated rabies and directly influences household decisions on vaccination and exposure risk management. The results are presented in Table 4.3.

Table 4.3

Frequency distribution of Knowledge on Causative Agent and Mode of Transmission

Knowledge on Causative Agent and Mode of Transmission	Frequency (Number)	Percentage (%)
Yes	355	79.4
No	86	20.4
No Response	1	0.2
Total	422	100

Table 4.3 shows that 79.4% (335/422) of respondents demonstrated awareness that cats and dogs' bites are common modes of transmitting the rabies causative agent. However, 20.4 % (86/422) of respondents expressed uncertainty about whether cats and dogs are involved in rabies transmission. Additionally, a negligible proportion 0.2% (1/422) did not provide a response.

4.2.4 Knowledge on Rabies Infection Presentation

The study assessed respondents' knowledge of the clinical signs and symptoms associated with rabies infection in humans and animals. The findings on awareness of rabies manifestations among respondents are presented in Table 4.4.

Table 4.4

Frequency distribution of Knowledge on Rabies Infection Presentation

Knowledge on Rabies Infection Presentation	Frequency (Number)	Percentage (%)
Flu like symptoms that are accompanied by fever, muscle weakness & tickling sensation	57	13.5
Biting behavior	59	14
Barking like a dog	269	63.7
Fear of water	15	3.6
Don't know	22	5.2
Total	422	100

The survey findings in table 4.4 on knowledge about rabies infection presentation among respondents indicate varied levels of awareness. A majority, 63.7% (269/422 respondents), correctly identified barking like a dog as a symptom associated with rabies infection. Additionally, 14% (59/422 respondents) recognized biting behaviour as indicative of rabies. However, only 13.5% (57/422 respondents) identified flu-like symptoms accompanied by fever, muscle weakness, and a tickling sensation as signs of rabies infection. A smaller proportion, 3.6% (15/422 respondents), correctly noted fear of water as a symptom, while 5.2% (22/422 respondents) admitted not knowing any symptoms of rabies infection.

4.3 Level of Adherence to Dog Vaccination

This section presents findings on the extent to which households in the study area comply with recommended dog rabies vaccination practices. It examines the proportion of dog-

owning households that vaccinate their dogs and the regularity of vaccination. This information is important in understanding their overall adherence to rabies vaccination guidelines.

4.3.1 Dogs Vaccination against Rabies

The level of adherence to dog vaccination was evaluated amongst the respondents to this study as it forms a key factor in reduction of rabies in our societies. The results are shown in table 4.5.

Table 4.5

Frequency distribution of Dogs Vaccination against Rabies

Dogs Vaccination against Rabies	Frequency (Number)	Percentage (%)
Yes	214	50.7
No	208	49.3
Total	422	100

The results in Table 4.5 shows that 49.3% (208/422) of the respondents had not vaccinated their dogs against rabies in the last 12 months, while 50.7% (214/422) of the respondents reported having done so. This finding indicates a low compliance with recommended rabies vaccination protocols and guidelines, which are essential for reducing rabies incidence in communities.

4.3.2 Dogs Vaccination Frequency

The study assessed the dog vaccination frequencies and the result was tabulated as in the table 4.6 below.

Table 4.6

Frequency distribution of Dogs Vaccination Frequency

Dogs Vaccination Frequency	Frequency (Number)	Percentage (%)
Annually	187	87.4
Biannually	27	12.6
Total	214	100

The study assessed the frequency of dog vaccination among respondents, revealing diverse practices. While 50.7% (214/422) of the respondents reported vaccinating their dogs, a majority 87.4% (187/214), indicated annual vaccination, while the minority, 12.6% (27/214), reported biannual vaccination. These findings highlight inconsistent vaccination practices among dog owners underscoring the need for improved awareness and adherence to recommended vaccination schedules to effectively combat rabies transmission.

4.4 Socio-Demographic Factors of the Respondents

In South Mugirango Sub-County, several socio-demographic factors play a role in shaping the vaccination practices of households concerning their dogs. These factors include gender, age, marital status, education level, occupation, income level, household size, and the identity of the household breadwinner. Each of these demographic characteristics influences households' decisions and ability to ensure their dogs are vaccinated against rabies. Understanding these factors is crucial for designing effective interventions aimed at improving vaccination rates and reducing the incidence of rabies in the community. The results are shown is shown in table 4.7 below.

Table 4.7

Association of socio demographic factors with level of adherence to vaccination of dogs

Variable		No F (%)	Yes F (%)	Chi-square	P value
Gender	Male	90(21.3%)	99(23.5%)	0.382	0.537
	Female	118(28.0%)	115(27.3)		
Age	< 25 Yrs	29(6.9%)	20(4.7%)	3.477	0.324
	25-35 Yrs	73(17.3%)	68(16.1%)		
	36-45Yrs	60(14.2%)	72(17.1%)		
	>46 Yrs	46(10.9%)	54(12.8%)		
Marital status	Single	26(6.2%)	25(5.9%)	4.928	0.295
	Married	152(36.0%)	155(36.7%)		
	Widowed	23(5.5%)	31(7.3%)		
	Separated	7(1.7%)	2(0.5%)		
	Divorced	0(0%)	1(0.2%)		
Education level	Primary	43(10.2%)	110(26.1%)	64.896	<0.001
	Secondary	60(14.2%)	69(16.4%)		
	Tertiary	105(24.9%)	35(8.3%)		
Occupation	Housewife	18(4.3%)	26(6.2%)	85.291	<0.001
	Self employed	48(11.4%)	113(31.5%)		
	Employed	141(12.1%)	51(33.4%)		
	Others	1(0.2%)	49(0.9%)		
Monthly income	≤ 5000	35(8.3%)	96(22.7%)	122.977	<0.001
	5001-10000	40(9.5%)	91(21.6%)		
	10001-20000	122(28.9%)	22(5.2%)		
	20001-30000	2(0.5%)	1(0.2%)		
	≥ 30001	4(0.9%)	4(0.9%)		
	NR	5(1.2%)	0(0.0%)		
Number of children	None	14(3.3%)	16(3.8%)	4.899	0.672
	1	19(4.5%)	18(4.3%)		
	2	42(10.0%)	43(10.2%)		
	3	59(14.0%)	57(13.5%)		
	4	36(8.5%)	50(11.8%)		
	5	26(6.2%)	18(4.3%)		
	≥6	11(2.6%)	12(2.8%)		
	NR	1(0.2%)	0(0%)		
Household breadwinner	Father	164(38.9%%)	157(37.2%)	7.713	0.021
	Mother	32(7.6%)	52(12.3%)		
	Children over 18years	12(2.8%)	5(1.2%)		

Variable: Lists the socio-demographic factors analysed in relation to adherence to vaccination of dogs against rabies. Adherence to vaccination of dogs: Indicates whether respondents reported adherence ("Yes") or non-adherence ("No") to vaccinating their dogs against rabies. No (F%): Number and percentage of respondents who reported not adhering to dog vaccination within each category of the socio-demographic factor. Yes (F%): Number and percentage of respondents who reported adhering to dog vaccination within each category of the socio-demographic factor. Chi-square: Chi-square value calculated to determine the association between adherence to dog vaccination and each socio-demographic factor value: Significance level (p-value) associated with the chi-square test, indicating the statistical significance of the association between adherence to dog vaccination and each socio-demographic factor.

The association between socio-demographic factors and adherence to dog vaccination against rabies was analysed as shown in Table 4.7. For gender, the data revealed that among males, 21.3% did not adhere to dog vaccination, while 23.6% reported adherence. In comparison, among females, 28.0% did not adhere, and 27.3% adhered to the recommended vaccination schedule. Statistical analysis using chi-square indicated a value of 0.382 with a corresponding p-value of 0.537, suggesting no significant association between gender and adherence to dog vaccination. These findings imply that gender may not be a decisive factor influencing the adherence to dog vaccination practices against rabies within the study population. Although there was a slight difference in adherence rates between males and females, it was not statistically significant according to the chi-square test. This suggests that other factors beyond gender might have a more substantial influence on dog vaccination practices.

The study further investigated the association between age groups and adherence to dog vaccination against rabies, as detailed in Table 4.7. Among respondents aged less than 25 years, 6.9% did not adhere to dog vaccination, while only 4.7% reported adherence. In the 25-35 years age group, 17.3% did not adhere, and 16.1% adhered. Similarly, in the 36-45 years and over 46 years age groups, 14.2% and 10.9% did not adhere, respectively, with adherence rates of 17.1% and 12.8%, respectively. The chi-square test yielded a value of 3.477 with a corresponding p-value of 0.324, indicating no significant association between age and adherence to dog vaccination against rabies. Despite the difference in adherence among the different age groups, the results suggest that age is not a significant predictor hence it does not influence the adherence to dog vaccination practices against rabies within the study population.

The study investigated the relationship between marital status and adherence to dog vaccination against rabies, as summarized in Table 4.7. Among single respondents, 6.2% did not adhere to dog vaccination, while 5.9% reported adherence. For married individuals, 36.0% did not adhere, with 36.7% adhering to the vaccination schedule. Among widowed respondents, 5.5% did not adhere, compared to 7.3% who adhered. Separated individuals showed the lowest non-adherence at 1.7%, with only 0.5% adhering. Finally, divorced individuals reporting 0.2% adhering. The chi-square test yielded a non-significant value of 4.928 ($p = 0.295$), indicating that there is no statistically significant association between marital status and adherence to dog vaccination against rabies. The findings suggest that marital status alone may not be a significant predictor of adherence to dog vaccination against rabies within the studied population. While there are variations in adherence rates across different marital statuses, the lack of statistical significance implies that other factors such as education, socioeconomic status, access to veterinary services, and awareness campaigns may have a more pronounced impact on adherence behaviours.

The study examined the relationship between education level and adherence to dog vaccination against rabies, as summarized in Table 4.7. Among respondents with a primary education, 10.2% did not adhere to dog vaccination, while 26.1% reported adherence. Similarly, among those with a secondary education, 14.2% did not adhere, with 16.4% adhering to the vaccination schedule. For individuals with tertiary education, 24.9% did not adhere, compared to 8.3% who adhered. The chi-square test yielded a significant value of 64.896 ($p <0.001$), indicating a statistically significant association between education level and adherence to dog vaccination against rabies. The findings suggest that education level significantly influences adherence to dog vaccination against rabies within the studied

population. Respondents with higher levels of education, particularly tertiary education, demonstrated higher adherence rates compared to those with primary or secondary education. This trend may be attributed to better understanding of health-related information, increased awareness of rabies prevention measures, and possibly better access to veterinary services among individuals with higher educational attainment. The statistically significant chi-square value suggests that education level is a relevant factor in predicting adherence behaviours related to dog vaccination against rabies. The study highlights that education level plays a significant role in determining adherence to dog vaccination against rabies. As educational attainment increases, so does the likelihood of adhering to rabies prevention practices for dogs. Public health interventions and educational campaigns aimed at improving rabies awareness and vaccination coverage should consider educational disparities to effectively target populations with lower adherence rates, potentially reducing the incidence of rabies in communities.

The association between occupation and adherence to dog vaccination against rabies was investigated as shown in Table 4.7. Among housewives, 4.3% did not adhere to dog vaccination, while 6.2% reported adherence. Self-employed individuals showed non-adherence at 11.4%, with 31.5% adhering to the vaccination schedule. Employed individuals showed non-adherence at 12.1%, with 33.4% adhering. The other category showed 0.2% non-adherence, with 0.9% adhering. The chi-square test resulted in a value of 85.291($p < 0.001$), indicating a statistically significant association between occupation and adherence to dog vaccination against rabies. The findings suggest that occupation significantly influences adherence to dog vaccination against rabies within the studied population. Housewives demonstrated lower rates of adherence compared to employed individuals. This

discrepancy may be attributed to differences in daily routines, availability of resources, and awareness of preventive health measures related to rabies. The statistically significant chi-square value implies that occupation is a pertinent factor affecting adherence behaviours related to dog vaccination against rabies. The study underscores the influence of occupation on adherence to dog vaccination against rabies. Employed individuals exhibited higher adherence rates compared to housewives. Public health strategies aimed at improving rabies prevention efforts should consider occupational disparities to effectively target populations with lower adherence rates, potentially reducing the incidence of rabies in communities.

The association between monthly income and adherence to dog vaccination against rabies was examined as shown in Table 4.7. Among individuals earning 5000 and below, 8.3% did not adhere to dog vaccination, while 22.7% reported adherence. Those earning between 5001 and 10000 showed 9.5% non-adherence and 21.6% adherence. For the income brackets of 10001-20000, non-adherence was observed in 28.9% of cases, with 5.2% adhering to vaccination. Higher income brackets of 20001-30000 and 30001 and above had lower rates of non-adherence at 0.5% and 0.9%, respectively, with adherence rates of 0.2% and 0.9%. The chi-square test yielded a value of 122.977 (<0.001), indicating a statistically significant association between monthly income and adherence to dog vaccination against rabies. The findings suggest that monthly income significantly influences adherence to dog vaccination against rabies within the studied population. Lower-income groups, particularly those earning 5000 and below, 5001-10000, and 10001-20000, exhibited higher rates of non-adherence compared to higher-income groups. Conversely, higher-income groups demonstrated lower rates of non-adherence and higher adherence to the vaccination schedule. This disparity may be attributed to differences in financial resources, awareness, and

prioritization of preventive health measures related to rabies. The statistically significant chi-square value indicates that monthly income is a crucial factor affecting adherence behaviours related to dog vaccination against rabies. The study underscores the influence of monthly income on adherence to dog vaccination against rabies. Lower-income groups showed higher rates of non-adherence, highlighting a potential barrier to accessing and adhering to rabies prevention measures.

The association between the household breadwinner and adherence to dog vaccination against rabies was examined, as detailed in Table 4.7. Among households where the father is the breadwinner, 38.9% reported non-adherence to dog vaccination, while 37.2% indicated adherence. Conversely, households where the mother is the breadwinner showed 7.6% non-adherence and 12.3% adherence to dog vaccination. In households where children over 18 years are the breadwinners, 2.8% reported non-adherence, and 1.2% reported adherence to dog vaccination. A chi-square test was conducted, yielding a value of 7.713 ($p = 0.021$), indicating a statistically significant association between the household breadwinner and adherence to dog vaccination against rabies. The findings suggest that the identity of the household breadwinner significantly influences adherence to dog vaccination against rabies within the surveyed population. Specifically, households where the father is the primary breadwinner tend to exhibit higher rates of non-adherence compared to those where the mother or adult children are the breadwinners. This could be attributed to various socio-economic factors, including decision-making power, financial resources allocated to pet care, and the prioritization of health-related expenditures. The study underscores the impact of the household breadwinner on adherence to dog vaccination against rabies. Understanding these

dynamics is crucial for designing targeted interventions that address barriers to vaccination among specific household types.

The association between the number of children and adherence to dog vaccination against rabies was investigated as presented in Table 4.7. Among respondents with no children, 3.3% did not adhere to dog vaccination, while 3.8% reported adherence. Similarly, those with one child showed 4.5% non-adherence and 4.3% adherence. For households with two children, non-adherence was observed in 10.0% of cases, with 10.2% adhering to vaccination. Families with three children demonstrated non-adherence in 14.0% of cases, and 13.5% reported adherence. Households with four children had 8.5% non-adherence and 11.8% adherence, while those with five children showed 6.2% non-adherence and 4.3% adherence. Families with six or more children exhibited 2.6% non-adherence and 2.8% adherence. Only 0.2% of respondents did not report their number of children (NR). The chi-square test yielded a value of 4.899 ($p = 0.672$), indicating no significant association between the number of children and adherence to dog vaccination against rabies. The findings suggest that the number of children in a household does not influence adherence to dog vaccination against rabies within the studied population. Larger families tend to exhibit higher rates of non-adherence compared to smaller families. However, the insignificant chi-square value shows that family size is not a determinant of adherence to rabies prevention measures involving dog vaccination.

4.4.1 Assumptions Test for Logistic Regression Analysis

Prior to conducting logistic regression analysis, various diagnostic tests were conducted to ensure that the regression assumptions are not violated. These assumptions were assessed

through: independence of observations, absence of multicollinearity, adequate sample size, and Hosmer–Lemeshow goodness-of-fit test.

The assumption of independence of observations was assessed through the study design and data structure. Each respondent participated only once in the survey, and each questionnaire represented a unique household. The dataset was examined for duplicate entries using SPSS, and no duplicated cases were identified. Therefore, the observations were considered independent, satisfying the assumption required for logistic regression analysis.

Multicollinearity among the independent variables was assessed using Tolerance and Variance Inflation Factor (VIF) statistics. The results are presented Table 4.8 below:

Table 4.8

Multicollinearity Test among socio-demographic factors influencing adherence to vaccination of dogs

Model		Collinearity Statistics	
		Tolerance	VIF
1	Respondent's Gender	.937	1.067
	Age of the Respondent	.799	1.252
	Marital status	.853	1.172
	Educational Level	.655	1.526
	Occupation	.737	1.357
	Monthly Income	.681	1.468
	Number of Children	.873	1.146
	Breadwinner In the House	.881	1.136

a. Dependent Variable: Have all your dogs been vaccinated in the last 12 months?

The results in Table 4.8 shows that the tolerance values ranged from 0.655 to 0.937, while the VIF values ranged from 1.067 to 1.526. Since all tolerance values exceeded 0.10 and all VIF values were below 5.0, there was no evidence of significant multicollinearity among the

predictor variables. Therefore, the assumption of absence of multicollinearity was satisfied, and all variables were included in the regression model.

Adequacy of the sample size was assessed using the Events per Variable (EPV) criterion recommended for logistic regression. The model included eight predictor variables, and the least frequent outcome category contained 208 cases. This yielded an EPV of 26 (208/8), which exceeded the recommended minimum threshold of 10 events per predictor variable. Therefore, the sample size was considered adequate for conducting binary logistic regression analysis.

The Hosmer–Lemeshow goodness-of-fit test was used to assess how well the logistic regression model fitted the observed data. The assumption of model fit was satisfied as evidenced by a non-significant Hosmer–Lemeshow test ($\chi^2 = 3.992$, df = 8, p = 0.858). Additionally, the model exhibited moderate explanatory power (Nagelkerke $R^2 = 0.333$) and correctly classified 73.7% of cases, supporting its suitability for examining the socio-demographic determinants of dog vaccination status.

In summary, all the assumptions for binary logistic regression were adequately met. Consequently, the model was considered suitable for subsequent inferential analysis and interpretation of the predictors of dog vaccination status.

4.4.2 Sociodemographic Factors Influencing Vaccination of Dogs

Binary logistic regression analysis was performed to determine the socio-demographic factors influencing adherence to dog vaccination among households in South Mugirango Sub-County. The factors that were found to statistically influence the adherence to

vaccination of dogs by households in the sub county were educational level of the household heads [(OR=1.722, 95% CI = 1.249 – 2.373, p<0.05)], occupation of the household heads [(OR=1.702, 95% CI = 1.170 – 2.476, p<0.05)], and monthly income [(OR= 2.128, 95%CI = 1.590 – 2.848, p<0.05)] as illustrated below in Table 4.9 below.

Table 4.9

Regression Analysis on Socio-demographic factors influencing adherence to vaccination of dogs

							95% C.I. for EXP(B)	
	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Respondent's gender	.374	.236	2.503	1	.114	1.453	.915	2.310
Age of the respondent	-.229	.132	2.986	1	.084	.796	.614	1.031
Marital status	.145	.213	.459	1	.498	1.155	.761	1.755
Educational level	.543	.164	11.017	1	.001	1.722	1.249	2.373
Occupation	.532	.191	7.747	1	.005	1.702	1.170	2.476
Monthly income	.755	.149	25.791	1	.000	2.128	1.590	2.848
Number of children	.122	.077	2.525	1	.112	1.130	.972	1.313
Breadwinner in the house	-.385	.232	2.762	1	.097	.681	.432	1.071
Constant	-4.161	.784	28.157	1	.000	.016		

a. Variable(s) entered on step 1: Respondent's gender, Age of the respondent, Marital status, Educational level, Occupation, Monthly income, Number of children, Breadwinner in the house.

The results of a logistic regression analysis examining the influence of various sociodemographic factors on adherence to dog vaccination against rabies. The table provides coefficients (EXP), standard errors (S.E.), Wald statistics, degrees of freedom (Df), significance levels (Sig.), and 95% confidence intervals (CI) for the exponentiated coefficients (EXP), which represent the odds ratios.

The logistic regression analysis reveals several key socio-demographic factors influencing adherence to dog vaccination. These findings highlight the complex interplay between education, occupation, income, and other variables in shaping vaccination practices.

The analysis demonstrates a moderately positive association between educational level and adherence to dog vaccination ($B = 0.543$, $p < 0.05$). Individuals with higher educational attainment are significantly more likely to adhere to vaccination recommendations. This association underscores the role of education in enhancing awareness and understanding of the importance of vaccination, which may lead to more informed health behaviours.

The results also indicate that occupation is a significant predictor of vaccination adherence ($B = 0.532$, $p < 0.05$). Those with formal employment are more likely to comply with vaccination guidelines compared to individuals in informal or non-employed statuses. This could be attributed to the stability and access to resources that formal employment often provides, facilitating better access to veterinary services and health information.

A strong positive relationship is observed between monthly income and vaccination adherence ($B = 0.755$, $p < 0.05$). Higher income levels are associated with better adherence, suggesting that financial resources play a crucial role in accessing and affording vaccination services. This finding highlights the importance of economic stability in ensuring compliance with health recommendations.

Among the significant predictors, monthly income demonstrated the strongest positive association ($OR = 2.128$), followed by educational level ($OR = 1.722$) and occupation ($OR = 1.702$). This implies that respondents with higher income, better educational attainment, and favourable occupational status were substantially more likely to comply with dogs vaccination guidelines than their counterparts.

Table 4.10

Unadjusted and Adjusted Odds Ratios with 95% Confidence Intervals for Socio-demographic Predictors of Vaccination of Dogs in South Mugirango Sub- County

Variable	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Respondent's Gender	1.129 (0.769 – 1.657)	1.453 (0.915 – 2.310)
Age of Respondent	0.844 (0.692 – 1.031)	0.796 (0.614 – 1.031)
Marital Status	0.978 (0.709 – 1.349)	1.155 (0.761 – 1.755)
Educational Level	2.756 (2.127 – 3.572)	1.722 (1.249 – 2.373)
Occupation	2.867 (2.080 – 3.952)	1.702 (1.170 – 2.476)
Monthly Income	3.024 (2.326 – 3.932)	2.128 (1.590 – 2.848)
Number of Children	0.996 (0.885 – 1.121)	1.130 (0.972 – 1.313)
Breadwinner in House	0.930 (0.649 – 1.333)	0.681 (0.432 – 1.071)

Table 4.10 presents the results of binary logistic regression analysis examining the association between socio-demographic characteristics and dog vaccination status. The unadjusted odds ratios (ORs) represent the effect of each variable independently, while the adjusted odds ratios (AORs) represent the effect of each variable after controlling for the influence of the other variables in the model.

The unadjusted odds ratio for gender was 1.129 (95% CI: 0.769–1.657), while the adjusted odds ratio was 1.453 (95% CI: 0.915–2.310). This suggests that one gender category had approximately 45.3% higher odds of vaccinating dogs compared to the reference category after controlling for other socio-demographic factors. However, because the confidence interval includes 1.0, the association was not statistically significant. Therefore, gender was not an independent predictor of dog vaccination.

Age had an unadjusted OR of 0.844 (95% CI: 0.692–1.031) and an adjusted OR of 0.796 (95% CI: 0.614–1.031). The odds ratios below 1 indicate a negative association, suggesting

that increasing age was associated with lower odds of vaccinating dogs. Specifically, after adjustment, the odds of vaccinating dogs decreased by approximately 20.4% with each increase in the age category. However, the confidence interval crossed 1, indicating that the association was not statistically significant.

Marital status had an unadjusted OR of 0.978 (95% CI: 0.709–1.349) and an adjusted OR of 1.155 (95% CI: 0.761–1.755). The adjusted model suggests that respondents in one marital status category were 15.5% more likely to vaccinate their dogs compared to the reference category. Nevertheless, the confidence interval includes 1, indicating no statistically significant association between marital status and dog vaccination.

Educational level showed a strong positive association with dog vaccination. The unadjusted OR was 2.756 (95% CI: 2.127–3.572), while the adjusted OR was 1.722 (95% CI: 1.249–2.373). After controlling for other factors, respondents with higher educational attainment were 1.72 times more likely to vaccinate their dogs compared to those with lower education levels. Since the confidence interval does not include 1, educational level was a statistically significant predictor of dog vaccination.

Occupation was also positively associated with dog vaccination. The unadjusted OR was 2.867 (95% CI: 2.080–3.952), and the adjusted OR was 1.702 (95% CI: 1.170–2.476). This indicates that respondents in the specified occupational category had approximately 70.2% higher odds of vaccinating their dogs than those in the reference category, after adjusting for other variables. The confidence interval excludes 1, demonstrating statistical significance.

Monthly income emerged as the strongest predictor among the socio-demographic factors. The unadjusted OR was 3.024 (95% CI: 2.326–3.932), while the adjusted OR was 2.128 (95% CI: 1.590–2.848). This means that respondents with higher monthly income were more than twice as likely to vaccinate their dogs compared to those with lower income levels, controlling for other factors. The confidence interval excludes 1, indicating a statistically significant association.

The number of children had an unadjusted OR of 0.996 (95% CI: 0.885–1.121) and an adjusted OR of 1.130 (95% CI: 0.972–1.313). Although the adjusted odds ratio suggests a slight positive association, the confidence interval includes 1. Therefore, the number of children was not significantly associated with dog vaccination.

Being the household breadwinner had an unadjusted OR of 0.930 (95% CI: 0.649–1.333) and an adjusted OR of 0.681 (95% CI: 0.432–1.071). The adjusted odds ratio suggests that breadwinners were approximately 31.9% less likely to vaccinate their dogs compared to non-breadwinners. However, because the confidence interval includes 1, this association was not statistically significant.

After adjusting for potential confounding factors, only educational level (AOR = 1.722, 95% CI: 1.249–2.373), occupation (AOR = 1.702, 95% CI: 1.170–2.476), and monthly income (AOR = 2.128, 95% CI: 1.590–2.848) were significant predictors of dog vaccination in South Mugirango Sub-County. Monthly income was the strongest predictor, indicating that households with higher income levels were substantially more likely to vaccinate their dogs. Gender, age, marital status, number of children, and breadwinner status did not demonstrate

statistically significant associations with dog vaccination after controlling for other socio-demographic characteristics.

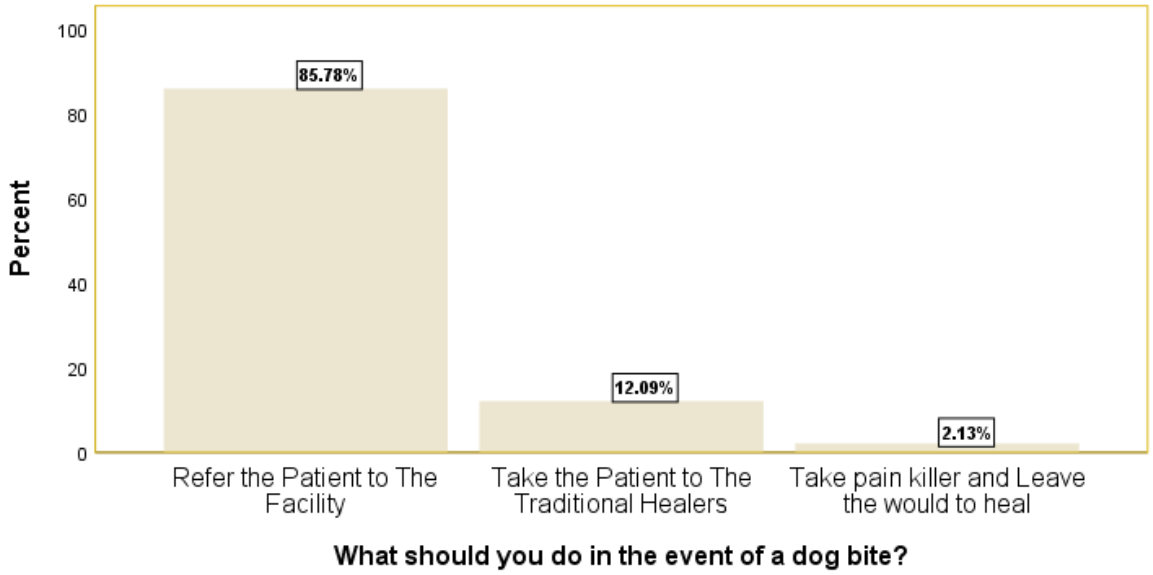
The interviews with livestock and public health officers corroborated the quantitative findings, emphasizing the significant role of socio-demographic factors in vaccination adherence. They noted that self-employed individuals, those with higher educational levels, and households with larger incomes are more likely to adhere to dog vaccination, likely due to their greater resources and better understanding of vaccination benefits. This reinforces the need for targeted interventions that address the specific needs of vulnerable groups and leverage socio-economic insights to improve vaccination coverage.

4.5 Dog Mediated Rabies Management Strategies by Households

The study assessed the management strategies employed by the households when a member is bitten by a rabies-infected dog and the data obtained is presented in figure 4.1 below. Most of household heads (85.3%-360/422) took household members bitten by dogs to nearby health facility, (10.4%-44/422) of the household heads took their household members bitten by dogs to traditional healers, (1.2%-5/422) provided pain killers and let the wound the heal. However, (3.1%-13/422) of the household heads did not respond.

Figure 4.1

Action taken when a household member is bitten by a dog



4.6 Knowledge and Practices Relating to Rabies among Residents of South Mugirango

A key informant interview was conducted to assess the level of awareness, level of adherence, challenges associated with adherence to vaccination of dogs and actions taken in case of dog bites. Four thematic areas emerged and these are: - high level of awareness of rabies, low levels of adherence to vaccination of dogs, challenges with dog vaccination and proper seeking of medical assistance in case of dog bites. 16 out of the 22 KII reported that people in South Mugirango were ware of rabies. Furthermore 14 out of the 22 KII agreed that the level of adherence to dog vaccination was low. Furthermore 6 of the KII agreed that the main challenge associated with dog vaccination is low publicity on dog vaccination, 3 KII agreed that inadequate funding on dog vaccination campaigns is a key challenge while another 3KII agreed that unpredictable weather conditions and poor infrastructure to be key challenges associated with low level of adherence to dog vaccination. Additionally, 19 KII

agreed that people are taken to the hospital when bitten by dogs while 3 KII agreed that people are given first aid when bitten by dogs.

THEME A: high level of awareness of rabies

"Most people are aware of rabies" key informant no 4.

"Everybody knows rabies due to the frequent cases reported here" key informant no 17.

THEME B: Low levels of adherence to vaccination of dogs against rabies

"People are aware of rabies yet they refuse to vaccinate their dogs". Key informant no 11.

"We try our best yet we get very low turn outs during the vaccination day". Key informant no 21.

THEME C: Challenges with dog vaccination

"There low publicity on dog vaccination" key informant no 16.

"There is little funding for campaigning for vaccination of dogs against rabies" key informant no.2.

THEME D: proper health seeking behavior in case of dog bites

"A lot of people seek medical help when they are bitten by dogs since they are aware of rabies" key informant no. 7

"People fear the effects of rabies and they therefore seek medical treatment early in the nearest health facilities" key informant no. 18

CHAPTER FIVE

DISCUSSION

5.1 Level of Awareness of Rabies within Households

Awareness of rabies and its transmission dynamics is crucial for effective disease management within any community. In South Mugirango Sub-County, our study revealed a high level of awareness among respondents, with 96.3% familiar with rabies and its symptoms, and 59.2% correctly identifying the virus as the causative agent. This finding was reinforced by key informants, including livestock and public health officers, who noted widespread understanding of rabies among household heads. This awareness is pivotal for timely intervention and management of rabies cases, as well as for implementing preventive strategies. The dynamics of rabies transmission highlight dogs as primary reservoirs and sources of infection. When infected, dogs transmit the virus through saliva during bites, targeting nerve cells and traveling to the central nervous system, causing severe neurological symptoms. Effective control strategies such as mass dog vaccination and public awareness campaigns are essential to reduce human exposure to rabies. Our findings contrast with those from Ethiopia, where informal sources dominate rabies awareness, possibly influenced by varying government initiatives, religious beliefs, or cultural factors (Beresa et al., 2024; Hagos et al., 2020). Additionally, our study aligns with reports from Zambia, underscoring dog bites as the predominant source of rabies transmission (Mulipukwa et al., 2017). Enhancing knowledge on rabies, its transmission modes, and prevention strategies is pivotal for effective disease management in South Mugirango subcounty and similar settings worldwide.

5.2 Socio-Demographic Factors Influencing Rabies Awareness

The analysis highlights several socio-demographic factors influencing adherence to dog vaccination against rabies in South Mugirango Sub-County. Although males showed a lower adherence rate (23.5%) compared to females (27.3%), this difference was not statistically significant ($p = 0.537$). Insignificant variations were noted across age groups ($p = 0.324$), with younger respondents (<25 years) exhibiting the lowest adherence (4.7%), and higher rates observed among those aged 25-35 years and 36-45 years (16.1% and 17.1%, respectively). Marital status did not significantly correlate with adherence ($p = 0.295$); however, married individuals demonstrated higher adherence (36.7%) compared to singles (5.9%), widowed (7.3%), separated (0.5%), and divorced (0.2%). Education level significantly influenced adherence (chi-square = 64.896, $p < 0.001$), with those having primary education showing higher adherence (26.1%) compared to those with secondary (16.4%) and tertiary education (8.3%). Occupation also played a role (chi-square = 85.291, $p < 0.001$); formally employed individuals exhibited higher adherence (33.4%) compared to self-employed (31.5%) and housewives (6.2%). Monthly income levels showed significant differences (chi-square = 122.977, $p < 0.001$), with higher adherence rates (22.7% to 21.6%) observed among those earning below 10,000. The number of children in households had no significant influence on adherence ($p = 0.672$), with lower adherence rates (2.8% to 4.3%) seen in households with more children, those with one child, and those with no child. The identity of the household breadwinner significantly influenced adherence (chi-square = 7.713, $p = 0.021$), with higher non-adherence among households where the father (38.9%) versus the mother (7.6%) or adult children (2.8%) was the breadwinner.

Insights from Key Informants (KI), including Livestock and public health officers, provided additional perspectives on socio-demographic factors influencing rabies awareness. They noted marital status and occupation as significant influencers, with single household heads and housewives often demonstrating higher awareness levels due to their family roles. Moreover, they observed that male household breadwinners showed greater awareness, likely due to their involvement in dog-related activities. Interestingly, household size, age, and gender of the household head did not significantly influence rabies awareness, which contrasts with findings in other studies such as those by Dhakal et al. (2023, Subedi et al. (2023), and Wolelaw et al. (2022).

Regarding household breadwinners, men were typically identified as the primary breadwinners and exhibited higher awareness of rabies than other household members. This may be attributed to their traditional roles in many African households, where they are more likely to own, manage, and make decisions regarding dogs, including vaccination, confinement, and seeking veterinary services. Their greater involvement in livestock and animal-related activities may also increase their exposure to information on rabies prevention and control. This finding is consistent with the observations of Costa et al. (2018), who reported that household heads and primary decision-makers involved in dog ownership generally exhibited higher knowledge of rabies and were more likely to adopt recommended rabies prevention practices.

These results are consistent with a study done in Zambia which stated that house head gender and marital status were not found to play any role in the vaccination of the household dogs (Mulipukwa et al., 2017). Our findings were also consistent with another recent KAP study

in south western Ethiopia that showed that older age groups were more knowledgeable about vaccinating dogs against rabies than younger age groups (Tiwari et al., 2019). Another recent study done in Zimbabwe reported that ‘pet ownership statuses’ and ‘occupation’ were both statistically associated with having adequate knowledge about rabies and vaccinating dogs against it. In the same study, healthcare providers had greater odds of having adequate knowledge about rabies and dog vaccination compared to teachers and students (Spargo et al., 2021).

However, no statistically significant relationship was found between rabies awareness and the size of the household, suggesting that awareness levels were consistent regardless of family size. This finding contrasts with expectations, as larger families might be presumed to have heightened awareness due to increased potential exposure. Similar findings were reported in studies conducted in other regions (Dhaka et al., 2023; Wolelaw et al., 2022).

Furthermore, age and gender of the household head did not significantly impact rabies awareness in this study. This independence suggests that awareness efforts are equally effective across different age groups and genders within household leadership roles. These findings diverge from expectations that younger household heads might have higher awareness due to improved access to information technology. Likewise, educational level and monthly income did not significantly correlate with rabies awareness, indicating that formal education and income levels do not necessarily enhance knowledge of rabies dynamics, as discussed by Hagos et al. (2020) and Spargo et al. (2021).

These results differ from studies that found significant associations between education level and awareness of rabies (Nejash et al., 2017; Sivagurunathan et al., 2021), suggesting

regional variations in awareness dynamics. Overall, these insights underscore the complex interplay of socio-demographic factors in shaping awareness and adherence to rabies control measures, emphasizing the need for tailored interventions to improve overall adherence rates across diverse demographic profiles.

5.3 Level of Adherence to Dog Vaccination

Both livestock and public health officers expressed concern over the low level of adherence to dog vaccination against rabies in South Mugirango Sub-County. They highlighted factors such as negligence, lack of awareness, high vaccine costs, and logistical challenges as barriers to vaccination. According to their observations, this poses a significant public health risk, as evidenced by household heads' inability to recall their dogs' last vaccination. They emphasized the urgent need for targeted interventions to improve vaccination coverage and control rabies transmission.

Adherence to dog vaccination is crucial in managing rabies, as dogs are primary transmitters of the disease. Studies have shown promising results in communities with stringent vaccination guidelines (Lodha et al., 2023). However, in this study, adherence was moderately low at 50.7%, falling well below the WHO recommendations of 70% (Jimmy & Jose, 2011; Sidebottom et al., 2018). This necessitates public health interventions such as targeted awareness campaigns, subsidized vaccine programs, enhanced veterinary services, and improved logistical support to ensure widespread and effective dog vaccination against rabies in the community (Adesola et al., 2023; Changalucha et al., 2019).

The low adherence observed can be attributed to several factors identified during the study. Many household heads neglected the importance of dog vaccination, citing low publicity from veterinary doctors about vaccination dates, difficulty transporting dogs to vaccination sites, erratic vaccine supply from the government, and the high cost of vaccines, especially for households with low socioeconomic status. Financial constraints were a significant barrier, as most inhabitants reported inability to afford vaccines. This situation not only facilitates the persistence of rabies infections but also poses risks to public health.

Additionally, a concerning 84.7% of respondents admitted they couldn't remember the last time their dogs were vaccinated against rabies. This indicates either a lack of seriousness among locals regarding dog vaccination or a general ignorance about the disease's impact. Negligence and failure to keep vaccination certificates safe were also noted contributing factors. These findings resonate with a similar study in Zambia where high vaccine costs led to low vaccination coverage (Mulipukwa et al., 2017). Similarly, in Tanzania, only 46% of respondents reported previous dog vaccinations, citing irregular vaccination schedules across districts (Sambo et al., 2014).

The reasons for poor compliance with dog vaccination, as seen in studies like the one in Germany addressing leptospirosis, include scheduling issues and annual vaccination costs (Eschle et al., 2020). These factors likely contribute to the low adherence observed in this study. Additionally, common perceptions in African communities about irresponsible dog ownership practices, including failure to restrain dogs and inadequate care, may further influence low vaccination rates (Sambo et al., 2014).

Key informants also highlighted other potential reasons for low adherence, including overall low awareness, vaccine charges for dogs, and unpredictable weather conditions impacting vaccination campaigns (Duamor et al., 2022; Galagali et al., 2022). Moreover, the absence of robust rabies legislations and control programs in low-income countries may explain the challenges observed in ensuring widespread dog vaccination (Haselbeck et al., 2021).

Furthermore, the small subset of respondents who reported adherence to dog vaccination in our study might possess higher incomes and education levels, indicating greater access to resources and knowledge about veterinary services. These individuals could also be more dedicated dog owners.

Addressing the barriers to dog vaccination against rabies requires multifaceted strategies, including enhanced awareness campaigns, subsidized vaccines for low-income households, improved logistical support for vaccination programs, and strengthened regulatory frameworks. These efforts are crucial for achieving higher vaccination coverage and effectively controlling rabies transmission in South Mugirango Sub-County and similar settings.

5.4 Association of Socio-Demographic Characteristics of the House Heads and Adherence to Vaccination of Dogs

Gender, age, marital status, house hold size, and breadwinner were not significantly associated with adherence to vaccination of dogs. On the other hand, education level of the dog owner ($p=0.001$), occupation of the dog owner ($p=0.005$), and monthly income of the house hold head ($p=0.000$) were significantly associated with the adherence to dog vaccination. Since the responsibilities of the household heads are the same regardless of the

gender, we would expect equal adherence to the vaccination of dogs. The higher the level of education the more the individual is informed and hence could make proper decisions on dogs' vaccination and this is due to knowledge on the importance of vaccination. Formally employed persons were vaccinating their dogs more than other groups. This is could be because of the fact that such individuals have a higher level of income, taking social responsibilities, and knowledge on the importance of vaccination of dogs. The higher income is also associated with the higher level of vaccination of dogs as the persons have ability to meet the cost of vaccination. These results are consistent with a study done in Democratic Republic of Congo (DRC) which reported that the age and socio-economic level of the household, occupation and the formal education level of the dog owner were significantly associated with dog vaccination (Kazadi et al., 2017), implying that when communities are knowledgeable, they are likely to implement preventive measures hence a better appreciation of dog vaccination.

In terms of age, respondents in this study aged between 36-45 years recorded the highest level of adherence (17.1%) to dog vaccination followed by those aged between 25-35 years (16.1%). This could be because people within this age group are adults and are likely to be responsible, educated and robust, traits that prompt them to vaccinate their dogs. Conversely in another study conducted in Ethiopia by (Beyene et al., 2018) it was reported that older dog owners were more likely to vaccinate their dogs compared to their younger counterparts. This differences in terms of age and adherence to dog immunisation could partly be attributed to culture, government policies and personal attributes of a given individual and society in regard to dog keeping and management. For instance, societies where policies on dog keeping

and management are clear seems to adhere to immunisation guidelines as compared to those without (Rajoromanana et al., 2024).

With regard to education level, a significant relationship with adherence to dog vaccination was observed. The highest level of adherence was observed among respondents with primary level education (26.1%), with tertiary level recording the highest percentage of non-adherence (24.9%). This outcome could be attributed to the relatively higher proportion of respondents in this category. Beyene et al. (2018) in an Ethiopian study reported a lower inclination to vaccinate dogs among owners with a higher level of education status.

In terms of occupation, it was observed in this study that formally employed people had the highest level of adherence (33.4%) to dog vaccination followed by the self-employed people (31.5%). This could be attributed by the fact that employed individuals are able to cover the rabies treatment cost from their income as compared to the other categories. This finding was consistent with the results of a Ghanaian study, which indicated that occupation of dog owners significantly influenced the decision vaccinate dogs against rabies (Awuni et al., 2019). According to the study, dog owners who were civil servants, traders or farmers were 1.3, 3.4 and 1.1 times more likely to vaccinate their dogs against rabies than their unemployed counterparts. This result could be attributed to the fact that self-employed people have flexible schedules that afford them time to visit veterinary facilities.

Income level significantly influenced adherence to vaccination. One of the challenges associated with vaccination of dogs is the cost, the persons with higher income could meet the cost. Our findings were in alignment with those of Sikana et al. (2021) who reported that

most households had men as the main breadwinners and decision makers and therefore decided whether to vaccinate their dogs.

5.5 Dog Mediated Rabies Management Strategies by Households

The chi-square analysis results indicate no significant difference in knowledge about dog vaccination between male and female household heads (Chi-square = 0.382, p = 0.537). This suggests that gender does not significantly influence the level of awareness or knowledge regarding dog vaccination in South Mugirango Sub-County. Despite both genders showing some degree of awareness about dog vaccination, the minimal impact of gender on knowledge implies that other factors, rather than gender, might be more critical in determining vaccination practices. Similar findings were reported by Subedi et al. (2023), who noted that community knowledge and practices towards rabies prevention were not significantly influenced by gender. This aligns with our results, indicating that interventions targeting rabies awareness and vaccination should not be gender-specific but should instead address broader community needs. Furthermore, studies like those by Amemiya et al. (2023), Mshelbwala et al. (2024) and Ogugu et al. (2024) highlight that various demographic factors, including marital status, occupation, and educational level, play a more substantial role in influencing practices related to rabies and dog vaccination.

The analysis of household breadwinner status shows a significant association with knowledge about dog vaccination (Chi-square = 7.713, p = 0.021). Households where the father is the primary breadwinner exhibit a higher proportion of non-knowledge (38.9%) compared to those where the mother is the primary breadwinner (7.6%). This suggests that the role of the household breadwinner may influence the level of awareness and knowledge

about dog vaccination. Men, as primary breadwinners, might face different challenges or prioritize health education differently compared to women, which could affect their knowledge and subsequent vaccination practices. This finding can be contextualized within broader gender and role-based research. Chesley and Flood (2017) highlight how gender roles and time availability influence domestic work and childcare responsibilities. While their study focuses on domestic work, the broader implications for gender roles suggest that traditional expectations of men as primary breadwinners might affect their engagement in health-related education and practices, such as dog vaccination. The pattern observed in our study reflects a similar dynamic where gender roles potentially impact knowledge and practices regarding dog vaccination.

Additionally, Oli et al. (2021) report that in rural communities in Nigeria, men with poor knowledge of routine vaccination (RI) often lack formal education, which correlates with lower uptake of vaccination. This finding underscores the importance of targeted educational interventions for men, particularly in roles that influence household decisions. The poor knowledge observed among men in our study might be similarly influenced by their educational background and the prioritization of health education, reflecting the need for increased awareness and education tailored to their specific roles and responsibilities.

The majority of household heads (85.3%) take their family members to a nearby health facility when bitten by a dog. This indicates a strong reliance on formal medical services for managing dog bites, which aligns with recommended practices for rabies prevention. However, a notable minority (10.4%) seek traditional healers, and a small percentage (1.2%) opt for only pain relief without further medical intervention. The fact that 3.1% of

respondents did not provide a response may indicate a lack of clarity or awareness about the appropriate actions to take, highlighting a potential area for improved public education on rabies management. These observations are consistent with broader research on rabies prevention and management. Dhakal et al. (2023) found that while most respondents in rural Nepal would visit a health facility after a dog bite, a notable percentage also resorted to traditional healers, demonstrating variability in treatment-seeking behaviour. Their study underscores the necessity of educating rural populations on effective rabies control practices and the importance of reporting dog bites and unusual animal behaviour to local authorities. Ngugi et al. (2018) further illustrate that appropriate management of dog bites, including timely PEP, is crucial for rabies prevention. Their research in Kenya indicates that improving public health education and encouraging early initiation of PEP can significantly reduce rabies cases. The high reliance on formal medical services observed in our study aligns with the need for timely and appropriate medical care as emphasized by Ngugi et al. (2018). Kisaka et al. (2020) also emphasize the importance of compliance with pre-clinical management guidelines for dog bites, such as immediate washing of wounds and seeking medical care. Their findings highlight factors associated with poor compliance, including lower education levels and lack of awareness, which can contribute to inadequate management of dog bites and potential rabies risk.

According to key informant interviews, there is a high level of awareness about rabies among the residents of South Mugirango, with 72.7% of key informants reporting that people understand the risks associated with dog bites. This high level of awareness is crucial for effective rabies control, as it provides a foundation for encouraging preventive measures such as vaccination. However, despite this awareness, there are varying levels of knowledge and

practice related to rabies management in different regions. For example, a study in Limpopo National Park, Mozambique, found that both community households and health practitioners had poor knowledge and practices regarding rabies. Only about 20% of households had good knowledge of rabies, and even fewer had appropriate practices, highlighting significant gaps in understanding and implementation of rabies control measures (Mapatse et al., 2022). Similarly, research conducted in Laikipia County, Kenya, revealed that delays in seeking postexposure prophylaxis (PEP) and challenges in accessing vaccines contributed to increased incidence of rabies. This situation underscores the need for improved public health infrastructure and access to timely medical care for effective rabies prevention (Obonyo et al., 2016). I n Ethiopia, a study in Shone Town identified that while there was general awareness of rabies, significant gaps in knowledge about transmission routes and preventive measures remained. The study found that education level was strongly associated with better knowledge about rabies, emphasizing the role of education in improving public understanding and management of rabies (Beresa et al., 2024).

Despite the high awareness, the level of adherence to dog vaccination is reported to be low. Key informants indicate that 63.6% of the population does not regularly vaccinate their dogs. This discrepancy between awareness and practice suggests that while people may understand the importance of vaccination, barriers exist that prevent consistent adherence. These barriers could include cost, accessibility, or lack of immediate perceived need. In regions with high rabies awareness but low vaccination rates, cost and accessibility frequently emerge as significant barriers. For instance, in Mozambique, the Limpopo National Park area, both community members and health practitioners exhibited poor knowledge and practices concerning rabies control (Mapatse et al., 2022). This gap suggests that even when awareness

is high, practical challenges such as the cost of vaccines and access to veterinary services can impede the implementation of preventive measures. Similar issues are evident in rural areas of Kenya, where delays in receiving postexposure prophylaxis (PEP) reflect the broader challenges of accessing timely medical care (Obonyo et al., 2016). As it is the case in Mozambique and Kenya, in Shone Town, Ethiopia, educational interventions are needed to improve understanding and encourage action towards rabies prevention (Beresa et al., 2024).

Key informants identified several challenges to dog vaccination, including low publicity (27.3%), inadequate funding (13.6%), and issues related to weather conditions and infrastructure. These factors contribute to the low adherence rates and highlight areas where intervention could improve vaccination coverage. Increased public awareness campaigns, better funding for vaccination programs, and improvements in infrastructure could address these challenges and enhance adherence to vaccination. Low publicity can result from a lack of effective communication strategies and insufficient community engagement, which can undermine efforts to promote vaccination and educate dog owners about its importance. Inadequate funding affects the ability to maintain consistent and widespread vaccination efforts, as seen in Tanzania, where high operational costs and a high turnover of the dog population present ongoing challenges (Duamor et al., 2023). Additionally, weather conditions and infrastructure issues complicate the logistics of vaccine delivery, particularly in remote areas where accessibility is limited. In rural communities in Mozambique, for instance, poor infrastructure and low levels of knowledge and practice regarding rabies control further highlight the need for better logistical support and education (Mapatse et al., 2022).

Enhanced public awareness campaigns can help overcome low publicity by increasing community knowledge and engagement, as demonstrated by the positive reception of the community-based continuous mass dog vaccination (CBC-MDV) approach in Tanzania, which successfully integrated community feedback and involvement (Duamor et al., 2023). Improved funding for vaccination programs is crucial to support sustained vaccination coverage and operational costs. Additionally, improving infrastructure and logistical support can help mitigate the effects of adverse weather conditions and ensure consistent vaccine delivery. Combining these strategies can enhance adherence to vaccination programs and improve overall vaccination coverage, ultimately leading to more effective control of rabies.

Most key informants (19 out of 22) reported that people generally go to the hospital when bitten by dogs, reflecting appropriate actions for managing potential rabies exposure. However, the fact that three informants mentioned only administering first aid underscores the need for further education on the importance of comprehensive medical care following dog bites.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions

High level of awareness and adherence to vaccination of dogs are imperative to manage and control the cases of rabies and protecting public health. The increase in infected dog bites since 2016 in Kisii County has contributed to high annual expenditure on post exposure prophylaxis and anti-rabies vaccines for human and also lead to a number of loss of lives. This study was an attempt to explore the level of rabies awareness and the factors influencing the adherence to vaccination of dogs. The summary of study findings are as below:

i. The level of awareness of rabies among house heads in South Mugirango Sub County was high (96.3%) a clear indication that most people residing in this region are aware of rabies.

ii. The levels of adherence to vaccination of dogs against rabies among house heads in South Mugirango sub county was still low (50.7%) which is below the WHO recommendation for vaccination coverage (70%) and to prevent outbreaks. This therefore means that a rabies outbreak within this dog population would be very disastrous.

iii. The house heads' socio-demographic characteristics that were significantly associated with the adherence to vaccination of dogs against rabies in South Mugirango sub county were level of education ($p=0.001$), occupation of the house head ($p=0.005$), and household monthly income ($p=0.000$).

iv. Most (79.3%) households in South Mugirango sub county took a household member to a health facility following a dog bite in regard to control of dog mediated rabies. Consequently, most (89.2%) house heads ended up stating that they referred patients to a health facility in efforts to manage rabies.

6.2 Recommendations

The study gives the following recommendation in an attempt to control and manage rabies' public health and economic effects on the people of South Mugirango, Kisii County:

i. Information regarding rabies and its effects to human health should continuously be disseminated to the people of South Mugirango and the citizens of this country at large to sustain and further increase the levels of awareness regarding rabies.

ii. The leadership of South Mugirango sub county and all partners in health should gear their efforts towards improving the levels of adherence by allocating resources for publicity and mobile vaccination campaigns. Dog owners should also be encouraged to vaccinate their dogs too. Also, sensitization on good animal welfare practices which include providing proper meals for dogs to avoid scavenging and vaccination needs to be enhanced. The county government should increase the number of veterinary officers to be consistently present across the county, and ensure the community is aware of the frequency, location and availability of veterinary services, government sponsored vaccination centres and encourage all residents to report all rabid or suspected rabid cases to the veterinary officers.

iii. To increase vaccination coverage from 50.7% to at least 70%, awareness campaigns should be carried out in schools, churches and through media sources (radio and TV)

to sensitize the community on rabies aetiology, modes of infection, clinical symptoms in man and animals, critical first aid measures and proper health seeking behaviour to be taken in case of a dog bite.

iv. The people of South Mugirango should continuously be informed and sensitized to seek medical help from health facilities in case of dog bite since the disease can cause serious fatalities.

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APPENDICES

Appendix I: Informed consent

INTRODUCTION: My Name **OBARA FANICE KERUBO**. I am a Master of Public Health Student at Kisii University. My Registration Number is Reg: **MHS16/40084/15.** I am currently conducting research in South Mugirango Sub County.

Purpose of the Study: The general objective of this study is to assess the factors influencing awareness and adherence to vaccination of dogs against rabies within households in South Mugirango Sub- County.

Participant selection: I would like to kindly request you to participate in this study. Your participation will help generate new information which may help eradicate rabies in this sub county. Your participation will involve accepting to be interviewed by my research assistant for a period of approximately 20 minutes.

Voluntary Participation: Your Participation is voluntary and information you give will remain confidential and will not be used for any other purpose apart from the purpose of this study.

Consent: I_____ of ID_____ accept to be part of this study.

Signature _____ Date: _____

(Note: Verbal Informed Consent acceptable in the event a participant cannot read and write)

Appendix II: Questionnaire for Quantitative Research

QUESTIONNAIRE FOR RABIES STUDY TO BE ADMINISTERED TO HOUSEHOLD HEADS

QUESTIONAIRE NUMBER: ……...

VILLAGE……...

SUBLOCATION……

WARD/DIVISION/LOCATION……...

SUBCOUNTY……

DATE OF INTERVIEW……...

INTERVIEWER NO: ☐

INSTRUCTIONS

- Fill by writing the appropriate number in the box provided

SOCIO-DEMOGRAPHIC CHARACTERISTICS

1.Sex **(i)** Male ☐

(ii) Female ☐

2.Age

i. Under 25 Years ☐

ii. 25-35 Years ☐

iii. 36-45 Years ☐

iv. Above 46 Years ☐

3. Marital Status

i. Single ☐

ii. Married ☐

iii. Separated ☐

iv. Divorced ☐

v. Any other

4. Education level:

i. Primary ☐

ii. Secondary ☐

iii. Tertiary ☐

iv. Non formal education ☐

v. Others, specify ☐

5. Occupation

i. House wife ☐

ii. Self employed ☐

iii. Formally employed ☐

iv. Others specify ☐

6. Average household income in Kshs.5000 and Above

i. 5001-10,000 ☐

ii. 15,001-20,000 ☐

iii. 20,001-25,000 ☐

iv. 25,000-30,000 ☐

v. Above 30,000 ☐

8. How many children have you given birth to? I. ☐ ii. ☐ iii. ☐ iv. ☐ v. ☐

6. Over 6

9. Religion of respondent

i. Christian ☐

ii. Muslim ☐

iii. Hindu ☐

iv. Others specify ☐

10. Who is the breadwinner in the house?

i. Father ☐

ii. Mother ☐

iii. Other specify ☐

11.Do you keep dogs in your household?

i.Yes ☐

ii.No ☐

12.If yes in question 10 above, how many dogs do you have?

i. 1-2

ii. 2-4

iii. Others specify

13 Have you heard of Rabies?

i. Yes ☐

ii. No ☐

14. What causes Rabies?

i. Virus ☐

ii. Others specify

15.Can donkeys cats and any other pets cause rabies?

i. Yes

ii. No

iii. Others specify

16. How is rabies spread?

i. Bite from man infected animal.

ii. Scratch from infected animal

iii. Through infected saliva

iv. Others, specify

17.Has any of your household members been bitten by a dog.

i. Yes

ii. No

18.If yes in question 17, what action did you take?

i. Take the patient to traditional healers.

ii. Take the person to the nearby facility

iii. Others, specify

19.If someone has been infected with rabies how do you usually manage the condition

i. we refer the patient to the facility

ii. Take

iii. the patient top traditional healers

iv. Others specify

20. Do you vaccinate your dogs?

i. Yes ☐

ii No. ☐

21 If Yes, how often do you vaccinate your dogs?

i. Once in a year ☐

ii. Twice in a year ☐

iii. Others specify ☐

---

22. If yes in question 20, what motivates you to ensure that your dogs are vaccinated regularly.?

i. Availability of vaccination service every year ☐

ii. Availability of antirabies vaccine at a cheaper price for dogs ☐

iii. Fear of previous exposure of having seen a patient with signs and symptoms ☐

iv. Availability of service in a nearby market centre/school ☐

v. Others, specify ☐

23. If, No in question 20 Why have you not vaccinated your dogs?

i. Not aware if they supposed to be vaccinated ☐

ii. Domesticated dogs do not have diseases ☐

iii. Veterinary have not taken the vaccination service. ☐

iv. Do not know where to obtain the service ☐

v. Inability to pay for the rabies vaccine ☐

vi. Others, specify ☐

24.What challenges are associated with vaccination of your dog?

i. Inability to transport dog to vaccination site ☐

ii. Sometimes failing to know vaccination dates ☐

iii. Do rely on vaccination campaign. ☐

iv. Others specify ☐

25.Is the antirabies vaccine for human available in the nearby health facility?

i. Yes ☐

ii. No ☐

26.. If yes, how much does it cost?

i. Kshs 800 ☐

ii. Kshs 1000 ☐

iii. Kshs 20000 ☐

iv. Others, Specify. ☐

27. Which challenges do you face in management of a person with dog bites due to infected dogs

i. Lack of antirabies in a nearby facility ☐

ii. High cost of antirabies for human ☐

iii. Inability to recognize signs/symptoms ☐

iv. Others, Specify.? ☐

28.What are the key signs that can be observed in individuals infected with rabies?

i. Flue like symptoms, fever, muscle weakness, tingling sensation ☐

ii. Biting behaviour ☐

iii. Barking like a dog ☐

iv. Fear of water ☐

v. Others, Specify ☐

29.What are the main sources of rabies to humans?

i. Dogs ☐

ii. Cats ☐

iii. Others specify ☐

30.How do you deduce as to whether a vector (dog) is infected by rabies (checking signs?)

i. Dog licking, biting or chewing at areas of infectious bite ☐

ii. Restlessness, dilated pupil. ☐

iii. Foaming at the mouth, jaws open ☐

iv. Hiding in dark places/loitering ☐

v. Others, specify ☐

Appendix III: Key Informant Interview Question Guide

INSTRUCTIONS

- Tick in the appropriate box provided.
- The information obtained is for learning purposes.

1. What is the level of dog bites cases in this area?
2. In what form is rabies most transmitted in this area?
3. What do most people do when bitten by dogs?
4. Is the public in this sub county aware of rabies as a zoonotic disease?
5. If yes in question 4, Do they know the importance of vaccinating their dogs against rabies?
6. What do you think can be done to increase level of awareness of rabies in this community?
7. Are dogs in South Mugirango Sub County vaccinated against rabies?
8. If yes in question 6, Give a score in a scale of 1 to 10.
9. Give a reason for the score
10. Is your office mandated to roll out Mass dog vaccination programs in this sub county?
11. If yes how often do you vaccinate dogs?
12. What challenges do you face before and during rolling out a mass dog vaccination program?
13. What do you do to control the dog's populations?
14. Is the Antirabies for dogs available?
15. If yes in question 14, how much does it cost?
16. Is the antirabies vaccine for human available in the nearby facility?
17. If yes in question 16, what is the cost?

Appendix IV: Ethical Clearance Certification

OFFICE OF THE DIRECTOR OF GRADUATE STUDIES AND RESEARCH

UNIVERSITY OF EASTERN AFRICA, BARATON

P. O. Box 2500-30100, Eldoret, Kenya, East Africa

January 16, 2019

Obara Fanice Kerubo
School of Health Sciences
Kisii University

Dear Obaro,

Re: ETHICS CLEARANCE FOR THESIS PROPOSAL (REC: UEAB/09/01/2019)

Your master thesis proposal entitled "***Factors Influencing Immunization of Dogs against Rabies among Household heads in South Mugirago Sub-County –Kisii County Kenya***" was discussed by the Research Ethics Committee (REC) of the University and your request for ethics clearance was granted approval.

This approval is for one year effective January 16, 2019 until January 15, 2020. For any extension beyond this time period, you will need to apply to this committee one month prior to expiry date.

Note that you will need a research permit from the National Commission for Science, Technology, and Innovation (NACOSTI) and clearance from the study site before you start gathering your data.

We wish you success in your research.

Sincerely yours,

University of Eastern Africa
16 JAN 2019
P. O. Box 2500-30100, ELDORET
Research Ethics Committee

Prof Jackie K. Obey, PhD
Chairperson, Research Ethics Committee

A SEVENTH-DAY ADVENTIST INSTITUTION OF HIGHER LEARNING
CHARTERED 1991

Appendix V: Introductory Letter to NACOSTI

KISII UNIVERSITY

Telephone: +254 773452323
Facsimile: +254 020 2491131
Email: research@kisiiuniversity.ac.ke

P O BOX 408 – 40200
KISII
www.kisiiuniversity.ac.ke

OFFICE OF THE REGISTRAR RESEARCH AND EXTENSION

KSU/R&E/ 03/5/vol.1/197 **Date:** 23rd November, 2018

The Head, Research Coordination
National Council for Science, Technology and Innovation (NACOSTI)
Utalii House, 8th Floor, Uhuru Highway
P. O. Box 30623 – 00100
NAIROBI – KENYA.

Dear Sir/Madam

RE: OBARA FANICE KERUBO REG. NO. MHS16/400084/15

The above mentioned is a student of Kisii University currently pursuing Masters Degree in Public Health in the School of Health Sciences. The topic of her research is, ***"Factors Influencing Immunization of Dogs against Rabies among Household Heads in South Mugirango Sub-County – Kisii County; Kenya".***

We are kindly requesting for assistance in acquiring a research permit to enable her carry out the research.

Thank you.

KISII UNIVERSITY
23 NOV 2018
REGISTRAR RESEARCH & EXTENSION

Prof. Anakalo Shitandi, PhD
Registrar, Research and Extension
Cc: DVC (ASA)
Registrar (AA)
Director SPGS

AS/mm

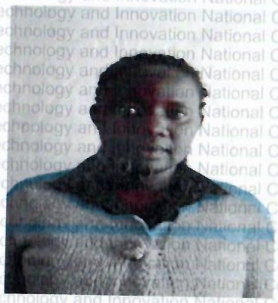
Appendix VI: NACOSTI Clearance Certification

THIS IS TO CERTIFY THAT:
MISS. FANICE KERUBO OBARA
of KISII UNNIVERSITY, 2428-40200
KISII,has been permitted to conduct
research in *Kisii County*

on the topic: *FACTORS INFLUENCING IMMUNIZATION OF DOGS AGAINST RABIES AMONG HOUSEHOLD HEADS IN SOUTH MUGIRAGO SUB-COUNTY-KISII COUNTY; KENYA*

for the period ending:
23rd July,2020

Permit No : NACOSTI/P/19/86707/29063
Date Of Issue : 24th July,2019
Fee Recieved :Ksh 1000



.....
Applicant's Signature

.....
Director General
National Commission for Science, Technology & Innovation

Appendix VII: Authorization Letter from Medical Services, Public Health and Sanitation, Kisii County

KISII COUNTY GOVERNMENT

MEDICAL SERVICES, PUBLIC HEALTH AND SANITATION

Telegramme "Medical"
Telephone: (058) 31249
Email kisiicountypublichealth@gmail.com

When replying please quote:

COUNTY PUBLIC HEALTH OFFICE
KISII COUNTY
P.O.BOX 92
KISII

Ref: No...**KC/PH/TR/VOL 10/2019(09)**

Date: ***26th July, 2019***

TO WHOM IT MAY CONCERN

RE: AUTHORIZATION OF FANICE OBARA TO CONDUCT A RESEARCH STUDY ON FACTORS INFLUENCING IMMUNIZATION OF DOGS AGAINST RABIES AMONG HOUSEHOLD HEADS IN SOUTH MUGIRANGO SUB-COUNTY – KISII COUNTY IN KENYA

Reference is made to the above subject matter.

Having met all the requirements, Fanice Kerubo Obara from Kisii University Reg. No: MHS16/400084/15 is authorized to conduct research in South Mugirango sub-county in Kisii County within one year from the date of this letter.

The study will be carried out subject to adherence to the laid down procedures. The research should observe confidentiality of study subjects and should only be used for study purposes.

Study times exceeding one (1) year shall require a renewal of approval application that will include an annual progress report.

Kindly accord her any support that she requires that fall within the scope of this study.

KISII COUNTY GOVERNMENT
P. O. Box 92, 40200, KISII
DEPUTY COUNTY STUDENTS CO-ORDINATOR

NICKSON OGUGU
FOR: COUNTY PUBLIC HEALTH OFFICER
KISII COUNTY

Appendix VIII: Gantt Chart Schedule for Research Activity 2018/2026

	Time/period								
Activity	**May 2018**	**June 2018**	**July-Dec 2018**	**Jan-Nov 2019**	**Dec 2019**	**2020 - 2021**	**2023**	**2024 - 2025**	**2026**
Research topic selection									
Research Proposal concept Development									
Research Concept Presentation									
Literature Review									
Research Proposal Development									
Research Proposal Presentation									
Ethical Approval									
Data Collection									
Data Entry and Analysis									
Thesis Writing Methodology &results Thesis writing discussion and conclusion									
Development of manuscript									
Manuscript paper review & Publishing of paper									
Result presentation									
Thesis submission to graduate school									
Thesis review									
Defence									
Report writing & submission of thesis.									

Appendix IX: Tentative Research Budget

No	Proposed Activities	Item Description	Unit	pax	Rate	Frequency	Total
1.	Project proposal development	Printing	50	8	10	4	16,000
		Reproduction	50	8	5	4	8,000
		Binding	1	8	100	4	3,200
		Library charges	1	1	150	20	3,000
		Internet charges	1	2	3000	3	9,000
2	Ethical clearance	Nacosti clearance	1		7000		7,000
3	Data collection	Questionnaire printing and reproduction	5	422	15	1	31,650
		Printing and reproduction of interviewer schedule	2	22	15	1	660
		Research assistants	5	1	1000	5	25,000
		Coordination airtime	1	1	1000	1	1,000
4	Data collation,validation and analysis	Data entry assistant	1	1	1000	3	3,000
		Data analysis	1	1	1000	5	5,000
		Internet services	1	1	5000	1	5,000
		Airtime	1	1	1000	1	1,000
5	Thesis development	Printing	50	2	20	3	6000
		Reproduction	50	2	5	3	1500
		Binding	1	2	150	3	900
		Internet services	1	1	2000	1	2000
		Publishing costs	1	1	20,000	1	20,000
						Sum total	148910
Grand Total			**10%miscellaneous**				**14,891**
			Total				**163801**

Appendix X: Publications

Article

PAMJ One Health

Research

Assessment of household head practices for the control of dog-mediated rabies in South Mugirango sub-County

Fanice Kerubo Obara, Eric Omori Omwenga, Japheth Nzioki Mativo, Lameck Ondieki Agasa

Corresponding author: Fanice Kerubo Obara, Department of Public Health, Kisii University. P.O. Box 408-40200 Kisii, Kenya. fanice.kerubo2@gmail.com

Received: 06 Nov 2024 - **Accepted:** 23 Feb 2025 - **Published:** 28 Mar 2025

Keywords: Rabies, dog vaccination, household practices, awareness, vaccination challenges

Cite this article: Fanice Kerubo Obara et al. Assessment of household head practices for the control of dog-mediated rabies in South Mugirango sub-County. PAMJ-One Health. 2025;16(9). 10.11604/pamj-oh.2025.16.9.45843

Available online at: https://www.one-health.panafrican-med-journal.com/content/article/16/9/full

Assessment of household head practices for the control of dog-mediated rabies in South Mugirango sub-County

Fanice Kerubo Obara[1,&], Eric Omori Omwenga[2], Japheth Nzioki Mativo[3], Lameck Ondieki Agasa[4]

[1]Department of Public Health, Kisii University. P.O. Box 408-40200 Kisii, Kenya, [2]Department of Medical Microbiology and Parasitology, Kisii University. P.O. Box 408-40200 Kisii, Kenya, [3]School of Nursing, Andrews University 8975 Old 31, Berrien Springs, MI 49104-United States, [4]Department of Community Health and Behavioral Sciences, Kisii University, P.O Box 408-40200, Kisii, Kenya

[&]**Corresponding author**

Fanice Kerubo Obara, Department of Public Health, Kisii University. P.O. Box 408-40200 Kisii, Kenya

PLOS Global Public Health

RESEARCH ARTICLE

Factors influencing vaccination of dogs against rabies in South Mugirango Sub-County-Kisii County; Kenya

Fanice Kerubo Obara[1*], **Eric Omori Omwenga**[2], **Japheth Mativo Nzioki**[3], **Lameck Ondieki Agasa**[4]

1 Department of Public Health, Kisii University, Kisii, Kenya, **2** Department of Medical Microbiology and Parasitology, Kisii University, Kisii, Kenya, **3** School of Nursing, Andrews University Berrien Springs, United States of America, **4** Department of Community Health and Behavioural Sciences, Kisii University, Kisii, Kenya

* fanice.kerubo2@gmail.com

OPEN ACCESS

Citation: Obara FK, Omwenga EO, Mativo JN, Agasa LO (2025) Factors Influencing Vaccination of Dogs against Rabies in South Mugirango Sub-County-Kisii County; Kenya. PLOS Glob Public Health 5(5): e0004194. https://doi.org/10.1371/journal.pgph.0004194

Editor: Sukanta Chowdury, ICDDR B: International Centre for Diarrhoeal Disease Research Bangladesh, BANGLADESH

Received: October 17, 2024

Accepted: March 23, 2025

Published: May 9, 2025

Peer Review History: PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: https://doi.org/10.1371/journal.pgph.0004194

Abstract

Rabies is a fatal zoonotic viral disease affecting all warm-blooded mammals, with approximately 99% of human cases resulting from bites by infected dogs. This study assessed the factors influencing dog vaccination against rabies in South Mugirango, Kisii County, Kenya, where the disease remains endemic and a major public health concern. A quantitative descriptive cross-sectional survey was conducted, utilizing structured questionnaires administered to 422 household heads. Additionally, 22 key informant interviews were carried out with officials from relevant government departments to gain deeper insights. This was a mixed method study involving both a cross sectional survey and qualitative data collection. Data were analyzed using appropriate statistical techniques to identify patterns and determine associations between socio-demographic factors and vaccination practices. Socio-demographic factors significantly associated with rabies awareness included marital status ($p = 0.049$), occupation ($p = 0.029$ for housewives), and the gender of the household breadwinner ($p = 0.017$ for males). Despite high awareness levels, 4.1% (17/422) of respondents had not vaccinated their dogs in the past year, and only 15.9% (67/422) reported recent vaccinations. Older individuals were 12% more likely to vaccinate their dogs per year of age (OR = 1.12, $p = 0.002$). Higher education (OR = 1.45, $p = 0.010$), income (OR = 1.20, $p = 0.008$), rabies awareness (OR = 2.30, $p < 0.001$), and access to veterinary services (OR = 1.75, $p < 0.001$) significantly improved adherence. Despite high awareness, dog vaccination rates in South Mugirango remain low, highlighting the need for targeted interventions. Expanding access to veterinary services, subsidizing vaccines, and prioritizing outreach to younger individuals, less-educated and female-headed households can improve vaccination adherence and reduce rabies transmission.

Appendix XI: Plagiarism Report

School Of Postgraduate

FACTORS INFLUENCING VACCINATION OF DOGS AGAINST RABIES WITHIN HOUSEHOLDS IN SOUTH MUGIRAGO SUB-C...

FACTORS INFLUENCING VACCINATION OF DOGS AGAINST RABIES WITHIN HOUSEHOLDS IN SOUTH MUGIRAGO SUB-COUNTY-KISII COU...

Postgraduate

Kisii University

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