RABIES IN TWO COMMUNITIES OF ETHEKWINI DISTRICT, KWAZULU-NATAL PROVINCE, SOUTH AFRICA: KNOWLEDGE, ATTITUDE AND PRACTICE (KAP).

BY

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DEDICATION

I would like to dedicate this dissertation to my family for their immeasurable support while I pursued my studies.

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DECLARATION

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Exactly wording of the title of the thesis as appearing on the electronic copy submitted for examination:

“RABIES IN TWO COMMUNITIES OF ETHEKWINI DISTRICT, KWAZULU-NATAL PROVINCE, SOUTH AFRICA: KNOWLEDGE, ATTITUDE AND PRACTICE (KAP)”.

I declare that the above dissertation is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete reference.

I further declare that I submitted the dissertation to originality checking software and that it falls within the accepted requirements for originality.

I further declare that I have not previously submitted this work, or part of it, for examination at UNISA for another qualification or at any other higher education institution.

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PUBLICATIONS

a) Abstracts from this Dissertation presented at conferences.

1. **Mohube Titus Letsoalo**, Daniel Nenene Qekwana, Christian. A. Mbajiorgu, James Wabwire Oguttu. Knowledge and attitude towards rabies disease among residents of two communities of eThekwini District, KwaZulu-Natal province, South Africa. Warm Bath, "18th Annual SASVEPM Congress", 2021/08/26 (Oral presentation).
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3. **Mohube Titus Letsoalo**, Daniel Nenene Qekwana, Christian. A. Mbajiorgu, James Wabwire Oguttu. Knowledge and attitude towards rabies disease among residents of two communities of eThekwini District, KwaZulu-Natal province, South Africa. Durban, "14th SAAAHT National Congress", 2022/05/24 (Oral presentation).

b) Full article from the Dissertation under peer review

1. **Mohube Titus Letsoalo**, Daniel Nenene Qekwana, Christian. A. Mbajiorgu, Ishmael Festus Jaja, James Wabwire Oguttu *(Under review)*. Knowledge, attitude and practices towards rabies: A community survey in selected areas of KwaZulu-Natal Province, South Africa. *PLoS Neglected Tropical Diseases*

ABSTRACT

Background: Despite the important role dogs play in society, they are vectors of rabies and as a result they can be a danger to human beings. People who lack knowledge of the disease are at higher risk of contracting the disease and even dying from rabies. Recent reports show a rise in canine rabies cases in the province of KwaZulu-Natal compared to other provinces in South Africa. This study investigated knowledge, attitude and practices regarding rabies in two selected communities in eThekwini, KwaZulu-Natal, South Africa.

Methods: A prospective cross-sectional questionnaire-based study design was adopted for this study. Systematic random sampling was employed to select respondents ≥18 years (n = 768). Data was captured in Microsoft Excel 365. Proportions and their 95% confidence intervals were computed for categorical variables. A logistic regression model was used to investigate factors that predict knowledge of rabies as the outcome. Statistical significance was set at $\alpha < 0.05$.

Results: The majority of respondents (79.04%, n = 607) were of the view that receiving an anti-rabies injection was important. Equally, a very high percentage of respondents (78.26%, n = 601) indicated that they would seek medical attention immediately after being bitten by a suspected rabid dog. In addition, just over half (52.47%, n = 403) of the respondents said they would quarantine a dog that had bitten someone. On the contrary, a small percentage of the respondents (23.83%, n = 183) said that they would not take any action regarding the dog. A very low number (34.51%, n = 265) did not think it would be appropriate to put down a suspected rabid dog. Pet ownership was the only factor that was a significant ($p < 0.05$) predictor of a high knowledge score for rabies disease, with people who owned pets twice as likely to obtain a high knowledge score for rabies compared to those who did not own pets.

Conclusion: The study identified gaps in the knowledge of rabies in the study population. Socio-demographic characteristics of the respondents were identified that predict a high knowledge score for rabies. Therefore, educational programmes for the control of canine rabies must take into consideration the identified socio-demographic characteristics of community members.

Key words: Anti-rabies, pet ownership, rabies awareness, rabies cases, rabies prevention.

SETSOPOLWA

Tshedimošo ya mathomong: Ka ntle le tema ye bohlokwa yeo e kgathwago ke dimpša setšhabeng, ke tšona di fetetšago ka bogaswi bja dimpša gomme ka lebaka leo bo ka ba kotsing go batho. Batho bao ba hlokago tsebo ka ga bolwetši bjo ba kotsing ye kgolo kudu ya go fetelwa ke bolwetši bjo le go hlokofala ka lebaka la bogaswi bja dimpša. Dipego tše di sa tšwago go dirwa di laetša go hlatloga ga ditiragalo tša bogaswi bja dimpša ka phrobentsheng ya KwaZulu-Natal ge go bapetšwa le diphrobentshe tše dingwe ka Afrika Borwa. Dinyakišišo tše di nyakišišitše tsebo, maikutlo le ditiro mabapi le bogaswi bja dimpša ka ditšhabeng tše pedi tše di kgethilwego ka eThekwini, KwaZulu-Natal, ka Afrika Borwa.

Mekgwa: Tlhamo ya dinyakišišo ya dipotšišonyakišišo tša makala a mantši e dirišitšwe ka mo dinyakišišong. Go dira sampole ka sewelo go dirišitšwe go kgetha baarabi ba mengwaga ye ≥18 (n = 768). Tshedimošo e kgobokeditšwe ka Microsoft Excel 365. Dipalogare le dikgoba tša tšona tša boitshepo tša 95% di ile tša tsenywa ka gare ga khomphutha go dira dipharologantši tša magoro. Mokgwa wa tatelano wa poelamorago o šomišitšwe go nyakišiša dintlha tše di akanyago tsebo ka ga bogaswi bja dimpša bjalo ka poelo. Bohlokwa bja dipalopalo bo dirilwe go $\alpha < 0.05$.

Dipoelo: Bontši bja baarabi (79.04%, n = 607) ba be ba na le maikutlo a gore go hlabja ka tšhwana ya moento wa twantšho ya bogaswi bja dimpša go bohlokwa. Go swana le se, palo ya godimo kudu ya baarabi (78.26%, n = 601) e laeditše gore ba tla nyaka šedi ya tša kalafo ka pela ka morago ga go longwa ke mpša ye go belaelwago gore e fetetšwe ke bogaswi bja dimpša. Godimo ga fao, tekano ya go feta (52.47%, n = 403) ya baarabi e boletše gore e tla beela thoko mpša yeo e lomilego motho. Go fapana le se, persente ye nnyane ya baarabi (23.83%, n = 183) e boletše gore e ka se dire selo mabapi le mpša yeo. Palo ya fase kudu (34.51%, n = 265) ga e nagane gore go ka ba maleba go bolaya mpša ye go belaelwago gore e fetetšwe ke bogaswi bja dimpša. Go ba le diruiwa tša ka ntlong e bile yona ntlha yeo e bilego bohlokwa ($p < 0.05$) ya kakanyo ya ntlha ya godimo ya tsebo ya bogaswi bja dimpša, fao e lego gore batho bao ba nago le diruiwa tša ka ntlong go ba le kgonagalo gabedi ya gore ba ka hwetša ntlha ya godimo ya tsebo ya bogaswi bja dimpša ge go bapetšwa le bao ba se nago le diruiwa tša ka ntlong.

Mafetšo: Dinyakišišo di hlathile dikgoba ka go tsebo ya bogaswi bja dimpša ka go batho bao go bego go dirwa dinyakišišo go bona. Sebopego sa seemo sa setšhaba

sa baarabi se ile sa hlathwa gomme sona se akantše ntlha ya godimo ya tsebo ya bogaswi bja dimpša. Ka fao, mananeo a thuto a taolo ya bogaswi bja dimpša a swanetše go hlokomela sebopego sa seemo sa setšhaba seo se hlathilwego sa maloko a setšhaba.

Mantšu a bohlokwa: Mananeo a twantšho ya bogaswi bja dimpša, beng ba diruiwa tša ka ntlong, temošo ka ga bogaswi bja dimpša, ditiragalo tša bogaswi bja dimpša, thibelo ya bogaswi bja dimpša.

ISIFINQO

Isendlalelo: Naphezu kweqhaza elibalulekile elibanjwa izinja emphakathini, zingabathwali bamarabi futhi ngenxa yalokho zingaba yingozi kubantu. Abantu abangenalo ulwazi ngalesi sifo basengcupheni enkulu yokuthola lesi sifo baze babulawe amarabi. Imibiko yakamuva ikhombisa ukukhula kwezibalo zamarabi ekhenayini esifundazweni saKwaZulu-Natal uma kuqhathaniswa nezinye izifundazwe zaseNingizimu Afrika. Lolu cwaningo luphenye ulwazi, isimo sengqondo kanye nemikhuba mayelana namarabi emiphakathini emibili ekhethiwe eThekwini, KwaZulu-Natal, eNingizimu Afrika.

Idizayini yocwaningo ezoba khona esekelwe kuhlu lwemibuzo ehlukene yamukelwe kulolu cwaningo. Ukusampula okungahleliwe nokuhleliwe kwasetshenziswa ukukhetha abaphendulayo ≥ iminyaka eyi-18 (n = 768). Idatha eqoshwe nge-Microsoft Excel 365. Izilinganiso kanye nezikhawu zazo zokuzethemba ezingama-95% zenziwe ikhompuyutha eziguquguqukayo zezigaba. Imodeli yokuhlehla kwempahla yasetshenziswa ukuze kuphenywe izici ezibikezela ulwazi lwamarabi

Imiphumela: Iningi labaphendulile (79.04%, n = 607) lalinombono wokuthi ukuthola umjovo wokulwa namarabi kwakubalulekile. Ngokulinganayo, amaphesenti aphezulu kakhulu abaphendulile (78.26%, n = 601) abonise ukuthi azofuna usizo lwezokwelashwa ngokushesha ngemuva kokulunywa inja okusolakala ukuthi inamarabi. Ngaphezu kwalokho, ngaphezudlwana kwengxenye (52.47%, n = 403) yabaphendulile bathi bazovalela inja elume umuntu. Ngokuphambene nalokho, iphesenti elincane labaphendulile (23.83%, n = 183) lathi angeke lithathe noma yisiphi isinyathelo mayelana nenja. Inombolo ephansi kakhulu (34.51%, n = 265) ayizange icabange ukuthi kungaba okufanelekile ukubeka phansi inja okusolakala ukuthi inja enamarabi. Ubunikazi bezilwane yikona kuphela okwakuyisibikezelo esibalulekile ($p < 0.05$) solwazi oluphezulu lwesifo samarabi, esinabantu abanezilwane ezifuywayo okungenzeka ukuthi bathole amaphuzu aphezulu olwazi ngamarabi uma kuqhathaniswa nalabo abangenazo izilwane ezifuywayo.

Isiphetho: Ucwaningo luveze izikhala ezikhona olwazini lwamarabi esibalweni socwaningo. Izici zenhlalo yabantu zabaphenduli zihlonzwe njengezibikezela amaphuzu aphezulu olwazi lwamarabi. Ngakho-ke, izinhlelo zemfundo zokulawula amarabi ekhanayini kufanele zicabangele izici ezihlonziwe zenhlalo yabantu zamalungu omphakathi.

Amagama abalulekile: Ukuhambisani namarabi, ubunikazi bezilwane ezifuywayo, ukuqwashisa ngamarabi, amacala amarabi, ukuvimbela amarabi.

OPSOMMING

Agtergrond: Hoewel honde ’n belangrike rol in die samelewing speel, is hulle draers van hondsdolheid en kan gevolglik gevaar vir mense inhou. Mense wat nie kennis van dié siekte het nie, het ’n hoër risiko om die siekte op te doen en kan selfs sterf weens hondsdolheid. Onlangse verslae toon ’n toename in die aantal gevalle van hondsdolheid in die KwaZulu-Natal-provinsie in vergelyking met ander provinsies in Suid-Afrika. Hierdie studie het kennis, houdings, en praktyke ten opsigte van hondsdolheid in twee gekose gemeenskappe in eThekwini, KwaZulu-Natal, Suid-Afrika ondersoek.

Metodes: ’n Waarskynlike deursneevraelys-gebaseerde studie-ontwerp is vir hierdie studie ingespan. Sistematiese, ewekansige steekproefneming is gebruik om respondente ≥18 jaar (n = 768) te kies. Data is vasgelê in Microsoft Excel 365. Verhoudings en hul 95%-vertrouensintervalle is bereken vir kategoriese veranderlikes. ’n Logistiese-regressie-model is gebruik om faktore te ondersoek wat kennis van hondsdolheid as die uitkoms voorspel. Statistiese beduidendheid is gestel op $\alpha < 0.05$.

Resultate: Die meerderheid van die respondente (79.04%, n = 607) was van mening dat dit belangrik is om ’n inenting teen hondsdolheid te kry. Net so het ’n baie hoë persentasie respondente (78.26%, n = 601) aangedui dat hulle onmiddellik mediese hulp sal soek indien hulle gebyt sou word deur ’n hond wat vermoedelik hondsdolheid het. Daarby het net meer as die helfte (52.47%, n = 403) van die respondente gesê hulle sal ’n hond wat iemand gebyt het, in kwarantyn plaas. Daarenteen het ’n klein persentasie van die respondente (23.83%, n = 183) aangedui dat hulle niks sal doen wat die hond betref nie. ’n Baie lae persentasie (34.51%, n = 265) het gedink dit sou nie gepas wees om ’n hond uit te sit wat vermoedelik dol is nie. Troeteldier-eienaarskap was die enigste faktor wat ’n beduidende ($p < 0.05$) voorspeller van ’n hoë kennistelling vir hondsdolheid was – dit is dubbel so waarskynlik dat mense wat troeteldiere besit ’n hoë kennistelling vir hondsdolheid sal kry, as diegene wat nie troeteldiere het nie.

Gevolgtrekking: Die studie het gapings in die kennis van hondsdolheid onder die studiepopulasie geïdentifiseer. Sosiodemografiese kenmerke van die respondente wat ’n hoë kennistelling vir hondsdolheid voorspel, is geïdentifiseer. Opvoedkundige programme vir die beheer van hondsdolheid moet dus die sosiodemografiese kenmerke wat onder gemeenskapslede geïdentifiseer is, in ag neem.

Sleutelwoorde: Anti-hondsdolheid, troeteldier-eienaarskap, hondsdolheid-bewustheid, hondsdolheid-gevalle, hondsdolheid-voorkoming.

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ABBREVIATIONS

ARV – Anti-rabies vaccine

CI – Confidence interval

CP – Central point

CVR – Capture-vaccinate-release

DD – Door to door

EC – Eastern cape

FAO – Food and agriculture organization of the united nations

FAT – Fluorescent antibody test

GARC – Global alliance for rabies control

GVS – Government veterinary services

KZN – KwaZulu-Natal

KAP – Knowledge, Attitude and Practices

MOKV – Mokola virus

OIE – Office international des epizootic

ORV – Oral rabies vaccination

PEP – Post exposure prophylaxis

SA – South Africa

RABV – Rabies virus

RIG – Rabies immunoglobulin

RNA – Ribonucleic acid

UAR – United against rabies

WHO – World Health Organization

WOAH – World organization for animal health

CHAPTER 1

INTRODUCTION

1.1 Background

Human beings occupy the same space with dogs, and the latter have moreover been regarded for over 10 000 years as the companion to human beings (Wallace *et al.*, 2019). Besides being companions to humans, dogs are helpful as they assist with leading the way for the blind individuals, they also play the role of security guards to the owners and their household. For example, humans use dogs to safe-guard their livestock from theft (Setiawan, 2018; Wallace *et al.*, 2019). However, despite the important role dogs play in society they are vectors of rabies and thus pose a risk to human beings.

Almost all terrestrial warm-blooded species are at risk of contracting rabies (Fazeli *et al.*, 2018). Moreover, rabies has been classified as one of the neglected zoonotic diseases that has 100% fatality rate among humans and animals (Rattanavipapong *et al.*, 2019). In addition, rabies is regarded as one of the deadliest, progressive and grossly fatal infectious disease (Costa *et al.*, 2018; Kadowaki *et al.*, 2018).

Although rabies is preventable through adequate vaccination of the reservoir host (Acharya *et al.*, 2020), once the victims contract the virus and become morbid, they are more likely to succumb to the disease (Costa *et al.*, 2018). This is a result of lack of therapeutic treatment for the disease. In addition, it is usually not possible to reverse harm derived from the virus once it reaches the brain (Fazeli *et al.*, 2018). Therefore, the disease is a major public health concern (Barecha *et al.*, 2017). It is because of this that rabies is listed as a controlled disease in South Africa and it is controlled under Act 35 of 1984, which requires government intervention when cases of the disease emerge (DAFF, 2016).

Dogs and cats are the reservoir hosts and major transmitters of the rabies virus to humans in communities (Setiawan, 2018). Therefore, since dogs and cats share the same space with human beings, they pose the greatest threat of transmitting rabies to humans (Barecha *et al.*, 2017). Other authors have indicated that dogs and cats remain an important source of rabies to humans, because they usually share homes with humans for companionship (Wallace *et al.*, 2019).

Outbreaks of rabies have been reported in the district of eThekwini and the adjacent areas (Weyer *et al.*, 2016; Chambers, 2020). These incidents of rabies cases have resulted in multiple deaths in humans and occur mainly in children within KwaZulu-Natal (KZN) province of South Africa (Hergert, LeRoux and Nel, 2016). According to Hergert and Nel (2013), KZN has recorded more cases of rabies compared to other provinces in South Africa over the past decades. This is because of either failure to implement the right vaccination programme for dogs or failure to follow prescribed laws (Setiawan, 2018). This implies that the impact of rabies will continue to be felt as long as the disease has not been controlled or eradicated.

The management of rabies in animals usually relies on mass vaccination campaigns (Adomako *et al.*, 2018). It is therefore important that animals remain vaccinated at all times. However, the problem associated with vaccination of the domestic dogs and cats is that, there are people who cannot afford the cost of the rabies vaccine for their animals and as a result depend on the mass vaccination campaigns organised by the government department (Zinsstag *et al.*, 2017). This implies that if on the day the free government vaccination campaign is run, such owners are not available, their animals are likely to remain unvaccinated (Hergert, LeRoux and Nel, 2016) . This therefore poses a threat to the animals and human beings, should they get in contact with the saliva of exposed animals that are unvaccinated (Lavan *et al.*, 2017). As a result, the risk of spread of rabies in communities by animals that are carrying the rabies virus is high (Mbilo *et al.*, 2019). Unfortunately, individuals who are not aware of the effect of rabies are likely not to look for other means to get their animals vaccinated, which is a constraint to rabies prevention (Mbilo *et al.*, 2019).

Awareness of rabies is critical for better management of the disease. However, knowledge of how rabies affects people in communities, and how it can be prevented or controlled is very limited (Wasay *et al.*, 2012). This usually results in failure to apply the correct measures regarding rabies (Mbilo *et al.*, 2019). The implication of such failure is the spread of rabies in the communities (Lavan *et al.*, 2017). In Texas, USA, It was observed that community members lacked the necessary knowledge on the prevention and transmission of rabies (Sparkes *et al.*, 2017). For example, the household survey done in the same area of Texas, showed that up to 98% of respondents had heard about rabies, but out of the same number only 59% knew that rabies is fatal if the treatment is not sought following exposure to the virus (Sparkes *et*

al., 2017). From this it can be concluded that even if rabies is prevalent in an area, it does not translate into knowledge amongst the community members.

In eThekwini, cases of rabies death have consistently been reported over the years (Chambers, 2020). However, there is no record of data on studies conducted to determine the drivers of rabies. In view of this, it is important conduct a study that investigates contributors to the rise in number of cases of rabies in the area (Tiwari *et al.*, 2019).

Knowledge, attitude and practice (KAP) studies are useful to determine the gaps about rabies within the areas of concern (Abdela *et al.*, 2017; Pal *et al.*, 2021). Moreover, such information is useful for combating rabies (Pal *et al.*, 2021). The relationship between humans and dogs, and the understanding and perception of rabies by humans needs to be known if measures to control rabies are to be effective (Ehimiyein and Ehimiyein, 2014). Therefore, the proposed study aims to investigate the knowledge and attitude towards rabies and related practices within two communities (Embo and Verulam) of eThekwini District in KZN province of South Africa.

1.2 Problem statement

Despite effort to control rabies in KZN, the disease incidence has been on the increase. It is probable that factors such as poor awareness, attitude and practices among members of the communities in the province contribute to the burden of the disease in the province. It has been reported that some populations are at a higher risk of falling victim to rabies due to inadequate knowledge (Wasay *et al.*, 2012). This is because of the failure to appreciate the risk involved when one does not vaccinate their pets against rabies and/or the follow up measures needed to prevent fatalities following exposure to rabies. Some animal owners may perceive their animals as not being suitable for vaccination based on their age and therefore do not present them for vaccination as reported elsewhere (Morters *et al.*, 2015). There is a dearth of studies that have investigated the knowledge, attitude and practices in communities of eThekwini District. This study therefore elucidates the KAP in two communities of eThekwini District in KZN province of South Africa. Findings of this study can be used by responsible authorities to design policies and intervention strategies to help curb rabies that continues to be a public health problem in the study area despite the ongoing rabies eradication campaigns.

1.3 Aim, objectives and research questions

1.3.1 Aim

The study assessed the knowledge of and attitude towards rabies disease and also investigated practices associated with rabies among members of two communities (Embo and Verulam) in eThekwini District, KZN, South Africa.

1.3.2 Objectives

a) To establish the level of knowledge on rabies among community members of selected communities (Embo and Verulam).
b) To assess the attitude and practices related to rabies management among community members of selected communities (Embo and Verulam),
c) To investigate the factors that are correlated with the level of knowledge of rabies among residents of Embo and Verulam in eThekwini District.

1.3.3 Research questions

The study answered the following questions:

a) What is the level of the knowledge of rabies in the study area?
b) Have the residents of selected communities of KZN adopted positive attitude and practices towards rabies?
c) Which factors are significantly correlated with knowledge of the disease rabies in the study area?

1.4 Significance of study:

The present study identified the factors that are significantly correlated with rabies and describes for the first time the level of knowledge of rabies among residents of the study areas. Results obtained from the present study can be used by policy makers to design policies that can help reduce the number of fatalities associated with rabies in humans and also lead to improved control of the disease in the study area. The information generated in this study can be used by the Department of Agriculture and Rural Development (DARD), especially the Veterinary services in eThekwini District to develop strategies to better disseminate information about rabies and engage with the community in order to facilitate behavioural change for disease control.

CHAPTER 2

LITERATURE REVIEW

2.1 OVERVIEW OF RABIES

This chapter provides an overview of rabies. The chapter discusses the cause of rabies, its symptoms, how it is diagnosed and controlled or prevented. It focuses on the epidemiology of rabies with specific reference to the burden of the disease globally, and locally in South Africa.

2.1.1 Aetiology of rabies

Rabies is a viral disease caused by a bullet-shaped, single-stranded RNA virus that belongs to the *Rhabdoviridae* family (Costa *et al.*, 2018). The *Rhabdoviridae* family belongs to the group of Lyssaviruses characterised by classical rabies virus (genotype 1) and other six rabies related viruses namely; Lagos bat virus (genotype 2), Mokola virus (genotype 3), Duvenhage virus (genotype 4), European bat lyssavirus 1 (genotype 5), European bat lyssavirus 2 (genotype 6) and Australian bat virus (genotype 7). Of these rabies-related viruses, genotype 2, 3 and 4 have been isolated in South Africa (Bishop *et al.*, 2010; Ajoke, Solomon and Ikhide, 2014).

Animals and man get infected when they are exposed to the virus following a bite or scratch from a rabid animal (Tschopp, Bekele and Aseffa, 2016). The rabies virus is invasive and able to circulate in the cells of all warm-blooded animals (Dubey *et al.*, 2022). Once the virus parasitizes the host, it exerts an impact and causes pathology (Fazeli *et al.*, 2018). This is because the virus multiplies in the host after entry and replicates itself and thus able to attack the body and result in rabies disease.

The Lyssavirus virus is able to survive in all warm blooded hosts. However, it is sensitive to factors such as; heat at 60 °C for five minutes, sunlight, ultraviolet irradiation, lipid solvent (70% alcohol and ether), sodium deoxycholate, trypsin and common detergents (Ehimiyein and Ehimiyein, 2014).

2.1.2 Pathogenesis and symptoms of rabies

Although the rabies virus can remain dormant in hosts following exposure (Ehimiyein and Ehimiyein, 2014), most cases of rabies lead to the death of infected host be it animal or humans (Dubey *et al.*, 2022). However, there are animals that are likely to remain apparently healthy without showing signs, while they carry the virus. This may be due to the stages that the virus undergoes to develop into a disease following

infection. Therefore, while some other animals take a short period to develop the disease, others may take a longer period to show the signs of the disease.

In humans, adults and children are equally susceptible to the infective lyssavirus. However, children are usually the most common victims of rabies disease, especially those under the age of 15 (Bailey *et al.*, 2018). Children are frequent victims of dog bites because they are young, like playing with dogs and are not able to defend themselves when attacked. In addition, their size makes it easy for the animal to bite them on the face or head, leading to a short incubation period and death thereafter due to the closeness of the bite to the central nervous system (brain) (Bailey *et al.*, 2018; Ngugi *et al.*, 2018). Therefore, following exposure to the virus, adults usually take longer to show clinical signs as compared to children (Ehimiyein and Ehimiyein, 2014).

The most common route by which the rabies virus (RABV) is introduced to the body is puncture of the skin, such as laceration to the skin and also through the mucous membranes. The latter happens, when the virus comes in contact with the eye, mouth, anus and vagina (Fazeli *et al.*, 2018).

Before the virus finds its way to the brain and spinal cord, there is usually a local viral proliferation at the entry site on the non-neural tissue and then pass through to the peripheral nerve ending, after that the virus attaches to the nerve cell receptors (Bishop *et al.*, 2010; Begeman *et al.*, 2018). The virus is neurotropic and after proliferating in the brain and spinal cord it enters the salivary glands where it can be shed through contact with saliva (Begeman *et al.*, 2018). The infective agent is also reported to be able to enter the host via ingestion, trans-placental and trans-mammary routes (Ehimiyein and Ehimiyein, 2014). The virus has an affinity for the central nervous system and the ability to alter the normal demeanour of the host when it penetrates the brain (Begeman *et al.*, 2018). After the virus reaches the salivary glands, the virus is then able to be shed to other hosts.

Human beings usually experience an abnormal sensation on the wound following the bite from dogs (Begeman *et al.*, 2018). Humans usually suffer from dog bites as compared to cats (Ngugi *et al.*, 2018). Free-roaming dogs are the major contributor to the rabies cases seen in people (Tiwari *et al.*, 2019).

The virulence of the rabies virus is influenced by the dose of the agent that is deposited into the host (Begeman *et al.*, 2018). The wound site in which the virus has been introduced usually has an influence on whether the incubation period will be shorter or will take a while before clinical signs manifest.

The period that can be differentiated before the appearance of signs in both human beings and animals usually takes about 2 to 10 days (Begeman *et al.*, 2018). However, the virus can remain latent, leading to an extended incubation period of about 31 and 90 days. The longest could be four months (Barecha *et al.*, 2017).

The longer incubation period is associated with bites on the leg or the extremities, whereas short incubation period are associated with close proximity to the brain of bites (Begeman *et al.*, 2018). The shorter period is associated with the entry of the virus with bites from innervated parts of the body such as; the neck, and on the face with bleeding involved in some cases (Barecha *et al.*, 2017). This is also true for human beings (Coetzee *et al.*, 2008). Small breeds of dogs have a shorter incubation period as compared to larger breeds (Ehimiyein and Ehimiyein, 2014).

Rabies has different developmental stages that include; the prodromal, which precedes the furious, and then ends with the dumb and atypical (paralytic) stage (Ehimiyein and Ehimiyein, 2014; Setiawan, 2018). Following infection there is a change in demeanour of the infected animal. For example, docile animals may start to wander around secluding themselves from their usual routine. Whereas aggressive animals will start to behave in a normal way (Ehimiyein and Ehimiyein, 2014). This usually happens after the virus invades the nervous system. One of the symptoms of rabies is related to encephalomyelitis (Kadowaki *et al.*, 2018). This may include unusual signs such as; hallucination whereby the dog may be seen fly-biting, spring on the passing object (Barecha *et al.*, 2017).

In some cases, the bites site is usually itchy and dogs may start to chew on it while hurting itself, the animal becomes uncomfortable being in closed places and the dogs are likely to run away from home for longer periods than anticipated (Barecha *et al.*, 2017). However, this stage is likely to lapse without being noticed by people as it usually takes a short time that may range from few to 36 hours. From there, the animals may enter into an advanced stage of the disease (Barecha *et al.*, 2017).

The signs usually progress to the furious stage, whereby the animals become intense and easily agitated (Barecha *et al.*, 2017; Adomako *et al.*, 2018). In addition, the animals show the sign of hyper-excitability and develop the propensity to attack other animals and biting odd objects (Barecha *et al.*, 2017). These animals may also move away from their home, develop hydrophobia, suffer from depression and display incoordination (Bishop *et al.*, 2010; Barecha *et al.*, 2017).

When exposed animals reach a final stage, muscles become weak and loss of control is evident (Setiawan, 2018). In addition, the lower jaw becomes dispositioned, and this usually leads to difficult swallowing. From then, the salivary glands profusely release the saliva (Bishop *et al.*, 2010; Barecha *et al.*, 2017). After that, the disease progresses to the comatose stage which is followed by death of the host.

2.1.3 Transmission of rabies

The agent of rabies is able to affect the primary hosts that are in turn able to disseminate the disease and infect other susceptible hosts (Costa *et al.*, 2018). The infectious particles of the disease are usually transferred by physical contact from the infected host (Setiawan, 2018). The pathogens requires an intermediate host in order to progress in the environment (Wallace *et al.*, 2019).

Animals that are known to be the reservoir of the virus amongst others are, dogs, bats, cats, and foxes. However, since dogs are implicated in most incidences, they are regarded as the largest vector of the disease to other susceptible hosts, especially to human beings (Laager *et al.*, 2018). In most countries, free-roaming dogs are the major transmitters of rabies to humans. For example, in India 96% of all human rabies fatalities emanates from dogs that move without supervision (Tiwari, *et al.*, 2019).

According to Adomako et al (2018), all biting animals are perceived as possible transmitters of the rabies virus. This is because rabid animals sometimes bite without showing any signs of the disease and therefore are likely to spit the virus in the process. In the early stages of the disease, the animal is likely not to show any signs and tends to bite unsuspecting vulnerable hosts. This is because the animals usually are no longer in their usual behaviour when they are infected with the virus. For example, their brain functioning is deviated and therefore an animal that is known to be friendly usually starts to attack at anything it comes across without being provoked,

and similarly the one that usually attack may become numb, but still attack at an unexpected time.

Dogs, if not vaccinated are potential vectors of rabies. This is because they will have no immunity against the disease. Therefore, they are likely to acquire and pass on the virus to the vulnerable hosts. Most episodes of rabies in humans are dog-bite related (Setiawan, 2018). On the average 96% confirmed cases of human rabies are contracted from dogs (Tiwari *et al.*, 2019). The disease usually develops in dogs and human beings are the accidental host (Begeman *et al.*, 2018).

The spread of rabies is associated with seasons of the year. For example, in the late summer and autumn because of hunger, animals are in pursuit of food, and also this is when the wild animals move in a large scale to mate. As a result, there is an increased risk of animals infecting other hosts (Barecha *et al.*, 2017).

The challenge with the rabies virus is that animals do not develop immunity following infection. In addition, it is unlikely that the animal may shed the disease as a carrier without showing any signs (Bishop *et al.*, 2010). Although all vertebrate animals are at risk of contracting rabies, domestic and wild animals are the major role players in the transmission of rabies among each other and humans (Fazeli *et al.*, 2018).

Humans contract rabies following the exposure to the contaminated particle of the RABV. This may be via direct or indirect routes. In case of direct transmission, the animal charges at a human and inflict a wound on them. While indirect transmission may occur when an individual touches the saliva of an infected animal and later rubs the site of the body with an open wound (Chambers, 2020). This is also confirmed by other authors when they mention that bite or scratches from an infected animal can transmit the disease especially when saliva from infected animal comes into contact with an open wound or any other opening on the body (Tschopp, Bekele and Aseffa, 2016).

2.1.4 Diagnosis of rabies

In case of a dog bite, the dog is considered rabid unless proven to be vaccinated by their vaccination card. Factors such as whether the dog was provoked or unprovoked before such incident are essential during the observation (Hikufe *et al.*, 2019). Clinical history of the dog is important to the veterinary personnel when they assess suspect rabies animals. However, the animals, especially cats, dogs or ferrets should be

isolated and quarantined when such episode occur to observe the changes that may further arise. This usually takes a period of 10 days, counting from the time of the incidence, and this action is usually taken as a precaution, even if the vaccination card is available (Anyiam *et al.*, 2017; Barecha *et al.*, 2017).

While observation of clinical signs on an animal is important to suspect rabies, post-mortem is equally important to confirm the disease (Adomako *et al.*, 2018). Suspected animals are euthanized to extract the brain for autopsy to confirm the disease (Sabeta *et al.*, 2013; Hikufe *et al.*, 2019)

The brain sample is packaged in a leak-proof bottle with glycerol saline inside and marked as a suspect rabies. This goes together with detailed documentation in order to guide the personnel who handle the sample at the laboratory (Barecha *et al.*, 2017). The laboratory results are essential to give a definite diagnosis of the disease (Adomako *et al.*, 2018).

In South Africa, the use of fluorescent antibody test (FAT) to diagnose rabies is standard (Bishop *et al.*, 2010). The hippocampus is the preferred tissue of the brain to demonstrate the presence of negri bodies (Barecha *et al.*, 2017). The light microscope is used to observe the giemsa stained brain smear prepared for immunofluorescence using antirabies fluorescein conjugate to reveal aggregates of the viral negri bodies (Bishop *et al.*, 2010; Barecha *et al.*, 2017).

2.1.5 Treatment, control and prevention of rabies

a) Treatment

There is no effective treatment prescribed for rabies disease in humans, meaning that once one develops the clinical symptoms of the disease, then the end results is likely to be death (Fazeli *et al.*, 2018). However, one can reduce the potency of the virus by adopting non-specific treatment such as firstly washing with soap and running water after coming in contact with contaminated saliva from the reservoir, followed by immediately seeking medical care (Tiwari *et al.*, 2019).

Washing of the wound is imperative and regarded as the first aid measure to flush out some of the virus deposited on the site of the bite (Setiawan, 2018). In addition, iodine and alcohol also serve the purpose of disinfectant when applied on the wound (Setiawan, 2018). This may also prevent sepsis and entry of other opportunist agents (Ngugi *et al.*, 2018; Wallace *et al.*, 2019).

Post exposure prophylaxis (PEP) is used to prophylactically treat human beings in the aftermath of exposure to rabies virus worldwide. This is usually taken after an individual is exposed to the virus to promote a good immune response (Tschopp, Bekele and Aseffa, 2016; O'Brien and Nolan, 2019). The prompt use of PEP significantly reduces the number of fatalities as it prohibits the virus from propagating in the body of the host (Esmaeilzadeh *et al.*, 2017; Costa *et al.*, 2018). However, if one does not use PEP after the exposure, the prognosis is usually drastic.

In humans, rabies exposure is characterised into three categories that determine the possibility of rabies infection (Bishop *et al.*, 2010). In category I, a person does not necessarily require any medical intervention. This when there is no exposure of saliva to the mucous membranes or openings on the skin. Category II: includes people with minor wound from superficial scratches that are unlikely to bleed. To such individuals, only human anti-rabies vaccine is administered. In category III: the person has an open wound from an animal bite or scratch, and the wound is contaminated with saliva that enters the opening on the body, such people are administered with a combination of anti-tetanus, antibiotics and rabies immunoglobulin and vaccine (Bishop *et al.*, 2010).

Children are the frequent victims of rabies, but they can be protected through prompt vaccination (Mbilo *et al.*, 2019). The heightened risk of rabies in children associated with dog bite is due to the fact that they cannot differentiate when the animals behaviour is not friendly (Adomako *et al.*, 2018). Dogs must be seen as a possible threat as long as their status of vaccination is unknown, especially in the rabies endemic areas.

Although rabies is not treatable, pre-exposure immunization for rabies prevention offers protection (Barecha *et al.*, 2017). On the other hand, PEP prevents deaths after exposure to the infective agent (Anyiam *et al.*, 2017). Therefore, the course of the PEP therapy must be consistent until completed for effective results on prevention (Tschopp, Bekele and Aseffa, 2016).

Rabies immunoglobulin (RIG) may also be administered to patients, depending on the severity of the inflicted wounds within the period of 7 days, preferably together with the first dose of PEP (O'Brien and Nolan, 2019). After the exposure to what may be suspected to be rabies virus contaminants, human beings usually obtain various doses of preventive measure (Bishop *et al*., 2010). For example, a person with compromised

immune system, receives a 5-dose regimen of cell culture-derived vaccine together with the rabies immunoglobulin (RIG) from day 0, followed by days 3, 7, 14 and 28. Similarly, a person with a healthy immune system, receives both combined treatments. However, the number of days for the vaccine administration are reduced to days 0, 3, 7 and 14 (Bishop *et al*., 2010). In addition, 2 doses of rabies vaccine are recommended for persons who are previously immunised as a booster on days 0 and 3.

b) Control and prevention of rabies

In 2018, the organisation called United Against Rabies (UAR) in collaboration with four international organisations namely; the World Health Organisation (WHO), the Global Alliance for Rabies Control (GARC), the Food and Agriculture Organization (FAO) of the United Nations, and the World Organisation for Animal Health (WOAH) launched a global strategic plan, to be effective by 2030 as a way to eliminate rabies and end human rabies fatalities that are dog-mediated (Mbilo *et al.*, 2019). However, this can only be realised when all the strategies laid down to control rabies are implemented.

Globally, the key strategic plan for rabies prevention is sustained through mass vaccination of dogs (Mbilo *et al.*, 2019). Annual vaccination of dogs with the suggested 70% coverage rate or higher has the potential to eliminate rabies and also result in less human beings seeking medical attention (Cleaveland and Hampson, 2017; Bailey *et al.*, 2018). However, the recommended protocols must be adhered to in order to produce effective results and prevent death (Bailey *et al.*, 2018).

It is imperative that rabies is eradicated in animals across the world (Kadowaki *et al.*, 2018). This can be done by concerted effort to put the number of rabies cases to zero worldwide. In addition, there should be deliberate effort to ensure that there is no risk of rabies in the world (Zinsstag *et al.*, 2017).

Dog rabies has been eliminated in countries in Europe and North America, continents (Zinsstag *et al.*, 2017). That is, the number of rabies cases has been reduced close to a level were not a single case of the disease is likely to be seen (Zinsstag *et al.*, 2017).

Immunisation of animals gives great result in the fight against rabies disease. Burdon Bailey et al., (2018), are of the view that immunisation of animals is highly impactful in the fight against rabies. Vaccination has been shown to significantly reduce the spread of rabies to the vulnerable host (Mbilo *et al.*, 2019). This is supported by Fazeli et al.,

(2018), who suggested that rabies can be mitigated with robust vaccination programmes.

To prevent rabies in dogs, different vaccination approaches have been suggested. For example, vaccination of animals may be done through door to door (DD), whereby the vaccinator moves around the community asking for dogs to be presented for vaccination. This saves the dog owner effort and time to have to walk long distances to points of vaccination. This contrasts with the central point (CP) vaccination approach that requires the vaccination team to identify a vaccination point to which the owners can bring their dogs for vaccination on the day. This requires the owners to be informed of the campaign before the vaccination takes place. The other approach that is often employed, is the capture-vaccinate-release (CVR) method. Here, a well-equipped team with the necessary skills vaccinates animals that are presented by their owners and use nets on those that are not easy to handle. Another approach involves the use of the oral rabies vaccination (ORV) method. Here, a bait is distributed to either owned or unowned free-roaming dogs (Wallace *et al.*, 2019).

In resource poor communities, it is difficult for dog-owners to vaccinate their animals due to the challenge related to the cost and therefore most dog owners rely only on mass vaccination organised by the state or non-governmental organisations (Zinsstag *et al.*, 2017; Adomako *et al.*, 2018). Although it is recommended that all animals should receive vaccination yearly irrespective of their age (Morters *et al.*, 2015; Sparkes *et al.*, 2017), in resource poor setting it is not possible to meet these targets of vaccinating each animal annually (Morters *et al.*, 2015). For example, in some settings young dogs such as puppies are not presented for vaccination (Morters *et al.*, 2015). This therefore hinders efforts aimed at achieving the prescribed coverage for rabies prevention programmes (Setiawan, 2018).

The other reason is that owners at times cannot travel too far to get to sites where vaccination is taking place. To counter this, the Government Veterinary Services (GVS) in South Africa carries out street to street vaccination campaigns (Hergert, LeRoux and Nel, 2016). It has been suggested that this approach of vaccination against rabies takes place during the period that suits the working class and school children. Through this, it is possible to reach the minimum percentage of animals required to be vaccinated (Hergert, LeRoux and Nel, 2016). It has been observed that the group that is likely to bring its dogs is usually children (Bailey *et al.*, 2018).

Therefore, vaccination strategies that target periods when children are available to bring their dogs are likely to be more effective.

It has been suggested that dogs and cats should receive vaccination as a preventive measure towards rabies (Zinsstag *et al.*, 2017). Such concerted efforts to vaccinate all domestic animals offers prevention (Lankester *et al.*, 2016). This is because unvaccinated animals are the greatest imposer of rabies to the humans (Anyiam *et al.*, 2017). Vaccinated dogs and cats develop immunity to the disease. Therefore, this interrupts the rate of dissemination of the disease to susceptible individuals (Rupprecht *et al.*, 2019). Vaccination ought to remain constant and repeated within a year and then later in the coming three years (Barecha *et al.*, 2017). However, during mass campaigns in the rabies endemic areas all animals must receive vaccination despite their age and phenotype (Barecha *et al.*, 2017).

Although, the control of rabies in the dog population is usually achieved through the mass vaccination, movement control, and sterilisation are other means that can be employed to control rabies (Wallace *et al.*, 2019). Sterilization is an effective measure to control rabies through reduction of the dog population growth (Setiawan, 2018). However, most countries in Africa and Asia carry a high burden of rabies due to lack of resources, which leads to insufficient or non-existent measures to control the disease in dogs (Lembo *et al.*, 2010).

Dogs that roam have an increased chance of contracting the disease and therefore pass the virus onto other dogs or people. This is attributed to the fact that animals are sometimes out of reach by the owners when they should be vaccinated and therefore remain unvaccinated (Mbilo *et al.*, 2019).

It is easier for rabies to be transmitted among animals in the congested place, whereby the infected animal will shed the virus through bite (Costa *et al.*, 2018). Dogs that are let to roam free are usually not vaccinated and therefore culprits for rabies transmission (Mbilo *et al.*, 2019). However, an intensive mass dog vaccination campaign renders successful rabies control (Cleaveland and Hampson, 2017).

In some areas herd immunity cannot be achieved due to beliefs among the owners of pet-hunting dogs to the effect that vaccinated animals are not able to run faster and catch prey. They believe that vaccination negatively affects their ability to hunt. Others believe that their animals will cease to be strong or not be able to bark which is a

necessary feature for guard dogs, and so are unable to protect them from intruders (Setiawan, 2018). The problem is compounded by roaming dogs that cannot be vaccinated, because there are no owners to hold them (Mbilo *et al.*, 2019; Tiwari, Robertson, *et al.*, 2019).

The immunisation of dogs is dependent on their availability at the rabies vaccination point (Wallace *et al.*, 2019). However, less interaction between humans and their dogs is a constraint to the prevention of rabies as they are unable to handle their dogs during vaccination outreaches (Bailey *et al.*, 2018). This results in less participation of dog owners during rabies vaccination campaign. Rabies control should therefore involve engagement with the communities to bring their animals for vaccination, so that they may also be protected from getting the disease (Setiawan, 2018). For this to happen communities need to be knowledgeable and have a positive attitude toward the disease rabies.

Unreported cases of suspect rabid animals by the communities to the veterinary personnel is among the challenges to combat rabies (Mbilo *et al.*, 2019). Communities need to be educated on the importance of reporting any suspected case of rabies for control programmes to be successful.

Awareness of the burden of rabies calls for the effective assessment and the correct measure to be put in place. Hence lack of accurate data on the surveillance of rabies makes it difficult to control the disease in the society (Adomako *et al.*, 2018). Therefore, it is not possible to determine the exact impact of the disease and as a result the disease remains one of the neglected zoonotic disease (Adomako *et al.*, 2018). Effective control strategies for rabies rely on the enhanced surveillance in areas that are assessed to be high risk to human beings (Costa *et al.*, 2018). Therefore, in places such as Tanzania, active surveillance is practiced through rabies projects with the aim of determining the rabies burden (Tschopp, Bekele and Aseffa, 2016). Awareness of the burden of rabies calls for the effective assessment and the correct control measures to be put in place.

Although rabies in humans can be prevented through measures such as, vaccination of the reservoir and also through the course of PEP following bite exposure, the fatalities still persist (Savadogo *et al.*, 2021). This is attributed to the lack of knowledge by human beings on the right form of action to be followed and unavailability of the

right treatment in the healthcare services (Fazeli *et al.*, 2018). Effective implementation of rabies disease control is sustainable through the participation of individuals, when they bring their pets for vaccination to the veterinary personnel for vaccination and when human beings seek PEP from the medical services (Setiawan, 2018).

In view of the above, unlike in human beings the use of post exposure treatment (PET), which combines anti-rabies immunoglobulin (RIG) and vaccine is not recommended in dogs and cats and this is because they yield poor antibodies (Bishop *et al.*, 2010). In South Africa, the use of PET is not recommended in the contact animals as it is unlikely to result without risk (Hudson *et al.*, 2016; Hikufe *et al.*, 2019).

For example, it is thought that attaining sufficient dog vaccination, drastically reduces the number of cases within countries where outbreak of rabies occurs (Lankester *et al.*, 2016). The low dog rabies immunisation coverage in South Africa is attributed to factors such as; interruptions of vaccination campaigns, an increased number of dogs born and those that are not accessible during vaccination campaigns, limited community knowledge and awareness on rabies control and prevention approaches and lax in enforcement of government regulations (Hergert and Nel, 2013).

Increased education even of school children on rabies has proved to be an efficient way to increase awareness of the disease. This is important because children make up a huge statistic on the dog-bite list (Adomako *et al.*, 2018; Bailey *et al.*, 2018). The people seeking PEP in the Philippines increased after efforts of rabies disease awareness had been implemented (Sparkes *et al.*, 2017).

2.2 Epidemiology of rabies

2.2.1 Rabies disease worldwide

Rabies is distinguished into two epidemiological cycles namely; a) the urban rabies, of which dogs are the predominant reservoir and major transmitter. This cycle is observed much in the areas of Asia, Africa, and South and Central America where there is a low rabies vaccination coverage and a large population of dogs is not confined. b) The sylvatic cycle, occurs in wild animals whereby the disease is perpetuated by wild animals such as, Jackals, foxes, wolves, mongoose, skunks and others (Dubey *et al.*, 2022). However, the sylvatic cycle is likely to revert to the urban due to the fact that stray dogs usually come in contact with wild animals (Barecha *et al.*, 2017).

Globally, an estimated 15 million and more people seek post-bite vaccination to prevent rabies disease (Ngugi *et al.*, 2018). Of these, Africa alone, records approximately 200,000 people each year who use PEP (Costa *et al.*, 2018).

The mortality rate in the human population due to dog-mediated rabies is high worldwide (Costa *et al.*, 2018). Therefore, the disease poses a threat to many lives, as it remains uncontrolled in many parts of the world, especially on continents like Asia and Africa (Tohma *et al.*, 2016).

The rabies virus is highly infectious and results in over 2 million infections in human beings annually (Wallace *et al.*, 2019). In addition, this infectious disease causes at least 60 000 deaths in human beings annually (Hudson *et al.*, 2016; Ngugi *et al.*, 2018). Out of the reported deaths, 24 000 emanate from Africa alone (Tschopp, Bekele and Aseffa, 2016). In view of this, rabies is an important disease that requires intervention.

The number of rabies cases is much likely to be substantially higher than recorded around the world, due to underreporting of the disease incidences (Tschopp, Bekele and Aseffa, 2016). It is estimated that up to 95% of human rabies cases go unreported in the Eastern and Southern Africa which, results in the extent of the widespread nature of rabies being undermined on some continents such as Africa (Costa *et al.*, 2018). In light of this, the true burden of rabies is not clear due to inadequate reporting systems in Africa and also on the subcontinent of India (Tiwari *et al.*, 2019).

In Australia, there is a low prevalence of rabies in the dog population. This is attributed to the efforts to halt the disease from circulating that were introduced in the country such as vaccination of dogs (Hudson et al., 2016). Similar efforts implemented by Europe and North America have also managed to control rabies in dogs with the resultant elimination of rabies in most industrialised countries (Zinsstag *et al.*, 2017).

A project initiated in the Philippines in 2007 to with the goal to halt the spread of the disease and thus prevent rabies has yielded good outcome (Sparkes *et al.*, 2017). In the Southern and Central American countries, the strategies put in place to prevent and limit the transmission of rabies has been productive as they managed to bring the disease close to elimination (Zinsstag *et al.*, 2017). It is therefore evident that when a lot of effort to halt rabies is implemented, the spread and circulation of the disease is achievable.

Rabies is influenced by the population density of dogs and a large number of dogs that remain unvaccinated in an area (Costa *et al.*, 2018). Both urban and rural areas carry a high burden of rabies in most countries (Tiwari *et al.*, 2019). This has been attributed to congestion of people and dogs in such places (Brunker *et al.*, 2018).

The distribution of rabies is influenced by the geographical location. For instance, in Nepal, the flat areas tend to have more cases of rabies than mountainous areas. This may be associated with the more densely and populated areas in the flat areas.

While countries with sufficient resources such as America and western Europe have been able to control and eliminate rabies in both wildlife population and dogs within their countries (Yalemebrat, Bekele and Melaku, 2016), other countries especially poorly resourced countries in Asia and Africa have not been able to deal properly with rabies as the disease still persist in those countries (Tohma *et al.*, 2016; Zinsstag *et al.*, 2017). For example, Ethiopia still maintains the status of being a high-burdened country with rabies (Tschopp, Bekele and Aseffa, 2016).

In Ghana, rabies is a major public health concern (Adomako *et al.*, 2018). In the period 2000 and 2004, the public health facilities recorded 123 clinically diagnosed human rabies cases. In addition, 22 more rabies cases were seen in 2010 and 2014 at the Korle-Bu Teaching Hospital in Accra, the national capital (Adomako *et al.*, 2018).

According to Ngugi *et al.* (2018), Asia contributes 53% of rabies cases, while Africa accounts for 43.6% of the rabies burden. In Africa, most cases of rabies are thought to be in the rural setting as compared to the urban areas (Tiwari *et al.*, 2019). For example, 76% of human deaths in Africa are recorded in rural areas (Costa *et al.*, 2018). However, the disease persists in both rural and urban setting (Tiwari, Robertson, *et al.*, 2019).

Between 2002 and 2012, Kenya recorded 858 human bite cases that were associated with animals found on the streets (Ngugi *et al.*, 2018). This has been blamed on poor dog management by their owners. Dogs that are not confined, and hence freely move around contribute to the burden of rabies (Tiwari *et al.*, 2019). Even where there is increasing evidence to suggest that a number of dogs have homes, many of these dogs are still able to reach different places due to being let loose (Mbilo *et al.*, 2019). When animals are not confined, they are likely to contract rabies and increase the possibility of the spread of the disease (Setiawan, 2018).

In countries with low socio-economic background, animals such as dogs, rodents and cats are associated with bites on humans, dogs account for about 85 to 90% of human injuries, followed by cats (5 - 10 %) and rodents (2 - 3%) (Ngugi *et al.*, 2018). In Ghana, a total of 4821 dog bites were reported within a period of three years (Adomako *et al.*, 2018). In Kenya, an upsurge of the burden of animal-bites has been observed with an estimated 146,362 cases reported (Ngugi *et al.*, 2018).

2.2.2 Rabies in South Africa

In South Africa (SA), rabies disease has been a public health threat for over 50 years (Weyer, 2015). This followed the introduction of the disease into the country by a rabid dog from Mozambique in 1960 (Hergert, LeRoux and Nel, 2016). From then, the epidemic continued until it was brought under control by the deliberate effort implemented in 1963. However, in 1980, the disease resurfaced and managed to establish itself throughout, and spread to various provinces within the republic of SA.

Canid rabies was introduced in the Vhembe district in Limpopo province through a dog from Zimbabwe way back in 2004 (Weyer, 2015). The spread of rabies in the Free State province emanated from a canine from the Lesotho, a neighbouring country (Weyer, 2015). In 2010, a dog from KZN entered into Soweto township in Gauteng province and was diagnosed with rabies (Sabeta *et al.*, 2013). However, since then, the disease has occurred in sizeable outbreak in Gauteng province. Thereafter, there has been a spill over of rabies to other adjacent areas and the disease has consequently become endemic in many parts of the country (Weyer, 2015).

Since 1970, most recorded cases of rabies in humans in SA have occurred in the province of KZN (Coertse *et al.*, 2017). This is because of the endemic status of the disease in the province (Sabeta *et al.*, 2013). The latter is not the only province in which rabies is endemic. The disease has spread across provinces to Gauteng, Eastern Cape (EC), Free State (FS) and Mpumalanga provinces (Sabeta *et al.*, 2013; Hergert, LeRoux and Nel, 2016). However, rabies cases are most prevalent in the northern, central and south-western parts of the Republic of SA (Sabeta *et al.*, 2013). Compared to KZN province, other provinces tend to experience mild outbreaks of rabies, with intermittent outbreaks (Weyer, 2015).

In SA, although the burden of rabies is dominant among the domestic dogs, other domestic animals also frequently fall victim to the disease. However, the number of

cases in the country differs greatly by species (Weyer, 2015). For example, between 2008 and 2013, the number of rabies cases observed in animals, increased to 304 in bovines, 71 in caprine and 26 in ovine (Weyer, 2015). In addition, from January 2010 to December 2011, out of the 53 confirmed positive rabies cases in Gauteng province, majority were observed in domestic dogs (n=46), followed by three (n=3) in bovines and with a single case (n=1) observed in each of the following: domestic cats, small spotted genet, banded mongoose and unidentified mongoose (Sabeta *et al.*, 2013).

In SA, apart from the cases of rabies associated with domestic animals, cases of rabies associated with wild animals have also been recorded (Sabeta *et al.*, 2013; Weyer, 2015). The wild animals that are known to contribute to human rabies include, black-backed jackal, bat-eared fox, and mongoose species (Weyer, 2015).

The rabies virus that causes rabies in SA, has multiple variants of species (Begeman *et al.*, 2018). In 2008, 4 years after the initial isolation, the Mokola virus (MOKV) species was discovered to be invasive in the cat family within the KZN province of SA (Coertse *et al.*, 2017). However, this is not limited to KZN province, the EC province has also isolated the same virus species, and it has been associated with a number of the outbreaks in the area. Only a single case of the MOKV to date has been diagnosed in the Mpumalanga province (Coertse *et al.*, 2017).

Therefore, surveillance of rabies is crucial and is usually used as a proxy to determine the number of cases that result from the transmission of dogs rabies to humans and the necessary control measures (Ngugi *et al.*, 2018). South Africa as a nation has not been able to collect sufficient surveillance data from all its provinces. However, while the number of rabies cases are not clear in some provinces, other provinces such as the EC, Mpumalanga, North West and KZN have been able to record 77% of the animal rabies cases (Weyer, 2015).

The South African province of KZN has identified the rural areas as high-risk spots. This is because, unlike the urban communities that are able to access the veterinary services from private and government with relative ease, this is not the case with rural areas (Hergert, LeRoux and Nel, 2016). The rural communities in the province depend on mass vaccination of dogs carried out free of charge by government veterinary services (GVS) to reduce the number of cases of rabies (Hergert and Nel, 2013).

Following vaccination, the GVS issues a certificate to the owner of the animal as a proof of vaccination. The certificate details the owners name, demographic data, and the vaccination history of the animal, such as the date of first and the successive vaccinations. In addition, the name of the animal, colour, age, and the type of breed of dog, along with the residential address to which a follow-up can be made are captured (Hergert, LeRoux and Nel, 2016). This approach helps to determine the vaccination history of the animal.

The SA government recommends that communities begin with the rabies vaccination schedule of their pets from as early as three months (Bishop *et al.*, 2010). This is because at this age, pets are deemed to acquire the immunity effectively after the inoculation against rabies. Following the initial injection, pets should receive a booster vaccine within a year. This can be continued every three years after the second vaccination. However, in rabies endemic areas, animals are usually vaccinated every year to avoid the spill over of the rabies disease (Bishop *et al.*, 2010).

The certificate issued by GVS in SA is usually used as reference to indicate the coverage of animals in that specified area (Hergert, LeRoux and Nel, 2016). This practice can enable one to tell which pets have been inoculated amongst the total population (i.e., to determine those that have been immunised from those that have not yet received vaccination). In addition, this approach can in turn indicate whether the vaccination campaign of animals has reached the stipulated minimum vaccination coverage required to reduce the rabies burden (Setiawan, 2018).

The private veterinarians, GVS and Society for the Prevention of Cruelty to Animals (SPCA) in SA, collaborate in taking care of animals in communities that require health intervention (Hergert and Nel, 2013). Therefore, community members are usually in contact with one of the organisations to either immunize, treat, or seek advice regarding their animals. In addition, animals suspected to carry the disease that pose a danger to communities must be reported to GVS for intervention.

Although rabies in SA, is controlled in animals to prevent human exposure (Lavan *et al.*, 2017), SA Directorate of Veterinary Services has not been able to prevent outbreaks (Hergert, LeRoux and Nel, 2016). However, this is not limited to SA. For example, outbreaks of rabies have repeatedly been reported in other countries as well as other continents (Ngugi *et al.*, 2018).

2.3 Socio-economic aspects of rabies

The cost associated with medical care remains a barrier to those that cannot afford it. For instance, post dog bite, poor victims are likely to ignore medical attention due to financial implications associated with post exposure prophylaxis (PEP) treatment (Costa *et al.*, 2018). The high cost of PEP and transportation to multiple health care centres following exposure especially when there is shortage of medication, are associated with people not being able to get medical attention immediately following a dog bite (Costa *et al.*, 2018; Kadowaki *et al.*, 2018).

Prevention of rabies requires at times the combination of therapies such as rabies immunoglobulin (RIG) and anti-rabies vaccine (ARV) (Tiwari *et al.*, 2019). However, the high cost incurred on PEP therapy tends to lead to a break in the course of treatment by the personnel who cannot afford the treatment (Kadowaki *et al.*, 2018). Furthermore, the PEP therapy is taken at different intervals within a month (Deray *et al.*, 2018; Kessels *et al.*, 2019). Therefore, there is a challenge people who need the treatment have to make multiple trips to the health care centre until the course is completed (Tschopp, Bekele and Aseffa, 2016; Kessels *et al.*, 2019). This is also likely to lead to a break in the course of treatment by the people receiving the treatment.

The fight against rabies disease is characterised by different aspects that may include direct and indirect costs (Elser *et al.*, 2018). For example, costs emanate from direct prevention of the disease in animals and people by vaccination and also indirectly when the people have to travel to seek medical attention following exposure, costs involved in the surveillance process, the loss of income due to the fatalities of livestock associated with the disease following exposure and the management of the dog population during the disease outbreaks are enormous (Taylor and Nel, 2015).

In rural communities, the economic impact of rabies associated with deaths of livestock and poultry is huge (Tiwari *et al.*, 2019). For example, in Africa and Asia, the annual cost of livestock losses due to rabies is estimated to be USD 12.3 million. Meanwhile, an estimated USD 583.5 million is directed to rabies control in Africa and Asia alone (Gebeyehu and Gebeyaw, 2016). Therefore, financial prioritization of rabies programs to combat the disease are crucial.

In low-income countries, rabies cause more harm as compared to countries with sufficient resources (Costa *et al.*, 2018). For instance, rural areas with poor socio-

economic resources are not able to manage rabies in both animals and humans (Tiwari *et al.*, 2019). For example, in Uganda, dog vaccination coverage is below the stipulated coverage in poor rural areas compared to affluent areas due to differences in the distribution of resources (Costa *et al.*, 2018).

The disease claims many human lives worldwide per annum (Ngugi *et al.*, 2018). This could be attributed to low prioritisation of rabies especially by low-income countries (Ngugi *et al.*, 2018). Unlike livestock diseases that impact on the economy and food security that receive a lot of attention, rabies receives less attention (Barroga *et al.*, 2018).

Poverty influences rabies occurrence due to factors such as, lack of education, information about the burden and impact of the disease, and limited resources (Fazeli *et al.*, 2018; Ngugi *et al.*, 2018). For example, poor dog management is blamed for the spread of rabies in a number of countries (Gebeyehu and Gebeyaw, 2016).

2.4 Knowledge, Attitude and Practices (KAP)

Knowledge is characterised by understanding that is harboured by perception of an individual and imagination towards a particular phenomenon, whereas attitude is tendency to some thoughts and how one would respond to a particular stimulus. On the other hand, practices are the application of the knowledge by action implemented on a specific matter (Setiawan, 2018).

Awareness is critical towards rabies and its associated risk (Rine, 2017). Awareness helps members of the community to make informed decisions and take action to protect their lives. For instance, in some parts of the world, there is a high mortality due to rabies in human as a result of lack of knowledge regarding the correct measure to be followed following exposure (Tiwari *et al.*, 2019). In addition, lack of awareness is an impediment to rabies prevention and people are likely to undermine the correct procedure to be followed to control rabies in communities (Abdela *et al.*, 2017; Barroga *et al.*, 2018). Raising the level of awareness in the community is significant to avoid rabies.

People who lack sufficient knowledge tend not to follow the prescribed measures such as, prior washing of the wounds following a bite by the dog, and/or seeking medical care after exposure to saliva of suspect rabid animal (Tiwari *et al.*, 2019). The people who are limited in their understanding of rabies are not conscious to the fact that rabies

is an animal mediated disease and are therefore not likely to adopt rabies prevention practices (Setiawan, 2018). In addition, the perceived need for the community to apply the necessary preventive measures are undermined by the lack of understanding of the risks involved with rabies disease (Bailey *et al.*, 2018).

It is not only good knowledge on how the disease develops, spread, and prevented, that is essential for the control and prevention of rabies but a good attitude towards the preventive measures and following the correct practices towards rabies are equally important (Fazeli *et al.*, 2018). When individuals have the right attitude towards the disease, they are likely to follow preventive measures such as, how to handle the dog bite wound and also to keep a reduced number of dogs and/or sterilise the animals in order to decrease the chances of rabies spread (Costa *et al.*, 2018).

The lack of participation by animal owners in the prevention campaigns of rabies is attributed to the fact that they are not aware of the impact of rabies and the right procedure that should adhered to with respect to the disease. Some individuals who do not know the dynamics of rabies tend to follow their own methods of prevention such as, such as traditional healing practices (Tiwari *et al.*, 2019).

According to Wasay et al., (2012), some populations fall victim to rabies due to a lack of knowledge of the public health importance of the disease. This leads to failure to appreciate the risk involved when one does not vaccinate their pets against rabies and the follow up measures to prevent fatalities. Some owners perceive their animals as not suitable for vaccination according because of their age and therefore do not present them for vaccination (Morters *et al.*, 2015). Therefore, rabies continues to be a problem in such communities (Rine, 2017).

Having good knowledge, attitude and adopting good practices regarding rabies have been shown to reduce the spread of the disease and the fatalities that the disease may cause (Fazeli *et al.*, 2018). In view of this, the present study investigated the KAP of selected communities of eThekwini District of KZN Province of South Africa.

CHAPTER 3

METHODOLOGY

3.1 Study area

The study was conducted within the eThekwini District in KwaZulu-Natal (KZN) province of South Africa. KwaZulu-Natal is one of the nine provinces in South Africa and is populated by different races. The population of KZN is approximately 10,819,130 living on 94,361 km² area. Its population growth is estimated at 1.2% for different races (Hergert and Nel, 2013). The people of Zulu cultural ancestry are the majority and make up 84% of the population in KZN (Hergert and Nel, 2013).

eThekwini District is occupied by about 3.7 million people on land that is approximately 2,555 km² in size (eThekwini Municipality, 2017). Its population has increased with an average of 1.13 % per annum from 2001 to 2011, moving from 3.09 million to 3.44 million people (eThekwini Municipality, 2017). This increase is also due to people from other provinces and countries that migrate to the district. Migrants contribute 15 % of population with some staying in informal settlements.

The central and northern regions of eThekwini District have the largest population, whereas the south and western regions accommodate the least number of people. The central region is the urban core of the district and has approximately 1.18 million people (34.54 %), followed by the northern region with approximately 1.15 million people (33.61 %). The south has approximately 758000 people (22.03 %). The western region has the least number of people with a total of approximately 338000 people (9.82 %) (eThekwini Municipality, 2017).

Embo is one of the rural areas situated in the inlands of eThekwini in the western region of the district, and is part of ward 8 (Jama-ah, 2011). The population size of ward 8 is approximately 40,924 people (Jama-ah, 2011).

Verulam is a town in eThekwini District. It is located in the upper part of the northern region (eThekwini Municipality, 2017). The town has an approximate population of 184,114 occupants on a land of 18.13 km² (eThekwini Municipality, 2017). It has been estimated that Verulam has about 64,950 households (Personal communication, Verulam Environmental Health Manager).

3.2 Study design

A cross-sectional study design was adopted to achieve the objectives of this study because this study design can be used on randomly selected individuals to further obtain information about the reference population. In addition, it is an inexpensive method that is easy to mount (Levin, 2006). Furthermore, it allows the use of questionnaires to obtain information about the study subject from a population with different characteristics, such as; age, gender, religion, residential background and educational level at one point in time. This study design was thus used to investigate knowledge, attitude and practices of community members towards rabies in eThekwini District in KZN province of South Africa.

3.3 Target population and sampling strategy

The target population for this study was the residents of Embo (a rural area) and Verulam (an urban area). The latter was estimated to have 64,950 households, while Embo had an estimated 8,184 households.

Systematic random sampling method was used to select a representative sample of the target population from the two study areas (Embo and Verulam), as it is best suited in the absence of a sampling frame. It also gives every subject the chance of being selected and therefore minimises selection bias.

The distribution of households from the selected areas was determined, so that the sampling interval was evenly maintained (Sharma, 2017). The first household was selected randomly. The successive households were selected following the predetermined interval for each of the areas. However, in the event that an adult was absent at the time of interviewing the next house with an adult person (>18 years old) was chosen to be interviewed (Tiwari *et al.*, 2019).

In the two areas (Verulam and Embo), the distribution of household selection was drawn by computing the total number of households together with the sample size desired for the study. In addition, the proportion of the total number of households and sample size was computed to determine the sampling interval. Afterwards, the sampling interval was adopted to select the households.

3.4 Sample size determination

This sample size for each of the study areas was determined using the formula described by Guadu et al. (2014).

$$N = \frac{1.96^2 \times Pexp(1 - Pexp)}{(d)^2}$$

N= Sample size

P_{exp}- Estimate or expected proportion of knowledge about rabies from community at least 50%

d^2- Desired absolute precision (5%)

Based on the above formula, 384 participants were drawn from each of the two areas. Verulam had 64,950, which was used to compute sampling interval as; 169th, and in Embo, an estimated 8,184 households was used to compute sampling interval to the value of 21.

3.5 Data collection

3.5.1 Data collection instrument

The data was collected using structured questionnaire, during face-to-face interviews. A questionnaire developed by Fenelon *et al* (2017), was adapted for this study.

The questionnaire included the following sections:

- Demographic data (Age of respondents, sex, place of residence (Embo or Verulam), pet-ownership (own a pet dog or cat, or does not-pet dog/cat), religion (Christian, African religion, Hindu, Muslim, Jew, other) educational level (no education, completed primary, or secondary, or matric, or post matric).
- Knowledge of rabies,
- Attitude towards rabies and
- Practices of safety towards rabies.

A pilot study involving few participants, drawn with an equal number (n=15) from each of the two area was used to assess the fitness for purpose of the questionnaire before the study commenced. The results of pilot study were used to improve on the questionnaire. The questionnaire was prepared in English and translated into the local language that is most widely spoken (isiZulu) to cater for respondents who are not able to communicate in English.

3.5.2 Administering the questionnaires.

The researcher with the help of trained assistants conducted structured interviews with the respondents from randomly selected households in the two study areas. The first 50th household from Verulam was selected randomly and then the sampling interval was followed to select the subsequent 169th household. This was continued until the estimated sample size was reached. In Embo, 21 was adopted as the sampling interval. The first 11th household was selected randomly and the interval of 21 was employed to select the successive households until the estimated sample size was reached. Each interview lasted between 30-45 minutes and was conducted either in English or isiZulu.

3.6 Data management and analysis

3.6.1 Data management

Each questionnaire was reviewed carefully after each data collection session to ensure that it was filled in correctly. Each question was coded before data capturing commenced. All raw-data was captured into a computer using Microsoft Excel 365 (Microsoft Corp., Redmond 137, USA). Duplicates of the questionnaires were made and stored separately in case the questionnaire got lost, altered or destroyed.

The knowledge score of each respondent was computed and presented as a percentage. Thereafter, a binary variable was created from the knowledge score using 60% as the cut off for being knowledgeable (≥ 60%) or not knowledgeable (< 60%) using the criteria described by Alam et al. (2021).

3.6.2 Data analysis

Descriptive statistics

Objective 1: To establish the level of knowledge on rabies among two selected communities:

- The Chi square test of differences of proportions was used to compute the proportions of people considered knowledgeable or not knowledgeable about the disease.

Objective 2: To assess the attitude and practices related to rabies management:

- The Chi square test of differences of proportions was adopted to assess the difference in terms of the attitude and practices related to rabies among the respondents.

Inferential statistics

Objective 3: To investigate the factors correlated with a high knowledge score of rabies among respondents.

- A binary logistic regression models were fitted to the data to investigate factors that are significantly correlated with a high knowledge about rabies.

3.7 Limitations

This study was subject to limitations of both cross-sectional surveys and associated recall biases. The study was only limited to Verulam and Embo in eThekwini District and hence the results cannot be generalised to other areas in South Africa. The study was conducted during the lockdown due to the Covid-19 pandemic. This could have led to selection bias. Nonetheless, this study presents baseline information on the knowledge, attitude and practices towards rabies, which has previously not been available in the study area. It also provides baseline information upon which future research can be developed.

3.8 Ethical and Consideration

Approval to conduct the study was granted by the State Veterinary services (Annexure E) of KZN Department of Agriculture and Rural Development. In addition, permission to carry out the study was granted by the Ethics Committee of the College of Agriculture and Environmental Science, University of South Africa prior to commencement of the study (REC Reference #: 2019/CAES_HREC/105) (Annexure D). The rights of the respondents were protected by ensuring that they remain anonymous. The objectives of the study were first explained to the respondents, and thereafter each participant signed the consent form to indicate that they voluntarily accepted to participate in the study. All respondents had the right to withdraw from the study at any time during the study. Findings of this study will be reported to the residents of the study areas during rabies vaccination campaigns and will also be presented at conferences to the broader scientific community and researchers.

CHAPTER 4

RESULTS

4.1 Descriptive statistics

4.1.1 Demographic profile of respondents

The study was conducted in two residential areas namely; Embo and Verulam. An equal number of respondents (n=384) was drawn from each of the two areas. Therefore, a total of 768 respondents from the two areas participated in the study.

Table 4. 1: Demographic profile of people who participated in the study

Variables	Level	(n)	%	[a]95% CI	
				Lower interval	Upper interval
Age	18 – 35	409	53.26	49.65	56.83
	36 -53	288	37.50	34.06	41.03
	54 - 71	64	8.33	6.48	10.52
	>71	7	0.91	0.37	1.87
Sex	Male	280	36.46	33.05	39.97
	Female	488	63.54	60.03	66.95
Residence	Verulam	384	50.00	46.40	53.60
	Embo	384	50.00	46.40	53.60
Own a pet dog and/ or cat	Yes	559	72.79	69.49	75.91
	No	209	27.21	24.09	30.51
Religion	Christian	366	47.66	44.07	51.26
	African religion	140	18.23	15.56	21.15
	Hindu	204	26.56	23.47	29.84
	Muslim	31	4.04	2.76	5.68
	Other	27	3.52	2.33	5.07
Education	No education	43	5.60	4.08	7.47
	Completed primary	101	13.15	10.84	15.75
	Secondary not completed	275	35.81	32.41	39.31
	Completed matric	234	30.47	27.23	33.86
	Tertiary completed	115	14.97	12.52	17.70

[a]95% CI = 95% Confidence Interval

As shown in Table 4.1, most participants were aged, 18-35 years (53.26%, n=409), followed by participants aged 36-53 years (37.50%, n=288), 54-71 years (8.33%, n=64) and those who were above 71 years (0.91%, n=7). More females (63.54%, n=488) participated in the study compared to males (36.46%, n=280). Majority of respondents owned pets (72.79%, n=559), in comparison to only 27.21% (n=209) who did not own pets.

Majority of respondents were Christians (47.66%, n=366) and least being those who identified their religion as others (3.52%, n=27) (Table 4.1). Based on education attained, the majority of respondents had not complete secondary (35.81%, n=275).

4.1.2 Knowledge of rabies

While the majority of respondents (86.98%, n=688) reported dog bite as a major route of transmitting rabies to humans, just over half (50.52%) were not aware of the cause of rabies (Table 4.2). Although a significant proportion of respondents (78.3%) acknowledged that individuals exposed to dog bite should receive anti-rabies injection immediately, only half of the respondents indicated cleaning the wound with running water and soap as first aid and that rabies could be cured (Table 4.2). Furthermore, 79.56% (n=611) of the respondents were aware that vaccination of pets is important for control of rabies among humans.

In response to the question on the age at which dogs start to receive their vaccination against rabies, 42.19% (n=324) indicated that 3 months was the start-up age to vaccinate pets, followed by those who said they did not know the age at which pets should start to get rabies vaccination (28.65%, n=220) and those who indicated immediately from birth (15.89%, n=122).

Majority of respondents indicated that a human clinic or hospital (87.24%, n=670) is where they could obtain anti-rabies injection in case, they became victims of a dog bite. A few indicated that the human vaccine could be sourced from a veterinary clinic or hospital (5.08%, n=39) or any supermarket (1.30%, n=10).

When asked, whether it is possible for rabies to be transmitted from animals to humans, the majority (83.33%, n=640) were aware that rabies can be transmitted to humans from animals, followed by participants who did not know (12.76%, n=98) if rabies could be transmitted to humans from animals. Those who said that rabies cannot be transmitted from animals to humans were the minority (3.91%, n=30).

As shown in Table 4.2, majority of respondents (79.04%, n=607) indicated that, it is advisable for someone to get anti-rabies after a bite from a suspected rabid dog. This was followed by those who did not know (17.58%, n=135) if a person should get anti-rabies following a dog bite. However, 3.26% (n=25) did not think that they should get anti-rabies following a bite from a suspected rabid dog.

Table 4. 2: The assessment of the knowledge of rabies among respondents

Knowledge Variables	Level	(n)	%	[a]95% CI	
				Lower interval	Upper interval
What is the cause of rabies?	Chemical substances	19	2.47	1.50	3.84
	Virus	207	26.95	23.84	30.24
	Insufficient intake of feed and water	77	10.03	7.99	12.37
	Psychological problem	77	10.03	7.99	12.37
	Don't know	388	50.52	46.92	54.11
How can human beings become infected with rabies?	Dog-bite	668	86.98	84.39	89.28
	Playing with the dog	15	1.95	1.10	3.20
	Feeding the dog	0	0	0	0
	Don't know	85	11.07	8.94	13.50
What is the first thing to do after dog-bite while at home?	Cover the wound with bandage	96	12.50	10.24	15.05
	Cleanse the wound with soap and running water	411	53.52	49.92	57.09
	Apply any topical medication	134	17.45	14.83	20.32
	Don't know	127	16.54	13.98	19.36
Can rabies be cured?	Yes	387	50.39	46.79	53.98
	No	123	16.02	13.49	18.80
	Don't know	258	33.59	30.26	37.06
When is it appropriate to receive anti-rabies injection after being bitten by a dog suspected of having rabies?	Later after weeks	27	3.52	2.33	5.07
	Immediately	601	78.26	75.17	81.12
	Any time after months	41	5.34	3.86	7.17
	Don't know	99	12.89	10.60	15.47
Is vaccination of pets important for preventing human rabies?	Yes	611	79.56	76.53	82.36
	No	13	1.69	0.90	2.88
	Don't know	144	18.75	16.05	21.69

[a]95% CI = 95% Confidence Interval

Majority of respondents (71.74%, n=551) indicated that vaccination against rabies after being bitten by a rabid dog will protect them from developing the disease. This was followed by 22.14% (n=170) who were not aware or did not know if vaccination following a rabies bite could protect them against rabies. However, 5.73% (n=44)

thought that getting vaccinated does not protect one from developing rabies after being bitten by a rabid dog.

Table 4. 3: Proportions of respondents based on the knowledge on rabies

Knowledge variables	Level	(n)	%	[a]95% CI	
				Lower interval	Upper interval
At what age do pets (dogs or cats) start to receive their vaccination?	Immediately from birth	122	15.89	13.37	19.01
	From 3 months	324	42.19	38.67	44.75
	From 12 months	100	13.02	10.72	19.60
	Never	2	0.26	0.03	0.94
	Don't know	220	28.65	25.47	31.99
Where can you obtain anti-rabies injection if you are a victim of dog bite?	Veterinary clinic or Hospital	39	5.08	3.64	6.88
	Any supermarket	10	1.30	0.63	2.38
	Human clinic or Hospital	670	87.24	84.67	89.52
	Don't know	49	6.38	4.76	8.35
Is it possible for rabies to be transmitted from animals to humans?	Yes	640	83.33	80.51	85.90
	No	30	3.91	2.65	5.53
	Don't know	98	12.76	10.48	15.33
Is it advisable for someone to get anti-rabies after a bite from a suspected rabid dog?	Yes	607	79.04	75.98	81.86
	No	25	3.26	2.53	4.77
	Don't know	135	17.58	8.79	20.46
	Did not answer	1	0.13	0	0.72
If you are vaccinated against rabies after being bitten by a rabid dog, will that protect you from developing rabies?	Yes	551	71.74	68.42	74.91
	No	44	5.73	4.19	7.62
	Don't know	170	22.14	19.25	25.24
	Did not answer	3	0.39	0.08	1.14

[a]95% CI = 95% Confidence Interval

4.1.3 Attitude and practices towards the disease rabies

Results of the attitude and practices towards rabies are summarised in Table 4.4, Majority of respondents (81.77%, n=628) were of the view that it is necessary to receive anti-rabies injection after a dog bite. However, 14.97% (n=115) indicated that they did not know if it was necessary to receive anti-rabies injection immediately after a dog bite and a very small percentage (3.13%, n=24) indicated that they did not think that it was necessary to receive anti-rabies injection after a dog bite.

The results reported in this study, show that most respondents (90.10%, n=692) would seek medical attention if they were bitten by a suspect rabid dog, followed by 3.91% (n=30) who indicated that they would do nothing about it. However, the minority indicated that they would purchase medication to treat the wound (3.26%, n=25) or even leave the wound to heal by itself (2.60%, n=20).

Regarding the question, what should be done to a dog that has bitten someone, just over half of the respondent (52.47%, n=403) indicated that they would quarantine the dog and report to the Department of Agriculture or Society for the Prevention of Cruelty to Animals (SPCA), followed by 23.83% (n=183) who would not act against the dog that had bitten someone. A small number of respondents (13.54%, n=104) indicated that they would kill the dog. Meanwhile an even smaller number of respondents (10.03%, n=77) indicated that they would chase the dog away. Only one respondent (0.13%) indicated that he or she did not know what to do with such a dog.

Majority of respondents (39.45%, n=303) in this study, indicated that it was appropriate to put-down the dog if it was suspected to have rabies, followed by 34.51% (n=265) who did not think that it was appropriate to put-down the dog if it was suspected to have rabies. Few of the respondents (25.78%, n=198) indicated that they do not know what should happen if a dog is suspected to have rabies. Two (0.26%, n=2) of the respondents did not respond to the question.

Slightly over half of respondents (53.39%, n=410) who indicated that they had pets, did not sterilise them. However, 27.21% (n=209) of the study population did not have pets. The participants (19.40%, n=149) who indicated that they sterilised their pets were the minority.

With respect to the question, “Do you have a copy of certificate of vaccination for your pet”, majority of the respondents (59.77%, n=459) were able to produce the certificate as proof of vaccination. Meanwhile, 27.21% (n=209) did not have pets and therefore could not produce the certificate. Only 13.02% (n=100) of the respondents were not able to produce the certificate of vaccination.

In answering the question, “How often do you vaccinate your dog?”, majority of respondents (75.91%, n=583) indicated that they vaccinated their dogs at different interval, followed by 19.14% (n=147) who did not know. Those that indicated only once

in a lifetime (3.91%, n=30) and those who indicated that they never vaccinate (1.04%, n=8) their dogs were the minority.

The highest percentage of respondents (58.07%, n=446) indicated that they kept their dogs in a fenced place, while only 14.71% (n=113) said they did not keep their dogs in a fenced place.

Most respondents (43.23%, n=332) said that they did not allow their dogs to go out of the yard unsupervised, followed by 29.56% (n=156) who said that at times they allowed their dog out of the premises unsupervised. Those who did not own dogs made up 27.21% (n=209) of the respondents.

Referring to the question, “Do you always vaccinate your pet (dog or cat) when there are ongoing campaigns?”, the majority (64.32%, n=494) indicated that they always vaccinated their pets when there are ongoing campaigns. Those who do not always vaccinate their pets (8.46%, n=65) were the minority.

In response to the question, “Do you vaccinate your pet (dog or cat) even though it is always restrained”, the majority (62.50%, n=480) indicated that they vaccinate their dogs even though they were always restrained. While, 10.29% (n=79) did not see the need to vaccinate their animals as they keep them restrained all the time.

When asked, “How do you know if an animal has rabies?”, most respondents (35.42%, n=272) indicated that when the animals bite people when confronted, followed by those who did not know (31.77%, n=244). Meanwhile, 17.84% (n=137) indicated that they can only know after the results from the laboratory declares the animals as positive to rabies. Meanwhile, 13.28% (n=102) of those who indicated that they will know when the animal is showing a sign of laziness and also those who indicated that when the dog suddenly dies (1.69%, n=13) were the minority.

In response to the question “What do you do when you see a suspect rabies stray dog?”, the majority of respondents (53.52%, n=411) indicated that they would report the dog to the department of Agriculture/ or SPCA, followed by 29.56% (n=227) who indicated that they would do nothing. A small number of respondents (10.42%, n=80) indicated that they would kill the dog and throw or bury it, while others indicated that they would chase the dog away (6.51%, n=50).

Table 4. 4: The Proportions of respondents based on the attitude and practices among towards rabies disease

Variables	Levels	(n)	%	95% confidence interval	
				Lower interval	Upper interval
Attitude towards animal bite					
Do you think it is necessary to receive anti-rabies injection after a dog bite?	Yes	628	81.77	78.85	84.44
	No	24	3.13	2.01	4.61
	Don't know	115	14.97	12.52	17.70
	Did not answer	1	0.13	0	0.72
What should someone who has been bitten by a suspect rabid dog do following a bite?	Nothing	30	3.91	2.65	5.53
	Leave the wound to heal	20	2.60	1.60	3.99
	Seek medical attention	692	90.10	87.77	92.12
	Purchase medication for the wound	25	3.26	2.12	4.77
	Did not answer	1	0.13	0	0.72
What should be done to dog that has bitten someone?	Nothing	183	23.83	20.86	27.00
	Kill the dog	104	13.54	11.20	16.17
	Chase the dog away	77	10.03	7.99	12.37
	Quarantine the dog	403	52.47	48.87	56.06
	Did not answer	1	0.13	0	0.72
Do you think it is appropriate to put-down the dog if it is suspected to have rabies?	Yes	303	39.45	35.98	43.01
	No	265	34.51	31.14	37.99
	Don't know	198	25.78	22.72	29.03
	Did not answer	2	0.26	0.03	0.94
Practices of safety towards rabies					
Did you sterilise your pet?	Yes	149	19.40	16.66	22.38
	No	410	53.39	49.78	56.96
	Don't have	209	27.21	24.09	30.51
Do you have a copy of certificate of vaccination for your pet, to produce?	Yes	459	59.77	56.20	59.77
	No	100	13.02	10.72	15.61
	Don't have a pet	209	27.21	24.09	30.51
How often can you vaccinate your dog?	Only once in a life time	30	3.91	2.65	5.53
	Never	8	1.04	0.45	2.04
	Different interval	583	75.91	72.73	78.90
	Don't know	147	19.14	16.42	22.10
Do you keep your dog in a fenced place?	Yes	446	58.07	54.49	61.59
	No	113	14.71	12.28	17.42
	Don't have	209	27.21	24.09	30.51
Do you ever allow your dog to go out	Yes	227	29.56	26.35	32.92
	No	332	43.23	39.69	46.82
	Don't have	209	27.21	24.09	30.51

of the yard unsupervised?					
Do you always vaccinate your dog when there are ongoing campaigns?	Yes	494	64.32	60.82	67.72
	No	65	8.46	6.59	10.66
	Don't have	209	27.21	24.09	30.51
Do you vaccinate your dog even though it is always restrained?	Yes	480	62.50	58.97	65.94
	No	79	10.29	8.23	12.65
	Don't have	209	27.21	24.09	30.51
How do you know if an animals has rabies?	When the animal is lazy	102	13.28	10.96	15.89
	You only know if you send the animal to the laboratory	137	17.84	15.19	20.73
	Wait until it suddenly dies	13	1.69	0.90	2.88
	If it bites people when confronted	272	35.42	32.03	38.92
	Don't know	244	31.77	28.49	35.19
What do you do when you see a suspect rabies stray dog?	Nothing	227	29.56	26.35	32.92
	Kill the dog and throw or bury	80	10.42	8.35	12.80
	Chase the dog away	50	6.51	4.87	8.49
	Report to the Department of Agriculture/Society for the Prevention of Cruelty to Animals (SPCA)	411	53.52	49.92	57.09

*95% CI: 95% Confidence Interval

Figure 4.1 below presents the percentage of respondents based on their response to the question which hosts are "susceptible to rabies?". Dogs were mentioned by majority of respondents (92.2%) as being susceptible to rabies. Only 7.8% of respondents did not mention dogs as being susceptible to rabies. More than 70% of respondents indicated that human beings can contract rabies, however, only 27,47% of respondents did not mention human beings as one of the susceptible to rabies. Cats were mentioned by slightly over half of respondents (57.42%) as animals which are susceptible to rabies, compared with 42.58% who did not mention cats as being susceptible to rabies.

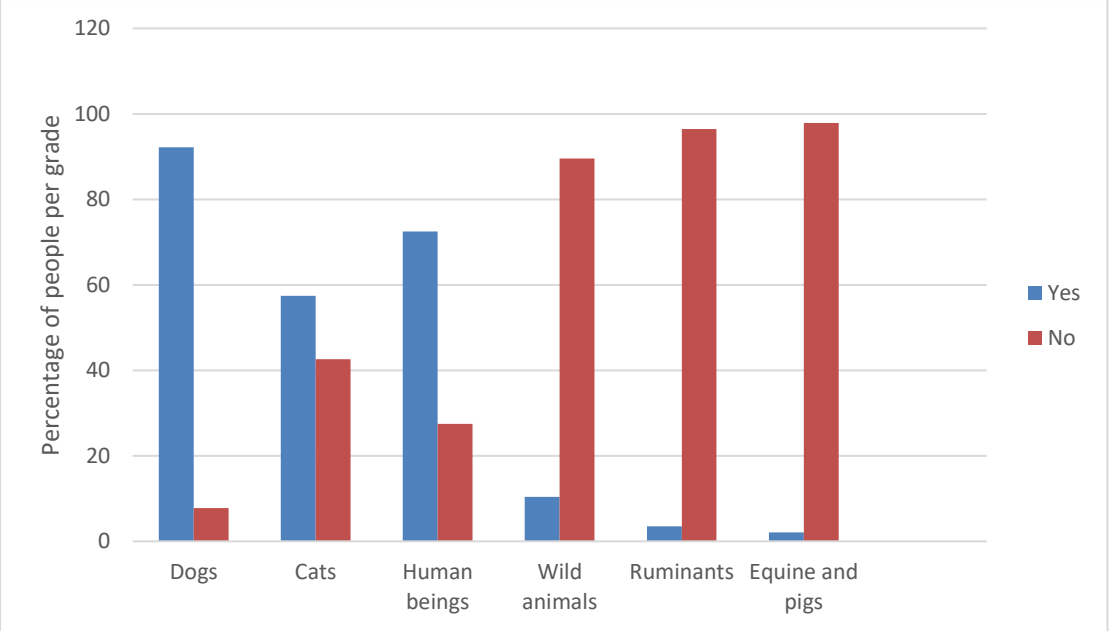

Figure 4. 1: Proportion of respondents based on their response to the question on animals that are susceptible to rabies

Figure 4.2 below, presents the percentage of respondents who responded to the question “Which clinical signs can make you to suspect rabies in dogs?”. Change in behaviour was mentioned by the overwhelming majority of the respondents (74,61%). However, only 20,83% of respondents indicated stop drinking and eating as one of the clinical signs of rabies, with the majority (79,17%) not mention stop drinking and eating as one of the clinical signs for rabies. Very few respondents (16,28%) identified salivation in animals as a clinical sign of rabies, with the majority (83,72%) indicating that they were not aware that salivation was one of the clinical sign of rabies.

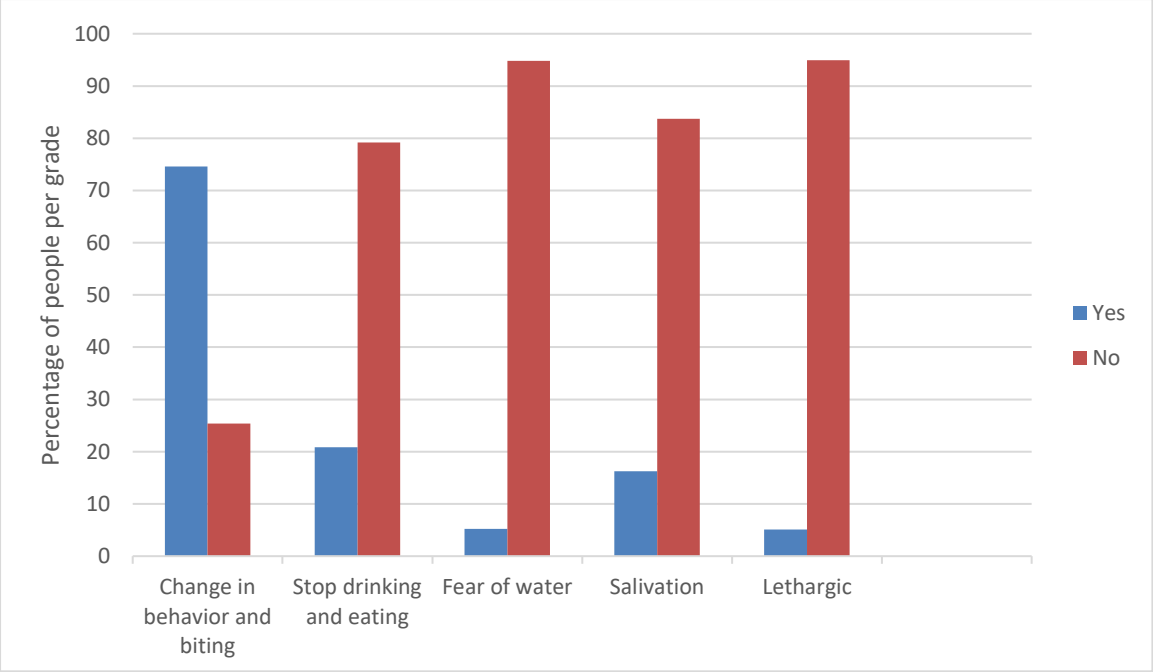

Figure 4. 2: Proportion of respondents based on their responses to questions on clinical signs of rabies

Figure 4.3 below, shows the number of people who responded to the question “How do you keep safe from contracting rabies?”. Majority of respondents (81,77%) chose vaccination, compared to 18,23% who did not choose vaccination as means of preventing rabies. Slightly over half of respondents (50,26%) selected staying away from stray animals, compared to 49,74% who did not select staying away from stray animals.

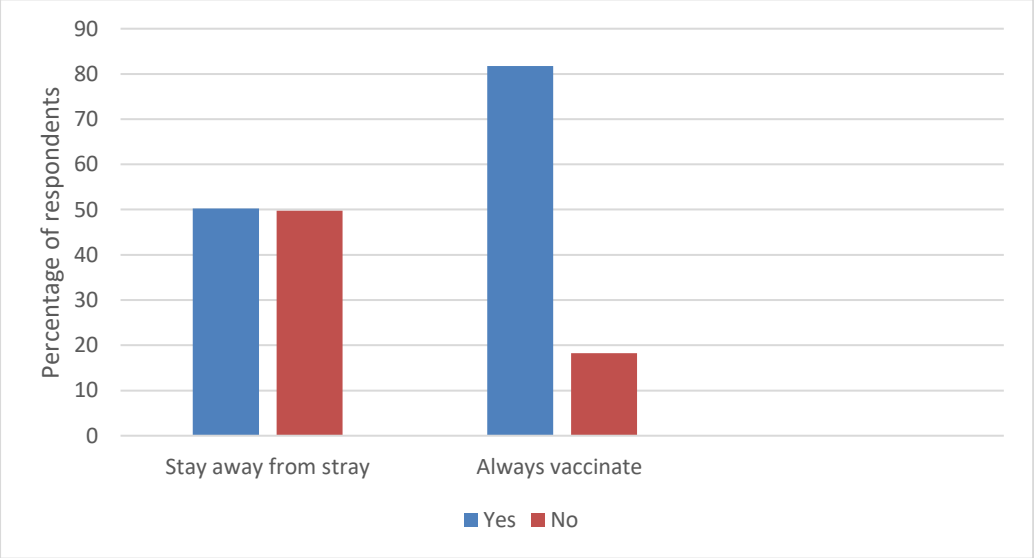

Figure 4. 3: The proportion of respondents based on their responses on measures to prevent rabies in eThekwini District.

4.1.4 Knowledge score across the different socio-demographic variables of the respondents

Generally, the proportion of respondents who were considered knowledgeable about the disease rabies was low (Table 4.5). This was true for all the socio-demographic characteristics of the respondents.

There was significant difference (p-value= 0.0037) between the number of respondents who were considered knowledgeable, with respondents aged >71 years having a higher percentage of respondents (85.71%) who were considered not to be knowledgeable. This was followed by respondents aged 18-35 year-old of which 85.09% were not knowledgeable. The middle-aged respondents (36-53-year-old), had the lowest number of respondents (73.96%) who were considered not to be knowledgeable.

In terms of the proportions of respondents who were not Knowledgeable about rabies disease, the difference between male (81.07%) and female (80.12%) respondents was not significant (p-value= 0.7496). In terms of the area of residence, Embo had more people (80.99%) who were not knowledgeable about rabies as compared to Verulam (79.95%). However, the difference did not reach statistical significance (p-value= 0.7158).

Based on ownership of pets, more respondents who did not own a pet, were not knowledgeable (90.43%) about rabies disease compared to 76.74% who owned a pet that were knowledgeable. The difference between the two groups was highly significant (p-value=0.0001).

Based on the respondent's religion, the people who indicated "other" as their religion had more people (96.30%) who were not knowledgeable. 80.39% of the people who follow the Hindu faith were not knowledgeable about rabies. However, the difference based on religion was not significant (p-value=0.0806).

The difference in the proportions of respondents who were not knowledgeable based on the educational level of the respondents was not significant (p-value=0.1258). However, respondents who had not completed primary had the highest proportion of people (86.14%) who were not knowledgeable, while respondents who had completed tertiary had the lowest number of respondents (73.04%) who were considered not to be knowledgeable about rabies disease.

Table 4. 5: The proportion of respondents based on their knowledge of rabies disease by socio demographic characteristics of the respondents

Variable	Level	[a]Not knowledgeable (%)	[b]Knowledgeable (%)	P-value
Age	18-35	85.09	14.91	0.0037
	36-53	73.96	26.04	
	54	79.69	20.31	
	>71	85.71	14.29	
Sex	Male	81.07	18.93	0.7496
	Female	80.12	19.88	
Residence	Verulam	79.95	20.05	0.7158
	Embo	80.99	19.01	
Do you own a pet?	Yes	76.74	23.26	<0.0001
	No	90.43	9.57	
Religion	Christian	81.42	18.58	0.0806
	African	77.86	22.14	
	Hindu	80.39	19.61	
	Muslim	67.74	32.26	
	Other	96.30	3.70	
Educational level	No education	83.72	16.28	0.1258
	Completed primary	86.14	13.86	
	Secondary not complete	82.18	17.82	
	Completed matric	79.06	20.94	
	Tertiary completed	73.04	26.96	

[a]Respondents scored <60% in the knowledge; [b]Respondents scored ≥60% in knowledge

Results of the attitude and practices by demographic variables are presented in Table 4.6. Based on the age of the respondents, there was a significant difference (p-value=0.0123) between the number of respondents who exhibited a good attitude and practices (i.e., scored ≥60%) towards rabies. More respondents aged 36-53 years (62.15%) had a good attitude compared to the other age groups. The oldest age group (> 71 years), had the least number of respondents (42.86%) with a good attitude.

With respect to sex, there was a significant difference in the proportion of people who exhibited good attitude and practices towards rabies disease. More male respondents (61.79%) had a good attitude compared to female respondents (51.43%).

Based on residence, the results showed that more respondents from Verulam (56.77%) scored high on attitude and practice compared to those from Embo

(53.65%). However, the difference did not reach statistical significance (p-value=0.3839)

Regarding pet ownership, there was a significant difference (p-value=0.0001) in the score for attitude and practices towards rabies. Majority of respondents who owned pets (75.31%) exhibited a good attitude and practices towards rabies compared to those who did not own pets (1.44%).

There was a significant association between high score for attitude and practice and religion (p-value=0.0001). Muslim (67.74%) respondents tended to score higher on attitude and practices as compared to respondents from the other religions. A group of respondents who indicated other as religious affiliation (7.41%) had the lowest number of respondents who scored high on attitude and practices.

There was a significant difference (p-value=0.0001) between the score for attitude and practices towards rabies disease based on education. More respondents who completed tertiary (66.96%) scored high for attitude and practice towards rabies, followed by those who did not complete secondary (61.82%). Those who indicated that they had completed primary had the least number (39.60%) of respondents who exhibited good attitude and practices towards rabies.

Table 4. 6: Score for the attitude and practices on rabies by the socio-demographic characteristics of the respondents.

Variables	Levels	Attitude and Practices (≥60% score)	Attitude and Practices (<60% score)	P-value
Age	18-35	50.12	49.88	0.0123
	36-53	62.15	37.85	
	54-71	57.81	42.19	
	>71	42.86	57.14	
Sex	Male	61.79	38.21	0.0055
	Female	51.43	48.57	
Residence	Verulam	56.77	43.23	0.3839
	Embo	53.65	46.35	
Do you own a pet?	Yes	75.31	24.69	<0.0001
	No	1.44	98.14	
Religion	Christian	59.29	40.71	<0.0001
	African	46.43	53.57	
	Hindu	58.33	41.67	
	Muslim	67.74	32.26	
	Other	7.41	92.59	
Educational level	No education	53.49	46.51	<0.0001
	Primary completed	39.60	60.40	
	Secondary not completed	61.82	38.18	
	Completed matric	48.72	51.28	
	Tertiary completed	66.96	33.04	

4.2 Inferential statistics

4.2.1 Factors associated with high knowledge score

From the output provided in the Table 4.7, considering “Do you own a pet” variable with “No” as the reference level, the coefficient estimate of “Yes” is 1.0254 with the odds ratio of 2.788. Therefore, the chances of being knowledgeable about rabies is significantly higher (p-value=0.0001) for respondents who said that they owned pets.

Considering the respondent’s age, with the category “Over 71” as the reference level, the coefficient estimates of the age group “18-35” years was -0.0706 with odds ratio of 0.932. Therefore, the odds of respondents aged “18-35” years of age obtaining a higher knowledge score were lower compared to the >71 year olds. However, the association was not statistically significant (p-value=0.9490).

The coefficient estimates of the age group “36-53” was 0.5991 with the odds ratio of 1.1030. This means that the chances of being knowledgeable about rabies was higher for respondents between “36-53 years” compared to the reference level. However, the association did not reach significance (p-value=0.5870).

Table 4. 7: Multivariate analysis of factors associated with a high knowledge score on rabies disease

Variable	Coefficient estimate	Standard error	Odds Ratio	95 % Wald Confidence limits		P-value
Own Pet?				Lower limit	Upper limit	
No	**Ref**					
Yes	1.0254	0.2570	2.788	1.721	4.737	0.0001
Age						
>71	**Ref**					
18-35	-0.0706	1.1034	0.932	0.149	18.009	0.9490
36-53	0.5991	1.1030	1.821	0.291	35.170	0.5870
54-71	0.2741	1.1388	1.315	0.191	26.364	0.8098

CHAPTER 5

DISCUSSION

To the best of my knowledge this is the first study to investigate the knowledge, attitude and practices towards rabies disease among respondents in the study area. Few respondents were aware that rabies is caused by a virus. Majority of respondents (86.98%) identified dog bite as the main mode of transmission for rabies to humans. Only slightly over half of respondents interviewed, mentioned that washing of the wound following a dog bite with soap and running water was important for preventing a dog bite victim from developing rabies disease. Similarly, few respondents were aware that licking of an open wound by a suspected rabid dog is one of the ways in which rabies disease spreads from dogs to humans. A very low number of respondents in the present study indicated that they were aware that rabies disease was fatal. However, a considerable number of respondents knew that it is important for one to receive anti-rabies vaccine immediately after being bitten by a dog suspected of having rabies. Overall, the level of knowledge about rabies disease was low. Only pet ownership was a significant predictor of a high knowledge score of rabies.

5.1 Descriptive statistics

5.1.1 Demographic profile of respondents

Out of 768 respondents enrolled for this study, over half of respondents (53.26%) were in the range of 18-35 years of age. Similarly, a study conducted in Jammu, India observed that the majority (55%) of participants were aged 18-29 years (Tandon *et al.*, 2017). However, this was not the case for study conducted in El Jadida region, Morocco where majority (71.3%) of respondents interviewed were aged 40 years and above (Bouaddi *et al.*, 2020).

More females (63.54%) than males were involved in the current study. This observation contrasts with findings by Bihon et al., (2020) and Abdela and Teshome (2017), who observed that male respondents made up 71.4% and 59.3% of the study population respectively.

Almost three quarters of respondents (72.79%) in this study were pet owners. This contrasts with just over half (53%) of the respondents who owned dogs in a study done in Shirsuphal in western India (Tiwari *et al.*, 2019). It also contrasts with findings of a

study conducted in Cameroon in which it was reported that less than half of respondents owned pets (Costa *et al.*, 2018). The findings of the present study suggest a high dog ownership in the study area as compared to other areas. This could be attributed to the high level of crime in South Africa that necessitates households to own dogs as a means of security in addition to provision of companionship.

In this study, slightly less than half (47.66%) of respondents were followers of the Christian religion. Studies conducted in Kombolcha and Dedo district reported that Muslims made up 56.8% and 94.8% of the study population respectively (Abdela *et al.*, 2017; Gebremeskel *et al.*, 2019). The difference observed in terms of the religion followed by the respondents in the different studies, could be due to differences in the dominant religions in the different study areas.

Although most respondents in the current study had not completed secondary education, they only made up 35.81% of the study population. This was followed by those who had completed matric or grade 12 (30.47%). On the contrary, Abdela et al., (2017) reported that 51.1% of respondents in their study did not have a formal education, while 52,5% of respondents in the study done in Berhampur, Odisha had only studied up to a primary school level (Tripathy, Satapathy and Karmee, 2017). This could be explained by differences in the literacy levels in the different study areas.

5.1.2 Knowledge of the disease rabies

In the present study, only 26.95% (n=207) of the respondents indicated that a virus was the agent responsible for rabies. This observation demonstrated that more respondents in the current study did not know the cause of rabies. This is in line with results from the study conducted in Dessie City where only 18% (n=25) of the respondents regarded a virus as the cause of rabies (Gebeyehu and Gebeyaw, 2016). However, results from the study conducted in Kombolcha, Ethiopia, indicated that 76.6% (n=294) of the respondents were aware that rabies is caused by virus (Gebremeskel *et al.*, 2019). This difference suggests a lack or low awareness of rabies disease in the study area of the present study.

Dog bite was mentioned by majority (86.98%) as the mode of transmission for rabies to humans. This is in line with findings from a study by Fesseha (2020), which reported almost a similar proportion (85%) of respondents who mentioned that the rabies virus

was transferred through bites by infected animals. A slightly lower number compared to what was observed in the present, was reported in Philippines, were 79.5% of the respondents indicated that dog bite plays a role in the transfer of rabies to people (Barroga *et al.*, 2018). A study conducted in Haiti also observed that 75.6% of the respondents were aware that rabies can be transmitted via a dog bite (Fenelon *et al.*, 2017). Findings of the present study show that the level of knowledge about the mode of transmission of rabies in the study area is comparable to that which has been observed in other countries like Ethiopia and Philippines.

Licking of an open wound by a dog as mode of transmitting rabies, was mentioned by 11.46% of the respondents in the present study. A very low proportion (1.8%) of members of the community in a study conducted in Haiti were aware that rabies can be transmitted to people through contact between saliva and an open wound (Fenelon *et al.*, 2017). While biting was mentioned by majority of respondents as one of the ways the virus gains entry to the victim, licking of the open wound by the suspected animal was not viewed as being important in the spread of rabies. This suggests that if humans in the study area were licked by a rabid dog, they would not seek medical care. This would hence put them at risk of rabies infection.

Just over half (53.52%) of respondents from this study considered washing of the wound with soap and running water as the first aid to prevent rabies. In contrast, a higher number (92.4%), of respondents from the study in and around South Gondor in North West Ethiopia observed that washing the wound with soap was the first measure before seeking other preventative measure of rabies (Gebremeskel *et al.*, 2019). Findings reported here also contrasted with the findings by Bihon et al (2020), who reported that a very low number of respondents (8.9%) regarded wound washing to be an immediate response to prevent rabies. In view of these findings, while the number of people who indicated that washing of the wound was important as the first step in the prevention of rabies is higher in the present study as compared to what Bihon et al., (2020) reported, there is room for improvement on the understanding of how to prevent rabies in event of a bite among residents in the study area.

In this study, only 16% of respondents considered rabies as a fatal disease. This figure is much lower than the findings from the report by Bihon et al (2020) and Abedela and Teshome, (2017), who observed that 84.6% and 82% respectively of the respondents were aware that rabies cannot be cured once clinical signs appear. The fact that only

few respondents in this study were aware that rabies is not treatable is significant and therefore suggest people are most likely not to seek medical care early. Awareness campaign may be critical to convince the community that the disease is fatal once clinical signs develop.

The current study showed that a considerable number of respondents (78%) knew that they should obtain anti-rabies vaccine immediately after being bitten by dog suspected of having rabies. A slightly lower response (65.2%) was reported in Dedo district of Jimma zone, Ethiopia (Abdela *et al.*, 2017). Even a much lower number was reported by, Abdela and Teshome, (2017) who observed that only 32.7% of the respondents indicated that anti-rabies should be administered immediately following exposure.

Although a much higher number of respondents in this study indicated that it was important to receive anti-rabies vaccines immediately after being bitten by a suspect dog, there is room for improvement to bring the number closer to 100%. The researcher is of the view that everyone should know the importance of receiving anti-rabies treatment immediately after being bitten by a dog suspected of having rabies.

More than 90% of the respondents showed that they were aware that dogs were susceptible to rabies. A similar observation was reported by Digafe et al. (2015) and Straily and Trevino-Garrison (2017) in Gondar Zuria district, Ethiopia and Kansas, US respectively, where the majority of respondents indicated that dogs are largely infected by rabies. This finding is important because it shows that the majority of residents were aware of the role dogs play in the spread of rabies. However, the low numbers of respondents who identified other animals including humans that are susceptible to rabies is a public health concern. It suggests that respondents in the study area were likely to miss a case of rabies in other species.

Over three quarters (79.75%) of the respondents in this study indicated that vaccinating pets was significant for keeping humans safe from rabies. Consistent with findings of this study, most respondents (68%) from Jamma were also of the view that rabies vaccination in dogs helps prevent the disease (Tandon *et al.*, 2017). Dubey et al., (2022) reported a slightly higher proportion of respondents who believed that dog vaccination was a good practice in a study conducted in Jabalpur central India. Such a high number of respondents in this study that was aware of the importance of

vaccinating dogs as measure for rabies control could be attributed to the continuous awareness campaigns carried by GVS. It is important to vaccinate pets as vaccination is known to create a barrier of diseases shared among pets and humans given that they occupy the same space.

Awareness of starting vaccination of dogs at 3 months of age was relatively low among respondents (42.19%) in the study area. However, this contrasts to what was observed by other authors such as Ntampaka et al. (2019) and Mbilo et al. (2019) who reported that only 20.6% in Rwanda and 14% in the Democratic Republic of Congo respectively were aware that vaccination of dogs should start when the dogs are 3 months old. The difference could be because rabies vaccination campaigns in SA involve vaccination of puppies from 3 months of age.

More respondents (87.24%) from this study indicated that they would seek medical attention from human clinic or hospital after exposure to a dog bite. This is a welcome observation given that it is important for people to know where they can receive post exposure prophylaxis (PEP) for effective rabies prevention. This result is consistent with what Edukugho et al., (2018) reported. The latter observed that more than 86% of respondents would report to the hospital or see a doctor when they were bitten by dogs. However, a report by Fesseha (2020), observed that only 55.6% of respondents would seek medical attention following a dog bite. The low number of people who would seek medical care that was reported by Fesseha (2020) in relation to what was observed in the present study suggests that the education of the public regarding how to treat exposed people is very impactful in South Africa.

In the current study, 83.33% of respondents knew that rabies can be transmitted from animals to humans. This is consistent with findings from studies done in Munesa district and Tigray regions of Ethiopia, where 88.7% and 89.5% respectively indicated that humans were likely to contract rabies from animals (Abdela and Endale, 2017; Ebuy *et al.*, 2019).

Majority of respondents (79.04%) in this study thought that it was advisable to obtain anti-rabies vaccination after a bite by a suspected rabid dog. Contrary to findings of this study, other studies conducted in Odisha, India (Tripathy, Satapathy and Karmee, 2017) and Ethiopia (Digafe, Kifelew and Mechesso, 2015) found that respondents who were aware of the importance of receiving anti-rabies vaccination after being bitten by

a dog made up only 14% and 38.8% respectively. This difference could be attributed to differences in the proximity to health care facilities in the study area. Although others may be going with the intention to get anti-rabies others are likely to be going for the wound treatment. It could also be attributed to the frequent rabies vaccination campaigns carried out in the study area by the GVS.

Most people (71.74%) in the present study were aware that if vaccinated against rabies, a person is protected from developing rabies. This is consistent with 87% of respondents from a study conducted in Abuja, Nigeria who reported that they had visited health care facilities to obtain help following a dog bite (Edukugho *et al.*, 2018). On the contrary, just over half (54.9%) of respondents from Tigray region, Ethiopia preferred traditional medicine as treatment following a dog bite incidence (Ebuy *et al.*, 2019). The differences in the number of people willing to receive the anti-rabies vaccine in the different areas, is indicative of the effectiveness of the education campaign offered by the different authorities.

Change in behaviour of the dog and biting people or other animals was mentioned by 74.61% of respondents as a major clinical sign of rabies in this study. These results are in line with the findings reported in Dedo district, Southwest Ethiopia (Abdela *et al.*, 2017), Gondor Zuria, Ethiopia (Digafe, Kifelew and Mechesso, 2015), and Gondar, North West (Bihon, Meresa and Tesfaw, 2020) that reported that 50.4%, 63.5% and 75.8% respondents respectively knew that change in behaviour is one of the signs of rabies.

On the other hand, paralysis as clinical sign of rabies did not feature predominantly. This was expected since paralysis is usually the last sign to be manifested in a rabid dog. It further suggests that paralysis is likely to be overlooked as the sign of rabies by the study population. Therefore, when such people are bitten by a rabid dog even if it was showing paralytic signs, they are not likely to seek medical help or go for PEP.

5.1.3 Attitude and practices of community members towards rabies

There was a considerable number of respondents (81.77%) in this study, that showed a willingness to receive anti-rabies vaccine following a dog bite. This suggests that people are willing to obtain anti-rabies vaccine soon after exposure to prevent rabies. Given that currently there is no available treatment for the disease, this is an encouraging finding. The number of people in the current study willing to receive anti-

rabies vaccine in this study, was a bit higher than that reported in a study done in Berhampur, Odisha, India, in which far less respondents (51%) were willing to obtain anti-rabies as a control measure for rabies following dog bite (Tripathy, Satapathy and Karmee, 2017). An even lower percentage (38.8%) of people from Gondar Zuria District, Ethiopia was willing to obtain anti-rabies in response to dog bite. The difference between the proportion of people with a positive attitude to receiving anti-rabies vaccine observed in the present study could also be attributed to the nature of educational programmes implemented in the different countries.

Most respondents (90.10%) in this study, were willing to seek medical attention in case they became dog bite victims. This is consistent with results of a survey done in Kombolcha, Ethiopia where 89.3% of respondents would seek medical care if they were bitten by an animal suspected to have rabies (Gebremeskel *et al.*, 2019). However, results from this study slightly contrasted with results of a study conducted in and around South Gondar, Ethiopia, which indicated that 79.4% of respondents were not in favor of visiting health care centers following a dog bite (Bihon, Meresa and Tesfaw, 2020).

Slightly over half (52.47%) of respondents indicated that they would put their dogs in quarantine for observation following a dog bite, especially if rabies was suspected. This is comparable to 69% of the respondents from Kigali City, Rwanda, who were found to be in favor of isolation of animals when they start biting people (Ntampaka *et al.*, 2019). However, results from this study were far higher than the findings in Cameroon, where only 2.6% were in favour of confining their dogs for observation when they start behaving unusually including after biting people (Costa *et al.*, 2018).

The current study reported a low percentage of respondents (39.45%) who would put-down the dog if they suspected rabies, while a higher number (60.29%) either did not think it was appropriate to put-down the dog suspected of having rabies or did not know what to do when they see such an animal. This sharply contrasts with results of studies conducted in South Gondar and Kombolcha were 64.3% and 84.1% respectively, indicated that they would kill the dog suspected to have rabies (Gebremeskel *et al.*, 2019; Bihon, Meresa and Tesfaw, 2020). The low numbers of people who were willing to have their animals put down if they suspected them to be rabies positive is likely influenced by the belief that rabies can be treated. Therefore, putting-down the dog to control rabies was not seen as necessary by majority of

people. It is also possible that it is influenced by the religious believes that an animal should die naturally without human interference.

Over half (53.39%) of the respondents in the current study did not sterilise their pets. The low number who would sterilise their pets suggests that people are not concerned about their dogs breeding. This practice might increase the risk of rabies. This is because when the population of dogs is high then more dogs are likely to roam freely especially during mating season. Therefore, dog population control has the potential to reduce the spread of rabies. The number of people who were willing to sterilise their pets in the present study contrast to the numbers that were reported by a study conducted in Sri Lanka by Ubeyratne et al., (2020). The latter reported that up to 86.41% had not sterilised their pets. Consistent with findings of the present study, a study conducted in El Jadida, Morocco reported that just under half (45%) of the respondents indicated that they did not agree with the practice of sterilising their pets (Bouaddi *et al.*, 2020).

A copy of the rabies vaccination certificate was requested from respondents as a confirmation of vaccination of pets in the study areas. A vaccination certificate was valid if the pet had received the vaccine in the previous year or same year when the study was conducted. Just over half of respondents (58.77%) in the present study were able to produce a valid vaccination certificate as proof of vaccination of their pets. This finding is a serious public health concern because it implies that the vaccination coverage in the study area is way below the 70% recommended by the World Health Organization (WHO) (Bouaddi *et al.*, 2020). In a study conducted in El Jadida Region, Morocco (Bouaddi *et al.*, 2020), a higher number of respondents (76.6%) presented rabies vaccination certificates in comparison to the current study. On the other hand, Costa et al, (2018), reported a low vaccination coverage (30.8%) of pets in their study conducted in Cameroon. The differences observed between results of this study and those of other studies, suggests that while the study area is doing well compared to other areas from other countries, there is room for improvement to ensure that the vaccination coverage is at the level recommended by the WHO.

Adhering to repeated regular rabies vaccination helps boost the immune level of pets. Therefore, the fact that up to 75.91% of the respondents in the present study showed willingness to vaccinate their pets, following guidelines provided by the state to vaccinate dogs, is a welcome finding. The results of the present study were slightly

higher than findings reported in El Jadida, Morocco, where 67.8% of the respondents indicated that they appreciated dog vaccination to be repeated once in each year (Bouaddi *et al.*, 2020). However, only 28.1% of respondents in North West Ethiopia indicated that dogs should be vaccinated repeatedly to prevent rabies (Bihon, Meresa and Tesfaw, 2020).

Half of the respondents (50.26%) in the present study, mentioned that to avoid getting rabies from animals, one must avoid any contact with stray dogs, while 81.77% advocated for animals getting vaccinated. These findings contrast with only 33.3% of respondents in Kansas who were of the view that avoiding contact with animals they do not know was key to preventing of rabies (Straily and Trevino-Garrison, 2017), These also contrasts with findings observed by Ntampaka et al (2019), who indicated that the majority of respondents (81.8%) in their study vaccinated their animals to prevent them from getting rabies and 81.2% of respondents from southern Wollo, Ethiopia who indicated that vaccination was important for maintaining a society free from rabies (Gebremeskel *et al.*, 2019).

This study found that just over half (58.07%) of respondents kept their dogs in a fenced place, which is far less than the number of respondents (84%) in Shirsuphal who kept their dogs in a fenced place to limit them from going outside the households (Tiwari *et al.*, 2019). However, a lower percentage of respondents (25%) in the Filipinos kept their animals in enclosed environment to prevent them from roaming freely (Davlin *et al.*, 2014). Findings of the present study contrast with those in Bobo Dioulasso, Burkina Faso (85%) who kept their animals in closed places to prevent dogs from going outside in the streets (Davlin *et al.*, 2014; Savadogo *et al.*, 2021). Preventing contact between dogs and stray animals limits the chance of rabies infection. Therefore, lack of fences around homes with dogs, increases the likelihood of contact between the owner's dogs and other animals that may lead to the rapid spread of rabies. Therefore, confinement of dogs is very important, and clearly needs to be improved on.

Over one quarter (29.56%) of respondents in the present study indicated that they occasionally allowed their dogs to move freely out of the yard unsupervised. However, this figure is lower than what was reported by Costa et al (2018) and Corfmat et al (2022) who reported a significantly higher percentage of respondents (61% and 59% respectively), who indicated that they occasionally allowed their dogs to freely move

out of the yard. Dogs that move freely are at risk of contracting the rabies virus from other infected animals.

It was observed in the present study that 64.32% of respondents, frequently presented their dogs for vaccination during vaccination campaigns. Similarly, it was also observed in the Filipinos that the majority of respondents (64%) consistently vaccinated their dogs to prevent rabies (Davlin *et al.*, 2014). In addition, a study conducted in south Gondar reported similar results, with 69.8% of people showing commitment to dog vaccination (Bihon, Meresa and Tesfaw, 2020). Although the number of people who showed consistency in vaccination of their dogs was high, it was below the recommended 70% vaccination coverage recommended by WHO (Bouaddi *et al.*, 2020). The low number could be because other people are not available during the campaigns due to work or other commitment, while others are unable to handle their dogs and they end up not presenting the dogs for vaccinations. It is also possible that the high the number of dogs that were not confined as observed earlier in this report could explain the low numbers of people who consistently present their dogs for vaccination. This is because such dogs are likely not to be available to be immunized at the time of the campaigns.

Majority (62.50%) of respondents in the present study indicated that dog vaccination is necessary even if dogs are being kept in closed yards. This shows awareness regarding vaccination as a tool to drive rabies elimination.

A very lower response (17.84%) was noted with respect to submitting the carcass of suspected animals to the laboratory to confirm if it had rabies. The results of the study conducted in the Democratic republic of the Congo about submitting carcasses for confirmation of rabies was worse, with only 2% of respondents indicating that they would take the carcass of a suspected rabid animal to veterinary services for laboratory testing (Mbilo *et al.*, 2019). Efforts are needed to increase awareness of the need to submit carcasses of animals that have died for laboratory confirmation. This has the potential to assist in early outbreak detection and improving on surveillance.

Just over half (53.52%) of respondents indicated that they would report animals to the authorities when they suspect them to have rabies. In contrast, a higher percentage (73%) of respondents from Shirsuphal village in western India, indicated that they

would report the presence of rabid dog to the municipal authorities when they encounter them (Tiwari *et al.*, 2019). However, in Debark Worenda, Ethiopia 84.1% of the respondents said that they would kill the animal if they suspected it had rabies (Yalemebrat, Bekele and Melaku, 2016). In the study by Mbilo et al (2019), 20% of respondents indicated that they would alert the veterinary services if they recognized a suspected rabid animal. This completely contrasted with the findings of the present study and the difference could be attributed to the impact of the rabies eradication campaigns. In the results reported here, it was found that change in behavior was reported by a higher number of respondents, while other signs of rabies were less frequently mentioned. These findings are of significant public health importance in that respondents are likely to report to the authorities when they observe change in behavior, which is an important sign of rabies. However, studies show that aggressive animals are likely to become polite when they are rabid. This might be difficult to identify when the animal is rabid.

5.1.4 Knowledge of rabies among residents of the study area

The respondents aged 36-53 years had the highest proportion (26.04%) of people who were knowledgeable about rabies. The number of people who were knowledgeable decreased with increase in age, with respondents aged >71 years having the lowest percentage of people (14.29%) who were knowledgeable. These findings suggest that younger people are more likely to be knowledgeable about rabies compared to the older people. Based on the author's experience, usually it is young people who take their dogs to where rabies vaccinations and eradications campaigns are held to have their dogs vaccinated.

There was a slight difference between the proportions of female (19.88%) and male (18.93%) respondents who obtained a high knowledge score for rabies. Based on these findings the distribution of knowledge is not limited to any specific sex. However, the number of people who were knowledgeable in both sexes was low. In view of this, there is a need to intensify education programmes to increase the number of people with a good level of knowledge about rabies irrespective of their sexes.

The proportions of individuals from Verulam (20.05%) as well as Embo (19.01%) who were considered knowledgeable was very low. Furthermore, the difference between the proportions of individuals from Verulam (urban) and Embo (rural) who were knowledgeable about rabies was very low. These findings could be attributed to the

fact that in South Africa, rural communities usually have meetings to discuss issues around their area. This helps to keep members of the rural communities abreast with issues affecting the communities. It is therefore possible that through these meetings just like the urban dwellers, residents of rural areas also keep themselves abreast with the status of rabies in their areas.

Contrary to findings of the current study, reports from Jammu, India indicate that there was a significant difference (p=0.000) in terms of awareness towards rabies between residential settings (Tandon *et al.*, 2017). The difference between the findings of the present study and the study in Jammu, India, could be attributed to how the education campaigns aimed at eradicating rabies are conducted.

Followers of the Muslims faith (32.26%) tended to score high on the knowledge about rabies as compared to followers of other faiths like Christianity (18.58%), Hinduism (19.61%) and African religions (22.14%). There is no plausible reason to explain these differences. Consistent with findings reported here, a higher percentage (83.1%) of respondents who follow Muslim belief displayed good knowledge towards rabies in a study conducted in Kombolcha Wollo, Ethiopia (Gebremeskel *et al.*, 2019).

It was noted in this study that a higher number of respondents who owned pets (23.26%) had good knowledge towards rabies compared to those who did not own pets (9.57%). Likewise, a study conducted in Jammu, India observed a significant difference (p=0.004) between respondents who had dogs and those who had no pets in terms of rabies knowledge (Tandon *et al.*, 2017). In the case of South Africa, this is likely attributed to respondents who own dogs being exposed to knowledge about rabies during rabies campaigns driven by the GVS.

A higher number of respondents who had attained tertiary education (26.96%) were knowledgeable on rabies compared to those who attained secondary education (17.82%), or had no formal education (16.28%), or completed matric (20.94%) or completed primary (13.86%). These findings were expected because the higher education one obtains, the more likely they are exposed to information on many things including diseases.

5.1.5 The Attitude and practices of respondents towards rabies

A higher number of respondents aged 35-53 years (62.15%) demonstrated a good attitude and practices towards rabies as compared to those aged 54-71 (57.81%), 18-35 (50.12%), as well as those who were above 71 years of age. In view of this, the age of respondents is important with respect to having a good attitude and adopting good practice towards rabies. This could be attributed to increased access to information on several things including diseases through the various social networks they are engaged in.

In this study more male respondents (61.79%) had a good attitude towards rabies compared to their female (51.43%) counterparts. A higher percentage of male respondents (79.9%) from Southern Wollo, Ethiopia, displayed a good attitude towards rabies (Gebremeskel *et al.*, 2019) than respondents in the present study. Contrary to findings of this study, fewer male respondents (28.3%) from communities in Thailand had a good attitude towards rabies (Kiratitana-olan *et al.*, 2021).

In terms of the attitude and practice towards rabies, there was a slight difference with respect to the people with good attitude and practices between respondents from Verulam (56.77%) and Embo (53.65%). More respondents who owned pets (75.31%) had a good attitude towards rabies compared to only 1.44% of those who did not. These results were expected as only people who own pets are likely to attend rabies eradication and vaccination campaigns.

A higher number (67.74%) of respondents who practiced the Muslim faith had a good attitude and practices towards rabies as compared to those who practice or followed the Christian faith (59.49%), Hindus faith (58.33%) and followers of African religion (46.43%). A study conducted in Kombolcha Wollo, Ethiopia, showed that 78.9% of respondents who were followers of Muslim faith were likely to have good attitude towards rabies (Gebremeskel *et al.*, 2019).

A higher number of respondents who had attained tertiary qualification (66.96%) or had completed secondary education (61.82%), displayed a good attitude and practices towards rabies. Contrary to the expectation of the author, over half of the respondents (53.48%) with no formal education had a good attitude towards rabies compared to those who had completed matric/grade 12 (48.72%), as well as those who had

completed only primary schooling (39.60%). The latter had the lowest number of people who had a good attitude towards rabies.

5.2 Inferential statistics

5.2.1 Factors significantly associated with a high knowledge score

The odds of people who had pets obtaining a high knowledge score about rabies was 3 times (AOR: 2.788) that of respondents who did not own pets. This finding was similar to what was observed in a study by Abdela et al., (2017) who reported that dog owners were 2.9 times more likely to have good KAP score than those who did not own dogs (P=0.029). Similar results were observed among residents of Abuja municipal area, where it was found that people who owned dogs were 7.8 times more likely to have a better knowledge of rabies than those who had no dogs (Edukugho *et al.*, 2018). The reason as mentioned earlier, could be that people who own pets are likely to receive information during rabies campaigns when they take their dogs for vaccination.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

The findings of this study clearly show that knowledge of rabies was widespread but only on some aspects of the disease rabies such as how it spreads, its control, the importance of vaccination in prevention of dog rabies. Knowledge of dog bites as route of rabies transmission was also widespread. However, on other aspects such as the cause of rabies, and the signs of rabies in dogs, the number of respondents who were knowledgeable was low. In addition, the number of knowledgeable respondents with respect to the age when to start vaccinating pets for rabies as a preventative measure was very low. In addition, lack of understanding that after clinical signs appear there is no treatment available for rabies that can still be administered was widespread among the respondents.

The knowledge and understanding of the community of the importance of vaccination of pets, quarantining of rabies positive suspected dogs and the appropriate use of PEP have the potential to reduce the burden of rabies significantly. It is essential that people understand the importance of not approaching dogs that they are not familiar with to avoid being infected with rabies, especially when they are not aware of their vaccination status. The high number of people lacking understanding of the need to put down a dog suspected of having rabies, is of concern due to its ability to influence the spread of rabies in the area.

The good attitude displayed by many people towards rabies is a welcome finding from a public health point of view. This is supported by the high number of respondents who indicated that they would report animals that were showing visible signs or were suspected to have rabies.

Based on the number of respondents who were able to produce valid vaccination certificate, the vaccination coverage in this study was below 70%, the level recommended by the WHO. This is a serious public health concern, because it suggests that the vaccination rate against rabies in the area is low and as a result, the risk of exposure to rabies by both dogs and humans in the study could be high.

Households without fences and respondents who allowed their dogs to freely move out-side the homestead unsupervised is also a serious public health concern. Such

practices have the potential to heighten the risk of rabies outbreaks in the area following exposure of dogs to other susceptible hosts.

The poor attitude towards sterilization of dogs in study area suggests that control of the dog population growth in the study area is a challenge. This has the potential to increase the size of the population of dogs at risk of contracting rabies in the study area. In view of this, more resource will be required to avert outbreaks of rabies.

Wild animals that contribute to the sylvatic rabies and domestic animals such as, ruminants, equine and pigs that maintain the urban rabies were barely mentioned among animals susceptible to rabies. Furthermore, besides dog bites, many respondents did not show awareness of other routes of rabies transmission. These findings also have an incredibly significant bearing from a public health point of view, in that respondents might not take the necessary precautions when they encounter wild animals especially those that can spread rabies.

There was no disparity in the numbers of people with a good attitude between respondents from the two communities. As a result, place of residence did not seem play a significant role in the attitude of respondents towards rabies. This is an encouraging finding that needs to be promoted through continued education of people from all walks of life irrespective of their place of residence.

Pet ownership was the only socio-demographic factor that was significantly associated with a high knowledge score for rabies among residents of the study areas in eThekwini district. This highlights the role played keeping pets in owners being knowledgeable on rabies management.

This study recommends based on the gaps in knowledge observed that there should be continuous rabies awareness campaigns in the study areas. Such campaigns should not only be limited to people who own pets. Every member of the community should be included in the program to attain knowledge about this deadly disease.

Education campaigns should include teaching pet owners about the importance of implementing rabies control measures which may include erecting fences around their properties to prevent their animals from coming into contact with other dogs that may predispose them to rabies exposure. This will also help reduce or eliminate the number of free roaming dogs that can be a danger to society. Sterilization should be recommended to pet owners who are not breeding. This can also act as a form of dog

management to prevent an influx of pets. Education programmes for the control of rabies should take into consideration things such as age when to start vaccination of pets and number of doses of the vaccine and that no treatment is available for rabies disease in dogs.

The attitude towards suspected rabid animals needs to be addressed. The awareness campaigns should emphasize the importance of handling suspected animals and reporting each and every animal that is unwell to the authorities. This can be achieved through the collaboration of veterinary services with other institutions to expand and strengthen the awareness in different areas.

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ANNEXURES

Annexure A: Questionnaire (English)

QUESTIONNAIRE DOCUMENT

Topic

Rabies in two (a rural and urban) communities in eThekwini District in KwaZulu-Natal province of South Africa: Knowledge, attitude and practices (KAP).

Aim

The aim of the study is to assess the knowledge and attitude of pet-owners and non-pet owners on rabies disease and also investigate practices associated with rabies in rural and urban communities in eThekwini District in KwaZulu-Natal Province of South Africa.

1. **Demographic data**
   1.1 What is your age?
      1. 18-35
      2. 36-50
      3. 51-70
      4. Above 70
   1.2 Sex of the respondent?
      1. Male
      2. Female
   1.3 Where is your residential setting?
      1. Verulam (urban)
      2. Embo (rural)
   1.4 Do you have a pet dog and/or cat?
      1. Yes
      2. No
   1.5 What is your religion?
      1. Christian
      2. African religion
      3. Hindu
      4. Muslim
      5. Other
   1.6 What is your educational level?
      1. No education
      2. Completed primary
      3. Secondary not completed
      4. Completed Matric
      5. Tertiary completed
2. **Knowledge questions**
   2.1 What is the cause of rabies disease?
      1. Chemical substances
      2. Virus

3. Insufficient intake of feed and water
4. Psychological problem
5. Don't know

2.2 How can human beings become infected with rabies?

1. Dog-bite
2. Playing with the dog
3. Feeding the dog
4. Don't know

2.3 What is the first thing to do after dog-bite while at home?

1. Cover the wound with bandage
2. Cleanse the wound with soap and running water
3. Apply any topical medication
4. Don't know

2.4 Can rabies be cured beyond appearance of clinical signs?

1. Yes
2. No
3. Don't know

2.5 When is it appropriate to receive anti-rabies injection after being bitten by a dog suspected of having rabies?

1. Later
2. Immediately
3. Any time
4. Don't know

2.6 Which of the following are susceptible to rabies?

1. Dogs
2. Cats
3. Human beings
4. Wild animals
5. Ruminants
6. Equine and pigs
7. Don't know

2.7 Is vaccination of pets important for preventing human disease?

1. Yes
2. No
3. Don't know

2.8 At what age do pets (dogs or cats) start to receive their vaccination?

1. Immediately from birth
2. From 3 months, again within 12 months, annually or every 3 years.
3. From 12 months, again every 3 years
4. Never
5. Don't know

2.9 Where can you obtain anti-rabies injections if you are a victim of dog bite?

1. Veterinary clinic or Hospital
2. Any supermarket

3. Human clinic or Hospital
4. Don't know

2.10 Is it possible for rabies to be transmitted from animals to humans?
1. Yes
2. No
3. Don't know

2.11 Is it advisable for someone to get anti-rabies after a bite from a suspected rabid dog?
1. Yes
2. No
3. Don't know

2.12 If you are vaccinated against rabies after being bitten by a rabid dog, will that protect you from developing rabies?
1. No
2. Yes
3. Don't know

2.13 Which clinical signs can make you to suspect rabies in dogs?
1. Change in behaviour and biting
2. Stop eating and drinking
3. Fear of water
4. Salivating
5. Laziness/Lethargic/Paralysis
6. Don't know

3. Attitude towards animal bite

3.1 Do you think it is necessary to receive anti-rabies injection after a dog bite?
1. Yes
2. No
3. Don't know

3.2 What should someone who has been bitten by a suspect rabid dog do following a bite?
1. Nothing
2. Cleanse the wound
3. Seek medical attention
4. Purchase medication for the wound
5. Report to a traditional healer

3.3 What should be done to dog that has bitten someone?
1. Nothing
2. Kill the dog
3. Chase the dog away
4. Quarantine the dog and observe for 7-14 days to see if it dies and also inform the Department of Agriculture (Veterinary services)/ Private veterinarian/Society for the Prevention of Cruelty to Animals (SPCA)

3.4 Do you think it is appropriate to put-down the dog if it is suspected to have rabies?

1. Yes
2. No
3. Don't know

4. Practices of safety towards rabies

4.1 Did you sterilise your pet?

1. No
2. Yes
3. Don't have

4.2 Do you have a copy of certificate of vaccination for your pet, to produce?

1. Yes
2. No
3. Don't have a pet

4.3 How often can you vaccinate your dog?

1. Only once in a life time
2. Never
3. Different interval
4. Don't know

4.4 How do you keep safe from contracting rabies?

1. Staying away from stray animals
2. Always vaccinate your pets
3. Don't know

4.5 Do you keep your dog in a fenced place?

1. Yes
2. No
3. Don't have

4.6 Do you ever allow your dog to go out of the yard unsupervised?

1. Yes
2. No
3. Don't have

4.7 Do you always vaccinate your dog when there are ongoing campaigns?

1. Yes
2. No
3. Don't have

4.8 Do you vaccinate your dog even though it is always restrained?

1. No
2. Yes
3. Don't have

4.9 How do you know if an animal has rabies?

1. When the animal is lazy
2. You only know if you send the animal to the Laboratory
3. Wait until it suddenly dies
4. If it bites people when confronted

5. Don't know

4.10 What do you do when you see a suspect rabies stray dog?

1. Nothing
2. Kill the dog and throw or bury
3. Chase the dog away
4. Report to the Department of Agriculture/Society for the Prevention of Cruelty to Animals (SPCA).

Annexure B: Questionnaire (isiZulu)

UMBHALO WEHLU LWEMIBUZO

Isihloko

Isifo samarabi ezindaweni zemiphakathi yasemakhaya nasemadolobheni ngaphansi koMasipaladi waseThekwini, eNingizimu Afrika: Ulwazi, ummoya kanye nezingqubo (KAP) (***Rabies in rural and urban communities in eThekwini Municipality in KwaZulu-Natal, South Africa: Knowledge, attitude and practices (KAP)***)

Inhloso

Inhloso yocwaningo ukuhlola ulwazi kanye nommoya wabaninizilwane ezingabangane kanye nalabo abangebona abanini bezilwane ezingabangane zasemakhaya. Kanye nokuphonya izenzo ezihlobene nesifo samarabi ezindaweni zemiphakathi yasemakhaya nayasemadolobheni kuMasipaladi weTheku kwaZulu-Natali, eNingizimu Afrika..

1. **Idatha yedemografi**
   1.1 Ngabe unemlnyaka emingaki?
      1. 18-35
      2. 36-50
      3. 51-70
      4. Over 70
   1.2 Ngabe yibuphi ubulili bakho?
      1. Obesilisa
      2. Obesifazane
   1.3 Ngabe uhlala kuphi??
      1. ngaseVerulam
      2. Ngase-Embo
   1.4 Ngabe unenja kanye/noma ikati elingumngani wakho?
      1. Yebo
      2. Qha
   1.5 Ngiyiphi inkolo yakho?
      1. NgeyobuKrastu
      2. Eyesintu/yesi-Frika
      3. EyesiHindu
      4. EyesiSulumane
      5. Ngenye nje inkolo

1.6 Ngabe ukwiliphi izinga lemfundo?

1. Angifundanga
2. Sengiqede isikole sebanga eliphansi
3. Angiqedanga isikole sebanga eliphezulu
4. Sengiqede umatekuletsheni/ibanga leshumi
5. Sengiqede Imfundo yezinga eliphakeme

2. Imibuzo emayelana nolwazis

2.1 Ngabe isifo samarabi sibangwa yini?

1. Wuketshezi lwamakhemikhali
2. Ylgclwane
3. Ukungadli kanye nokungaphuzi ngokwanele amanzi
4. Yinkinga yokusebenza kwengcondo
5. Angazi

2.2 Ngabe abantu bangatheleleka kanjani ngesifo samarabi?

1. Ngokulunywa yinja
2. Ngokudlala nenja
3. Ngokupha inja ukudla
4. Angazi

2.3 Ngabe isifo samarabi singatheleleka kanjani ukusuka esilwaneni esihlanyiswa amarabi ukuya kwezinye izilwane noma kwabanye abantu?

1. Ngokuthintana
2. Ngokulunywa
3. Ngokukhotha inxeba
4. Ngokukhonkotha ezinye izilwane noma abantu
5. Nge-erosol/ngamathonsana avela ezimbotsheni zesikhumba
6. Angazi

2.4 Ngabe yini okufanele ukwenze kokuqala ngemuva kokulunywa yinja ekhaya?

1. Vala inxeba ngebhandeshi
2. Geza inxeba ngensipho nangamanzi agijimayo
3. Gcoba inxeba ngomuthi osebenzayo
4. Angazi

2.5 Ngabe isifo samarabi singalapheka na?

1. Yebo
2. Cha
3. Angazi

2.6 Ngabe yisiphi isikhathi esifanele sokuthola umjovo wesifo samarabi ngemuva kokulunywa yinja osolwa ngokuba nesifo samarabi?

1. Ngemuva kwesiknathi
2. Ngaleso sikhathi
3. Noma ngasiphi isikhathi
4. Angazi

2.7 Ngabe yikuphi okungenwa kalula yisifo samarabi?

1. Yizinja
2. Amakati
3. Abantu
4. Yizilwane zasendle
5. Yizilwane ezetshesayo (isib. Yizinkomo)
6. Izilwane ezimise okwohashi (isib. Amahashi kanye nezimbongolo) kanye nezingulube
7. Angazi

2.8 Ngabe ukuyiviwa kwezilwanyana ezingumngane womuntu kusemqoka ekuvikeleni isifo ukuba singene kumuntu?

1. Yebo
2. Cha
3. Angazi

2.9 Ngabe izilwane ezingumngane womuntu (izinja noma amakati) zingaqala ngayiphi iminyaka ukuthola umjovo?

1. Ngaleso sikhathi ngemuva kokuzalwa
2. Ukuqala ezinyangeni ezi-3, kanti futhi esikhathini esingangezinyanga ezi-12, kanye ngonyaka noma eminyakeni emi-3
3. Ukusuka ezinyangeni ezi-12, futhi eminyakeni emithathu
4. Aziqali nakancane zijoviwe
5. Angazi

2.10 Ngabe ungayithola kuphi imijovo eqeda amarabi uma kwenzeka ulunywa yinja?

1. Emtholampilo wezilwane noma ezibhedlela
2. Kwinoma iyiphi isuphamakethe
3. Emtholampilo wabantu noma esibhedlela

4. Angazi

2.11 Ngabe kufanele ukuthi isifo samarabi sithelelane ukusuka ezilwaneni ukuya ebantwini?

1. Yebo
2. Qha
3. Angazi

2.12 Ngabe kufanele ukuthi umuntu athole umjovo oqeda isifo samarabi ngemuva kokulunywa yinja esolwa ngokuthi inesifo samarabi?

1. Yebo
2. Qha

2.13 Uma ngabe ujovelwa ukuqeda isifo samarabi ngemuva kokulunywa yinja ehlanyiswa yisifo samarabi, ngabe lokho kuzokuvikela ukuthi ungatheleleki ngamarabi?

1. Qha
2. Yebo
3. Angazi

2.14 Ngabe yiziphi izimpawu zasemzimbeni ezingenza ukuthi usole ukuthi inja inesifo samarabi?

1. Ukushintsha indlela yokuziphatha kanye nokuluma kwenja
2. Ukungasadli kanye nokungasaphuzi
3. Ukusaba amanzi
4. Ukuphuma amathe
5. Ukuvilapha
6. Angazi

3. **Ummoya okhona ngemuva kokulunywa yinja**

3.1 Ngabe ubona kufanele ukuthola umjovo oqeda amarabi ngemuva kokulunywa yinja?

1. Yebo
2. Qha
3. Angazi

3.2 Ngabe umuntu olunywe yinja esolwa ngokuba nesifo samarabi kufanele enzeningemuva kokulunywa yinja?

1. Angenzi lutho
2. Ageze inxeba
3. Athole usizo lokwelashwa

4. Athenge umuthi wokwelapha inxeba
5. Kuyiwe enyangeni yesintu

3.3 Ngabe kufanele kwenziwe ini ngenja elume umuntu?

1. Kungenziwa lutho
2. Kubulawe inja
3. Inja ixoshwe ihambe
4. Inja ivoviwe ngomjovo obula ayo futhi ibhekwe izinsuku ezisukela kwezi-7-10 ukubona ukuthi ngabe inja iyafa na futhi nokwazisa uMnyango weZolimo/SPCA (UPhiko oluVikela iZilwane kuBudlova (*Society for the Prevention ofCruelty to Animals*)

3.4 Ngabe ucabanga ukuthi kufanele ukuthi ubu ale inja uma ngabe usola ukuthi inesifo samarabi?

1. Yebo
2. Qhao
3. Angazi

4. Izindlela zokuphepha kwisifo samarabi

4.1 Ngabe inja yakho uyiphakulile/uyivalile inzalo?

1. Qha
2. Yebo
3. Anginaso isilwane esingumngane

4.2 4.2 Do you have a copy of the certificate of vaccination of your pet that you can produce when required?

1. Yebo
2. Qha
3. Anginaso isilwane esingumngane

4.3 Ngabe uyijova kangaki inja yakho?

1. Kanye empilweni yaso
2. Angikaze
3. Amahlandla ahlukahlukene
4. Angazi

4.4 Ngabe uzigcina kanjani uphephile ekuthelelekeni ngesifo samarabi?

1. Ziqhelanise nezilwane ongazazi
2. Hlala njalo ujova izilwane zakhe
3. Angazi

4.5 Ngabe inja yakho uyiccina ingaphakathi kwendawo ebiyelwe?

1. Yebo

2. Qha
3. Anginayo inja

4.6 Ngabe uyo uyivumele inja yakho iphumele ngaphandle kwejaladi?
1. Yebo
2. Qha
3. Anginayo Inja

4.7 Ngabe uh ala uyijova njalo inja yakho uma kunemikhankaso eqhubekayo?
1. Yebo
2. Qha
3. Anginayo inja

4.8 Ngabe uyayijova inja yakho ngisho nomauhlala unqatshelwa njalo?
1. Qha
2. Yebo
3. Anginayo inja

4.9 Ngabe usibona kanjani isilwane esiphelhwe yisifo samarabi?
1. Uma isilwane silvilapha
2. Wazi kuphela uma uthumela isilwane elaborathi
3. Uyayilinda ukuze isheshe ife
4. Uma iluma abantu ngesikhathi ihlaselwa
5. Angazi

4.10 Ngabe wenzani uma ubona inja ongayazi iphelhwe yisifo samarabi?
1. Angenzi lutho
2. Ngizobulala inja bese nglyllahle ekudeni noma ngiyimbele
3. Ngizoyixosha ihambey
4. Ngizobikela uMnyango weZolimo/uPhiko lwezoKuvikelwa kweZilwane mayelana nokuPhathwa ngeSihluku (SPCA).

Annexure C: Consent form

UNISA university of south africa

PARTICIPANT INFORMATION SHEET

Ethics clearance reference number:

Research permission reference number: 2019/CAES_HREC/105

Title: Rabies in two (a rural and urban) communities in eThekwini District in KwaZulu-Natal Province of South Africa: Knowledge, attitudes and practices (KAP)

Dear Prospective Participant

My name is Letsoalo Mohube Titus. I am conducting the study with the University of South Africa (UNISA), under the supervision of Prof James Oguttu, a professor in the Department of Agriculture and Animal Health. You are therefore invited to take part in the study with the above mentioned title. This study will lead to the award of MSc degree (Animal Health) within the same institution.

WHAT IS THE PURPOSE OF THE STUDY?

The study is conducted to assess the knowledge and attitudes of community members on rabies disease and investigate practices associated with rabies in rural and urban communities within eThekwini District. This study will also be extended to find out factors that influence rabies vaccination coverage among pets in the study area.

WHY AM I BEING INVITED TO PARTICIPATE?

The invitation is extended to you as a member of the community living with one or more pets (dogs or cats) and or within the community whereby there are pets moving around which make you a target of the disease rabies. The information obtained from you is crucial to the study in order to determine the level of knowledge, assess the attitude and practices related to rabies within the area.

Permission to conduct the study was obtained from the authorities within the Municipality respectively. The information will be obtained from other selected households to cover the whole area.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

The study involves the use of questionnaires, which will be administered during face to face interviews.

The following areas will be included in the questionnaires:

- Demographic data

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- Knowledge of rabies
- Attitude towards animal bite
- Practices of safety towards rabies

The expected duration of participation and the time needed to complete a questionnaire will be 30-45 minutes per session/household.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

You are at liberty to withdraw from the study without producing any reason on that account. The study is not meant to inflict any form of distress or make you uncomfortable, as the study is secondary to your wellbeing. However, after handing in the questionnaire it will not be possible to withdraw. This is because the questionnaire does not have names of respondents and so it will be difficult to identify the questionnaire that belongs to you.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

The outcome of the study will provide information to the policy makers to design policies that will suit the area and the Department of Agriculture and Rural Development for guidance on the distribution of services related to rabies disease in the study area, which will lead to improved control of the disease, through extension channel to the community and comprehensive rabies prevention and control in pets, which will in turn have a positive impact on the wellbeing of human being and dog population.

ARE THEIR ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

Your engagement in the study has no negative consequences as far as the study is concerned, unless unforeseen circumstances may arise. The study will only keep you away from your routine in order to engage in answering the questionnaire. This will be through taking your valued time in participation.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

All the participant's names will not be revealed in any publications. The participant's name will be replaced with a pseudonym or code to ensure that the answers given are not traced back to the source. This will be retained whenever the findings are to be used.

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

The data presented on hard copies will be filed and kept safe for a maximum period of five years. This data will be duplicated electronically by entering the data in the Microsoft excel

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spreadsheet in a computer. Backup will be stored in external devices and kept safe to a reach by the researcher. The data used for other purposes, will also label or identify the participants with a pseudonym to prevent any damage to the reputation of participants.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

Participation in this study is solely voluntary and there will be no form of reimbursement that participants will receive.

HAS THE STUDY RECEIVED ETHICS APPROVAL

This study has received written approval from the Research Ethics Review Committee of the College of Agriculture and Environmental Sciences, Unisa. A copy of the approval letter can be provided upon your request.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Mr Letsoalo Mohube Titus on +27 79 987 1985 / +27 842621336.

Should you require any further information or want to contact the researcher about any aspect of this study, please contact Mr Letsoalo Mohube Titus on +27 798971985 / +27 842621336 or 51084473@mylife.unisa.ac.za

Should you have concerns about the way in which the research has been conducted, you may contact Prof James Oguttu, e-mail: joguttu@unisa.ac.za. Contact the research ethics chairperson of the CAES General Ethics Review Committee, Prof EL Kempen on 011-471-2241 or kempeel@unisa.ac.za if you have any ethical concerns.

Thank you for taking time to read this information sheet and for participating in this study.

Thank you.

Mr M.T Letsoalo
P O Box 308
Sovenga
0727
Cell: 0842621336
E-mail: lestoalokingsize@gmail.com

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CONSENT TO PARTICIPATE IN THIS STUDY

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the questionnaire.

I have received a signed copy of the informed consent agreement.

Participant Name & Surname..... (please print)

Participant Signature.....Date.....

Researcher's Name & Surname.....(please print)

Researcher's signature.....Date.....

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Annexure D: Ethics clearance

UNISA

UNISA-CAES HEALTH RESEARCH ETHICS COMMITTEE

Date: 11/06/2019

Dear Mr Letsoalo

NHREC Registration # : REC-170616-051
REC Reference # : 2019/CAES_HREC/105
Name : Mr MT Letsoalo
Student #: 51084473

Decision: Ethics Approval from 06/06/2019 to 31/05/2020

Researcher(s): Mr MT Letsoalo
51084473@mylife.unisa.ac.za

Supervisor (s): Prof JW Ogutu
jogutfhu@unisa.ac.za; 011-471 3353

Prof CA Mbajiorgu
mbajica@unisa.ac.za; 011-471-3590

Working title of research:

Rabies in rural and urban communities in Ethekwini municipality in Kwazulu-Natal Province of South Africa: Knowledge, attitude and practice (KAP)

Qualification: MSc Agriculture

Thank you for the application for research ethics clearance by the Unisa-CAES Health Research Ethics Committee for the above mentioned research. Ethics approval is granted for a one-year period. After one year the researcher is required to submit a progress report, upon which the ethics clearance may be renewed for another year.

Due date for progress report: 31 May 2020

*The **minimal risk application** was **reviewed** by the UNISA-CAES Health Research Ethics Committee on 06 June 2019 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

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1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No field work activities may continue after the expiry date. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:
*The reference number **2019/CAES_HREC/105** should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

Prof MA Antwi
Chair of UNISA-CAES Health REC
E-mail: antwima@unisa.ac.za
Tel: (011) 670-9391

Prof MJ Linington
Executive Dean : CAES
E-mail: lininmj@unisa.ac.za
Tel: (011) 471-3806

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Annexure E: Permission to conduct research from State Veterinary office

agriculture
& rural development
Department:
agriculture
& rural development
PROVINCE OF KWAZULU-NATAL

KZN Department of Agriculture & Rural Development
Private Bag X3451, Durban, 4000
Enquiries: Dr S Dhanilall
Tel: 031 3268200
Free: 0800 002 866
Email: shavetha.dhanilall@kzndard.gov.za
Website: www.kzndard.gov.za

31 May 2019

To Whom it May Concern,

PERMISSION FOR STUDY TO BE CONDUCTED IN ETHEKWINI DISTRICT

Dear Sir/Madam,

This letter serves to confirm that this office, State Vet Ethekwini, has no objection to Letsoalo Mohube Titus conducting his study on 'Rabies in rural and urban communities in Ethekwini Municipality in KwaZulu-Natal Province of South Africa', within the Ethekwini State Vet area.

Kind regards,

Signature of Official Veterinarian

Name in print: Dr. S. D. Dhanilall
Designation: State Veterinarian Ethekwini District
Telephone: +27 (0)31 3268300
Email: shavetha.dhanilall@kzndard.gov.za

Official Stamp

Republic of South Africa
Department of Agriculture
Veterinary Services
2019 -05- 31
Official Veterinarian
Ethekwini District
Province of KwaZulu Natal