DOG ECOLOGY AND EPIDEMIOLOGICAL STUDIES OF CANINE RABIES IN ABA, ABIA STATE, NIGERIA

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DEPARTMENT OF PUBLIC HEALTH AND PREVENTIVE MEDICINE
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JUNE, 2014

DECLARATION

I declare that the work presented in the thesis entitled **'Dog ecology and epidemiological studies of canine rabies in Aba, Abia state, Nigeria'**has been carried out by me in the Department of Veterinary Public Health and Preventive Medicine .The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this thesis was previously presented for another degree or diploma at this or any other Institution.

_____ _____ _____

Gbeminiyi Richard OTOLORINSignature Date

CERTIFICATION

This thesis **"Dog ecology and Epidemiological Studies of Canine Rabies in Aba, Abia state Nigeria"** by **Gbeminiyi Richard OTOLORIN** meets the regulations governing the award of **Master of science (**M.Sc) degree of the Ahmadu Bello University, Zaria and is approved for its scientific contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to God Almighty who gave me the wisdom and grace to accomplish this research work and to my late mum Mrs Josephine NnamakaOtolorin.

ACKNOWLEDGEMENT

My special thanks and appreciation goes to God Almighty for giving me the strength, wisdom and grace to carry out this research work.

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ABSTRACT

Rabies is an acute fatal viral zoonotic disease that affects all warm-blooded vertebrates and ischaracterized by central nervous system infection, followed by paralysis and death. For a proper understanding of the epidemiology of canine rabies in an area, it will be meaningful to study the ecology and population biology of dogs in the area. A descriptive and cross-sectional study was designed to assess the level of vaccination against rabies, factors associated with dog bite, to study dog ecology and also to detect the presence of rabies antigen in brain tissues of dogs slaughtered for human consumption in Aba, Abia State.Information was obtained from the Zonal Veterinary Clinic, Aba on dog bites and dog vaccination records covering six (6) years (2007-2012). Out of the3,169 dogs that were presented to the Veterinary Clinic,1354 (42.7%) received anti-rabies vaccination. Males (58.2%), exotic breed (50.6%) and dogs within 3 to 12 months of age (44.2%) had the highest frequency of vaccination.Out of 215 human dog bite cases, 11.6% were in individuals < 15 years of age while 44.7% were in individuals>30 years of age and 62.8% of the bites occurred among males.Most of the dog bites (63.7%) occurred on the leg.The study revealed that the 500 households surveyed had 5,823 individuals and 747 dogs, giving a dog-to-human ratio of 1:7.8. Thus the dog population in Aba is estimated to be 68,121.Of the 747 dogs, 66.3% were exotic,62.2% were males while 37.8% were females. About 63.8% of the households had fences that restricted dog movement. There were associations between breeds of dogs (χ^2= 79.8, df = 2, P< 0.05), age of dogs (χ^2= 22.9, df = 2, P<0.05) and vaccination against anti-rabies.Exotic breed (adjusted OR = 0.39; CI= 0.23- 0.65) and local breed of dogs (adjusted OR= 0.08; CI= 0.04 – 0.14) had less odds of being vaccinated as compared to cross breed of dogs, Similarly dogs used as guard dogs (adjusted OR = 0.65; CI = 0.37 – 1.12) and dogs used for breeding/sales (adjusted OR = 0.41; CI= 0.22 – 0.79) purposes had less odds of being vaccinated as compared to dogs used as pets. One hundred

and twenty six (126) dogs were estimated from street counts survey. Rabies antigen was detected in 13 out of 185 (7.0%) brain samples examined by direct fluorescent antibody test. The relatively high dog-to-human ratio, low vaccination coverage of owned dogs population, increasing reports of human dog bite cases and the presence of rabies antigen in dogs slaughtered for human consumption pose public health concerns and require adequate and well planned intervention through public health education and anti-rabies vaccination campaigns.

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ABBREVIATIONS

ABSG - Abia State Government

CDC - Centre for disease prevention and control

LGA - Local Government Area

MM - Millimetres

^{o}C - Degree Celsius

WHO - World Health Organization

WSPA - World society for the Protection of Animals

CHAPTER ONE

INTRODUCTION

1.1 Background Information

Rabies is an acute infection of the central nervous system. Itis characterized by central nervous system irritation, followed by paralysis and death (Harper, 2004). The disease is of viral aetiology and all warm-blooded vertebrates can be affected (Zulu *et al*., 2009). Rabies virus belongs to the *Lyssavirus*genus, of the family *Rhabdoviridae* within the order *Mononegavirales* (Tordo*et al.,* 2006). Based on antigenic characterization of panels of lyssaviruses, seven genotypes are currently recognized (WHO, 2005; Tordo*et al.,* 2006). These are classical rabies virus (RABV, genotype 1), Lagos bat virus (LBV, genotype 2), Mokola virus (MOKV, genotype 3), Duvenhage (DUVV, genotype 4), European bat lyssavirustype-1 (EBLV-1, genotype 5), European bat lyssavirustype-2 (EBLV-2, genotype 6) and Australian bat *lyssavirus (*ABLV, genotype 7). Also, four putative viruses (Aravan, Khujand, Irkut and West Caucasian bat virus) have been reported. More recently, Shimoni bat virus isolated in 2009, Bokeloh bat lyssavirus(Freuling*et al.,* 2011) and the Ikomalyssavirus (Marstron*et al*., 2012) were discovered in 2011 and 2012 respectively. The virus is found in the salivary glands and central nervous system of infected warm-blooded animals (including humans).

Worldwide, approximately 55,000 people die each year from rabies. The highest risk of human infection is from rabid dogs (Harper, 2004). In endemic areas, rabies virus is maintained in two interrelated ecological niches(Woldehivet, 2005), an urban cycle (largely limited to domestic dogs and cats) and a sylvatic (wildlife) cycle. This varies between geographical regions (Kaplan *et al.*, 1986). The dog is the major reservoir of rabies in Africa (Oboegbulem,1994;WHO, 2005).

Human fatalities associated with rabies occur in people who fail to seek medical assistance usually because they are unaware of their exposure, lack access to treatment or have no resources for the treatment (CDC, 2002). Rabies post exposure prophylaxis if given promptly to exposed humans is highly effective and it includes: wound cleansing, immunization with a human rabies modern cell culture vaccine, and administration of human rabies immunoglobulin (HRIG) (CDC, 1999). A successful rabies control programme depends on knowledge of local dog ecology, which includes dog population density, dog population structure as well as pattern of dog ownership (Hsu *et al.*, 2003; Cleaveland*et al.*, 2006).

1.2 Statement of the Research Problem

The domestic dog is themain source of exposure and vector for human rabies in Africa (Zinsstag*et al*., 2007). The domestic dog (*Canisfamiliaris*) plays a pivotal role in rabies transmission, with 85-95% of human rabies cases being associated with dog bites due to their close association with man (Mckenzie, 1993). Rabies remains a major public health threat and this is attributable to the low priority given to the disease (Ogo, 2009). Aba is a densely populated city and there are no religious or cultural restrictions to the keeping of dogs; hence dogs are freely kept by homes in the city. Presence of dump sites in some locations in the city encourages dog movement as they scavenge for food. Dog meat processors also ply their trade in specific regions in the city and majority of these individuals are unaware of the risk they are exposed to in the course of their activities.

A study by Aliyu*et al*. (2010) established the presence of rabies antigen in 44%of apparently healthy dogs slaughtered inYola, Nigeria.Also, Ehizibolo*et al*.(2008) reported that out of 189 brain samples of dogs from different part of Plateau State submitted to the Rabies Diagnostic Laboratory of the National Veterinary Research Institute (NVRI) Vom, 115(60.8 %) tested positive. Also studies carried out in various parts of the country have reported the presence of

rabies antigen in the brain of some of the dogs slaughtered for human consumption (Ajayi, 2006; Sabo *et al*., 2008; Idachaba*et al*., 2009; Akombo, 2009 Odeh*et al.*, 2013; Isek, 2013). This could have far-reaching implications since these dogs could be potential sources of the virus. Dog meat is regarded as a delicacy and is consumed by some communities in Nigeria, thus constituting a great public health risk to dog handlers and butchers who may be exposed to the virus (Ajayi*et al.*, 2006).

The human population in Africa expanded enormously during the 20th century, and the dog population expanded in parallel (Brooks, 1990). Social change such as urbanization resulted in an increase in human and dog movement as well as interactions between domestic and stray dogs. This may have enhanced persistence of the rabies virus in the local dog population and greater movement of infected dogs (Bingham, 2005).

1.3 Justification of the Study

Understanding of the epidemiology of rabies in dog populations is crucial in controlling the disease (Widdowson*et al*., 2002). Dogs are the most widely spread and abundant of all carnivores (Wandeler*et al*., 1993), therefore it is important to study the role of dogs in human cultures and the impact of their interactions. This can be achieved by having a good knowledge of the epidemiology of canine rabies through studying the ecology and population biology of dogs (Wandeler*et al*., 1993). Even though some studies have shown prevalence of rabies antigens in the brain tissues of apparently healthy dogs slaughtered for human consumption in some parts of the country, (Sabo *et al*., 2008; Akombo, 2009;Idachaba*et al*., 2009; Aliyu*et al*.,2010) confirming the presence of the disease and its health risk to the general public,there is a dearth of this information in many other parts of the country, including Aba, Abia State.

Canine ecology studies can generate information that public health workers and veterinarians can use to characterize owned-dog populations and plan vaccination campaigns, hence reducing the risk of rabies in domestic animals and humans (Flores- Ibara and Estrella-Valenzuela, 2004). Knowledge of the epidemiology of rabies in dogs and the ecology of dogs including their population density and structure in Aba, Abia State will equip public health workers with relevant data that will help in the planning of rabies control programmes in this area.

1.4 Theoretical Framework

The structure and turnover of a dog population is determined by a great number of different factors. Its analysis depends on vital statistics such as sex and age ratios, natality and rearing success, survival and mortality rates (WHO/WSPA, 1990).Rabies has a high incidence in dogs in areas where dog populations reach high densities and wherethe animals are poorly supervised(WHO/WSPA, 1990). Free-roaming and unvaccinated dog population may increase the likelihood of the spread of rabies virus. Well-planned and executed vaccination campaigns may reduce rabies incidence in dog drastically and may even eliminate the disease in areas where the virus is not maintained in wildlife (Wandeler*et al*., 1993).

The direct fluorescent antibody test (DFAT) is the gold standard for rabies diagnosis (CDC, 2011). This is based on detection of rabies virus antigen by visual observation of specific antigen-antibody reaction. This technique operates on the principle that anti-bodies (immunoglobulin G) labelled with flouresceinisothiocyanate react with specific antigen in the brain smear and the product is viewed under ultra violet light as described by Dean *et al*. (1996). Apple green fluorescence indicates the presence of rabies antigen. Detection of rabies

antigen indicates presence of the virus which is a significant factor in transmission of rabies from slaughtered dogs to the dog meat processors.

Dog ecology questionnaire surveys produce information on dog human ratios, dog keeping practices,reproduction, morbidity and mortality (Wandeler, 1993). Also understanding some determinants or risk factors associated with rabies such as age, breed, season and location are all critical in the epidemiological studies of rabies (Widdowson*et al*., 2002).Therefore, the study of the dog ecology, the assessment of frequency of dog bites and vaccination of dogs, detection of rabies antigen in dogs slaughtered for human consumption; will together be useful in elucidating the epidemiology of rabies and devising effective preventive and control strategy against rabies transmission in the study area.

1.5 Aim and Objectives of the Study

1.5.1 Aim: To determine the ecology and role of dogs in the epidemiology of rabies in Aba, Abia State.

1.5.2 Objectives

The objectives of this study are:

1. To assess the level of dog vaccination against rabies and cases of dog bites from the Zonal Veterinary Clinic Aba, Abia State, Nigeria.
2. To assess factors associated with dog bites such as age, sex, location of bite and season.
3. To determine the distribution, structure and population density of dogs and the pattern of dog ownership (dog ecology) in Aba, Abia State.
4. To detect the presence of rabies antigen in the brain tissues of dogs slaughtered for human consumption in Aba ,Abia State.

1.6 Research Questions

I. What is the vaccination status of dogs against rabies and pattern of dog bite cases in Aba South, Abia State?

II. What are the factors associated with dog bites in Aba, Abia State?

III. What is thedog distribution, structure, population density and pattern of ownership of dog population in Aba, Abia State?

IV. What is the prevalence of rabies antigen among slaughtered dogs in Aba, AbiaState.

CHAPTER TWO

LITERATURE REVIEW

2.1 Dog Ecology

Dog ecology studies dog population density, dog population structure as well as pattern of dog ownership (Cleaveland*et al.*, 2006).In developing countries, the domestic dog is the most important reservoir and vector of human rabies, accounting for 99% of exposures (WHO, 1992). Rates of disease transmission depend on the density of the dog population and social behaviour that determines the extent of contact(Maherisoa, 2007).

Bogel and Meslin (1990) have convincingly argued that effective dog vaccination is the most cost-effective approach to reducing human rabies in comparison to strategies based solely on post-exposure treatment of humans.Domestic dogs are present on every continent and practically every island settled by humans. Only in a small minority of cultures are dogs completely rejected. The dog:human ratio most commonly lies between 1:6 and 1:10, but considerable variation exists (Oboegbulem and Nwakonobi, 1989). Urban areas in Africa have a ratio of 1: 21, while rural areas in Africa have a ratio of 1:7.4(Knobel*et al*., 2005).

Rabies epidemiology in the dog is directly associated with dog ecology. Thus, better understanding of dog ecology would be useful for designing appropriate rabies control measures in the dog population (Matter, 2000).Mass vaccination of domestic dogs has been shown to effectively control canine rabies and hence human exposure to rabies. Knowledge of dog population demography is essential for planning effective rabies vaccination programmes. However, such information is still rare for African domestic dog populations, particularly in urban areas (Gsell, 2012).

As recognised by World Health Organization (WHO,1988) dog demography study is key to addressing many of these knowledge gaps. Rapid changes in human and dog demographics have important implications in the control of rabies (Hampson, 2009). Rates of urbanization in Africa are amongst the highest in the world (UN, 2005), and urban communities often are characterised by highly mobile, rapidly increasing and closely-linked human and dog populations. Therefore, gaining better understanding of dog demography and ecology in these expanding urban communities remains a high priority. Estimates of worldwide dog abundance are at around 500 million, with factors such as geography, climate, availability of food and shelter influencing local abundance (Wandeler*et al*., 1993).A number of methods have been suggested to enumerate dog populations, including the use of block count, mark-recapture using paint solution sprays (Totton*et al*, 2010), household surveys (Kitala, 2001), collar marking with transect line recaptures (Matter and Daniel, 2000) and distance sampling (Childs *et al.*,1998).

Recently, the mark-resight framework has been applied to estimate dog abundance using ear-notched marks made during Animal Birth Control (ABC) programmes (Hiby*et al*, 2011).Methods are available for estimating the number of free-roaming carnivores, all of which are based on two assumptions: that the mortality, emigration and recruitment into the population are minimal during the period of census, or that corrective factors can be incorporated into the resultant estimates and that all individuals within the population to be estimated have an equal chance of being counted (WHO, 1990).

2.2Survey of Observation Inventory by Questionnaire.

This is conducted to quantify and assess dog population through direct observation inventory. It should be noted that surveys on questionnaires alone lead to a preponderance of data

concerning restricted and semi- restricted dogs. In areas where relatively unrestrained dogs predominate, capture/recapture and dog accessibility studies will help to correct such biases (WHO, 1988). The use of questionnaire has been employed in most dog population studies (Aiyedun and Olugasa, 2012;Omudu*et al.*, 2010; Akombo, 2009).

Data such as number of owned dogs, age ratios, sex ratio, rate of reproduction and dog keeping practices and useful services rendered by dogs can be obtained via questionnaire based surveys (WHO,1990). The household information contained in such designed questionnaires includes garbage scavenging by dogs, dog control, dog numbers and gender, other animals kept, and whether any householder had been bitten by an animal in the previous 12 months. While Individual dog information includes: sex, age, owner, source, function, confinement, food sources, vaccination history, number of litters produced by female dogs and information on the last litter (WHO, 1987).

2.3Capture/Recapture Techniques and Dog Accessibility Studies

2.3.1 Total population size estimated from total or direct counts

This method simply consists of making direct visual counts of individual dogs in a defined geographical area and within a limited period of time in order to meet the assumptions mentioned above. Direct counts are not practical over large geographical areas or in sizeable cities but can be used in small communities and rural situations where dog populations are small(WHO,1990).

2.3.2 Total population size estimated from rate of capture

Here estimates of dog populations can be obtained by graphically plotting either the sum of daily captures, the cumulative sum of captures, the probability of capture or the catch-effort

required. Plots can be smoothed and /or extrapolated to provide estimates of dog population size(WHO,1990).This technique was employed by (Okoh,1988) to estimate dog population size in Plateau State.

2.3.3 Total population size estimated from recaptures

This is based on the use of a simple ratio obtained by capturing a number of individuals, marking or tagging them, and releasing them back into the population. This technique has been utilized by (Akombo, 2009)to estimate dog population size. The population is subsequently sampled again by trapping or field observation and the total number of dogs caught (observed) and the numbers that are marked are determined(WHO,1990).

Estimated dog population =

$$\frac{\text{Number. of dogs caught marked and released} \times \text{Number of dogs subsequently caught}}{\text{Number of marked dogs recaptured}}$$

2.3.4 Total population size estimated from photographic recaptures (Beck's method)

It is not actually necessary to capture and mark animals if they are individually distinguishable so as to determine recaptures. Dogs are so variable that they lend themselves to this sampling approach. It is difficult to remember every dog observed, but photographing every individual dog while surveying the same area, in the same way on two or more occasions, will generate the data that can use the recapture portionestimate the population of dogs in the area using the formula.

$$N = \sum (Mn)/\sum m$$

Where:

M = the number of dogs photographed each time and considered " marked", i.e. "observed";

m = the number of dogs recognised as being previously photographed i.e. " re-observed" ;

∑m = the summation of m to that point in time.

n = the total number of dogs previously observed, i.e. each day's observations (M) less those previously observed (m) would be added to each day;

Mn = the product of each days M and n ;

∑(Mn) = the summation of Mn to that point in time, and

N = the population estimate (WHO/WSPA, 1990).

2.3.5 Participatory research.

Human demographic and social data, dog population and structure, community resources, knowledge, as well as qualitative and quantitative data on all relevant factors can be collected, assessed, applied and evaluated by community residents. In addition, when ecological research is embedded in the context of a participatory health system control campaign, it increases community awareness in indigenous terms of the rabies problem. Participatory rabies research should take inventory of every household in the community and involve as many individual community members as possible(WHO,1990). .

2.4Dog Population Structure

The ratio of owned dogs to people is usually higher in rural areas of a country, but there is also considerable variation within cities(Lembo, 2010). The structure and turnover of a dog population is determined by a great number of different factors. Its analysis depends on vital statistics such as sex and age ratios, natality and rearing success, and survival and mortality rates(WHO/WSPA, 1990).The ground survey method for dog population census is considered to be prone to error in enumeration. As aresult, use of aerial photography has been suggested as capable of enhancing ground survey methods for moreaccurate results.(Aiyedun

and Olugasa, 2012).Aerial photograph of Ilorin, Kwara State Nigeria was utilized in a study as a guide to enhance dog population study (Aiyedun and Olugasa, 2012).Some dog population densities studies in Nigeria have been carried outapplying techniques such as total street-dog count,estimates from the rate of capture and re-capture (Akombo, 2009, El-yugud*aet al.,* 2007; Okoh,1988; Ezeokoli and Umoh, 1986).

2.4.1 Age ratios and age determination

Data on the age structure of the owned segment of a dog population can be collected by an inquiry of owners because they provide important information regarding the population e.g young to adult ratios are an indication of natality and productivity of the populations and of the pattern of mortality (WHO, 1990). Data regarding age should be collected by months/year in questionnaire surveys and/or at the time of vaccination. The size of the unvaccinable population (under 3months of age), of the juvenile dogs entering the vaccinable population, and the portion of the adult population which is unvaccinated are all data needed in planning vaccination strategies (WHO, 1988).

2.4.2 Sex ratio

Data on sex ratio are needed in order to understand and interpret other vital statistics that are frequently expressed separately for each sex. Variation in dog/sex ratios are commonly expressed as the number of males per 100 females. The sex ratio of owned dogs is inquired by questionnaire surveys (WHO, 1990). Sex ratio data will be needed for understanding population dynamics and canine reproduction patterns (WHO, 1988).

2.4.3 Dog reproduction and rearing success.

Measurements of natality and rearing success are indicative of population dynamic processes. Data needed to determinenatality and rearing success include the number of adult breeding female, the number of young born per adult female and the number of young that remain alive to adulthood (WHO, 1990).

2.4.4 Habitat analysis

Some of the specific elements that comprise dog habitats are shelter/housing, water and foodsex ratio, rate of reproduction, dog keeping practices and useful services rendered by dogs (WHO, 1990). In Africa, dogs are heavily dependent on humans for food and shelter, so the size of dog populations can be correlated with the human population (Matter, 2000).

2.5Categorization of Individual Dogs According to Restriction and Dependency on Humans.

The World Health Organization (WHO) has highlighted dog categories based on the dog's level of dependence (i.e. intentional provision of resources) and level of restriction by man namely; Restricted (supervised) dogs - fully dependent and fully restricted by man, Family dogs – fully dependent and semi-restricted, Neighbourhood dogs - semi-dependent and semi-restricted, Unrestricted (unsupervised) dogs - semi-dependent and unrestricted and Feral dogs - independent and unrestricted (WHO, 1990).A study to determine Populationdensity and ecology of dogs in Nigeria (Oboegbulem and Nwakonobi, 1989) revealed that in the urban areas a small proportion (22%) of the dogs are confined during day time only, while most of the dogs(particularly the guard dogs) are permitted freedom during the night. The free movement is usually within fenced premises or a very small home range within the neighbourhood. In the rural areas, where 96% of the owned dogs are never confined, the feeding pattern is adapted to different local

2.6 Rabies in Nigeria

Rabies is endemic in Nigeria and remains an important public health issue.This is because dog bites are common and regular routine vaccination of dogs are very low (Adeyemi and Zessin, 2000). The 2006 census estimated that there were between 2 and 5 million dogs in Nigeria (Meseko, 2010).Clinical records and epidemiological studies have established that, in Nigeria, the dog is the primary or maintaining reservoir of rabies, accounting for over 90% of animal cases(Boulger and Handy, 1960).The endemicity of rabies in Nigeria has been well documented(Opaleye*et al.*,2006).Although available records on rabies in Nigeria are far from complete, reports of human deaths from rabies in the country are a matter of great concern (Fagbami*et al.*,1981).Gross under reporting is another factor responsible for the continued endemicity of rabies in Nigeria and has affected rabies elimination especially in Nigeria. Rabies is no doubt underreported and probably misdiagnosed in Nigeria and elsewhere in Africa (Fagbami*et al.*,1981).

Rabies remains a very important public health problem in Nigeria posing serious fear to the populace and about 10,000 annual human cases is reported in Nigeria (Nawathe, 1980). The first laboratory confirmation of rabies in Nigeria was in 1925 by the demonstration of negri bodies in the brain smear of a rabid dog (Boulger and Handy, 1960).Reported cases of dog bites and rabies in humans in Nigeria are low; this could be attributed to under-reporting, or lack of knowledge of the danger of rabies to humans and cultural beliefs in the area (Oginni*et al.*, 2002).

The 1942 annual report of the veterinary division of northern Nigeria recorded canine rabies outbreaks from Kano, Zaria, Bornoand Ilorin States and in 1946 outbreaks were reported from Plateau, Benue and Enugu states. A more extensive record complied from the annual reports of the rabies diagnostic laboratory at the National Veterinary Research Institute

(NVRI) Vom, indicated that during the period 1928 to 1990, 3,555 out of 3,770 animal rabies cases confirmed in Nigeria occurred in dogs (Idachaba, 1999).

Because of the dominant role dogs play in the anthropophilic transmission of rabies to humans (Teuliere*set al,*1988), the idea of routine prophylactic vaccination of dogs has been generally accepted for effective control ofurban rabies world-wide (WHO,1989).Additionally, an estimated 10 million people received post exposure vaccination treatment each year due to bites from rabid suspected animals (WHO, 2001).

When animal rabies control measures are inadequate, animal rabies then spills to human population at risk due to the bite of man by rabid animals (Adeyemi*et al.*, 2005),thus, early diagnosis of rabies in dogs and other animals forms the basis for post-exposurehuman rabies vaccination and treatment. Single dose of human rabies vaccine is three times more expensive than animal rabies vaccines in Nigeria(Adeyemi*et al*., 2005).Also five doses of human rabies vaccines are required for post-exposure treatment of each confirmed rabid dog-bite victim.The head and face are the most common sites of dog bites in studies in the developed countries (Croft,1997) whereas the lower limbs is the commonest site in studies carried out in Ilorin, Kwara state Nigeria (Ojuawo, 2000). Not all the victims of a dog bite seek medical help. Unquestionably the level of knowledge of the community and concern about dog bite injuries has an important role to play in dealing with this problem (Khokhar, 2003)

CHAPTER THREE

MATERIALS AND METHODS

3.1 Study Area

The study was carried out in Aba, Abia State, located in South Eastern Nigeria, consisting of two Local Government Areas, Aba North and Aba South. Aba is a major urban settlement and commercial centre in a region that is surrounded by small villages and towns. Aba is well known for its industrial nature, involving manufacturing, buying and selling. It has the largest concentration of people in the State. It is the largest commercial centre in the State with the famous Ariaria Market sited west of the town. Aba lies between latitudes 5^{o} 07' N and longitude 7^{o} 22'E with an area of 72 km**².** Thehuman**population of Aba is estimated at 531,340 according to the 2006 population census**.Aba is linked closely by road to Port-harcourt (Rivers State), Owerri (Imo State), Umuahia(Abia State capital), IkotEkpene and IkotAbasi (AkwaIbom State).With an average temperature of about 21^{o}C, the climate is humid tropical type and is characterized by wet and dry seasons. The agricultural practices depend solely on the annual rainfall which has a mean value of 200mm and relative humidity of 80%.There is a Zonal Veterinary Clinic located in the center of the city, and two other government veterinary clinics located in the city, with nine (9) privately owned veterinary clinics. Government and private health care centres are evenly spread across the city (ABSG, 2012).

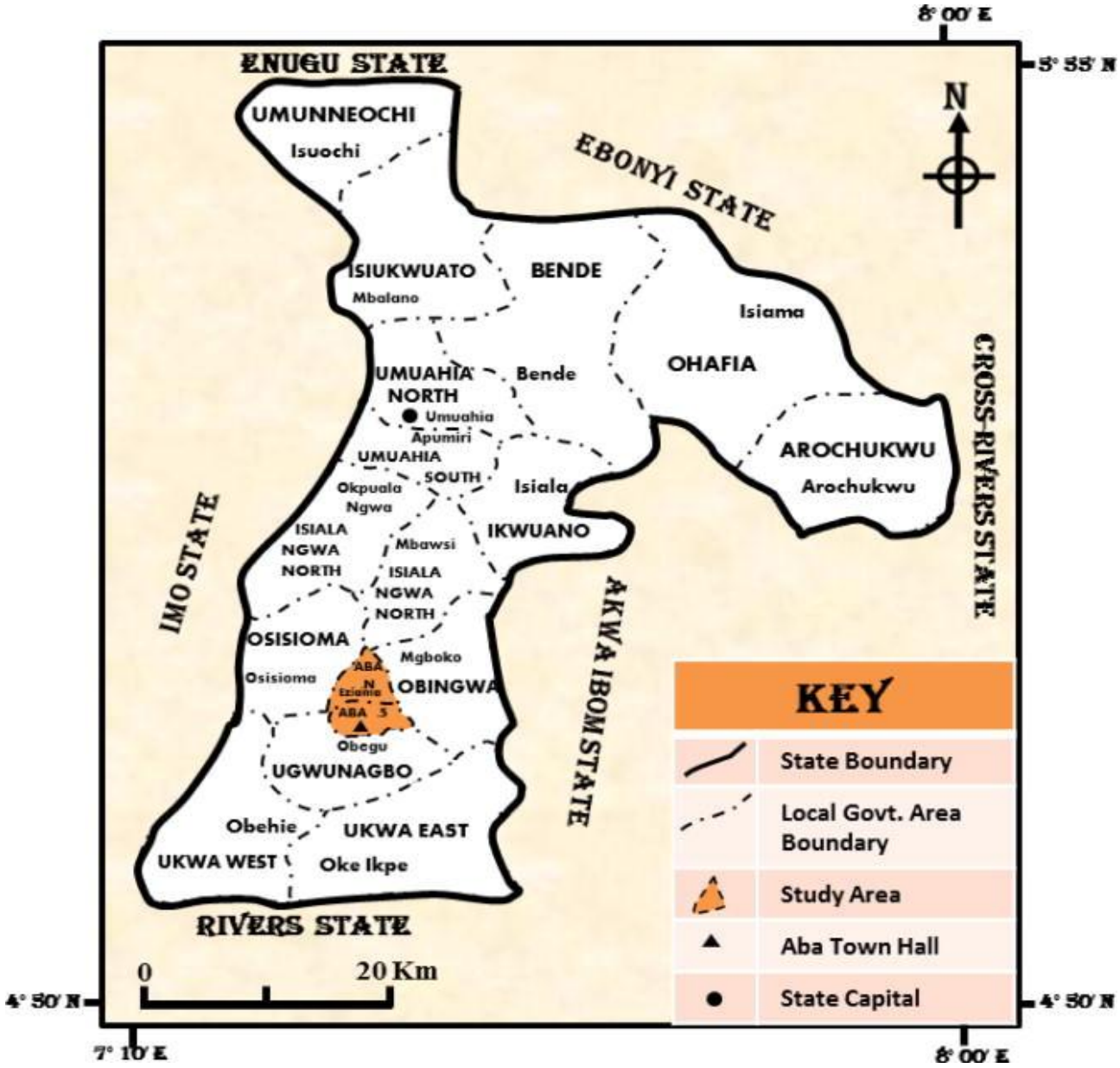


Figure 3.1. Map of Abia state showing the study area(Aba North and Aba South).

(Source: ABSG, 2012)

3.2 Study Design

A cross sectional study was carried out to study dog ecology and detection of rabies antigen in the brain of slaughtered dogs in Aba, Abia state

3.3Information on Vaccination of Dogs and Cases of Dog bites in Humans.

Information on rabies vaccination status was obtained from the Zonal Veterinary Clinic Aba, Abia State.The existing vaccination recordswas evaluated for a period of seven years (2007 – 2012). Records of age (3 -12months, > 12-24 months and >24 months), sex (male and female), breed (Exotic, local, cross) and the number of dogs vaccinated were assessed and recorded.Monthly variation of dog vaccination was also obtained to determine the seasonal index.

The existing records of reported cases of dog bite in humanswere obtained from the Zonal Veterinary Clinic Aba, Abia State for the same period. The age and sex of dog bite victims, monthly variation of dog bite cases to determine the seasonal index, the site of bite and breed of dogs involved in the bite were assessed and recorded. Records of dog bite cases in humans and vaccination against anti-rabies in dogs in privately owned veterinary clinic in the study area were poorly kept and were not use in this study. Data generated were analysed using the statistical packages for social sciences (SPSS) Version 17.0 to carry out descriptive analysis. Data obtained were presented using tables and charts.

3.4Enumeration of Dog Population

Fifty (50) streets in the study area consisting of twenty five (25) streets each in Aba North and Aba South Local Government Area were surveyed using***compound questionnairesurvey*** and ***street counts***. A total of 500 households, 250 each in Aba North and Aba South Local Government Area were surveyed.Starting from thefirst major street of each Local Government Area, every fifth street was surveyed using systematic random sampling

technique for both compound questionnaire survey and dog population enumeration by street count.

3.4.1 Survey of dogs by questionnaire

In each chosen street, starting from the first houses on either side, every 10^{th} house was selected, and an adult member on either side was interviewed usingquestionnaire.Household information obtained such as numbers of dog in the premises, housing and control of dog movement and history of dog bites. Individual dog information obtained included breed, sex, age, source of dog, source of food and vaccination status. A total of ten (10) houses were surveyed in each street chosen. Houses without dogs or houses that refused to participate in the compound questionnaire survey were skipped for the next houses possessing dog(s).

3.4.2 Dog population enumeration by street counts

Total population size estimated from photographic recapture technique (Beck's methods) was employed for the street count. The area surveyed was divided into Aba North and Aba South consisting of four (4) areas determined by the major roads linking the streets in the two local government areas.

It involved two street counts on two different days and the counts was averaged to reduce sampling error. On each day of the study,the counting of dogs was carried out in the morning (between 6 and 9 a.m) and in the evening (5.30 to 7.00 p.m). Every dog within a given distance was photographed and recorded. The number of counted dogs in the selected streets in each area was estimated using the formula.

$$N = \sum (Mn)/\sum m$$

where:

M = the number of dogs photographed each time and considered " marked", i.e. "observed";

m = the number of dogs recognised as being previously photographed i.e. " re-observed" ;

$\sum$m = the summation of m to that point in time.

n = the total number of dogs previously observed, i.e. each day's observations (M) less those previously observed (m) would be added to each day;

Mn = the product of each days M and n ;

$\sum$(Mn) = the summation of Mn to that point in time, and

N = the population estimate (WHO/WSPA, 1990).

Data generated were analysed using the Statistical Packages for Social Sciences (SPSS) Version 17.0. Data obtained were presented using tables and charts.Chi square test was used where appropriate to test for association of variables (such as vaccination status of dog, sex, breed, confinement of dogs and confinement of dogs) obtained from the questionnaires.Values of $P < 0.05$ were considered significant. Data obtained were also analysedusing multivariable logistic regression analysis.

3.5.Sampling and Sample Collection

3.5.1 Sample size calculation

The sample size was determined using the formula by Thrusfield(2007).

$$N = \frac{Z^2P(1- P)}{d^2}$$

Where n = sample size

Z= 1.96 standard normal value for desired confidence (Normal distribution table)

P= prevalence rate (15.8%) (Akombo, 2009).

d = allowable error (5 %)

$\frac{1.96^2 \times 0.158(1- 0.158)}{}$ = 204.44

0.05^2

3.5.2 Sample collection

A total of 204 brain samples from slaughtered dogs were collected between April and June 2013 from various slaughter points in Umude village, Ekiakpara, Faulks road and Ugbor hill at various relaxation places called 'joints' where dogs are slaughtered and processed for consumption. The brain samples were collected by excising a portion of the hippocampus from harvested brain at each dog processing location in the study area, which was then stored in a sterile bottle at -4^oC prior to transportation to the Viral Zoonoses Laboratory of the Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University, Zaria for fluorescent antibody test as described by Dean *et al*. (1996). Each slaughter point was visited twice daily (morning and afternoon) and brain samples were collected.

3.6.Detection of Rabies Antigen from Slaughtered Dog Brains in Aba, Abia State.

3.6.1.Fluorescent antibody test procedure

This procedure was carried out on 185 brain samples, the others were left out due to spoilage. Rabies direct fluorescent antibody assay (DFA) monoclonal antibody conjugate reagents (Fujirebio Diagnostic Inc. Malvern, P.A 19355, USA) was used and the working reagents dilution was prepared according to the manufacturer's recommendation and as described by Flamand*et al*. (1980). A small fraction of the brain sample was smeared on one part of a slide and then air dried and fixed in cold acetone for one hour at -20^o C. The slide was air-dried for 3 minutes and the rabies conjugate was applied and incubated for 30 minutes at 37^o C in a humid chamber after which excess conjugate was then removed from the slides by rinsing it withphosphate-buffered saline (pH 7.4) solution. The slides were then placed in a coupling jar containing phosphate-buffered saline (pH 7.4) solution which was replaced every 5 minuteswith a fresh solution, this was done thrice and the slidesair dried. The slides were

examined usingfluorescence microscope within two hours after staining. The presence of brilliant apple green fluorescence or greenish–yellow objects and its intensity (+,++,+++ and ++++) against a dark background was regarded as positive result for rabies while if no specific apple green fluorescence was observed, the test result was regarded as negative for rabies.The prevalence rate of rabies antigen in the brain of dogs sampled from dog meat processing joints was calculated using the formula:

$$\text{Prevalence} = \frac{\text{Total number of samples positives}}{\text{Total number of samples collected.}} \times 100$$

CHAPTER FOUR

RESULTS

4.1 Information on Vaccination of Dogs

Dataobtained from the clinic records of the Zonal Veterinary Clinic Aba, AbiaStatebetween 2007 and 2012 showed that out of a total of 3,169 cases presented at the clinic during the period,1354(42.7%) dogs received anti-rabies vaccination. The year 2007 had the highest number of dogs vaccinated, 320(23.6%) (Figure4.1). Approximately 58.2% of the dogs vaccinated were maleswhile 41.8%were females (Table 4.1).Exotic breed had the highest vaccination rate (50.6%) while 34.9% and 14.5% of the vaccinated dogs were local and cross breeds respectively (Table 4.1). Among the dogsvaccinated (44.2%) were within the ages of 3-12 months followed by dogs in the age range > 12-24 months (38.6%) anddogs> 24 months(17.3%) (Table 4.1). Seasonal changes expressed as seasonal index showed the greatest values of vaccination of dogs against rabies during November and December. The lowest indices were observed in June (Figure 4.3).

4.2 Information on Cases of Dog Bites in Humans

Out of 215 reported cases of dog bites from 2007 – 2012, 25(11.6%) were victims less than 15 years of age, 94(43.7%) were victims between 15-30 years and and 96 (44.7%) greater than 30 years of age (Table 4.2). Dog bite victims were more of males 135 (62.8%) than females 80(37.2%) (Table 4.3). Time series decomposition using ratio to moving average revealed seasonal fluctuations (Figure 4.2). Seasonal changes of dog bite expressed as seasonal index showed the greatest values during the months of August, October to January. The lowest indices were observed in February.

Local breed of dogs (50.7%) were the most involved in the dog bites, followed by exotic breed(36.7%), with cross breeds(12.6%) being the least. Also (54.9%) of the dogs involved in the bites were unvaccinated against rabies, (7.4%) of the dogs involved were vaccinated

while (37.7%) of the dogs had unknown anti-rabies vaccination status (Table 4.4).Most of the dog bites (63.7%) occurred on the leg, followed by (25.6%) on the hand, (7.9%) on the back and (2.8%) on the abdomen (Figure 4.4). Most of the dog bites on the leg, hand, back and abdomen occurred in individual from 15 years and above (Table 4.5).

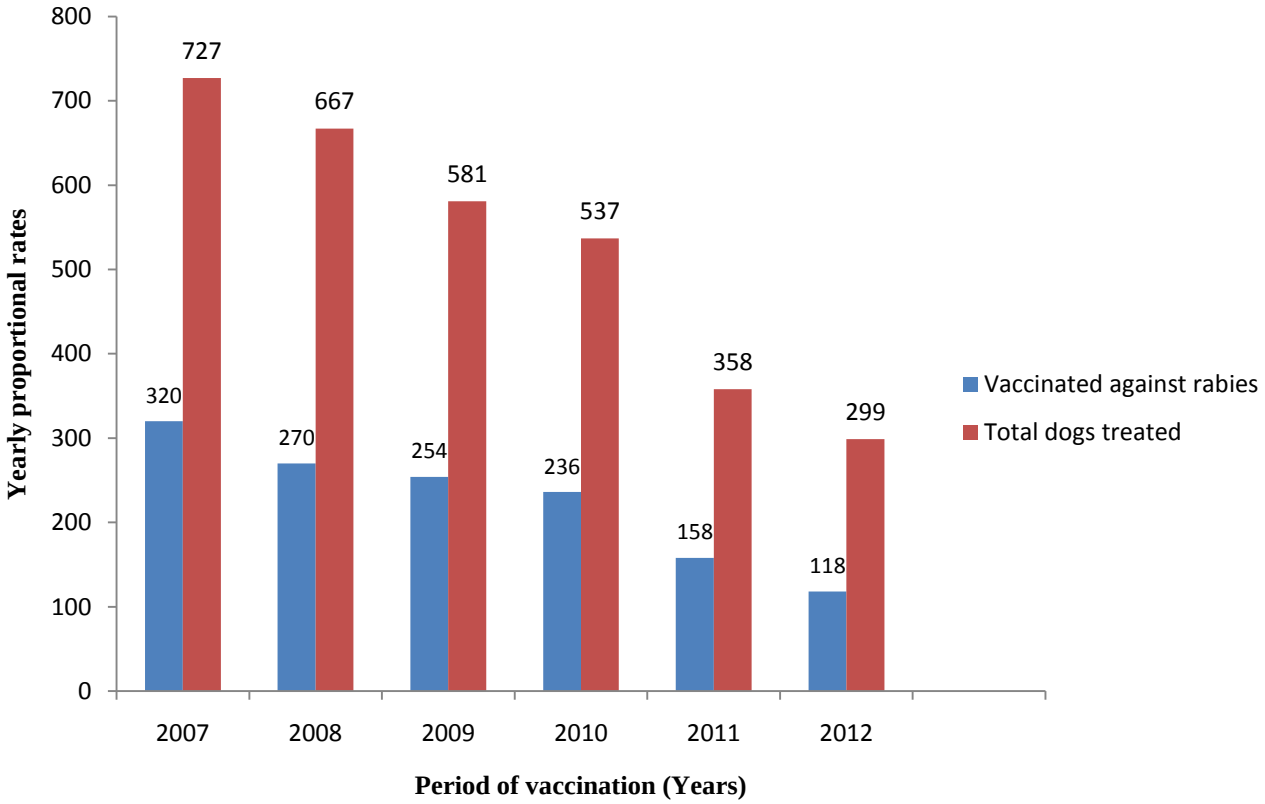


Figure 4.1Annual distribution of dogs vaccinated against rabies and dogs attended to at the Zonal Veterinary Clinic Aba,Abia State from 2007 – 2012.

Table 4.1: Age,sex,breed, and year specific rates of dog vaccination at the Zonal Veterinary Clinic Aba, Abia State from 2007 - 2012

Years under study							
Variable	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Total**
Age (months) (%)							
n = 320	n=270	n =252	n= 236	n = 158	n = 118		
3-12	122(38.1)	109(40.4)	113(44.8)	111(47.0)	77(48.7)	73(61.9)	605(44.7)
>12 -24	151 (47.2)	104(38.5)	100(39.7)	105(44.5)	72(45.6)	30(25.4)	562(41.5)
> 24	47 (14.7)	57(21.1)	39(15.5)	20(8.5)	9(5.5)	15 (12.7)	187(13.8)
Sex (%).							
Males	215(67.2)	150(55.6)	139(55.2)	125(53.0)	81(51.3)	78(66.1)	788(58.2)
Females	105(32.8)	120(44.4)	113(44.8)	111(47.0)	77(48.7)	40(33.9)	566(41.8)
Breed(%) .							
Exotic	117(36.6)	145(53.7)	133(52.8)	131(55.5)	85(53.8)	74(62.7)	685(50.6)
Local	136(42.5)	95(35.2)	96(38.1)	70(29.7)	52(32.9)	24(20.3)	473(34.9)
Cross	67(20.9)	30(11.1)	30(11.9)	35(14.8)	21(13.3)	20(16.9)	203(14.9)
Year (%) n = 1354							
Year rates	320(23.6)	270(19.9)	252(18.6)	236(17.4)	158(11.7)		

Table 4.2:Distribution by age of humansbitten by dogs obtained from the Zonal Veterinary Clinic Aba, Abia 2007 – 2012

Year	Age		
S/N	< 15(%)	15 – 30(%)	> 30(%)
2007	4(12.5)	14(43.8)	14(43.8)
2008	5(8.9)	35(62.5)	16(28.6)
2009	8(18.2)	17(38.6)	19(43.2)
2010	2(10.5)	7(36.8)	10(52.6)
2011	5(13.2)	11(28.9)	22(57.9)
2012	1(3.8)	10(38.5)	25(57.7)
Total25(11.6)	**94(43.7)**	**96(44.7)**	

Table 4.3:Distribution by sexof humans bitten by dogs obtained from the Zonal Veterinary Clinic Aba, Abia State2007 – 2012

YEAR	SEX	
S/N	Male (%)	Female (%)
2007	20(62.5)	12(37.5)
2008	30(53.6)	26(46.4)
2009	26(59.1)	18(40.9)
2010	16(84.2)	3(15.8)
2011	20(52.6)	18(47.4)
2012	23(88.5)	3(11.5)
Total 135 (62.8)	**80(37.2)**	

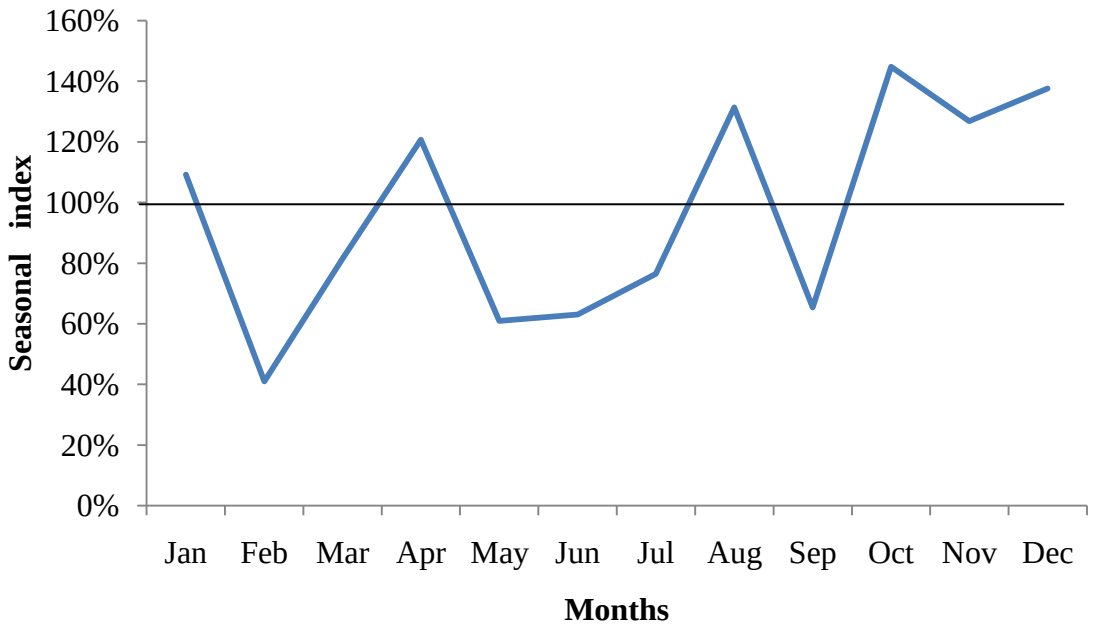


Figure4.2 Seasonal index of monthly dog bite cases covering the period from 2007-2012 obtained from Zonal Veterinary Clinic Aba, Abia State.

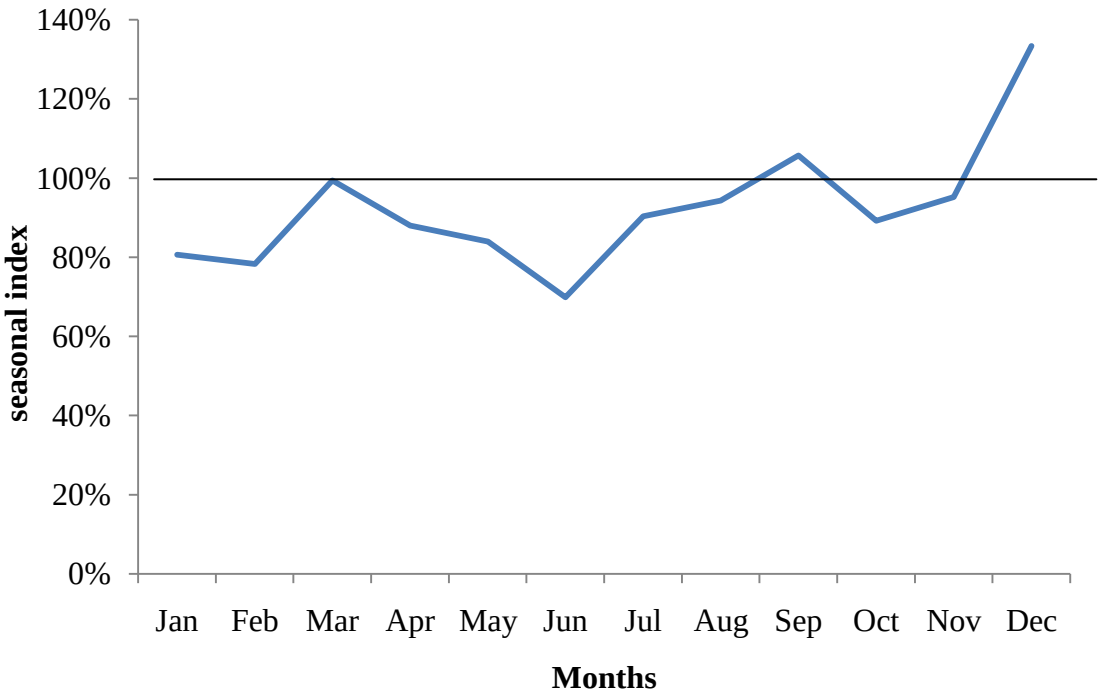


Figure 4.3Seasonal index of monthly vaccination of dog covering the period from 2007-2012 obtained from Zonal Veterinary Clinic Aba, Abia State.

Table 4.4: Breed and vaccination status of dogs involved in bite cases reported at the Zonal Veterinary Clinic Aba, Abia Statefrom 2007 – 2012

Breed of dogs

Variable	Exotic	Local	Cross	Total
n = 215				
Breed specific rates (%)	79(36.7)	109(50.7)	27(12.6)	
Vaccination status specific rates (%)				
n = 79	n = 109	n = 27		
Unvaccinated	60(75.9)	90(82.6)	18(66.7)	168(78.1)
Vaccinated	10(12.6)	10(9.2)	2(7.4)	22(10.2)
Unknown	9(11.4)	9(8.30)7(25.9)	25(11.6)	

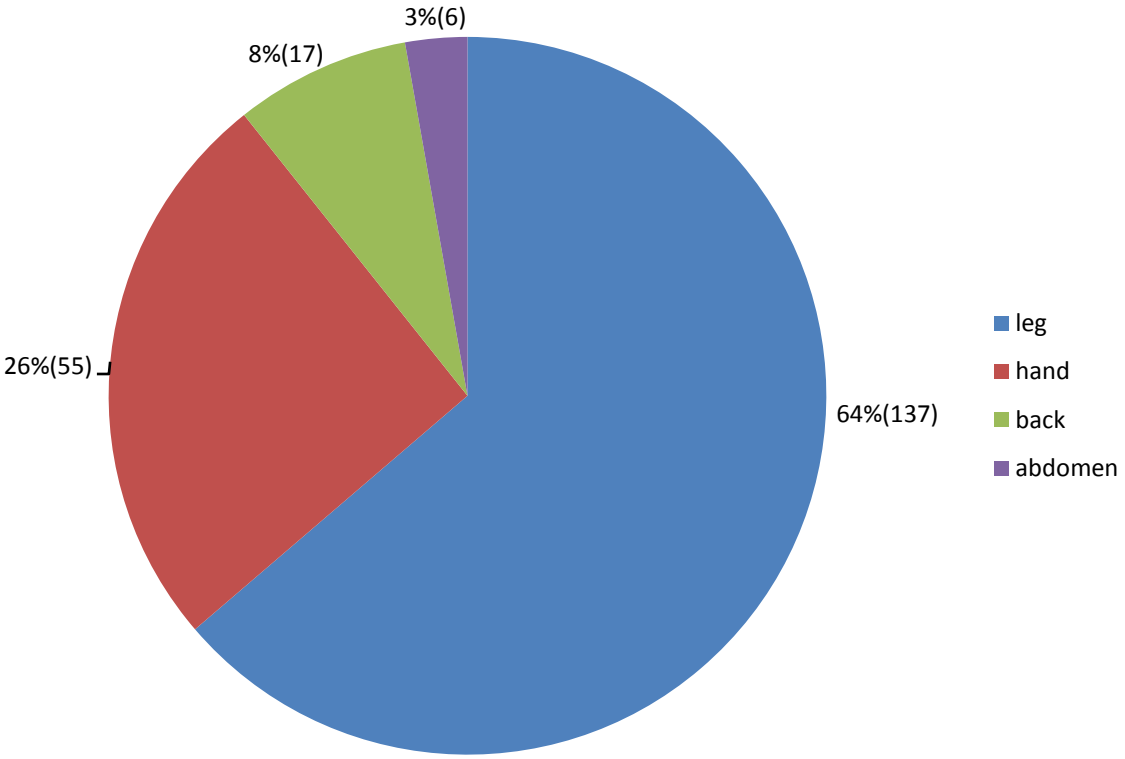


Figure 4.4Distribution of dog bites by anatomical location on humans in Aba Abia State.

Table 4.5:Anatomical location of dog bites on humans and age of dog bite victims obtained from the Zonal Veterinary Clinic Aba, Abia 2007 – 2012

Anatomical location	**Age of victims**		
	<15	15 – 30	>30
Leg (n= 137)	16(11.7)	60(43.8)	61(44.5)
Hand (n = 55)	6(10.9)	25(45.5)	24(43.6)
Back (n=17)	2(11.8)	7(41.2)	8(47.10
Abdomen (n=6)	1(16.7)	3(50)	2(33.3)
Total n =215	**25(11.6)**	**95(44.2)**	**95(44.2)**

4.3Dog Ecology Study

4.3.1 Information on dog ecology from 500 households in Aba North and Aba South LGA of Abia State.

Information on dog ecology in 500 households (250 households each) in Aba North and Aba south L.G.A of Abia State is summarized in Table 4.6. In the 500 households surveyed, 63.8% (319) household had fences/walls that completely restricted their dogs' movement, 23% (115) household had fences that did not restrict dog movement while 13.2% (66) of the household had no fence.

Most of the households 73.6% (368) had specially constructed house/cage as housing for their dogs, 21%(105) of the households keep their dogs on house passage way/corridor while 5.4%(27) indicated their dogs were kept anywhere on the premises. About92.8%(464) of the households never allowed their dogs to leave their premises while 7.2% (36) allowed their dogs to roam freely in the neighbourhood. Also, 22.4%(112) of the respondents indicated the presence of stray dogs in their neighbourhood.A total of 63 (12.6%) householdshadfamily members that had been bitten by stray dog in the preceding 12 months while 87.4% (473) reported no bite. About 94.2% (471) householdsreported that no stray dogs ate at their homes while 5.8%(29) of the households indicated the presence of stray dogs eating at their home.

4.3.2 Individual dog information from 500 households in Aba North and Aba south LGA of Abia State.

A total of 747 dogs were present in the 500 household surveyed. Majority of the dogs 495 (66.3%) were exotic, 142 (19%) were local and 110 (14.7%) were cross breeds. A total of 465 (62.2%) were males while 282 (37.8) were females. About 284 (38.0%) of the dogs were within 0 to 6 month of age, 169(22.6%) between 7 to 12 months of age and 294 (39.4%) greater than 12 months of age. About 44.7% of the dogs were purchased by members of the household from dog breeders/neighbours, 46(6.2%) weregifts from families and friends while 367(49.1%) were offspring of the bitches present in the household (Table 4.7).

During the day, 438 (58.6%) of the dogs were confined to restrict their movement while 13(1.7%) were e confined during the night and 260 (34.8%) confinedduring the day and at night, while 36 (4.8%) were reported to be allowed to roam during the day and at night. The respondents reported that 474(63.5%) of the dogs were used for security purposes, 182 (24.4%) for breeding and 91(12.2%) as pets (Figure 4.5). A total of 649(86.9%) of the dogs were fed by household members, 1(0.10%) was fed by neighbours, 3(0.4%) of the dogs roamed about to fend for themselves while 94(12.6%) were fed by both household members and their neighbours. A total of 298 (47.9%) of the dogs encountered during the survey had up to date anti-rabies vaccination record, while 324 (52.1%)were unvaccinated. 125 (16.7%) of the dogs were unvaccinated because they were below the age of anti-rabies vaccination (Table 4.9).

4.4Structure of Dogs and Human Population in the Compound Count in Aba North and Aba South L.G.A

Among the 500 households surveyed there were 5,823 number of occupants and 747 dogs, the average number of dogs per house was 1.5, while the dog to human ratio was 1:7.8. The street count of dogswas 126 dogs (67 dogs in Aba North and 59 dogs in Aba South). From the 2006 population census figure of Aba North and Aba South which was estimated to be531,340 people the estimated dog population in Aba North and south is about 68,121 (Table 4.8).

4.5 Rabies Vaccination Status of Dogs and Individual Dog Information in Aba North and Aba South L.G.A

Chi-square analysis was used to determine association between dog vaccination status and individual dog information. There were associations between breeds of dogs (χ^2= 79.8, df = 2, P< 0.005), age of dogs (χ^2= 22.9, df = 2, P<0.005), reason for dog ownership (χ^2= 8.1, df =2, P<0.005), confinement of dogs (χ^2= 10.0, df =3, P < 0.005) and rabies vaccination

status of dog. There was no statistical association betweensex ($\square^2$= 0.81,df =1, P= 0.368), source ($\square^2$=4.5, df = 2, P= 0.104) and rabies vaccination status of dogs (Table 4.10)

4.6 Multivariable Logistic Regression Analysis of Vaccination Status with Individual Dog Information in Aba, Abia State

Exotic breed (adjusted OR = 0.39; CI= 0.23- 0.65) and local breed of dogs (adjusted OR= 0.08; CI= 0.04 – 0.14) had less odds of beingvaccinated as compared to cross breed of dogs similarly,dogs used as guard dogs (adjusted OR = 0.65; CI = 0.37 – 1.12) and dogs used for breeding/sale(adjusted OR = 0.41; CI= 0.22 – 0.79) purposes had less odds of being vaccinated as compared to dogs used as pets. Dogs within the age range >7 – 12 months(crude OR = 2.50; 1.70 – 3.69) (adjusted OR=0.40;CI=0.25- 0.61) had higher odds of being vaccinated than dogs > 12 months of age. There was no statistical significance found between confinement of dogs and vaccination status (Table 4.11).

Table 4.6:Household information on dog ecology obtained from 500 households in Aba North and Aba south LGA of Abia State (from April to June 2013)

Variable	Frequency	Percentage (%)
Enclosure of home		
No fence	66	13.2
Fence/wall, but does not restrain dogs	115	23.0
Fence/wall, completely restrain dogs	319	63.8
Housing of dogs		
Specially constructed house/cage	368	73.6
On house passage way/corridor	105	21.0
Anywhere on the premises	27	5.4
Control of dog(s) movement		
Never allowed to leave premises	464	92.8
Allowed to roam freely	36	7.2
Do you observe stray dogs on your street?		
Yes	112	22.4
No	388	77.6
Has any member of the household been bitten by household/neighbour dog(s) in the last 12 months?		
Yes	53	10.6
No	448	89.4
Has any member of the household been bitten by stray dog in the last 12 months?		
Yes	63	12.6
No	437	87.4
Do dogs other than yours eat at your home?		
Yes	29	5.8
No	471	94.2
Total	**500**	**100**

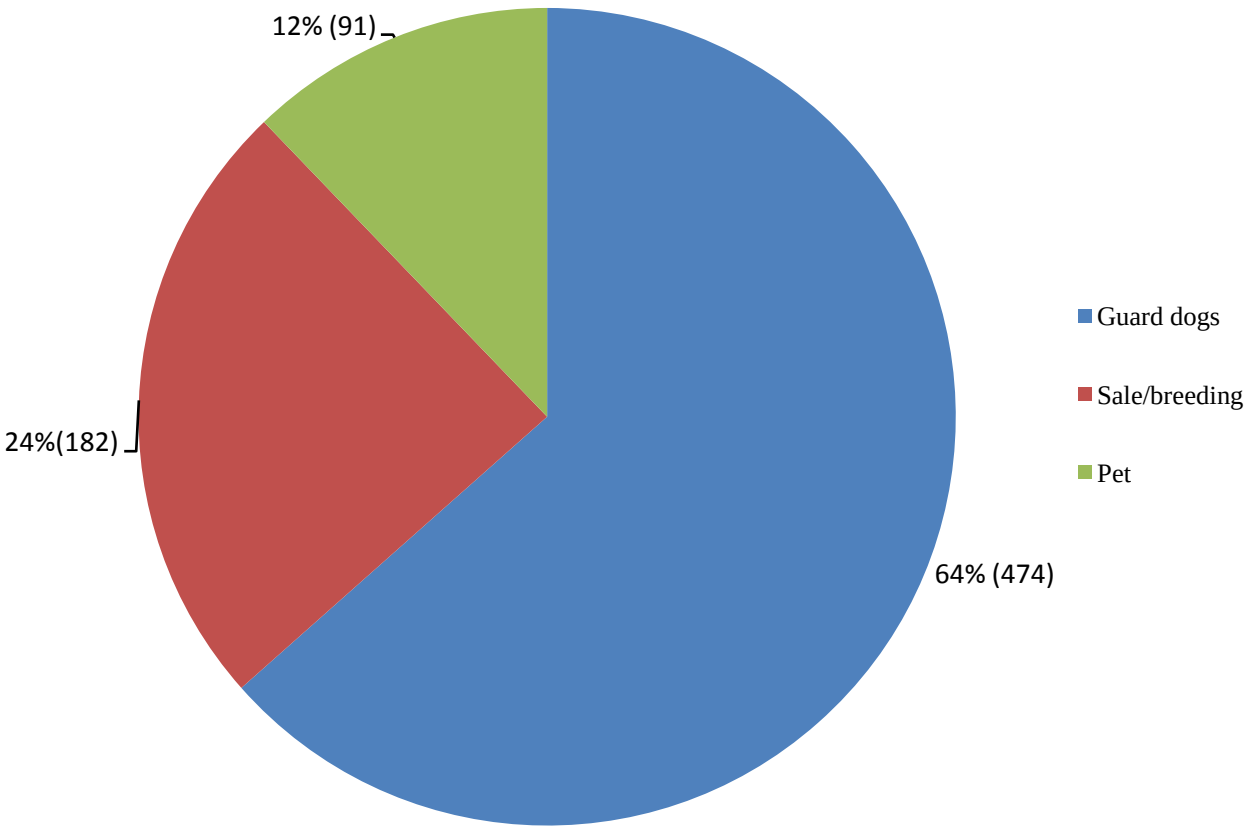


Figure 4.5Reasons for keeping dogs in thehouseholds surveyed in Aba, Abia State.

Table 4.7:Information obtained from 500 dog-owning households in Aba North and Aba South LGA of Abia State (from April to June 2013).

Variable	Frequency	Percentage (%)
Breeds of dogs		
Exotic	49566.3	
Local	142	19.0
Cross	110	14.7
Sex of dogs		
Male	46562.2	
Female	28237.8	
Ages of dogs		
0– 6 Month	28438.0	
7- 12 Month	169	22.6
> 12 Month	29439.4	
Source of dogs		
From own bitch	367	49.1
Bought	33444.7	
Receive as gift	46	6.2
Confinement of dogs		
Day	438	58.6
Night	13	1.7
Day and night	260	34.8
Allow to roam	36	4.8
Feeding of dogs		
Household members	649	86.9
Neighbours	1	0.1
Find its own food	3	0.4
Neighbours/household	94	12.6
Rabies vaccination status		
Yes	298	39.9
No	324	43.4
Not due	125	16.7
Total747	**100**	

Table 4.8: Structure of dogs and human population in compound count carried out in Aba North and Aba South L.G.A.

Variables	Values
Number of compounds surveyed	500
Total number of people in the streets surveyed	5823
Total number of Dogs	747
Dog human ratio	1: 7.8
Average Number of dog per house	1.5
Total dog population size estimated from street count	126
2006 population census of Aba North and South L.G.A	531, 340
Estimated dog population in Aba North and South L.G.A	68,121

Table 4.9: Dog vaccination status obtained from 500 dog-owning households in Aba North and Aba South L.G.A

Variable	Vaccinated (%)	Unvaccinated (%)	Not due (%)
Breed of Dog			
Exotic	200(40.4)	182 (36.8)	113(22.8)
Local	23(16.2)	113(79.6)	6 (4.2)
Cross	75(68.2)	29(26.4)	6(5.5)
Sex of dogs			
Male	188(40.4)	193(41.5)	84(18.1)
Female	110(39.0)	131(46.5)	41(14.5)
Age of dogs			
0– 6 Mnth	82 (28.9)	77(27.1)	125(44.0)
7- 12 Mnths	103(60.9)	66(39.1)	0(0)
> 12 Mnths	113(38.4)	181(61.6)	0(0)
Source of dog			
From own bitch	123(33.5)	160(43.6)	84(22.9)
Bought	153(45.8)	147(44.0)	34(10.2)
Receive as gift	22(48.0)	17(34.0)	7(18.0)
Reason for dog ownership			
Guard dogs	212(44.7)	224(47.3)	38(8.0)
Sale/breeding	42(23.1)	69(37.9)	71(39.0)
Pet	44 (48.4)	31(34.1)	16(17.6)
Confinement of dog			
Day	203(46.3)	192(43.8)	43(9.8)
Night	7(53.8)	5(38.5)	1(7.7)
Day and night	79(30.4)	102(39.2)	79(30.4)
Allow to roam	9(25)	25(69.4)	2 (5.6)
Feeding of dogs			
Household members	259(39.9)	280(43.1)	110(16.9)
Neighbours	0(0)	0(0)	1(100)
Find its own food	0(0)	3(100)	0(0)
Neighbours/household	39(41.5)	41(43.6)	14(14.9)
Total	**298**	**324**	**125**

Table 4.10:Association between dog vaccination status of dogs up to the age of vaccination and individual dog information obtained from Aba North and Aba South L.G.A

Variable	vaccinated (%)	unvaccinated (%)	χ^2	df	p-value
Breed of Dog					
Exotic	200(40.4)	182 (36.8)	79.8	2	0.000
Local	23(16.2)	113(79.6)			
Cross	75(68.2)	29(26.4)			
Sex of dogs					
Male	188(40.4)	193(41.5)	0.81	1	0.368
Female	110(39.0)	131(46.5)			
Age of dogs					
0– 6 Month	82 (28.9)	77(27.1)	22.9	2	0.000
7- 12 Months	103(60.9)	66(39.1)			
> 12 Months	113(38.4)	181(61.6)			
Source of dog					
From own bitch	123(33.5)	160(43.6)	4.5	2	0.104
Bought	153(45.8)	147(44.0)			
Receive as gift	22(48.0)	17(34.0)			
Reason for dog ownership					
Guard dogs	212(44.7)	224(47.3)	8.1	2	0.018
Sale/breeding	42(23.1)	69(37.9)			
Pet44 (48.4)	31(34.1)				
Confinement of dog					
Day	203(46.3)	192(43.8)	10.0	3	0.018
Night	7(53.8)	5(38.5)			
Day and night	79(30.4)	102(39.2)			
Allow to roam	9(25)	25(69.4)			
Total	**298**	**324**			

Table 4.11: Multivariable logistic regression analysis of vaccination status with individual dog information in Aba, Abia state.

	Vaccination status						
Variable	**Yes**	**No**	**χ^2**	**P-value**	**Crude 0R (95% CI on OR)**	**Adjusted OR (95% CI on OR) Vaccinated dogs**	**Adjusted OR (95% CI on OR) unvaccinated dogs.**
Breeds of Dogs							
Exotic	200	182	79.8	0.000	0.42(0.26- 0.68)	2.57(1.54 – 4.28)	0.39 (0.23– 0.65)
Local	23	113			0.08(0.04-0.15)	13.30(7.00 – 25.27)	0.08(0.04 – 0.14)
Cross	75	29			1	1	1
Age of dogs							
0– 6 Month	82	77	22.9	0.000	1.71(1.16-2.52)	0.75(0.48– 1.17)	1.34(0.86 – 2.09)
7- 12 Months	103	66			2.50(1.70- 3.69)	0.40(0.25 – 0.61)	2.55 (1.65- 3.94)
> 12 Months	113	181			1	1	1
Reason for dog ownership							
Guard dogs	212	224	8.1	0.018	0.67(0.40-1.10)	1.55(0.89 – 2.69)	0.65(0.37 – 1.12)
Sale/breeding	42	69			0.42(0.24 – 0.78)	2.43(1.27- 4.65)	0.41(0.22– 0.79)
Pet	44	31			1	1	1
Confinement of dog							
Day	203	192	10.0	0.018	2.91(1.33-6.45)	0.43(0.19- 1.02)	2.30(0.98 – 5.42)
Night	7	5			3.89(0.98-15.42)	0.35(0.08 – 1.55)	2.86(0.65 – 12.70)
Day and night	79	102			2.15(0.95-4.87)	0.55(0.23 - 1.34)	1.82(0.75 – 4.42)
Allow to roam	9	25	1		1	1	
Sex of dogs							
Male	188	193	0.81	0.368	1.16(0.84 -1.60)		
Female	110	131			1		
Source of dog							
From own bitch	123	160	4.5	0.104	0.59(0.30- 1.17)		
Bought	153	14			0.80(041- 1.58)		
Receive as gift	22	17			1		
Total	**298**	**324**					

4.7Detection of Rabies Antigen among Slaughtered Dogs by Direct Fluorescent Antibody Test (DFAT)

A total of 185 dog brains were tested for rabies antigen by direct fluorescent antibody technique, out of which 13 samples (7.0%) were positive for rabies antigen. A total of 95 (51.4%), 30 (16.2%), 45 (24.3%) and 15 (8.1%)of the brain samples were collected from Umude village, Ekiapara village, Faulksroad,Ugbor Hill respectively (Table 4.12).A total of 39.5% of the samples tested were from male dogs while 60.5% were from female dogs.The rate of infection was higher in females (8.9%) than males (4.1%) (Table 4.13).

Table 4.12: Distribution of dogbrain samples bylocation in Aba, Abia State

Location	No. of sample collected(%)	Sample tested positive
	n = 185	
UmudeVillage (OsisiomaNgwa)	95 (51.4)	7/95
Ekiapara (OsisiomaNgwa)	30(16.2)	3/30
Faulks road (Aba North)	45(24.3)	1/45
Ugbor hill (Aba North)	15(8.1)	2/15
Total 185	13(7.0)	

Table4.13: Sex distribution of dogs slaughtered for human comsumption in Aba, Abia State.

Gender	No. tested	No. positive Sex specific rates
Male	73	3/73 (4.1%)
Female	112	10/112(8.9%)
Total	**185**	**13/185(7.0%)**

CHAPTER FIVE

DISCUSSION

Information obtained from 500 dog-owning households, 250 each in Aba North and Aba South L.G.As indicated a relatively high density of dogs in the study area (dog to human ratio of 1: 7.8) probably due to the absence of religious and cultural inhibition to the keeping of dogs in Aba, Abia State. There is also an increase in keeping of dogs as a source of income especially exotic breeds which are used for security and breeding purposes.These reasons for keeping dogs contribute to their high density in the study area, hence it is necessary for rabies control and enlightenment programs to be organized in order to ensure that dog owners vaccinate their dogs against rabies on a regular basis.This is in contrast to the low density of dogs in other urban cities in Nigeria, where dog to human ratio is 1: 43 in Makurdi, Benue State (Omudu*et al*, 2010), 1: 21 in Lagos, Lagos State and 1: 1000 in the moslem dominated part of Kaduna north, Kaduna State (Oboegbulem and Nwakonobi, 1989) .

Most (63.8%) of the dog-owning houses had fences thatcompletely restricted dog movement as the study was conducted in an urban area where most houses are properly demarcated from each other by well defined fences hence restricting movement of dogs from one household to the other.Majority (73.6%) of the households had specially constructed houses/cages and 92.8% of the households never allowed their dogs to roam about. Dogs owned by inhabitants of the town were mostly exotic breeds that are highly priced hence they are well cared for because of the value attached to them. About 24.4% of the dogs kept were used for breeding, as this is gradually becoming a form of income generation by some dog-owning houses. Most of the respondents interviewed indicated low activity of free roaming dogs in their streets. This is further confirmed by the result of the street count where few dogs (126) were seen in the 50 streets surveyed in the study area. The low activity of free roaming dogs observed in

the study area reduces the risk of dog bites by stray dogs and indicates that most households properly restrict the movement of their dogs.

The anti-rabies vaccination coverage of dogsin the houses surveyed was estimated at 47.9%.This still falls below the World Health Organization standard of vaccination of 70-80% dog population in an area to boost herd immunity (WHO, 2005).This vaccination rate can be improved on if there are more veterinary clinics in the city and public health awareness campaigns are organized on a regular basis to educate dog-owners on the need to vaccinate their dogs yearly against rabies.Local breed of dogs were the least vaccinated against rabies (16.2%) due to the low priority given to this breed by most owners as compared to exotic and cross breeds. Dogs within 7-12 months old had higher anti-rabies vaccination rateprobably because dog owners usually abide to the first year vaccination schedule of their dogs which includes three DHLPP vaccine shots and then an anti-rabies vaccination.More male dogs were kept than female dogs as they are perceived as better guard dogs than the females.

Data obtained from the Zonal Veterinary Clinic, Aba indicated thatthere was free anti-rabies vaccination campaign in 2007 hence that year recorded the highest number of dogs vaccinated. The high frequency of vaccination of dogs that year gives an indication thatthe cost of vaccination and poor awareness of dog owners on the need to vaccinate their dogs against rabies regularly arefactors that discourage most dog-owners from vaccinating their dogs yearly against rabies.Study done by Adeyemi and Zessin (2000) in Ibadan indicates an increase in rabies vaccination coverage in 1991 and 1992 by over 300% and 200% respectively when there was free vaccination of dogs against rabies. Hence there is need for regular mass vaccination campaigns and the cost for anti-rabies vaccine should be highly subsidized. The year specific rate records of vaccination against anti-rabies decreased steadily from 2007 to 2012 owing to the fact that new privately owned veterinary clinics are now

operational, and there is now a steady decline in the patronage of the government-owned veterinary clinics.The vaccination records also showed that exotic breeds (50.6%) had higher vaccination coverage. This could be due to the large number of exotic breed of dogs in the study area as compared to local and cross breed of dog and also on the special attention paid by dog ownersto the exotic breed of dogs they have. Similarly 58.2% of the dogs vaccinated were males. This is slightly higher than the number of female dogs vaccinated.This can be attributed to moremale dogs in the study area compared to female dogs, also male dogs tend to be more aggressive than female dogs, and hence most dog owners are forced to vaccinate their male dogs as a precautionarymeasure. Dogs within the age range of 3- 12 months had the highest vaccination coverage (42.2%) than older dogs. This could be because most dog owners tend to seek medical consultations for younger dogs than they do for their older dogs, and usually tend to follow the first year vaccination schedule of their dogs.

Majority (62.8%) of the individuals that were victims of dog bites were males, similar to results obtained by Opaleye(2006) and Aghahowaand Ogbevoen (2010), also individuals greater than 30 years of age were mostly the victims of dog bites contrary to some studieswhere children are recorded to be the most frequent victims of dog bites (Claudia, 2007;Abubakar and Bakari, 2012).This may probably be attributed to the fact thatmale adults appear to be more enterprising and adventurous in their quest to meet up with their needs and the needs of their families and are therefore exposed to bites the more.

Frequency of dog bites was higher within the months of September to December this coincides with the breeding period of dogs where there is an increase in dog movement. There was also a corresponding increase in the frequency of vaccination of dogs within the same months, which could be as a result of advice given to owners of dogs that are involved in dog bite cases to vaccinate their dogs and also some dog owners vaccinate their dogs because they travel with them to various locations where they spend their festive holidays,

and have a need to vaccinate them.Local dogs were more involved in the dog bites reports probably due to the fact that most of the dog bite cases reported at the Zonal Veterinary clinic Aba were from individuals living in surrounding villages close to the main town, where the proportion of local breed of dogs is high and where there is little or no restriction in dog movement. Also 54.9% of the dogs involved in the bites were unvaccinated. This is also closely linked to the fact that local breed of dogs that are more involved in the dog bite cases have less chances of being vaccinated and alsoveterinary clinics are not evenly spread across the city, where dog owners can carry their dogs to be vaccinated.

Most of the dog bites (63.7%) occurred on the leg in agreement with (Ojuawo, 2000) whoreported the lower limbs as the commonest site of dog bites in a study carried out in Ilorin, Kwara State. This may also be due to the fact that most dogs have easy access to the legs of victims during an attack and most individuals tend to defend themselves with their legs during an attack by an offending dog.

Rabies antigen was detected in13 (7%)of the 185 dog brains tested. This indicates that dogs slaughtered for human consumption could be a source of infection to dog handlers and butchers. Most of the individuals involved in dog meat processing do not utilize personal protective wears and also the method of slaughter predisposes these dog meat processors to bites from dogs during restraint. About 60.5%of the brains tested were obtained from female dogs as female dogs were slaughtered more in the study area.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

6.1 Conclusion

This study revealed high vaccination coverage in exotic breed (50.6%), in males (58.2%)and in dogs within 3 – 12months of age (44.2%). Cases of dog bite in humans occurred more frequently during the months of September to December, with local breed of dogs (50.7%) being the most involved in such bites most of which were unvaccinated (82.6%), this poses a public health risk as these unvaccinated dogs can serve as a source of transmission of rabies to humans if they are infected with the virus. Also dog ecology survey was able to determine an average of 1.5 dogs per household surveywith an estimated dog population of 68,121, the dog population density in the study area is high compared to other urban cities in Nigeria.This figure should be borne in mind when planning anti-rabies campaign in Aba.Most of the dog movement in the study area were restricted as most of the houses in the study area are well fenced and most of the dogs are kept inwell-constructed houses and are not allowed to roam freely in the neighbourhood. The prevalence of rabies antigen in the brain of dogs sampled within the study area was 7% and poses a significant health risk to dog meat processors and handlers.

6.2 Recommendations

The following recommendations are made

1. There is need for educational program aimed for the public on the need to vaccinate their dogs and also to seek adequate medical attention when bitten by dogs.
2. Mass vaccination campaign programs should be organized inorder to attain the 70 % anti-rabies vaccination coverage as recommended by the WHO, and also dog ecology study should be conducted in all the L.G.As in the State to have an estimate of the total dog population in the state that may aid in such mass vaccination campaigns.
3. There should be establishment of more veterinary clinics across the city to complement the existing ones inorder to ensure that dog owners get access to Veterinary services and that dog bite victims can readily obtain medical advice promptly.Such clinics should have proper records of cases handled.
4. Dog meat processors and handlers need to be educated on the need to utilize personal protective wears during their activities and on the need to receive anti-rabies vaccine yearly.

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APPENDIX 1

Questionnaire for Dog Ecology Survey

DEPARTMENT OF VETERINARY PUBLIC HEALTH AND PREVENTIVE MEDICINE

FACULTY OF VETERINARY MEDICINE

AHMADU BELLO UNIVERSITY, ZARIA

THIS QUESTIONNAIRE IS DESIGNED TO OBTAIN INFORMATION ON "DOG ECOLOGY" ALL INFORMATION PROVIDED BELLOW WILL BE TREATED WITH ABSOLUTE CONFIDENTIALITY.

SECTION A: HOUSEHOLD INFORMATION

1. How many Adult and juvenile female(s) dogs are on your premises?: a. 0 [ ] b. 1 [ ] c. 2[ ] d. 3 [ ] e. 4 [ ] f. 5 [ ]
2. How many Adult and juvenile male(s) dogs are on your premises? a. 0 [ ] b. 1 [ ] c. 2[ ] d. 3 [ ] e. 4 [ ] f. 5 [ ]
3. How many puppy(ies) are on your premises? a. 0 [ ] b. 1 [ ] c. 2[ ] d. 3 [ ] e. 4 [ ] f. 5 [ ]
4. Enclosure of home: a. No fence or wall [ ] b. Fence or wall, but does not restrain dogs [ ] c. Fence or wall, completely restrain dogs [ ]
5. How are the dogs in your premises housed? a. specially constructed house/cage [ ] b. on house passage way/corridor [ ] c. any were on the premises [ ]
6. How do you control your dog(s) movement? a. never allowed to leave the premise [ ] b. allowed to roam freely in the neighbourhood [ ]
7. Are there unowned dogs in your neighbourhood? a. yes [ ] b. no [ ]
8. Have members of your family been bitten by dogs in the past 12 months by own/neighbour dog(s) a. yes [ ] b. no [ ]
9. Have members of your family been bitten by dogs in the past 12 months by stray dog(s) a. yes [ ] b. no [ ]
10. Do dogs other than yours eat at your home? a. yes [ ] b. no [ ]
11. Street name …….
12. Local government area ? a. Aba North [ ] b. Aba south [ ]

SECTION B: INDIVIDUAL DOG INFORMATION (one form for each dog)

1. House number……..
2. Street name……
3. Breed: a. Exotic [ ] b. Local [ ] c. cross [ ]
4. Sex : a. male [ ] b. Female [ ]
5. Age : a. 0 – 6mnths [ ] b.> 6 – 12 mnths [ ] c. > 12mnths [ ]
6. Source of dog : a. Offspring of own bitch [ ] b. Bought [ ] c. Received as gift [ ]
7. Uses of dog: a. Guarding of premises [ ] b. Puppy sale/breeding [ ] c. Hunting [ ] d. Pet [ ]
8. The dog is fed by: a. household members [ ] b. By neighbours [ ] c. Dogs finds its own food [ ] d. By household members/neighbour [ ]
9. Source of food: a. Commercial dog food [ ] b. specially prepared food for the dog(s) [ ] c. Family garbage and waste [ ] d. Garbage on roads and dumps [ ]
10. Is the dog rabies vaccination schedule up to date: a. yes [ ] b. no [ ] c. Not due [ ]
11. The dog is confined to house or garden during a. the day [ ] b. at night [ ] c. day and night [ ] d. dog(s) are allowed to roam freely [ ]

APPENDIX 2

Monthly dog bite cases in humans reported at the Zonal veterinary clinic Aba, Abia statebetween 2007 - 2012.

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
2007	4	7	2	0	0	0	0	1	3	6	5	4	32
2008	0	0	3	2	5	4	6	12	3	8	4	9	56
2009	9	4	6	3	0	3	5	5	1	1	5	2	44
2010	2	0	1	0	0	0	0	1	2	3	3	7	19
2011	5	2	0	7	2	2	3	9	1	4	1	2	38
2012	3	2	3	7	3	2	2	0	0	2	1	1	26
Total	**23**	**15**	**15**	**19**	**10**	**11**	**16**	**28**	**10**	**24**	**19**	**25**	**215**
(%)	**10.7**	**7.0**	**7.0**	**8.8**	**4.7**	**5.1**	**7.4**	**13.0**	**4.7**	**11.2**	**8.8**	**11.6**	**100**

APPENDIX 3

Streets surveyed for the street dog count in Aba, Abia state

Area 1……. Total population size estimated from photographic recaptures (Beck's Method) covering 13 streets along Faulks road in Aba North L.G.A

1. Chubuike street/ Aba North Faulks road
2. Ikonne Street/Faulks road Aba North
3. Omenazu Street/Aba North Faulks road
4. Echianu street/ Aba North Faulks road
5. Amucha street/ Aba North Faulks road
6. Osusu street/ Faulks road Aba North
7. Nwala street/ Faulks road Aba North
8. Nwankpa street/ Faulks road Aba North
9. Dike street/ Faulks road Aba North
10. Nworustreet Faulks road, Aba North .
11. Ajiwe street Faulks road Aba North
12. Nwagba street Faulks road Aba North
13. Ekenna street Faulks road Aba North

Area 2…….. Total population size estimated from photographic recaptures (Beck's Method) covering 12 streets along Okigweroad in Aba North L.G.A.

1. Cemetry street Okigwe road Aba North
2. Akalana Street Okigwe road Aba North
3. Nkoro street Okigwe road Aba North
4. Owerri Street Okigwe road Aba North
5. Ugorji Street Okigwe road Aba North
6. Umule Street Okigwe road Aba North
7. Ajagba street Okigwe road Aba North

8. Ije Street Faulks road Aba North
9. Umueleke street Faulks road Aba north
10. Nicholas/Nweke streets Aba owerri road Aba North
11. Margeret street Aba -owerri road Aba North
12. Jojo/Ngozi streets Aba owerri road Aba North

Area 3……. Total population size estimated from photographic recaptures (Beck's Method) covering 9 streets along Asa road Aba south in Aba south L.G.A

1. Obohia street Asa road Aba south
2. School street Asa road Aba south
3. Ehi street Asa road Aba south
4. Cameroun street Asa road Aba south
5. Tenant street Asa road Aba south
6. Market street Asa road Aba south
7. Clifford street Asa road Aba south
8. Hospital street Asa road Aba south
9. Jubilee /st.Micheal road Asa road Aba south

Area 4…… Total population size estimated from photographic recaptures (Beck's Method) covering 16 streets along Portharcourt road Aba south in Aba south L.G.A

1. Umumesu street, Portharcourt road Aba south
2. Ahiaelu street Portharcourt road Aba south
3. Umuaro/UmuhiaeluPortharcourt road Aba south
4. Ojoto/EhiaemerePortharcourt road Aba south
5. Emeghariabe street Portharcourt road Aba south
6. Nwachukwu street Portharcourt road Aba south
7. Adindu street Portharcourt road Aba south

8. Obuda/Ozubulu street Portharcourt road Aba south
9. Dan's Avenue Portharcourt road Aba south
10. Onouha/Duru street Portharcourt road Aba south
11. Nweke/Onyeocha street Portharcourt road Aba south
12. Bright street Portharcourt road Aba south
13. Ozumba street Portharcourt road Aba south
14. Olewe street Portharcourt road Aba south
15. Chigbu street Portharcourt road Aba south
16. Ibina/Ukachi street Portharcourt road Aba south .

APPENDIX 4

Cut sustained by one of the dog meat processor in Umude village Aba, Abia State



APPENDIX 5

Free roaming dogs on the streets of Aba, Abia State.



A. Ije Street Okigwe road Aba North



B. Ozumba Street Portharcourt road Aba North



C. Olewe street Portharcourt road Aba south



D. Amucha street Faulks road Aba North

APPENDIX 6

Dogs supplied to a dog meat processor in Umude village Aba, Abia State.

