TRENDS OF DOG BITE, CLINICAL HUMAN RABIES AND ANTI-RABIES VACCINATION COVERAGE IN IMO STATE, NIGERIA (2005-2014)

BY

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CERTIFICATION

This dissertation titled "THE TRENDS OF DOG BITE, CLNICAL HUMAN RABIES AND ANTI-RABIES VACCINATION COVERAGE IN IMO STATE, NIGERIA (2005-2014)" by Iroh, Gabriel Anosike meets the regulations governing the award of the Degree of Master of Public Health in Veterinary Epidemiology of the University of Ibadan, Ibadan and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This work is dedicated to the DIVINE MERCY for making me part of this programme, for all the miracles the LORD did to me from admission into this programme to its completion.

Also dedicated to my supportive wife, Lilia Chibuzo Iroh and my lovely children, Gabrielyn Ebubechukwu, Gabriel Chinecherem and Marylyn Onyedikachi for their prayers, understandings and supports.

ABSTRACT

Rabies is an acute viral encephalomyelitis which mainly affects carnivores and bats but can affect any mammal. It is invariably fatal once clinical signs appear. Rabies account for the death of about 55,000 people worldwide yearly and it is endemic in Nigeria. Epidemiological data needed for planning control strategies for rabies in Imo State is not available. This study determined the trend of rabies, dog bites and vaccination coverage in dogs in Imo State, Nigeria.

Registration and vaccination records of dogs were obtained from the veterinary clinics. Cases of dog bites and clinical cases of rabies in humans were extracted from the hospitals using data extraction forms. Variables extracted included age and sex of victims of dog bites and clinical rabies as well as age and sex of vaccinated dogs. Data were analyzed using descriptive statistics. The relationships between dog bites/rabies cases and rainy and dry seasons were determined using correlation coefficient. Level of significance was at $p<0.05$.

A total of 10,264 dogs (mean 1,026) were registered and 5,595 dogs were vaccinated giving vaccination coverage of 55.4 %. The annual dog registration and vaccination coverage were on the increase. The vaccination coverage was below the 70% recommended vaccination coverage level by the WHO. Vaccination coverage increased over the years while more female dogs (60%) were vaccinated. A total of 436 cases of human dog bites were reported, giving a mean average of 44 bites per year. The trend of dog bite cases was on the increase. Cases were more in males (54.4%) and in children less than 20 years of age (51.2%). There is a weak non-significant positive correlation ($r = 0.3$) between dog bites and precipitation. Seventeen clinical human rabies cases were recorded. The trend of clinical human rabies was on the decrease. Twelve (70.6%) of them were in males and the most affected were the under 20 age group (94.1%).

It is therefore recommended that Government of Imo State should organize enlightenment campaign to sensitize the public on the danger posed by unvaccinated dogs in the society. Government should also subsidize the cost of anti-rabies vaccination. The dog laws should be reviewed, updated and enforced in Imo State.

KEYWORDS: Dog-bites, Human-rabies, Vaccination-coverage, Dog-registration, Rabies.

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LIST OF ABBREVIATIONS

Abbreviation		Meaning
ACUREC	-	Animal Care and Use Research Ethical Committee of the University of Ibadan
CDC	-	Centre for Disease Control
FAT	-	Fluorescent antibody test
FITC	-	Fluorescein Isothioanate
LGAs	-	Local Government Areas
PEP	-	Post-exposure Prophylaxis
WHO	-	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background Information:

Rabies is an acute viral encephalomyelitis that principally affects carnivores and bats, although it can affect any mammal. It is invariably fatal once clinical signs appear. Rabies is found throughout the world, but a few countries are free of the disease due to either successful elimination programs and/or to their island status and enforcement of rigorous quarantine regulations (Kahn and Scott, 2005). Rabies causes acute viral encephalomyelitis in humans and other warm-blooded animals (WHO, 2013).

Rabies is caused by *Lyssaviruses* in the *Rhabdovirus* family. The recognized genotypes are: *RABV...1, LBV...2, MOKV...3, DUVV...4, EBLV1...5, EBLV2...6, ABLV...7.* (*Fauquet et al.*, 2004)

Group one includes: Rabies virus (genotype 1), *Duvenhage* (genotype 4), European Bat *Lyssavirus* 1 and 2 (genotype 5 & 6), Australian Bat *Lyssavirus* (genotype 7).

Group Two: Lagos Bat virus (genotype 2), Mokola virus (genotype 3).

Rabid animals of all species usually exhibit typical signs of CNS disturbance. The most reliable clinical signs, regardless of species, are acute behavioral changes and unexplained progressive paralysis. Behavioral changes may include sudden anorexia, signs of apprehension or nervousness, irritability and hyper-excitability. The animal may seek solitude. Ataxia, altered phonation, changes in temperament are apparent and uncharacteristic aggressiveness may develop. Commonly, rabid wild animals may lose their fear of humans, and species that are normally nocturnal may be seen wandering about during the day times (Kahn and Scott, 2005). The signs of the excitative (furious) form include non-specific signs such as fever, malaise, anorexia, tingling sensation of site of bite, chocking, gaggling, hyperventilation, aggression, agitation, hyper-excitability, hydrophobia, aerophobia. The signs of the "dumb" form are apathy, depression, tachycardia, confusion, hallucination, coma and death (due to respiratory failure).

Rabies is the most fatal zoonotic disease. Dog is the most important vector of rabies accounting for about 94% of the confirmed diagnosed cases? Rabies also occurs in a host of other domestic

animals such as cattle, sheep, goats, pigs, horses, and donkeys (to which it is transmitted by infected dogs). It has also been diagnosed in the cat, Caracas and ferret (Oduye *et al*, 1985).

In Nigeria, it is believed that rabies had been recognized quite early in time because of the various dialectic names by which it is called such as *digbolugi, (Yoruba), ciwon kare, (Hausa), ginnaji, (Fulani), ebua idat (Efik) and arankita (Igbo)* (Oduye *et al*.1985) (Nottige 2005). However, the first scientific report of rabies in man was in 1912, and in the dog, 1925 (Boulger *et al*, 1960). Since then rabies has been recognized as a major health problem and is known to be widespread in Nigeria (Nawathe *et al*,1980).Traditional rabies control measures in dogs have included mass vaccination, movement restriction and control of stray dogs. The measures have been effectively applied in most of the developed world since the 1940s, resulting in relatively effective control and in some cases elimination of dog and human rabies (Kitala *et al*, 2001). However, in Nigeria rabies control measures in dogs have not been effective and canine rabies is increasing and spreading.

1.2 Statement of the problem

Rabies is one of the oldest communicable diseases of humans (Wilkinson, 1988). The disease accounts for annual human deaths of about 24,000 in Africa and about 30, 000 human deaths annually in Asia (Kirby, 2009). Rabies is recognized as a neglected zoonotic disease by World Health Organization (WHO) and perhaps more accurately as a disease of neglected communities (WHO, 2001). Practically, all human rabies cases result from viral introduction through broken skin into the flesh by the bite of a rabies infected mammals (Bishop *et al*., 2003). Between 1980 to 1998 there were eleven children with rabies in Sokoto, Nigeria (6 males, 5 females, aged 3 to 13 years old) all had history of dog bites but in only 2 cases was post exposure anti-rabies vaccination commenced (Ahmed *et al*., 2000). However, animals contract the disease through wounds, when they are bitten by another animal infected with rabies (Aiyedun., 2009). The issues surrounding animal bites are a major public health concern, particularly in areas of low income where accessibility to adequate health care, veterinary services and sufficient management of their population control is low (Ogun *et al*.,2010). Adedeji *et al*., (2010) noted that the incidence of rabies is increasingly on the high side. In developed countries, rabies is controllable because it has been controlled in domestic animals. But in the less developed World, Nigeria inclusive, where there is no infrastructure to provide controls and where effective

vaccines and post-exposure treatments are not affordable, rabies is still a significant threat to humans.

Human-animal interactions in rabies exposure are poorly defined even though descriptions of the circumstances of human exposure exist. In Imo State, necessary data to explain these phenomena convincingly are unavailable. Studies to understand, show the magnitude of rabies and alter the transmission dynamics of rabies virus as well as its spread which depend on risk factors that are directly or indirectly associated with the establishment of the disease have not been previously carried out in Imo state.

1.3 Justification:

Rabies is endemic in Nigeria and vaccination remains the most important means of controlling the disease. In Imo State, suspected outbreaks of the disease have often been reported, but the actual prevalence, trend of the disease and vaccination coverage of dogs as a major vector of rabies are not established in the State. These records are vital to plan and put in place effective interventions for control of the disease in Imo State. This study seeks to establish accurate records on the frequency of dog bites in humans in Imo State, to establish the characteristics of the disease and to determine the level of dog registration and extent of anti-rabies vaccination coverage of dogs in the State. Determining the vaccination coverage will put us in the position to know the proportion of dogs that are protected and this will help to determine the risk of interaction with dogs in Imo State.

1.4 Research questions

1. What is the anti-rabies vaccination coverage of dogs in Imo State?

2. What is the trend of dog bite cases in Imo State?

3. What is the frequency of clinical human rabies in Imo State?

1.5 Objectives

1.5.1 General Objectives

To determine the anti-rabies vaccination coverage of dogs, human dog bite cases and trend of clinical human rabies in Imo State, Nigeria.

1.5.2 Specific Objectives:

The specific objectives of this study include:

1. To determine the anti-rabies vaccination coverage of dogs in Imo State.
2. To determine the dog bite cases in humans in Imo State
3. To determine the trend of clinical human rabies in Imo State

CHAPTER TWO

LITERATURE REVIEW

2.1. Prevalence of Rabies

Rabies is globally distributed. There is an estimated 55,000 human deaths annually from rabies Worldwide (WHO, 2005).Almost all human deaths caused by rabies occur in Asia and Africa. According to Kirby, 2009, the annual human rabies death include: Asia 30,000, Africa 24,200 and United States 1-2. Greater than 98% of human deaths are caused by canine rabies and a majority of these occur in children (Nandi *et al,* 2011). Other parts of Asia with high rate of human rabies are Vietnam, Thailand (Denduangboripant *et al,* 2005) and China (Thestar.com). Different variants of rabies viruses and/or rabies related Lyssavirus occur in all continents, except Antarctica. Each variant is generally associated with a principal host species whose use of space and social interactions allow the virus to persist in its populations. These principal hosts are all members of the orders Chioptera (bats) or Carnivores (Wandeler, 2004). The disease is of paramount importance because of its global distribution, wide host range including a number of wild animals and extremely high case fatality rate. In spite of development of anti-rabies vaccine by Pasteur in 1885, the disease is still endemic in about 100 countries in the World where 2.5 thousand million people live (Nandi *et al*, 2011).

Within one geographical region different infection cycles may occur simultaneously, as in the Americas where independent rabies infection cycles in raccoons *(Procyon loto),* Skunks *(Mephetis spp),* red foxes *(Vulpes Vulpes),* grey foxes *(Urocyon Cinereoargentus),* coyotes *(Canis latarans)* and artic foxes *(Alopex)* exist. (Rabies-Bulletin- Europe, 2014).

Canine rabies is by far more important for public health and contributes up to 99% of the human death toll. Dogs maintain and transmit rabies through bite infections, causing more than 50,000 human casualties annually. Mainly developing countries from Asia and Africa suffer from the burden of the disease. WHO regards rabies as a neglected disease and efforts are promoted to establish wider access to appropriate post --exposure treatment for humans (Rabies-Bulletin-Europe, 2014).

Over the last 100 years, rabies in the United States has changed drastically. More than 90% of all animal cases reported annually to CDC now occur in wild life; before 1960 the majorities were in domestic animals. The principal hosts today are in wild carnivores and bats (CDC, 2013).

Despite evidence that control of rabies through programs of animal vaccination and elimination of stray dogs can reduce the incidence of human rabies, exposure to rabid dogs is still the cause of over 90% human exposures to rabies and over 99% of human deaths Worldwide (CDC, 2013).

A number of countries throughout the World have been free from rabies for many years. Nine deaths from rabies were reported in Germany between 1981 and 2005 (Johnson *et al.* 2005), but on 28 September 2008, the World Organization for Animal Health declared Germany as free of rabies (BMELV-Wikipedia).

The Netherlands has been designated rabies-free since 1923, Belgium since 2008. Though isolated cases of rabies involving illegally smuggled pets from Africa, as well as infected animals crossing the German and French borders do occur (British Broadcasting Corporation BBC, 2009). The UK was declared rabies-free in 1902 but there were further outbreaks after 1918 when rabid dogs were smuggled into Britain. The disease was subsequently eradicated and Britain was declared rabies-free in 1922 after the introduction of compulsory quarantine for dogs (Rabies: a new awareness in Ireland. 2010).

Tom Paulson (2014) stated that the World's deadliest human disease is not Ebola but rabies, which still kills at least 70,000 people every year. 'Rabies is the most uniformly fatal disease known to mankind' (Tom, 2014). Dog licensing, euthanasia of stray dogs, muzzling and other measures contributes to the elimination of rabies from the United Kingdom in the early 20th century, large scale vaccination of cats and ferrets has been successful in combating rabies in many developing countries (Wikipedia, 2015).

In a global rabies statistics, Signs et al, 2012 indicated that more than 15 million post-exposure prophylaxis treatments are administered each year. While 40% children in Africa receive rabies pre-exposure prophylaxis (PEP), most deaths from rabies occur in Africa and Asia and are associated with dog rabies variants. Over 50% of rabies death is in children under 15 years of age. An estimated 20 million dogs are killed every year in attempts to control rabies (Signs *et al.* 2012).

Rabies still remains a fatal infection in man and animals. It is found all over the World, except in some countries where there is strict quarantine system, rigorous eradication programme or natural barriers like mountains and rivers (Rupprecht *et al*, 2007). By 1995, the World estimate deaths were about 70,000 humans per year (CDC, 2004). Animal rabies ranked 12th in the WHO list of infections and parasitic diseases that constitute the major causes of death (WHO, 1994).

According to data submitted to OIE World Animal Health Information System, there were 38 human cases of rabies in 2011 (OIE, 2011).

In Africa, rabies kills 24,000 people a year. Most of them children, because many of the World poorest continent cannot afford the cost of the vaccination (Health News, 2013). Experts said that Africa is home to nearly half the 55, 000 people around the World who die each year from rabies, caused mainly by bites from dogs contaminated with the virus. "This is the disease of the poorest of the poor who can't afford the vaccine" (Health News, 2013). In 2010, Angola reported a total of 151 cases of rabies in humans (OIE, 2010). In 2012, five human cases of rabies were reported in Luanda's Cazenga municipality and 44 known human rabies cases were reported in the Central Province of Angola (Angola, 2012). Rabies in humans in Namibia is mostly transmitted through rabid dog bites and occurs in the Northern parts of the country. Children up to the age of 16 are mostly affected representing 83% of all human rabies cases (Global alliance for rabies control, 2014). Rabies in humans in Swaziland is mostly transmitted through the bite of the domestic dog (Global alliance for rabies control, 2014).

Rabies is the most important zoonotic disease in Nigeria. From the available evidence and records, rabies is endemic in Nigeria and occasionally, it may attain an enzootic proportion. The endemicity is maintained in the country by dog to dog transmission (Oduye et al, 1985). Rabies as a fatal viral zoonosis remains an important public health problem in Nigeria due to uncontrolled enzootic rabies, lack of vaccination and poor information (Adedeji et al, 2010).

2.2. Epidemiology of Canine Rabies

Besides some isolated countries that are regarded rabies free, classical rabies caused by rabies virus (RABV) occurs Worldwide (Rabies-Bulletin-Europe, 2014).

"Many factors affect the epidemiology of canine rabies, such as the prevalent virus reservoir, the degree of adaptation of rabies virus to dogs and related canines, the natural virus spread, the degree of virus excretion, the existence of asymptomatic carriers, the structure and dynamics of the dog population as well as the correlation of human and canine rabies" (WHO, 1987).

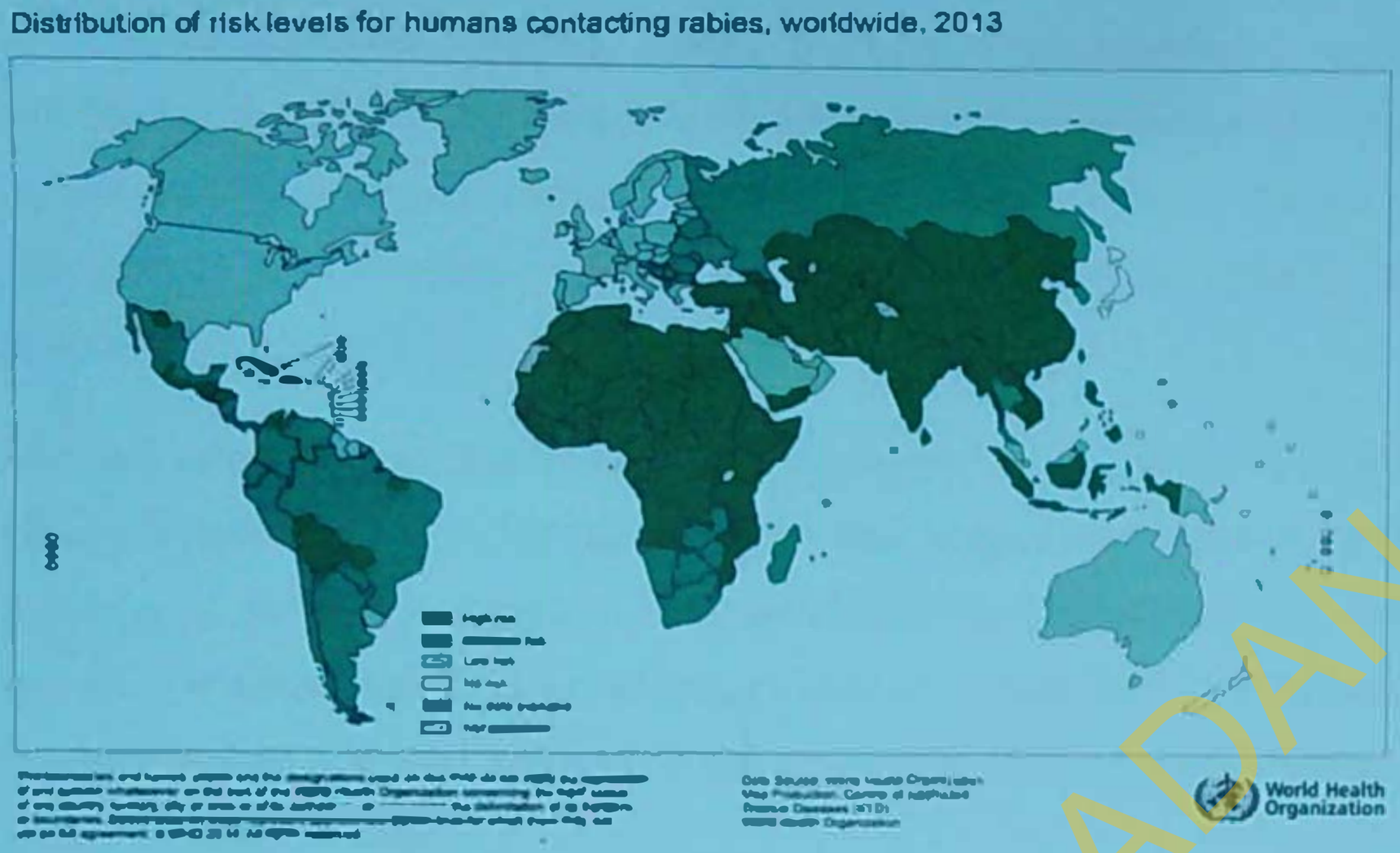

Fig.2.1: Global epidemiology/distribution of human rabies (WHO, 2013)

2.2.1 The Rabies Virus

Rabies virus is a rod-or bullet-shaped, single-stranded, negative-sense, unsegmented, enveloped RNA virus (Rupprecht, 1996). It is classified in the Rhabdoviridae family, genus Lyssavirus which includes rabies virus, Lagos bat virus, Mokola virus, Duvaenhage virus, European bat virus 1 and 2 and Australian bat virus (CDC, 2011). The RNA genome of rabies virus encodes five genes. These codes for nucleoprotein (N), phosphoprotein (P), matrix protein (M), glycoprotein (G), and the viral RNA polymerase (L) (Finke, *et al*, 2005). The complete genome sequences range from 11, 615 to 11, 966nt in length (Rabies complete genome, 2013). All replication activities occur in the cytoplasm inside specialized "virus factory", the Negri body (named after Adelchi Negri) (Synd/2491 at Who Named it?). These are 2-10μm in diameter and are typical for a rabies infection and have been used as definite historical proof of such infection (Albertini, 2008).

2.2.2 The Structure of rabies virus:

Rabies is a bullet-shaped negative single-stranded RNA virus composed of five structural proteins (Diezschold *et al.* 2005). The first protein, trimeric glycoprotein, surrounds the ribonucleicprotein core (Wunner, 2007). The trimeric glycoprotein is essential for recognizing and binding to specific sites on host cells and is therefore instrumental in determining what type of cell the virus attacks (Wunner, 2007). The second protein, matrix protein, acts as the intermediary in the binding of the ribonucleicprotein core of the virus and the membrane of the host cell (Wunner, 2007).

The last three proteins that compose the remainder of the rabies virus are located within the ribonucleicprotein core (Wunner, 2007). The polymerase cofactor phosphoprotein is the regulator of nucleocapsid protein and a cofactor in the transcription and replication of the virus' genome (Wunner, 2007). The nucleocapsid protein is important in the phosphorylation of serine residue, which is a vital element in the regulation of the transcription and replication of the genome (Wunner, 2007).

The last is the virion-associated RNA polymerase, the large protein; this protein encodes more than half of the RABV's genome and is responsible for most of the enzymatic activity involved in the transcription and replication of the genome (Wunner, 2007).

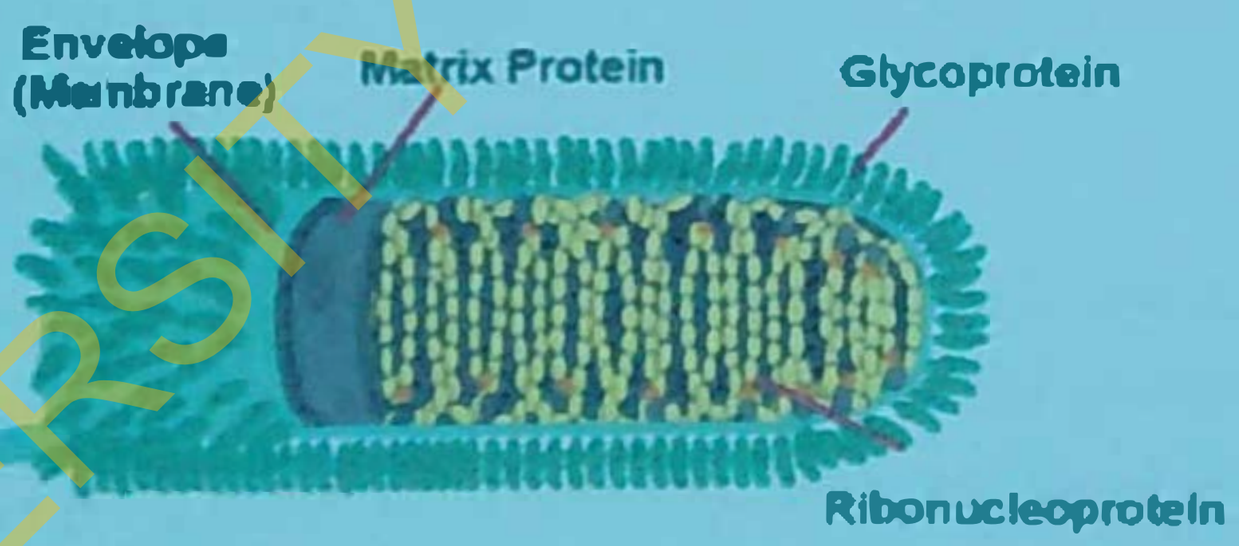

Fig 2.2: Structure of Rabies Virus.

2.3 Risk Factors for Rabies

Special risk factors that may expose pets to risk of rabies transmission are exposure to wildlife and exposure to other pets that may not be vaccinated (imrab.us.). According to Mayo clinic staff (2014), factors that can increase risk of rabies includes traveling or living in developing countries where rabies is more common, including countries in Africa and Southeast Asia,Activities that are likely to put you in contact with wild animals that may have rabies, such as exploring caves where bats live or camping without taking precautions to keep wild animals away from your campsite, working in a laboratory with the rabies virus, wounds to the head, neck or hands, which may help the rabies virus travel to your brain more quickly.

Persons at greatest risk of exposure include animal control officers, spelunkers, laboratory workers (CDC, 2008), animal handlers and veterinarians (virtual medical clinic, 2013). These people should consider receiving pre-exposure vaccination. This process simplifies the post-exposure prophylaxis (PEP) series required if a person is bitten by a rabid animal (CDC, 2008).

2.4 Transmission of Rabies

Transmission of rabies virus usually begins when an uninfected animal comes in contact with the saliva of an infected host. Other routes of transmission include contamination of mucous membranes and aerosol transmission, often in caves inhabited by bats (Edukugho, 2014). Another rare occurrence of rabies transmission occurred via a corneal transplant to a patient in France (University of Florida, 1999).

2.5 Distribution of Rabies

Rabies is widely distributed across the globe (WHO, 2013) except Australia, Antarctica, some islands where there is strict quarantine system, rigorous eradication or natural barrier like mountains and rivers (Mayo clinic newsletter, 2011) and New Zealand (Virtual medical clinic, 2013).

2.6 Pathogenesis of Rabies

The major source of introduction of rabies virus into uninfected host is through the bite of an infected animal. Transmission can occur if the virus is introduced onto any mucous membrane (eyes, nose, and mouth) (Mass.gov, 2015). The virus does not penetrate intact skin (Fishbein, 1991). At the site of entry, there may be local viral proliferation in non-neural tissue followed by viral attachment to nerve cell receptors and entry into peripheral nerve endings (Charlton, 1994). The virus moves slowly as it jumps from nerve cell to nerve cell on its way to the brain. Though very small amounts of virus could enter the blood stream when the bite occurs, it would be unable to replicate there, so the blood from a rabid animal is not considered infectious (Mass.gov, 2015). The virus is transported along afferent axons, eventually reaching the central nervous system where proliferation is followed by widespread distribution of the virus throughout the brain and spinal cord (Charlton, 1988).

The time it takes the virus to go from the bite wound to the brain is the Incubation Period. The incubation period can range anywhere from 2 weeks to several months. The average incubation period for dogs and cats is about 2 months. Usually, the location of the bite wound will determine the length of incubation. If an animal is bitten on the neck, the virus would have a relatively short distance to travel to the brain, and would likely have a short incubation period" (Mass.gov, 2015).

Following central nervous system infection, the virus is transported centrifugally along cranial nerves and along motor and sensory pathways as well as the spinal cord. This results in the presence of viral particles in peripheral nerve tracts in many tissues, particularly those of the bead. Therefore, a diagnosis of rabies may sometimes be possible by examination of skin sections, where antigen can be detected within nerve tracts or corneal smears" (Bingham *et al.* 1995), (Schneider, 1969). There is a period of about 3 days that the animal will be actively shedding the virus but will not appear to be sick in any way. After this 3 day period, the virus in the brain has infected enough of the brain tissue that it begins to affect the animal's behavior (Mass.gov. 2015).

2.7 Immunity to Rabies

Protective ~~immunity~~ against rabies involves both B-cell (humoral) and various pathways of the T-cell response (Lafon, 1994).The effective humoral response is directed only against the glycoprotein envelope of the viru. Cytotoxic T-cell responses are directed against the glycoprotein, nucleoprotein and phosphoprotein components of the virus (Vonteichman, *et al.*1998). Where the host has been successfully vaccinated, virions within a wound will be cleared mainly by the humoral immune system through neutralization before they gain entry into the nervous system (Vonteichman, *et al.* 1998). Once inside the neurons, virions are inaccessible to this immune pathway. This is the main reason for urgent initiation of post-exposure vaccination and passive immunoglobulin treatment (Vonteichman, *et al.* 1998). Additional cytolytic ~~immune~~ mechanisms may operate against intracellular virus. Inoculation of rabies ~~virus-containing~~ saliva into a wound does not normally induce a detectable immune response (Vonteichman, *et al.* 1998). Generally, veterinary vaccines are used for pre-exposure treatment, while human vaccines, which are considerably more expensive to produce, are used post-exposure (Vonteichman, *et al.* 1998). There are a number of available vaccines that are both safe and effective. They can be used to prevent rabies before and for a period of time after exposure to the virus such as by a dog or bat bite (WHO, 2010). The immunity that develops is long lasting after three doses. They are usually given by injection into the skin or muscle (WHO, 2010). After exposure vaccination is typically used along with rabies immunoglobulin (WHO, 2010). It is recommended that those who are at high risk of exposure be vaccinated before potential exposure (WHO, 2010). Vaccines are effective in humans and other animals. Immunizing dogs is very effective in preventing human disease.

2.8 Diagnosis of Rabies

Brain tissue is the preferred specimen for post-mortem diagnosis in both humans and animals (Rabies-Bulletin-Europe, 2004). Many diagnostic methods exist for the detection of rabies in animals. Such as direct florescent antibody, mouse inoculation technique, tissue culture infection technique, and polymerase chain reaction (Bourhy, *et al.* 2005). The most widely used method for diagnosing rabies infection in animals and humans and recommended by both WHO and OIE is the fluorescent antibody test (FAT) (Rabies-Bulletin-Europe, 2004). FAT is the gold standard

for routine rabies virus detection that uses postmortem brain tissue (Kamruddin, 2012). Brain tissue ~~samples,~~ smears or cells are treated with antirabies serum or globulin labelled with fluorescein isothiocyanate (FITC). Preferentially polyclonal conjugates with fluorescence-labelled antibodies are used. Specific aggregates of rabies virus antigen are detected by their fluorescence using a reflected light (incident light) fluorescence microscope. The FAT is accurate, sensitive and rapid. Results can often be obtained within 1 to 2 hours of receipt of the specimen (Rabies-Bulletin-Europe, 2004).

"Historically, microscopic examination of histological preparations was the primary means of identifying evidence of rabies infection in post mortem samples from animals and humans. Fresh brain smears or microtome-cut sections of formalin fixed paraffin-embedded tissue were stained with combinations of basic fuchsin and methylene blue or with hematoxylin and eosin"(Tierkel, *et al.* 1996).

"Histopathologic evidence of encephalitis includes signs of inflammatory response, such as perivascular cuffing and cellular infiltrations. The presence of acidophilic intracytoplasmic inclusions, called Negri bodies, found prominently in the purkinje cells of the cerebellum and the pyramidal cells of the hippocampus, is virtually pathognomonic for the disease"(Perl, *et al.* 1991).

2.9 Treatment of Rabies

There is no established therapy for human patients with rabies. An approach to the management of human rabies by Jackson in 2003 recommended using a combination of therapies and discussed the pros and cons of using a variety of specific agents (Jackson 2003). The first documented case of one recovery from a naturally acquired case of human rabies was by Hattwick (Hattwick *et al* 1972). Since then, five other instances of recovery have been documented. Five of the six known survivors of rabies infection received prophylaxis prior to developing clinical symptoms (Jackson, 2005). In 2004, a 15-year-old patient survived rabies who had not received rabies vaccine prior to the onset of clinical disease (Willoughby, *et al* 2005). This is the only documented survivor who had not received vaccination prior to onset of clinical disease. The therapy included therapeutic (induced) coma using intravenous midazolam for seven days; a burst-suppression pattern on the electroencephalogram was maintained and

supplemental phenobarbital was given. Also given was therapy with ketamine and antiviral therapy, including ribavirin and amantadine. There was improvement and the patient was discharged from the hospital with neurologic deficits, but subsequently had progressive neurologic improvement (Hu, *et al.*2007). However, since that time, there have been at least 13 known cases in which the main components of this approach (the "Milwaukee" protocol) have been used, and fatal outcomes have resulted (Jackson, 2009). The Milwaukee protocol is an experimental course of treatment of an infection of rabies in a human being. The treatment involves putting the patient into a chemically induced coma and administering antiviral drugs. It was developed and named by Rodney Willoughby, Jr., M. D. following the successful treatment of a patient (Rodney *et al* 2007). The Milwaukee protocol is sometimes referred to as the "Wisconsin protocol" (CDC, 2012).

2.10 Prevention of Rabies

Reliable data on rabies are scarce in many areas of the globe. This makes it difficult to assess the full impact on human and animal health (WHO, 2001). However, vaccination of pet animals provides a barrier to transmission of rabies to humans. This has provided a major mechanism for prevention by breaking the link between rabies cycles in wildlife and transmission to domestic animals; the latter providing a ready means to pass the infection on to humans (Krebs, *et al.* 1995). Since dog has been established as the predominant vector of rabies in Nigeria, the most logical and cost effective approach to rabies control is the elimination of stray and ownerless dogs combined with a programme of single mass vaccination in the shortest possible time, at least 80% of the entire dog population (WHO, 2001). Owned dogs should be kept in confinement to avoid their having contact with stray dogs and wild animals which are the potential source of rabies to domestic dogs.

CHAPTER THREE

METHODOLOGY

3.1 Study Area

This study was carried out in Imo State, South-East Nigeria. Imo State was created in 1976. It is located in the South-Eastern part of Nigeria with Owerri as its capital and largest city. The State lies within latitude $4^0 45'N$ and $7^0 15'N$ and longitude $6^0 50'E$ and $7^0 25'E$ (Fig: 3).

Imo State has a total area of 5, 530sqkm (2,140sqm), and a total population of 3,934,899 (www.getamap.net.>...>.imo). Imo State is divided into three Senatorial zones-Owerri, Orlu and Okigwe senatorial zones. The State has 27 Local Government Areas.

The weather is characterized by two seasons (rainy and dry seasons). The rainy season begins in April and last until November and the dry season lasts from December to March. The annual rainfall vary from 1500mm to 2200mm. Imo State has a mean temperature of above 20^0C and relative humidity of 75%. The dry season has two months of harmattan from late December to late February and the hottest months are between January and March.

The traditional occupations of Imo people are farming and business. There are also public and civil servants.

Dogs are kept in Imo State for various purposes: such as hunting, for security, as pets, breeding for financial support and for meat. Dog butchers slaughter dogs using their hands as mouth muzzles. This practice is a risk factor for rabies because in some cases it had led to the butchers being bitten by dogs while trying to severe their throats. Local breed of dogs are mainly used for hunting and are rarely taken to the veterinary clinic for vaccination or any form of treatment.

Imo State has high population of dogs, as dogs are kept for security and for breeding purposes especially in the urban areas. Cats are also kept as pets but by a few people in the State. Unlike in some states in Nigeria where hills and Caves exist and bats which also transmit rabies virus are present in large numbers, bats are not very common in Imo State, but are seen from time to time flying out from bushes and sometimes from within the roof of houses.

Public and private Veterinary clinics are located in the three senatorial zones of Imo State which renders veterinary services to dog and livestock owners in the State. The public veterinary clinics are managed by the Veterinary department of the State Ministry of Agriculture and Natural

Resources. The public Veterinary clinics are responsible for providing veterinary services for famers in the State and medical services for pet animals such as dogs, cats etc. The Veterinary Department of the State Ministry of Agriculture is also responsible for the enforcement of Veterinary and animal Laws in the State Local breed of dogs are hardly taken to clinics for treatment and are commonly seen roaming the streets unconfined.

Some private and public Veterinary clinics in Imo State do not keep records of dog vaccination and treatment

Figure 3.1: Map of Nigeria highlighting Imo State

Figure 3.2: Map of Imo State showing the 3 senatorial zones and the 27 LGAs

3.2 Study Design

A retrospective study was conducted to determine dog bite cases, rabies cases, dog registration and vaccination coverage of dogs in Imo State.

Study Population

The study populations were hospital patients and the dogs registered by the veterinary clinics in Imo State.

Inclusion Criteria

Included in this study were all recorded victims of dog bite in the selected hospitals and all registered dogs in the LGAs studied.

Exclusion Criteria

Excluded from the study:

All Veterinary clinics without records on dog registration and vaccination coverage.

Sample Size and Sampling Technique

Proportional sampling technique was used to determine the number of Local Government Areas studied from each senatorial zone. Simple balloting technic was used to select the hospitals studied. By proportional sampling (4:3:2, based on the number of LGAs in each zone -Orlu : Owerri : Okigwe=12 :9: 6), four LGAs (Oru West, Egbema, Oguta and Arondizuogu) were chosen from Orlu senatorial zone, three (Owerri West, Aboh Mbaise and Ngor Okpuala) from Owerri senatorial zone and two (Okigwe and Ihitte Uboma) were chosen from Okigwe senatorial zone. By balloting, a public hospital was picked from each of the selected LGA for study. Where a selected LGA have only one public hospital, automatically that hospital is selected. Nine hospitals (Imo State Specialist Hospital (ISSH), General Hospital (GH) Aboh Mbaise, GH Ngor Okpuala, GH Awo Omamma, GH Oguta, GH Egbema, GH Arondizuogu, GH Okigwe and GH Ihitte Uboma) were selected.

All public and private veterinary clinics in Imo State were studied. A total of nine public and one private Veterinary clinic with dog registration and anti-rabies vaccination records were reviewed. Dog registration and anti-rabies vaccination were studied for the period of 10-years.

Data collection Instruments

- Data were collected using data extraction forms : Dog registration and vaccination extraction form (Form 01) and Dog bites and clinical human rabies data extraction form (Form 02) (Appendices 1 and 2)

Data collection Method

Trained research assistants were responsible for data collection. Data on dog bite cases, age and sex of victims and outcome of bites (rabies or no rabies) registered in the hospitals over a 10-year-period (2005-2014) were collected from the hospital records.

Data on dog registration, age, sex and vaccination records of the veterinary clinics over a 10-year-period (2005-2014) were collected.

Data Analysis

Dog bite cases were classified according to date of bite, age, sex and outcome of bite (clinical rabies or no-clinical-rabies) on victim were determined.

Data on dog registration, age and sex and vaccination status (vaccinated or not-vaccinated) were also determined.

The vaccination coverage was calculated using the formula:

$$\text{Vaccination coverage (\%)} = \frac{\text{No of dogs vaccinated}}{\text{Total no of registered dogs}} \times 100$$ (Adeyemi *et al*, 2005).

Moving average curve was used to determine the trend of vaccination coverage and dog bites during the study years. The 3-year moving average was calculated by finding the average of subsequent 3 years vaccination coverage/dog bite cases (Wikipedia., 2010). Figures obtained were used to form tables and plotted against the years of study to smooth the curve to determine whether the trends are on the increase or decrease. Correlation coefficient or Pearson product

moment correlation coefficient (PMCC) was used to determine the relationship of dog bite/rabies between the rainy and dry seasons. This is used to express the relationship between the two variables.

The correlation coefficient formula used is:

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{\sqrt{\left(n\sum_{i=1}^{n} x_i^2 - \left(\sum_{i=1}^{n} x_i\right)^2\right)\left(n\sum_{i=1}^{n} y_i^2 - \left(\sum_{i=1}^{n} y_i\right)^2\right)}}$$

(www.alcul.com/calculators/statistics/correlation-coefficient/

Where:

r = correlation coefficient = numerical value between -1 and +1,

n = total no of samples, x_1 (x_1, x_2..., x_n) are the x values and y_1 (y_1, y_2...y_n) are the y values.

When r is closer to 1 it indicates a strong positive relationship. A value of 0 indicates that there is no relationship. Values close to -1 signal a negative relationship between the two variables.

Figures were presented with tables, bar charts, pie charts, histograms and line graphs.

Ethical Clearance

Ethical approval was obtained from the Animal Care and Use Research Ethical Committee of University of Ibadan (ACUREC) (Appendix 3).

Permissions were sort from the Chief Medical Directors of the hospitals that participated in the study.

Limitation

Most veterinary clinics, public and private had no records of registered and vaccinated dogs in the State. Hence, the study was limited to Veterinary clinics with records of registered and vaccinated dogs in the State.

CHAPTER FOUR

RESULTS

4.1 Dog Registration and Anti-rabies Vaccination in Imo State 2005-2014

4.1.1 Dog Registration in Public and Private Veterinary Clinics in Imo State.

A total of ten thousand two hundred and sixty four (10,264) dogs were registered in all the veterinary clinics of Imo State from January 2005 to December 2014 giving a mean of 1,026 dogs per annum. Of the total number of registered dogs, 76.2% were registered by public veterinary clinics while the rest 23.8% were by private veterinary clinics (Appendix 4) (Fig: 4.1). The number of dogs registered by the veterinary clinics increased yearly during the study period (Fig: 4.2 :). All the registered dogs were domiciled in the State. Of the total number of registered dogs, 6,415 (62.5%) were females and 3,849 (37.5%) were males (Table: 4.1).

The highest number of dogs 5,583 (54.5%) were registered in Owerri Municipal LGA during the study period, this was followed by 1,711 (16.7%) dogs registered in Ahiazu Mbaise LGA, while the least number of registered dogs 53 (0.5%) was in Mbaitoli LGA (Fig: 4.3).

4.1.2 Anti-rabies Vaccination of Dogs in Imo State.

Five thousand five hundred and ninety five (5,595) dogs were vaccinated against rabies in Imo State (Appendix 5), giving a mean of 560 dogs per annum (Fig: 4.4). Of the total dogs vaccinated, 3,355 (60.0%) were females and 2,240 (40.0%) were males (Fig: 4.5). The highest number of dogs vaccinated against rabies 3,049 (54.5%) were in Owerri, followed by 15.9% (891) in Ahiazu Mbaise LGA. The least number of vaccinated dogs 25 (0.5%) were in Mbaitoli LGA (Fig: 4.6).

The overall vaccination coverage of dogs was 55.5% (Table 4.2). The vaccination coverage in the State within the study period showed a decrease in trend (Fig 4.7). The study showed yearly vaccination coverage of dogs of 67.5% in 2008 as the highest and the least coverage was 49. 1% in 2011.

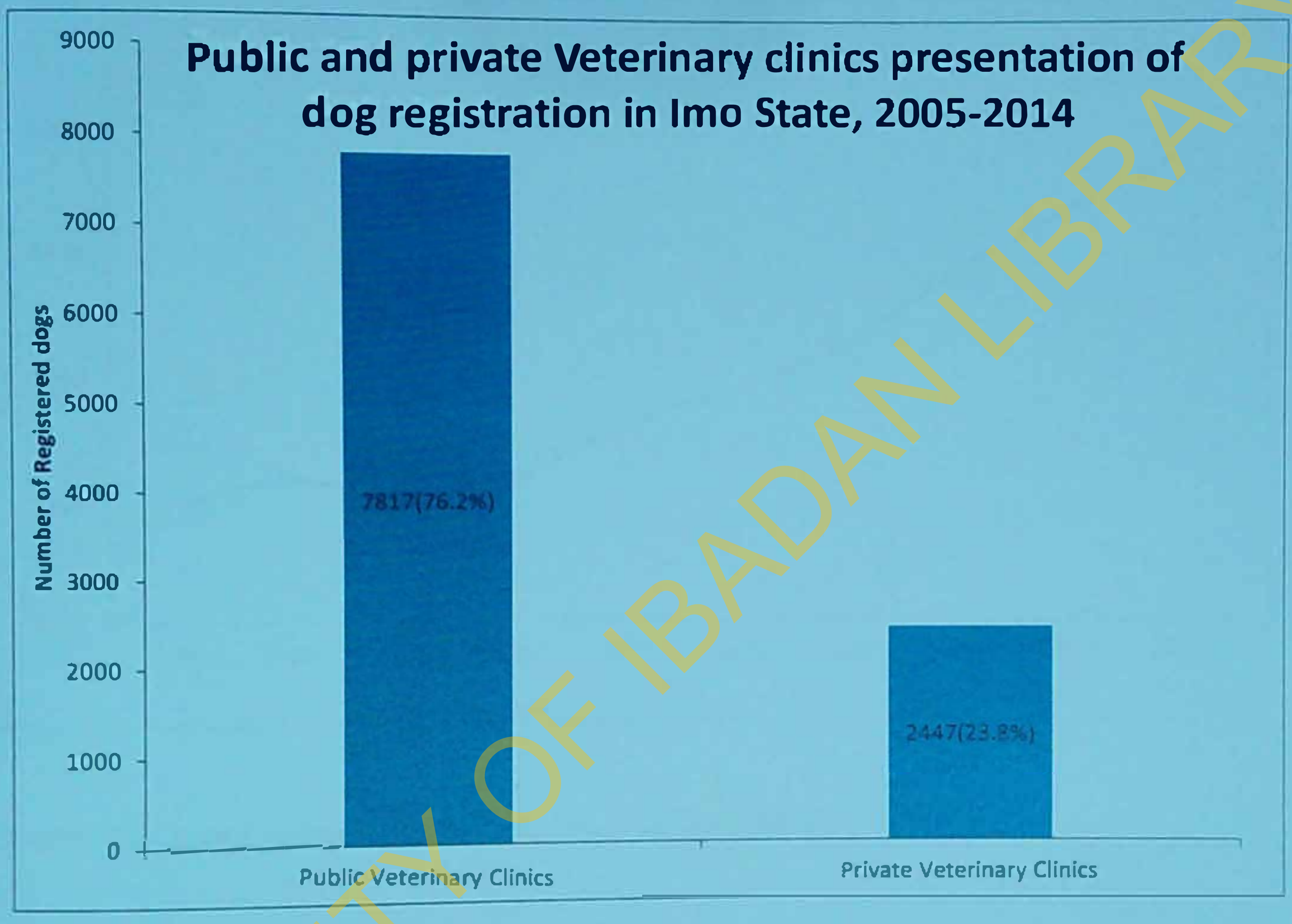

Figure: 4.1: Presentation of dog registration by public and private veterinary clinics in Imo State, 2005-2014

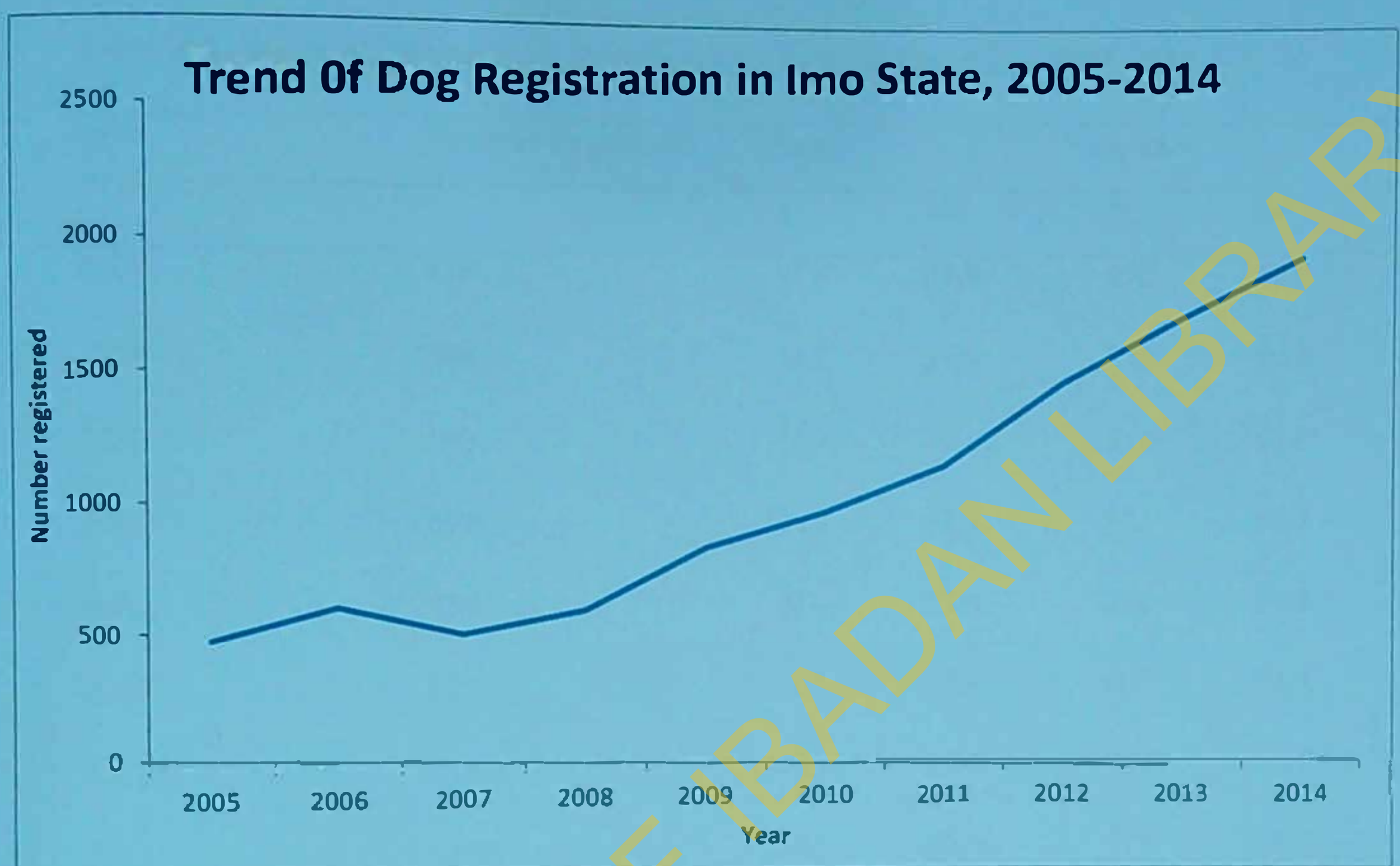

Figure: 4.2: Trend of dog registration in Imo State 2005-2014

Table: 4.1. Sex of registered dogs at veterinary clinics in Imo State, 2005-2014

Year	Number registered	Male		Female	
		n	%	N	%
2005	474	178	37.6	296	62.4
2006	604	227	37.6	377	62.4
2007	503	189	37.6	314	62.4
2008	593	222	37.4	371	62.7
2009	835	313	37.5	522	62.5
2010	972	365	37.6	607	62.4
2011	1151	432	37.5	719	62.5
2012	1470	551	37.5	919	62.5
2013	1717	644	37.5	1073	62.5
2014	1945	729	37.5	1216	62.5
Total	**10264**	**3850**	**37.5**	**6414**	**62.5**

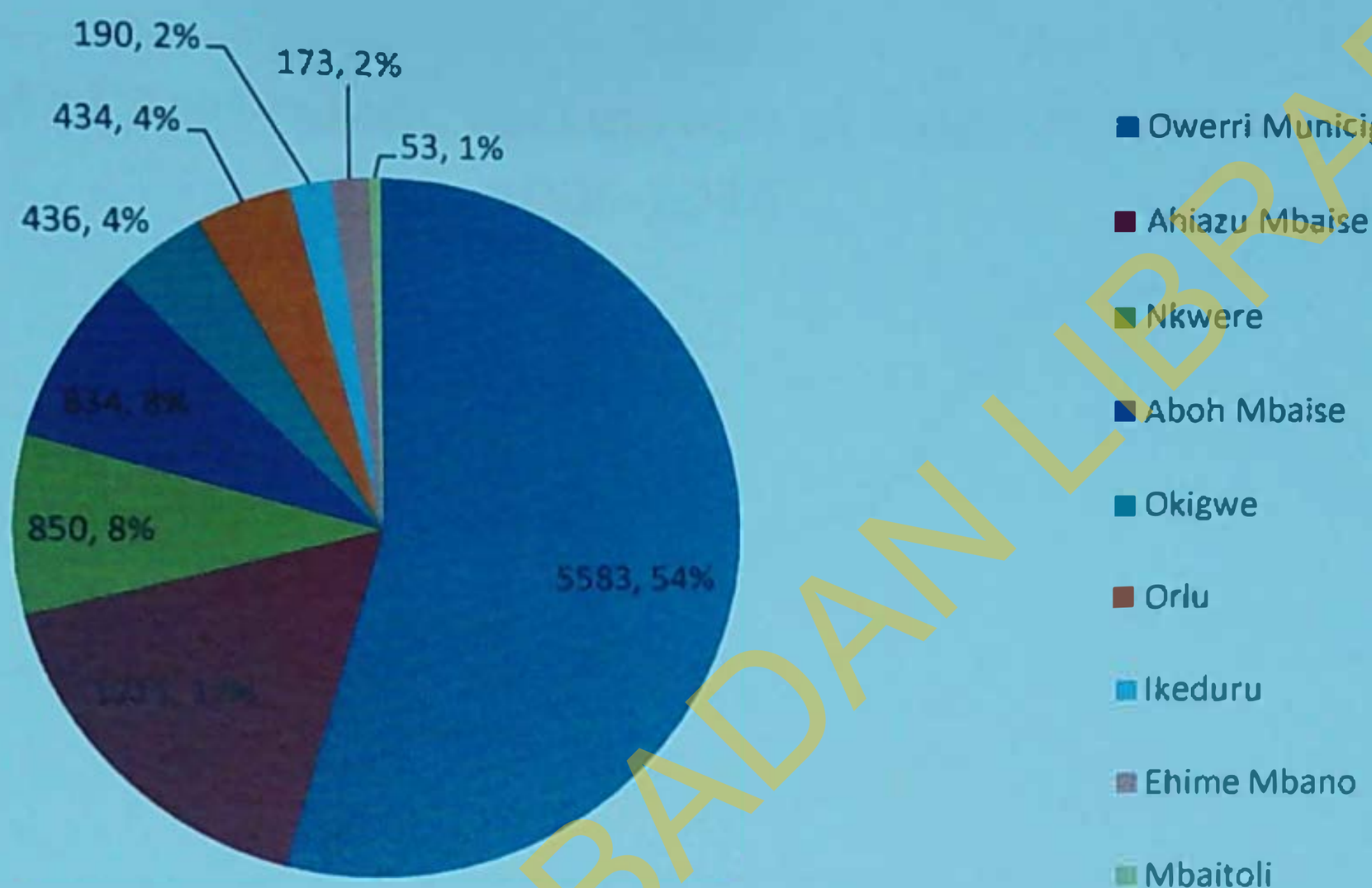

Figure: 4.3: Number of registered dogs in LGAs, Imo State, 2005-2014

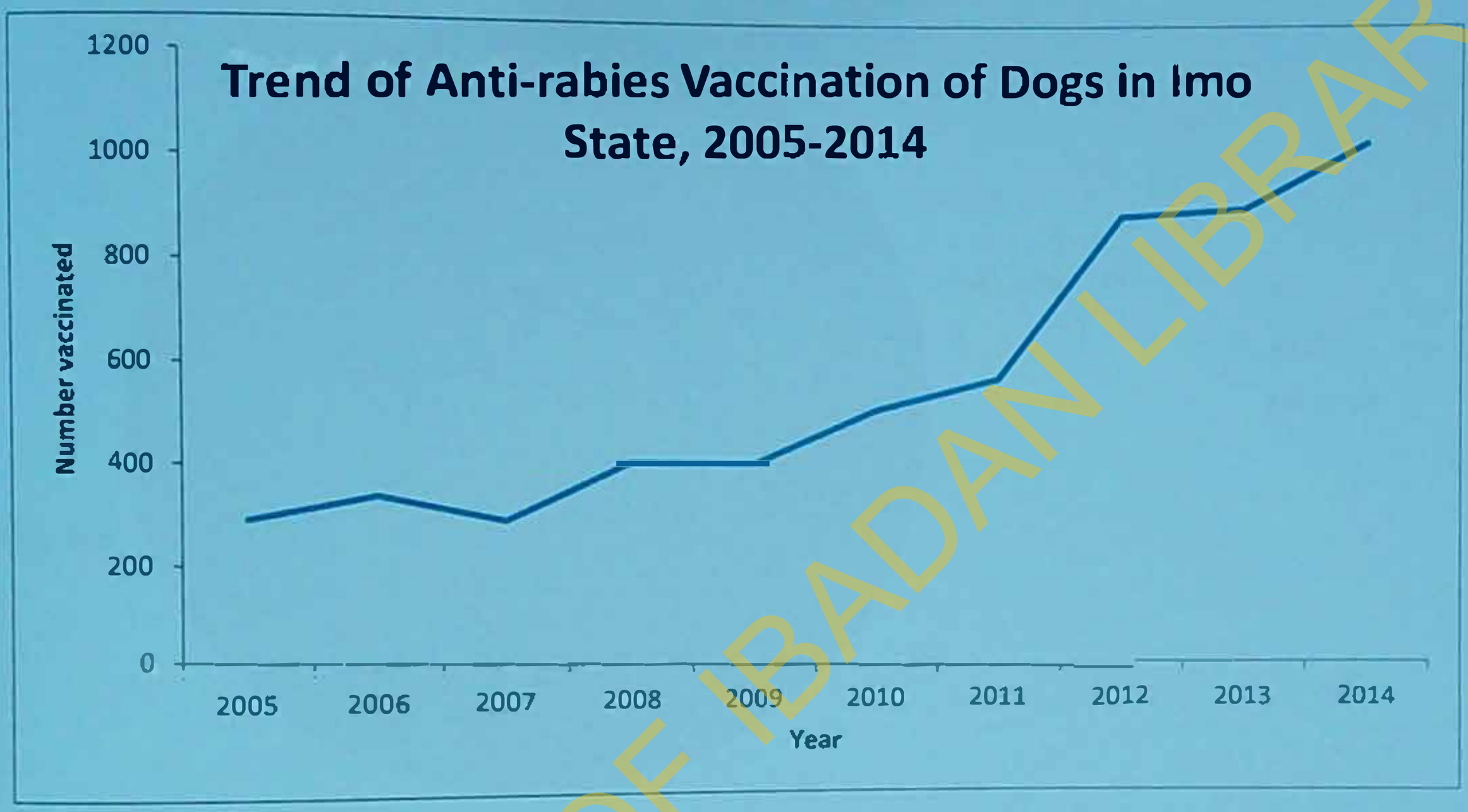

Figure: 4.4: Trend of Anti-rabies Vaccination of dogs in Imo State, 2005-2014

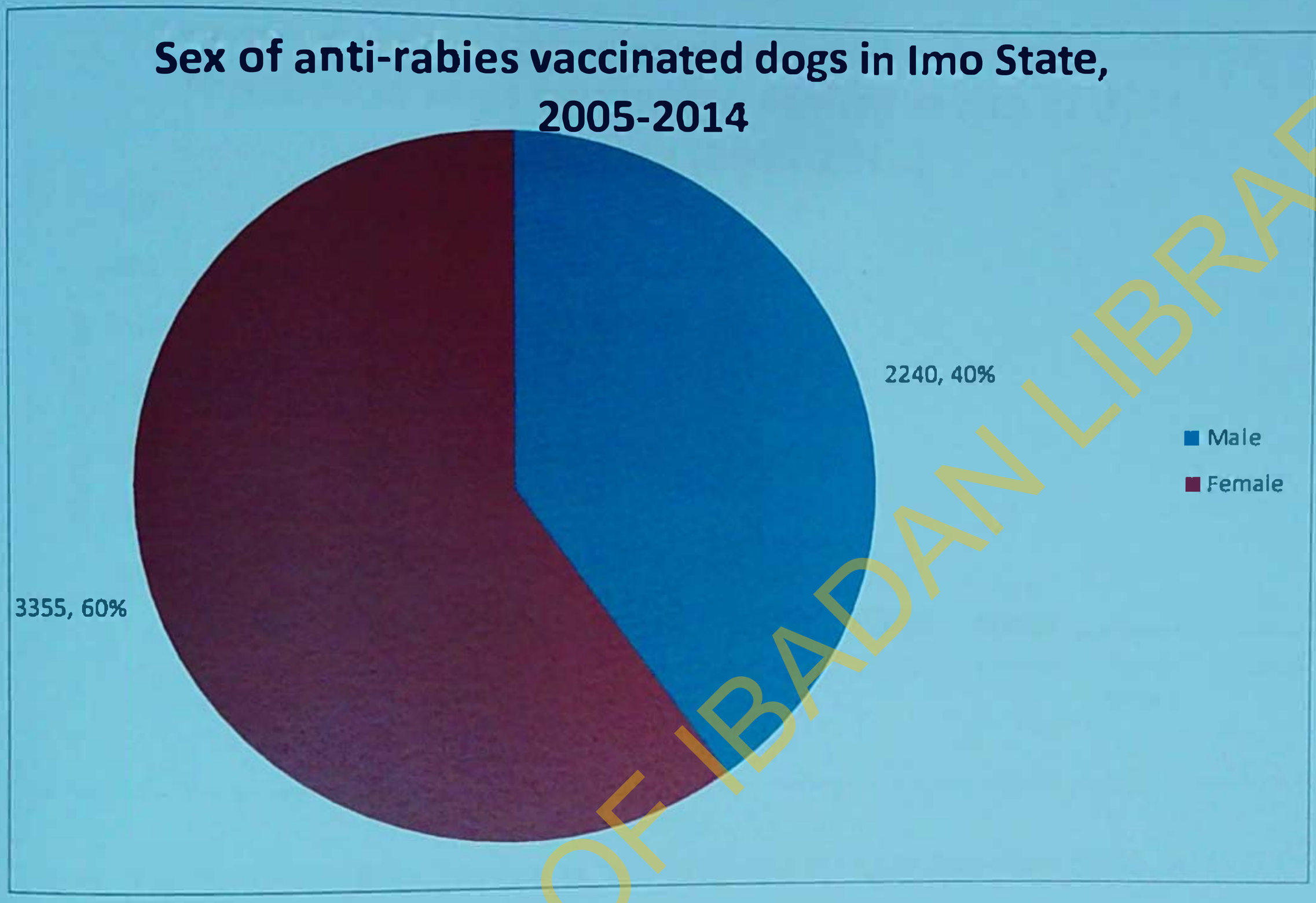

Figure: 4.5: Sex of Dogs vaccinated against Rabies, Imo State 2005-2014

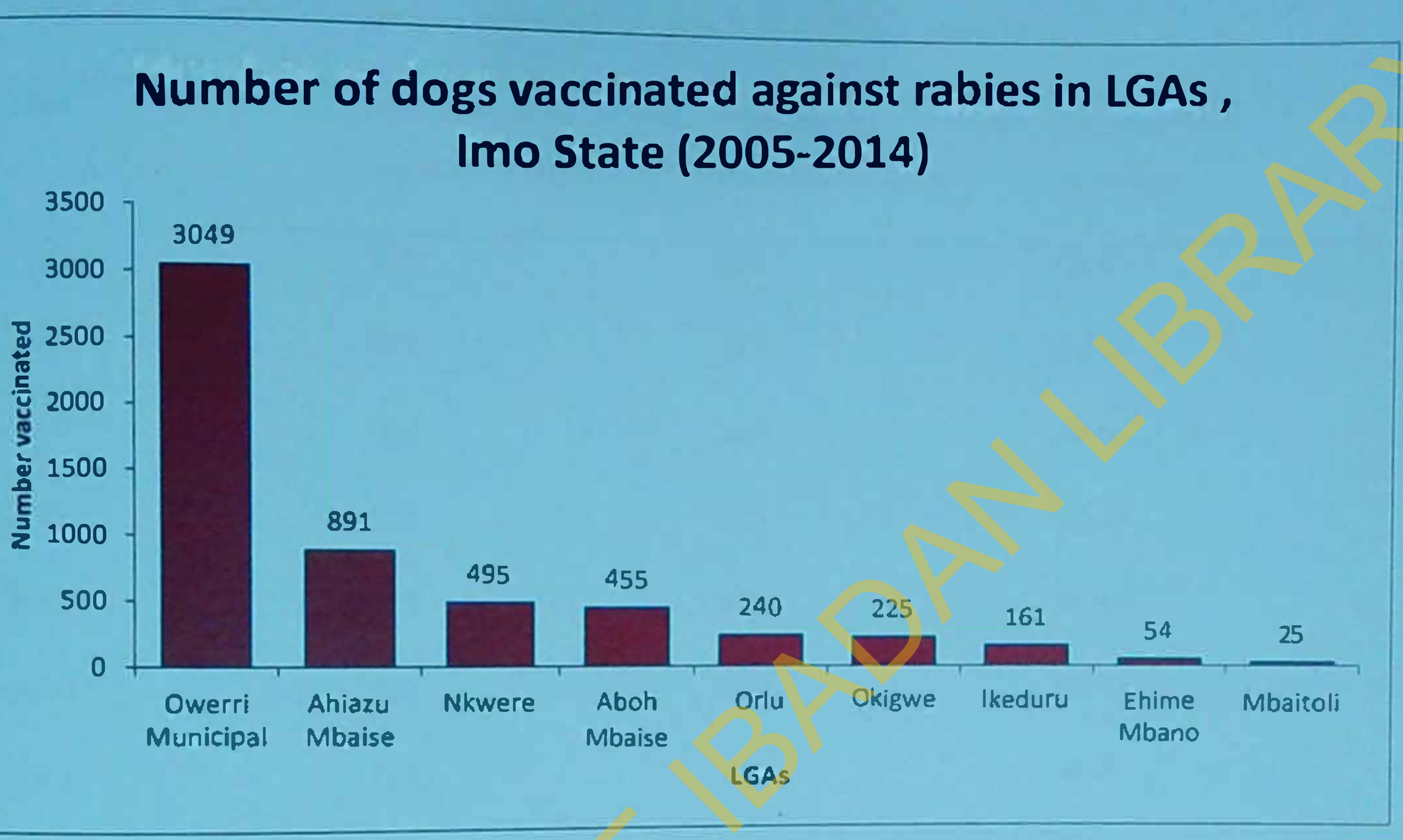

Figure: 4.6: Number of Dogs Vaccinated against Rabies in LGAs, Imo State (2005-2014)

Table: 4.2: Yearly vaccination coverage of dogs in Imo State 2005-2014

Year	Number of registered dogs	Number of vaccinated dogs	Vaccination coverage
2005	474	289	60.97
2006	604	335	55.46
2007	503	285	56.66
2008	593	400	67.45
2009	835	496	59.40
2010	972	503	51.75
2011	1151	565	49.09
2012	1470	881	59.93
2013	1717	903	52.59
2014	1945	1032	53.06
Total	**10264**	**5595**	**54.51**

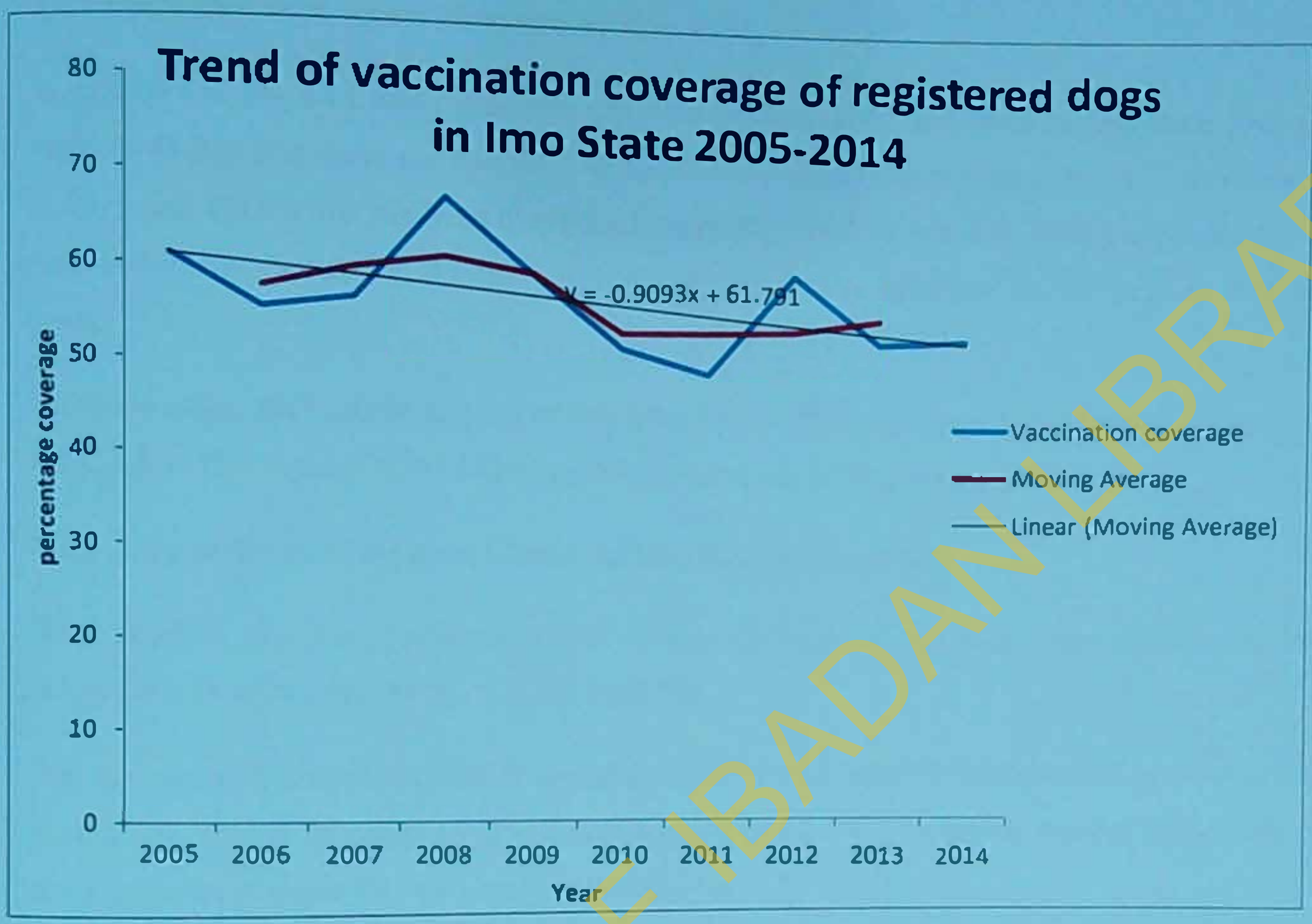

Figure: 4. 7: Trend of vaccination coverage of registered dogs in Imo State 2005-2014

4.2 Dog Bite cases in Humans

4.2.1 Dog Bite Cases across Hospitals in Imo State

A total of 436 cases of dog bites were reported between 2005 and 2014 in Imo State giving a mean of 44 dog bite cases per annum. The highest number of dog bite cases 52 (11.9%) occurred in 2010 and 2013 while the least number of cases 30 (6.9%) occurred in 2008 (Appendix 6). As observed in figs; 4.8 & fig; 4.9 the trend of dog bites in Imo State was on the increase over the years.

Of all the cases, the highest number of dog bites 74 (16.9%) were recorded in Owerri West (OW) LGA, while Oru West (ORW) LGA had the lowest cases of dog bites (Table: 4.3).

4.2.2 Sex and Age of Human Victims of Dog Bites in Imo State

Two hundred and thirty seven (54.4%) victims of cases of dog bites were males, and 199 (45.6%) cases were female (fig. 4.10. & fig.4.11).

The age range of human victims of dog bite cases 0-9 year with 124 or 28.4% of total cases was the highest. This is followed by 10-19 year with 99 or 22.7%. The lowest number 11 or 2.5% of cases occurred in those 70 years and above (Appendix 7), (Fig.4.12).

A total of 301 cases of dog bite occurred during the rainy season in Imo State. Also 135 cases of dog bite occurred during the dry season (Appendix: 8, Fig. 4.13), giving a correlation coefficient of 0.2666 and a P-value of 0.4022. The result is positively correlated but weak. The result is not significant at $p<0.05$. The mean dog bite cases during the rainy season are 3.8 bites per month and 3.4 bites per month during the dry season. The difference in the mean values of dog bites between the rainy and dry seasons showed increased cases during the rainy season than during the dry season. The seasonal trend of dog bites in Imo State showed a decreasing pattern (Fig. 4. 13b).

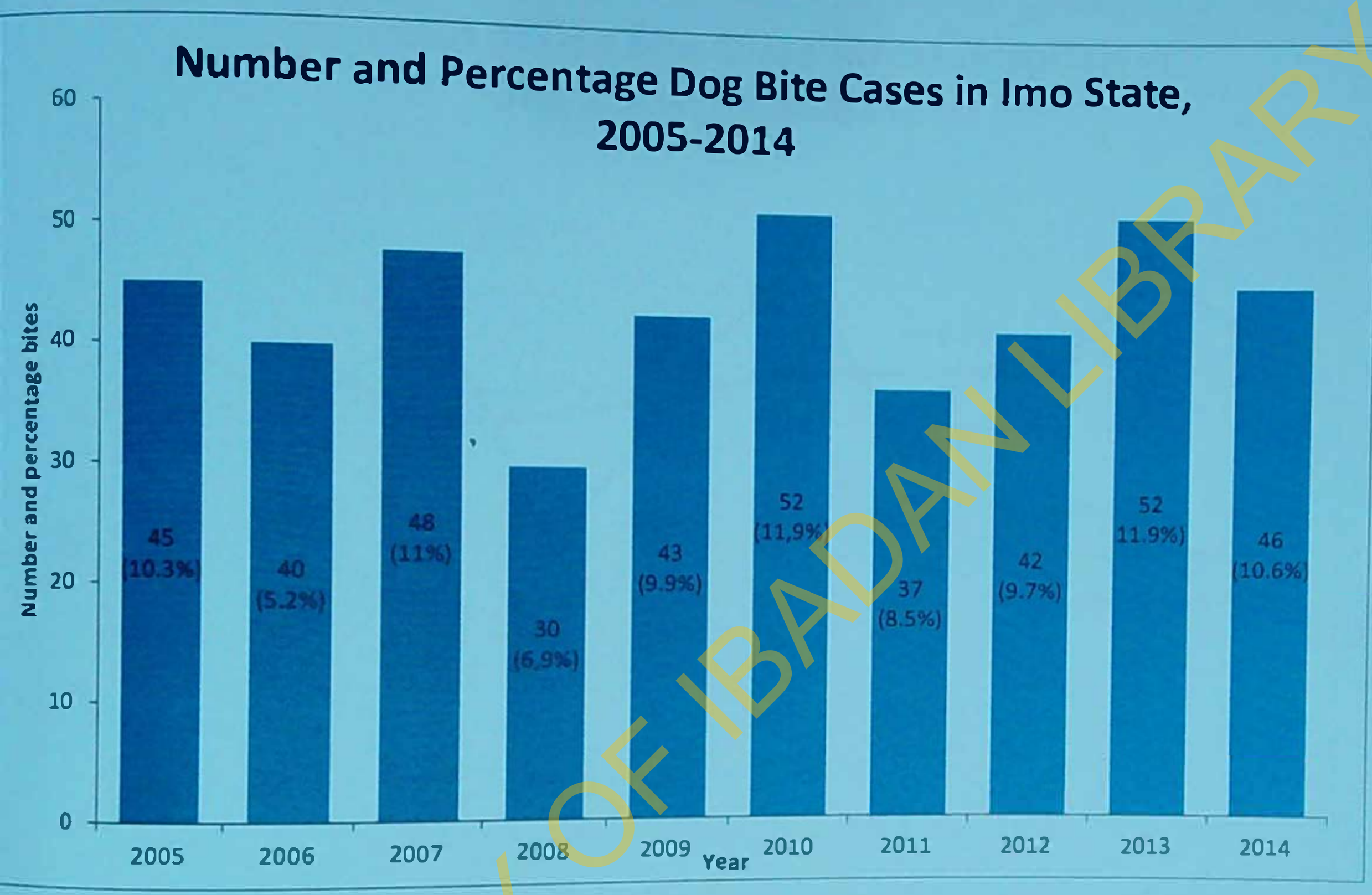

Figure: 4.8: Dog bite cases in Imo State, 2005-2014

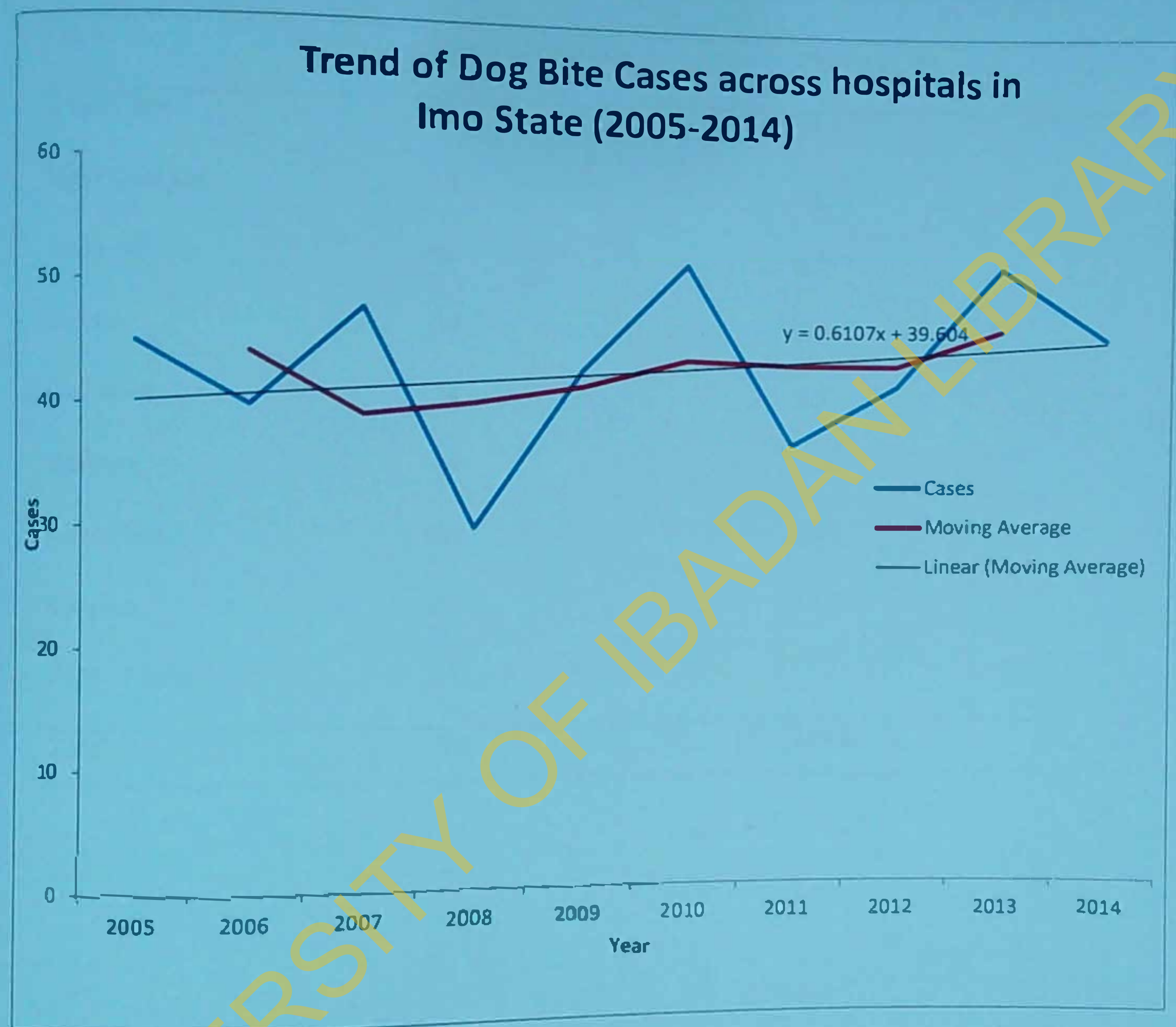

Figure: 4.9: Trend of dog bite cases across hospitals in Imo State 2005-2014

Table: 4.3: Yearly presentation of dog bite cases across LGAs in Imo State, 2005-2014

LGA	Cases of dog bite	Percent (%)
Owerri West	74	16.8
Ngor Okpuala	57	13.1
Aboh Mbaise	38	8.7
Oguta	39	8.9
Oru West	24	5.5
Egbema	46	10.6
Ideato North	60	13.8
Okigwe	49	11.3
Ihitte Uboma	49	11.3
Total	**436**	**100.1**

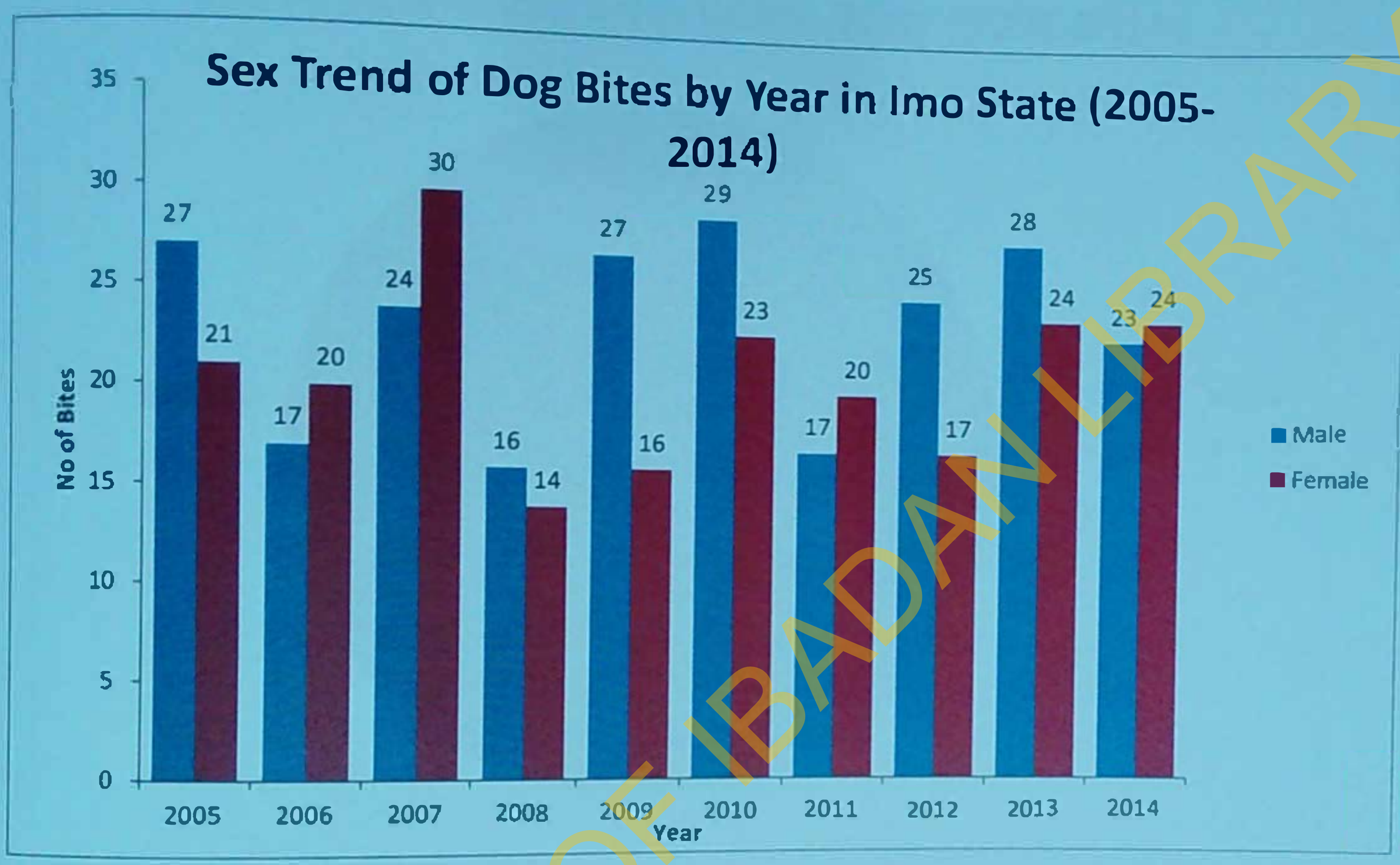

Figure: 4.10: Sex trend of dog bites in Imo State 2005-2014

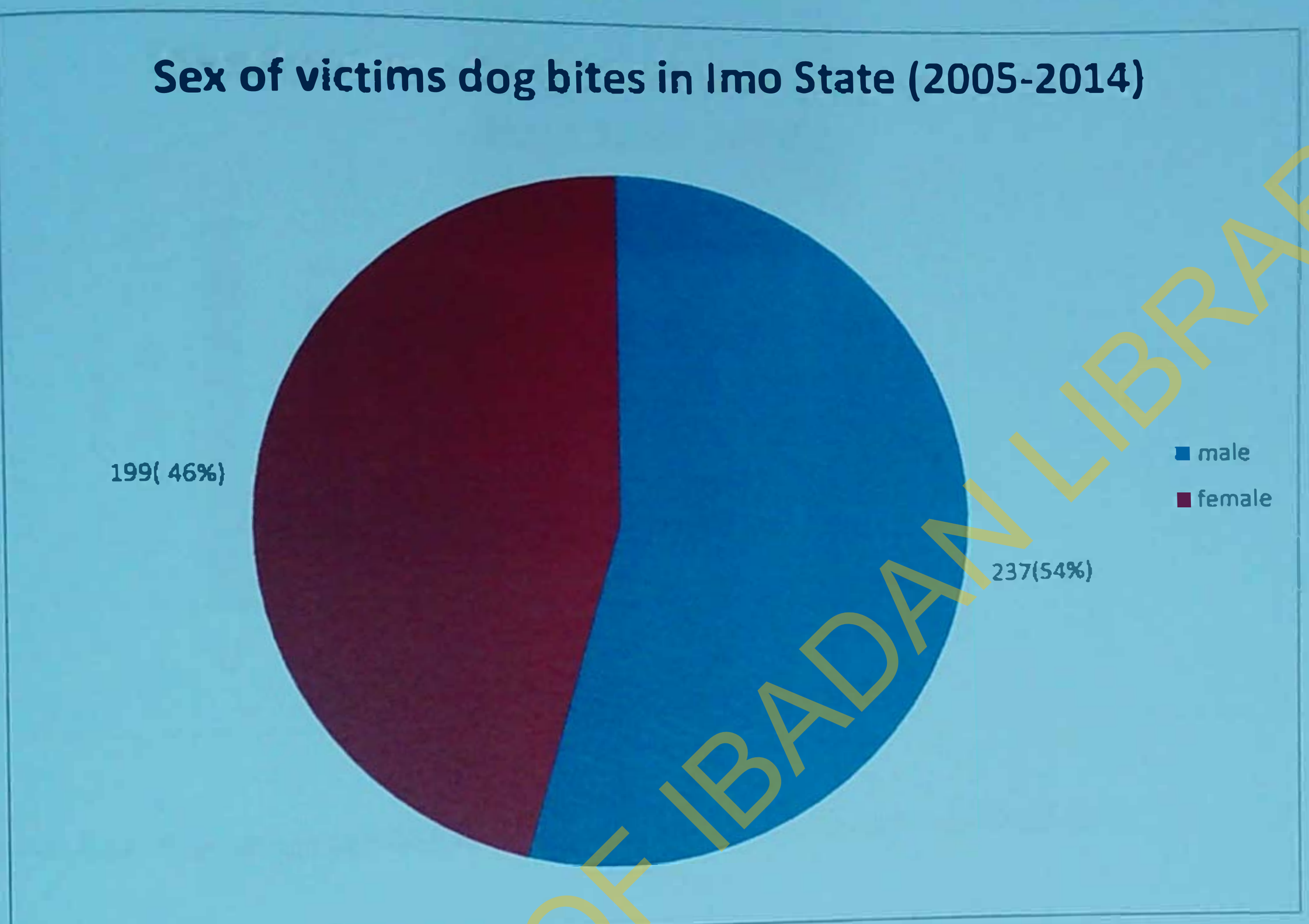

Figure: 4.11: Sex presentation of dog bites in Imo State 2005-2014

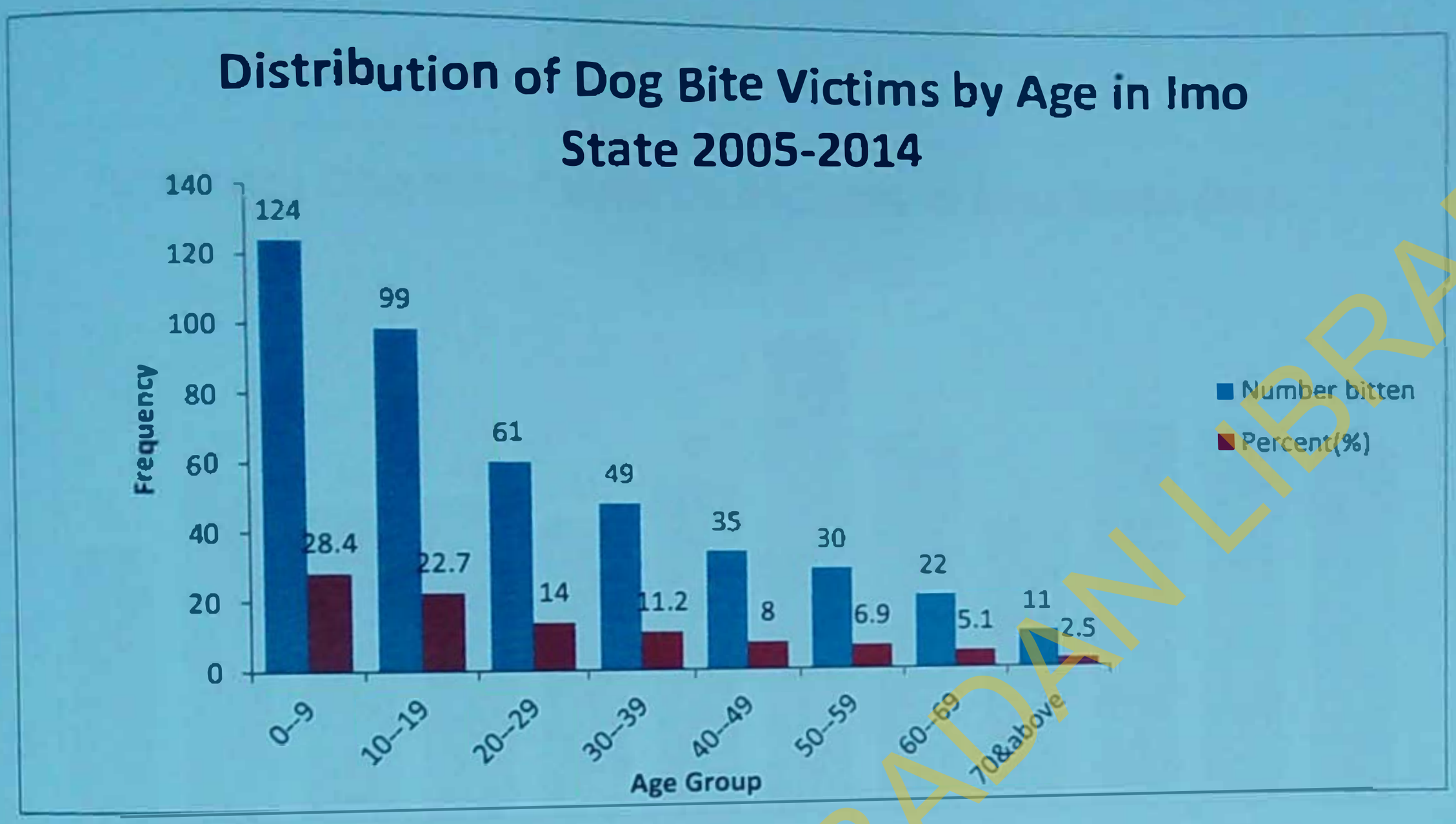

Figure: 4.12: Percentage age distribution of dog bite victims in Imo State 2005-2014

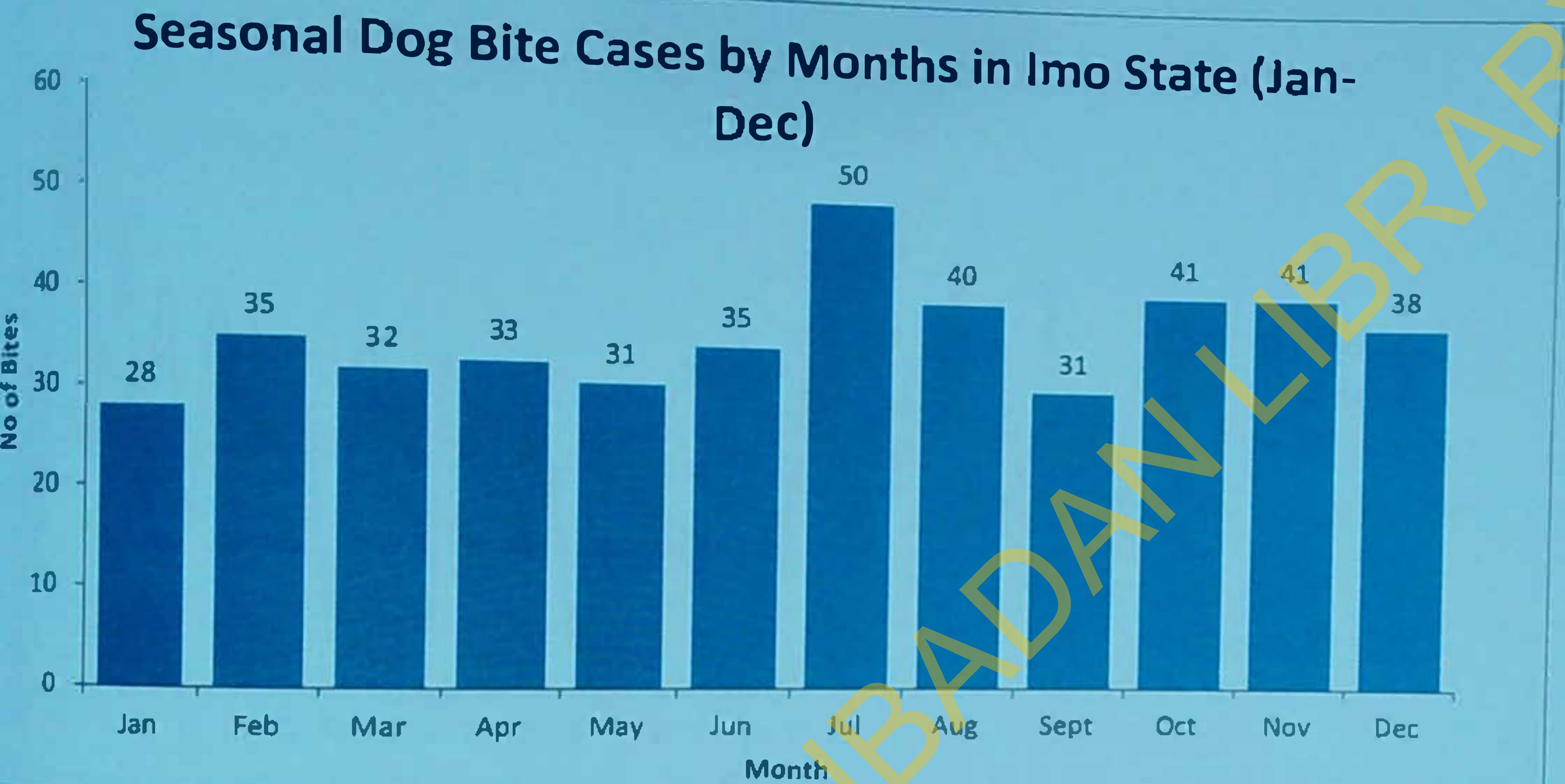

Figure: 4:13: Seasonal Distribution of Dog Bites in Imo State, 2005-2012

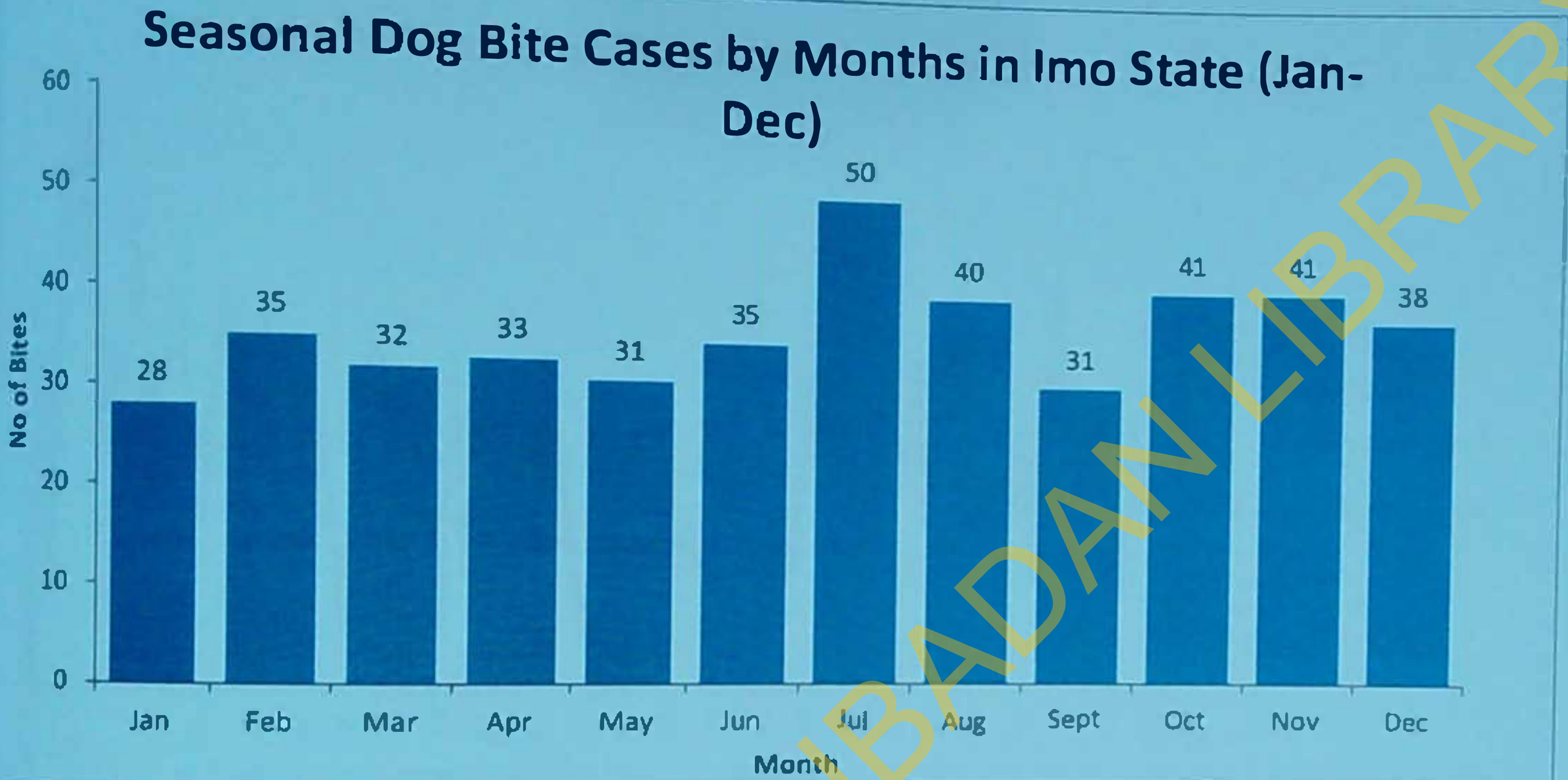

Figure: 4:13: Seasonal Distribution of Dog Bites in Imo State, 2005-2012

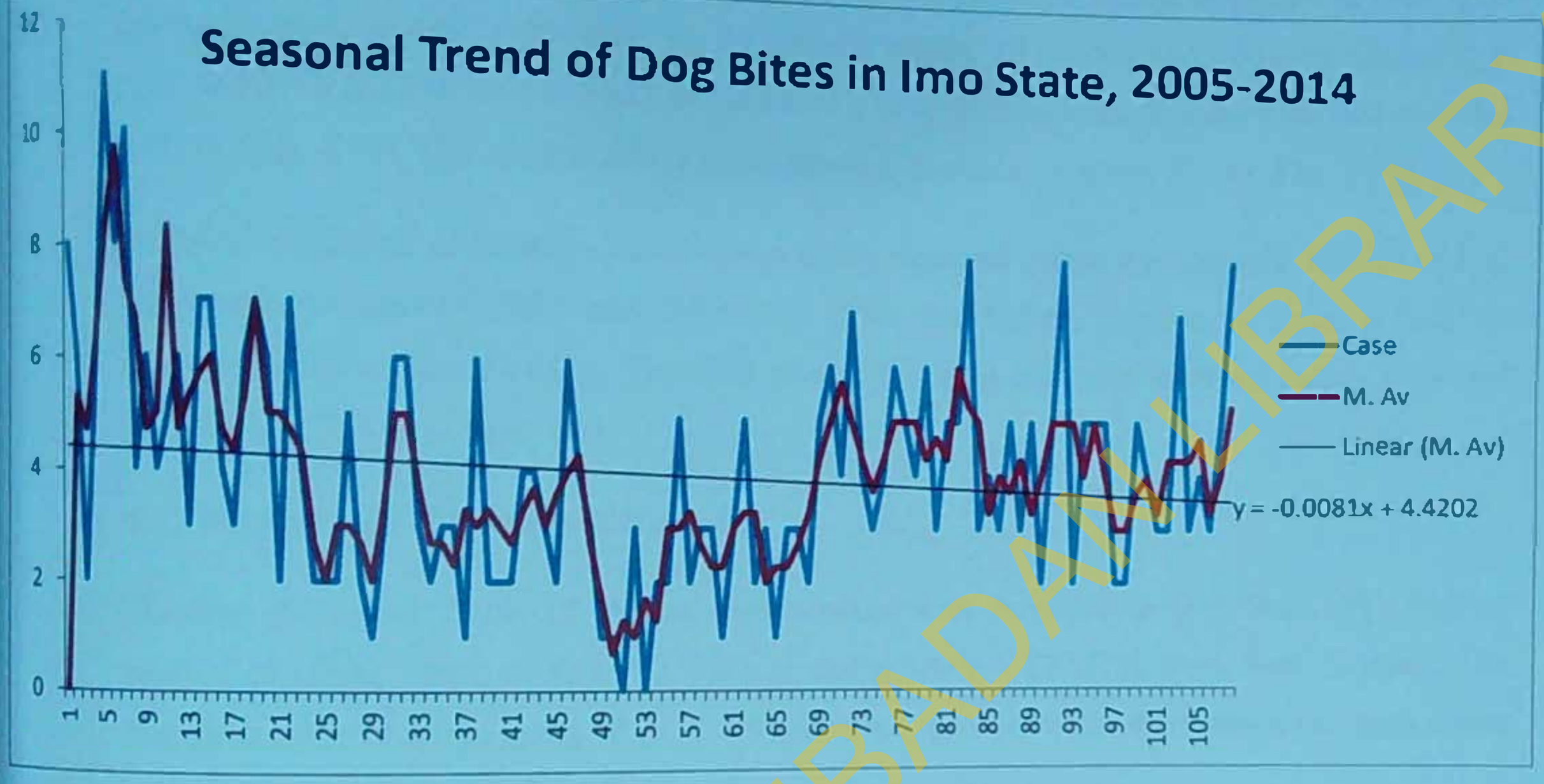

Figure: 4.13b: Seasonal Trend of Dog Bites in Imo State, 2005-2014

4.3 Clinical Human Rabies Cases

4.3.1 Rabies cases across Hospitals in Imo State 2005-2014

A total of 17 cases of clinical rabies were reported in humans across hospitals in Imo State during the study period (Appendix: 9), the highest number of cases 3 (17.7%) were recorded in 2006 and 2012 and the least in 2007 and 2009. While no clinical human rabies case was recorded in 2014 (Fig: 4.14). The clinical rabies trend shows a decreasing pattern during (Fig: 4.15).

Of the total number of human clinical rabies cases recorded across the hospitals studied in Imo State between January 2005 and December 2014, the highest number of cases 3 (17.7%) occurred in Ngor Okpuala LGA. The least case of 1 (5.9%) each was recorded in Oru West and Ihitte Uboma LGAs (Table: 4.4)

4.3.2 Sex and Age of Victims of Rabies

Between 2005 and 2014, 17 clinical rabies cases were recorded in Imo State. The highest number of rabies cases 12 (70.6%) were in males while 5 (29.4%) cases were females. The highest number of rabies cases of 3 (17.7%) occurred in 2006, while there was no clinical rabies case recorded in 2014 (Table: 4.5).

Of the total number of clinical human rabies recorded within the study period, the age group with the highest cases was 11-20 years old with 9 (52.9%) rabies cases, closely followed by the age-group 0-10 years with 7 (41.2%) cases. There was no case of rabies recorded in the age-groups 21-30 and those above 41 years of age (Table:4.6).

4.3.3 Seasonal Trend of Clinical Human Rabies in Imo State 2005-2014

The study revealed a higher proportion of rabies cases during the rainy season. Rabies incidence cases during the wet season were 13/17 (76.5%), while 4/17 (23.5%) clinical rabies occurred during the dry season (Table 4.7).

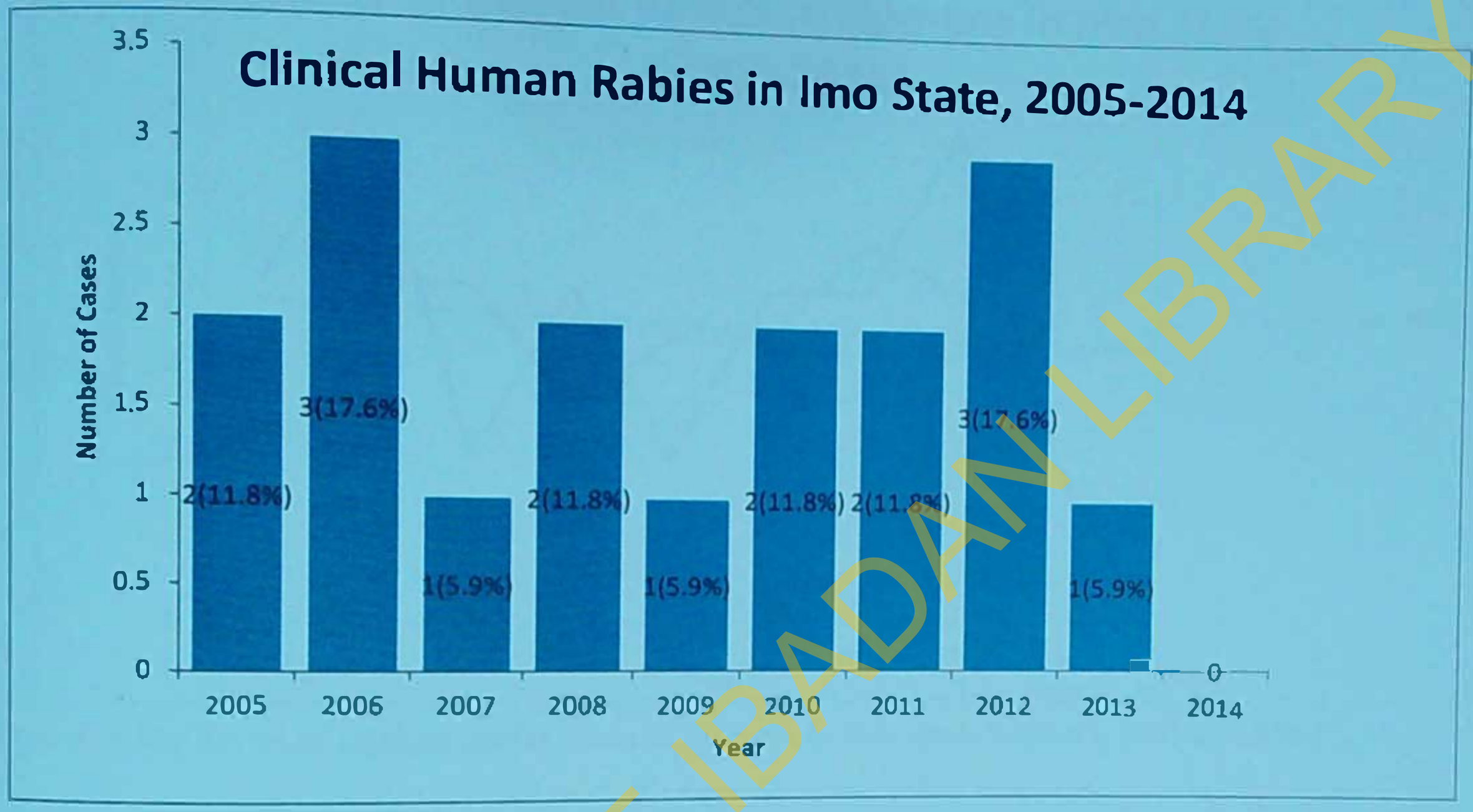

Figure: 4.14: Clinical Human Rabies in Imo State 2005-2014

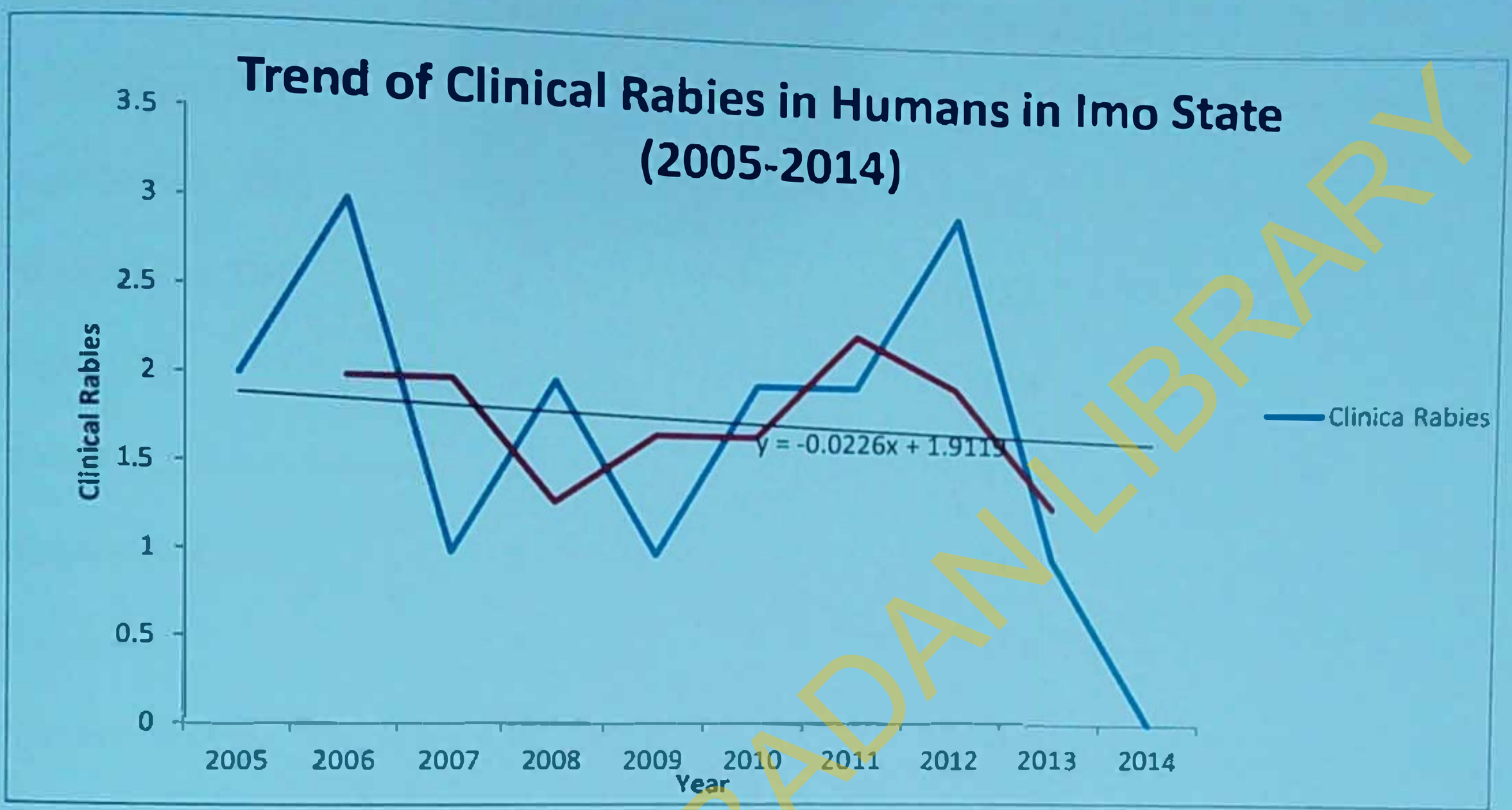

Figure: 4.15: Trend of clinical rabies cases in humans in Imo State between 2005 and 2014

Table: 4.4: Yearly presentation of rabies cases across LGAs/Hospitals studied in Imo State, 2005-2014

LGA/Hospital	Rabies Cases	Percent (%)
Owerri West (ISSH)	2	11.8
Ngor Okpuala (GH)	3	17.6
Aboh Mbaise (GH)	2	11.8
Oguta (GH)	2	11.8
Oru West(GH Awomamma)	1	5.9
Egbema (GH)	2	11.8
Ideato (GH)	2	11.8
Okigwe (GH)	2	11.8
Ihitte Uboma (GH)	1	5.9
Total	**17**	**100.2**

Table: 4.5: Human rabies cases by year and sex presented by the general hospitals in Imo State 2005-2014

Year	Male		Female		Total	
	n	%	N	%	N	%
2005	2	11.8	0	0.0	2	11.8
2006	3	17.6	0	0.0	3	17.6
2007	1	5.9	0	0.0	1	5.9
2008	1	5.9	1	5.9	2	11.8
2009	1	5.9	0	0.0	1	5.9
2010	1	5.9	1	5.9	2	11.8
2011	1	5.9	1	5.9	2	11.8
2012	1	5.9	2	11.8	3	17.6
2013	1	5.9	0	0,0	1	5.9
2014	0	0.0	0	0.0	0	0.0
Total	**12**	**70.6**	**5**	**29.4**	**17**	**100.0**

Table: 4.6: Age of victims of clinical human rabies in Imo State, 2005-2014

Age Group (years)	Rabies Cases	Percent (%)
0-10	7	41.2
11-20	9	52.9
21-30	0	00.0
31-40	1	5.9
41 & Above	0	00.0
Total	**17**	**100.0**

Table: 4.7: Seasonal distribution of dog bites and clinical human rabies in Imo State, 2005-2014

Season			Bite cases without rabies	Bite cases with rabies	Total cases
April to Nov	(wet)	Count (%) Within season	288 95.7%	13 4.3%	301 100.0%
Dec to Mar	(dry)	Count (%) within Season	131 97.0%	4 3.0%	135 100.0%
Total		**Count (%) within season**	**419** **96.1%**	**17** **3.9%**	**436** **100.0%**

CHAPTER FIVE

DISCUSSION, CONCLUTION AND RECOMMENDATION

5.1 Discussion

Ten thousand two hundred and sixty four dogs were registered in Imo State with the highest number of dogs 7817 (76.2%) registered by the public veterinary clinics. This study showed annual increase in dog registration in Imo State (Fig. 4.1). The observation may be due to the higher income of public servants and increasing crime rate which thus is increasing the tendency to keep dogs for security purposes. This agrees with similar study by Adeyemi *et al* (2005) on ten year retrospective evaluation of vaccination of dogs against rabies at the University of Ibadan, Nigeria. It could also be due to the fact that people now keep dogs for breeding as source of income due to the increasing demand for dog for security in the recent times. Owerri, with the highest number of registered dogs may be due to urbanization and habitation by educated people and public servants who can afford to keep and maintain dogs. There were more registered female (62.5%) dogs than males over the study period (Table 4.1). This may be due to increase rearing of dogs for financial purposes. Hence, more female dogs are kept for breeding purposes than male dogs.

There were 5,595 dogs vaccinated against rabies in the State. The highest number of vaccinated dogs was in Owerri and the least was in Mbaitoli LGA. There was a yearly increase in the number of vaccinated dogs (Fig. 4.4). However, the vaccination coverage of dogs in Imo State (Table 4.2) is lower than the 70% total vaccination coverage recommended by World Health Organization (WHO, 2005). The low vaccination coverage indicates that the population may not be aware or do not consider the threat dogs pose in the epidemiology of rabies. It also indicates that a large proportion of dog population is at risk of being infected with the rabies virus. The non-vaccination of all registered dogs (Table 4.2), the high rate of human exposure and the seventeen clinical human rabies/deaths encountered in the study (Appendix: 6) also suggested that rabies vaccination coverage in Imo State is low. According to Bello et al. 2007, this figure is of concern, noting that it represents only reported cases in one state of Nigeria. In some countries such as the UK, only 26 cases of human rabies were recorded from 1902-2005 (Johnson *et al*. 2005). The highest vaccination coverage was in

Owerri Municipal LGA and may be due to the fact that Owerri houses a larger population of enlightened, educated and employed people who can afford to keep and maintain dogs. The high cost of vaccination and lack of enlightenment of the public on the importance of vaccinating their dogs against rabies may be a contributory factor to the low vaccination coverage in the State.

The total number of dog bite cases (436) retrieved from the hospital records across the State was low. The highest number of cases occurred in Owerri West LGA, while Oru West had the lowest cases of dog bites. This may be due to poor or lack of case presentation to the hospitals by victims. Many cases may have been locally treated and many taken to other healing centers such as churches and private hospitals. This agrees with the study by Sunday *et al,* (2014) who stated that "the absence of standard reporting makes accurate estimate of the exact incidence of dog bite injuries difficult. Also some people do not report; seek medical treatment or post-exposure prophylaxis especially when the wound is small. The reported dog bite cases may be likened to an ice-barge phenomenon. What is not reported may be larger than what is reported. The highest number of dog bites reported in Owerri West LGA may be due to the location of Imo State Specialist Hospital which attracts patients from different parts of the State. About 54.4% of the dog bite victims were males compared to females (45.6%). This can be attributed to the fact that males are more likely to stay out of the home for work or for recreational outings than females especially at night. This finding is in agreement with the findings of Sunday *et al* (2014) in Lagos State, Aghahowa and Ogevoen (2010) in Benin City. Majority of dog bite victims (77.3%) were in children and youths less than 40 years of age compared to adults (22.7%). This finding was in agreement with the findings of Aghahowa and Ogbevoen (2010), Dressa *et al.* (2010) and Bata *et al.* (2011). Generally, this may be due to provocation, practice of playing with dogs by children and more frequent handling of dogs by youths than the aged.

The seasonal distribution of dog bite cases in Imo State showed higher dog bite cases (69%) during the wet season as against 31% during the dry season. This may be attributed to mating season of dogs which is predominantly between July and October (Fig. 4.14). This result is in agreement with Bello *et al.* (2007), who obtained a similar observation in a study on prevalence of rabies in Bauchi State, but inconsistent with the findings in some developed

countries which have reported that most dog bite incidents occur during the spring and summer months (Sacks *et al*, 1996., Keuster *et al*, 2006., Daniel *et al*, 2008).

Only 17 human rabies/death cases were reported over the 10 year study period in Imo State. This is grossly under reported as many cases may not have been presented to the hospitals studied. This is evident by Cleaveland *et al*., 2002 and Fevre *et al*. 2005, who stated that "it is widely recognized that rabies is grossly under reported even though it is a notifiable disease and the lack of accurate figures has rendered rabies a low public and veterinary health priority and the burden of rabies have relied upon hospital records". Many dog bites and rabies cases may have been taken to private hospitals, herbalists, and churches for management. Some out of negligence and ignorance may have been left at home without any form of medical attention. Also, high cost of treatment, poverty and waiting long hours for medical attention at the hospitals may be contributory factors to many victims of dog bites and rabies preferring private clinics and local treatments rather than hospitals. Rabies is most common in children in this study. About 94.1% of rabies victims were children below the age of 20. This finding is in agreement with WHO 2010 report. Males were more frequent victims of clinical human rabies than females. This is in accordance with the findings in Sokoto (Ahmed *et al*. 2000) and other parts of Africa (Hampson *et al*. 2008) where males were found to be more affected than females. This may be because males engage in more activities in most countries including Nigeria where males make up the majority that form the productive labour force unlike females (house wives) that are indoors more frequently.

Despite the fact that only cases in dogs were reported in this study, all domestic species of animals stand the risk of exposure to rabies as this is a disease of mammals. The study showed a high incidence of dog bites. This may be due to the fact that rabies is endemic in Nigeria and dogs are the major reservoirs (Adeiga and Audu, 1998). This is also in accordance with the work of Oboegbulem (1994), who reported that "all cited and other reports available show conclusively that in the West African region, the dog accounts for over 90% of animal rabies".

Imo State Government policy of concession of the general hospitals in the State during the period of data collection was a major set-back for this study. This made accessibility to hospital records very difficult and sometimes impossible as staff of hospitals were forced out

of offices and security men used to guide the premises to prevent staff entry. This caused prolonged delay in the hospital data collection.

5.2 Conclusion

A review of the Veterinary and hospital records has shown that dog registration and vaccination against rabies in Imo State are grossly under reported and many veterinary clinics and hospitals do not keep records of dog registration, dog bites and vaccination in the state. This study has also shown that children form the most vulnerable group to dog bites and clinical human rabies in the State and that males are more victims of dog bite than females. This agrees with the WHO report on victims of dog bite (WHO; 2010). The study has also shown that more female dogs are kept in Imo State than male dogs. Also rabies cases are under reported in the State, available records are scanty due to poor or absence of rabies surveillance system in the State. In Africa and Asia, an estimated 24,000-70,000 persons die of rabies each year (Knob *et al;* 2005). The domestic dog is the main source of exposure and vector for human rabies (Zisstag *et al;* 2007). Rabies in humans can be prevented by appropriate post exposure prophylaxis and through vaccination of the animal vector (zinsstag *et al;* 2007).

The study showed increased annual dog registration and vaccination coverage during the study period. Rabies as a fatal viral zoonosis remains an important public health problem in Nigeria due to uncontrolled enzootic rabies, lack of vaccination and poor information.

5.3 Recommendations

1. Imo State should ensure that a robust surveillance system for rabies is adopted for efficiency emergency response and this will help in establishing a baseline data for rabies control in the State.
2. There is the need to review, update and enforce the Dog Law in Imo State to ensure that stray dogs are removed from the environment
3. Adequate dog census should be conducted in Imo State to assist in the determination of the actual vaccination coverage of dogs in the State.
4. Adequate record keeping by public and private veterinary clinics and hospitals is necessary for proper planning for rabies prevention and control in Imo State.
5. Children should be educated on the need to avoid dog provocation.

6. Government and private bodies should sponsor mass vaccination campaign programmes against rabies for total eradication of the deadly disease in the country.
7. An advocacy for interdisciplinary approach between Veterinarians and Medical personnel in the Spirit of "one world one health" should be encouraged.
8. Public enlightenment campaign should be carried out by the appropriate authorities to sensitize residents of Imo State and Nigeria on the danger posed by unvaccinated dogs on the society.

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Appendix: 1

FORM 01

DOG REGISTRATION AND VACCINATION EXTRACTION FORM

YEAR____________________

S/N	Date	Age	Sex	Vaccinated	
				Yes	No

Appendix: 2

FORM 02

DOG BITES AND CLINICAL HUMAN RABIES DATA EXTRACTION FORM

YEAR_____________

S/N	Date	Name of patient	Age	Sex	Bite	outcome	
						rabies	No rabies

Appendix: 3 Ethical Approvals

UNIVERSITY OF IBADAN
DEPARTMENT OF VETERINARY PATHOLOGY

Head of Department:
PROFESSOR V.O. TAIWO
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16th September, 2015

Dr. Gab. A. Iroh (DVM).
Nigerian Field Epidemiology and Laboratory Training Program,
50 Haile Salesie Street.
Asokoro, Abuja.

NOTICE OF ETHICAL PPROVAL FOR A RESEARCH PROJECT PROPOSAL

On behalf of the University of Ibadan Animal Care and Use Research Ethics Committee (UI-ACUREC), I write to grant you an Ethical Approval to carry out your research project with title: "**Prevalence of Rabies and Dog bites in Imo State, Nigeria (2005-2014.)**" as clearly outlined in your proposal submitted for assessment.

Please quote **UI-ACUREC/App/2015/050** as reference for this approval.

You are to note that **UI-ACUREC** reserves the right to monitor and conduct compliance visit to your research site without previous notification.

Thank you.

16/09/2015

Prof V.O. Taiwo
Chairperson, UI-ACUREC

Cc: Dean, FVM
Director, Research Management Office.

Appendix: 4 Study of Number of registered dogs by Veterinary clinics in Imo State 2005-2014.

Year	OWZVC	ORZVC	OKZVC	AHVC	ABVC	NKVC	EHVC	IHVC	NWVC	PrVC	Total
2005	126	18	27	132	39	22	12	0	10	88	474
2006	212	24	32	115	61	30	17	0	13	100	604
2007	192	19	16	98	48	21	3	0	11	95	503
2008	187	29	19	101	73	39	10	0	14	121	593
2009	218	33	21	172	112	49	12	0	17	201	835
2010	268	63	46	132	94	93	20	3	11	242	972
2011	364	78	32	186	72	104	11	10	19	275	1151
2012	484	59	62	219	93	127	16	12	23	375	1470
2013	526	65	82	264	111	155	31	11	32	440	1717
2014	559	46	99	292	131	210	41	17	40	510	1945
Total	**3136**	**434**	**436**	**1711**	**834**	**850**	**173**	**53**	**190**	**2447**	**10,264**

Abbreviations:

OWZVC-Owerri Zonal Vet Clinic

ORZVC-Orlu Zonal Vet Clinic

OKZVC-Okigwe Zonal Vet Clinic

AHVC-Ahiazu Vet Clinic

ABVC-Aboh Vet Clinic

NKVC- Nkwere -Vet Clinic

EHVC-Ehime Vet Clinic

IHVC-Iho Vet Clinic

PrVC-Private Vet Clinics

NWVC-Nworieubi Vet Clinic

Appendix: 5 Number of dogs vaccinated against rabies by veterinary clinics in Imo State 2005- 2014

Year	OWZVC	ORZVC	OKZVC	AHVC	ABVC	NKVC	EHVC	IHVC	NWVC	PrVC	Total
2005	89	13	14	62	20	14	9	0	7	61	289
2006	101	12	12	71	33	16	9	0	8	73	335
2007	79	11	13	68	29	11	1	0	8	65	285
2008	115	18	11	96	36	18	5	0	10	91	400
2009	136	21	7	113	82	29	3	0	13	92	496
2010	103	54	20	102	51	34	2	3	9	125	503
2011	162	31	14	99	36	63	3	3	16	138	565
2012	151	28	37	137	47	101	4	6	22	348	881
2013	148	23	41	107	49	100	7	5	31	392	903
2014	178	29	56	136	72	109	11	8	37	396	1032
Total	**1262**	**240**	**225**	**991**	**455**	**495**	**54**	**25**	**161**	**1781**	**5595**

Appendix: 6: Trend of dog bite cases across hospitals in Imo State 2005-2014

Year	Imo State Specialist Hospital	GH Ngor Okpuala	GH Aboh mbaise	GH Oguta	GH Awo Omamma	GH Egbema	GH Arondi zuogu	GH Okigwe	GH Ihtte Uboma	Total
2005	13	4	2	5	0	5	6	4	6	45
2006	4	5	3	2	0	7	7	6	6	40
2007	6	11	4	4	2	2	6	8	5	48
2008	5	3	2	4	4	4	4	2	2	30
2009	2	7	5	6	4	5	7	4	3	43
2010	15	7	2	2	0	7	8	5	6	52
2011	11	4	1	5	1	4	5	4	3	38
2012	4	6	7	1	4	4	6	6	4	42
2013	9	7	4	5	8	5	5	4	5	52
2014	5	3	8	5	1	3	6	6	9	46
Total	**73**	**53**	**38**	**39**	**24**	**46**	**60**	**49**	**49**	**436**

Abbreviation

GH- General Hospital

Appendix: 7 Age distribution of victims of dog bites across hospitals in Imo State 2005-2014

Age	ISSH	GH Okpuala	GH Abob	GH Oguta	GH Egbema	GH Arond izuogu	GH Okigwe	GH Ihitte Uboma	GH Awo-Omamma	Total
0-9	24	20	18	17	11	16	1	10	7	124
10-19	20	11	4	11	10	10	18	12	3	99
20-29	7	6	5	6	7	9	10	8	3	61
30-39	5	2	3	2	6	10	10	9	2	49
40-49	6	6	3	2	5	5	1	6	1	35
50-59	5	5	2	1	5	6	3	2	1	30
60-69	6	5	1	1	2	4	4	1	2	22
70above	1	2	2	0	0	0	2	1	4	11
Total	**74**	**57**	**38**	**40**	**46**	**60**	**49**	**49**	**23**	**436**

Appendix: 8 Seasonal distribution of Dog bites in Imo State 2005-2014

Month	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
Jan	5	2	4	1	3	0	6	2	3	1	27
Feb	1	2	6	3	8	5	1	5	1	4	36
Mar	3	2	7	0	4	1	1	5	7	3	33
Apr	6	1	6	0	3	4	1	1	5	5	32
May	2	0	3	7	2	3	1	1	4	6	29
Jun	3	3	2	3	4	3	4	2	9	2	35
Jul	10	5	2	0	4	7	7	2	9	2	48
Aug	1	7	4	5	2	4	4	10	2	2	41
Sept	4	3	2	1	3	6	3	4	1	4	31
Oct	3	5	0	5	6	5	6	1	5	6	42
Nov	5	6	5	3	1	7	3	5	3	5	43
Dec	2	4	7	2	3	7	1	4	3	6	39
Total	**45**	**40**	**48**	**30**	**43**	**52**	**38**	**42**	**52**	**46**	**436**

Appendix: 9 Rabies cases across hospitals in Imo State 2005-2014

HF	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total
ISSH	1	0	0	0	0	0	1	0	0	0	2
GHNO	0	1	0	0	1	0	0	1	0	0	3
GHAB	0	1	0	0	0	1	0	0	0	0	2
GHOG	1	0	0	1	0	0	0	0	0	0	2
GHAO	0	0	0	0	0	0	0	1	0	0	1
GHEG	0	1	0	0	0	0	0	1	0	0	2
GHAN	0	0	0	1	0	1	0	0	0	0	2
GHOK	0	0	1	0	0	0	0	0	1	0	2
GHIU	0	0	0	0	0	0	1	0	0	0	1
Total	**2**	**3**	**1**	**2**	**1**	**2**	**2**	**3**	**1**	**0**	**17**

Key:

ISSH - Imo State Specialist Hospital

GHNO- General Hospital Ngor-Opuala

GHAB- General Hospital Aboh

GHOG- General Hospital Oguta

GHAO- General Hospital Awo-Omamma

GHEG- General Hospital Egbema

GHAN- General Hospital Aro-Ndizuogu

GHOK- General Hospital Okigwe

GHIU- General Hospital Ihitte-Uboma

HF- Health Facility