



Retrospective study of dog bites and cases of rabies virus infected dogs in slaughter houses in Makurdi, Nigeria

PM Ikye-Tor^{1*}, JK Kwaga², GSN Kia², JU Umoh³ & TJ Ikye-Tor⁴

¹ Department of Veterinary Public Health and Preventive Medicine, Federal University of Agriculture, Makurdi, Nigeria

² Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University, Zaria, Nigeria

³ Department of Animals Science, Akwa Ibom state University, Obio Akpa, Akwa Ibom State, Nigeria

⁴ Department of Livestock Services, Ministry of Agriculture and Natural Resources, Makurdi, Nigeria

*Correspondence: Tel.: +2348037199697; E-mail: dvmde@yahoo.com

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Abstract

This study was carried out to obtain a 16-year retrospective data on dog bites/suspected dog rabies cases and to determine the prevalence of rabies antigen in the brains of dogs slaughtered for human consumption in Makurdi, Benue State. Data for retrospective studies (2003 - 2018) of dog bite/suspected rabies cases was collected from both government and private veterinary clinics in Makurdi while dog brain samples were collected from the dog slaughter slab at the mammy market in Makurdi. A total of 139 dog bite/suspected rabies cases were reported between January, 2003 and December, 2018 in the veterinary clinics with majority (55.3%) of the victims being children less than 16-years old. Only 18 (12.2%) of the offending dogs were quarantined at the time of bite, 11 of which died in quarantine. Five samples from the dogs that died in quarantine were later confirmed positive for rabies at the National Veterinary Research Institute Vom, Nigeria. Of the 464 brain samples collected from the slaughter slab, 52 (11.2%) tested positive for rabies antigen through the direct fluorescent antibody technique. The presence of rabies antigen in apparently healthy dogs may serve as a source of spread of the virus to the public as most people do not regard bites from healthy dogs as possible exposures. There is need for public health awareness on the health challenges posed by dog bites especially on the possibility of developing rabies from such bites, and the need to promptly report every bite so that proper medical attention can be given. With the world looking at eliminating canine mediated rabies by the year 2030, mass enlightenment programmes regarding rabies and its prevention in Makurdi is strongly recommended to help achieve this goal.

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Introduction

Rabies is a highly fatal viral disease of global public health significance. This disease kills an estimated 59,000 people annually despite the fact that the disease is vaccine preventable. Majority of these deaths occur in Asia (59.6%) and Africa (36.4%) where the disease is still very prominent especially among low income people (WHO, 2018). The disease is caused by a highly neurotropic single stranded, negative sense RNA virus belonging to the genus *Lyssavirus* of the family *Rhabdoviridae*. This genus, of which rabies virus is the prototype, currently consists of 14 species all capable of causing rabies. These include classical Rabies virus (RABV), European bat-1 lyssavirus (EBV-1), European bat-2 lyssavirus (EBV-2), Bokeloh bat lyssavirus, Duvenhage lyssavirus (DUVV), Australian bat lyssavirus, Aravan lyssavirus, Khujand lyssavirus, Irkut lyssavirus, Lagos bat virus (LBV), Mokola virus (MOKV), Shimoni bat virus, West Caucasian bat lyssavirus and Ikoma lyssavirus (WHO, 2018). The virus is widespread, maintained and transmitted by a variety of host species in different countries (Hankins and Rosekrans, 2004). However, domestic dogs (*Canis familiaris*) play the most significant role in human transmissions accounting for more than 99% of human rabies cases (Tang *et al.*, 2005) through their bites.

Dog bites in humans are a serious public health problem and have been documented worldwide (Dhand *et al.*, 2011) with millions of people affected annually (WHO, 2018). Besides the physical injuries and the adverse psychological trauma, they cause, dog bites can be complicated by infections including rabies, which has the highest case-fatality rate of all infectious diseases (Apanga *et al.*, 2016). While dog bites are a worldwide problem, the severity is most felt in developing countries as a vast number of people die from rabies due to these bites. The deaths in Asia and Africa account for more than 99% of the global human deaths from canine mediated rabies (WHO, 2018). These deaths are as a result of neglect and lack of political commitment for its control, the major reason being the lack of accurate data on the true impact of the disease (Knobel *et al.*, 2005).

Like other developing countries, dog bites are common in Nigeria because of the presence of a large number of free roaming dogs in the streets. Although cases of directly fatal dog attacks on humans are rarely documented, deaths due to rabies from dog bites have been frequently reported (Otolorin *et al.*, 2015). However, these reports are from a few states and are generally considered an understatement of the true situation. This paucity of data with regards to

rabies in Nigeria makes the true burden of the disease to remain unknown. Adequate surveillance and monitoring of dog bite cases are veritable tools in the determination of the epidemiology of rabies infections (Eke *et al.*, 2015). Likewise, studies on dogs slaughtered for human consumption. Results from various studies of brain samples from apparently healthy dogs in Nigeria have shown a prevalence of between 14 - 32% (Ajayi *et al.*, 2006; Akombo, 2009; Sabo, 2009; Garba *et al.*, 2010).

The presence of a high dog population in Makurdi and the low vaccination coverage (Akombo, 2009) suggests that rabies suspected dog bites will be a common occurrence. However, there is no published data on dog bites or the canine rabies situation in Makurdi, and local information on dog epidemiology greatly contributes to the planning and implementation of successful rabies control programs (Taylor *et al.*, 2017). Therefore, the objective of this study is to assess the cases of dog bites reported in various veterinary outlets in Makurdi over a 16-year period, and to determine the presence of rabies antigen in brains of dogs slaughtered for human consumption and those that were killed/died within communities in Makurdi.

Materials and Methods

Study area

Makurdi is the capital of Benue state, located in North-central Nigeria between latitudes 7°40' N and 7°53' N of the equator, and between longitudes 8°22' E and 8°35' E of the Greenwich Meridian. The city is a 16km radius circle located along the banks of the Benue River and covering an area of 804km² land mass. Based on the 2006 census, the population of Makurdi was 300,377 persons (NPC, 2007). The town is situated in the lower Benue valley, the relief of which is generally low, with heights ranging between 73 meters and 167 meters above sea level. Makurdi has two government owned veterinary clinics; the State Veterinary Clinic and Epidemiological unit and the University of Agriculture Veterinary Teaching Hospital, and 14 privately owned veterinary clinics/pet shops. Dogs are mainly kept in the state for security reasons or as companions while in few cases for hunting purposes in the rural and peri-urban areas. The use of dog for meat is not culturally accepted among the major ethnic groups (Tiv, Idoma and Igede) in the State but the presence of three relatively large military bases in the state capital has concentrated a lot of other ethnic groups to the town that favour dog meat as a delicacy. A survey of the

area showed two major dog slaughter slabs (having daily slaughter) and two minors (occasional slaughter) slabs with a combined average slaughter of eleven dogs on week days and about twenty-two at weekends in the rainy season. However, in the dry season, because of hunting activities the figures drop to 6 on weekdays and 9 at weekends. All Veterinary premises (government and private owned) in Makurdi and the biggest dog slaughter point located near the 72 Special Forces Army Barracks were selected for the study.

Data collection for retrospective studies

Data of reported cases of dog bite and suspected rabies cases from January 2003 to December 2018 were collected from records of the State Veterinary Centre, Veterinary Teaching Hospital, Federal University of Agriculture, Makurdi, Green Flash Veterinary Services and Lord Have Your Way (LHYW) Veterinary Centre, all in Makurdi. Data was retrieved from hard copies of referral documents given to victims to present at human hospitals or clinics. Information on date of bite, species of victim bitten, sex of victim, age of victim, circumstance of bite and recommended treatment was obtained and entered into pre-designed forms. Also, information on the breed, sex, vaccination status, owner and quarantine decision/ outcome of quarantine, of offending dogs, was collected.

Brain tissue collection

Brain samples were collected from February 2015 to June 2016 from dogs slaughtered in the “mammy market” of the 72 Special Forces Army Barracks based on availability and convenient sampling. Brain samples were also collected from rabies suspected dogs that died or were killed (2015 - 2017) within communities in Makurdi during the period of study. Samples from the community were collected by opening the skull and harvesting the brain directly while the samples from the slaughter slab were collected using the straw method as previously described (Barrat, 1996)). The procedure for the straw method is as thus described; following slaughter, a 5mm straw or a 2ml disposable plastic pipette was introduced into the occipital foramen in the direction of an eye. The straw cuts through the rachidian bulb, the base of the cerebellum, hippocampus, cortex and medulla oblongata (Barrat, 1996). The straw was then removed and the area containing the brain cut and deposited into pre-labeled bijoux plastic bottles and stored at -20°C. The samples were later transported on ice to the Viral Zoonoses Laboratory of the Department of Veterinary

Public Health and Preventive Medicine, Ahmadu Bello University Zaria where they were stored at -20°C until analyzed by direct fluorescent antibody test.

Information was obtained from the marketers by oral interview on the source of each dog sampled and whether the dog had a known history of bite before purchase. During sample collection, the age of the dogs was estimated using published methods (Kahn, 2010) and sex was duly noted.

Direct Fluorescent Antibody Test (DFAT)

DFAT was performed in the Viral Zoonoses Laboratory of the Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University, Zaria on the brain samples. The test was done according to the method described by Dean *et al.* (1996), to test for the presence of *Lyssavirus* antigens; Impression smears of the brain samples were prepared on clean glass slides, air dried and fixed in cold acetone for 30 minutes at - 20°C. The acetone fixed slides were air dried and then stained with fluorescein-labeled anti-rabies immunoglobulin (FITC anti-rabies monoclonal globulin, Fujirebio Diagnostic, Inc. (FDI), USA). The slides were incubated for 30 minutes at 37°C in a humid chamber after which phosphate buffered saline (PBS) pH 7.4 was used to wash off excess conjugate from the slides. Thereafter, the slides were rinsed three successive times by immersion in PBS for 5 minutes in separate containers. Slides were air dried and observed under Fluorescent microscope (Zeiss Techno Company Ltd, USA; Model mt6000 series) at X 400. The results were interpreted as positive if a bright apple-green fluorescence of particles ranging in size and morphology from “dust particles” to prominent cytoplasmic inclusion “Negri bodies” were observed under the microscope and negative when no specific apple-green fluorescence is exhibited under the fluorescent microscope i.e. rabies virus antigen is absent in all fields examined per impression.

Statistical analysis

The information obtained was inputted into IBM Statistical Package for Social Sciences (SPSS) Statistics version 23.0. and descriptive statistics was used to summarize data into tables.

Results

A total of 139 cases of dog bites were reported between 2003 and 2018 to the veterinary clinics (both government and private owned) in Makurdi, Benue state. The year 2008 recorded the highest number of cases (25) while 2018 had the lowest number of reported cases. Going by monthly prevalence, the

highest number of cases was recorded in January (21) and then February (16). Information on annual and monthly distribution of bite cases is presented in Table 1.

The victims of 132 of the dog bite cases were humans while the others included four puppies, two goats and one cow. Of the human victims, 67 (50.7%) were males and 61 (46.2%) were females, while four (3.1%) cases did not specify the sex of victim. Majority (55.3%) of the bites were in children less than 15 years of age, followed by adults of varying ages between 16 and 50 years (32.6%) and then adults above 50 years (9.1%). In four (3%) of the victims, the age was not stated. Among the children bitten, eight of them involved children less than five years of age. The site of bite was not documented in 76 (57.6%) cases but in the few cases where it was recorded, the lower limb was the most common (35) body part affected followed by the torso (10), upper limb (9), and lastly the head (2). Multiple bites were specifically reported in only two victims. In 31 (22.3%) of the bite cases, the victims were reported to have provoked the bites while in 50 (36%) of the cases the bites were unprovoked and the rest (41.7%) not specified. Post exposure treatment was recommended for only 24 victims while the records remained silent on the recommendations for the other victims (Table 2).

Only 23 (16.5%) of the offending dogs had been vaccinated against rabies of which three produced an expired vaccination certificate. Fifty-one (36.7%) of

the offending dogs had not been vaccinated and there was no information on the vaccination status of the remaining 65 (46.8%). In about half of the cases (50.4%) the sex of the offending dog was not recorded but, in the cases, where the sex of dog was specified, there was no much difference between the females (25.2%) and males (24.5%). The breed of the offending dog was not documented in majority of the cases (78.5%) but where this information was recorded, 26 (18.7%) involved local dogs, two (1.4%) exotic breeds and two (1.4%) cross breeds. In 69.8% of the bite cases, the offending dog was a known dog whose owner could be identified while 13.7% of the cases involved strays and 16.5% was not stated in the records.

The records did not show the decision on 118 (84.9%) of the offending dogs whether they were quarantined or not. Only 18 (12.2%) of the offending dogs were quarantined, 11 of which eventually died and seven later released. Five samples from the dogs that died from quarantine were later confirmed positive for rabies by the National Veterinary Research Institute, Vom, Nigeria. Samples from the other 6 dogs that died were not sent for

confirmation, but were recorded as rabies suspect cases (Table 2). A total of 476 dog brain samples were collected from February 2015 to June 2016; 464 were from the dog slaughter market and 12 were field samples from suspected rabies cases that died or were killed in communities around Makurdi. Of the

Table 1: Annual and Monthly figures of dog bite cases obtained from Government and private owned veterinary clinics from 2003 – 2018 in Makurdi, Benue State

Year	Monthly Figures												Total
	Jan	Feb	Mar	April	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	
2003	0	2	2	0	0	0	0	0	0	0	0	0	4
2004	4	6	6	4	1	0	1	0	1	0	0	0	23
2005	3	2	0	0	0	0	0	0	0	0	0	0	5
2006	3	0	0	1	0	0	0	1	3	6	0	0	14
2007	0	1	0	0	0	0	0	2	1	0	0	0	4
2008	2	6	2	2	2	2	3	0	0	1	2	3	25
2009	5	0	1	0	2	1	0	0	0	2	1	0	12
2010	0	0	0	0	0	0	0	0	0	3	2	0	5
2011	1	0	0	0	1	1	0	0	0	0	0	0	3
2012	0	1	0	1	1	0	0	0	0	0	0	0	3
2013	3	1	0	3	0	0	1	0	0	1	1	0	10
2014	0	0	0	1	0	1	0	1	1	0	0	0	4
2015	0	0	0	1	0	1	0	2	1	0	0	0	5
2016	0	0	0	0	0	2	0	0	3	0	0	1	6
2017	1	0	2	0	1	2	4	0	0	0	1	3	14
2018	1	0	0	0	0	0	1	0	0	0	0	0	2
Total	23	19	10	13	8	10	10	6	10	13	7	7	139

Table 2: Profile of human victims of dog bites in Makurdi, Benue State from January 2003 to December 2018

Variable	Frequency (n = 132)	Percentage (%)
Sex		
Male	67	50.7
Female	61	46.2
Not stated	4	3.1
Age range (years)		
1 – 15	73*	55.3
16 – 50	43	32.6
51 – 70	12	9.1
Not stated	4	3
Circumstance		
Provoked	31	23.5
Unprovoked	50	37.9
Not stated	51	38.6
Site of bite		
Head	2	1.5
Upper limb	9	6.8
Lower limb	35	26.5
Torso	10	7.6
Not stated	76	57.6
PET		
Recommended	24	18.2
Not stated	108	81.8

* 8 of the children were below five years of age
Key: PET = Post Exposure Treatment

464 samples from the slaughter slab, 205 (44.2%) were females and 259 (55.8%) were males while the field samples had eight males and four females (Table 3). All the dogs sampled from the field were of the local breed.

The marketers at the slaughter slab reported that all the dogs were sourced within Makurdi and its environment except one dog which was bought from Jos. The specific figures obtained based on reported origin of the dogs from various locations were 419 (90.3%) from North bank, 27(5.8%) from Makurdi metropolis, 17(3.7%) from Makurdi peri-urban and one (0.2%) from Jos. Dogs with known history of bite before purchase from the original owners were 11.

Most (55.2%) of the dogs slaughtered were estimated to be between the ages of 1 and 2 years, followed by 6-11 months (23.5%) and those that were 3-5 years (20%). Only six dogs (13%) were estimated to be above 5 years (Table 4).

Fifty-two of the samples obtained from the slaughter slab were positive for rabies by DFAT giving a prevalence of 11.2%. Of these positive samples, seven of the dogs had a history of human bite. Of the

Table 3: Profile of dogs involved in bite cases in Makurdi, Benue State from January 2003 to December 2018

Variable	Frequency (n = 139)	Percentage (%)
Species bitten		
Human	132	95
Dog	4	2.9
Goat	2	1.4
Cattle	1	0.7
Sex		
Male	34	24.5
Female	35	25.2
Not stated	70	50.3
Breed		
Exotic	26	18.7
Cross	2	1.4
Local	2	1.4
Not stated	109	78.5
Vaccination status		
Vaccinated	23*	16.5
Not vaccinated	51	36.7
Not known	65	46.8
Dog owner		
Known	97	69.8
Not known	19	13.7
Not stated	23	16.5
Outcome		
Quarantine	18**	12.9
Killed (by the community)	4	2.9
Not stated	117	84.2

*3 of the vaccinated dogs had expired certificates

**11 of the quarantined dogs died in quarantine and 5 tested positive for rabies through DFAT

Table 4. Prevalence of rabies antigen in brain tissue of dogs in Makurdi, Benue State from February 2015 to June 2016.

Source of sample	Number of samples tested			Number positive
	Males	Females	Total	
Slaughter slab	259	205	464	52
Field samples	8	4	12	7
Total	267	209	476	59

12 field samples collected, seven turned out to be positive for rabies (Table 3).

Discussion

The findings of this study revealed that only 139 bite cases were reported over a 16 -year period (2003 – 2018), which may be far short of the actual situation as only cases that had sought medical attention were reported and documented. This low figure may be

due to the fact that many people are unaware of the importance of reporting dog bites to medical facilities in this locality. It could also be that some cases are lost to the dog markets and others go unreported because they originate from family owned dogs. Bites by family dogs are likely not to be reported because of the fear of paying a penalty, especially if the dog is not vaccinated or its vaccination status is not current (Tong, 1992). The fact that none of the cases reported in this study came from the family dog only supports this claim. On the other hand, people not bitten by their own dogs usually report the bites so that the owner of the offending dog may incur the cost of post-exposure treatment. Other authors (Bello *et al.*, 2007; Bata *et al.*, 2011; Hambolu *et al.*, 2014; Ehimeyin *et al.*, 2014; Eke *et al.*, 2015) who reviewed records of shorter durations from Bauchi, Plateau, Lagos, Kaduna and Edo states respectively reported a higher number of bite cases.

The monthly trends of dog bite cases revealed an increase in the number of exposures recorded in January and February coinciding with the peak of dry season where dog activity is considered to be highest (Okoh, 2007). Both sexes of dogs were almost equally involved in the bite cases recorded. Most bitches whelp around this period (Garba *et al.*, 2005) and thus, tend to be more aggressive and more likely to bite, while unneutered males tend to roam more and have higher chances of contact with humans (Deressa *et al.*, 2010). Alabi *et al.* (2014) also reported a higher number of dog bite cases in the dry season. It is also worrisome that the reported annual bite cases remain consistently low even with increasing dog populations and increased number of veterinary centers including a Veterinary Teaching hospital. This is an indication that people are neither aware of the importance of reporting bites nor are they aware of the implications of these bites.

Among the victims, more children (55.3%) compared to adults (41.7%) were affected. But of great concern is the attack on children less than five years old. The high vulnerability of children to dog bite injuries as shown by many studies conducted locally and internationally, has been attributed to children's inability to defend themselves, their small stature and also the fact that they are more likely to provoke an attack from a dog. They also have limited experience or skills in recognizing a dog's body language and in perceiving hazardous situations that might trigger the occurrence of a bite. Generally, dogs can be aggressive when provoked. However, the need to protect children from undue attacks from dogs cannot be overemphasized as cases of unprovoked

dog bites also occur in children. This finding is contrary to the findings of Hambolu *et al.*, 2014 and Konzing *et al.*, 2019 who reported more bites in adults but in agreement with many other authors (Dwyer *et al.*, 2007; Aghahowa & Ogbevoen, 2010; Deressa *et al.*, 2010; Bata *et al.*, 2011; Dhand *et al.*, 2011; and Alabi *et al.*, 2014), The male preponderance (50.8%) among the bite victims is also similar to findings of other authors (Georges & Adesiyun, 2008; Alabi *et al.*, 2014; Hambolu *et al.*, 2014; Eke *et al.*, 2015; Ogundare *et al.*, 2017) and can be explained that men are more adventurous, daring and more likely to go outside their homes than females and as a result are at a higher risk of exposure. Although in more than 50% of the cases, the site of bite was not documented but where stated, the lower limb was the most common site affected which is similar to what was reported by other authors (Abubakar & Bakari, 2012; Iyalohme & Iyalohme, 2014; Konzing *et al.*, 2019) in Nigeria. Also similar to their findings, head injuries were not common in this study. Studies in other countries have also found the lower limb to be the common anatomical site for dog bite injuries (Dwyer *et al.*, 2007; Georges & Adesiyun, 2008)

Majority of the dogs involved in the bites were dogs whose owners could be identified (69.8%). This may be due to the fact that the offending dogs are closer to home and tend to protect their territory. However, the low level of vaccination (16.5%) in the offending dogs suggests that these are not properly managed dogs who may be allowed to roam within their neighborhood and beyond. There have been many reports of rabies antigen in the brains of apparently healthy dogs as well as shedding of the virus by such dogs (Mshelbwala *et al.*, 2014; Hambolu *et al.*, 2014; Kia *et al.*, 2018). Therefore, any bite from an unvaccinated or poorly managed dog is a potential threat in the transmission of rabies regardless of whether the dog is healthy or not. Ehimeyin *et al.* (2014) also reported a similar situation where most of the offending dogs were known dogs.

The death of a dog under observation for rabies is suggestive of the disease. Although only five of the cases were confirmed by laboratory testing, it is possible that all the 11 dogs that died in quarantine could have been rabid. The importance of laboratory confirmation cannot be overemphasized and therefore, it is important to encourage health workers not to neglect this aspect of surveillance. The four dogs that were killed by the community is suggestive of furious rabies although, there were no records to show that these cases were further investigated.

The low quality of data obtained from most of the clinics visited is a reflection on the poor record keeping system in the veterinary centers visited. There was no standard reporting system in the clinics except in the Veterinary Teaching Hospital, and the fact that only two of the 14 privately owned veterinary clinics/pet shops contacted had records of dog bites emphasizes the poor attitude to record keeping. This situation further makes accurate estimation of the burden of dog bite injuries difficult as it is possible that many reported cases were lost or not properly documented. Poor record keeping is a problem in many facilities in Nigeria and has been reported by other authors as well (Hambolu *et al.*, 2014).

This study also showed that rabies antigen was present in brain tissues of apparently healthy dogs slaughtered for human consumption in Makurdi with a prevalence of 11.2%. This finding further buttresses the fact that some dogs may harbor rabies virus without demonstrating clinical signs. (Fekadu *et al.*, 1982) and corroborates the works of other authors (Aliyu *et al.*, 2010; Garba *et al.*, 2008, 2010; Akombo, 2009; Sabo, 2009; Mshelbwala *et al.*, 2014; Hambolu *et al.*, 2014; Kia *et al.*, 2018) in Sokoto, Niger, Benue, Plateau, Abia, and Lagos states respectively. Although the possibility of occult disease or even the chronic form of the disease in dogs cannot be completely overlooked, the fact that 11 of the slaughtered dogs had a known history of bite and seven of which turned out positive suggests that some of the slaughtered dogs could be in the early stages of infection rather than have inapparent infection. Kia (2014) also reported that 8 of the 10 dogs with history of bite tested positive for rabies virus antigen through DFAT. Dog owners may trade their dogs to the dog markets once they notice signs of aggression or change in behavior (Sabo, 2009). Thus, they would rather make some profit on the dog than have the dog become rabid and be involved in problems with the law. This practice, however, reduces the number of cases documented in official records thereby encouraging the cycle of neglect seen in developing countries. All the dogs sampled were reported to have been sourced from communities in Makurdi except one. This is an indication that these dogs most likely lived a normal life and excreted the virus in their saliva without showing clinical signs. This situation is of great public health concern as most people are only aware of the violent form of rabies. Garba *et al.* (2008) and Mshelbwala *et al.* (2013) also had the same finding of slaughtered dogs positive for rabies virus antigen being sought within the locality.

However, in the case of Makurdi, due to the high dog population and the poor acceptability of dog as meat for human consumption by indigenous tribes (Akombo, 2009), some southern states like Cross River (Ekanem *et al.*, 2013), Enugu and Akwa Ibom states, source for dogs for human consumption from Makurdi and its environs. Therefore, the presence of the rabies antigen in the brain tissue of these dogs poses a risk of possible spread of the disease to other states since the dog trade and movement is not regulated by government.

This study was limited by incomplete and low quality data on dog bite cases.

In conclusion, although the dog bites cases documented in this study were not many, each one of them presented a significant public health threat as majority of them were from unvaccinated dogs and a good proportion of the bites occurred in children who may not be able to defend or express themselves. The finding of rabies antigen in the brain tissues of dogs (11.2% prevalence) sourced from Makurdi and slaughtered for human consumption shows that the rabies virus is circulating in dogs in Makurdi. Therefore, there is a need for public health awareness on the health challenges posed by dog bites especially on the possibility of developing rabies from such bites, and the need to promptly report dog bites so that proper medical attention can be given. There was also a poor attitude towards record keeping especially as it relates to rabies suspected bite cases among veterinary practitioners. More accurate data on dog bites is a necessity for rabies control programmes in the country. With the world looking at eliminating canine mediated rabies by the year 2030, mass enlightenment programmes regarding rabies and its prevention in Makurdi is strongly recommended to help achieve this goal.

Conflicts of Interest

The authors declare no conflict of interest.

References

- Abubakar SA & Bakari AG (2012). Incidence of dog bite injuries and clinical rabies institution: A 10-year retrospective study *Annals of African Medicine*, doi: 10.4172/2157-7560.1000262.
- Aghahowa SE & Ogbeveon RN (2010). Incidence of dog bite and antirabies vaccine utilization in the, University of Benin Teaching Hospital, Benin City, Nigeria: A 12-year assessment. *Vaccine*, doi: 10.4172/2157-7560.1000262.

- Ajayi BB, Rabo JS & Baba SS (2006). Rabies in apparently healthy dogs: Histological and immunohistochemical studies. *The Nigerian Postgraduate Medical Journal*, **13** (2): 128-134.
- Akombo PM (2009). Dog Ecology and epidemiological Studies of Canine Rabies in Benue State, Nigeria. MSc. thesis submitted to the Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria. Pp 58 – 62.
- Alabi O, Nguku P, Chukwukere S, Gaddo A, Nsubuga P & Umoh J (2014). Profile of dog bite victims in Jos Plateau State, Nigeria: A review of dog bite records (2006-2008). *Pan African Medical Journal*, doi:10.11694/pamj.suppl.2014.18.1.4341
- Aliyu TB, De N, Yenda RN & Lynn M (2010). Prevalence of rabies virus antigens in apparently healthy dogs in Yola, Nigeria. *The Researcher*. <http://www.sciencepub.net/researcher>. retrieved 19-08-2019.
- Apanga PA, Awoonor-Williams JK, Acheampong M & Adam MA (2016). A presumptive case of human rabies: A rare survived case in rural Ghana. *Frontiers in Public Health*, doi: 10.3389/fpubh.2016.00256.
- Barrat J (1996). Simple Technique for the Collection and Shipment of Brain Specimens for Rabies Diagnosis. In: *Laboratory Techniques in Rabies* (FX Meslin, MM Kaplan, H Koprowski, editors) fourth edition. Geneva: World Health Organization. 4: 25–32.
- Bata SI, Dzikwi AA & Ayika DG (2011). Retrospective study of dog bite cases reported to ECWA veterinary clinic, Bukuru, Plateau state, Nigeria. *Science World Journal*, **6**(4): 17-19.
- Bello M, Lukshi BM & Usman B (2007). A fifteen-year retrospective study of the prevalence of rabies in Bauchi State, Nigeria. *Nigerian Veterinary Journal*, **28** (2): 18- 23.
- Dean DJ (1996). The Fluorescent Antibody Test. *Laboratory Techniques in Rabies*.
- Deressa A, Ali A, Beyene M, Selassien BN, Yimer E & Hussen K (2010). The status of rabies in Ethiopia: A retrospective record review. *Ethiopian Journal of Health Development*, 10.4314/ejhd.v24i2.62961.
- Dhand NK, Gyeltshen T, Firestone S, Zangmo C, Dema C, Gyelshen R & Ward MP (2011) Dog bites in humans and estimating human rabies mortality in rabies endemic areas of Bhutan. *PLoS Neglected Tropical Diseases*, **5**(11): e1391.
- Dwyer JP, Douglas TS & Van AS (2007). Dog bite injuries in children - A review of data from a South African paediatric trauma unit. *South African Medical Journal*, **97**:597–600.
- Ehimeyein AM, Nanfa FI, Ehimeyein IO & Jahun BM (2014). Retrospective study of dog bite cases at Ahmadu Bello University, Zaria, Nigeria and its environment. *Veterinary World*, doi: 10.14202/vetworld.2014.617-621.
- Ekanem EE, Eyong KI, Philip-Ephraim EE, Eyong ME, Adams EB & Asindi AA (2013). Stray dog trade fuelled by dog meat consumption as a risk factor for rabies infection in Calabar, southern Nigeria. *African Health Sciences*, **13**(4): 1170–1173.
- Eke CB, Omotowo IB, Ukoha OM & Ibe BC (2015). Human rabies: Still a neglected preventable disease in Nigeria. *Nigerian Journal of Clinical Practice*, **18**(2): 268–272.
- Fekadu M, Shaddock JH & Baer GM (1982). Excretion of rabies virus in the saliva of dogs. *Journal of Infectious Diseases*. 10.1093/infdis/145.2.715.
- Garba A, Oboegbulem SI, Elsa AT, Junaidu AU, Magaji AA, Umoh JU, Yahaya K, Danbirni S, Habu AK & Masdoq AA (2008). A comparative rabies laboratory diagnosis: Peculiar features of samples from apparently healthy dogs in Nigeria. *Sokoto Journal of Veterinary Sciences*, **1**(7): 33–36,
- Garba A, Oboegbulem SI, Junaidu AU, Magaji AA, Umoh JU, Ahmed A & Masdoq AA (2010). Rabies virus antigen in the brains of apparently healthy dogs in Sokoto and Katsina States, Nigeria. *Nigerian Journal of Parasitology*, 10.4314/njpar.v31i2.69483.
- Garba A, Oyetunde IL, Kumbish PR, Clement AM, Chiko KL, Ahmed JS, Lapang H, Dashe Y, Tunde O & Banyigyi SA (2005). A retrospective study of biting dogs and rabies in Vom, Plateau State. *Vom Journal of Veterinary Sciences*, **1**(2): 57-63.
- Georges K & Adesiyun A (2008). An investigation into the prevalence of dog bites to primary school children in Trinidad. *BMC Public Health*, **5** (8): 85.
- Hambolu SE, Dzikwi AA, Kwaga JKP, Kazeem HM, Umoh JU & Hambolu DA (2014). Rabies and dog bites cases in Lagos State Nigeria: A prevalence and retrospective studies (2006-

- 2011). *Global Journal of Health Science*, **6**(1): 107 – 114.
- Hankins DG & Rosekrans JA (2004). Overview, prevention, and treatment of rabies. *Mayo Clinic Proceedings*. doi: 10.1592/phco.29.10.1182.
- Iyalomhe GBS & Iyalomhe SI (2014). Dog bite and clinical rabies in a suburban hospital in Nigeria: A 20-year retrospective study of the prevalence and treatment with anti-rabies vaccine. *World Journal of Pharmaceutical Research*, **4**(1): 113-121.
- Kahn C (2010). *The Merck Veterinary Manual*, tenth edition. Merck and Co. Inc. Whitehouse Station, New Jersey, USA. Pp 154.
- Kia GSN (2014). Molecular Studies of Rabies in Trade Dogs and Detection of Some RNA Viruses in Bats in Plateau State, Nigeria. PhD Dissertation submitted to the Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria.
- Kia GSN, Huang Y, Zhou M, Zhou Z, Gnanadurai CW, Leysona CM, Umoh JU, Kazeem HM, Ehizibolo DO, Kwaga JKP, Nwosu CI, Fu ZF (2018). Molecular characterization of a rabies virus isolated from trade dogs in Plateau State, Nigeria. *Sokoto Journal of Veterinary Sciences*, **16**(2): 54–62.
- Knobel DL, Cleaveland S, Coleman PG, Fevre EM, Meltzer MI, Miranda ME, Shaw A, Zinsstag J & Meslin FX (2005). Reevaluating the burden of rabies in Africa and Asia. *Bulletin of the World Health Organization*, doi /S0042-96862005000500012.
- Konzing L, Kwaga JKP, Kia GSN & Kazeem HM (2019). A retrospective study of dog bite cases reported to some hospitals in Plateau State, Nigeria (2019). *Sokoto Journal of Veterinary Sciences*, **17**(1): 56-61.
- Mshelbwala PP, Maikai VB, Angani MT, Nlebedum UC, Nwokocha QN, Garba A & Ogunkoya AB (2013). Retrospective study of dog bite cases reported to zonal veterinary clinic, Umuahia, Abia state, Nigeria. *Journal of Experimental Biology and Agricultural Sciences*, **1**(4): 317 – 320.
- Mshelbwala PP, Ogunkoya AB & Maikai BV (2014). Detection of rabies antigen in the saliva and brains of apparently healthy dogs slaughtered for human consumption and its public health implications in Abia State, Nigeria. *ISRN Veterinary Science*, doi: 10.1155/2013/468043.
- NPC (2007). National Population Commission. Federal Republic of Nigeria Official Gazette. Notice No. 24, Volume 94. Government notice No. 21. Legal notice on the publication of the details of the breakdown of the National and State Provisional totals 2006 Census.
- Ogundare EO, Olatunya OS, Oluwayemi IO, Inubile AJ, Taiwo AB & Agaja OT (2017). Pattern and outcome of dog bite injuries among children in Ado-Ekiti, Southwest Nigeria. *The Pan African Medical Journal*, **27**: 81.
- Okoh AEJ (2007). Rabies in Nigeria: Issues and Challenges. Sixth Inaugural Lecture of the Federal University of Agriculture, Makurdi. Held at North Core, Federal University of Agriculture on the 26th of September, 2007. Pp 1 – 7.
- Otolorin GR, Aiyedun JO, Mshelbwala PP, Ameh VO, Dzikwi AA, Dipeolu MA & Danjuma FA (2015). A Review on Human Deaths Associated with Rabies in Nigeria. *Journal of Vaccines and Vaccination*, **6** (1):1000262.
- Sabo GK (2009). The Role of Dog Trade in the Epidemiology of Rabies in Plateau state of Nigeria. MSc thesis, Department of Veterinary Public Health and Preventive Medicine, Ahmadu Bello University, Zaria, Nigeria. Pp 13 – 50.
- Taylor LH, Wallace RM, Balaram D, Lindenmayer JM, Eckery DC, Mutoonono-Watkiss B, Parravani E & Nel LH (2017). The role of dog population management in rabies elimination - A review of current approaches and future opportunities. *Frontiers in Veterinary Science*, **4**:109. doi.10.3389.
- Tang X, Lou M, Zhang S, Fooks AR, Hu R & Tu C (2005). Pivotal role of dogs in rabies transmission, China. *Emerging Infectious Disease*, **12**: 1970-1972.
- Tong JC (1992). Dog population studies and the epidemiology of Rabies in Cameroun. M.Sc. Thesis, Ahmadu Bello University, Zaria, Nigeria.
- World Health Organization (2018). WHO Expert Consultation on Rabies: Third report. WHO Technical Report Series 1012. World Health Organization, Geneva, Switzerland.