

THE USE OF CONTRACEPTIVES FOR CONTROL OF STRAY DOG POPULATION AND SPREAD OF RABIES VIRUS IN NIGERIA

¹NJOGA, Ugochinyere Juliet, ^{2,3}AJIBO, Festus Ejike and ³NJOGA, Emmanuel Okechukwu

¹Department of Veterinary Obstetrics and Reproductive Diseases, Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Enugu State, Nigeria.

²Department of Animal Health and Production, Enugu State Polytechnic, Iwollo, Enugu State, Nigeria.

³Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Enugu State, Nigeria.

Corresponding Author: Njoga, E. O. Department of Veterinary Public Health and Preventive Medicine, University of Nigeria, Nsukka, Enugu State, Nigeria. **Email:** njoga.emmanuel@unn.edu.ng
Phone: +234 803 968 3325

Received August 21, 2020; Revised September 1, 2020; Accepted September 03, 2020

ABSTRACT

Contraceptives are widely used in medical practice for birth control but dearth of information exists on the veterinary use for control of stray dog population in Nigeria. A closed-ended questionnaire survey of 309 dog owners and 333 dogs presented for veterinary care across three states of Nigeria was conducted; to assess the owners' awareness on use of contraceptives in dogs, vaccination history and demographics of the dogs. Only 23.6 % of the dog owners have good knowledge of contraceptives, although 42.7 % of them were educated up to tertiary level. Of the 333 dog, 47.8 % and 44.1 % were kept as security dogs and pets respectively. Most dog keepers (56.3 %) were not aware that contraceptives can be used in dogs, while 31.0 % of those who are aware have not used any contraception method on their dogs. Reasons adduced for non-use of contraceptives were: unawareness that contraceptives are available for veterinary use (60.4 %), opposition to birth control methods due to religious or cultural belief (15.9 %) and lack of access to the veterinary service providers (4.2 %). Only 76.9 % of the dogs were validly vaccinated against rabies. Statistical association existed between educational levels and awareness/use of contraceptives in dogs. The findings underscore the need for public enlightenment and legislation on use of contraceptives in dogs kept for non-breeding purposes; as contraception is cardinal in control of proliferation of stray dogs, known to be major reservoirs of rabies virus in Nigeria.

Keywords: Anti-rabies vaccination, Contraceptives, Dog owners, Rabies virus, Stray dog population, Nigeria

INTRODUCTION

The domestic dog, *Canis lupus familiaris* (Linnaeus 1758), is perhaps the first animal to be domesticated in human history. The long period of domestication and co-habitation with humans has made dogs adaptive to high carbohydrate-based diets that are not suitable for other canids (Axelsson *et al.*, 2013). Dogs vary widely in their physiques, sizes and colors.

They are domesticated for companion (pet), hunting, sports, herding, breeding, security and crowd control by security agencies, and more recently for aiding people living with disabilities. As pets, dogs often act as guards, children's playmates or walking companions. These roles and their other impacts on human society have earned dog the sobriquet of "man's best friend". In addition to all these, dogs, although not a conventional food-animal, is widely slaughtered

for human consumption in some parts of the world, particularly Korea, China and Nigeria (Kim, 2008; Garba *et al.*, 2010, 2013; Odeh *et al.*, 2013; Li *et al.*, 2017).

The domestication and various uses of dog may not be unconnected with their unique intellect, ability to bond with humans and exceptional loyalty to the owners, keepers or care givers. As an intelligent animal, the dogs are able to understand and interpret human body languages such as gesturing and pointing, and also obey voice commands of their owners or keepers. Behavioral scientists discovered some social-cognitive abilities in domestic dog which are comparable with some of the social-cognitive skills in children; but these abilities were neither possessed by other canine species nor by other intelligent mammals such as apes (Tomasello and Kaminski, 2009). As pets, the dog-owner bonding can be so strong that the owners find it difficult to give consent for euthanasia of severely ill or debilitating dogs but often prefer chemotherapy even when the prognosis is guarded (Njoga *et al.*, 2019).

Despite the advantages inherent in domestication and use of dog, uncontrolled dog procreation or lack of proper care may increase the number of un-owned dogs such as stray, roaming or wild dogs in the society. These un-owned dogs constitute major health and economic problems to the public. Beyond trauma of dog bites, predation on livestock and avoidable road traffic accidents caused by these dogs, they are also responsible for transmission of numerous zoonotic diseases (Smith *et al.*, 2019). Prominent among these dog-transmitted zoonoses are zoonotic visceral leishmaniasis, echinococcosis, toxocarosis and most importantly, rabies.

Rabies is a highly fatal but neglected tropical disease caused by rabies virus, belonging to the Genus *Lyssavirus* and Family *Rhabdoviridae* (Alhassan *et al.*, 2020). The first case of rabies in Nigeria occurred in 1912 and about 10,000 human cases are reported annually, making the disease a persistent and endemic public health problem (Ojo *et al.*, 2016; NCDC, 2017). In both humans and animals, rabies is characterized by fatal encephalitis with almost 100 % case fatality rate (Odeh *et al.*,

2013). Globally, rabies causes about 60,000 human deaths and economic loss of about 8.6 billion US dollars in medical treatment annually (Smith *et al.*, 2019). The bulk of these deaths (up to 90 %) occur in developing countries, especially in Asian and African countries (Ojo *et al.*, 2016). Dogs, particularly un-owned dogs, are the principal reservoir of rabies virus in Nigeria; transmissible via dog to dog, dog to other animals or dog to humans (NCDC, 2017; Alhassan *et al.*, 2020). Bites from dogs were responsible for 96% of animal (Odeh *et al.*, 2013) and 94 % of human (Alhassan *et al.*, 2020) cases of rabies in Nigeria.

Presently, the major rabies control strategy in Nigeria is anti-rabies vaccination (ARV) of dogs that have attained minimum of three months of age. The vaccination is legally binding on all dog keepers through the provisions of the Animal Disease Control Decree of 1988 and other various state or regional dog acts/laws across the federation (Abubakar and Bakari, 2012; Alhassan *et al.*, 2020). The laws are poorly enforced and cases of rabies in Nigeria have unfortunately been on the rise, even in dogs less than three months of age (Otolorin *et al.*, 2014; 2015; Ojo *et al.*, 2016; Maurice *et al.*, 2018; Audu *et al.*, 2019). These underscore the need to explore additional control measures to complement the ARV method of rabies control, which has not fully yielded the desired result, even after over four decades of its adoption.

The use of contraceptives in non-breeding dogs to limit whelping of unwanted puppies could be an efficient and cost-effective way of reducing stray dog population and hence the transmission of rabies virus. The numerosity of stray and roaming dogs in the streets in most developing countries, and their roles in the transmission of zoonoses underscore the urgent need for control of their population; through contraception of dogs kept for non-breeding (pet or security) purposes. The exact population of stray dogs in the world is unknown, but it is certain that an overpopulation of these animals exists (Smith *et al.*, 2019); due to their uncontrolled breeding activities, high fecundity, polytocous nature and short gestation interval. About 75 % of the world's 700 million dogs are

not owned (Hughes and Macdonald, 2013; Smith *et al.*, 2019) and roam the street especially in developing countries. The role of un-owned dogs and the need to control their population, in the epidemiology of rabies in Nigeria is obvious.

Globally, the major means of population control for dogs is surgical sterilization through ovariohysterectomy and orchietomy. The suitability of these methods in the control of un-owned dog population is in doubt as they carry the risk of physical handling of the dogs which may be unvaccinated and therefore may be harbouring rabies virus (Massei and Miller, 2013). Additionally, these procedures require anesthesia, medical/surgical equipment, adequate recovery time, and the services of a veterinary surgical expert (Massei and Miller, 2013) which not are readily available in rural settings. Additionally, surgical sterilization may not be appropriate for control of stray or wild dog populations as provision of shelters, food and post-surgical care for these animals may not be feasible after the surgery. The problem is further compounded in that the shoot at sight method currently adopted for depopulation of stray and wild dogs is met with ethical issues (Njoga *et al.*, 2019).

Fortunately, the nonsurgical methods of population control in dogs such as injectable and oral contraceptives are safe, effective, affordable and deliverable in single treatment. Orally administered contraceptives for dogs and cats have been available in Europe and the US since 1963 and 1970 respectively (Rhodes, 2017; Asa, 2018).

Contraceptive use in Nigeria has been largely restricted to humans as information on the veterinary use is at best sketchy. Therefore, the study determined the knowledge, awareness and use of contraceptive methods in dogs among randomly selected dog owners across three selected states of the federation. The study also determined the vaccination history, particularly ARV, of dogs presented for veterinary care in Veterinary Teaching Hospitals (VTHs) and State Veterinary Clinics (SVCs) across the states.

The findings will among other things, guide policy formulation for effective control of

un-owned dog population in Nigeria and hence the zoonoses transmitted by these dogs, especially rabies. It will also evaluate the suitability and effectiveness of ARV method of rabies control in the Nigerian context.

MATERIALS AND METHODS

Study Locations: Enugu, Oyo and Plateau states of Nigeria were the study locations. The states were purposively selected, based on the history of high canine veterinary practice in the areas. Enugu State is situated in the Southeast geo-political zone of Nigeria. The state has map coordinates of 6°51'24"N and 7°23'45"E, and a population of about 5 million people as at 2006 (NPC, 2006).

Oyo State is an inland state in Southwest Nigeria, with Ibadan as the capital city. The state has a coordinate of 8°00'N 4°00'E, population of over 5 million people as at 2006 and total land area of 28,454 km² (NPC, 2006).

Similarly, Plateau State is located at North-central zone of Nigeria. It has a total land area of 30,913 km² which is predominantly hilly. The state also has an estimated population of about 3.5 million people and a coordinate of 9°10'N 9°45'E (NPC, 2006).

Study Population and Sample Size

Determination: Dogs presented for veterinary care at the VTHs and the SVCs in the three selected states constituted the study population. The dog owners or keepers also formed part of the study population as their knowledge, awareness and use of contraceptives in dogs were determined. A minimum sample size of 384 was calculated, based on adoption of 50 % prevalence (since there is no published information on veterinary use of contraceptive in the study area) as described by Ajibo *et al.* (2020). However, 309 dog owners and 333 dogs were surveyed due to the uncooperative attitude of some dog owners. The survey lasted for six months, from June to November, 2019.

Data Collection: A structured closed-ended-questionnaire was developed and pre-tested on 20 respondents outside the study area. After the

validation, the questionnaire was administered to 309 dog owners/keepers who presented their dogs for veterinary care. The face to face interview schedule method was adopted. The questionnaire survey was carried out at the VTHs and SVCs located in the selected states. Oral consent for participation in the study was sought from the respondents prior to the survey. Those who did not consent were excluded. The content of the questionnaire was translated in native languages (Igbo, Hausa and Yoruba) to respondents who were limited in their understanding of the English language. The vaccination history of the dogs were determined from the dog owners/keepers but their claims were verified in the vaccination certificate (pet green card), where available. Only dogs which vaccination claims were confirmed in their pet green cards were accepted as genuinely vaccinated. Thereafter, responses in the completed questionnaire were collated for statistical analyses.

Data Analysis and Presentation: Data generated in the study were subjected to statistical analyses using GraphPad Prism (2020) version 8.4.3 (GraphPad Incorporated, San Diego, California, USA). Data bothering on the characteristics of the dogs, awareness and use of contraceptive in dog among the respondents were descriptively analyzed and presented in tables. Information on vaccination history of dogs and the association between socioeconomic variables of the respondents and use of contraceptives in dogs were analyzed using Chi-square test. The analysis were performed at 5 % probability level and significance was accepted at $p < 0.05$.

RESULTS

Characteristics of the Dogs Surveyed:

Majority of the dogs presented for veterinary care were females (58.6 %, 195/333), while only 41.4 % (138/333) were males. Most of the dogs were under two years of age (52.9 %, 176/333). The dogs were kept for companion (44.1 %, 147/333), security (47.8 %, 159/333) and breeding (8.1 %, 27/333). Major breed presented were Mongrels, Alsatians, Caucasians,

Rottweiler and German shepherds (Table 1). Information on distribution of the dogs surveyed according to states and sources of veterinary care are presented in Figures 1 and 2 respectively.

Table 1: Characteristics of dogs (n = 333) surveyed in three selected states across Nigeria

Information required	Number of respondents (%)
Sex of the dog kept	
Male	138(41.4)
Female	195(58.6)
Age of the dog kept (years)	
Less than 2	176(52.9)
2 – 5	104(31.2)
Above 5	53(15.9)
Major purpose domestication	
Companion(pet)	147(44.1)
Security	159(47.8)
Breeding	27(8.1)
Breed of the dog	
Rottweiler	36(10.8)
Caucasian	51(15.3)
German shepherd	33(9.9)
Alsatian	68(20.4)
Mongrel	83(24.9)
Bull mastiff	28 (8.4)
Mixed breed	34(10.2)

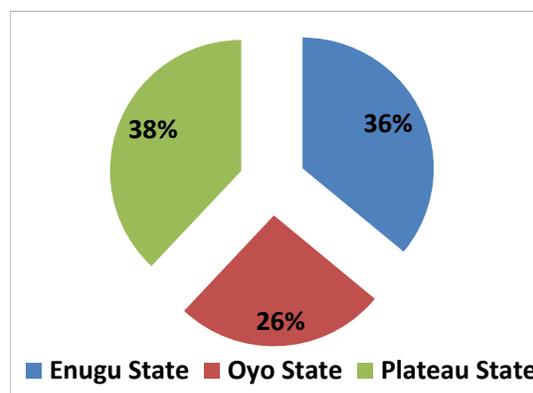


Figure 1: Proportions of dogs surveyed according to states/sources

Vaccination History

Anti-rabies vaccination: Results on the vaccination history of the dogs are presented in Table 2.

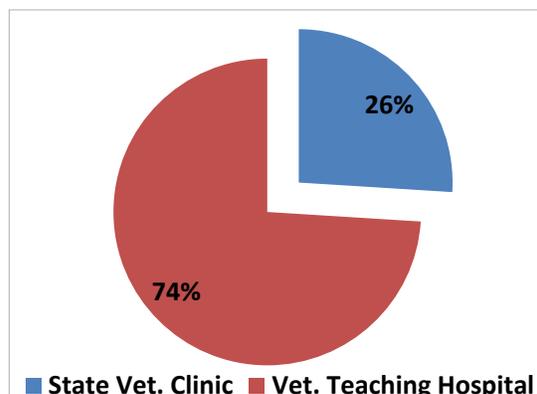


Figure 2: Distribution of dogs surveyed according to source of veterinary care

For anti-rabies vaccine, responses from the dog owners/keepers showed that 86.8 % (289/333) of the dog were vaccinated as at the time of the survey (Table 2). On scrutiny however, only 76.9 % (265/333) of the dogs have evidence of up-to-date vaccination as contained in the vaccination certificate presented. Out of the 265 anti-rabies vaccinated dogs, 192 of them may not have been vaccinated by Veterinary Doctors as the identities of the vaccinators were not shown as required in the pet green card. Female dogs (86.2 %) and those kept as pets (94.6 %) were mostly vaccinated. Similarly, dogs aged less than two years (76.1 %) were vaccinated more than other age groups (Table 2). There was significant association ($p < 0.05$) between ARV and purpose of domestication.

DHLPP vaccination: Unlike the ARV, only 50.5 % (168/333) of the dogs were vaccinated with DHLPP (Distemper, Hepatitis, Leptospirosis, Parvovirus and Para-influenza) vaccine. As in the anti-rabies, 23 of the 168 vaccinated dogs had no evidence of vaccination. Males (51.4 %) and dogs aged less than two years (76.1 %) were mostly vaccinated (Table 2). Out of the 53 dogs that were more than 5 years of age, none was vaccinated against DHLPP. However, 70.7, 32.7 and 44.4 % of dogs kept for companion, security and breeding purposes respectively had the vaccination. Statistical significant associations ($p < 0.05$) existed between DHLPP vaccination and age group of dogs and purpose of domestication; but none was found ($p > 0.05$) between the vaccination and sex of the dogs.

Use of Contraceptive in Dogs: The information on the dog owners' knowledge, awareness and use of contraceptive in dogs is presented in Table 3. Only few of the dog keepers (23.6 %, 73/309) have good knowledge of contraceptive, while 39.8 % of them were aware that contraceptives can be used in dogs. Majority of those who were aware got the information from other dog keepers, veterinarians and through seminars and workshops. Despite the knowledge of contraceptives and awareness that a number of contraceptive methods are available for veterinary use, only 27.5 % (85/309) of the respondents have used any of these methods in their dogs. Some of the contraceptive methods used were castration (56.5 %, 48/85), restriction (34.1 %, 29/85) and pills/injectable hormones (7.1 %, 6/85). Major reasons for non-use of contraceptives were ignorance that contraceptives are available for veterinary use (60.4 %), religious or personal reasons (15.9 %), contraceptives not recommended in breeding dogs (10.8 %) and unawareness of where to get the veterinary services (4.2 %).

Association between Socio-Demographics of Dog Owners and Use of Contraceptive in Dog:

Details on the link between socioeconomic variables of dog keepers and use of contraceptives in their dogs are shown in Table 4. Significant associations ($p < 0.05$) existed between used of contraceptive in dogs and Christian denomination and educational levels. Similarly, significant association ($p < 0.05$) was also found between educational levels and good knowledge of contraceptive and its use in dogs (Table 4). However, statistics showed that sex, marital status and religion of the dog keepers were not associated ($p > 0.005$) with neither good knowledge of contraceptive nor its use in dog.

DISCUSSION

Veterinary use of contraceptives, may limit the proliferation of stray and other un-owned dog populations globally (Taylor *et al.*, 2017).

Table 2: Vaccination history of dogs (n=333) presented for veterinary care across three states of Nigeria

Vaccines	Dog demographics	Number surveyed	Number vaccinated	Prevalence (%)	P-value
Anti-rabies	Sex				
	Male	138	121	87.7	0.744
	Female	195	168	86.2	
	Age (Years)				
	< 2	176	158	89.8	0.065
	2-5	104	90	86.5	
	> 5	53	41	73.4	
	Main purpose of domestication				
	Companion (Pet)	147	139	94.6	0.002*
Security	159	131	82.4		
Breeding	27	19	70.4		
DHLPP	Sex				
	Male	138	71	51.4	0.825
	Female	195	97	49.7	
	Age (Years)				
	< 2	176	134	76.1	0.001*
	2-5	104	34	32.7	
	> 5	53	-	-	
	Main purpose of domestication				
	Companion (Pet)	147	104	70.7	0.001*
Security	159	52	32.7		
Breeding	27	12	44.4		

* = Statistical significance; DHLPP = Polyvalent vaccine containing Distemper, Hepatitis, Leptospira, Parvovirus and Para-influenza antigens

Table 3: Knowledge, awareness and use of contraceptive in dogs among the owners (n = 309) surveyed in three states across Nigeria

Information required	Number of respondents (%)
Have good knowledge of contraceptive	
Yes	73(23.6)
No	236(76.4)
Aware that contraceptives can be used in dogs	
Yes	123(39.8)
No	174(56.3)
No response	12(3.9)
Source of information among those that are aware	
Seminars/workshop	31(25.2)
Other dog owners	42(34.1)
Veterinarian	32(26.0)
Electronic/print media	11(8.9)
Social media	7(5.7)
Have used any contraceptive method in dog among those that are aware	
Yes	85(69.1)
No	38(30.9)
Contraceptive method used	
Castration in males	48(56.5)
Spaying in bitches	2 (2.4)

Pills or injectable hormones	6(7.1)
Restriction method	29(34.1)
Reason(s) for the non-use of contraceptive among no respondents	
Unaware that contraceptives are available for veterinary use	174(60.4)
Religious or personal reasons	46(15.9)
Unaware of where to get the veterinary services	12(4.2)
Preferred contraceptive method not available in my locality	8(2.8)
High cost of contraceptives or provision of the services	11(3.8)
Not recommended for breeding dogs	31(10.8)
No decision yet	6(2.1)

Table 4: Association between socioeconomic variables and knowledge, awareness and use of contraceptives in dogs among the owners in Nigeria

Demographic variables	Number of respondents	Have good knowledge of contraceptives	P-value	Aware that contraceptives can be used in dogs	P-value	Use of contraceptive in dogs	P-value
Sex							
Male	234(75.7)	41	0.308	52	0.059	44	0.264
Female	75(24.3)	32		71		34	
Religion							
Christianity	281(90.9)	68	0.681	115	0.229	72	0.819
Islam	28(9.1)	5		8		6	
Christian denominations							
Catholics	121(43.1)	25	0.263	47	0.0115	22	0.003*
Non-Catholics	160(56.9)	43		78		57	
Marital status							
Single	120(38.8)	33	0.218	49	0.812	32	0.688
Married	189(61.2)	40		74		46	
Educational levels							
Primary	51(16.5)	6	0.023*	9	0.002*	4	0.000*
Secondary	126(40.8)	27		54		31	
Tertiary	132(42.7)	40		60		43	

*Denotes statistical association, Fishers exact test, GraphPad Prism version 8.4.3

The ignorance of the public on the merits of this emerging aspect of veterinary practice is particularly true in Nigeria considering the poor knowledge and poor awareness of dog keepers surveyed on the use of contraceptives in dogs. The findings are not totally unexpected considering the fact that even in humans, where use of various contraceptive methods have yielded considerable favourable results, through reduction in unplanned pregnancies and improvement in maternal and child health (Blackstone and Iwelunmor, 2017), there are still obstacles to the full adoption and use of contraceptives among most women of child

bearing age (Obasohan, 2015; Osaro *et al.*, 2017; Ajayi *et al.*, 2018).

One major impediment to veterinary use of contraceptives globally may be ignorance. Although veterinary contraception is gaining ground in some developed countries (Rhodes, 2017; Asa, 2018), its application in most developing countries, especially Nigeria, is very limited. Ignorance of contraceptive use in dogs, even among educated/elite dog owners is worrisome. In addition to ignorance, religious, ethnic or cultural beliefs are also among the major factors hindering contraceptive use in Nigeria (Obasohan, 2015; Adedini *et al.*, 2018) as corroborated in this study. It is possible that

these factors may have hindered the dog owners from adopting any contraceptive method even in their non-breeding dogs. Furthermore, the ethno-religious beliefs may have also influence veterinary care providers negatively. These care providers are in better positions to educate their clients on the need for contraception in non-breeding dogs, but the poor awareness noted among the dog owners in this survey suggests that the care givers may not have been doing enough in that regards. When the issue of belief (faith) is at stake, there is the possibility of one not questioning such belief, professionalism notwithstanding.

The wide-spread ignorance on the veterinary application of contraceptives among dog owners, underscores the need for massive campaign or public enlightenment on contraceptive use in non-breeding dogs. Just like in medical practice where massive public enlightenment campaign is gradually changing the norm of rejection of contraception (Blackstone and Iwelunmor, 2017), similar campaign for veterinary use of contraceptives to control un-owned dog population may be worthwhile. This is because, the contraceptive method of dog population control offers better and cost-effective option that could complement the current shoot at sight method, which appears cruel and has been widely condemned by animal right advocates (Alleyne *et al.*, 2015; Fiber-Ostrow and Lovell, 2016). It is also a more ethical-friendly way of animal depopulation, than the cruel killing of dogs by shooting. Besides the brutal waste of animal life, the shoot at sight method is costly, tedious and very risky, as people have to move from place to place in search of un-owned dogs, which may be rabid. Occasionally, human error involving killing of owned dogs do occur as owned dogs may be perceived as un-owned or stray dogs (FAO, 2014).

In addition, the shoot at sight method raises serious ethical questions that may lead to ethical dilemma. For instance, one may ask how a veterinarian who is under oath to protect animal health, relieve animal suffering and conserve animal resources (as contained in the Veterinary Oath) shoot or at least order the shooting of his/her patient? On the other hand,

how can a veterinarian who swore an oath to protect and promote public health, allow the proliferation of stray or wild dogs, knowing that these are the major reservoirs of rabies virus? The simplest way to solve these quagmires or ethical dilemmas is the use of contraceptive to prevent unwanted puppies that may become stray or un-owned, thereby constituting public health risks.

Just as vaccination against rabies is legally binding on all dog owners in Nigeria, through the provisions of Animal Disease Control Decree of 1988, a legal framework that makes contraception (temporal or permanent) compulsory in dogs kept for non-breeding purposes could be promulgated. This could help to control the menace of the ever increasing number of un-owned dogs, considering the fact that the anti-rabies vaccination method has not fully yielded the desired result (Maurice *et al.*, 2018). It is not certain whether the ARV method of rabies control will succeed because of inconsistency in organizing nationally-coordinated campaign against rabies. The few national campaigns that held were marred with unimpressive results, as exemplified in the 1.5 % success recorded during the 2007 national mass dog vaccination campaign against rabies (Garba *et al.*, 2007).

In addition, insufficient production of anti-rabies vaccine locally has been a major limiting factor to the ARV method. For instance, the only anti-rabies vaccine producing body in Nigeria, National Veterinary Research Institute (NVRI), has not been producing sufficient quantity of the vaccines (Garba *et al.*, 2007) due to lack of funds, basic facilities and manpower. In addition, recent surge in the number of animals needing the vaccination may have also contributed to the insufficiency problem as the NVRI has not been significantly upgraded to boost its production capacity. In 2007, the population of dogs in Nigeria was estimated at 4.5 million (Garba *et al.*, 2007) but this may have skyrocketed considering the dog to human ratio of 1:7.6 reported in 2018 (Luga *et al.*, 2018). Veterinarians have therefore resorted to the use of imported anti-rabies vaccines for ARV as a coping strategy.

Use of anti-rabies vaccines produced locally with the field strain causing rabies in Nigeria is preferred to the imported ones, as the latter may carry some measures of risks. Strain differences between the vaccine antigen and the field virus (strain responsible for the disease), as well as break in the cold-chain due to logistical problems associated with clearing of imported goods at ports may lead to primary vaccination failure. Vaccination failure in diseases of major public health importance like rabies is most undesirable due to the human lives involved. These uncertainties surrounding ARV method for effective control of rabies in the Nigeria context accentuates the need for another rabies control method, such as the dog population control (using contraceptives), to complement the ARV method.

For effective control of rabies in endemic countries, the World Health Organization has set a benchmark of up to 80 % success in annual vaccination of all anti-rabies vaccine eligible dogs (WHO, 2010). The 76.9 % valid vaccination rate found in this work is far higher than the 32.4 % reported in Kaduna State, Nigeria (Luga *et al.*, 2018) but still below the WHO benchmark. The high vaccination status reported could be due to the sampled population in which only dogs presented to VTHs and SVCs were surveyed. In these veterinary care service points, ARV is compulsory irrespective of the primary complaint. This may have influence the number of vaccinated dogs being reported as household dogs in villages and other rural settings were not surveyed. Notwithstanding the 76.9 % vaccination rate found, the 80 % WHO minimum standard has never been achieved in Nigeria (Garba *et al.*, 2007). This therefore lends credence to the need to explore contraceptive option in the control of un-owned dog population and indirectly the spread of rabies virus in the society.

Conclusion: In view of the poor awareness on veterinary use of contraceptives, as well as the sub-optimal ARV rate found in this study; there is urgent need for awareness creation on use of contraceptives in non-breeding dogs. Furthermore, legislation on compulsory

contraception in dogs domesticated for non-breeding purposes is imperative to limit the number of dogs needing ARV. It will also reduce the number of un-owned dogs, known to be reservoirs and transmitters of rabies virus in Nigeria (Alhassan *et al.*, 2020). In the meantime, coordinated annual ARV campaign, involving free vaccination of all eligible dogs, is recommended to reduce the incidence of rabies and its untoward public health and socioeconomic consequences in Nigeria.

ACKNOWLEDGEMENTS

The authors acknowledge dog keepers/clients who consented to partake in the study and volunteered useful information. Drs Blessing Joachim, Chiazor Ogbodo, Chukwudi Ezugwu and Stella N. Ozioko are specially acknowledged for their kind assistance during the questionnaire survey.

REFERENCES

- ABUBAKAR, S. A. and BAKARI, A. G. (2012). Incidence of dog bite injuries and clinical rabies in a tertiary health care institution: a 10-year retrospective study. *Annals of African Medicine*, 11(2): 108 – 111.
- ADEDINI, S. A., BABALOLA, S., IBEAWUCHI, C., OMOTOSO, O., AKIODE, A. and ODEKU, M. (2018). Role of religious leaders in promoting contraceptive use in Nigeria: evidence from the Nigerian urban reproductive health initiative. *Global Health, Science and Practice*, 6(3): 500 – 514.
- AJAYI, A. I., ADENIYI, O. V. and AKPAN, W. (2018). Use of traditional and modern contraceptives among childbearing women: findings from a mixed methods study in two southwestern Nigerian states. *BMC Public Health*, 18: 604. <https://doi.org/10.1186/s12889-018-5522-6>
- AJIBO, F. E., NJOGA, E. O., AZOR, N., IDIKA, K. I. and NWANTA, J. A. (2020). Epidemiology of infections with zoonotic pig parasites in Enugu State, Nigeria.

- Veterinary Parasitology: Regional Studies and Reports*, 20: 100397. <https://doi.org/10.1016/j.vprsr.2020.10.0397>
- ALHASSAN, S. A., GARBA, B., BELLO, B., MUSA, S., ALI, M. K., TANKO, Y., UMAR, Y. and SAIDU, B. (2020). A case of fatal rabies in a donkey in Dawakin Tofa, Kano State, Nigeria. *Journal of Animal Health and Production*, 8(1): 40 – 44.
- ALLEYNE, E., TILSTON, L., PARFITT, C. and BUTCHER, R. (2015). Adult-perpetrated animal abuse: development of a proclivity scale. *Psychology, Crime and Law*, 21(6): 570 – 588.
- ASA, C. S. (2018). Contraception in dogs and cats. *Veterinary Clinic of North American: Small Animal Practice*, 48(4): 733 – 742.
- AUDU, S. W., MSHELBWALA, P. P., JAHUN, B. M., BOUADDI, K. and WEESE, J. S. (2019). Two fatal cases of rabies in humans who did not receive rabies post exposure prophylaxis in Nigeria. *Clinical Case Reports*, 7(4): 749 – 752.
- AXELSSON, E., RATNAKUMAR, A., ARENDT, M. L., MAQBOOL, K., WEBSTER, M. T., PERLOSKI, M., LIBERG, O., ARNEMO, J. M., HEDHAMMAR, Å. and LINDBLADTOH, K. (2013). The genomic signature of dog domestication reveals adaptation to a starch-rich diet. *Nature*, 495(7441): 360 – 364.
- BLACKSTONE, S. R. and IWELUNMOR, J. (2017). Determinants of contraceptive use among Nigerian couples: evidence from the 2013 demographic and health survey. *Contraception and Reproductive Medicine*, 2(1): 9. <https://doi.org/10.1186/s40834-017-0037-6>
- FAO (2014). *Dog Population Management*. Report of the FAO/WSPA/IZSAM Expert Meeting, Banna, Italy, 14 – 19 March 2011. Animal Production and Health Report, Number 6, Food and Agricultural Organization, Rome. <http://www.fao.org/3/a-i4081e.pdf> Accessed September 1, 2020.
- FIBER-OSTROW, P. and LOVELL, J. S. (2016). Behind a veil of secrecy: animal abuse, factory farms, and Ag-Gag legislation. *Contemporary Justice Review*, 19(2): 230 – 249.
- GARBA, A., DZIKWI, A. A., OKEWOLE, P. A., CHITUNYA, W. B., TIRMIDHI, A. B., KAZEEM, H. M. and UMOH, J. U. (2013). Evaluation of dog slaughter and consumption practices related to the control of rabies in Nigeria. *Journal of Experimental Biology and Agriculture*, 1(25): 125 – 130.
- GARBA, A., NWOSUH, C. I., QADEER, M. A., MESEKO, C. A., HABU, A. K., ABDULRAHMAN, A., GOJI, J.N. and TIRMIDHI, A. B. (2007). Anti-rabies vaccines production and dog rabies vaccination campaigns in Nigeria: an overview. Pages 338 – 340. In: REMI-ADEWUNMI, B. D., HASSAN, A. Z. and OGO, I. N. (Eds.). *Proceedings of the 44th Annual Congress of the Nigerian Veterinary Medical Association (NVMA)*. October 22nd - 27th at Petroleum Training Institute, Effurum, Delta State, Nigeria. Published by Nigeria Veterinary Medical Association.
- GARBA, A., OBOEGBULEM, S. I., JUNAIDU, A. U. MAGAJI, A. A., UMOH, J. U., DANBIRNI, S., CHIKO, K. L., HABU, A. K. and MASDOOQ, A. A. (2010). Rabies virus antigen in the brains of apparently healthy slaughtered dogs in Sokoto and Katsina States, Nigeria. *Nigerian Journal of Parasitology*, 31(2): 123 – 125.
- GRAPHPAD PRISM (2020). *GraphPad Prism Version 8.4.3*. GraphPad Incorporation, San Diego, California, USA. <http://www.graphpad.com/prism/8/statistics/index.htm>
- HUGHES, J. and MACDONALD, D. W. (2013). A review of the interactions between free-roaming domestic dogs and wildlife. *Biological Conservation*, 157: 341 – 351.
- KIM, R. E. (2008). Dog meat in Korea: a socio-legal challenge. *Animal Law*, 14: 231 – 235.
- LI, P. J., SUN, J. and YU, D. (2017). Dog “meat” consumption in China: a survey of the controversial eating habit in two

- cities. *Society and Animals*, 25(6): 513 – 532.
- LUGA, I. I., ENEMUNEME, O. V. and APAA, T. T. (2018). Dog population and ecology in Ahmadu Bello University (ABU) main campus and Bomo village, Kaduna State, Nigeria. *Sokoto Journal of Veterinary Sciences*, 16(1): 54 – 59.
- MASSEI, G. and MILLER, L. A. (2013). Nonsurgical fertility control for managing free-roaming dog populations: a review of products and criteria for field applications. *Theriogenology*, 80(8): 829 – 838.
- MAURICE, N. A., LUKA, P. D., MAURICE, M. N., NGBEDE, E. O., ZHAKOM, P. N., MSHEL BWALA, P. P., TEKKI, I. S., UDOH, U. A. H., INYANG, U. A., EKANEM, N. J. and IFUT, O. J. (2018). Rabies in a set of eight-week old puppies in Nigeria: the need for review of current dog antirabies vaccination schedule. *African Journal of Infectious Diseases*, 12(2): 72 – 77.
- NCDC (2017). *Rabies*. Nigerian Centre for Disease Control and Prevention (NCDC), Jabi, Abuja, Nigeria. <https://ncdc.gov.ng/diseases/info/R> Accessed August 21, 2020.
- NJOGA, E. O., ARIYO, O. E. and NWANTA, J. A. (2019). Ethics in veterinary practice in Nigeria: challenges and the way-forward. *Nigerian Veterinary Journal*, 40(1): 73 – 85.
- NPC (2006). Population and housing census, population distribution by states, LGAs and senatorial districts. Nigeria: National Population Commission, Priority Table, Volume III, 1 – 64. <http://catalog.ihnsn.org/index.php/catalog/3340/download/48521> Accessed September 1, 2020
- OBASOHAN, P. E. (2015). Religion, ethnicity and contraceptive use among reproductive age women in Nigeria. *International Journal of MCH and AIDS*, 3(1): 63 – 73.
- ODEH, L. E., UMOH, J. U. and DZIKWI, A. A. (2014). Assessment of risk of possible exposure to rabies among processors and consumers of dog meat in Zaria and Kafanchan, Kaduna State, Nigeria. *Global Journal of Health Science*, 6(1): 142 – 153.
- OJO, D. T., NWADIKE, W., ONYEDIBE, K., KALU, I. E. and OJIDE, K. C. (2016). Rabies in Nigeria: a review of literature. *African Journal of Clinical and Experimental Microbiology*, 17(2): 159 – 163.
- OSARO, B. O., TOBIN-WEST, C. I. and MEZIE-OKOYE, M. M. (2017). Knowledge of modern contraceptives and their use among rural women of childbearing age in Rivers State, Nigeria. *Annals of Tropical Medicine and Public Health*, 10(4): 1043 – 1048.
- OTOLORIN, G. R., AIYEDUN, J. O., MSHEL BWALA, P. P., ODINYA, A. V., ADAMU, D. A., ATINUKE, D. M. and AUDU, D. F. (2015). A review on human deaths associated with rabies in Nigeria. *Journal of Vaccines and Vaccination*, 6(1): 000262. <http://dx.doi.org/10.4172/2157-7560.1000262>
- OTOLORIN, G. R., UMOH, J. U. and DZIKWI, A. A. (2014). Demographic and ecological survey of dog population in Aba, Abia State, Nigeria. *International Scholarly Research Notices (ISRN) Veterinary Science*, 2014: 806849. <http://dx.doi.org/10.1155/2014/806849>
- RHODES, L. (2017). New approaches to non-surgical sterilization for dogs and cats: opportunities and challenges. *Reproduction in Domestic Animals*, 52(Suppl. 2): 327 – 331.
- SMITH, L. M., HARTMANN, S., MUNTEANU, A. M., DALLA VILLA, P., QUINNELL, R. J. and COLLINS, L. M. (2019). The effectiveness of dog population management: a systematic review. *Animals*, 9(12): 1020. <http://dx.doi.org/10.3390/ani9121020>
- TAYLOR, L. H., WALLACE, R. M., BALARAM, D., LINDENMAYER, J. M., ECKERY, D. C., MUTONONO-WATKISS, B., PARRAVANI, E. and NEL, L. H. (2017). The role of dog population management in rabies elimination – a review of current approaches and future opportunities.

- Frontiers in Veterinary Science*, 4: 109.
<https://doi.org/10.3389/fvets.2017.00109>
- TOMASELLO, M. and KAMINSKI, J. (2009). Like infant, like dog. *Science*, 325(5945): 1213 – 1214.
- WHO (2010). *WHO Position Paper - Rabies Facts Sheets: Immunization, Vaccines and Biologicals*. World Health Organization, Geneva, Switzerland. <http://www.who.int/immunization/topic/rabies/en/index.html> Accessed March 21, 2019.



This article and articles in *Animal Research International* are Freely Distributed Online and Licensed under a [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/) (CC-BY 4.0) <https://creativecommons.org/licenses/by/4.0/>