



## An Audit of Castration of Male Dogs in Enugu Metropolis, South Eastern Nigeria

**Raheem, K. A.**

<sup>1</sup>Department of Veterinary Surgery & Theriogenology Michael Okpara University of Agriculture, Umudike, Nigeria; \*Corresponding author: Email: ka.raheem@mouau.edu.ng; Tel No:+2349031310693

### SUMMARY

Dog, though a major companion or pet animal in Nigeria house-hold is kept for various reasons ranging from security, breeding business, sports and recreation to hunting as well as source of meat. This study was conducted to i) estimate the prevalence of castration in dogs, ii) determine the influence of breed on the likelihood of castration and iii) evaluate the reasons for castration using the record of dogs presented to two private veterinary practices between January 2006 to December 2010 in Enugu, South-East Nigeria. Three hundred and twenty seven (327) dogs aged between 1 to 36 months out of the 2112 dogs presented for treatment were castrated during the 5-year retrospective study. The Nigeria local dogs accounted for 64% of the total dogs castrated, followed by crossbreed and then German Shepherd with 29% and 5% respectively. Other foreign breeds accounted for 2% of the castrate. The commonest age of castration was 3-6 months (49%) and the least age group castrated was the '> 1 year' age group (8%). The most favoured reason of castration was to increase the body weight (36%), followed by reduction in the straying ability or roaming (24%) and then for increase or decrease in aggression with 14% and 10% respectively. Only 16% of the dogs were castrated for the purpose of preventing in-breeding. In-breeding prevention was achieved in 100% of dogs castrated for this purpose. 87% of dogs had increase in body weight, while roaming and aggression were reduced in 79% and 50% respectively. Increased aggression was seen in 29% of dogs castrated for this purpose. The study showed that breed had a significant ( $P < 0.05$ ) effect on the likelihood of the dog being castrated. It also underscored the need for educating dogs' owners about the concept of castration. It is concluded that castration may be one of the strategies to control dogs' population vis-à-vis prevention of rabies transmission to human usually associated with dogs' bites in Nigeria.

**Key words:** Audit, breed, castration, dog, Enugu.

### INTRODUCTION

Dogs are one of the primitive companion animals to be domesticated by man. Their domestication dated as far back as 8,000 BC (Matznick-Koler, 2002). In Nigeria, dogs

remain the most useful kept domestic mammals. They are kept for different reasons including security, hunting, as source of meat, recreation, biomedical

research and for companionship. There are about 78 million dogs in United States and about 8.5 million in United Kingdom (FEDIAF, 2010) against human populations of about 302 and 62million respectively. Presently, there is no clear record on the population of dogs in Nigeria. Meseko (2010) speculated a population between 2 to 5 million. Considering the estimated dog population density of 1:13 dog per household in Ilorin alone using aerial photographs (Aiyedun and Olugasa, 2012), it is reasonable to believe that the number of dogs in Nigeria is far more than 10 million.

Male dog at puberty displays characteristic features of marking his territory by spraying strong-smelling urine around his surroundings while following his natural hormonal instincts in roaming to find bitches on oestrus (heat). Castration otherwise known as orchidectomy is the surgical removal of the testes and a permanent way of making a male dog infertile. It is one of the most common simple surgical procedures done by veterinarians across the globe. Castration of male dog is done for different reasons that include canine population control, medical health benefit, genetic-disease control and behavioural modification.

Perception towards castration varies from one country to another. When it is widely encouraged and promoted in some countries like the US, it is disliked and discouraged in most European countries. At least, it has been declared illegal in Norway (Farstad, 2011), possibly because dogs' population is not a problem in these countries. Millions of healthy dogs are euthanized every year in the US (Patronek and Rowan, 1995), therefore castration is a good measure of population control. When the Nigeria Veterinary Medical Association has no official statement as regards castration yet, American and British Veterinary Medical Associations have blueprint guidelines on

neutering of dogs and cats covering issues like age, anaesthetic procedure, pre and post-operative care and others (Looney *et al.*, 2008).

Castration of dog has its own advantages and disadvantages. Among the benefits of castration are reduced incidence of reproductive tract (testicular and prostatic) diseases, decreased incidence of reproductive behaviours and possible increased longevity and reduced roaming. On the contrary, castration may prone a dog to increased incidence of hematologic, bone and prostate cancer, predisposition to knee injury and obesity (Mckenzie, 2010) as well as associated post-operative complications.

There are bodies of contentious information posted on the internet by interested and sometimes lay persons on the subject matter of castration. Many studies related to best age of castration have been also been conducted and documented. However, few of such studies on this subject are found in Nigeria. In this study, a 5-year retrospective audit of dogs castrated within Enugu Metropolis was carried out with objectives of i) evaluating the influence of breed on the incidence of castration, ii) examine the major reasons for castration as well as iii) to appropriately inform on some controversial issues as regards castration from a Theriogenologist's point of view.

## **MATERIALS AND METHODS**

### **Study Area**

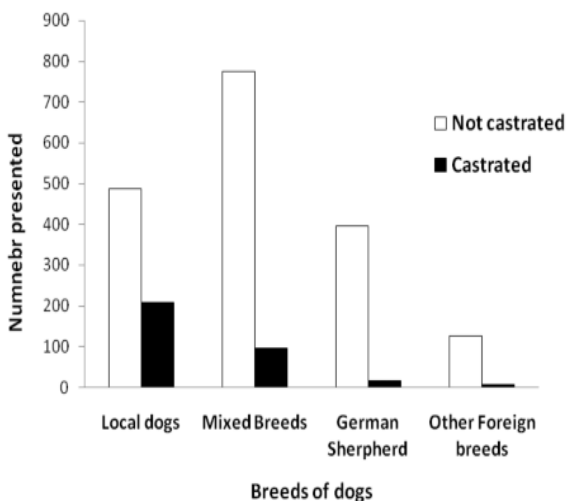
Enugu, the area considered in this study, is the capital of Enugu state and was the former capital of the Eastern region of Nigeria. There are 3 local government areas (out of 17 in Enugu State) in Enugu Metropolis, namely Enugu East, Enugu South and Enugu North LGs with a population of 722,664 people according to the 2006 Nigerian census (NPC, 2006). Majority of the Enugu residents are Igbo and of Christian faith with no cultural or religious bias against keeping dog.

**Data Collection**

The clinic record books of two veterinary practices located within Enugu metropolis were studied to appraise the cases of dogs presented for castration. The periods under study were January 2006 to December 2010. The dogs were classified into breed and age. Method of castration and any post castration complications were also noted. Then after, a questionnaire was designed to evaluate the contentment or satisfaction of the owners over their dogs after the castration.

**The Structured Questionnaire**

The questionnaire was administered with 85 castrated dogs’ owners residing within Enugu metropolis to find out the motives for castration, health status of their dogs after castration and to know if they were contented with their dogs or had a remorse feeling for doing so possibly because the intended reason for castration was achieved or not respectively. Only those whose dogs were castrated at least one year ago were selected for the survey such that allowed the envisaged behavioural/developmental changes to be manifested.



**Figure 1:** Breeds of dogs treated by the two veterinary practices during the period under study (n=2112)

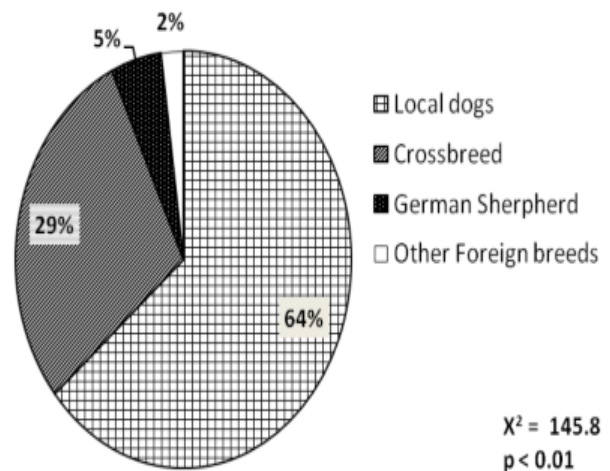
**Data Presentation and Analysis**

Data were presented with descriptive statistics, frequency and percentage. The influence of breed on the likelihood of castration was done using Chi square with SPSS 18.0 for Windows (Chicago, IL, USA). P value less than 0.05 was considered significant.

**RESULTS**

**Influence of Breed on Castration**

Out of the 2112 dogs presented for treatment in the two clinics within the period of study, the crossbreed occupied the highest number (775) presented, followed by local dogs (485) and then German shepherd (396). The foreign breeds (127) were the least category presented. 327 that represented 15.5% of the total canine cases handled were presented for castration (Figure 1). There is significant ( $X^2 = 145.8$ ;  $P < 0.01$ ) influence of breed on the likelihood of the dogs being castrated. The results also showed that Nigeria local dogs represented the greatest number castrated constituting 64% of the total dogs castrated during these periods. This was followed by crossbreed (29%) and then German shepherd (5%). Other foreign breeds (2%) were the least castrated (Figure



**Figure 2:** The influence of breed on the likelihood of castration in dogs (n=327) at Enugu South-Eastern Nigeria. The breed of dog had a significant influence on the likelihood of its being castrated

2). The only method of castration employed by the veterinarians in this study was surgical method that involved usage of local anaesthesia such as lignocaine infused into the scrotum prior to surgery. Also, no post-operative complication was recorded.

**Age at Castration**

The data on ages at castration is presented in Figure 3. The results showed that 3-6 months age category constituted the highest age of castration, representing 49% age of the total dogs castrated during this period. This was followed by 6 months-12 months (25%), while Less than 12 weeks had 18%. The least age category of dogs castrated was ‘the more than one year’ age group with 8%.

**Reasons for castration**

Dogs’ owners castrated their dogs for various reasons ranging from increasing body weight or aggression, reducing roaming or to avoid in-breeding between male and female dogs from the same parents. This is shown in Figure 4. Increasing body weight accounted for the highest reason with 36% of the 327 castrates. This was followed by reduction in roaming (24%) and then prevention of in-breeding (16%). Increase and decrease

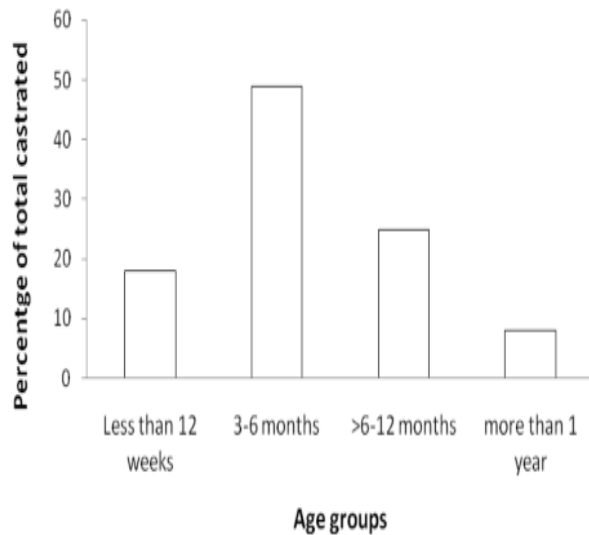
aggression were envisaged in 14% and 10% respectively.

**Attainment of the desired behavioural/developmental changes after castration**

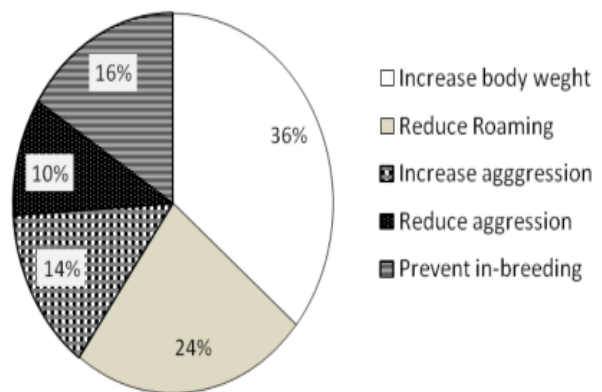
The in-breeding purpose was achieved in 100% of the dogs castrated for this purpose, while reduced aggression was observed only in 50% of dogs castrated, whereas 29% of the dogs exhibited increased aggression (Figure 5). Reduction of roaming and increase in body weight were achieved in 79% and 87% of dogs after castration respectively.

**DISCUSSION**

Dogs’ castration is an issue that continues to generate argument between supporters of animal welfare, veterinarians and the general public. When castration is promoted in United States basically because of population control, most dogs in UK are intact because dogs’ expert advocate against this practice. To the best of my knowledge, this is the first study evaluating the incidence of castration in dogs in Nigeria. Other reports have dealt with dogs’ population and control, however, there is



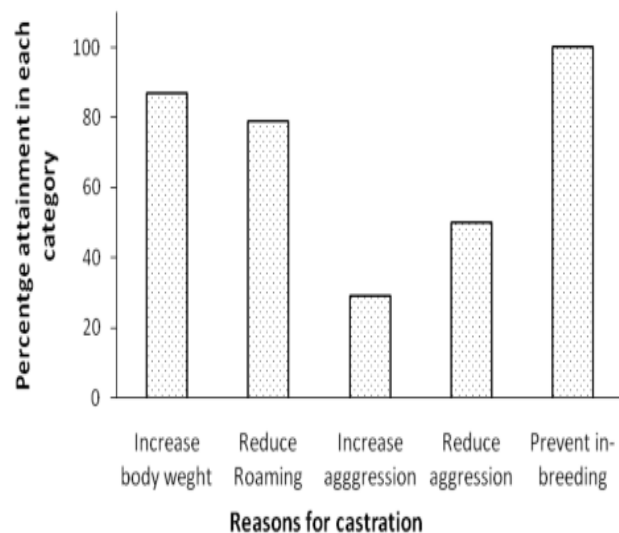
**Figure 3:** Bar chart presentation of the ages of dogs at castration (n=327) in Enugu, South-Eastern Nigeria



**Figure 4:** Pie Chart representations of various reasons for castrating dogs (n=327) in Enugu metropolis, South-eastern Nigeria

dearth of information on incidence of castration in dogs in Nigeria particularly in Enugu, Eastern Nigeria. Enugu was chosen because majority of the residents are Christians, which unlike Islam, has no religious restriction against keeping dogs as pets. Therefore, the city may possibly have one of the highest dog populations in Nigeria.

The percentage incidence of castration in this study is at par with 17% incidence reported for Nsukka (Eze and Eze, 2002), however, it is lower than 33% incidence reported in the South-western, Nigeria (Ajala and Fayemi, 2011). Reichler (2008) reported incidence of castration of 12% (8508), 6% (4510) 25% (6473) in France, Spain and Germany respectively. The results also indicated that the local mongrel represented the highest number of dogs castrated during the period under study. This is expected as the local breed constitutes the greatest number of dogs' population in Nigeria. On the contrary, the crossbreed had the highest number of dogs presented for treatment as was earlier reported by Ajala and Fayemi (2011). This is possibly due to the economic and educational status of those owning the crossbreeds. The crossbreed was second to local mongrel on the number castrated, while German Shepherd and other foreign breeds were the least castrated, altogether being 7% of the total (327) castrated during the period under the study. There are other foreign breeds in Nigeria such as Rottweiler, Great Dane, Dalmatian and Bull Mastiff. German Shepherd is a foreign breed as well, however, is considered singly on its own in this study because the breed is the most popular foreign breed found in Nigeria. The owners of these foreign breeds make money by using their dogs to serve other bitches during oestrus. The price of such service varies from one place to another and in some places may include taking one of the puppies when the mated bitch whelps. The



**Figure 5:** Bar chart presentation of attainment of intended behavioural /developmental change in dogs after castration (n= 85)

few of foreign breeds castrated in this study were owned by white men or indigenous clients having other male dogs at home.

The only method of castration found in this study was open castration with local anaesthesia such as lignocaine/lidocaine infiltrated into the scrotum. Open castration involves the removal of the external genitalia -the testis, epididymis, vas deferens and some parts of the cremaster muscles. The internal genital organs like the prostate gland, urethra, penis, bulbis glandis and much of the dog's testicular blood vessels are left intact. Testis plays dual roles of exocrine and endocrine organ by producing spermatozoa and testosterone respectively (Senger, 2005). Without the spermatozoa, the dog is infertile, while the testosterone is proposed to mediate the male behaviour patterns such as roaming (partly in search of oestrus bitch), aggression, inter-male aggression and dominance. This method of castration is simple with minimal equipment and least time consuming, though it is not without post-operative complications such as scrotal swelling especially when used in older dogs. Complication rates for routine castration ranged from 2.6% to 20% of the cases, majority of which were minor and

require no treatment and mostly observed with surgeries performed by students in training (Burrow *et al.*, 2005; Pollari *et al.*, 1996). However, no complication was observed in the present study.

As biotechnology and medicine continue to advance, other convenient methods such as hormonal implants, immune-contraceptive, vaccines and chemical reagents have been tried to induce sterility in dogs, however, not all are found satisfactory in the parlance of animal welfare (ACC&D, 2013). Progestins (progesterone-like compounds) are the most common compounds used to control oestrous cycle in the female dog (ACC&D, 2013). Such compounds include chlormadinone acetate (CAP), delmadinone acetate (DMA), proligestone (PRO) and Megestrol acetate (MGA). The principle is based on sustained increased plasma progesterone such that inhibits the hypothalamus and hence release of gonadotropins that are essentially required to return the animal to oestrus (Noakes *et al.*, 2009). Chemicals such as zinc gluconate/arginine were reported to induce azoospermia and disrupt spermatogenesis in cat (Fagundes *et al.*, 2014) and dog (Ngoka, 2013), sequel to which is sterility. Induction of castration was also shown with immunisation of male dog with recombinant gonadotropin-releasing hormone (GnRH)-canine distemper virus (CDV) T helper cell epitope p35 (Jung *et al.*, 2005). Trials on immune-contraceptive vaccines using porcine zona pellucida vaccines derived from porcine oocyte have also proved successful. There is no evidence of any of these methods in Nigeria veterinary practice. Possibly, there are reports of such methods for research purpose. Muhammed and James (2013) reported successful use of Purit® (chlorhexidine gluconate and cetrimide) for castration in goats. Developing a convenient method of contraceptive with single, non-surgical method/treatment of neutering is a subject of many on-going bodies of reproductive research across the globe.

Aitken (2014) noted paucity of funding for contraceptive research in human and regretted that development of wider acceptable contraceptives could have saved more lives than the number of deaths recorded for cancer. It is worthwhile to mention the Found Animal Foundation, a non-profit US-based agency that is currently sponsoring research towards this breakthrough in dog and cat to the tune of \$75 million. The fund is sought under the name Michelson Prize and grants, and it is accessible via the link; (<http://www.michelsonprizeandgrants.org/michelson-grants>).

In this study, there was no disease associated with castration from the results of 85 dogs surveyed a year after the castration. In the literature, the reports of castration and disease have been inconsistent and may depend on some factors such as (i) breed of dog, (ii) the type of disease and (iii) the time the dog was castrated (pre or post puberty). While castration promotes the incidence of some diseases, it prevents and reduces the incidence of others (Mckenzie, 2010). Sexually transmitted diseases like transmissible venereal tumour, brucellosis and campylobacteriosis are reduced. Castration has a prophylactic and therapeutic effect on androgen-dependent diseases such as benign prostatic hyperplasia, chronic prostatitis, and perineal hernia (Reichler, 2009). Castration also prevents testicular and epididymal disorders such as testicular neoplasia, torsion of the spermatic cord, orchitis and epididymitis since these organs (testes, epididymis and spermatic chord) have been removed. Castration may also reduce bacterial infection of prostate (Cowan *et al.*, 1991). Benign prostatic hyperplasia (BPP) is the most common disease of the prostate whose incidence increases with age from 15-40% in dogs under 7 years and to 60-100% in dogs over 7 years (Berry *et al.*, 1986; Lowseth *et al.*, 1990). Sometimes, BPP may predispose to prostatitis in dogs. These two

conditions- BPP and prostatitis are preventable and have been successfully treated by castration (Mukaratirwa *et al.*, 2007). Some studies have implied the tendency of castration to be associated with certain diseases such as those connected with obesity and bone. Even though some of these diseases may have some underlying factors, castration have been identified as increasing the risk of hip dysplasia and rupture of cruciate ligament (Genevois *et al.*, 2008) simply because of increase in weight of castrated dogs which bore down on the legs. In diseases like prostate cancer, the effect of castration is not consistent (Fan and de Lormier, 2007; Sorenmo *et al.*, 2003). A body of studies has linked castration with cancer of the prostate (Teske *et al.*, 2002). Generally, unexpected outcome related to gonadectomy are becoming more observable because companion animals are living longer (Reichler, 2009). Therefore, it is possible that some of these diseases may not necessarily be connected with castration but with senility.

The commonest age of castration in this study was found to be between 3-6 months (49%). This is attributed to the advice of the veterinarians to the owners to allow the dogs to reach about 3 months before castration. The optimal time for castrating dog is controversial. Several decades before now, the traditional age of castrating dogs was 6-9 months. There is no clear scientific basis for choosing this age. It seemed the practice actually arose from anaesthetic mortality in younger animals in the first half of the twentieth century (Root, 2007). Recent advancement in anaesthesia has eliminated this anaesthetic danger in small pups (Faggella and Aronsohn, 1994). Therefore many veterinary medical associations including American Veterinary Medical Association have consented to castrating pups as early as 8 to 16 weeks of age (Root, 2007). A retrospective study of Spain (2004) involving 1842 dogs indicated that early castration before 5 months is more

beneficial than the traditional 6-8 months in male dogs whereas about 3 months was suggested for female because of urinary incontinence. On the contrary, evidence have shown that castration at a very early age may prone a dog to bone pathologies such as hip dysplasia since testis produces testosterone that plays crucial roles in body processes including bone growth plate closure. The loss of testosterone at very earlier age may also interfere with development of male sexual characteristic such as deep voice and chested muscles. The two veterinarians in this study actually advocated for the period between 3-6 months, because that period is required for the masculinity nature of the dog to be expressed through the influenced of testosterone. Therefore, a male castrated at early stage when the male features or characteristics have not been expressed because of low testosterone may fail to exhibit such masculine features after castration once the source of the testosterone is removed. Testosterone administration into male dogs increased skeletal muscle mass and maximal voluntary strength (Nieschlag *et al.*, 2012). In Nigeria, most dogs' owners take pride in having big and highly masculine dogs with deep voice and muscular chest. 'Show me your pet, I will tell who you are' is a common slogan in Nigeria communities. This might have informed the decision of these Veterinarians in promoting castration at the most prominent age observed in this study.

The results of this study clearly demonstrate that dogs were castrated for various reasons, the highest being to increase body weight, followed by reduction of roaming and then to moderate aggression. The enhancement of the body weight by castration is due to reduction in metabolism of the dog due to low level testosterone post-castration such that food intakes are deposited to make body fat. If this is not taking into consideration, the castrated dog gains much weight to an extent of becoming obese. Nigeria dogs'

owners are always proud of their dogs looking robust and busty. Such features are considered as a prestige to the owners in some localities in Nigeria. However, increase in body weight is more of a function of nutritional level of the dog. Therefore, it is reasonable to hypothesize that 13% of the dogs that failed to attain increment in body weight in this study had not been well-fed after castration.

This study also shows that a 100% attainment of envisaged behavioural/developmental changes was not feasible except in prevention of inbreeding. This is logical as the testis that produces spermatozoa essentially required for fertilisation of the ova has been removed. Effect of castration on aggression is both positive and negative in this study with reduction effect (50%) higher than increase (29%). This is at par with previous studies. Most studies have found intact male dogs to be disproportionately involved in aggressive behaviour (Borchelt, 1983). Others have reported marked reductions in aggression and other problems of behaviours in male dogs as effects of castration. A previous study showed reduction in roaming behaviour (90%), aggression between males (62%), urine marking (50%) and mounting (80%) following castration (Hopkins *et al.*, 1976). The reduction of roaming in this study is also similar to 90% reduction reported by Gunzel-Apel (1998). Some studies have also reported intact dogs are more likely to bite humans than neutered animals (Gershman *et al.*, 1994). In Nigeria, one of the most common reasons for keeping dogs is for security. Castrated male dogs are in better position to perform this function. Most security outfits private or public employ the service of dogs. The Nigeria Police, Nigeria Army, The Nigeria Custom and Nigeria Immigration have dogs' unit to assist in performing their statutory roles of safeguarding the lives and properties of citizenry, as well as in maintaining peaceful and legal passage of citizens/goods

across the borders. Male dogs are reported to be more valiant than female (Starling *et al.*, 2013). It is also certain that castrates used for guards are not likely to be lured away from their security function by female on oestrus. This possibly explains the reason why castrates were preferred to intact non-castrated dogs for security by Nsukka residents as was reported by Eze and Eze (2002).

Testis is the main source of testosterone and its removal unequivocally reduces the amount of plasma testosterone (Xia *et al.*, 2013). The testosterone influences the male dog behavioural trait and pattern including urine marking and roaming. This is logical as one major reason for roaming is finding bitches on oestrus. Therefore, reduction in the circulating testosterone is associated with reduction in sexual desire (Noakes *et al.*, 2009). Generally, behavioural changes in dogs may also be influenced by some other factors such as environment, time factor and other dogs (Heidenberger & Unshelm 1990). The positive and negative effect of castration on aggression as observed in this study suggests that aggression may be more genetically inclined than the state of the gonads.

Dog industry is actually becoming a booming industry in Nigeria contributing to the Nigeria economy in terms of creating wealth and providing employment opportunities to the teaming youths. A good number of Nigerians earn their livelihood through breeding of dogs especially the foreign breeds. Some are also involved in dogs' training and care, not to mention the veterinary care and sales of dog food and accessories. In some part of Nigeria, dog meat is regarded as a delicacy. At the moment, however, there is no regulation on control of dogs' population and breeding in Nigeria. Neither is there a concrete strategy to reduce straying dogs. The public health implication of indiscriminate breeding especially of stray dogs with attendant uncontrolled dogs' population is increase in



rabies associated with bite from an unvaccinated dog. According to Oduye and Aghomo (1985), rabies is the most important zoonotic disease in Nigeria with more than 94% occurring through dogs' bite. Coincidentally, more than 50% of dogs' bites were linked to stray dogs in Nigeria (Aworh *et al.*, 2011). Certainly, for an effective control of human rabies in Nigeria, there is a need for control of dogs' bite usually associated with population control of stray dogs.

In conclusion, it is acknowledged that the sample size in this study might not be a true representation of number of male dogs castrated in the study area, however, these findings generally have given a pattern to the incidence of castration in dogs within Enugu metropolis of Enugu State, Nigeria. Besides, the veterinary practices used for the study appeared to have clients that covered a wider area across the three LGAs of Enugu. The results have identified the need for educating dogs' owners about the concept of neutering their dogs. Further studies are suggested to determine if these findings are correct under a more elaborate study that may incorporate more veterinary practices and more areas within Enugu State. This study is valuable to current and potential dogs' owners, veterinary practitioners and agencies (governmental or non-governmental) as well as societies involved in the dog industry in Nigeria. Dog's bite is a frequent case in Nigeria. Moreover, castration of stray dogs may be one of the strategies of reducing dogs' population and indirectly by controlling roaming, may also contribute to reduce incidence of dogs' bites and hence rabies transmission to human usually associated with such bites as was suggested by Adedeji *et al.*, (2010). This method was reported to have been used successfully to control rabies transmission from dog to human in Jaipur, India (Reece *et al.*, 2013).

## REFERENCES

- ADEDEJI, A.O., ODE, I.O., OKONKO, M.O., OJEZELE, T.A. AMUSAN and ABUBAKAR, M.J. (2010). Why is there Still Rabies in Nigeria? - A Review of the Current and Future Trends in the Epidemiology, Prevention, Treatment, Control and Possible Elimination of Rabies. *Br. J. Dairy Sc.*, **1**:10-25.
- ACC&D Alliance for Contraception in Cats & Dogs (2013): Contraception and Fertility Control in Dogs and Cats. A Report of the Alliance for Contraception in Cats & Dogs (ACC&D).
- AITKEN, R. JOHN (2014). Age, the environment and our reproductive future: bonking baby boomers and the future of sex. Sex in Three Cities Review. *Reproduction*, **147**: S1-S11
- AJALA, O.O. and O.E. FAYEMI (2011). A Retrospective Study of Reproductive Conditions and Requested Procedures in Dogs in South Western Nigeria. *J. Anim. Vet. Adv.*, **10** (19): 2612-2617.
- AWORH, M.K., NWOSUH, C.I., AJUMOBI, O.O. OKEWOLE, P.A., OKOLOCHA, E.C., AKANBI, B.O. and NGUKU, P. (2011). A Retrospective Study of Rabies Cases Reported at Vom Christian Hospital, Plateau State, Nigeria, 2006 – 2010. *Nig. Vet. Journal*, **32**(4): 366-370.
- AIYEDUN, J.O. and OLUGASA, B.O. (2012). Use of aerial photograph to enhance dog population census in Ilorin, Nigeria. *Sokoto Journal of Veterinary Sciences*, **10**(1):22-27.
- BERRY, S.J., STRANDBERG, J.D., SAUNDERS, W.J. and COFFEY, D.S. (1986). Development of canine benign prostatic hyperplasia with age. *Prostate*, **9**(4):363-73.
- BORCHELT, P.L. (1983). Aggressive behavior of dogs kept as companion animals: lassification and influence

- of sex, reproductive status, and breed. *Appl. Anim. Ethol.*, **10**:45–61.
- BURROW, R., BATCHELOR, D. and CRIPPS, P. (2005). Complications observed during and after ovariohysterectomy of 142 bitches at a veterinary teaching hospital. *Vet. Rec.*, **157** (26):829–33.
- COWAN, L.A., J.A. BARSANTI, W. CROWELL and BROWN, J. (1991). Effects of castration on chronic bacterial prostatitis in dogs. *J. Am. Vet. Med. Assoc.*, **199**: 346–350.
- EZE, C.A. and EZE, M.C. (2002). Castration, other management practices and socio-economic implications for dog keepers in Nsukka area, Enugu state, *Nigeria. Prev. Vet. Med.*, **55** (4): 273–280.
- FAGGELLA, A.M. and ARONSOHN, M.G. (1994). Evaluation of anaesthetics protocols for neutering 6- to 14-week-old pups. *J. Am. Vet. Med. Assoc.*, **205**: 308–314 .
- FAGUNDES, A.K., E.C. OLIVEIRA, B.M. TENORIO, C.C. MELO, L.T. NERY, F.A. SANTOS, L.C. ALVES, R.H. DOUGLAS and V.A. SILVA, Jr. (2014). Injection of a chemical castration agent, zinc gluconate, into the testes of cats results in the impairment of spermatogenesis: A potentially irreversible contraceptive approach for this species? *Theriogenology*, **81**:230-236.
- FAN, T.M. and de LORIMIER L. (2007): Tumors of the male reproductive system. In: Winthrow S.J., Vail D.M., editors. Winthrow and MacEwen's Small Animal Clinical Oncology, 4th Ed. W.B. Saunders Elsevier, St. Louis, MO Pp. 637–48.
- FARSTAD W. (2011): Canine neutering: Legal aspect In: *Veterinary Practice*, 43(11): 21.
- LOONEY, ANDREA L., MARK, W. BOHLING, PHILIP A. BUSHBY, FEDIAF (The European Pet Food Industry) (2010): Facts and Figures, [www.fediaf.org/fileadmin/user\\_upload/facts\\_and\\_figures\\_2010.pdf](http://www.fediaf.org/fileadmin/user_upload/facts_and_figures_2010.pdf) Accessed Aug 2015
- GENEVOIS, J.P., REMY, D., VIGUIER, E., CAROZZO, C., COLLARD, F., CACHON, T. ET AL. (2008). Prevalence of hip dysplasia according to official radiographic screening among 31 breeds of dogs in France. *Vet. Comp. Orthop. Traumatol.*, **21**(1):21–4.
- GERSHMAN, K.A., SACKS, J.J. and WRIGHT, J.C. (1994). Which dogs bite? A case-control study of risk factors. *Pediatrics*, **93**(6 Pt 1):913–917.
- GUNZEL-APEL, A.R. (1998). Early castration of dogs and cats from the point of view of animal welfare. *Dtsch Tierarztl Wochenschr*, **105**:95-98.
- HEIDENBERGER, E. and J. UNSHELM (1990). Changes in the behavior of dogs after castration. *Tierarztl Prax.*, **18**:69-75.
- HOPKINS, S.G., SCHUBERT, T.A. and HART, B.L. (1976). Castration of adult male dogs: effects on roaming aggression urine spraying, and mounting. *J. Amer. Vet. Med. Assoc.*, **168**:1108–10.
- JUNG, M.J., Y.C. MOON, I.H. CHO, J.Y. YEH, S.E. KIM, W.S. CHANG, S.Y. PARK, C.S. SONG, H.Y. KIM, K.K. PARK, S. MCRIST, I.S. CHOI and LEE, J.B. (2005). Induction of castration by immunization of male dogs with recombinant gonadotropin-releasing hormone (GnRH)-canine distemper virus (CDV) T helper cell epitope p35. *J. Vet. Sci.* **6**: 21-24.
- LISA M. HOWE, BRENDA GRIFFIN, JULIE K. LEVY et al.

- (2008). The Association of Shelter Veterinarians Veterinary medical care guidelines for spay-neuter programs. *J. Amer. Vet. Med. Assoc.*, **233**(1):74-86.
- LOWSETH, L.A., GERLACH, R.F., GILLET, N. A. and MUGGENBURG, B. A. (1990). Age-related changes in the prostate of the beagle dog. *Vet. Path.*, **27**:347-53.
- MCKENZIE B. (2010). Evaluating the benefits and risks of neutering dogs and cats. CAB  
*Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources*, **5**(045):1-18.
- MATZNICK-KOLER J. (2002). The Origin of dogs revisited, *Anthrozoos*, **15** (2): 98-118.
- MESEKO, C. (2010): Dog population dynamics in Nigeria, FAO, 3 September 2010, <http://www.fao.org>. (11)
- MOHAMMED, A. and JAMES, F.O. (2013). Chemical castration by a single bilateral intra-testicular injection of chlorhexidine gluconate and cetrimide in bucks. *Sokoto Journal of Veterinary Sciences*, **11**(1): 62-85.
- MUKARATIRWA, S. and CHITURA, T. (2007). Canine subclinical prostatic disease: histologic prevalence and validity of digital rectal examination as a screening test. *J. S. Afr. Vet. Assoc.*, **78**(2):66-8.
- NATIONAL POPULATION COMMISSION (2006): Population and housing census. [www.population.gov.ng](http://www.population.gov.ng). Accessed July 20<sup>th</sup>, 2014.
- NGOKA, I. THOYA (2013): Humane Canine Population Management for Human Health ACC & D 5th International Symposium on Non-Surgical Methods of Pet Population Control. Portland, Oregon, June 2013
- NOAKES, D.E., PARKINSON, T. J. and ENGLAND, G.C. (2009): *Veterinary Reproduction and Obstetrics*. 9th Ed. Elsevier, China.
- NIESCHLAG, E. HERMANN, M. BEHRE and SUSAN NIESCHLAG (2012): *Testosterone: Action, Deficiency, Substitution*. 4<sup>th</sup> Ed. Cambridge University Press, Cambridge: 200
- ODUYE, O. O. and H.O. AGHOMO (1985): Epidemiology of rabies in Nigeria in *Rabies in the Tropics*. Springer Berlin, Heidelberg. Pp 491-496
- PATRONEK, G.J. and ROWAN, A.N. (1995). Determining dog and cat numbers and population dynamics. *Anthrozoos*, **8**:199-205.
- POLLARI, F.L., BONNETT, B.N., BAMSEY, S.C., MEEK, A.H. and ALLEN, D.G. (1996). Postoperative complications of elective surgeries in dogs and cats determined by examining electronic and paper medical records. *J. Amer. Vet. Med. Assoc.*, **208**(11):1882-6.
- REECE, J.F., S.K. CHAWLA and HIBY A.R. (2013). Decline in human dog-bite cases during a street dog sterilisation programme in Jaipur, India. *Vet. Rec.*, **172** 473.
- REICHLER, I.M. (2008). Surgical contraception: Pros and cons. Paper presented at: 6th International Symposium on Canine and Feline Reproduction and 6th Biannual European Veterinary Society for Small Animal Reproduction Congress; 2008; Vienna.
- REICHLER, I.M. (2009). Gonadectomy in cats and dogs: a review of risks and benefits. *Reprod Domest Anim.*, **44** (Suppl 2): 29-35.
- ROOT KUSTRITZ M.V. (2007). Determining the optimal age for

- gonadectomy of dogs and cats. *J. Amer. Vet. Med. Assoc.*, **231**(11):1665–75.
- SENGER, P. L. (2005): Pathways to pregnancy and parturition. edn 2nd rev. Current Conceptions, Pullman, WA.
- SORENMO, K.U., GOLDSCHMIDT, M., SHOFER, F., GOLDKAMP, C. AND FERRACONE, J. (2003). Immunohistochemical characterization of canine prostatic carcinoma and correlation with castration status and castration time. *Vet. Comparative Oncol.*, **1**(1):48-56.
- SPAIN V. (2004). Long-term risks and benefit of early –age gonadectomy. *J. Amer. Vet. Med. Assoc.*, **224**(3): 380-387
- STARLING, M.J., BRANSON, N., THOMSON, P.C. and MCGREEVY, P.D. (2013). Age, sex and reproductive status affect boldness in dogs. *Vet. J.*, **197**(3):868-72.
- TESKE, E., NAAN, E.C., VAN DIJK, E.M., VAN GARDEREN, E. and SCHALKEN, J.A. (2002). Canine prostate carcinoma: epidemiological evidence of an increased risk in castrated dogs. *Mol. Cell. Endocrinol.*, **197**: 251-255.
- XIA, F., X. H. ZHAI, Y. MENG, H. ZHANG, S. DU, H. XU, H. WU and LU Y. (2013). Castration-induced testosterone deficiency increases fasting glucose associated with hepatic and extra-hepatic insulin resistance in adult male rats. *Reprod. Biol. Endocrinol.*, **11**:106.