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https://dx.doi.org/10.4314/nvj.v44i1.1 **ORIGINAL ARTICLE**

PREVALENCE OF HIP DYSPLASIA IN BOERBOEL DOGS IN NIGERIA: A RETROSPECTIVE STUDY OF RADIOGRAPHIC SCREENING BETWEEN 2016 AND 2022.

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ABSTRACT

Canine hip dysplasia is a complex developmental disease of coxo-femoral joints accounting for 30% of canine orthopaedic cases. Radiological examinations of coxofemoral joints are done to determine the genetic carriers for canine hip dysplasia (CHD) and remove such dogs from breeding. There is scanty record on prevalence of CHD in Boerboel dogs. We reviewed the anterioposterior and flexed lateral hip radiographs of apparently normal Boerboel dogs presented for hip certification between 2016 and 2022 to determine CHD prevalence in the breed. Radiographs were graded using modified Federation Cynologique International grading system. CHD prevalence was expressed as percentages, while age and sex difference in prevalence of CHD were compared using chi-square test. Relative percentages were calculated for CHD grades C, D, and E. Differences were considered significant at p ? 0.05. Median age for the dogs was 2 years with age ranging between 1 and 6 years. 27 (42.2%) were non dysplastic, while 37(57.8%) were dysplastic. Dogs with grade A accounted mostly for the non-dysplastic dogs, while dogs with grade C accounted mostly for dysplastic dogs. HD Prevalence was significantly ($p < 0.05$) higher in female than male, however, there was no significant ($p > 0.05$) difference in CHD prevalence between dogs (1 – 2 years of age) and dogs (3 – 6 years of age). Dogs with grade C have the highest relative percentage among the dysplastic grades. It was concluded that CHD prevalence in Boerboel dogs is high and dogs with grade C accounted for most of the CHD cases.

Keywords: Boerboel, Dogs, Coxofemoral joint, Hip dysplasia, Prevalence

INTRODUCTION

Canine hip dysplasia (CHD) is a complex developmental disease of the coxo-femoral joint characterized by varying degree of laxity of the coxo-femoral joint resulting in subluxation of the femoral head, shallow acetabulum and flattening of the femoral head (Baldinger et al., 2020). This causes an inflammatory response with subsequent osteoarthritis which causes variable degrees of discomfort and lameness. It is one of the most frequent orthopaedic illnesses in dogs, accounting for 30% of all orthopaedic cases (Ajadi et al., 2018). Canine hip dysplasia is a multifactorial disease caused by genetic, environmental and epigenetic factors (Mikkola et al., 2019). The disorders' genetic basis is unknown, although it is thought to be a complicated genetic feature with a polygenic inheritance pattern. (Ohlerth et al., 2019). The disease has been linked to both dominant and recessive inheritance types. Excluding afflicted dogs from breeding has been found to lessen the occurrence of hip dysplasia in various nations due to its genetic potential (Baldinger et al., 2020; Oberbauer et al., 2017; Ohlerth et al., 2019). Radiological examination of coxo-femoral joint is done in various breeds with the purpose of assessing and determining the genetic carriers for hip dysplasia in order to remove such dogs from breeding (Baldinger et al., 2020; Ohlerth et al., 2019). Standardized system for hip dysplasia grading has been developed in several countries. These include the method of Orthopaedic Foundation for Animal, Federation Cynologique International, and the British Veterinary Association/Kennel club (Fluckiger, 2007). These methods assess degree of remodelling and radiological severity of osteoarthritis. The Federation Cynologique International (FCI) score is alphabetically divided into five categories: A through E, where A is normal and E is severe CHD (Verhoeven et al., 2009). The FCI score is derived from various 'sub-traits' of the hip, such as joint congruency, Norberg angle, joint subluxation degree, acetabulum shape and depth, and radiographic indications of osteoarthritis in the joint (Baldinger et al., 2020). Prevalence of canine hip dysplasia varies significantly between breeds and in several countries depending on the degree of breeding restriction and selection put in place by the breed club in that country. In France, the prevalence varied between 5% in Siberian husky and 51.9% in Cane Corso (Baldinger et al., 2020). In the United States, the prevalence ranges between 5.24% in Retrievers and 20.4% for Molloser type of dog (Loder and Todhunter, 2017). In Switzerland, the prevalence of hip dysplasia ranged from 3% in Labrador retriever to 18% in German shepherd dog (Ohlerth et al., 2019). In South Africa, the reported prevalence of hip dysplasia in Rottweilers and Labrador retrievers was estimated at 22% and 31%, respectively (Kirberger, 2017). Boerboels also known as South African Mastiff are large Molloser breed of dog present in many countries of the world. In spite of their large size, very little is known about the prevalence of hip dysplasia in this breed compared to other large breeds like Rottweiler, Labrador or Cane corso. In current preliminary report of 20 dogs, we found a prevalence of 65% for hip dysplasia in Boerboel dogs in Nigeria (Ajadi and Doyin-Dada, 2019). In this study, we evaluated the prevalence of canine hip dysplasia in Boerboel dogs using a larger sample size in order to determine the progress in the prevalence of canine hip dysplasia among Boerboel dogs in Nigeria.

MATERIALS AND METHODS

Animals

This study involved the review of extended anteroposterior and flexed lateral radiographs of Boerboel dogs presented for hip and elbow certification between April, 2016 and September, 2022. Prior to taking the radiographs, the dogs were anaesthetized with intramuscular administration of 0.4 mg/kg xylazine hydrochloride (Xylased 20mg Bioveta, Czech Republic) and 0.04 mg/kg atropine sulphate (Stropine 1mg, Tianjin Kingyork group Hubei Tianyao Pharma Co. LTD, Xiangyang Hubei China) as premedicants followed by intravenous injection of 4.0 mg/kg of 1% propofol (Hyprovan 200, Celon laboratories) to induce general anaesthesia. After carefully choosing the optimum exposure variables, which vary from 7.5-12.5 Miliamperes and 69-75 Kilovoltage Peak depending on the dog size, all of the radiographs were taken using a digital X-ray machine (Brivio XR 115, GE Health Care Services, General Electric Company, India).

Hip Dysplasia Grading

The modified Federation Cynologique International grading scale described by Ajadi and Doyin-Dada (2019) was used to grade each radiograph. Each joint was assigned to one of five grades (A- E). Where the grading for the two joints varies, the worst of the grade assigned to either of the limb is recorded as the final grade for the dog. Hip grades A and B are considered as normal joints (non-dysplastic), while grades C, D and E represent mild, moderate and severe dysplasia, respectively.

Data Analysis

CHD prevalence was expressed as percentages. Sex and age difference in the prevalence of CHD were compared using Chi-square test and value of $P \leq 0.05$ was considered statistically significant. Data were analyzed using Graph Pad Prism 6 (La Jolla, USA, CA).

RESULTS

Radiographs from a total of sixty four (64) dogs consisting of 29 (45.3%) male and 35 (54.7%) female Boerboel dogs were reviewed. The median age of the dogs was 2 years with age ranging between 1 and 6 years. Of all the radiographs reviewed, 27 (42.2%) were graded as non-dysplastic, while 37(57.8%) were graded as dysplastic. TABLE I showed the prevalence of the different hip grade in the Boerboel dogs. Dogs with grade A (Plate 1a & b)) accounted for most of the non-dysplastic dogs, while dogs with grade C (Mild hip dysplasia) accounted for most of the dysplastic dogs. Dogs with grade E (Plate 2a & b) accounted for the least of the dysplastic dogs.

TABLE I: Prevalence of different hip grade in Boerboel dogs

Hip Grade	Male	Female	Total	Prevalence (%)
A	9	9	18	28.1
B	2	7	9	14.1
C	8	11	19	29.7
D	8	2	10	15.6
E	2	6	8	12.5
Total	29	35	64	100

Plate 1a: Extended craniocaudal radiograph of a Boerboel dog with grade A (Excellent) hip.

Plate 1b: Flexed lateral radiograph of a Boerboel dog with grade A (Excellent) hip.

Plate 2a: Extended craniocaudal hip radiograph of a Boerboel dog with grade E (severe) hip dysplasia. Note the luxation of the femoral head and severe remodelling of the femoral head and the acetabulum.

Plate 2b: Flexed lateral hip radiograph of a Boerboel dog with grade E (severe) hip dysplasia. Note the complete luxation of the femoral head and severe remodelling of the acetabulum

Plate 3a: Extended craniocaudal hip radiograph of a Boerboel dog with grade C (mild) hip dysplasia. Note the incongruency of femoral head and the acetabulum.

Plate 3b: Flexed lateral hip radiograph of a Boerboel dog with grade C (mild) hip dysplasia. Note the incongruency of femoral head and the acetabulum.

The sex prevalence of hip dysplasia in Boerboel dogs is shown in TABLE II. Prevalence of hip dysplasia was significantly ($p < 0.05$) higher in the female Boerboel dogs than male Boerboel dogs.

TABLE II: Sex prevalence of hip dysplasia in Boerboel dogs

Sex	**Normal**	**Dysplastic**	**Prevalence (%)**
Male	11	18	28.1
Female	16	19	29.7
Total	27	37	57.8

P value ≡ 0.003

However, there was no significant ($p > 0.05$) difference in the prevalence of hip dysplasia between dogs that are 1 – 2 years of age and dogs that are 3 – 6 years of age (TABLE III).

TABLE III: Age prevalence of hip dysplasia in Boerboel dogs.

Age (Years)	Normal	Dysplastic	Prevalence (%)
1 – 2	16	24	37.5
3 – 6	11	13	20.3
Total	27	37	57.8

P value ≡ 0.18

The relative percentage of different grades of hip dysplasia in Boerboel dogs is shown in TABLE IV. Dogs with grade C have the highest relative percentage, while dogs with grade E have the lowest percentage.

TABLE IV: Relative percentage of different grades of hip dysplasia in Boerboel dogs

Grades	Relative Percentage (%)
C	51.4
D	27.0
E	21.6

DISCUSSION

Although there are several grading systems for canine hip dysplasia such as Orthopaedic Foundation for Animal, Federation Cynologique International, and the British Veterinary Association/Kennel club (Fluckiger, 2007), the FCI grading systems was used in this study. The choice of the FCI systems over others was because it is the grading system used by the Kennel Union of South Africa (KUSA). The dogs in this study were presented for radiographic hip and elbow examination as part of the requirement for registration of the dog by KUSA. The FCI uses extended craniocaudal and flexed lateral radiographs of the hip obtained under deep sedation or general anaesthesia. The extended craniocaudal projection masks hip joint laxity which is a key factor for the development of CHD (Ohlerth et al., 2019). Thus, other methods for measuring hip joint laxity such as PennHip method, Fluckiger technique and dorsolateral subluxation test have been proposed as being more sensitive in the detection of hip dysplasia in dogs (Baldinger et al., 2020). The limitation to the use of these techniques includes the requirement for specialized distraction apparatus which is unavailable, as well as the technical skills involved. Proper positioning of dogs for extended craniocaudal radiograph of the hip joint is very important and requires that dog is well relaxed. This is even more important in highly muscular breed such as Boerboel dogs. The radiographs for this study were obtained following anaesthesia with a combination of alpha -2-agonist (Xylazine) and an alkyl phenol hypnotic drug (Propofol). Although no standardized anaesthetic protocol has been proposed for obtaining hip radiographs, the ideal protocol should be the one that is safe and will allow adequate positioning of the patient (Ohlerth et al., 2019). Protocols involving the use of α-2 agonist, or combination between α-2 agonist and other injectable drugs such as diazepam, ketamine or butorphanol for hip radiography have been reported (Maitre et al., 2010). The use of acepromazine as sedation for hip radiography has been reported to produce very poor muscle relaxation (Malm et al., 2007). The overall prevalence of 57.8% for CHD in this study is lower when compared with our previous study (Ajadi and Doyin-Dada, 2019). This may be because of the higher sample size when compared with the previous study. However, the current figure for prevalence of CHD in Boerboel dogs is still very high when compared with the prevalence of CHD in other large breeds such as Rottweiler, Labrador retriever and Cane corso (Baldinger et al., 2020; Kirberger, 2017; Ohlerth et al., 2019). The low CHD prevalence reported in this other breed is associated with selective breeding using classification of hip joints phenotypes. Lower CHD prevalence due to improvement in breeding has been reported in countries such as South Africa, France, Sweden and USA (Baldinger et al., 2020; Kirberger, 2017; Loder and Todhunter, 2017; Ohlerth et al., 2019). However, breeding restriction using results of hip grading has not been implemented in Boerboel dogs in Nigeria. In this study, dogs with Grade C accounted for the majority of the cases of CHD in the Boerboel dogs. This appears to be an improvement over our previous study in which dogs with Grade D accounted for most of the cases of CHD in the breed (Ajadi and Doyin-Dada, 2019). The exact reason for the increase in the C grade is unknown since breeding restrictions are yet to be enforced. The increase in C grade with a decrease in D grade is similar to that reported for Australian Shepherd dog and Belgian Shepherd dog

(Baldinger et al., 2020). However, it should be noted that there appears to be a relative increase in the number of dogs with Grade E compared to our previous study. Dogs with Grade E have severe dysplasia with complete luxation of the femoral head and severe remodelling of the acetabulum. Dogs with Grades D and E have been banned from breeding in many countries, (Kirberger, 2017; Ohlerth et al., 2019), while grade C are still allowed to be bred to dogs with Grade A in some countries. The median and modal age of the dogs in this study was 2 years with age ranging between 1 and 6 years. According to FCI recommendation, dogs presented for CHD screening must not be less than one year (Kirberger, 2017). The age range of the dogs in this study is similar to that reported in our previous study (Ajadi and Doyin-Dada, 2019) and is in agreement with that reported for Rottweiler and Labrador in South Africa (Kirberger, 2017), as well as similar report from USA (Loder and Todhunter, 2017). The lower median or modal age for CHD screening may be because the breeders want to get their breeding dog registered into canine breeding registry such as Kennel Union of South Africa (KUSA) before breeding commences. CHD and ED certification are among the requirements for registration of dogs into the breeding register (Kirberger, 2017). This study also showed that there were no age differences in the prevalence of CHD in Boerboel dogs. This result is consistent with our prior work (Ajadi and Doyin-Dada, 2019) and a similar study in the United States (Loder and Todhunter, 2017). There are contrasting reports about the effect of sex on the prevalence of CHD in dogs. No significant sex related differences in CHD prevalence were reported in studies from South Africa and UK (Kirberger, 2017; Krontveit et al., 2010). However, significant increases in CHD prevalence in female dogs compared to male were reported for German shepherd dogs and Golden Retrievers (Torres de la Riva et al., 2013). In a previous study, we reported that there were no significant diference in the prevalence of CHD between male and female Boerboels (Ajadi and Doyin-Dada, 2019). However, in this current study, CHD prevalence was significantly higher in the female Boerboel dogs. The exact reason for this observation is not clear but might be due to the fact that more female dogs were presented for radiographic screening that the male dogs. This may be because most breeders prefer to acquire female dogs than male dogs. The result of this study should be interpreted with cautions. The data only reflect the results of dogs whose owner presented the dog for hip and elbow radiographs as part of requirement for registration under KUSA. Majority of the dogs presented for the radiographs are dogs with very high appraisal score and which the owner presumed will have good hip grade. In addition, it is of noteworthy that phenotypic hip grading score is not mandatory for breeding in Nigeria and breeding is not being controlled. Intra- and inter-observer variation in CHD scoring has been reported and could affect the result of study of this nature (Baldinger et al., 2020; Kirberger, 2017; Ohlerth et al., 2019). However, in this study, all the radiographs were reviewed by the same scrutineer and at the same time to remove possible inter-observer and intra-observer variability.

CONCLUSIONS

In conclusion, the result of this study showed a decrease in the prevalence of CHD in Boerboel dogs compared to our previous report as well as an increase in the percentage of dogs with

Grade C and a decrease in the percentage of dogs with grade D. The over 10% of dogs with severe CHD (Grade E) is of concern because such dogs may suffer severe pain and mobility impairment in the future along with the attendant welfare concerns (Stock et al., 2011). In addition to the suffering, treatment of CHD is very expensive, requiring long-term medical treatment or expensive surgical procedures which are very difficult to assess in developing nations. Therefore, in order to minimize or completely reduce the prevalence of CHD in Boerboel dogs, it is recommended that phenotypic radiographic screening of CHD in Boerboel dogs should be made mandatory for breeding dogs. Only dogs with CHD grades A – C should be allowed to be bred and further restriction to prevent the breeding of two dogs with grade C should be put in place as such breeding can result in offspring with CHD grade D. Prevalence of CHD in Boerboel dogs from other countries of the world is also required.

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