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Preliminary evaluation of prevalence of hip and elbow dysplasia in Boerboel dogs

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Abstract

Hip dysplasia (HD) and elbow dysplasia (ED) are developmental diseases that affect large breed of dogs disproportionately. Despite the large size of Boerboel dogs, there are no breed prevalence for HD and ED in Nigeria. This study provides preliminary information about HD and ED prevalence in Boerboels. Twenty Boerboels of both sexes were evaluated. Ventrodorsal radiographs of the hip joint and flexed lateral radiographs of elbow joint were made from each dog, using digital technology. Hip grading was done using the Fédération Cynologique Internationale system (World Canine Organization), assigning grades ranging from A - E. Elbow radiographs were graded based on the International Elbow Working Group criteria, and scores ranging from 0-3 were assigned. Prevalence of HD and ED were expressed as percentages. Age and sex difference were compared using a chi square test. Differences were considered significant at $P \leq 0.05$. Mean age of the dogs at the time of radiography was 2.4 ± 0.4 years. Seven (35%) Boerboels had normal hips, while thirteen (65%) had HD. Fifteen (75%) Boerboels had normal elbows, while five (25%) had ED. Five (25%) Boerboels with HD were males, while 8 (40%) HD diagnoses were in females. Two (10%) Boerboels with ED were male, while three (15%) were female. There was no significant ($p > 0.05$) association between the sex and age of the dogs and distribution of HD and ED, or between sex and concurrent presence of HD and ED in Boerboels. In conclusion, HD prevalence in Boerboels (65%) is higher than that of ED. Further research on hip and elbow disease of African large dogs is indicated.

Keywords: Boerboel, Dogs, Dysplasia, Elbow, Hip, Prevalence, Radiography

Introduction

Hip dysplasia (HD) is a quantitatively-inherited disease of the canine coxofemoral (hip) joint, especially involving large breed of dogs such as Rottweiler, Labrador retriever, German shepherd dog, and Boerboel (Todhunter *et al.,* 2005; Janutta & Distl, 2006). Hip dysplasia is characterized by a primary lesion of lateral laxity and subluxation or luxation of the femoral head from the acetabulum, with secondary remodeling and osteoarthritic changes; chronic pain and lameness are common sequelae (Sanchez-Molano *et al.,* 2014). Hip dysplasia has no cure, although surgical interventions such as triple pelvic osteotomy, pectineus tenotomy, excision arthroplasty, trochanteric osteotomy, and total hip replacement, help relieve pain and maintain degrees of function (Zhu *et al.,* 2012). As with all traits that are inherited quantitatively, environmental and genetic factors

both play important roles in HD. Environmental factors that that have been suggested to contribute to canine hip dysplasia (HD) include the level of exercise and diet, with both influencing the dog's body weight and muscle mass (Kirkby & Lewis, 2012).

Elbow dysplasia (ED) is a developmental and evidently familiar disease that involves primarily rapidly growing, large breed dogs. The several components of ED include joint incongruity, fragmented medial coronoid process (FCP), un-united anconeal process (UAP), and osteochondritis (OCD) of the humeral epicondyle. Secondary osteoarthritis is common (Michelson, 2012). Elbow dysplasia is a major cause of persistent forelimb lameness in dogs. Although ED is primarily a disease of large breed of dogs, it has been reported in smaller chondrodystrophic breeds such as Daschunds and French bulldogs (Narojek *et al.,* 2008). Mechanisms that may be involved in the development of ED include osteochondrosis (OC), joint incongruities (Kramer *et al.,* 2006), and biomechanical force mismatch across the elbow joint (Hulse, 2008)**.** All are hypothesized to occur as a result of genetic predisposition with contributing environmental factors, such as high energy diets, rapid growth rates, or excessive exercise (Kirberger & Stander, 2007).

Plate I: Photograph of an adult male Boerboel dog

According to the Orthopaedic Foundation for Animals (OFA), in the USA, HD prevalence in Rottweilers was estimated as 20.2%, and that of Labrador retrievers as 11.5% (OFA, 2015). In the United Kingdom, HD prevalence in Rottweilers and Labrador retrievers was estimated between 25% and 40% (Sanchez-Molano, 2014). The prevalence of HD in Rottweilers and Labrador retrievers in South Africa was estimated at 22% and 31%, respectively (Kirberger, 2017). However, there are no HD prevalence data for Boerboel dogs.

Reported prevalence of ED in UK Labrador retrievers was estimated as 17%, while prevalence in Bernese mountain dogs in The Netherlands was estimated as 70% (Michelson, 2012). In a survey of ED among purebred dogs in Finland, Rottweilers revealed 55% prevalence, and Golden retrievers 30%. German shepherd dogs and Labrador retrievers each had 25% ED prevalence (Maki *et al.,* 2004). In a study of purebred dogs in South Africa, Rottweilers had the highest ED prevalence at 55%, followed by the Bullmastiff, Chow-chow, Boerboel, and Golden retriever, all of which had ED prevalence over 38 percent (Kirberger, 2017).

Both HD and ED can result in chronic lameness, with ultimate outcomes frequently including significant pain and chronic disability, as degenerative joint disease becomes progressive over time periods that can be relatively brief or prolonged to years (Zhu *et al.,* 2012). Although the naturally-occurring mortality associated with HD and ED is very low, the cost of treatment and other associated losses usually creates serious economic burdens. Thus, new knowledge about these diseases could guide proper selection and breeding, based on radiographic and clinical findings, to reduce disease prevalence.

The Boerboel is kept for security and breeding purposes in Nigeria today, because it is a large, strong, and intelligent working dog. Boerboels are crossbred between Bullmastiff and local South African dog breeds such as the Bullenbijter. Boerboels (Plate I) have good muscle development and buoyancy of movement, and are known for good general health. However, they can suffer from hip or elbow dysplasia, cervical spondylomyelopathy, vaginal hyperplasia, ectropion, and entropion (Gray, 2003).

Despite the size of the Boerboel dog and the recognized risk for HD and ED, there are no prevalence data for HD, while the data for ED are scanty. In addition, owing to lack of regulation of dog breeding practices in Nigeria, prevalence of inherited diseases is expected to rise over time, especially when compared to similar numbers from other parts of the world, where dog breeding is guided. This study provides preliminary information on prevalence of HD and ED in Boerboel dogs.

Materials and Methods

Twenty clinically healthy adult Boerboel dogs of both sexes were radiographed, including twelve (12) females and eight (8) males. The dogs were sourced from Boerboel dog breeders located in Ogun, Lagos, and Oyo States. We studied only dogs that were microchip-identified and registered with Boerboel.

Dog Breeders Association of Nigeria (BDBAN) or Boerboel Alliance. Before the commencement of the study, informed owners' consent and ethical approval (FUNAAB/COLVET/CREC/006/2017) were obtained.

The dogs were premedicated with intramuscular injections of 0.5 mg/kg of 2% xylazine hydrochloride (Xylazine 20 Inj®, Kepro, Holland) and 0.04 mg/kg atropine sulphate (Atocan®, Sishui Xierkang Pharma, China). Thereafter, anaesthesia was induced with 4.0 mg/kg of 1% propofol injection (Diprivan, ICI - Zeneca Pharmaceuticals) intravenously. Following anaesthesia, ventrodorsal and flexed lateral radiographs of the hip joint, and flexed latero-medial radiograph of the elbow joint, were obtained from all dogs. The dogs were positioned in ventrodorsal recumbency with legs extended for the hip radiograph, while they were placed in lateral recumbency for the flexed lateral elbow radiograph. All the radiographs were obtained using a digital X-ray machine (Brivio XR 115, GE Health Care Services, General Electric Company, India) with a Potter-Bucky grid. Exposure factors ranged from 10-16 mAs and 74-80 KvP, depending on the size of the dog.

The hip radiographs of the dogs were graded based on standardized projections using the Federation Cynologue International (FCI) criteria (Table 1), while the elbow radiographs were graded based on the International Elbow Working Group (IEWG) criteria (Table 2). Dogs with hip classifications A1, A2, B1 and B2 were classified as non-dysplastic, while dogs with hip classifications C1, C2, D1, D2, E1 and E2 were classified as dysplastic. Dogs with elbow grade 0 were classified as normal, while those with elbow grade 1-3 were classified as dysplastic.

Statistical analysis

The prevalence of HD and ED were stated as percentages. Age and sex difference in the prevalence of HD and ED were compared using a chi-square test. Risk ratio was calculated for HD grades C, D, and E; and for ED grades 1 and 2. Differences were considered significant at $P \leq 0.05$. All statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) 17.0 software (SPSS Inc., Chicago, IL, USA).

Results

The mean age of the Boerboel dogs at the time of radiography was 2.4 ± 0.4 years (median 2.0 years). The hip grading scores of the Boerboel dogs are shown in Table 3. Seven (35%) of the Boerboel dogs had hip grades A or B, thus classified as non-dysplastic. Thirteen (65%) of the dogs had hip grades

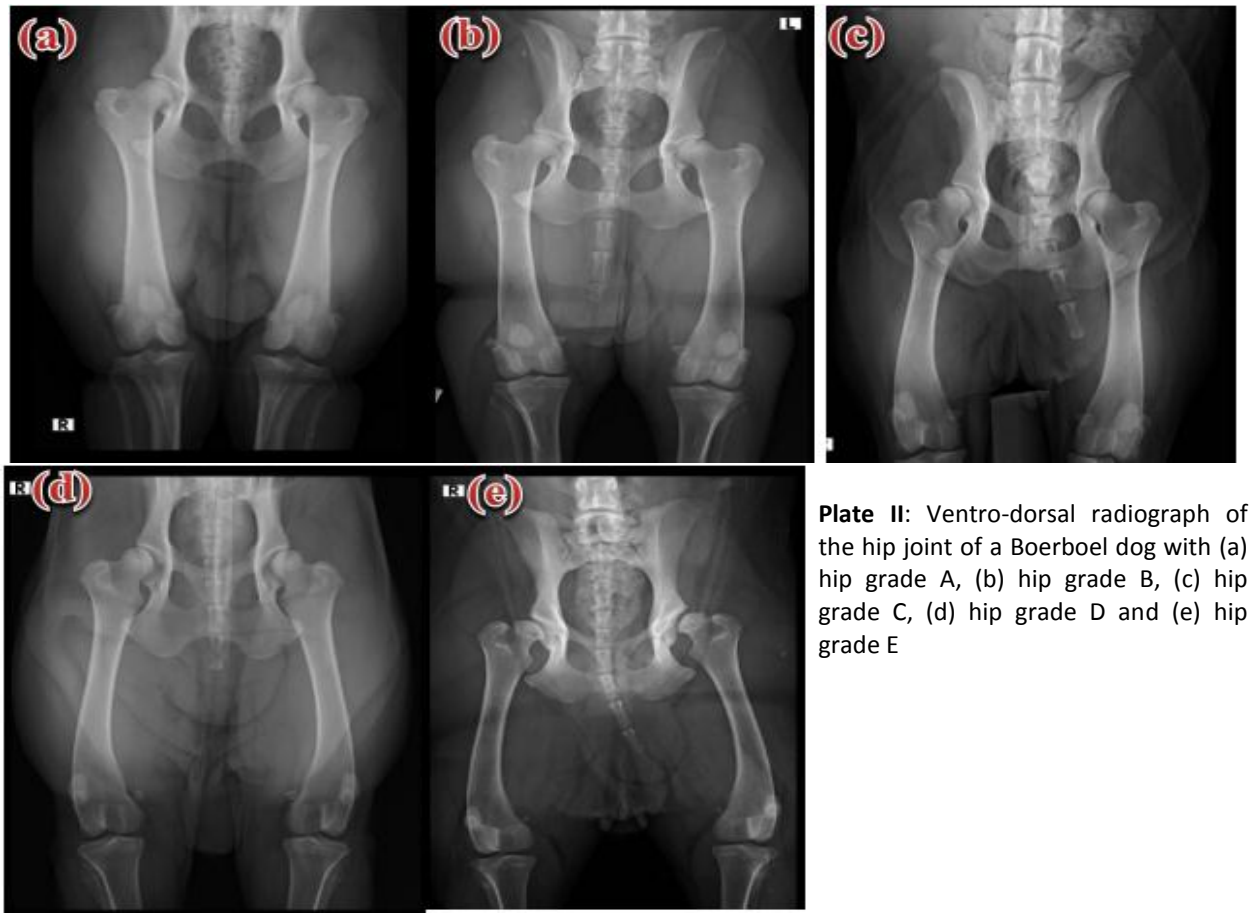

Plate II: Ventro-dorsal radiograph of the hip joint of a Boerboel dog with (a) hip grade A, (b) hip grade B, (c) hip grade C, (d) hip grade D and (e) hip grade E

Table 1: Federation Cynologue Internationale (FCI) Criteria for hip grading (www.fci.be)

FCI Grade	Description	FCI Criteria
A1	Excellent Hips	The femoral head and the acetabulum are congruent. The craniolateral rim appears sharp and slightly rounded. The joint space is narrow and even. The acetabular angle according to Norberg (adapted for Position I) is about 105° (as a reference). In excellent hip joints the craniolateral rim encircles the femoral head somewhat more in latero-caudal direction.
A2	Good Hips	The femoral head and the acetabulum are congruent. The craniolateral rim appears sharp and slightly rounded. The joint space is narrow and even. The acetabular angle according to Norberg (adapted for Position I) is about 105° (as a reference). In excellent hip joints the craniolateral rim encircles the femoral head somewhat more in latero-caudal direction
B1	Fair Hips	The femoral head and the acetabulum are slightly incongruent and the acetabular angle according to Norberg (adapted for Position I) is about 105° or the center of the femoral head lies medial to the dorsal rim of the acetabulum and the femoral head and the acetabulum are congruent.
B2	Marginal Dysplasia	The femoral head and the acetabulum are slightly incongruent and the acetabular angle according to Norberg (adapted for Position I) is about 105° or the center of the femoral head lies medial to the dorsal rim of the acetabulum and the femoral head and the acetabulum are congruent.
C1	Mild Dysplasia	The femoral head and the acetabulum are incongruent, the acetabular angle according to Norberg is about 100° and/or there is a slightly flattened craniolateral rim. Irregularities or no more than slight signs of osteoarthritic changes of the margo acetabularis cranialis, caudalis or dorsalis or on the femoral head and neck may be present.
C2	Mild to Moderate Dysplasia	The femoral head and the acetabulum are incongruent, the acetabular angle according to Norberg is about 100° and/or there is a slightly flattened craniolateral rim. Irregularities or no more than slight signs of osteoarthritic changes of the margo acetabularis cranialis, caudalis or dorsalis or on the femoral head and neck may be present.
D1	Moderate Dysplasia	Obvious incongruity between the femoral head and the acetabulum with subluxation. Acetabular angle according to Norberg more than 90° (only as a reference). Flattening of the cranio-lateral rim and/or osteoarthritic signs.
D2	Moderate to Severe Dysplasia	Obvious incongruity between the femoral head and the acetabulum with subluxation. Acetabular angle according to Norberg more than 90° (only as a reference). Flattening of the cranio-lateral rim and/or osteoarthritic signs.
E1	Severe Dysplasia	Marked dysplastic changes of the hip joints, such as luxation or distinct subluxation, acetabular angle according to Norberg less than 90°, obvious flattening of the margo acetabularis cranialis, deformation of the femoral head (mushroom shaped, flattening) or other signs of osteoarthrosis
E2	Very Severe Dysplasia	Marked dysplastic changes of the hip joints, such as luxation or distinct subluxation, acetabular angle according to Norberg less than 90°, obvious flattening of the margo acetabularis cranialis, deformation of the femoral head (mushroom shaped, flattening) or other signs of osteoarthrosis

C, D, or E (Plates II), thus classified as dysplastic. The hip grades on left and right sides were the same in ten (50%) of the Boerboel dogs, while the hip grades were laterally different in ten (50%). Six (30%) of the Boerboel dogs were graded as severe (D & E) for HD, while seven (35%) of the dogs were graded as moderate (C).

The elbow grading of the Boerboel dogs is shown in Table 3. Fifteen (75%) of the Boerboel dogs had elbow grade 0 and were classified normal, while five (25%) had elbow grades 1 or 2 (Plate III), and were classified dysplastic. Three (15%) of the dogs had bilateral elbow dysplasia, while two (10%) were affected unilaterally. Two (10%) dogs had moderate

Plate 3: Latero-medial radiograph of the elbow joint of a Boerboel dog with (a) ED grade 0-Note the smooth humeral epicondyle (Red arrow) and clear joint space (black arrow) (b) ED grade l. Note the mild osteophytes (red arrow) on the humeral epicondyle (c) ED grade 2. Note the moderate osteophytes (green arrow) on the humeral epicondyle with narrowing of the joint space

Table 2: International Elbow Working Group (IEWG) criteria for elbow grading (www.vet-iewg.org)

	Elbow dysplasia scoring	Radiographic findings
0	Normal elbow joint	Normal elbow joint, No evidence of incongruency, sclerosis or arthrosis
1	Mild arthrosis	Presence of osteophytes 2mm high, sclerosis of the base of the coronoid process - trabecular pattern still visible
2	Moderate arthrosis or suspected primary lesion	Presence of osteophytes of 2 - 5 mm high Obvious sclerosis (no trabecular pattern) of the base of the coronoid processes Step of 3-5 mm between radius and ulna (INC). Indirect signs for a primary lesion (UAP, FCP/ MCD, OCD)
3	Severe arthrosis or evident primary lesion	Presence of osteophytes of > 5 mm high Step of > 5 mm between radius and ulna (obvious INC) Obvious presence of a primary lesion (UAP, FCP, OCD)

ED, while three (15%) had mild ED.

The sex distribution of HD in the Boerboel dogs is shown in Table 4. Five (25%) of the dogs with HD were males, while 8 (40%) with HD were females. There was no significant ($p > 0.05$) association between sex and distribution of HD. The sex distribution of dogs with ED is shown in Table 5. Two (10%) of the dogs with ED were male, while three (15%) were female. There was no significant association between the sex and the distribution of ED.

The age distribution of HD is shown in Table 6. Five (25%) of the dogs with HD were between ages 3-5 years, while 8 (40%) were between 1-2 years. There was no significant ($p > 0.05$) association between the ages of the dogs and distribution of HD. The age distribution of ED in the Boerboel dogs is shown in Table 7. One (5%) of the dogs with ED was 3 years, while 4

Table 3: Hip and Elbow grading in apparently healthy Boerboel dogs

Patient Identification	Age	Sex	Radiographic Grading L/R Hip	L/R Elbow
1	5	F	D_1/D_2	0/0
2	4	F	C_2/B_1	0/0
3	2	M	D_2/D_2	0/0
4	2	F	C_1/C_2	1/2
5	2	M	D_2/D_2	0/0
6	2	M	D_2/D_2	1/0
7	3	F	D_2/D_1	0/0
8	2	F	B_1/B_1	0/0
9	3	F	C_1/C_1	0/0
10	2	F	A_2/A_2	0/0
11	2	M	A_1/A_2	1/0
12	2	M	B_1/C_1	0/0
13	3	M	A_1/A_1	2/1
14	3	F	D_2/D_2	0/0
15	2	F	A_2/B_2	0/0
16	2	F	A_1/B_1	1/2
17	2	F	E_2/E_1	0/0
18	2	M	D_1/D_2	0/0
19	2	M	A_1/B_1	0/0
20	2	F	C_2/C_2	0/0

L: Left R: Right F: Female M: Male

(20%) of the dogs with ED were between ages 1-2 years. There was no significant ($p > 0.05$) association between age and distribution of ED.

The sex distribution for concurrent occurrence of HD and ED in Boerboel dogs is shown in Table 8. One (5%) male had both HD and ED. Similarly, one (5%) female of the Boerboel dogs had both HD and ED. There was no significance ($p > 0.05$) between the sex and concurrent HD and ED.

Table 4: Sex distribution of hip dysplasia in apparently healthy Boerboel dogs

Sex	Hip quality		
	Normal	Dysplastic	Percentage dysplastic
Male	3	5	25%
Female	4	8	40%
Total	7	13	65%

P value = 0.608

Table 5: Sex distribution of elbow dysplasia in apparently healthy Boerboel dogs

Sex	Elbow quality		
	Normal	Dysplastic	Percentage Dysplastic
Male	6	2	10%
Female	9	3	15%
Total	15	5	25%

P value = 0.704

Table 6: Age distribution of hip dysplasia in apparently healthy Boerboel dogs

Age	Hip quality		
	Normal	Dysplastic	Percentage dysplastic
1 - 2	6	8	40%
3 - 5	l	5	25%
Total	7	13	65%

P value= 0.277

Table 7: Age distribution of elbow dysplasia in apparently healthy Boerboel dogs

Age	Elbow quality		
	Normal	Dysplastic	Percentage dysplastic
1 - 2	10	4	20%
3 - 5	5	1	5%
Total	15	5	25%

P ≡ 0.547

Table 8: Sex distribution of concurrent HD and ED in apparently healthy Boerboel dogs

Sex	HD alone	ED alone	HD and ED	Percentage HD and ED
Male	4	1	1	5%
Female	7	2	1	5%
Total	11	3	2	10%

Discussion

The results of this study showed that six (30%) of the Boerboel dogs had severe HD (grades D & E), while seven (35%) had moderate HD (grade C). On the other hand, only 25 percent of the Boerboel dogs had elbow dysplasia, suggesting that the prevalence of hip dysplasia in the Boerboel dogs is greater than that of elbow dysplasia. In addition, there was no significant association between age, sex, and prevalence of both HD and ED. Qualitative screening of dogs for hip dysplasia is based on descriptions of radiological features (Fluckiger, 2007).

Screening methods include Orthopaedic Foundation for Animals (OFA), Federation Cynologique International (FCI), and the British Veterinary Association/Kennel club (BVA/KC) (Hedhammar & Indrebo, 2011). These methods assess the degree of laxity of a ventrodorsally-viewed, symmetrically-positioned pelvis with inward rotation and caudal, parallel extension of the femora. The FCI grading scheme was used in our study to allow registration of the dogs under the Kennel Union of South Africa. The results of hip grading showed that 35 % of the Boerboel dogs had hip grades A or B, while 65 percent of the dogs had hip grades between C and E. The grades were similar laterally for both hips in 50 percent of the dogs and dissimilar in the other 50%.

Screening programmes for grading severity of ED have been established to limit breeding severely affected dogs. Many screening programmes have involved certain breeds of dogs or organisations such as Bernese mountain dogs in Switzerland (Cachon *et al.,* 2010), Bernese mountain dogs and Rottweilers in Scandinavia, and Rottweilers in Australia. These grading systems do not predict the degree of clinically-evident lameness, because pain perception is highly individual.

We used the International Working Elbow Group (IEWG) grading scheme. IEWG is a group that includes veterinary clinicians, veterinary radiologists, geneticists, and dog breeders. IEWG was established in 1989 to reduce incidence and prevalence of ED, and to promote a greater worldwide understanding of elbow dysplasia (Kirberger & Fourie, 1998). The Federation Cynologue International adopted the

IEWG grading scheme as the grading method for elbow dysplasia in dogs.

In our study, fifteen (75%) of the Boerboel dogs were scored grade 0 for ED, while two (10%) were scored grade 1, and three (15%) were scored grade 2. The number of dogs scored grade 1 (10%) in our study was small, compared to (40.6%) reported for Rottweilers in another study (Beuing *et al.,* 2000). However, 2 (15%) Boerboel dogs were scored grade 2 in our study, compared to a similar 13.6% in the study of Rottweilers (Beuing *et al.,* 2000).

The prevalence of HD varies among breeds and and from one country to another. In a study of CHD in the USA, the overall prevalence of hip dysplasia among all breeds was 15.56 %, with expected breed-associated variation (Loder & Todhunter, 2017). In another study of HD in South Africa, Rottweilers and Labrador retrievers were estimated at 22% and 31% HD prevalence, respectively (Kirberger, 2017). Apart from the OFA record that estimated the HD prevalence in Boerboel dogs as 47% (OFA, 2017), there are no similar studies of HD in Boerboel dogs. In our preliminary investigation, prevalence of HD in Boerboel dogs was 65%, high compared to reports for Labrador retriever and Rottweilers (Kirberger, 2017), but similar to Cane Corso dogs (59.7%) in France (Genevois *et al.,* 2008) and Doberman Pinschers (70.6%) in Turkey (Loder & Todhunter, 2017).

Elbow dysplasia has estimated prevalence of 17% among UK Labrador retrievers, and 70% among Netherlands Bernese mountain dogs (Michelsen, 2013). The prevalence of ED in Estrela Mountain dogs was estimated as 16.5% (Alves-Pimenta *et al.,* 2013). In South Africa, the prevalence of ED for Labrador retrievers and Rottweilers was estimated at 19% and 39%, respectively (Kirberger, 2017). In our study, ED prevalence was (25%), similar to Labrador retrievers and Estrela Mountain dogs, but lower than Rottweilers and Bernese Mountain dogs (Alves-Pimenta *et al.,* 2013; Kirberger & Stander, 2007).

We found no sex-related prevalence for HD or ED among the Boerboel dogs, thus comparing favorably with studies involving different breeds and geographic areas. In the UK, no sex differences were noted for HD in various breeds studied (Kronveit *et al.,* 2010). In a South African study, no significant sex-related difference was found for HD among Rottweilers and Labrador retrievers, although females trended toward slightly higher overall prevalence (Kirberger*,* 2017). However, other studies have reported opposite outcomes for some breeds. A study from Sweden noted that HD was 1.14 times more common in female German shepherd dogs, compared to males (Hedhammar *et al.,* 1979). In the United States, sex differences were noted for HD prevalence among Golden Retrievers with a prevalence of 5.1% in intact males and 39% in intact females (Torres de la Riva *et al.,* 2013). In a South African study of ED, male Rottweilers had a higher ED prevalence than the female but there was no significant difference in ED prevalence in Labrador retrievers. Similarly, Rottweiler males had significantly higher ED numerical scores than females (Kirberger*,* 2017). Thus, sex prevalences may differ in some breeds or breed populations, but not in others.

We noted that the mean age of the Boerboel dogs at the time of radiography was 2.4 ± 0.4 years. This is a bit higher than the 16 months reported for dogs from a study in France (Cachon *et al.,* 2010) but agrees with that reported for Rottweiler (22 months) and Labrador (18months) from a study in South Africa (Kirberger*,* 2017). Also the age range of the Boerboel dogs (2 – 5 years) at radiography was similar to that reported from a study of HD prevalence from USA (Loder & Todhunter, 2017). In this study, there was no significant difference in the incidence of HD between the age groups (1-2 years vs. 3-5 years). This is in agreement with a previous study of HD prevalence in dogs from USA (Loder & Todhunter, 2017).

Hip and elbow dysplasia are among the most common orthopaedic diseases that are associated with osteoarthritis in medium- and large-breed of dogs. Both appear to be inherited quantitatively (Cachon *et al.,* 2010). A major gene role recently has been proposed for HD in some breeds of dogs, while other genes have been proposed for ED development in dogs (Alves-Pimenta *et al.,* 2013). Although HD and ED can be present simultaneously, reports on their clinical correlation are few. In this study, only two (10%) of the Boerboel dogs had concurrent HD and ED.

Finally, our study has several limitations. The study population included only 20 dogs between ages 2 and 5 years. Increasing the number of dogs could have provided greater statistical power. Another limitation is that the dogs were sourced from different breeders that may have introduced varying environmental influences such as different feeding and exercise schedules, and inconsistent breeding selection practices. These might have influenced the HD and ED status of the dog. Another limitation is that only the flexed lateral radiographic view was used to grade ED, according to FCI recommendation.

This view can underestimate the prevalence of ED, particularly fragmented medial coronoid process, if the elbows were maximally flexed (Kirberger, 2017). Lastly, some dogs may have primary ED without detectable arthrosis. Our study could have overlooked these dogs, since we used only the flexed lateral radiographic projection.

In conclusion, HD prevalence among Boerboel dogs (65%) appears to be high, compared to Rottweilers and Labrador retrievers, but low compared to Bernese Mountain dogs. However, we found that ED prevalence among Boerboel dogs (25%) aligns with prevalence recorded for Rottweilers and Labrador retrievers. Although prevalence of HD and ED can be sex-associated in some breeds of dogs, sex did not influence HD and ED in Boerboel dogs, based on our approach and study population size.

Our preliminary study underscores a need for more widespread radiographic screening for HD and ED, as an important component of the breeding selection process among all large and medium size breeds of dogs in Nigeria. In addition, programs should be implemented to begin a collaborative approach to reduce the prevalence of HD and ED, since there are several large and medium size dogs imported and bred in Nigeria.

Conflicts of Interest

The authors declare no conflicts of interest.

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