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# Journal of Veterinary Medicine and Animal Health

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*Full Length Research Paper*

# **Prevalence of gastrointestinal helminth parasites and identification of major nematodes of cattle in and around Bishoftu, Oromia Region, Ethiopia**

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Although, many studies have been conducted to estimate the prevalence of gastrointestinal tract (GIT) helminths of cattle in Ethiopia, most of them were conducted using simple fecal egg examination rather than larval identification to identify the nematodes. A cross sectional study was conducted from November 2016 to April 2017 with the aim of estimating the prevalence of GIT helminths and identifying nematode genera in cattle in and around Bishoftu, Ethiopia. Of the 300 cattle examined using standard parasitological methods, 42.33% were positive for GIT helminth egg presence. The prevalence rates of GIT helminth based on the age and sex of the cattle were 37.6, 43.9, 60 and 27.9%, in young, adult, male and female animals, respectively. Strongyle type eggs were the most prevalent among the helminthes investigated. The pooled larval culture showed that *Haemonchus*, *Oesophagostomum* and *Trichostrongylus* were the most common nematodes found, with *Haemonchus* being present in 27.8% of cases, followed by *Trichostrongylus* (18%) and *Oesophagostomum* (4.48%). Mixed infection of GIT nematodes (44.4%) is higher than single (mono) infection. Thus, it could be concluded that GIT helminths of cattle cause serious problems in livestock production in the area.

**Key words:** Control, fecal culture, nematode, mixed infection, season.

## **INTRODUCTION**

Ethiopia possesses about 53.99 million heads of cattle (CSA, 2013). Despite the large cattle population, productivity in Ethiopia is low due to poor nutrition, reproduction inefficiency, management constraints and animal diseases (Alsan, 2012). Helminth parasite infections in cattle's are a primary factor in the reduction of livestock production and productivity (Wadhawa et al., 2011). Helminthosis, in large part, is caused by

nematodes, cestodes and trematodes in domestic animals. Helminthosis lead to a reduction in fertility, work capacity, involuntary culling (Rafiullah et al., 2011), reduction in food intake, weight and milk production, and higher mortality rate (Getachew et al., 2012).

Gastrointestinal nematodes are cosmopolitan parasites that develop within the digestive tract of domestic ruminants. The gastrointestinal tract (GIT) of cattle

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harbors a variety of parasites, particularly helminthes, which causes clinical and subclinical parasitism. These parasites adversely affect the health status of animals and cause enormous economic losses to the livestock industry (Rafiullah et al., 2011; Singla et al., 2014). The effect of infection by gastrointestinal parasites varies according to the parasite concerned, the degree of infestation and other risk factors such as species, age, season and intensity of worm burden (Perry et al., 2002; Singh et al., 2014).

Analysis of nematodes based on fecal examinations beyond the clinical sign, and the presence of worm eggs or larvae is the most common routine aid to diagnosis. The egg and larvae of nematodes are most often diagnosed via fecal floatation and fecal culture (Hendrix, 1998; Gupta and Singla, 2012). Because of the large differences of the common worms' genera parasites, it is necessary at least to identify the nematodes genera in order to evaluate the significance of the parasitological infestation or the anthelmintic treatment effectiveness (Lancaster and Hong, 1987). The only practical method, available to the helminthologists to obtain ante-mortem indexes for the parasites genera that are found in ruminants infestation, is larvae identification that are found in fresh faeces or in those developed on the culture faeces. The infective larvae (L3) of the common parasites genera are, generally easier to identify than their eggs (Van Wyk, 2004).

In Ethiopia several studies have been conducted to determine prevalence of GIT helminthes in different agro-ecology of the country. A prevalence of 27.57% GIT nematodes of cattle were reported in Gondar (Tigist et al., 2012), 50.08% gastrointestinal helminths in Tulu district, West Harergae Zone (Tulu and Lelisa, 2016), 41.15% GIT nematodes in Diredawa (Yimer et al., 2015) and 61% GIT helminthosis in the East Showa Zone (Telila et al., 2014). Although, many studies (Tigist et al., 2012; Telila et al., 2014; Yimer et al., 2015; Tulu and Lelisa, 2016) have been conducted to estimate the prevalence of GIT helminths of cattle in Ethiopia, most were concerned with determining the prevalence of the GIT helminths in cattle by using simple fecal egg examination rather than larval identification to identify the nematodes. In identification of parasitic nematode infections of ruminants by egg morphology, faecal worm egg counts is relatively inaccurate method as compared to larva identification, as no indication can be obtained for the identities of most of the common worm genera, except for those genera with morphologically distinct ova, for example, *Strongyloides papillosus*, *Nematodirus* spp. and *Trichuris* spp. Thus, the aim of the present study was to estimate the overall prevalence of GIT helminths, and identify major nematode parasites of cattle at genera level in and around Bishoftu, Ethiopia. This study has paramount importance in evaluating the significance of a specific parasitological infestation and designing appropriate prevention and control strategies against identified

nematodes in the area.

## MATERIALS AND METHODS

### Study area

The study was conducted in and around the town of Bishoftu. The town is located at 9°N latitude and 40°E longitudes at an altitude of 1850 m above sea level, and situated in central highlands of Ethiopia. Bishoftu has an annual rainfall of 866 mm of which 84% falls in the rainy season (June to September). The rainfall is bimodal. The mean annual maximum and minimum temperature ranges are 26 and 14°C, respectively (CSA, 2012).

### Study animals

The study animals were 300 cattle of three breeds (local, cross and exotic breeds), both sexes (139 male and 161 female), managed under intensive, semi-intensive and extensive production systems. Body condition score was according to Nicolson and Butterworth (1986) and recorded as poor, medium or good. The age of the animal was estimated by looking at the dentition pattern of the animals according to Frandson (1992) and also by owners' response. Based on this, study animals were classified as young (1 to 3 years) and Adult (> 3 years).

### Sampling method and sample size

Simple random sampling technique was employed to select the study animals. The total number of cattle required for the study was calculated using the formula given by Thrusfield (2005) with 5% acceptable error and 95% confidence level. Accordingly, by taking previous study prevalence of (82.8%) cattle GIT parasites around Holleta by Estehiwot (2004), the total number of cattle calculated for the study was 228. However, to increase precision, a total of 300 cattle were sampled for this study.

$$N = [1.962 P_{exp} (1 - P_{exp})] / d^2$$

Where, N = sample size;  $P_{exp}$  = expected prevalence; D = desired absolute precision.

### Study design

A cross sectional study was carried out from November 2016 to April 2017 to collect data on events associated with gastrointestinal helminth of cattle and identify nematode parasites. The study animals in each selected kebele and peasant association are categorized into two age groups, that is, young (1-3 years) and adult (above 3 years). A simple random selection was employed to select cattle reared under different management conditions.

### Data collection

Fecal samples were directly collected per rectum. Each fecal sample was put in plastic containers with lids and labeled with animal identification record including age, sex and body condition (thin, moderate and good). Then, transported using ice box, to Addis Ababa University Veterinary Parasitology Laboratory at Bishoftu, and immediately examined or stored in refrigerator at 4°C for later examinations.

**Table 1.** Prevalence of gastrointestinal helminths in cattle.

Types of helminth eggs encountered	Number examined	Positive samples	Prevalence (%)
Strongyle	300	72	24
<i>Toxocara</i> spp.	300	14	4.7
<i>Monezia</i> spp.	300	8	2.6
<i>Fasciola</i> spp.	300	19	6.3
<i>Paraphistomum</i> spp.	300	14	4.7

### Fecal examination

The collected fecal samples were processed and examined by the standard flotation using saturated sodium chloride and sedimentation technique for qualitative investigation of the types of gastro-intestinal helminth eggs (Charles, 2006). Eggs of the different helminths were identified on the basis of morphological appearance and size of eggs according to the literature (Foreit, 1999).

### Fecal culture and L3 identification

Fecal samples from nematode eggs positive animals, were pooled and cultured for harvesting of third stage larvae and identification of genera of nematode eggs. Pooled fecal samples were then finely broken using stirring device, kept moist and brittle; the mixtures were transferred to Petri dishes and placed at 27°C in an incubator for 7 to 10 days. The culture was kept moist by adding water every 2 days. During this period, the larvae was hatched from the eggs and developed into L3. Finally, larvae were recovered using the modified Baermann technique (Hansen and Perry, 1994). The presence of larvae was assessed by using a stereomicroscope, when present; two drops of larval suspension were mixed with drop of lugols iodine on glass slide, and examined at low magnification power for identification. From each culture, the third-stage larvae (L3) was morphologically differentiated and identified according to Van Wyk (2004). Conventional characteristics for identification (total length, esophagus length, tail sheath length and the number of intestinal cells) of infective larvae from gastrointestinal nematode genera/species were microscopically examined.

### Data management and analysis

The raw data obtained from each animal were coded, entered and filtered into Microsoft Office Excel spread sheet and analyzed using STATA software version 17 (Stata Corp, Texas, USA). The prevalence of each parasite infection was calculated as the number of animals diagnosed positive for a given parasite divided by the total number of animals examined at the particular time (Thrusfield, 2005). Chi-square statistics ( $\chi^2$ ) was used to determine the association of the variables (sex, age, breed, body condition and management) with the prevalence of GIT parasitism. The P-value less than 0.05 were taken as statistically significant and greater than 0.05 was taken as statistically insignificant at 95% confidence interval.

## RESULTS

Of the 300 cattle examined, 42.33% were positive for gastrointestinal helminth egg presence. Eggs from five

genera, including two nematodes (Strongyle and *Toxocara*); two trematodes (*Paramphistomum* and *Fasciola*) and one cestode (*Monezia*) were identified. The prevalence of all identified parasitic helminth eggs (Table 1) showed that Strongyle-type eggs had the highest (24.00%) prevalence and *Monezia* species was the least (2.6%).

It was observed that the prevalence of gastrointestinal helminths had statistically significant difference association in relation to sex, breed, body condition and management system ( $P < 0.05$ ). However, it is also shown that there were no statistical association among the age groups ( $P > 0.05$ ) as indicated in Table 2.

Morphological identification of L3 of most parasitic nematodes was based principally on examination of the caudal and cranial extremities, size of the larvae, presence or absence of filament, presence or absence of sheath, and also differentiation by staining property by lugoliodine (Hansen and Perry, 1994). Based on these morphological characteristics, four nematode larvae belonging to genera *Trichostrongylus*, *Haemonchus*, *Oesophagostomum* and *Bunostomum* were recovered and identified as show in Figures 1 to 4.

The pooled larval cultures showed that *Haemonchus*, *Trichostrongylus* and *Oesophagostomum* were the most common gastrointestinal nematodes found in the animals. Table 3 indicates that *Haemonchus*, *Trichostrongylus* and *Oesophagostomum* were the dominant genera among the cultivated larvae having 20 (27.8%), 13 (18%) and 9 (12.5 %), respectively. Mixed infection (poly infection) was more prevalent (32; 44.4%) than single infection (mono-infection).

Mixed infection between different nematodes species was also observed and described as high prevalence of the *Haemonchus*, together with *Oesophagostomum* (6.98%) and *Trichostrongylus* (4.65%), and less prevalence of the *Oesophagostomum* together with *Bunostomum* (1.55%) as shown in Table 4.

## DISCUSSION

### Overall prevalence rate

The present study shows that 42.3% (127/300) of the cattle screened had a GIT helminth infection, indicating



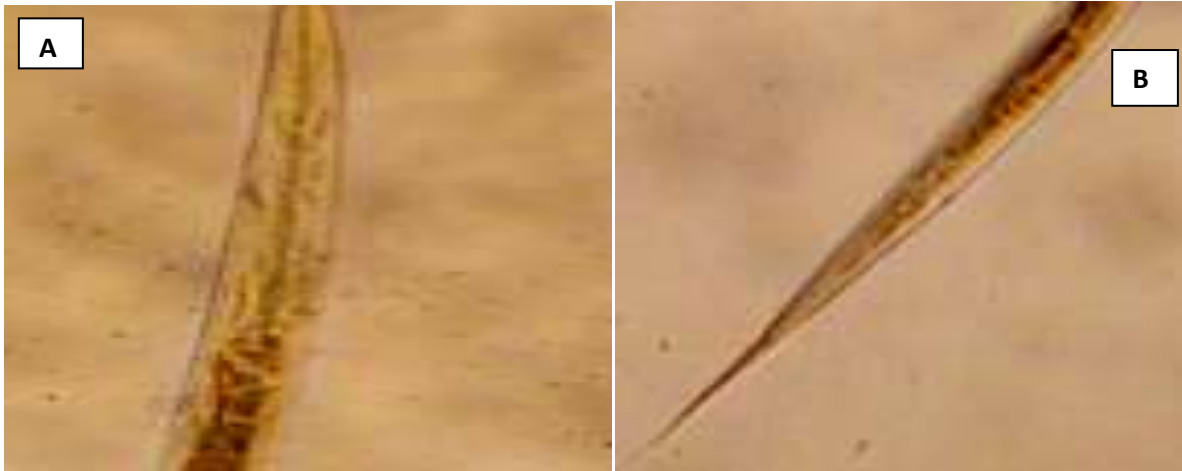
**Table 2.** Prevalence of gastrointestinal helminths in cattle and their variation among/between the categories of the considered risk factors.

Variables	Number of examined	Number of positive	Proportion (%)	X <sup>2</sup>	P value
<b>Sex</b>					
Male	139	82	60	29.5	0.0203
Female	161	45	27.9		
<b>Age</b>					
Young	77	29	37.6	0.93	0.336
Adult	223	98	43.9		
<b>Breed</b>					
Local	163	84	51.5	12.99	0.002
Cross	102	34	33.3		
Exotic	35	9	25.7		
<b>Body condition</b>					
Good	65	31	47.7	14.54	0.001
Medium	157	51	32.5		
Poor	78	45	57.7		
<b>Management</b>					
Intensive	68	12	17.6	28.54	0.0001
Semi- intensive	79	30	37.9		
Extensive	153	85	55.5		

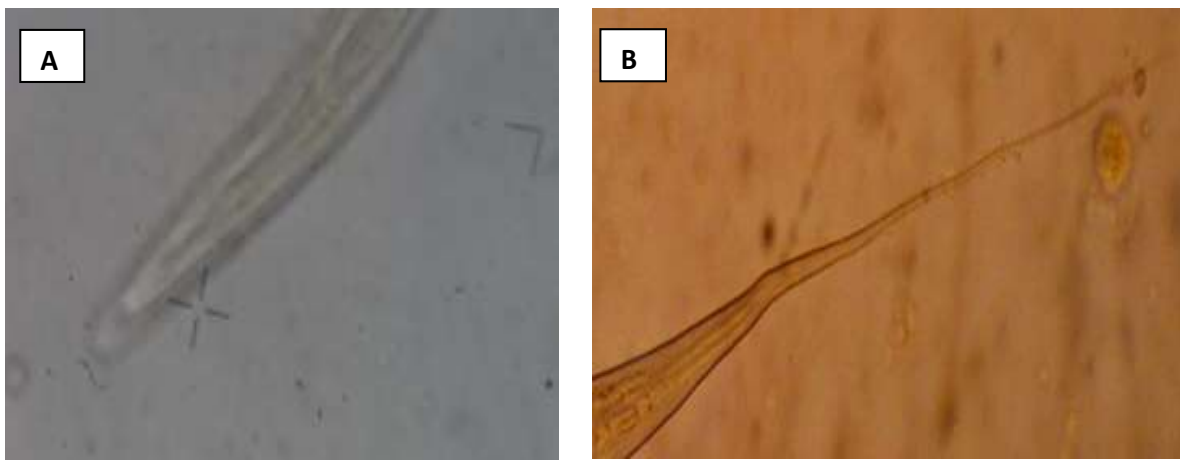
**Figure 1.** *Trichostrongylus* spp. third stage larva (L3); (A) Rounded head cranially, pale esophagus and (B) tail part is not uniformly stained by the iodine, it tapers so sharply and resembles the point of a sharpened wooden pencil, no filament caudally.

the high burden of GIT helminths among cattle in and around Bishoftu. This prevalence is comparable to that of Yimer et al. (2015) who reported 41.5% prevalence in Direedawa but lower than 50.08 and 61% in the East Showa Zone and Tulu district, West Harergae Zone

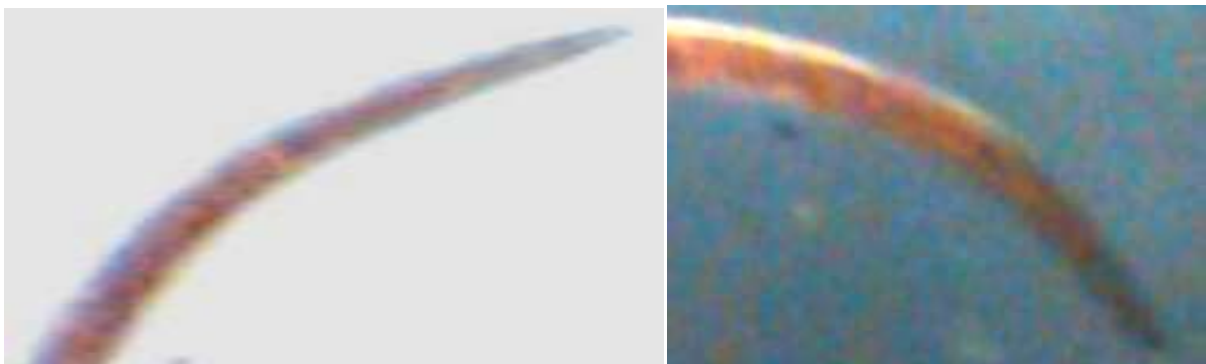
reported by Telila et al. (2014) and Tulu and Lelisa (2016), respectively. The differences observed could be due to the variation in the periods or seasons in which the studies were conducted, climate and husbandry of the animals.



**Figure 2.** *Haemonchus* spp. third stage larva (L3); under 10x objective lens (top); (A) Shows cranial appearance of *Haemonchus* species, the head is bullet shaped, after staining with iodine it has pale esophagus and (B) tail part and short filament caudally.



**Figure 3.** *Oesophagostomum* spp. third stage larva (L3); (A) cranial part of the head is square in shape (broad cranial end) after staining with iodine, it has pale esophagus and (B) caudal end with long filament



**Figure 4.** *Bunostomum* spp. third stage larva (L3); cranial end with single caudal bulb, and the head part is bullet shaped after staining with iodine, the larvae is uniformly stained, and it is the shortest one. Caudally, it has medium filament.

**Table 3.** Prevalence and identification of specific genera using fecal culture.

Identified larvae	Number of positive	Prevalence (%)
<b>Single infection</b>		
<i>Haemonchus</i>	20	27.8
<i>Trichostrongylus</i>	13	18
<i>Oesophagostomum</i>	9	12.5
<i>Bunostomum</i>	7	9.7
<b>Mixed infection</b>	32	44.4

**Table 4.** Mixed infection in different nematode identified (%).

Nematode	<i>Trichostrongylus</i>	<i>Oesophagostomum</i>	<i>Bunostomum</i>
<i>Haemonchus</i>	6 (4.65)	9 (6.98)	3 (2.32)
<i>Trichostrongylus</i>	0	4 (12.5)	4 (12.5)
<i>Strongyloides</i>	3 (2.32)	0	0
<i>Oesophagostomum</i>	0	0	2 (1.55)

The current study overall prevalence of 28.6% for gastrointestinal nematode parasites in cattle is comparable to Birhanu (2011) in Gondar who reported 33.3%. It was observed that nematode infections were particularly high, as they accounted for 28.6% of the helminth burden. High nematode infection has a significant impact on livestock production since they result in reduced milk, meat, wool, hide products and stamina of working animals (Ekong et al., 2012), hence resulting in the reduction of production potentials such as decreased growth rate, weight loss in young growing calves, and late maturity of the animals (Swai et al., 2006).

The present finding disagree with the report of Epherem (2007) and Addisu and Berihu (2014) who reported 41.2% for Western Amhara Region and 49% for the West Arsi zone, respectively. These high prevalence values could be due to topography, season and climate that could favor the survival of parasitic stage, due to difference in management system of the study animals and breeds of these animals. Unlike the present study done on cattle of different breeds and from three management systems, those studies were conducted on cattle managed under extensive management, which could increase the degree of pasture contamination, leading to higher prevalence rates. In contrast to the present finding, Yehuelaeshet (2005) reported a lower prevalence value (11%) for Bahirdar. This difference in prevalence might be due to the differences in deworming practice, study design and ecology, season and husbandry system among the different studies (Singla, 1995).

### Prevalence per helminth type

The highest prevalence of helminths was in the strongyle

type, while other helminths parasites like cestodes were found to be the least prevalent. The result of the present study agrees with that of Telila et al. (2014) who reported a 41% prevalence of the strongyle type in East Showa zone, Central Ethiopia. In addition, this finding also agrees with Tulu and Lelisa (2016) who reported a 36.23% prevalence of the strongyle type egg in Tulo District, West Hararghe Zone. However, it disagrees with Etsehiwot (2004) and Derib (2005) who reported that trematodes are more prevalent than strongyle species. The high prevalence of strongyles may be due to the suitability of the climatic condition of Bishoftu for survival and transmission of these parasites.

The overall prevalence for trematode infection in this study is 11%. This finding is lower than the 60.42% reported for Andassa by Yenenehet al. (2012), 34.5% in Bahir Dar and its surroundings (Derib, 2005) and 52.53% for Jimma (Abebe et al., 2011). This variation could be associated with differences in geographical and/or climatic conditions and ecology since the presence of trematode infections is dependent on availability of the intermediate hosts. The only cestode observed in the cattle in the present study was *Moniezia* (2.6%) and the occurrence of parasite is very low as compared to other gastrointestinal parasites. This might be due to the fact that the climatic condition is not suitable for survival of the intermediate host (oribatid mite) and transmission of the parasite.

### Infection rate among sexes

Statistically significant difference exists in the infection rate of gastro-intestinal helminth infection among sexes, with a higher prevalence rate in males (60%) than in females (27.9%). This is in agreement with Wondimu

(2009), Birhanu (2011) and Tulu and Lelisa (2016) who found prevalence rates in males (45.86%) to be greater than that in females (41.4%). This might be due to males being more exposed to grazing areas than females. In the study area, females are used for milking purposes; as such, the owners do not allow them to graze on pastureland. However, this is in disagreement with previous study report that stated statistically non-significant difference among male and female cattle ( $P>0.05$ ) (Tigist et al., 2012). In this study, a statistically significant difference was observed in GIT helminth infection in relation to body condition where a higher prevalence was recorded in poor body condition (57.7%) than good (47.7%) and medium body conditions (32.7%). This finding agrees with Tigist et al. (2012) but contradicts the findings of Regassa et al. (2006) who reported that body condition of the animal did not show significant association with prevalence of the parasite. This could be explained by the fact that loss of body condition in the study animals could be due to other factors, such as seasonal change of forageable feedstuff and the presence of other concurrent disease conditions.

### Helminth infection and management system

The result of the present study showed significantly higher GIT helminth infection rate in extensively managed cattle (55.5%) than semi intensive (37.9%) and intensive (17.6%) managed cattle. This finding agrees with the reports of Keyyu et al. (2006) and Kabaka et al. (2013). This might be due to the fact that extensively managed cattle have more access to contaminated pasture.

### Single and mixed infection

The pooled larval culture showed that *Haemonchus*, *Oesophagostomum* and *Trichostrongylus* were the most prevalent nematodes, with *Haemonchus* being present in 27.8% followed by *Trichostrongylus* (18%) and *Oesophagostomum* (12.5%). The detection of *Haemonchus* species as the commonest infection in this study may suggest that these worms are seriously affecting the cattle in the study area. Similar report by Waruiru et al. (1998) indicated *Haemonchus* as the most prevalent species of gastrointestinal nematode in Kiambu District, Kenya. The overall prevalence of mixed infection (poly infection) was 32% which is characterized by two or more genera. The highest prevalence in this mixed infection with different genus is seen in *Haemonchus* with *Oesophagostomum* (6.98%).

### Conclusion

The overall prevalence of gastrointestinal helminths

parasite in the current study indicates that gastrointestinal helminthosis is an important health problem due to its high prevalence (42.3%) and occurrence of mixed infection. The phenomenon of mixed infection has been suggested to be an important cause of morbidity and reduced production in livestock. Furthermore, the immunosuppression of the host immune system by mixed infections increases host susceptibility to other diseases or parasites. Thus, it can be concluded that GIT helminths of cattle cause serious problems in livestock production in and around Bishoftu. Therefore, more studies on seasonal transmission pattern of all these parasites are required in order to design rational, economic and locally sustainable parasite control programs. Further studies that will help in taking obligatory preventive and control measures against parasitism as well as maximize the production, are suggested.

### CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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*Full Length Research Paper*

# **Dog breeds acquisition and owners' awareness of associated surgical conditions in Nigeria**

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The study evaluated dog owners' awareness of breed-associated surgical conditions in Nigeria as indices for breed choice with structured pre-tested questionnaires administered to dog owners in 17 states of Nigeria. Alsatians (36.8%) and Rottweiler (13%) breeds were mostly possessed by owners. The majority of the respondents were females (60.4%) owners. Lagos (53.4%) and Oyo (52.1%) states had the highest number of respondents while Kaduna (1.25%), Enugu (1.25%), Ekiti (1.25%), and Plateau (1.25%) states had the lowest. Most of the respondents (84.8%) are within the age bracket of 16 to 30 years, while 46.6% were University graduates and 90.8% had kept dogs previously. Factors that influenced dogs' breed choices included: body size (66.6%), coat colour (78.6%), natural intelligence (96.4%), information on the internet about the breed (54.6%), breed type possession by a close relative (53.4%), information regarding animal care from the Veterinarian (39.2%), and recommendation by friends (42.6%). Respondents routinely visited the veterinary health centre for a general check-up and disease prevention (79.6%), vaccination and routine worming (79.2%), and treatment of diseases (79.8%). Respondents had varying knowledge of common surgical diseases: cruciate ligament rupture (13.6%), gastric dilation/volvulus (13.6%), portosystemic shunt (15.0%), entropion (17.7%), ectropion (17.7%), osteochondrosis dessicans (17.7%), tracheal collapse (17.7%) etc. Only 10.9% of the respondents were aware of persistent health challenges in their dogs, while 84.4% of the respondents were uninformed of their dog breed predisposition to certain health challenges, and 82.3% of respondents were not aware of their dogs' predisposition to any surgical disease. These findings imply a need for veterinarians' input in dog choices, for recommendation of legislation mandating potential owners to seek out information about health care conditions of prospective dog breeds from authorized sources before possession to forestall frustrations, and avoidance of ultimate pet abandonment associated with management cost and social adjustment following surgical diseases.

**Key words:** Breed, clients, predisposition, surgical diseases.

## **INTRODUCTION**

Surgical diseases are challenging animal health conditions that require surgical therapy for their

amelioration. They affect different body systems and are predominant in certain dog breeds. They include eye,

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conditions such as: cataract, central progressive retinal atrophy, corneal dystrophy, distichiasis, ectropion entropion and retinal dysplasia that are common in Labrador retrievers, Boxers, German shepherd and Golden retriever (Gough and Thomas, 2004). Ear conditions such as chronic otitis externa, otitis media, and internal auricular hematoma, are common in Cocker Spaniel, Boerboel, Caucasian, and other breeds with pendulous ears, and those with excessive oil and sweat glands that predispose them to blocked or infected ear canal (Tidholm and Johnson, 1997).

Cardiac conditions such as: mitral dysplasia, ventricular ectopy and tricuspid dysplasia are common in Bull terrier, German shepherd dog, Golden retriever, Great Dane, Labrador retriever and Old English sheepdog (Gough and Thomas, 2004). Gastrointestinal conditions, such as: oropharyngeal dysplasia, gastric dilatation/volvulus, perianal fistula are common in Great Dane, Doberman, Irish setter, Labrador retriever and Irish wolfhound (Gough and Thomas, 2004; Zeltzman, 2015). Musculoskeletal conditions, such as: elbow dysplasia, hip dysplasia, and bone cyst are common in Bullmastiff, English setter, and Labrador retriever, to mention a few.

Most of these surgical diseases are preventable if pet owners are adequately informed and necessary precautionary measures are taken for prevention. Dog possession in different climes is influenced by many dog breeds' attractive qualities such as; coat colors, coat type, facial, body and tail conformations, size, behaviour, temperament, cuteness and resilience (Waller et al., 2013; Brown et al., 2013; Pederson et al., 2016; Teng et al., 2016). Puppies are typically readily acquired compared to adult dogs (Brown et al., 2013).

Dog breeds of moderate cost are also more readily acquired than the more expensive ones (McMillan et al., 2013; Pirrone et al., 2016). A search for 'ideal dogs' in some climes has advanced some dog choice criteria. In Australia, medium size (10 to 20 kg), neutered, short/straight haired puppy, that requires 16 to 30 min exercise per day and between 1 and 15 min grooming per week, safe with children, easily house-trained, obedient, friendly and affectionate, do not escape from home facility, and are not destructive when left alone, and with expected lifespan of at least 10 years are preferred (King et al., 2009).

A similar study in Italy found a much lower preference for neutered than intact dogs (Diverio et al., 2016). A surge in influx of exotic dog breeds from South Africa and some western countries for companionship and security purposes has been observed in Nigeria and some West African countries (Eyarefe and Dei, 2014; Eyarefe et al., 2015). The socio-economic cost of morbidity and mortality through surgical diseases, could be avoided or curtailed if adequate information were provided about breed-associated medical conditions for owners' awareness and possible prevention. This study therefore sets to investigate Nigerian dog owners' awareness of breed associated surgical conditions, and possible efforts

made at prevention, as there is a paucity of studies on pet owners' knowledge of breed-associated surgical diseases in Nigeria. This could provide the basis for dog owners' education on breed-associated surgical disease for rational decision making on dog possession.

## MATERIALS AND METHODS

### Survey instruments design

A structured, pre-tested questionnaire with a reliability coefficient of 0.98 was administered to pet owners to evaluate their awareness of breed-associated surgical conditions in Nigeria. The instrument consisted of two parts. Part A (two sections) included pet's and pet owner's demography. Part B (seven sections) included: assessment of dog owner's previous experience with dog keeping; of factors that influenced dog owner's choice of dog breed, of dog owner's purpose on dog possession; of how conversant dog owners are with dog breeds; assessment of dog owner's reasons for seeing the veterinarian; assessment of pet owners rating of pet's health status; and assessment of dog owner's knowledge of breed-associated surgical conditions. The Likert scale was adopted as respondents' indicators for the study.

### Instrument administration

Hard copies and online copies of questionnaires were made available to dog owners. Incompletely filled questionnaires were excluded from analysis. Respondents were able to communicate in English language.

### Data analysis

Data generated were coded and entered into Microsoft Excel for windows 2010 version and exported into a statistical package for the Social Sciences: (SPSS®) version 17, for further analysis. Data generated within each category were presented in percentages and standard error of means.

## RESULTS

### Pet demography

Of over 1062 dogs recorded, the Alsatian breed (390.36.7%) was mostly possessed by dog owners surveyed, closely followed by Rottweiler (141.13.0%), Boerboel (78.7.3%), Mongrel (56.5.2%), and Lhasa Apso (56.5.2%), Samoyed (51.5.0%), Bull Dog (41.3.7%), Caucasian (33.3.1%), Doberman (12.1.1%), Chowchow and Pitt Bull each having 6 (0.7%), Beagle, Neopolitan Mastiff, and Bull Mastiff each having 5 (0.5 %), Retriever having 4 (0.4%), other unlisted exotic breeds added up to 173 (16.2%) (Figure 1 and 2).

### Pet owners' demography

The majority of the respondents were females 302 (60.4%), and the rest males were 198 (39.6%). Lagos

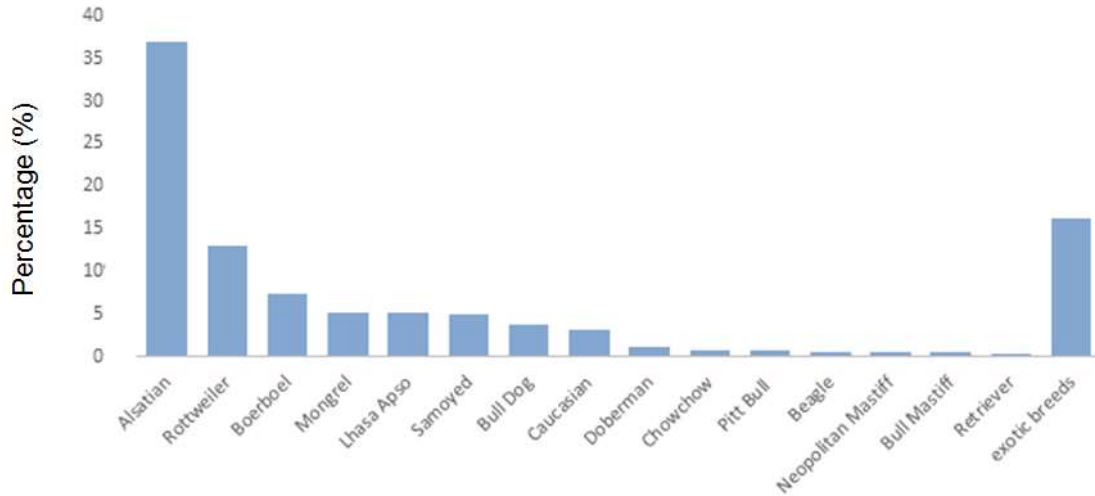


Figure 1. Pet demography: distribution of dog breeds owned by respondents surveyed.

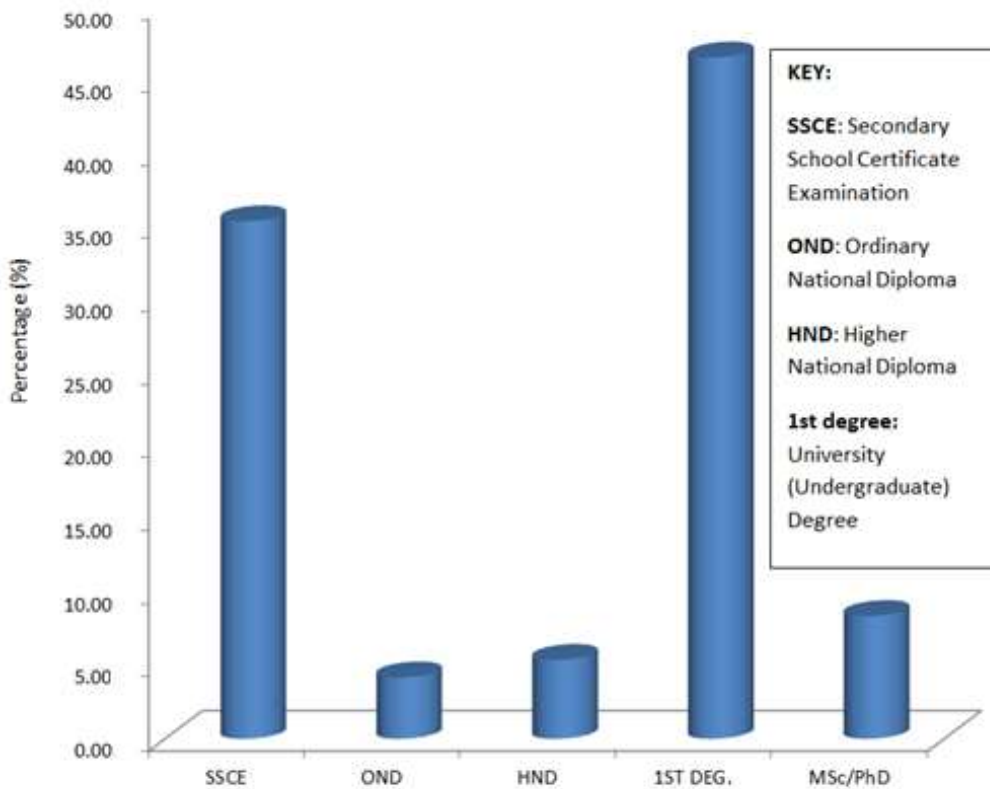


Figure 2. Distribution of educational qualifications dog owners.

(53.4%) and Oyo (52.1%) states had the highest number of respondents, while Kaduna, Enugu, Ekiti, and Plateau states had the lowest number of respondents all with 1.25% each. 3.0% of respondents are within the age bracket of 10 to 15 years, while 84.8, 7.0, 5.2% respectively are within the age brackets of 16 to 30, 31 to

45, and ≥45 years respectively. A large percentage (46.6%) of respondents were university graduates, 35.4% had secondary school leaving certificate, 4.2% had Ordinary National Diploma, 5.4% had Higher National Diploma, and 8.4% had M.Sc /Ph.D certificates (Figure 2).



**Table 1.** How conversant dog owners are with dog breeds.

S/N	Knowledge of various dog breeds	% Yes	% No	Std. Err.
1	Alsatian	78.6	21.4	0±0.066
2	Bull Dog	70.8	29.2	0±0.082
3	Chihuahua	33.6	66.4	0±0.068
4	Doberman	27.6	72.4	0±0.074
5	Lhasa Apso	25.2	74.8	0±0.078
6	Beagle	16.0	84.0	0±0.074
7	Dachshund	16.2	83.8	0±0.062
8	Poodle	30.2	69.8	0±0.064
9	Caucasian	59.8	40.2	0±0.076
10	Rottweiler	73.4	26.6	0±0.090
11	Retriever	22.4	77.6	0±0.080
12	Neapolitan Mastiff	23.8	76.2	0±0.070
13	Samoyed	27.4	72.6	0±0.072
14	Boerboel	42.6	57.4	0±0.076
15	Dalmatian	28.4	71.6	0±0.074
16	Chowchow	25.8	74.2	0±0.084
17	Pug	24.8	75.2	0±0.074

**Table 2.** Distribution (in %) of owners' purpose of dog possession.

Purpose of dog ownership	Strongly agree	Agree	Disagree	Strongly disagree	No. of respondents	Std. Err.
For Companionship	36.1	49.7	8.8	3.4	2.0	0±0.013
For security	51.0	45.6	1.4	1.4	0.7	0±0.011
Just seeing dogs	18.4	58.5	18.4	2.0	2.7	0±0.013
For commercial breeding	9.5	24.5	49.7	14.3	2.0	0±0.140
For both security and companionship	50.3	44.9	2.0	1.4	1.4	0±0.122

### Assessment of dog owners' previous dog keeping experience and reasons for seeing the veterinarian

The majority of respondents (90.8%) had previous experience with dogs keeping, while 9.2% were first-time owners. Some of the respondents (74.4%) had one dog, while others, 21.6% had two, 16.6% had three, 8.8% had four, and 5.6% had more than four dogs. Most of the respondents (74.4%) visited the veterinarian for their pets' healthcare while 25.6% had never visited any veterinarian for their pet's health care.

### Assessment of how conversant dog owners are with dog breeds

The Alsatian breed was identified by 78.6% of respondents, Bull dog by 73.4%, Rottweiler by 70.8%, Caucasian by 59.8%, Neapolitan mastiff (23.8%), Retriever (22.4%), Dachshund (16.2%) and Beagle

(16.0%) (Table 1).

### Assessment of purpose of dog possession

The majority of respondents (96.4%) possessed their dogs for security purpose. Others, 94.8% had their dogs for companionship and security, commercial breeding purpose (34.0%) and for the love of just seeing a dog around (20.4%) (Table 2).

### Assessment of factors that influenced dog owners' choice of breed

Different factors influenced dog possession, including the size of the breed (66.6%), coat colour (78.6%), natural intelligence (96.4%), information on the internet about the breed (54.6%), possession of the same dog breed by a close relative (53.4%), information from their veterinarian

**Table 3.** Factors (in %) that influenced dog owners' choice of dog breed.

Factors that influence choice of breed	Strongly agree	Agree	Disagree	Strongly disagree	No. of respondents	Std. Err.
Size	17.7	48.3	28.6	2.7	2.7	0±0.133
Coat colour	24.5	53.1	19.0	1.4	2.0	0±0.127
Natural intelligence	60.5	34.7	1.4	1.4	2.0	0±0.104
Information on the internet	16.3	37.4	38.1	5.4	2.7	0±0.150
Possession by close relation	17.7	32.7	40.1	7.5	2.0	0±0.146
Information from vet	15.0	24.5	45.6	12.2	2.7	0±0.145
Friend's comment	12.2	29.9	44.2	10.9	2.7	0±0.148

**Table 4.** Dog owners' reasons (in %) to visit the vet clinic / hospital.

Purpose of visit to the vet	Strongly agree	Agree	Disagree	Strongly disagree	No Resp.	Std. Err.
For general check- up and disease prevention	40.1	35.4	17.0	3.4	4.1	0±0.014
For vaccination and routine deworming	38.4	40.8	14.3	2.7	4.1	0±0.014
For treatment of diseases when dog is sick	44.9	34.0	15.0	2.7	3.4	0±0.013

(39.2%), and recommendation by friends (42.6%) (Table 3).

#### Assessment of dog owners' reasons to visit the vet clinic

Respondents visited the vet for different reasons, ranging from general check-up and disease prevention (79.6%), vaccination and routine deworming (79.2%), and treatment of diseases (79.8 %) (Table 4).

#### Assessment of dog owners' awareness of breed-associated surgical diseases

Respondents were aware of some common surgical diseases. Cruciate ligament rupture (13.6%), gastric dilatation/volvulus (13.6%), portosystemic shunt (15.0%), entropion (17.7%), ectropion (17.7%), osteochondrosis dissecans (17.7%), tracheal collapse (17.7%), patella luxation (17.7%), aortic stenosis (18.4%), chronic otitis externa (19.0%), lens luxation (19.0%), inguinal hernia (20.4%), retinal detachment (20.4%), elbow dysplasia (20.4%), traumatic proptosis (22.4%), hip dysplasia (22.4%), cherry eye (32.0%), epilepsy (36.1%), glaucoma (40.8%), arteritis (53.7%), and cataract (57.1%) (Table 5).

#### Assessment of dog owners' knowledge about their pet's health status

Only 10.9% of the respondents were aware of persistent/recurrent health challenges in their dogs. Only 13.6% of

respondents were informed of the predisposition of their dog's breed to certain health challenges while majority (84.4%) were un-informed. Only a small percentage (34.7%) were aware of diseases that can make their dog go through surgery, among which only 19.0% know such diseases could be associated with their dog's breed, yet, 82.3% of these respondents were not aware of their dog having any of such disease (Tables 1 and 6).

## DISCUSSION

The result of this study shows that majority of dog owners in Nigeria made their dogs' choice based on factors, other than their predispositions to certain surgical diseases. The majority of respondents are within the age bracket of 16 to 30 years. This age range consists of individuals capable of surfing the internet or interacting with professionals at animal health centers to obtain vital information about dog breeds and associated health challenges (Maczewski, 2002; Subrahmanyam et al., 2008; Pascoe, 2009; Lenhart et al., 2010).

Previous studies have shown that dogs' owners' choice of breed is often influenced by factors such as body sizes, body coats and colours, natural intelligence, as well as social and security qualities which are attractive to owners and may mean more income to breeders (Hare and Tomasello, 2005; Kubinyi et al., 2009). The German shepherd and Rottweiler breeds are prized for their mental acuity, strength, sizes, coat colour, and protective companionship. These qualities may have influenced their influx into many African countries, including Nigeria (Eyarefe and Dei, 2014).

Security concerns in African countries influence the breed of dogs acquired especially in cities (Fielding and

**Table 5.** Assessment of dog owners' awareness of breed associated surgical diseases.

<b>Knowledge of surgical diseases</b>	<b>Yes (%)</b>	<b>No (%)</b>	<b>Std. Err.</b>
Entropion	17.7	82.3	0±0.068
Ectropion	17.7	82.3	0±0.070
Cataract	57.1	42.9	0±0.080
Glaucoma	40.8	59.2	0±0.084
Lens luxation	19.0	81.0	0±0.066
Traumatic proptosis	22.4	77.6	0±0.072
Cherry eye	32.0	68.0	0±0.076
Chronic otitis externa	19.0	81.0	0±0.070
Hip dysplasia	22.4	77.6	0±0.066
Osteochondrosis dessicans	17.7	82.3	0±0.062
Arthritis	53.7	46.3	0±0.088
Inguinal hernia	20.4	79.6	0±0.072
Tracheal collapse	18.4	81.6	0±0.062
Patella luxation	17.7	82.3	0±0.060
Retina detachment	20.4	79.6	0±0.062
Cruciate ligament rupture	13.6	86.4	0±0.056
Elbow dysplasia	20.4	79.6	0±0.068
Portosystemic shunt	15.0	85.0	0±0.064
Epilepsy	36.1	63.9	0±0.072
Aortic stenosis	18.4	81.6	0±0.060
Gastric dilatation/volvulus	13.6	86.4	0±0.056

**Table 6.** Assessment of dog owners' knowledge about their pet's health status.

<b>Knowledge of pet's health status</b>	<b>Yes (%)</b>	<b>No (%)</b>	<b>No. of respondents (%)</b>	<b>Std. Err.</b>
Knowledge of persistence/recurrent health challenges	10.9	87.7	1.4	0±0.115
Vet information about breed's responsibility for health challenges	13.6	84.4	2.0	0±0.071
Knowledge of breed's influence on dog's health	47.6	51.0	1.4	0±0.086
Knowledge of diseases that can make a dog go through surgery	34.7	63.3	2.0	0±0.091
Knowledge of any such disease that is as a result of dog's breed	19.0	78.2	2.7	0±0.081
Knowledge of pet having such disease	12.9	82.3	4.8	0±0.079

Plumridge, 2004; Eyarefe and Dei, 2014; Eyarefe et al., 2015), consistent with our observation that the majority of dog owners in Nigeria (96.4%) obtained their dogs for security purpose. The increased human population in cities also necessitate dogs for security purposes. The southern part of Nigeria with high commercial potentials and relative peaceful neighbourhood, compared with the northern part has attracted more people resulting in increased need for dogs to protect homes from burglars. This may explain the higher numbers of respondents observed in Lagos and Oyo states, as also previously asserted (Eyarefe et al., 2011; Hambolu et al., 2014).

Dog owners visit the veterinarians for various reasons, including general check-up and disease prevention, vaccination, deworming and treatment of diseases. Seeking for information from veterinarians about breed-associated surgical diseases had a low percentage. Most

dog owners do not consult veterinarians before acquiring their preferred dog breed.

Clients are more influenced by the attractive features of the dog breed, recommendations from their friends and relatives than information from veterinarians. Therefore, they were un-informed of surgical diseases such dog breed predisposed to. It is known that veterinarians are excellent sources of information that guide in logical decision making on dog breed choices (Heuer, 2005).

Most dog owners were conversant with the Alsatian, Caucasian, Rottweiler, and Bull dog breeds due to their high population in the communities for security purposes. Yet these owners are less informed of condition such as gastric dilatation/volvulus that is common among these deep-chested breeds (Gough & Thomas, 2004). Some owners are even less informed of the nutritional requirement of these large dog breeds, and their

predisposed nutritional osteopenia, pathologic fractures, and other musculoskeletal diseases associated with poor nutrition (Chouinard et al., 2012).

We, therefore, recommend a legislation mandating potential dog owners to seek out information about medical and surgical conditions of prospective dog breed from authorized sources. This could forestall frustrations and ultimate pet abandonment associated with cost management and social adjustment following surgical disease.

In conclusion, it is advised that dog owners and prospective dog owners should seek advice, especially from certified veterinarians, about the breed of dog to acquire, as well as all that is needed to be put in place to prevent or minimise occurrence of breed-associated surgical conditions, as this will ultimately affect the owners, both psychologically and financially in case of pet disease or loss.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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*Full Length Research Paper*

# **Anaesthetic and cardiopulmonary parameters of dogs administered propofol-acepromazine-butorphanol or propofol-acepromazine-buprenorphine anaesthesia**

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The efficacy and safety of premedication with acepromazine-butorphanol or acepromazine-buprenorphine combination were compared in dogs anaesthetized with propofol using total intravenous anaesthesia. Six mature Nigerian indigenous dogs were randomly assigned to 1 of 2 premedication groups: Group 1 (acepromazine, 0.03 mg/kg, IM; butorphanol, 0.4 mg/kg, IM), or 2 (acepromazine, 0.03 mg/kg, IM; buprenorphine, 0.02 mg/kg, IM); propofol was administered using bolus injection method of total intravenous anaesthesia (TIVA); cardiopulmonary parameters of anaesthetized dogs were recorded at 20 min intervals for 2 h. The results of this study showed that significant alterations ( $p > 0.05$ ) were not observed in the anaesthetic indices of dogs on the two protocols. However, significant increase ( $p < 0.05$ ) was observed in the heart rate of dogs anaesthetized with ACE-BUP-PRO compared with those anaesthetized with ACE-BUT-PRO at all time intervals of 20 to 120 min after the induction of anaesthesia. The mean arterial blood pressure decreased significantly ( $p < 0.05$ ) in dogs anaesthetized with ACE-BUP-PRO at 40 and 120 min post anaesthetic induction, compared with dogs anaesthetized with ACE-BUT-PRO. Likewise, the respiratory rate of dogs anaesthetized with ACE-BUP-PRO decreased significantly ( $p < 0.05$ ) at 60, 100 and 120 min post anaesthetic induction. Haemoglobin-oxygen saturation and rectal temperature were not significantly at variance in dogs on the two anaesthetic protocols. In conclusion, either butorphanol or buprenorphine can be used in combination with acepromazine for premedication of dogs for routine surgical and diagnostic procedures. However, caution is advised with use of buprenorphine in dogs with pre-existing cardiac disease or hypertension.

**Key words:** Propofol, acepromazine, butorphanol, buprenorphine, total intravenous anaesthesia (TIVA), dogs.

## **INTRODUCTION**

Propofol is an alkyphenol anaesthetic agent widely used for total intravenous anaesthesia (TIVA). The

administration of propofol usually is accompanied by smooth and rapid induction of anaesthesia and short

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recovery times (Adetunji et al., 2002). Smooth inductions and short recovery times are peculiar characteristics of propofol which qualifies it to be used as a constant rate infusion for maintenance of anaesthesia (Aoki et al., 2017).

Despite the widespread use of propofol for total intravenous anaesthesia (TIVA) in dogs (Kumar et al., 2014), the drug has no potent antinociceptive activity when used alone (Quandt, 2013). Therefore, propofol is not recommended as the sole agent for maintenance of surgical anaesthesia, as it does not prevent haemodynamic responses to noxious stimulation except at high doses, which are invariably accompanied by considerable cardiopulmonary depression (Alipour et al., 2014).

Neuroleptanalgesia is a state of profound sedation and analgesia produced by co-administration of a neuroleptic agent such as acepromazine and an opioid such as butorphanol or buprenorphine (Poller et al., 2013, Chang et al., 2014). The neuroleptic acepromazine has a relatively low toxicity and potentiates the analgesic effect of an opioid (Quandt, 2013). Butorphanol and buprenorphine are both partial agonists that produce short and long duration of analgesia respectively and are widely used as premedication in small animals (Izer et al., 2014). Till date, the comparative effects of both neuroleptanalgesics have not been reported in propofol-anaesthetized dogs.

Thus, these drugs are used without adequate information that may be associated with the haemodynamic disturbances when used as premedicants with propofol. The aim of this study, therefore, was to compare the efficacy and safety of TIVA with propofol in dogs premedicated with either acepromazine-butorphanol or acepromazine-buprenorphine without the confounding effects of a surgical procedure.

## MATERIALS AND METHODS

### Animals

This study was carried out with the approval of University of Ibadan Animal Care and Use Research Ethics Committee (UI-ACUREC/App/2015/002). Six adult Nigerian indigenous dogs comprising 4 intact male and 2 intact, non-pregnant, non-lactating females were used for the study. Apparently healthy dogs were purchased from a local dog market in Ibadan. They were clinically observed for ectoparasites, overt signs of anaemia and infection (inflamed lymph nodes), and the heart rate, pulse rate and respiratory rate were recorded before the commencement of the study. Their body weight ranged between 10 and 13 kg. They were housed in a standard animal house at the faculty of veterinary medicine, University of Ibadan.

The dogs were fed ad libitum once daily on a home-made, rice-based diet with fish and meat offal supplements. Fresh drinking water was made available free choice at all times. Before the experiments of the trials, the dogs were allowed three weeks to get accustomed to their new environment, feeding regime and constant human handling. They were judged to be healthy (American Society of Anaesthesiologists physical status classification 1 or 2) on the basis of complete physical examination and minimal blood analysis (packed cell, volume and total solids). All findings were within

reference limits (Khan et al., 2011) for dogs.

### Study design

This study was a randomized, blinded, cross-over trials, in which each dog received the two regimens of premedication with a washout period of 7 days between treatments. Dogs were randomly allocated into the two treatments; the randomization scheme was generated by using the Web site Randomization.com (<http://www.randomization.com>).

### Experimental procedure

Food was withheld from the dog the night before the trial but water was allowed up to the time of premedication. The dog was weighed for the purpose of drug dose determination. Syringe containing a neuroleptic - opioid mixture was prepared by one person that was not involved in the trial. The drug mixtures were prepared as follows:

1. 0.03 mg kg<sup>-1</sup> acepromazine (Plegial 10 mg mL<sup>-1</sup>, Pharmaxim Sweden AB, Sweden) and 0.4 mg kg<sup>-1</sup> butorphanol tartarate (Torbugesic 10 mg mL<sup>-1</sup>, Forte Dodge, Iowa 50501, USA)
2. 0.03 mg kg<sup>-1</sup> acepromazine (Plegial 10 mg mL<sup>-1</sup>, Pharmaxim Sweden AB, Sweden) and 0.2 mg Kg<sup>-1</sup> buprenorphine hydrochloride (Temgesic 0.3 mgmL<sup>-1</sup>, ReckitH Benckiser Healthcare, UK)

Each drug mixture was administered intramuscularly (IM) in the pelvic limb. After 15 min of drug administration, sedation was scored by another person using a numeric descriptive scale (NSP) as follows:

- 0: No sedation
- 1: Mild sedation, ataxic, ambulatory
- 2: Moderate sedation, sternal recumbency, cervical tone present
- 4: Deep sedation, sternal recumbency, lift up head sporadically
- 5: Very deep sedation, lateral recumbency.

After obtaining sedation scores of the unrestrained and undisturbed dog, cephalic venous access was then secured using a 21G winged needle and an intravenous administration of 5% dextrose in water at an infusion rate of 5 mLKg<sup>-1</sup>h<sup>-1</sup> was begun. Twenty minutes after premedication intravenous anaesthesia was induced with 4 mg kg<sup>-1</sup> propofol (Propofol-lipuro 10 mg.mL<sup>-1</sup>, FresiusKabi, Halfway House, South Africa) administered by hand over approximately 2 min at a rate of approximately 0.25 mg Kg<sup>-1</sup> every 1.5 s. The end point was an absence of head, jaw and tongue movements and a jaw tone sufficiently reduced to allow intubation of the trachea with a cuffed 6 mm1D endotracheal tube immediately after tracheal intubation, the anaesthetised dog was placed in left lateral recumbency and a multiparameter physiological monitor (Cardell 9500 HD) was attached. Anaesthesia was maintained for 2 h with repeat bolus injections of 2 mg Kg<sup>-1</sup> propofol at 5-minute interval (Adetunji et al., 2002). Anti-nociception was assessed at 2-minute intervals using a toe-pinch pedal withdrawal reflex response to haemostatic forceps closed to one ratchet.

### Calculations

1. Onset of analgesia: Time interval (in minutes) between the initial bolus injection of propofol to disappearance of pedal reflex induced with artery forceps closed to the first ratchet.
2. Duration of analgesia: Time interval (in minutes) between the disappearance and return of the pedal reflex.

**Table 1.** Anaesthetic indices for ACE-BUT-PRO and ACE-BUP-PRO trials.

Anaesthetic index	ACE-BUT-PRO (minute)	ACE-BUP-PRO (minute)
Induction time	4.3 ± 0.2	4.3 ± 0.6
Duration of analgesia	124.0 ± 1.4	121.6 ± 1.1
Duration of recumbency	139.8 ± 6.9	134.3 ± 1.4
Time to standing	7.8 ± 2.6	5.0 ± 1.8

3. Duration of recumbency: time interval (in minutes) between acepromazine-buprenorphine or acepromazine-butorphanol induced recumbency and the dog's assumption of the sternal posture.

4. Extubation time: Time interval (in minutes) between the last bolus injection of propofol and the time of extubation.

5. Recovery time: Time interval (in minutes) between the last bolus injection of propofol and the dog's ability to stand

6. Induction dose: Quantity in milligrams of general propofol used for induction of anaesthesia.

7. Duration of analgesia: Time interval (in minutes) between loss of pedal reflex and return of pedal reflex.

8. Duration of recumbency: Time interval (in minutes) between assumption of standing posture and assumption of sternal posture.

#### Measurements

Heart rate (HR), respiratory rate ( $f_R$ ), haemoglobin oxygen saturation ( $SpO_2$ ), mean arterial blood pressure (MAP), and rectal temperature (RT) were measured immediately after induction of anaesthesia and during the course of maintenance of anaesthesia at 20 min intervals over a period of 120 min. This was considered as the most critical period of anaesthesia. The variables were monitored to assess relative safety of six total intravenous regimens under study. The patient monitor (Cardell 9500 HD Multiparameter monitor) was utilized to take all these mentioned physiological parameters.

#### Data analysis

All calculated and measured variables are expressed as mean ± SEM (Standard error mean) of six dogs. The means of duration of analgesia, duration of recumbency for total intravenously administered drug was compared in both instance of premedication using student t-test when a significant difference was indicated.

The mean values of the physiological variables (HR, RR, SP, MAP,  $SpO_2$  and RT) were compared using analysis of variance (ANOVA) for repeated measures followed as appropriate by Duncan test when a significant difference was indicated. A value of  $p < 0.05$  was considered statistically significant for all the comparisons.

## RESULTS

### Anaesthetic indices

The anaesthetic indices of dogs administered ACE-BUT-PRO AND ACE-BUP-PRO anaesthesia are presented in Table 1. Significant alterations ( $p > 0.05$ ) were not observed in the anaesthetic indices of dogs on the two protocols.

### Cardiopulmonary parameters

The cardiopulmonary parameters of dogs administered ACE-BUT-PRO and ACE-BUP-PRO anaesthesia are presented in Table 2. Significant increase ( $p < 0.05$ ) was observed in the heart rate of dogs anaesthetized with ACE-BUP-PRO compared with those anaesthetized with ACE-BUT-PRO at all time intervals of 20 to 120 min after the induction of anaesthesia. However, the mean arterial blood pressure decreased significantly ( $p < 0.05$ ) in dogs anaesthetized with ACE-BUP-PRO at 40 and 120 min post anaesthetic induction, compared with dogs anaesthetized with ACE-BUT-PRO. Likewise, the respiratory rate of dogs anaesthetized with ACE-BUP-PRO decreased significantly ( $p < 0.05$ ) at 60, 100 and 120 min post anaesthetic induction. Haemoglobin-oxygen saturation and rectal temperature were not significantly at variance in dogs on the two anaesthetic protocols.

## DISCUSSION

Premedication is often carried out in practice to alleviate fear and anxiety, to reduce the induction and maintenance dose of general anaesthesia, to provide extra analgesia when necessary, to counteract the side effects of other drugs, and to ensure an uneventful induction and recovery from anaesthesia (Hedenqvist et al., 2013). Anaesthetic indices and physiological parameters are monitored in patients under general anaesthesia periodically or continuously to warn, advise or to instruct on a patient's condition (Alam et al., 2014). In this study, the mean induction time, duration of analgesia, duration of recumbency and time to standing with both groups of anaesthetic protocols (ACE-BUT-PRO and ACE-BUP-PRO) were similar. Moreover, long duration recumbency and smooth recovery was achieved with both anaesthetic protocols. Therefore, where applicable, the two opioids, BUP or BUT, possess beneficial effects and may be used for premedication in dogs to alleviate common complications of propofol-induced general anaesthesia. However, the observation of significantly higher heart rate with BUP may be interpreted as a need to exercise caution with the use of this premedicant as there may be inherent arrhythmogenic complications in some patients. Total

**Table 2.** Cardiopulmonary parameters of dogs anaesthetized with propofol following premedication with either acepromazine-butorphanol (ACE-BUT) or acepromazine-buprenorphine (ACE-BUP).

Variable	Time interval (min) after anaesthetic induction					
	20	40	60	80	100	120
<b>Heart rate (beats/minute)</b>						
ACE-BUT	107.7±8.4	104.8±10.4	103.7±9.3	102.3±10.3	105.2±8.0	106.0±7.0
ACE-BUP	143.0± 9.0*	137.0±11.6*	126.3±13.0*	123.3±12.2*	128.2±17.7*	127.5±15.0*
<b>Mean arterial blood pressure (mmHg)</b>						
ACE-BUT	71.0±6.0	73.7±4.4	70.0±3.9	70.0±3.4	76.2±4.1	78.8±5.1
ACE-BUP	68.5±4.4	65.0±6.5 <sup>#</sup>	71.0±6.3	72.3±4.8	72.0±4.8	70.0±5.7 <sup>#</sup>
<b>Respiratory rate (breath/minute)</b>						
ACE-BUT	22.2±1.9	21.5±3.2	24.8±3.7	24.2±3.3	26.2±3.5	21.5±1.5
ACE-BUP	20.5±3.0	18.0±3.4	18.8±2.0 <sup>#</sup>	22.0±2.0	17.0±1.7 <sup>#</sup>	15.7±1.7 <sup>#</sup>
<b>Haemoglobin-oxygen saturation (%)</b>						
ACE-BUT	92.2±1.0	92.7±0.6	93.2±0.5	93.5±0.9	93.0±1.3	93.3±1.0
ACE-BUP	94.5±1.0	94.5±0.9	94.5±1.0	93.8±1.1	94.2±1.0	95.5±1.0
<b>Rectal temperature (°C)</b>						
ACE-BUT	37.2±0.2	36.9±0.2	36.4±0.1	36.2±0.1	36.0±0.1	35.7±0.2
ACE-BUP	37.2±0.3	37.0±0.3	36.8±0.3	36.7±0.3	36.5±0.3	36.4±0.3

intravenous anaesthesia (TIVA) is generally accomplished by repeat bolus injection or continuous rate infusion via infusion pump. Repeat bolus injections can be administered based on the patient response or at regular interval depending on the drug half-life (Bergmann et al., 2013). In this study, since the published half-life of propofol is 5 to 10 min, repeat bolus was adopted every 5 min throughout the anaesthetic period. Intravenous (IV) fluids are routinely administered during anaesthesia to maintain venous access as well as circulating blood volume, cardiac output and blood pressure (Sasai et al., 2014). The various types of intravenous fluids used include crystalloid, colloid and whole blood. Dextrose saline (5%) was used for this study as previously reported by Sriganesh et al. (2017). Although IV fluid is usually administered at the rate of 10 ml/kg/h during anaesthesia and surgery, a rate of 5 ml/kg/h was used in this study because abdomen or thorax were not entered.

Patients under general anaesthesia need to be endotracheally intubated to maintain open airway, to protect the airway from reflux gastric content and to connect the patient to anaesthetic machine (Krausz et al., 2015). In this study, endotracheal intubation was done after induction with propofol to maintain patent airway. Anaesthetic indices and physiological parameters are monitored generally in patients under general anaesthesia periodically or continuously to warn, advice or to instruct on a patient's condition (Alam et al., 2014). In this study, they were monitored non-invasively without surgical procedure. The quality of the recovery in this study was judged to be good to excellent.

It is concluded that either butorphanol or buprenorphine can be used in combination with acepromazine for premedication of dogs for routine surgical and diagnostic procedures. However, caution is advised with the use of buprenorphine in dogs with pre-existing cardiac disease or hypertension.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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