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Prevalence of haemoprotozoan parasites of dogs presented at the Veterinary Teaching Hospital, University of Jos - Nigeria

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Abstract Haemoprotozoan parasites have been a major health challenge in animals and are known to affect the blood vascular system resulting in various diseases. The present study investigated the prevalence of haemoprotozoan parasites in dogs at the veterinary teaching hospital, university of Jos, and the risk factors associated with their occurrence. One hundred ninety dogs were sampled at the University of Jos, Veterinary Teaching Hospital (VTH) within three months (May 2021-July, 2021) and Giemsa stained blood smears including Buffy coat, thin and thin and thick blood smears, were observed. The dogs screened were more females than males between ages <1, 1-3, and >3 years. Russian Shepherd breed of dogs were mostly presented as compared to other breeds. A total of 103 dogs were discovered to be infected with haemoprotozoan parasites and had a prevalence of 54.21%. Haemoprotozoan parasites discovered from this study include *Babesia spp., Ehrlichia spp.,* and *Mycoplasma spp. (Haemobartonella canis),* with prevalence of 22.11%, 11.05%, 6.32% respectively. Some of the dogs sampled were discovered to have mixed haermoprotozoan parasitic infections, and a prevalence of 14.74% was calculated. Haemoprotozoan parasites were also discovered to be more prevalent in female dogs, with a value of 54.47%, in the Bull mastiff breed of dogs, with a value of 66.7%, and in age range > 3 years, had a value of 30.7%. The various risk factors, including age, sex, and breed, were measured using the Chi-square test and revealed age to be statistically significant ($P < 0.05$). In contrast, sex and breed were not statistically significant ($P > 0.05$). The result from this study showed that haemoprotozoan parasites are detectable among dogs presented to the Veterinary Teaching Hospital (VTH) university of Jos and hence, the need to raise awareness on the prevention and control of haemoprotozoan parasitic infections in dogs due to possible threat to animal and human health in the study area.

Keywords: haemoparasites, occurrence, risk factor, vascular system

1. Introduction

Dogs are most likely the oldest domesticated animal and have, for many millennia, been human companions (Otranto et al 2009). Jos, the capital of the plateau state, has a large population of dogs as its meat is culturally accepted as a delicacy. There is a good weather condition for exotic breeds, persistent security challenges, and dog breeding activities which are very lucrative (Momoh et al 2015). Dogs are infected with various haemoprotozoan parasites, including *Trypanosoma spp., Babesia spp., Hepatozoon spp., Anaplasma spp., Mycoplasma spp. (Haemobartonella canis), Dirofilaria spp., Leishmania spp*., and some of these parasites could have zoonotic importance, e.g., *Babesia canis, Trypanosoma cruzi,* and *Ehrlichia canis* and are referred to as canine vector-borne disease (CVBD) in the tropical countries(Ezema et al 2021). Companion animals such as dogs and cats are infected with haemoprotozoan parasites. This poses a severe health challenge due to their adverse effect on blood parameters and the rate of spread from one animal to another, with a significant economic impact on owners (Ezema et al 2021). Haemoprotozoan parasites in dogs have been reported throughout Africa, Asia, Europe, the Middle East, North America, and America (Nwoha et al 2013). Haemoprotozoan infections, which occur worldwide and are transmitted by arthropod vectors, pose a major health challenge in animal species because they inhabit the bloodstream and affect the cardiovascular system of the living host (Stuen 2020). While some haemoprotozoan parasitic infections result in obvious clinical signs like anaemia due to the possibility of a blood-borne infection as an underlying course, others could be subclinical (Hii et al 2012; Kamani et al 2013). The common blood-borne pathogens of dogs in Nigeria associated with high morbidity and mortality are *Babesia spp*., *Ehrlichia spp*., *Hepatozpoon canis*, *Theileria spp*., and *Trypanosoma spp*. (Anise et al 2018).

Kamani et al 2011 recorded a 42% prevalence of haemoprotozoan parasites in dogs at Vom, Nigeria, comprising mainly of *Babesia canis* 27%, and Pam et al (2015) recorded a prevalence rate of 14% in a research work carried out at NVRI, Vom. Therefore, it is vital to periodically screen haemoprotozoan parasites circulating in dog populations, which may benefit both veterinary and public health.

2. Materials and Methods

2.1. Study area

This study was carried out at the University of Jos, Veterinary Teaching Hospital (VTH) in the Northern part of Plateau State (08°24'N and 08°32'E). The teaching hospital is a referral clinic where people take their animals for examination and treatment. Dogs brought to the clinic are from Jos environment. Plateau State covers an area of 27,147 square kilometres and is almost centrally located between latitude 80°24'N and longitude 80°32' and 100°38' east of the Greenwich meridian. Plateau state has a high altitude ranging from approximately 1,200 to a peak of 1,829 metres above sea level. It has a near-temperate climate with a mean annual rainfall of between 131.75 cm and 146 cm and an average annual temperature ranging from 16.3 to 28.1 °C. Plateau state records a mean relative humidity of between 46.9% and 51.3% (NBS 2016; Bolajoko et al 2016).

2.2. Sample collection

Animal care and handling procedures followed the guidelines of the ethics committee on the use of animals in experiments under the supervision of Prof. Dogo G.A and Dr Karaye G.P, also verbal consent was taken from the clients who presented their dogs at the University of Jos Veterinary Teaching Hospital for sampling. Blood samples were collected via the cephalic vein; about 5ml of blood was collected aseptically and transferred into the vial containing EDTA as an anticoagulant. The blood sample was collected randomly from 190 dogs and presented to the University of Jos, Veterinary Teaching Hospital (VTH) small animal unit within three months (May-July 2021). Each dog was properly restrained. The blood samples were analyzed immediately in the parasitology laboratory of the university of Jos Veterinary teaching hospital.

2.3. Thin blood smear

A drop of blood was placed on a grease-free clean glass slide at about 2cm from the right end; the drop was touched with the edge of another slide. It was held at an angle of 30° and pushed gently to the left till the blood was exhausted. The film was allowed to dry. The slide was fixed with methanol for 5 minutes and stained with dilute 10% Giemsa stain according to standard procedures (Cheesbrough 2006). The stained slides were examined at 100x under oil immersion to detect haemoprotozoan parasites.

2.4. Buffy coat technique

One end of the capillary tube was placed on the blood sample and allowed to fill to about three-quarters by capillary action and then sealed by plasticine at the other end. It was placed in the haematocrit centrifuge machine and was centrifuged for five minutes at 10,000 rpm. The capillary tube was placed above a glass slide and fixed with plasticine. The buffy coat region of the capillary tube was then examined microscopically at low magnification (10×), as described by Cheesbrough (2006).

2.5. Statistical analysis

The data obtained from the applied parasitological techniques were recorded and analyzed for percentage proportions using Microsoft Excel® software. The results were further expressed in graphical and tabular form and analyzed using the Chi-square test.

3. Results

3.1. Prevalence of haemoparasites in sampled dogs

In this study, out of the 190 dogs sampled, haemoprotozoan parasites were discovered from 103 screened blood samples giving an overall prevalence of 54.21%. Haemoprotozoan parasites from this study include *Babesia spp., Ehrlichia spp.,* and *Mycoplasma spp.* (*Haemobartonella canis*) with a prevalence of 22.11%, 11.05%, and 6.32%, respectively. Some of the dogs sampled were discovered to have mixed haermoprotozoan parasitic infection and a prevalence of 14.74%, as represented in Table 1.

3.2. Characteristics of the dogs sampled concerning age, breed, and sex with prevalence rates

Dogs sampled were classified into three basic risk factors: age, breed and sex, and prevalence rates. These results were further represented in tabular (Table 2) and graphical forms using ®Microsoft Excel 2010.

Table 1 Prevalence of haemoprotozoan parasites in dogs.

Haemoparasites	Number of infected dogs	Prevalence (%)
Babesia spp.	42	22.11
Mycoplasma spp. (Haemobartonella canis)	12	6.32
Ehrlichia spp.	21	11.05
Mixed infection	28	14.74

Table 2 Age, sex, and breed distribution of the incidence and prevalence of dogs presented at the Veterinary Teaching Hospital, the University of Jos, with their respective prevalence rate.

	Group	Number of dogs sampled	Number of infected dogs	Prevalence (%)	Infected (%)
Age	<1 year	71	43	60.56	42
	1-3 years	92	41	44.57	40
	>3 years	27	19	70.37	18
	TOTAL	190	103	54.21	100
Sex	Male	67	36	53.73	35
	Female	123	67	54.47	65
	TOTAL	190	103	54.21	100
Breed	NIBD	52	31	59.62	30
	German Shepherd	31	19	65.52	19
	Russian Shepherd	84	43	51.19	42
	Dobermann	2	1	50	1
	Saint Bernard	2	1	50	1
	Rottweiler	5	2	40	2
	Neapolitan Mastiff	9	3	33.33	3
	Bull Mastiff	3	2	66.67	2
	Lhasa Apso	1	0	0	0
	Pitt Bull	1	0	0	0
	TOTAL	190	103	54.21	100

3.3. The age-wise prevalence rate of haemoprotozoan diseases

According to age classification, 71 were discovered to be <1 year, 92 were within the age range of 1-3 years, and 27 were >3 years. Upon screening of the sampled dogs, 43(42%) of the age group < 1, 41 (40%) of the age group 1-3 years, and 19 (18%) of the age group >3 years were infected with haemoprotozoan parasites. Age groups of <1 year had a prevalence rate of 60.56%, 1-3 years had a prevalence rate of 44.57%, and the age range >3 years had the highest prevalence rate of 70.37%. These were also represented graphically, as indicated in Figure 1.

Of the 190 dogs sampled, 123 were females, and 23 were males. These were further represented graphically in Figure 2. Upon screening, 67 females (65%) and 36 male dogs (35%) were infected with haemoprotozoan parasites. Male dogs had a prevalence of 53.73%, and female dogs had a prevalence rate of 54.47%, slightly higher than the prevalence of male dogs.

3.4. Breed Wise Prevalence Rate of Haemoprotozoan Diseases in Dogs

From the data obtained, a total of 10 breeds of dogs were screened, including Nigerian Indigenous Breed of Dogs (NIBD) (52), Russian Shepherd (84), Bull mastiff (3), German shepherd (31), Rottweiler (5), Pitbull (1), Lhasa Apso (1), Saint Bernard (2), Neapolitan mastiff (9) and Dobermann (2). After screening the blood samples obtained from the various breeds of dogs, 31(30%) NIBD, 43(42%) Russian Shepherd, 2(2%) Bull mastiff, 19(19%) German shepherd, 2(2%) Rottweiler, 0(0%) Pitbull, 0(0%) Lhasa Apso, 1(1%) Saint Bernard, 3(3%) Neapolitan mastiff and 1(1%) Dobermann were infected with haemoprotozoan parasites, having prevalence rates of 59.62%, 51.19%, 66.67%, 65.52%, 40%, 0%, 0%, 50%, 33.33%, and 50% respectively. Bull mastiff dogs had the highest prevalence, followed by German shepherds. This study revealed that local breeds of dogs have a higher prevalence rate of 59.62% than exotic breeds, with a prevalence rate of 52.17%. These were further represented graphically, as indicated in Figure 3.

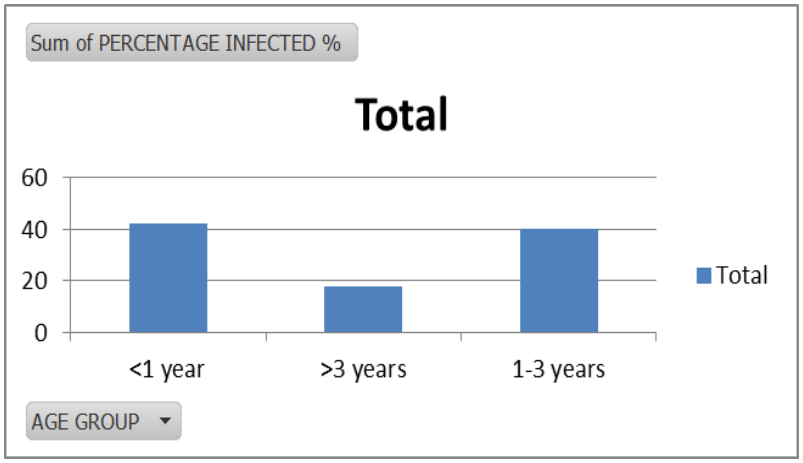

Figure 1 Representation of age-wise occurrence of haemoprotozoan parasites in dogs.

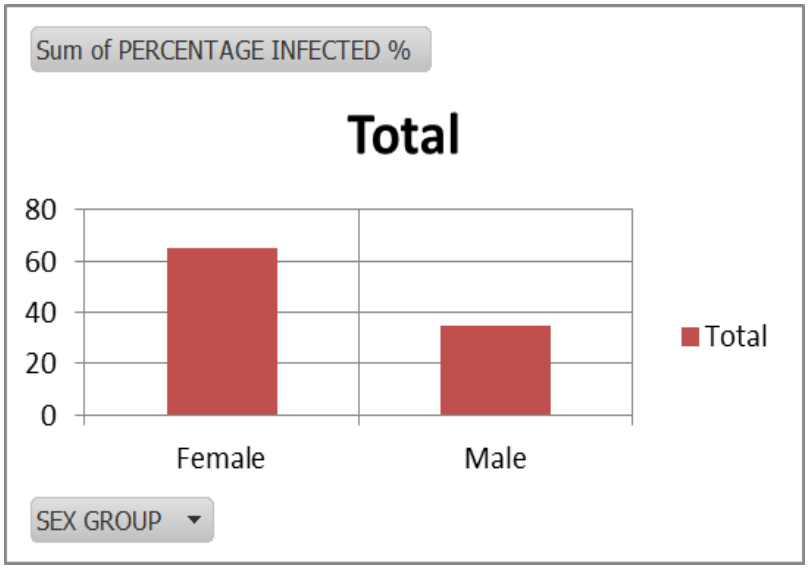

Figure 2 Representation of sex-wise occurrence of haemoprotozoan parasites in dogs.

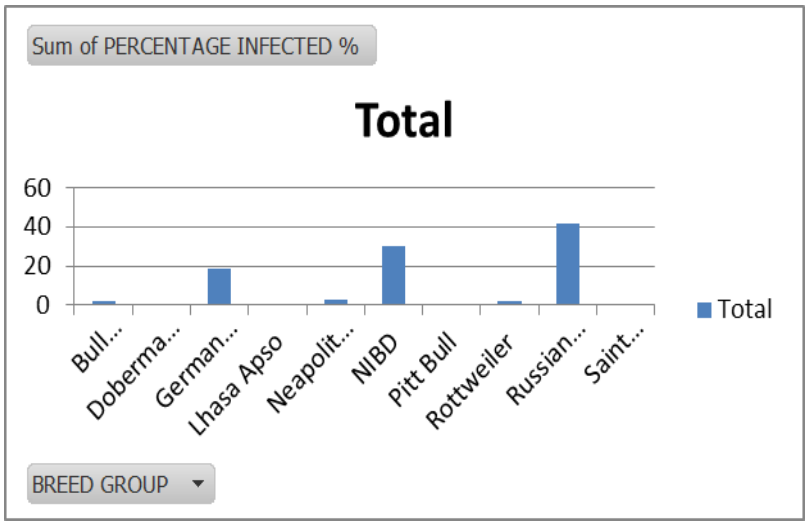

Figure 3 Representation of Breeds wise occurrence of haemoprotozoan parasites in dogs.

3.5. Chi-square analysis of different independent variables (risk factors): age, sex, and breed

The various risk factors, including age, sex, and breed, were measured using the Chi-square test and showed that age was statistically significant ($P < 0.05$), while sex and breed were not statistically significant ($P > 0.05$), as stated in Table 3.

Table 3 Results of chi-square analysis of different risk factors with haemoprotozoan parasite infection in dogs.

	Group	Number of dogs sampled	Number of infected dogs	Prevalence (%)	Infected (%)	*P*- value
Age	<1 year	71	43	60.56	42	0.048
	1-3 years	92	41	44.57	40	
	>3 years	27	19	70.37	18	
	TOTAL	190	103	54.21	100	
Sex	Male	67	36	53.73	35	1.000
	Female	123	67	54.47	65	
	TOTAL	190	103	54.21	100	
Breed	NIBD	52	31	59.62	30	0.774
	German Shepherd	31	19	65.52	19	
	Russian Shepherd	84	43	51.19	42	
	Dobermann	2	1	50	1	
	Saint Bernard	2	1	50	1	
	Rottweiler	5	2	40	2	
	Neapolitan Mastiff	9	3	33.33	3	
	Bull Mastiff	3	2	66.67	2	
	Lhasa Apso	1	0	0	0	
	Pitt Bull	1	0	0	0	
	TOTAL	190	103	54.21	100	

Chi-square *P*-value is considered significant at < 0.05.

4. Discussion

In the current study, an overall prevalence of 54.21% of haemoprotozoan parasites was observed in the dogs presented at the Veterinary teaching hospital polo, Jos North Central Nigeria. This result is similar to Ifeoma (2013) findings, who reported a prevalence of 59.3%. Kamani et al (2011) reported 42.1% in Bukuru and Vom, respectively, Jos South Local Government in Plateau State, Nigeria. However, a low prevalence of 10.67% was reported by Ogbu *et al.* 2021 in Bukuru, Jos South Local Government in Plateau State. These variations could be due to the sample size and season of the year in which the research was carried out. Ehimiyein et al (2018) recorded a low prevalence of haemoprotozoan parasites in dogs in Zaria at 19.67%, while Ezema et al (2021) reported a prevalence of 14.16% in Maiduguri, Borno State, in North Eastern Nigeria. The disparity and variable prevalence rates reported from different parts of the country might be due to different ecology, which affects the population of tick vectors and hence the presence of the haemoprotozoan parasites they transmit. It might also be due to low parasitaemia, which might be missed by microscopic examination of the blood smear, although the absence of parasites in the blood smear is not an absence of infection.

This study reported a high prevalence rate of *Babesia spp*. (22.11%), followed by *Ehrlichia spp.* with a prevalence rate of 11.05%, and the least was (*Haemobartonella canis) Mycoplasma spp.* with a prevalence rate of 6.32%. These observations are similar to the findings of Adamu et al (2017) and Ehimiyein et al (2018), who reported a higher prevalence of 16.00% and 19.67% in Makurdi and Zaria respectively. Although another study carried out in Maiduguri, Borno State, reported a very low prevalence of 2.8% for both *Babesia spp.* and *Ehrlichia spp.* (Adamu et al 2012). This result could be attributed to the increase in the disease vector (*Rhipicephalus sanguineus*) observed on the animal's body and the abundance of vegetative cover, which serves as a conducive environment for the vector to thrive. Also, the high occurrence of *Babesia spp.* strongly suggests the role of vectors (ticks) in disease transmission since *Rhipicephalus sanguineus* (brown dog tick) has been reported as the most common vector implicated in the transmission of canine babesiosis (Adamu et al 2017).

A higher prevalence rate was observed in female dogs (54.47%) as compared to the males (53.73%), and this agrees with the work of Adamu et al (2017). This high prevalence of infection in females could be a result of the increase in exposure to haemoprotozoan parasitic vectors during oestrus and subsequent contact with many males who may harbor these vectors as well as stress being posed on the female animals due to the demand of reproduction, causing their immunity to be compromised (Opara et al 2017).

In terms of breed, the local breed of dogs was more infected with haemoprotozoan parasites as compared to other exotic breeds, which could be due to the lack of proper care and attention being given to the local breed of dogs, as they are allowed to roam freely in the environment where they come in contact with disease vectors such as *Rhipicephalus sanguineus* (Oguche et al 2021). In addition, exotic breeds of dogs are given better attention and provided with better veterinary care to forestall transmission of these haemoprotozoan parasites into the human owner and household.

The different age ranges screened were ascertained to be infected with haemoprtotozoan parasites. According to the age ranges, the older dogs (>3 years) had more haemoprotozoan parasitic infections, with a prevalence of 70.37%. This occurrence may result from maximum care and attention being given to the younger dogs in the control of vectors over the older ones, as it is believed that the older dogs are strong enough to withstand diseases (Pam et al 2013; Phuyal et al 2017).

The various risk factors, including age, sex, and breed, measured using Chi-square analysis, showed that age was statistically significant ($P < 0.05$), while sex and breed were not statistically significant ($P > 0.05$). This result agrees with Oguche et al 2021 who reported that age is significantly correlated with haemoprotozoan parasitic infection in dogs due to its prevalence in older dogs. In contrast, Peter et al (2019) observed a significant association between breed, sex, and haemoprotozoan parasitic infection in dogs. The variations in significance level may be due to sampling size, which will be used to determine the association between dog phenotypic and physiologic characteristics with haemoprotozoan parasitic infection.

The significant high prevalence rate of infection in the adult dog population (>3 years) compared to younger dogs of (<1 year) and (1-3 years) of age. An association between haemoparasitisim and age observed in this study agrees with the report of Ehimiyein et al (2018), Jalali et al (2013), and Subedi (2009). They all reported higher haemoprotozoan parasite prevalence in older dogs. On the contrary, our results are at variance with the report of Adamu et al (2017), who reported a higher prevalence in younger dogs. This could be since younger dogs easily show clinical disease and thus often attract the attention of their owners.

5. Conclusions

In conclusion, the haemoprotozoan parasites observed in this study were *Babesia spp*.*Ehrlichia spp*.and (*Haemobartonella canis) Mycoplasma spp.* The study shows the endemicity of haemoprotozoan parasites in Jos North Central part of Plateau State Nigeria. Therefore, it is recommended that further investigation using a more sensitive diagnostic technique such as Polymerase Chain Reaction (PCR) is carried out to obtain a better insight into the epidemiology of blood parasites in the study areas. This will facilitate the adoption of efficient control and preventive measures against the parasites and eliminate any possible threat of diseases caused by these parasites to animals and humans in the study areas.

In as much as green grassy areas serve as momentary habitats for ticks in their life-cycle development, absolute care should be enforced to prevent and control overgrowth, hence the regular use of pesticides/insecticides (biodegradable). Dog owners should take good care of them by regularly consulting veterinarians and dipping or spraying them with biodegradable insecticide in powder or liquid form. Those incriminated with Babesiosis must be treated entirely.

Ethical Considerations

Animal care and handling procedures followed the guidelines of the ethics committee on the use of animals in experiments under the supervision of Prof. Dogo G.A and Dr. Karaye G.P. Also, verbal consent was taken from the clients who presented their dogs at the University of Jos Veterinary Teaching Hospital for sampling.

Conflict of Interest

There was no conflict of interest.

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