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Prevalence of Canine Helminthosis and Anthelminthic Usage Pattern at a Veterinary Teaching Hospital in Nigeria

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HELMINTHOSIS still a neglected disease, especially in developing countries, in spite of its economic and public health importance. A ten-year retrospective study on confirmed canine helminthosis cases presented to the Veterinary Teaching Hospital, Abeokuta, Nigeria was conducted. Descriptive statistics were used to characterize animal signalment, infection severity, anthelminthic usage pattern and outcome. Relationships between dog/owner's profiles with the presence/absence of helminthic infection were determined using Pearson's and Wald Chi square and multivariate logistic regression analysis. Total number of case records was ninety-five; forty-five males and fifty females, ages ranged between 1 month to 9 years, with complete data and confirmed laboratory diagnosis were reviewed. At the univariate level, the odds of having helminths increased twice (COR = 2.172, 95% CI; 0.850 – 5.504, p=0.098) in exotic breeds than indigenous ones. Likewise, the odds of infection in dogs owned by clients with high economic status increased almost three times (COR = 2.696, 95% CI; 0.966 – 7.524, p=0.053) than those with low economic status. At multivariate level, the odds of helminthosis being present in dogs significantly reduced in dogs above 5 months of age (AOR = 0.219, 95% CI; 0. 071 – 0.681, p=0.009). This study highlights associated clinical signs, variations in anthelminthic therapy, outcome, and the predisposing factors to resistance. Standardized approaches for collection, assessment, and risk management of helminthosis is needed.

Keywords : Helminths, Dogs, Prevalence, Resistance, Nigeria

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Introduction

Helminthosis is a parasitic disease caused by parasitic worms infecting both humans and animals. There are numerous species of these parasites, broadly classified into cestodes, trematodes and nematodes. In dogs, the nematodes (*Ancylostoma caninum, Toxocara canis, Trichuris vulpis*), and cestodes (*Dipylidium caninum, Echinococcus granulosus*) are the most common [1]. Primary infections are extremely severe in puppies (less than six months old), and worm load of 110 - 165 worms/kg body weight may be fatal [2]. Routes of transmission include vertical infection from bitch to puppies (transplacenta or transmammary), percutaneous, ingestion of the infective larvae (L_3) and/or paratenic hosts from the environment [3- 5].

Canine helminths such as *Ancylostoma* and *Toxocara* are important zoonotic parasites, as they cause cutaneous larva migrants, visceral larva migrants and eosinophilic enteritis in humans [4, 6-8]. Stray and pet dogs, in touch with humans, play important roles in disease transmission, through direct or indirect contact with infected food, water and environment [9]. This is especially important in developing and socioeconomically disadvantaged countries such as Nigeria and most African countries, where poor hygiene, overcrowding, inadequate veterinary care and awareness about zoonosis, exacerbate risks.

Currently, basic methods for the control of helminthosis in dogs include regular deworming with one or a combination of different classes of anthelmintics such as: Benzimidazoles (e.g., albendazole, mebendazole), Tetrahydropyrimidines (e.g., pyrantel pamoate) and Macrocyclic lactones (e.g., ivermectin) [10]. However, indiscriminate and unethical use of the same class of anthelmintic, sub-optimal dosing and frequent prophylactic treatment have caused widespread development of multidrug resistance (MDR) [11]. With few new drugs introduced into the market and the absence of vaccines, the degree and extent of MDR in canine helminths is likely to increase exponentially, as seen in livestock [10, 12].

There are several reports on the high endemicity of helminthosis in tropical countries such as India [13], Brazil [14], Pakistan [15] and sub-Saharan Africa [16]. It has also been reported in Northern Nigeria [17, 18], Southeast Nigeria [19, 20] and Ibadan, Southwest Nigeria [1]. However, there is a paucity of information on the prevalence, risk factor and the anthelminthic usage pattern in Southwest Nigeria. This study seeks to determine the prevalence of helminthosis in dogs presented at the Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta (FUNAAB), for a period of 10 years (2009-2019). The pattern of anthelminthic usage at the hospital was also assessed.

Materials and Methods

Ethical approval

Before starting this study, ethical approval was given by the Research Ethics Committee, College of Veterinary Medicine, FUNAAB (FUNAAB/COLVET/CREC/2020/07/07).

Study area

The Veterinary Teaching Hospital, FUNAAB, is located in Ogun State, Southwest Nigeria, lying within Latitude 70 114' 07' N and Longitude 30 26' 15''E (Fig. 1). The hospital is a referral centre from private veterinary clinics within the State and neighboring areas, and renders specialized veterinary clinical and diagnostic services [21].

Study design

Case records of all diagnosed helminthes infections of dogs brought to the Veterinary Teaching Hospital, FUNAAB from 2009 to 2019 were collected and analyzed. The information retrieved was animal data (breed, sex, age), clinical history, clinical signs, diagnosis [differential, tentative, confirmatory (through parasitological faecal examination)], treatment protocol and outcome. The season of the year, the house location of the animal/client and the clients' occupation (to determine the economic status of dog owner), were also noted.

Study variables

Outcome variable

The outcome variable for this study was presence of helminthes in dogs presented at the Veterinary Teaching Hospital, FUNAAB. The responses were recorded as dichotomous outcomes 'Present' and 'Absent'.

A case was considered positive based on 1) history of loss of appetite and no prior deworming, 2) clinical signs of helminthosis and 3) laboratory confirmation using direct faecal smear and floatation methods.

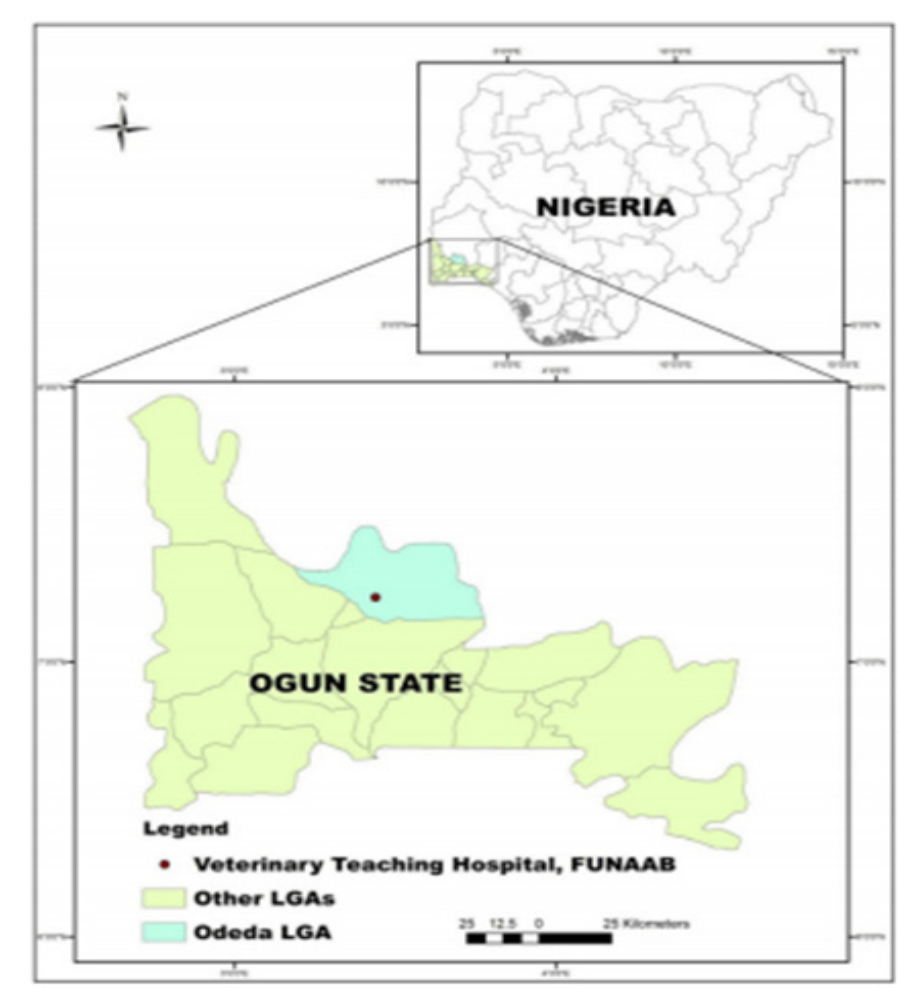
Explanatory variables

The main predictors tested for association with the presence of helminth infection in this

study, included the breed, sex, age, weight of the animal and the economic status of their owners.

Data analysis

Data were collated in Microsoft Excel® spreadsheets, 2013 (Microsoft Corporation, Redmond, WA, USA). Descriptive statistics were used to summarize data using SPSS® 21 analysis software package (IBM, Inc.). All categorical variables were presented in the forms of frequencies, proportions and percentages. For continuous data (age and weight of dogs), normality was tested using Shapiro-Wilk (> 0.05) and normal Q-Q plot, and were summarized as median, minimum and maximum values. All variables - breed, age, weight, sex, economic status of dog owner, and presence or absence of helminthosis were re-categorised into binary outcomes for further analysis. For categorization, the median age and weight of dogs were used as cut-off, breed and client's economic status were classified as exotic/indigenous and high/low income respectively. Relationships between dog/owner's profiles with the presence or absence of helminthosis were determined using Pearson's Chi square and multivariate logistic regression analysis (MRLA, SPSS® 21 analysis software package IBM, Inc.). The Wald test was used to determine variables that contributed significantly to the predictive ability of the model. The MLRA using backward stepwise selection, $p<0.05$ was considered statistically significant and adjusted odds ratios (AORs) were used to determine strength of associations at 95% confidence intervals (CIs).



FUNAAB - Federal University of Agriculture, Abeokuta; LGA - Local Government Area

Fig. 1. The Veterinary Teaching Hospital, Federal University of Agriculture, Abeokuta, Ogun State, Southwest Nigeria

Results

Demography of dogs presented at the Veterinary Teaching Hospital

A total of ninety-five dogs with complete data to be evaluated and confirmed, (51) with and (44) without helminthosis were presented to the Veterinary Teaching Hospital, FUNAAB, Nigeria within the study period. A total of 50 (52.6%) intact females and 45 (47.3%) intact males were recorded, of which 73.2% were exotic breeds while 21.6% were indigenous. Dogs within the ages of 1 month to 9 years were mostly affected. The median patient age and weight were 5 months (minimum 1 month, maximum 9 years) and 10 kg (minimum 1.2 kg, maximum 50 kg) respectively (Table 1).

Clinical signs

The overall prevalence of canine helminthosis was 54.2% (Table 2). The most reported clinical signs were pale mucous membrane, weakness, lethargy, diarrhea and starry hair coat. Presence of worms in the faeces grossly was reported in 2% of the cases during the period (Table 2).

There were cases of canine helminthosis all year round with most cases presented between February and March, while least cases were presented in June (Fig. 2).

The treatment regimen was varied amongst clinicians. Management plan involved administration of anthelminthics, multivitamins, intravenous fluid therapy to infected animals presented with dehydration resulting from diarrhea, antiemetics as well as antidiarrhea agents (Table 3). Approximately 95% of infected animals were discharged by Day 3 of admission, 4% had an extended hospital stay, while fatality was recorded in 1% of the cases.

TABLE 1. Prevalence of canine helminthosis and anthelmintic usage pattern

Variables	Frequency	Percentage
Age (months)		
0 - 24	83	93.3
25 - 48	3	3.4
49 - 72	2	2.2
>72	1	1.1
Sex	50	51.5
Female	45	46.4
Male		
Breed	71	73.2
Exotic	21	21.6
Indigenous	4	4.1
Mixed		
Weight (kg)	48	52.7
0-10	28	30.8
11-20	12	13.2
21-30	3	3.3
>30		
Economic status of dog owner	20	20.6
Low	76	78.4
High		

TABLE 2. Clinical signs of canine helminthosis

Clinical signs*	Frequency	(%)
Anorexia	40	27
Diarrhea	48	33
Alopecia	4	3
Vomiting	42	29
Starry hair coat	7	5
Recumbence	1	1
Lethargy	4	3

*Some dogs were presented with more than one clinical sign

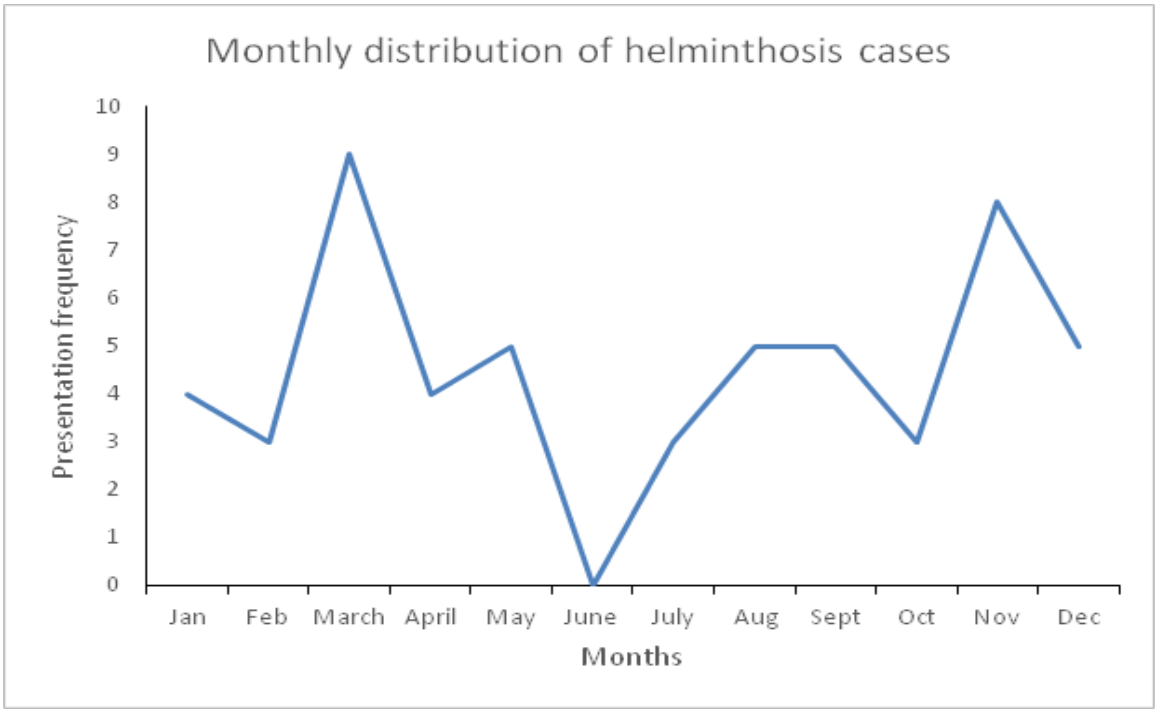


Fig. 2. The seasonal pattern of canine helminthosis within the study period (2009-2019)

TABLE 3. Anthelminthics administered to canine helminthosis cases

Drugs (Concentration)	Usage frequency (%)
Levamisole (10 mg/ml)	3 (5.6)
Prazisam® [febendazole (500 mg), pyrantel pamoate (144 mg), praziquantel (50 mg)]	30 (57.1)
Pyrantel pamoate (50 mg/ml)	6 (11.0)
Albendazole (25 mg/ml)	5 (9.1)
Piperazine (50 mg/ml)	8 (14.9)
Ivermectin (10 mg/ml)	1 (1.3)

Factors associated with the presence of helminthosis in dogs

At the univariate level, the dog age (p=0.014), breed (p=0.098), weight (p=0.080), and economic status of dog owners (p=0.053) were associated factors with the presence of helminths. The odds of having helminths increased twice (COR = 2.172, 95% CI; 0.850 – 5.504) in exotic breeds than indigenous ones. Likewise, the odds of having helminths in dogs owned by clients with high economic status increased almost three times (COR = 2.696, 95% CI; 0.966 – 7.524) than those with low economic status. In contrast, helminth infection reduced with dog's age (COR = 0.293, 95% CI; 0.107 – 0.802) and weight (COR = 0.475, 95% CI; 0.205 – 1.099) (Table 4).

At the multivariate level (Table 5), the odds of being diagnosed with helminthosis reduced 0.22 times in dogs above the age of five months.

TABLE 4. Risk factors associated with the presence of canine helminthosis

Variables	Helminthosis				
	Absent (%)	Present (%)	COR	95% CI	P value
Sex					
Female	24 (54.5)	26 (51.0)			
Male	20 (45.5)	25 (49.0)	1.154	0.514 - 2.590	0.729
Age					
≤ 5 months	27 (61.4)	38 (84.4)			
> 5 months	17 (38.6)	7 (15.6)	0.293	0.107 – 0.802	0.014*
Breed					
Indigenous	15 (34.1)	10 (19.2)			
Exotic	29 (65.9)	42 (80.8)	2.172	0.850 – 5.504	0.098*
Weight					
≤ 10 kg	18 (42.9)	30 (61.2%)			
> 10 kg	24 (57.1)	19 (38.8)	0.475	0.205 – 1.099	0.080*
Economic status of dog owner					
Low	13 (29.5)	7 (13.5)			
High	31 (70.5)	45 (86.5)	2.696	0.966 – 7.524	0.053*

*p ≤0.05; COR - Crude Odds Ratio; CI - Confidence Interval

TABLE 5. Multivariate analysis of risk factors associated with the presence of canine helminthosis

Variables	Helminthosis					
	Absent (%)	Present (%)	Wald test	AOR	95% CI	P value
Age						
≤ 5 months	61.4	84.4	-	Ref	0.071– 0.681	0 .009*
> 5 months	38.6	15.6	6.887	0.219		
Breed						
Indigenous	34.1	19.2	-	Ref	0.710 – 6.258	0.180
Exotic	65.9	80.8	1.801	2.107		

*p ≤0.05; AOR - Adjusted Odds Ratio; CI - Confidence Interval; Ref - Reference

Discussion

In spite of the economic and public health importance of helminth infection, it remains a neglected disease especially in developing countries [22]. In addition to humans, wild animals and fish are the major hosts, and infection could be transmitted inter- or intraspecies [23]. Retrospective study was carried out at the Veterinary Teaching Hospital, FUNAAB, Nigeria on the prevalence of laboratory confirmed canine helminthosis. The study gave an overall prevalence rate of 54.2%. This corroborates with two similar studies conducted in Southeast, Nigeria. The first study in Enugu State, reported overall prevalence of 56.1 and 51.7% in retrospective and prospective study respectively [24]. In the second study conducted in Enugu and Anambra States, a prevalence of 52.6% was documented [19]. Similarly, publications from Europe, Italy, Switzerland, Finland, Hungary, Brazil and China have given country-specific reports on the prevalence of canine helminthosis [25- 32]. The high prevalence reported may be linked to the increase in world dog population, poor living conditions in the developing world, poor hygiene leading to high degree of environmental contamination with infective worm stage and availability of intermediate host, and global warming, all of which create favourable climatic conditions for the survival of infective stages outside the host [33]. The neglect of the disease, inadequate veterinary care and MDR of helminths to the few available drugs hugely contribute to the global disease burden [34].

Age was strongly associated with the presence of helminthes infection in dogs and the median age in this study was five months. This result agrees with some researchers [16, 19, 35, 36], who reported 71.0, 80.6, 57.9, and 41.2% prevalence of helminthosis in dogs less than six months old respectively. On the other hand, retrospective/ prospective studies conducted by Idika et al. [24] in Nigeria, reported that dogs aged above 1 year had significantly ($p < 0.05$) higher prevalence (30.8%) than younger ones (20.9%). In Rwanda, the prevalence reported was 33.3% and dog's age, location, and feeding habits were associated risk factors [37]. The higher prevalence rate in young dogs, as seen in this study, might be due to their low innate immunity as well as transplacental and transmammary passage of larvae to them [38].

In this study, no association between sex and presence of canine helminthosis was observed, as infection was comparable in both females (51.9%) and males (49.0%). This supports similar studies investigating canine helminthes in Edo State, Nigeria [39] and in Ghana [40]. The authors reported prevalence of 56.0, 44.0% and 55.1; 48.2% in male and female dogs respectively. Other studies however, reported a significantly higher prevalence in female dogs [33, 41].

Association between breed and helminthes infection was established in this study at the univariate level. Exotic dogs had twice the odds of having helminthosis than the indigenous breed. In the study conducted by Idika *et al.* [24], breed was also significant, though, helminthosis was encountered more in the indigenous breeds. Breed relatedness with helminthosis may be attributed to the management, frequency of visits to the Veterinary Teaching Hospital for veterinary care, and breed susceptibility, as exotic breeds were presented more frequently during the period of this study. Their owners' high economic status may be linked to these frequent visits for good and prompt veterinary care whenever the need arises unlike dog owners of low economic status. In addition, exotic breeds may be less immune to the parasites than the indigenous breeds who have developed immunity against the helminths prevalent in their locality.

The region of this study, Ogun State, has rainy season between April and October (temperature ranges from 20-30^{o}C), and a dry season from November to March (temperature from 25-40^{o}C) [42]. This makes the environment suitable for the survival of many agents of veterinary and medical importance. In this study, canine helminthosis did not vary significantly with climatic change. It has however been reported, that the transmission and distribution of helminthosis are greatly influenced by some factors such as geographical, climatic, cultural and socio-economic factors, sampling protocol, anthelminthic usage, demographic factors, and diagnostic techniques [38, 43].

Currently, chemotherapy (anthelminthic drugs) is used to prevent and treat helminth infections. Between 1975 to 2004, 1 556 anthelminthic drugs were marketed [44]. The MDR of helminths over the years led to a hypothesis on whether preventive chemotherapy is beneficial [23]. In the Veterinary Teaching Hospital, treatment protocol was mainly based on the clinical and ethical judgment of the attending veterinarian as well as drug availability. Prazisam®, a broad spectrum anthelminthic agent, containing praziquantel 50 mg, pyrantel

pamoate 144 mg, fenbendazole 500 mg, was mostly prescribed or administered at 1 tab/10 kg, repeated every two weeks for dogs less than six months, and every three months for adult dogs. Other drugs used belong to either of the chemical classes - Benzimidazoles, Imidazothiazoles, Vinyl pyrimidines, Piperazine citrate, and Macrocyclic lactones, within which individual compounds have similar mechanisms of action. Thus, resistance to a drug may be accompanied by resistance to other members in the same class [45]. Worthy of note also, is that utmost care is generally not provided by owners of the indigenous dog breed (many of whom have low incomes), and minimal or no treatment provided except when the animal becomes very sick [24, 46].

Though data collection from veterinary clinics provides detailed case information (including outcome), allowing for a more thorough assessment of cases, it is difficult to collate and time-consuming. This is due to differences in documentation practices, coding of cases, investigative and treatment protocols, among clinicians [21]. Since data were collected retrospectively, this study was limited due to many cases of routine deworming, inadequate laboratory records and clinically asymptomatic dog population. Despite this, the study serves as a pointer to pattern of canine helminthosis in Southwest Nigeria, which may be representative of the developing world. This could help researchers and policymakers develop effective helminthes control measures locally and globally.

Conclusions

The prevalence and treatment regimen for canine helminthosis at a Veterinary Teaching Hospital in Nigeria is shown in this study. The need for conducting laboratory diagnosis and keeping adequate records upon which informed clinical decisions and plans for the treatment and control of infection can be made are critical. Evaluation of resistance pattern of helminthic to common anthelminthic drugs as well as prospective studies on parasite diversity, quantification of intensity of the actual incidence of infection and economic implications for dog owners in Southwest, Nigeria is needed.

Acknowledgment

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Authors' contributions

OTA conceptualized and designed the project; OAA, FAA, AIA and AFM were involved in data collection; OOA did the statistical analysis; OTA and OOA drafted the manuscript; OEO and JOO revised the manuscript critically for important intellectual content. All authors read and approved the final version of the manuscript.

Conflict of interest

Authors declare no conflict of interest.

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