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INCIDENCE OF *Echinococcucus granulosus* IN OWNED DOGS IN LOKOJA METROPOLITAN, KOGI STATE. NIGERIA

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ABSTRACT

Echinococcosis is a zoonotic disease affecting both animals and human with significant health hazard and economic impacts. A study to evaluate the incidence of *E. granulosus* was carried out on dogs from six study sites in Lokoja, Kogi State. Faecal samples from 300 dogs were collected and examined for the presence of *E. granulosus* cyst microscopically. A designed questionnaire was used to obtain both extrinsic and intrinsic information on the sampled dogs from their owners. Out of the 300 dog faecal samples screened, 59 had *E. granulosus* eggs with overall prevalence of 19.66%. Otokiti study unit had highest prevalence of 28.57%, GRA had the lowest prevalence (4.76%). With regards to sex, male and female dogs had a prevalence of 19.20% and 20.33% respectively. In terms of season, highest prevalence of 19.05% and lowest prevalence of 0.00% was recorded during rainy and dry season respectively. The incidence infection rate showed statistical significance with a ($P< 0.05$) relation to season. Free-range dogs recorded a prevalence of 22.69% while a prevalence of 8.06% was recorded in dogs reared under intensive condition ($P< 0.05$). The result from this study revealed the presence of E.granulosus in the study area. Therefore, appropriate and regular deworming of dogs should be undertaken as well as awareness campaigns to educate the masses on the preventive measures is highly recommended to reduce risk of *E. granulosus* transmission to humans.

Keywords: Incidence, *Echinococcus granulosus*, Dogs, Nigeria

INTRODUCTION

Echinococcosis is a parasitic infection caused by metacestode belonging to the genus *Echinococcus*. There are four major species of *Echinococcus* (*E. granulosus, E. multilocularis, E. vogeli* and *E. oligarthrus*) infecting man and animals but *E. granulosus* and *E. multilocularis* are species of major public health importance and are responsible for majority of all the human and animal burden caused by *echinococcus* species Erbeto *et al.*, 2010. Human cystic echinococcosis (CE) is caused by *E. granulosus* while *E. multilocularis is* responsible for alveolar echinococcosis (AE) (Erbeto *et al*.,2010). Echinococcosis has been named as an emerging or re-emerging disease (Torgerson *et al*., 2010). Dogs are the main definitive hosts while herbivores (sheep, goats and cattle) act as intermediate hosts. Sustainable transmission of *E. granulosus* is maintained between the hosts, in which the cystic or hydatid disease occurs (Budke *et al*., 2017). Echinococcosis has been classified as a zoonotic disease especially in livestock-raising areas in the villages where humans have close contact with dogs which feed on raw animal waste materials and poorly disposed body of dead intermediate host (Budke *et al*., 2017). Feeding dogs with fresh meat of animals' attributes to continuing the life cycle of *E. granulosus* (Wang *et al*., 2016). Domestic dogs have an important part in the passing on of *E. granulosus* infection to humans either directly (by petting or handling dogs that are infected with the *E. granulosus)* or indirectly through ingestion of environmental contaminated substances (soil, water, or vegetables). Many researches revealed the epidemiological roles of owned and stray dogs in varied values of prevalence rates in the African continent ranging from 12.2% to 51.3% (Amari *et al*., 2020; Oba *et al*., 2016). Cystic echinococcosis is highly endemic in the world with more prevalence in sub-Saharan Africa (Gong *et al*., 2021). Despite the differences in incidence of CE among the various states of the African countries, similar pattern related to feeding style, abattoir hygiene, free-range, and socio-cultural aspects, can be identified throughout sub-Saharan Africa (Roming *et al*., 2011). Particularly, dog ownership, as well as the uncontrolled access of dogs to abattoir, have been related to a significant risk of *E. granulosus* infection (Liu *et al*., 2018). Human infection with *Echinococcus granulosus* can also be related to high resistance of the cyst to adverse environmental condition and the human immune system (Li *et al*., 2019). Dogs that eat carcass of infected herbivores, become infected with *Echinococcus granulosus* eggs and can be found in their stool samples. Direct contact with infected dogs, especially close contact between humans and their pet dogs, may give rise to human infection (Agudelo *et al*., 2016; Wu, 2017). Ingestion of soil, water and vegetables polluted with infected dog faeces may also give on to human infections. Due to the spread of infection in numerous parts of the body and absence of certain diagnosis techniques, serologic procedure is totally convenient in the detection of the infection (WHO, 2022). The most valued immunoglobulin for diagnosis of the archive of cystic Echinococcosis or exposure to parasite is IgG, because the level continues to exist for a long time in blood (Heidari *et al*., 2011).

In Nigeria, the serological evaluation of CE in humans (3.3%) has been observed Jos, Plateau State (Bitrus *et al*., 2020). So also, a seroprevalence study carried out in the south west of Nigeria, reveled high prevalence of *E. granulosus* infection among dogs (12.45%) (Adediran). Likewise, the occurrence of hydatid cysts during meat inspection in livestock animals has also been recorded in abattoirs in Nigeria (Ola-Fadunsin *et al.* 2020). These revelations attest that large Nigerian population are at high risk of getting infected *echinococcus granulosus.* Considering the limited amount of data on the epidemiology of *E. granulosus* s.l. in Lokoja and Nigeria at large, we carried out this coprological study to ascertain the prevalence of the infection and its associated factors among owned dogs. Furthermore, identification of risk factors for *E. granulosus* infection in dogs will aid informed control and prevention strategies in dogs and guide to reduce or prevent risk of infection in humans.

MATERIALS AND METHODS

Study Area

Lokoja is located on latitude 7.796^{0}N and longitude 6.740^{0}E, at an altitude of 45-125m, at the confluence of River Benue and Niger River. Lokoja metropolis is characterized by high population density, 886000 as estimated by world population prospect (WPP), 2025. It experiences significant urban heat island effect, with land surface temperature of 28.13^{o}C to 63.14^{o}C. The raining season start from May to October and dry season from November to April. Lokoja ecosystem supports a range of plants and animal species. Although, biodiversity is threatened by habitat destruction and climate changes. The city ecosystem is influenced by both natural and anthropogenic factor. Lokoja metropolis was selected for this study because a survey in the area has revealed dog keeping is a common practice among the inhabitants. The dogs are kept for different purposes, such as, for security, hunting, breeding and as pets with little or no use of veterinary services. The study area was divided into seven study units for easy generation of samples: Ganaja, Banda, 200 unit, Otokiti, Zango dajji, Felele and Adonkolo.

Sample size determination

The 300-sample size used in this study was determined by using the formula for cross-sectional studies as described by Iboyi (2010): N= Z^2PQ/ D2. Where Z =standard normal distribution at 95% confidence interval = 1.96, P = population proportion, Q = population standard deviation, D = margin of error.

Study design and sample collection

In conducting this research, a cross-sectional design in which data was collected at a single point and time was used (Thrusfeild, 2005). Data was collected from dog owners on the dog's demographic characteristics (age, breed,). Faecal samples were obtained from privately owned dogs in the various study units by house-to-house visitation and sample collection. Each sample collected was put into a clean sterilized bottles then transported to the department Zoology, Federal University Lokoja. The samples were parked in a polytene bag with ice-block. Ten grams (10g) of stool samples were collected each from three hundred (300) dogs in around Lokoja Metropolis (Ganaja, GRA, 200 unit, Otokiti, Zango dajji, Felele and Adonkolo study units). For a fair representation, simple random sampling techniques was used to select the various study units from Lokoja metropolis. Data form was designed with clear information on sex, season, intrinsic (sex, breed and Age) and extrinsic (range system, educational status of the owner, season, feeding) risk factors of the year in which the stool sample was collected and whether the dogs were restricted (home-owned) or un-restricted (strayed).

Faecal Sample Preparation and Examination

Ten grams of each collected stool sample was mixed separately with distilled water and strained through sterile gauze in a funnel. The filtrates were centrifuged at 2000 rpm for three minutes. The supernatants were discarded and the sediments were re-suspended in 10ml of physiological saline. Then it was centrifuged for the second time. The supernatants were also discarded, the sediments were re-suspended in 7ml of formalin saline and allowed to stand for 10-15minutes for fixation. After which 3ml of ether was added, the tubes were stopped and shaken vigorously then the stopper was then removed and the tubes were centrifuge at 2000rpm for 2minutes, the tubes were allowed stand. Four layers becomes visible, the top layer consisted of ether, second layer was a plug of debris, and third was a clear layer of formalin saline and the fourth layer was the sediments. The plug of sediments was detached from the side of the tubes with the aid of a glass rod and the liquid was poured off leaving a small portion of formalin saline for suspension of the sediment. It was then poured onto a clean glass slide, covered with cover slip and examined under the microscope using 10X and 40X objectives for the presence of *echinococcus granulosus*.

Statistical Analysis

The data generated in this study was entered into Microsoft excel 2011 and analyzed using SPSS version 17. Bivariate analysis and chi-square test were used to test the association between the study variables.

Results

Incidence of *E. granulosus* eggs in the stool of owned dogs in relation to study units

The result in table 1 revealed the prevalence *E. granulosus* eggs in faecal samples of dog examined in the study units. Out of the 300 dog faecal samples examined, 59(19.66%) were infected. The highest prevalence 13(30.23%) of *E. granulosus* infection was recorded in Felele study unit followed by 12(28.70%) in Otokiti unit while the lowest infection prevalence 2(4.7%) occurred in GRA study unit. The result was statistically significant (P= 0.017).

Incidence of *E. granulosus* infection in the stool of owned dogs in relation to sex in the study units

Out of the 300 dogs sampled for this study. A total of 177 were males while 123 were females. The result showed a prevalence rate of 20.33% in female dogs as compared to male that showed a prevalence rate of 19.20%. The result showed higher prevalence rate of 20.33% in female dogs as compared to male that showed a prevalence rate of 19.20%. Statistically, the table 2, showed no significant difference in prevalence of *E. granulosus* with respect to dog gender (P = 2.006).

Table 1: Incidence of *E. granulosus* infection in the stool of owned dogs in relation to study units

Study Sites	Number Examined	Number Positive (%)
Ganaja	43	10(23.26)
GRA	42	2(4.76)
200 Unit	42	5(11.90)
Otokiti	42	12(28.57)
Felele	43	13(30.23)
Adonkolo	42	7(16.67)
Zango	46	10(21.74)
Total	**300**	**59(19.66)**

P = 0.018

Table 2: Incidence of *E. granulosus* infection in the stool of owned dogs in relation to sex in the study units

Study sites	No. of male examined	No. positive (%)	No. of female examined	No. positive (%)
Ganaja	29	8(27.59)	14	2(14.29)
GRA	17	0(0.00)	25	2(8.00%)
200 Unit	18	2(11.20)	24	3(12.50)
Otokiti	26	7 (26.92)	16	5(31.25)
Felele	30	8(26.67)	13	5(38.46)
Adonkolo	26	5(19.23)	16	2(12.50)
Zango	31	4(12.90)	15	6(40.00)
Total	**177**	**34(19.20)**	**123**	**25(20.33)**

P = 2.006

Incidence of *E. granulosus* eggs in the stool of owned dogs in relation to season in the study units

The result in table 3 showed a total of dog stool samples collected each for rainy and dry seasons. *E. granulosus* proved to be more prevalent in the rainy season with infection rate of 36(12.00%) as compare to dry season with 23(7.67%) infection rate. The result revealed that dogs from Otokiti unit recorded high prevalence in the rainy season followed by Adankolo and Zango with 6(14.29) each. The result showed statistically significance difference among seasons studied (P =0.871).

Incidence of *E. granulose* in intensive and free-ranged dogs in in relation to the range system

Table 4 showed that out of 300 stool samples collected and examined, 238 stool samples were from free range dogs, where 134 were males and 104 were females with a prevalence of 22.39% and 23.08% respectively. Similarly, a total of 62 stool samples were collected from intensive dogs, out of which 43 were from males and 19 were from females. Incidence of *E. granulosus* infection as observed in free-range male dogs was 22.39% and free-range female dogs as 23.08%. There was statistically significant (P = 0.001).

Incidence of *E. granulosus* in owned dogs in relation to the educational status of the owners

Table 5 showed that out of 300 stool samples screened, 193 stool samples were collected from dogs in houses whose owners were holders of primary school certificate and below, 65 were from dogs whose owners were secondary leavers and 42 were from people with tertiary education. The table depict highest infection incidence 44(22.80%) in dogs owned by those with primary school certificate holders, followed by those owned by secondary leavers 13(20.00). Dogs owned by tertiary leavers had the least infection 2(4.75%).

Table 3: Incidence of *E. granulosus* infection in the stool of owned dogs in relation to season in the study units

Study sites	Dry season		Rainy season	
	Number examined	No. positive (%)	Number examined	No. positive (%)
Ganaja	43	4(9.30)	43	6(13.95)
GRA	42	0(0.00)	42	2(4.76)
200 Unit	42	3(7.14)	42	2((4.76)
Otokiti	42	4 (9.52)	42	8(19.05)
Felele	43	7(16.28)	43	6((13.95)
Adonkolo	42	1(2.38)	42	6(14.29)
Zango	46	4(8.69)	46	6(14.29)
Total	**300**	**23(7.67)**	**300**	**36(12.00)**

P = 0.871, X2 = 5.71, df = 1

Table 4: Incidence of *E. granulose* in restricted and un-restricted dogs in relation to the range system

Variables	No. of M/F	Male		Female		% Total positive
		No. examined	No. positive (%)	No. examined	No. positive (%)	
Free-range system	238	134	30(22.39)	104	24(23.08)	54(22.69)
Intensive system	62	43	4(9.30)	19	1(5.26)	5(8.06)
Total	**300**	**177**	**34(19.20)**	**123**	**25(20.33)**	**59(33.33)**

P=0.001

Table 5: Incidence of *E. granulose* in owned dogs in relation to the education status of the owners

Variables	Characteristics	Owner of positive (+) dogs (%)	Owners of negative (-) Dogs (%)	Odds ratio or (95%Cl)	P. value
Educational Level	Primary (193)	44(22.80)	149(77.20)	0.33(0.04, 2.24)	0.71*
	Secondary (65)	13(20.00)	52(80.00)		
	Tertiary (42)	2(4.76)	40(95.24)		
	Total (300)	59(19.67)2	241(80.33)		

Discussion

This study aimed at determining the prevalence of *E. granulosus* among the owned dogs in the study area. The result of this study revealed the existence of *E. granulosus* apparently in healthy dogs in Lokoja metropolitan. Out of the total 300 dog stool samples screened in this research, *E. granulosus* showed an incidence of 19.67% in the study area. This finding is in agreement with the report from Gong *et al*. (2021) and Oba *et al*. (2016) that reported incidence rate of 15.17% and 14.5% in China and Uganda respectively. The low incidence rate of *E. granulosus* recorded in the present study may be related to consciousness of the dog owners on the risk factors that may responsible for its transmission. In the areas where dog owners are conscious of deworming their dogs as at when it is due, having modern abattoir (prevent the stray from having assess to visceral), no offal or visceral feeding will go a long way in reducing transmission rate.

The *E. granulosus* prevalence in the present study is contrary to the findings of some researchers that reported lower incidence rate in west Africa (5.50%) but it in agreement with report of incidence rate in East Africa (23.40%) and North Africa (24.70%) (Ohiolei *et al.*, 2020). This report showed lower incidence rate as compared to some reports from other part of this country. This finding proves to much lower compared to the report Bitrus *et al*., 2021 and Mathias *et al*., 2023 that reported 46.21% and 44.50% for respective studies conducted in Jos, Plateau and Adamawa state. The incidence of *E. granulosus* in relation to gender in the present study showed a lower incidence rate in male (19.20%) compared to the female (20.22%). This finding is not in agreement with report by some researchers Awosanya *et al.* (2021), those reported high incidence in male dogs than in the female dogs (Awosanya *et al*., 2021, Bitrus *et al*., 2021). The finding agrees to the report of Mathias *et al*. (2023) who reported high incidence in female than male. The high incidence of *E. granulosus* in female dogs in this study may be attributed to compromised immune system of during their pregnancy and breast feading as reported by Bitrus *et al*. (2021). High incidence rate of 36(12.00%) was recorded during the rainy season compared to the dry season with lowest prevalence of 23(7.67%) infection rate. Seasons play a vital role in *E. granulosus* transmission as revealed by Meta-analysis of the incidence rate, in dogs in China from 2010- 2019 (Gong *et al*., 2021). The result reported the prevalence of *E. granulosu*s egg as 11.20%, 10.20%, 10.00% and 10.90% during Spring, Summer, Autumn and winter season respectively which are lower than most of the result from tropical zones. In a similar study, Idika *et al*. (2017) reported an incidence of intestinal parasites in Enugu State, with infection rate of 68.59% in rainy season and 26.49% in the dry season which agrees with higher prevalence of *E. granulosus* in rainy season and lower prevalence in dry season as reported in this study. This revealed that climatic conditions in the humid zone are more favourable for the development and survival of the infective stages of *E. granulosus* in the environment, than in the arid region. *E. granulosus* eggs can withstand extremely cold temperature (Li *et al*., 2019). The incidence rate of *E. granulosus* in free-range male dogs was 22.39% and 23.08% in female dogs, while 9.30% and 5.26% prevalence were recorded for intensive male and female dogs respectively. The report is in agreement with what is reported by Igole *et al*. (2018). Contrary to the high prevalence of *E. granulosus* infection recorded in intensive dogs (66.1%) as observed by Mathias *et al.* (2023) from a study conducted in Adamawa State, Northeastern Nigeria. The *E. granulosus* prevalence observed in the study could have been affected by educational status of the dog owners, as the result revealed much high prevalence of the infected dogs among those owned by primary school certificate holders and below. Most of the dogs owned by this category are mostly free ranged, which give them access to offal's that might have been killed by some of the parasite in question. Many studies have supported that the free-range system had a significant influence on the prevalence of gastrointestinal parasites infection as reported by Scaramozzino *et al*., 2009 and Alvarez *et al*., 2014. Mathias, 2023, reported that free-range dogs are unlikely to come in contact with infective stages of gastrointestinal parasites. However, habit of keeping free-range dogs, feeding them with offal's, fresh meat had been the main factor responsible for high infection of *E. granulosus* in the free-range owned dogs. Extrinsic factors, such as dog owners' characteristics, dog roaming, feeding of offal, and dog deworming frequency, were significantly associated with *E.granulosus* This is also similar to the findings of Liu *et al.*,2012 among owned dogs in China. The impact of some of the extrinsic factors could have been influenced by the deworming status of the dogs.

CONCLUSION

Our study showed the presence and low prevalence of Echinococcus granulosus among owned dogs in Lokoja, Kogi State, Nigeria. To maintain this this status or prevent escalating beyond this stage, mass deworming needed to be introduced from time to time. Public education on the risk factors related to the transmission of *E. granulosus* from dogs to humans need to be the major priority in this part of the world.

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