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PREVALENCE OF *Echinococcucus granulosus* IN STRAY AND HOME OWNED DOGS IN ADAMAWA STATE, NIGERIA

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ABSTRACT

Echinococcosis is a zoonotic larval infection affecting both domestic animals and human with serious health and economic impacts. A study to determine the prevalence of E. *granulosus* was carried out on dogs from six Local Government Areas (LGA) of Adamawa State. Faecal samples from 384 dogs were collected and screened for the presence of E. granulosus cyst microspically. A structured questionnaire was used and obtained native and exotic data from dog owners. Out of the 384 dog faecal samples, 171 had E. granulosus cyst with overall prevalence of 44.5% where Guyuk LGA had highest prevalence of 53.1% and Michika LGA had a lowest prevalence of 39.1%). With regards to gender, male and female dogs had a prevalence of 30.5% and 32.4% respectively. In terms of season, highest prevalence of 42.7% and lowest prevalence of 33.3% was recorded during rainy and dried season respectively with a significant association ($P< 0.05$). Un-restricted dogs recorded a prevalence of 66.1% and 38.1% was recorded in restricted dogs with significant relationship ($P< 0.05$). Dogs living in suburban areas and kept for security purposes, hunting or guarding have higher chances of infection. Therefore, right and regular treatment of dogs with praziquantel is highly recommended to reduce risk of E. granulosus transmission to humans.

Keywords: Prevalence, *Echinococcucus, granulosus,* dogs, Nigeria

INTRODUCTION

Echinococcosis is a neglected zoonotic parasitic infection caused by metacestode (the larval stage of several species) belonging to the genus Echinococcus. There are four main species of Echinococcus affecting man and animals but *E. granulosus and E. multilocularis* are species of major public health importance and are responsible for virtually all the human and animal burden causing human cystic echinococcosis (CE) and alveolar echinococcosis (AE), respectively (Erbeto *et al.*,2010). Echinococcosis has been termed an emerging/re-emerging disease (Torgerson *et al.,* 2010). *E. granulosus* transmission is sustained between the definitive hosts which are dogs and intermediate hosts which are herbivores (sheep, goats and cattle) in which the cystic or hydatid disease occurs (Budke *et al*., 2017). Echinococcosis has been identified as a zoonotic infection especially in rural livestock-raising areas where humans have close contact with dogs which feed on raw livestock offal and poorly disposed carcass of herbivores intermediate host (Budke *et al*., 2017). Feeding dogs with raw viscera of infected animals contributes to perpetuating the life cycle of *E. granulosus* (Wang *et al*., 2016).

Domestic dogs have a prominent role in the transmission of E. granulosus infection to humans either directly or indirectly through environmental contamination of soil, water, or vegetables. Several studies confirmed the epidemiological importance of owned and stray dogs, revealing extremely varied values of prevalence rates in the African continent ranging from 12.2% to 51.3% (Amari *et al.*, 2020; Oba *et al.,* 2016). CE is highly endemic in sub-Saharan Africa, but to date the picture of the epidemiological situation for E. granulosus in this area is still incomplete (Gong *et al*., 2021). Despite the differences in prevalence of CE among the various countries, a common pattern related to livestock farming, slaughter hygiene, presence of free-roaming dogs, 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 slaughter facilities, have been associated to a significant risk of E. granulosus s.l. infection (Liu *et al*., 2018).

Human infection with *Echinococcus granulosus* can also be associated 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 sheep, goat and other livestock become infected with *Echinococcus granulosus* eggs and can be found in their faeces, direct contact with infected dogs, particularly intimate contact between humans and their pet dogs, may lead to human infection (Agudelo *et al.,* 2016; Wu, 2017). Ingestion of soil, water and vegetables contaminated with infected dog faeces may also lead to human infections. Due to the spread of infection in various parts of the body and lack of a certain diagnosis method, serologic methods are quite useful in the diagnosis of the disease (WHO, 2016). The most appropriate immunoglobulin for detection of the history of cystic Echinococcosis or exposure to parasite is IgG, because the level remains high for a long time in blood (Heidari *et al.,* 2011). Enzyme Linked Immunosorbent Assay (ELISA), one of the serological methods for detection of hydatidosis with advantages, such as high sensitivity and specificity and implementation form many samples at the same time, is an appropriate method for sero-epidemiological studies. Many researchers have reported on the prevalence of human hydatidosis by ELISA from several countries (Rakhshanpour *et al*., 2012)

MATERIALS AND METHODS

Study Area

Adamawa State of Nigeria fondly called "Land of Beauty, Sunshine and Hospitality" is geographically located between latitudes $9^0$20'-9.333^{0}North of Equator and between longitudes $12^0$30'-12.500^{0}East of Greenwich. The national population census, (2006) projected population of the State as 3,106,585. Adamawa is one of the largest states of Nigeria and occupies about 39,742.12 square kilometres. The State has a vast fertile land suitable for farming and other economic activities. The major occupation of the people is farming as

reflected in their two notable vegetation zones, the Sub-Sudan and Northern Guinea Savannah zones. Major cash crops are cotton and groundnuts while food crops include maize, yam, cassava, guinea corn, millet and rice. The village communities living around the banks of the rivers also engage in fishing especially village communities living on the banks of Rivers Gongola and Benue and their tributaries. The state has a network of roads linking all parts of the country. Cattle rearing are also a major occupation for a reasonable population. Average rainfall is 933 mm annually. The driest month is January, there is 0mm of precipitation in January, most of the precipitation falls in August with an average of 211mm. April is the warmest with average temperature of 32,^{0}C and December is the coldest month with average temperature of 25.9 ^{0}C (Adebayo and Tukur, 2020).

Sample size determination

The 384 sample size used in this study was determined by using the formula for cross-sectional studies as described by Araoye (2003):

$$N = \frac{Z^2PQ}{D^2}$$

Where N = Desired sample size.

Z = Standard normal deviation at 95% confidence level usually set at 1.96.

p = prevalence rate. D is the allowable error which is taken as 5%, Q =1 – p.

Research design and sample collection

Five grams (5g) of faecal samples were collected each from three hundred and eighty-four (384) dog in Guyuk, Hong, Yola-North, Mubi-North, and Michika local government areas. For a fair representation, a simple random sampling techniques was employed to select two local government areas each from the three geopolitical zones across Adamawa State making a total of six (6) Local Government areas. Data form was designed with clear information on sex of dogs, season of the year in which the stool sample was collected and either the dogs were restricted (home-owned) or un-restricted (strayed).

Laboratory Procedure

The dog faecal samples collected were processed by using formalin- ether sedimentation technique and were microscopically examined under low power at X10 magnifications and under high power at X40 magnifications for the presence of *E. granulosus* cysts. All the three hundred and eighty-four (384) faecal samples were tested in the Parasitology Laboratory of Federal Medical Centre Yola.

Data Analysis

The data collected was analysed using SPSS software, version 26 to assess the presence of any significant differences between dogs' location, gender and between stray and home owned dogs and also the relationship between the prevalence of *E. granulosus* in wet and dry season

RESULTS

Prevalence of *E. granulosus* cysts in stool samples of dog.

Table 1 showed that out of the 384 dog faecal samples examined, 171(44.5%) sheds *E. granulosus* cyst stool, with prevalence rate of 34(53.1%) in Guyuk, 29(45.3) in Lamurde, 28(43.8%) in Hong, 26(40.6%) in Yola-North, 29(45.3%) in Mubi-North, and 25(39.1%) in Michika. Statistically, there was a significant difference in the epidemiology of *E. granulosus* in the different Local government areas studied (P <0.05)

Prevalence of *E. granulosus* cyst in stool sample of dogs in relation to gender

As presented in table 2, a total of 384 male and female dog stool samples were examined from six (6) local Government from the study area out of which 239 were male dogs and 145 were female dogs. The result showed a prevalence rate of 30.5%bin male dogs as compared to female that showed a prevalence rate of 32.4%. Statistically the table showed significant difference in prevalence of *E. granulosus* with respect to dog gender (P<0.05).

Prevalence of *E. granulosus* cyst in relation to dry and rainy season in the study area

The result in table 3 showed a total of dog faecal samples collected each for rainy and dry season. *E. granulosus* proved to be more prevalent in the rainy season with infection rate of 82(42.7%) as compare to dry season with 64(33.3%) infection rate. The result revealed that dogs from Guyuk local area recorded high prevalence both in the dry season and rainy season as 13(40.6%) and 16(50.0) respectively followed by Yola-North with 15(46.9%) in the rainy season and 12(37.5%) in the dry season. Samples collected from dogs in Mubi-North recorded least prevalence of 8(25.0%) in both rainy season and dry season. The result showed significant statistical difference among the dogs' stool samples from different local government areas (P<0.05).

Prevalence of *E. granulose* in restricted and un-restricted in relation to gender

Table 4, revealed that out of 384 stool samples collected and examined, 192 faecal samples were from restricted dogs where 130 were males and 62 were females with a prevalence of 33.1% and 29.0% respectively. Similarly, a total of 192 faecal samples were collected from un-restricted dogs out of which 112 were from males and 80 were from females. Prevalence of *E. granulosus* cysts were observed in un-restricted male dogs as 46.2%)and 46.3%. There was no significant difference between male and female dog of both the restricted and unrestricted dogs (P>0.05). However, there was a significant difference between restricted and unrestricted dogs (P<0.05).

Table 1: Prevalence of *E. granulosus* cysts in faecal samples of dog in regards to LGA.

LGA	No. Examined	No. Positive (%)
Guyuk	64	34(53.1)
Lamurde	64	29(45.3)
Hong	64	28(43.8)
Yola-North	64	26(40.6)
Mubi-North	64	29(45.3)
Michika	64	25(39.1)
Total	**384**	**171(44.5)**

Table 2: Prevalence *of E. granulous* in faecal samples of dog in relation to gender

LGA	Gender			
	Males		Females	
	No. Examined	No. Positive(%)	No. Examined	No. Positive(%)
Guyuk	38	12(31.6)	26	10(38.5)
Lamurde	38	13(34.2)	26	9(34.6)
Hong	41	16(39.0)	23	8(34.8)
Yola-North	40	17(42.5)	24	7(29.2)
Mubi-North	38	8(21.1)	26	7(26.9)
Michika	44	7(15.9)	20	4(20.0)
Total	**239**	**73(30.5)**	**145**	**47(32.4)**

Table 3: Prevalence of *E. granulosus* cyst in relation to dry and rainy season

LGA	Dry season		Wet season	
	No. Examined	No. Positive (%)	No. Examined	No. Positive (%)
Guyuk	32	13(40.6)	32	16(50.0)
Lamurde	32	12(37.5)	32	13(40.6)
Hong	32	9(28.1)	32	14(43.8)
Yola-North	32	12(37.5)	32	15(46.9)
Mubi-North	32	8(25.0)	32	8(25.0)
Michika	32	10(31.2)	32	16(50.0)
Total	**192**	**64(33.3)**	**192**	**82(42.7)**

Table 4. Prevalence of *E. granulose* in restricted and un-restricted dogs in relation to gender

Variables	Gender				Total Positive (%)
	Males No. Examined	No. Positive (%)	Female No. Examined	No. Positive (%)	
Restricted	130	43(33.1)	62	18(29.0)	**61(31.8)**
Un-restricted	112	52(46.2)	80	37(46.3)	**127(66.1)**
Total	**242**	**95(39.3)**	**142**	**55(38.7)**	**188(49.0)**

DISCUSSION

Out of the total 384 dog faecal samples examined in this study, *E. granulosus* recorded an overall prevalence of 44.5%. However, in a similar work, Gong *et al.* (2021) and Oba *et al*. (2016) reported a lower prevalence rate of 15.17% and 14.5% respectively. The *E. granulosus* prevalence in dogs was also observed in Nigeria in a recent meta-analysis study that reported markedly lower values in West Africa (5.5%) compared to East (23.4%) and North Africa (24.7%) (Ohiolei *et al.,* 2020). The prevalence of *E. granulosus* in relation to gender in the present study observed a higher prevalence rate in female (32.4%) compared to the male (30.5%). The findings are in agreement with a study by Awosanya *et al. (*2021) who reported high prevalence in male dogs than in the female dogs. Bitrus *et al*. (2021) conducted a similar research in Jos-plateau and reported a prevalence rate of 7.50% in male and 4.10% in female dogs which is lower than the findings from the present study. The high prevalence of *E. granulosus* in male dogs in this study may be attributed to more faecal samples available and collected for the study as observed by Bitrus *et al*. (2021). High infection rate of 16(50.0%) was recorded during the rainy season compared to the dry season with lowest prevalence of 25.0% infection rate. Meta-analysis of the prevalence of Echinococcus in dogs in China from 2010- 2019 reported a prevalence of *E. granulosus* cyst as 11.20%, 10.20%, 10.00% and 10.90% during Spring, Summer, Autumn and winter season respectively which are lower than the pooled prevalence rate of 44.5% recorded in this study. In a similar study, Idika *et al. (*2017) reported a prevalence of gastrointestinal helminths in Enugu State, South- Eastern Nigeria with infection rate of 68.59% in rainy season and 26.49% 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 indicates 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 survive snow and freezing conditions (Li *et al.,* 2019). The prevalence rate of *E. granulosus* in restricted male dogs was 33.1% and 29.0% in restricted female dogs while 46.2% and 46.3% prevalence was recorded in un-restricted male and female dogs respectively. The findings in the present study is in agreement with a similar study reported by Igole *et al. (*2018). Contrary to the high prevalence of *E. granulosus* infection in unrestricted dogs (66.1%) as observed in this present study, Bitrus *et al*. (2021) reported a lower infection rate of 10.9% in Jos-Plateau State. The high infection rate of *E. granulosus* in the present study may be related to risk factors in the study areas including dog roaming, having slaughter slabs in the vicinity, feeding of visceral or offal, and lack of dog deworming frequency. The tendency to underfeed dogs in rural and urban areas or to provide them poor diet quality encourages their predatory behaviour thus increasing the risk of acquiring *E. granulosus* infection. In this respect, rodents have been assumed to play a role in the transmission of *E. granulosus* acting as intermediate hosts potentially preyed by dogs.

CONCLUSION

In comparison to other studies from African countries, a higher prevalence of E. granulosus in strayed and owned dogs was found in Adamawa State. Dogs living in suburban areas and kept for security purposes were more likely to become

infected. Moreover, large number of dogs used for hunting are not treated and are allowed to stray. Therefore, appropriate and regular treatment of praziquantel performed by qualified personnel is highly recommended to reduce risk of E. granulosus transmission to humans.

ETHICAL APPROVAL

Ethical approval was obtained from the ethical committee, Adamawa state ministry of health for the conduct of the research and we hereby declare that there was no competing or conflicting interest

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