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RESEARCH ARTICLE

PRELIMINARY INVESTIGATION OF CYSTIC ECHINOCOCCOSIS IN ANIMALS SLAUGHTERED IN DELTA STATE, SOUTH-SOUTH, NIGERIA

B. C. Okolugbo^{1*}, A. E. Abanimoro¹, V. U. Amuta¹, E. Imonitie¹, H. Ikechukwu¹, I. P. Otuata¹, A. P. Nwokebi¹, A. F. Ikomoni¹, J. Kpekpeduke¹ and S. A. Luka²

¹Department of Animal and Environmental Biology, Delta State University Abraka, Nigeria

²Department of Zoology, Ahmadu Bello University Zaria, Nigeria

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ABSTRACT

Aims: Cystic Echinococcosis (CE) or hydatid disease (HD) is a wide-spread zoonotic disease caused by the cestode parasite *Echinococcus granulosus* (sl). This study was aimed to carry out a preliminary investigation on the prevalence of the disease in animals slaughtered in Delta State, Nigeria. **Study Design:** A cross sectional study to determine the status of CE in 5 towns in Delta State, Nigeria was undertaken between the months of August 2021 – July 2022. **Methodology:** 1132 animals comprising of cattle, goats and pigs were investigated for the presence of hydatid cysts at postmortem. Information on knowledge, perception and risk factors of the disease among 500 randomly selected individuals was also investigated using a structured questionnaire. **Results:** Of the 1132 animals, 11 were positive for cystic echinococcosis giving an overall prevalence of 0.97%. Prevalence was highest in Obiaruku (3.01%), followed by Abraka (0.88%) and lowest in Eku (0%) (P=0.012). Cattle were the most infected followed by goats and the least was pigs with prevalence values of 2.9%, 0.37% and 0.32% respectively (P=0.266). All infected animals were females and aged ≥ 4 years, difference in the rate of infection across sex and age group was not statistically significant. Association between prevalence and risk factors (sex and age) was not statistically significant (P=0.189% and 0.169% respectively). Eleven visceral organs harbored one or more hydatid cysts and the occurrence of cysts was 100% in the liver. A total of 12 hydatid cysts were recovered from visceral organs and classified as 'small' and 'fertile' cysts. There was no association (P=0.560) between size of cyst and organs infected. Analysis of questionnaire revealed that 82% of respondents are ignorant of the disease, 85% disposed infected offal indiscriminately and 90% practice home slaughtering of animals. **Conclusion:** This study has revealed a potential for increased transmission of CE within the area due to prevalent factors that could favor transmission and this calls for concern. There is therefore need for further investigation to ascertain a clearer picture of the disease status in the area. Routine meat inspection and regular visits by health officials to abattoirs as well as public enlightenment on this disease is advocated.

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INTRODUCTION

Cystic echinococcosis (CE) also referred to as hydatid disease (HD) is a zoonotic food borne-disease caused by the larval stage of the cestode parasite *Echinococcus granulosus* species complex [1]. It is wide spread and has been described as a neglected zoonosis of increasing public health concern [2]. The definitive hosts for CE are canids (dogs) while several domestic animals such as camel, pigs, goats, cows, sheep etc, serve as intermediate hosts [3]. CE has a worldwide distribution and is endemic in many countries but higher in developing countries especially in rural communities where there is close contact between dogs and various domesticated animals [4,5]. It is a preponderant infection in Africa with the northern and eastern regions mostly implicated. In Nigeria however, there have been limited reports on the prevalence of CE, and available reports have shown prevalence to vary with location and host range [6]. Cystic echinococcosis continues to elicit global concerns most especially because of the attributed losses to the livestock industry as well as other public health concerns. This is very significant as the livestock industry is a major source of protein supply for large populations especially in small and slow growing industries relative to the population relying on it for meat [7].

Importantly, in Nigeria, current reports have shown that disease infestation is a major reason for decline in meat production and lack of good quality meat [8,9,10]. From the available records on studies on cystic echinococcosis across Nigeria, the exact picture and status of CE still remains unclear as most of the states including Delta are yet uninvestigated [2], Delta State inclusive. This implies a dearth of robust information and data on the status of CE in Nigeria and this has hampered planning and other interventions for proper management of the disease especially with respect to host range, risk factors and transmission dynamics. Arene in 1984 and 1985 documented the first reports on CE in domestic livestock [11] and dogs [12] in Port-Harcourt Rivers State, Nigeria; this is the only report from South-south region of Nigeria. To the best of our knowledge, this current study is the first documented report of CE in animals in Delta State and information from this study will provide baseline data for further studies in the region at large.

MATERIALS AND METHODS

Study Area: This study was conducted in Obiaruku, Abraka, Eku, Sapele and Ughelli which are major towns representing four local

government areas in Delta State; Ukwani, Ethiope East, Sapale and Ugheli North respectively. The entire study area lies between latitude 6.1023°E and longitude 5.500°N (Fig 1). Apart from Abraka being a University community, all five towns are not too different from each other as they share similar characteristics in terms of geography and other social cultural affinities. In fact, Obiaruku and Abraka have almost merged to become a metropolis even though they speak different languages and belong to different local government areas and the same can be said of Abraka and Eku. The total area is characterized by typical wet and dry seasons occurring between March to October as well as November to December respectively with temperatures ranging from 68°F and 89°F across both seasons. The inhabitants cut across different spheres but comprised mainly of petty traders, farmers, fishermen, civil servants/professionals and university students (especially in Abraka which is a university community).

Study Animals and Population: The study population comprised all cattle, goats and pigs presented for slaughter at the different abattoirs within the study area and study period.

Sample Collection: Samples were collected between the months of August 2011 and July 2022. The abattoirs were visited routinely and all animals presented for slaughter were examined. A total of 1132 animals were examined within the period of study.

Fertility of Cysts: The cysts were further observed if they were fertile or calcified. There was gross examination of individual cysts. Calcified cysts were hard and dry with no hydatid fluid and as such were not used for cysts fertility. Non calcified cysts were cut open or incised with a sterile blade and the content (hydatid fluid) emptied into a sterile beaker. The contents were then examined under the microscope for the presence of protoscoleces (hydatid sand). Those with protoscoleces were classified as fertile and those without hydatid sand classified as infertile according to standards [15,16, 7].

Statistical Analysis: Data collected were analyzed using the SPSS version 26.0 to determine significant differences between parameters. The Chi-square was also employed to check for association between variables. The confidence level was held at 95% and $P < 0.05$ was considered significant.

RESULTS

Of the 1132 animals examined, 11 were positive for hydatidosis giving an overall prevalence of 0.97%. Prevalence was observed to be highest in Obiaruku (3.01%) and lowest in Eku (0%) and the difference in prevalence among the towns was statistically significant ($P=0.012$) as presented in Table 1. Data in Table 2 showed that cattle had the highest prevalence (2.98%) followed by goats while pigs the least.

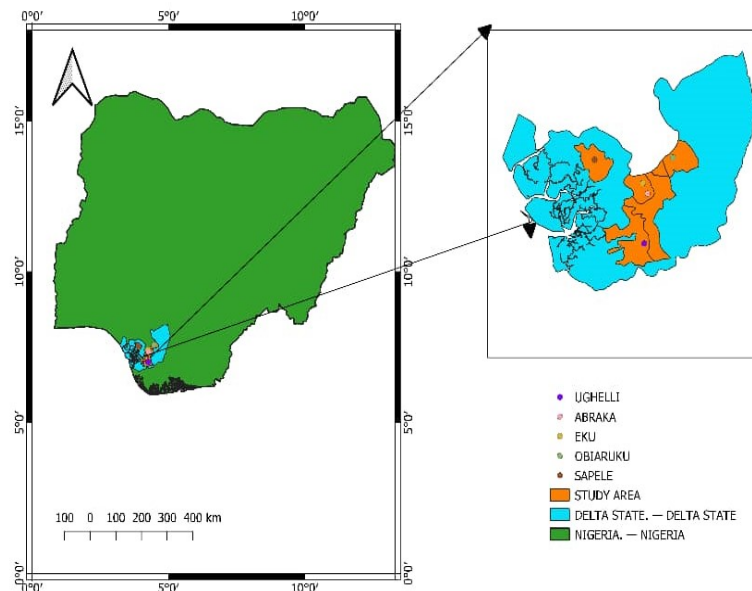


Fig. 1. Map of Delta State showing study locations

Table 1. Overall prevalence of Cystic Echinococcosis in animals slaughtered in 5 towns in Delta State

Communities	Number Examined	Number Positive	Prevalence (%)
Abraka	455	4	0.88
Obiaruku	133	4	3.01
Eku	84	-	0.00
Sapele	315	2	0.63
Ugheli	145	1	0.69
Total	1132	11	0.97

Ante Mortem and Post Mortem Examination

Prior to slaughter, information on the age, sex, origin and breed of animals were obtained and recorded. Following slaughter, animals were subjected to postmortem examination for the presence of cystic lesions. The Organs specifically the liver, lungs and heart were inspected for the presence of hydatid cyst by visualization and palpation [13,5]. Infected organs were incised and the cysts collected in 10% formalin and taken to the Parasitology Laboratory, Delta State University, Abraka for identification and characterization using the description of [14]. Information on predilection sites, type of cyst and the number of cysts was all collected; using a ruler, confirmed hydatid cysts was categorized into small, medium and large.

The difference in infection rates between the animal species was however not statistically significant ($P=0.266$). Furthermore, all positive cases recorded were females (Table 3) and aged four years and above (Table 4). Statistical analysis revealed no significant difference in infections across age groups and sex ($P= 0.189; 0.266$).

A total of 12 hydatid cysts (10 from cattle and 1 each from goats and pigs) were recovered during this investigation and were all classified as 'small' and 'fertile' following standard procedures. In addition, of the 11 visceral organs infected, 8 were lung tissues from cattle and 3 liver tissues (one from pig and two from goats).

Table 2. Specie Prevalence of Cystic Echinococcosis in animals slaughtered in 5 towns in Delta State

Animals	TOWN											
	Abraka		Obiaruku		Eku		Sapele		Ughelli		Total	
	No. Ex	P (%)	No.Ex	P (%)	No. Ex	P (%)	No.Ex	P (%)	No.Ex	P (%)	No. Ex	P (%)
Cattle	150	4 (2.7)	66	4 (6.06)	60	0(0)	0	0 (0.00)	0	0 (0.00)	276	8(2.98)
Pigs	100	0 (0.0)	55	0 (0.00)	12	0 (0)	0	0 (0.00)	145	1 (0.69)	312	1(0.32)
Goats	205	0 (0.0)	12	0 (0.00)	12	0 (0)	315	2 (0.63)	0	0 (0.00)	544	2(0.37)
Total	455	4 (0.88)	133	4 (3.01)	84	0 (0)	315	2 (0.63)	145	1(0.69)	1132	11(0.97)

$P=0.266$

Table 3. Prevalence of Cystic Echinococcosis in relation to sex in slaughtered in 5 towns in Delta State

Animals/ SEX	Cattle		Pigs		Goats	
	No. Ex	P(%)	No.Ex	P(%)	No. Ex	P (%)
Male	126	0 (0)	105	0 (0)	232	0 (0)
Female	150	8 (5.33)	207	1(0.48)	312	2 (0.64)

$P=0.169$

Table 4. Prevalence of Cystic Echinococcosis in relation to Age of animals slaughtered in abattoirs in 5 towns in Delta State

Age (Months)	Cattle		Pigs		Goats	
	No. Ex.	P(%)	No. Ex.	P(%)	No. Ex.	P(%)
0-24	89	0 (0)	88	0 (0)	113	0 (0)
25-48	111	3 (2.70)	113	1(0.48)	181	0 (0)
≥49	76	5 (6.58)	111	1 (0.90)	250	2 (0.80)

$P=0.189$

Table 5a. Organ Involvement and Hydatid Cyst Count of infected animals slaughtered in abattoirs in 5 towns in Delta State

Animal Species	Organ	No. of infected organ
Cattle	Lung	-
	Liver	8
	Heart	-
Pig	Lung	-
	Liver	1
	Heart	-
Goat	Lung	-
	Liver	2
	Heart	-

$P=0.560$

Table 6. Risk Factors for Cystic Echinococcosis among respondents in and around abattoir

Questions (section 1)	Response			
	Yes (%)	No (%)	Not sure (%)	Total (%)
1. knowledge of the disease	75 (15)	410 (82)	15 (3)	500 (100)
2. Home slaughtering of animals	450 (90)	35 (7)	15 (3)	500 (100)
Section 2				
3. Method of disposal of infected offal				
i. Burning	0 (0)	500 (100)	-	500 (100)
ii. Burying	75 (15)	425 (85)	-	500 (100)
iii. Feeding to dogs/other methods	425 (85)	75 (15)	-	500 (100)

There was no association between cyst abundance, cyst size and organ infected. The result is presented in Table 5. Questionnaire analysis of some risk factors revealed that of the 500 respondents, only 75 (15%) have heard or knows something about the disease, 410 (82%) had no knowledge or information whatsoever and 25 (5%) were indifferent. With respect to how animals are slaughtered, of the 500 respondents, 450 (90%) practiced home slaughtering of animals and only 35 (7%) do not. In addition, 85% (425) Of respondents dispose infected offal indiscriminately by feeding them to dogs. Result is presented in Table 6.

DISCUSSION

Despite the growing knowledge on the epidemiology of cystic echinococcosis, the disease continues to be a public health concern especially as a result of scanty data from remote and developing areas.

In this study, the overall prevalence and specie prevalence for cattle, pigs and goats was quite low compared to previous studies in other parts of the world especially in regions where the disease has become endemic. A foremost work of [17] documented a prevalence of 55.5% in camels slaughtered in Sokoto, other works on camels include those of [18], [19] reported prevalence of 26.2% and 20.5% in camels in Northern Nigeria while [3] reported prevalence of and 52.9% in Cattle in South West Ethiopia. Interestingly, camels are the major intermediate hosts for CE and their life style and longevity encourages the development and life cycle of *E. granulosus* spp. This could be a major reason for the high prevalence recorded in these studies in Northern Nigeria. Similarly, Ethiopia is known to be highly endemic for CE and this has been mostly attributed to the high population of dogs in the surrounding, the attitudes towards ownership and management of dogs as well as the method of cattle rearing [20-22]. However, results from this study are comparable to those of [13] who recorded a prevalence of 1.8% in cattle and [22]

who reported prevalence of 0.07% and 0.03% in cattle and goats respectively. In the same vein, the result from this study is similar with that of [6] who recorded prevalence of 0.47% and 0.31% in cattle and goats respectively. The low prevalence in this current study can be attributed to the nature of animal husbandry in this part of the country where cattle, goats, pigs and other farm animals are not reared together and rarely allowed to roam. Areas where there is mixed animal husbandry has shown the tendency to harbor infection because there is ease of transmission from one animal to another as they move together and forage [23]. There have been various reports on CE across the country to varying degrees and all these differences can be attributed to factors such as animal husbandry practices and distribution of free range hosts [24,25], climate [3], strain differences and host susceptibility [26,27], method of diagnosis [21], age [5], temperature, environmental condition and degree of pasture contamination [26]. Generally, livestock infection varies from one country to another but countries with known hyperendemicity such as Kenya, Ethiopia and Nigeria are known [15].

In this study, more females were infected across animal species examined although not statistically significant; it implies that all animals were equally susceptible to the infection. However, [27] reported a significantly higher prevalence in females. The high prevalence recorded for females in this study could be as a result of the higher ratio of female to male animals sampled. This is corroborated by findings of [26]. In addition, it has been reported that prevalence is usually higher in females than males, as males are generally preferred for slaughter than females because females are retained for breeding purposes and this allows them to live longer, giving them a better opportunity to be infected [27]. Older animals were more infected across species in this study. This is in agreement with previous findings; [28,29] and [5] all recorded higher prevalence in older animals. The high prevalence in older animals has been attributed to the fact that older animals have a greater possibility of being exposed to the parasitic ova over in grazing areas than younger ones and also a greater opportunity to have ingested larger number of *E. granulosus* eggs and the cysts having a greater chance to increase in size and mature [30,3] as observed in camels. All hydatid cysts recovered from this study were from the liver tissue and this is in agreement with previous studies that have established the preference of cysts to lungs in camels and liver in other intermediate hosts such as cattle, sheep, pigs and goats [23, 28, 27]. A total of 12 hydatid cysts (small and fertile) were recovered across species during this study at an average of one cyst per animal species. This could be an explanation for the low prevalence recorded during this study. Small cysts could be as a result of several factors such as the biotic potential of *E. granulosus* eggs as reported by [15], immunological response the host [31]. It is however important to note that palpation of visceral organs must be done patiently and skillfully or else, cysts may be missed especially if very small and could result in passing such animals as negative for infection. The 100% fertility rate of cysts from this study should not be taken lightly as these could serve as reservoir for the parasite and thus maintain the cycle of transmission. The poor perception of the disease, backyard slaughtering of animals and the indiscriminate disposal of offal from this study is worrisome as these are important factors in the epidemiology of the disease. The habit of backyard slaughtering especially without inspection and feeding of infected offal to dogs could favor high prevalence of CE [3,32] in the area and must be discouraged.

CONCLUSION

The livestock industry in Nigeria is very important and continues to thrive. This is because besides the need to meet dietary requirements, it is a major occupation for many especially in certain parts of the country. However, reports on CE and other food borne diseases and zoonoses are scarce as several states still remain unmapped. This is the first scientific report from Delta State, Nigeria. Though this study has recorded a relatively low level of CE in food animals when compared to earlier reports in the 80's from the South-South region, it has also shown the risk of increased infection due to prevalent factors

that could favor transmission. This calls for concern especially as abattoir surveys are often limited. There is therefore a dire need for further investigation covering a larger sample size to ascertain a clearer picture of the disease status in the area employing the use of more sensitive techniques such as ELISA and molecular approaches. Routine meat inspection and regular visits by health officials to abattoirs as well as public enlightenment on this disease is advocated.

Consent: It is not applicable.

Ethical approval: "All authors hereby declare that "Principles of laboratory animal care" (NIH publication No. 85-23, revised 1985) were followed, as well as specific national laws where applicable. All experiments have been examined and approved by the appropriate ethics committee".

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Competing Interests: Authors have declared that no competing interests exist.

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