SEROPREVALENCE OF HUMAN CYSTIC ECHINOCOCCOSIS IN SOME LOCAL GOVERNMENT AREAS OF ADAMAWA STATE, NIGERIA

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ABSTRACT

Echinococcosis is a neglected zoonotic parasitic infection affecting both domestic animals and human with serious health and economic impacts. A serological study was conducted on human subjects from six Local Government Areas (LGA) of Adamawa State. The questionnaire was designed containing information on socio-demography of subjects and the seroprevalence of human cystic echinococcosis in the study area. This community based study was conducted on consented subjects between August 2019 and April 2021. Five hundred and sixty-four (564) human blood samples were screened for IgG antibodies to Echinococcus granulosus using a commercial ELISA kit. All data were statistically analysed using SPSS Version 26. Out of the five hundred and sixty-four (564) samples screened. Two hundred and eighteen 218(38.65%) were found to be positive. The highest prevalence rate of 10.64% was recorded in Guyuk, while the lowest prevalence rate of 4.43% was recorded in Michika. The socio-demographic information of the subjects with respect to gender reveals that male had the highest prevalence (21.45%) than the female (17.19%). Participants within the age bracket 31 – 40 years had the highest prevalence (17.02%), while in relation to occupation, farmers recorded the highest percentage prevalence (16.84%). Statistically there was a significant relationship between contact/ownership of dog and dog meat consumption at p<0.05.

Keywords: *Echinococcus granulosus,* Seroprevalence, Human cystic echinococcosis, Adamawa, Nigeria

INTRODUCTION

Echinococcosis is a neglected zoonotic parasitic infection caused by metacestode (the larval stage of several species) belonging to the genus *Echinococcus*. Echinococcosis has been identified as a zoonotic infection especially in rural livestock-raising areas where humans cohabit 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 *Echinococcus granulosus* Batsch, 1786 (Cyclophyllidea: Taeniidae) (Wang *et al*., 2010). Humans infection can develop cystic lesions, principally in liver and lungs after several years (Ogunsan *et al*., 2000; Adediran *et al.,* 2014). *E. granulosus* has a worldwide geographic distribution and occurs in all continents with high prevalence in parts of Asia, Africa, Australia and South America (Reyes *et al*., 2012). Cystic echinococcosis is regarded as a global public health concern and is endemic in many parts of the world including sub-Saharan Africa (Wahlers *et al*., 2012). Over the years in Nigeria there is an increase in livestock production and dog keeping for hunting and as pets, in the rural areas and as guards in the urban areas, because of its public health significance, human cystic echinococcosis has been the subject of considerable research because of its

cosmopolitan distribution and is considered by the World Health Organization (WHO) as one of the most widespread parasitic diseases and also one of the costliest to be treated and prevented in terms of public health (Reyes *et al*., 2012). *E. granulosus* eggs can survive snow and freezing conditions (Li *et al.,* 2019). Humans can be exposed to these eggs by "hand-to-mouth" transfer or contamination, by ingesting food, water or soil contaminated with stool from infected dogs, this might include grass, herbs, greens, or berries gathered from fields and also by petting or handling dogs infected with the *E. granulosus,* infected dogs may shed the *E. granulosus* eggs in their stool, and their fur may be contaminated (Adediran *et al*., 2014).

Multiple risk factors are known to play important roles in *E. granulosus* prevalence and transmission, including dog contact, ownership, and lack of awareness, agricultural practices, animal herders and residency near or in rural areas with nomadic populations (Agudelo Higuita *et al.,* 2016). Due to the spread of infection in various parts of the body and lack of proper diagnosis method, serologic methods are quite useful in the diagnosis of the disease (WHO, 2021). The most appropriate immunoglobulin for detection of cystic echinococcosis or exposure to parasite is referred to as 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 seroepidemiological studies, many researchers have reported on the prevalence of human hydatidosis by ELISA from several countries (Rakhshanpour *et al*., 2012).

Considering the pathological effect of echininococcus on humans, the results obtained will provide information on the prevalence status and the risk factors for acquiring the infection. Hence the objective of this study among others was to determine the seroprevalence of *Echinococcus* antibody IgG in some LGAs of Adamawa State, Nigeria.

MATERIALS AND METHODS

Study Area: Adamawa State located in the north-east geopolitical zone of Nigeria, is one of the largest states of Nigeria and occupies 36,917 square kilometres. The state is bordered by Borno to the northwest, Gombe to the west, and Taraba to the southwest, while its eastern border forms part of the national border with Cameroon (Wikipedia, 2023). 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 rivers Gongola and Benue and their tributaries also engage in fishing. 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, where there is 0 mm of precipitation. Most of the precipitation occurs in August with 211 mm level of rainfall. April is the warmest with highest temperature of 32^0C and December is the coldest month with lowest temperature of 25.9 ^{0}C (Adebayo *et al*., 2020).

Experimental Design: An epidemiological survey experimental design was adopted involving 564 blood samples collected from subjects in six Local Government Areas (LGAs) of Adamawa State, Nigeria. Random sampling technique was adopted for the blood samples collection. The samples were collected over a period of one year between August, 2020 to August, 2021 covering dry and wet seasons. Blood samples were collected with the aid of health personnel in the laboratory of the Primary Healthcare Centres of the respective LGAs (Lamurde, Guyuk, Yola-North, Hong, Mubi-North and Michika).

Ethical Approval: Ethical approval for this study was obtained from the Ethical Committee, Adamawa State Ministry of Health. Consent was sought and obtained from the community heads

in the study locations, and that of the participants. The none-disclosure principle was observed as identity of all participants was not disclosed.

Sample Size: As at 2020, the studied population was 1,485,600 persons belonging to the six LGAs (City Population, 2020). The sampled size was derived using the formula: $n = Z^2P(1 - P)/d^2$ where n = sample size, Z = Z statistic for level of confidence, P = expected prevalence, and d = precision (Naing *et al.*, 2006). A total of 564 blood samples was collected, 94 blood samples from each of the six local government areas.

Data Collection: Non parametric data on the socio-demography of participants and the seroprevalence of human cystic echinococcosis in the study area was collected using closed ended structured questionnaire to obtain information from the study participants with the help of an interpreter. Questionnaire was face validated, pretested and tested for reliability before administration (Roopa and Rani, 2012). The data sought by the questionnaires included the knowledge of the disease, management of the disease, age, sex, occupation, location (LGA), dog ownership, dog contact and dog meat consumption.

Laboratory Analysis: Laboratory analyses of sampled blood sera were ran in the Serology Laboratory of Federal Medical Centre, Yola, Adamawa State, Nigeria. Enzyme-Linked Immunosorbent Assay (ELISA) for *E. granulosus* Antigen test kits and ELISA reader was used (Savardashtaki *et al.*, 2019).

Statistical Analysis: The data collected from the non parametric and parasitological examinations were analysed using Chi-square statistics to assess significant differences between age, gender, location, dog contact/ownership and dog meat consumption. Significant difference was set at $p<0.05$ and all analyses were done using SPSS version 26.

RESULTS

Seroprevalence of *Echinococcus* Antibody (IgG) in Adamawa State: Out of the total 564 blood samples collected from the participants, 218(38.65%) were infected with human cystic *Echinococcus*: Guyuk (10.64%), Lamurde (8.33%), Hong (5.140%), Yola-North (4.96%), Mubi-North (5.31%) and Michika (4.43%) (Table 1). Statistically there was significant difference ($p<0.05$) in the prevalence of *E. granulosus* antibody in the Local Government Areas of Adamawa State, Nigeria.

Table 1: Seroprevalence of *Echinococcocus* antibody (IgG) in some Local Government Area, Adamawa State, Nigeria

LGA	Number Examined (%)	Number Positive (%)
Guyuk	94(16.66)	59(10.64)
Lamurde	94(16.66)	47(8.33)
Hong	94(16.66)	29(5.14)
Yola-North	94(16.66)	28(4.96)
Mubi-North	94(16.66)	30(5.31)
Michika	94(16.66)	25(4.43)
Total	564	218(38.65)

Seroprevalence of *Echinococcus* Antibody (IgG) in Relation to Socio-Demographic Information of the Subjects: Out of the 564 blood samples that were collected and examined, 295(52.30%) were males and 269(47.7%) were females. The prevalence of echinococcus antibody of 21.45 and 17.19% were recorded in male and female respectively (Table 2). This indicated that there was a significant difference ($p<0.05$) in the seroprevalence of *Echinococcus* antibody with respect to sex. Regarding the age group of the subjects, the highest prevalence was recorded among the ages 31 – 40 years with infection rate of 17.02% and the least prevalencewas recorded among the ages of 61 – 70 with infection rate of (0.70%) and there was a significant difference ($p<0.05$) in prevalence of echinococcus antibody in relation to age group. In respect to the socio-economic status of the subjects, farmers had the highest prevalence 165(29.25%) and highest infection rate of 16.84% and the civil servants with low prevalence of 14.53% and least infection rate

(4.70%) and statistically indicates significant difference in the socio-economic status of the subjects at p<0.05.

Table 2: Seroprevalence of *Echinococcus* antibody (IgG) in relation to Socio-demographic information of the subjects

Variables	Number Examined (%)	Number Positive (%)
Gender		
Males	295(52.30)	121(21.45)
Females	269(47.7)	97(17.19)
Age Group (Year)		
11-20	165(29.25)	18(3.19)
21-30	149(26.41)	53(9.39)
31-40	150(26.59)	96(17.02)
41-50	83(14.71)	31(5.49)
51-60	49(8.69)	16(2.83)
61-70	20(3.55)	4(0.70)
Occupation		
Farmers	165(29.250	95(16.84)
Business	148(26.24)	68(12.05)
Civil Servants	82(14.53)	27(4.70)
Students	169(30.08)	28(4.96)
Total	564	218(38.65)

Seroprevalence of Echinococcus Antibody (IgG) in Relation to Some Risk Factors (Dog Contact/Ownership and Dog Meat Consumption): The result in Table 3 depicts the epidemiology of human cystic echinococcosis antibody (IgG) regarding risk factors. Out of the 348(61.70%) samples examined with information on either having dog contact or ownership had prevalence of 141(40.51%), while 201(35.63%) samples with information on dog meat consumption examined had prevalence of 77(38.31%) with cystic echinooccosis with no significant difference (p>0.05) with regards to contact/ownership in the epidemiology of human cystic echinococcosis and a significant difference (p<0.05) with relation to dog meat consumption and non-dog meat consumption.

DISCUSSION

A total of 564 blood samples were collected and examined for the presence of *E. granulosus* antibody, 38.65% were positive with the commercial *E. granulosus* ELISA kits.

The result obtained was in line with the findings of Alvi *et al*. (2021) who reported 19.61% human cystic echinococcosis in Pakistan. Khabisi *et al.* (2021), reported high prevalence of human cystic echinococcosis (12.5%) in Zahedan city in Iran. Ahmed *et al.* (2010) also reported seroprevalence of human cystic echinococcosis (14.8%) in Ktartoum in central Sudan, while in Nigeria a recent study by Bitrus *et al.* (2020) reported a prevalence of human cystic echinococcosis (3.30%) in some parts of Plateau State, this was considerably lower compared to the present study, though the sampled size was higher in the present study. Human cystic echinococcosis in relation gender showed that males had the highest infection rate of 55.50% compared to their female counterparts with 44.50%. This finding was in line with the findings of Hezarjaribi *et al*. (2017) that reported highest prevalence of 63.8 % and 36.2% for male and female respectively in Mazandaran province of Northern Iran. Furthermore, Andrabi *et al.* (2020) reported prevalence of human cystic echinococcosis of 6.81 and 2.54% in male and female respectively from South Kashmir, India. Contrary to this study Shafiei *et al.* (2016) in their systematic review and meta-analysis reported a higher prevalence of 3.60% and 2.10% in female and male respectively. Another study from Jos, Plateau State, Nigeria by Bitrus *et al.* (2020) reported higher prevalence in female (4.10%) than in males (2.80%). The high prevalence may be as a result of women washing infected fruits and vegetables and are thus exposed to eggs of a parasite than men. However, in a recent study on the prevalence of human cystic echinococcosis in the towns of Ñorquinco and Ramos Mexia in Rio Negro Province, Argentina, no significant relationship was observed between gender and sero-positivity to the hydatid cyst (Uchiumi *et al.,* 2021).

This study have shown that human cystic echinococcosis can affect both male and females the variation in the prevalence of the infection in relation to gender may be as a result of differences in hygienic practices, exposure to the risk factors which are associated with the epidemiology of *E. granulosus.*

Table 3: Seroprevalence of *Echinococcus* antibody (IgG) in relation to some risk factors (dog contact/ownership and dog meat consumption

LGAs	Dog Contact/Ownership		Dog Meat Consumption	
	Number Examined (%)	Number Positive (%)	Number Examined (%)	Number Positive (%)
Guyuk	73(20.98)	39(11.2)	49(24.34)	20(9.95)
Lamurde	44(12.64)	23(6.60)	33(16.41)	24(11.94)
Hong	54(15.52)	21(6.03)	11(5.47)	8(3.98)
Yola-North	63(18.10)	24(6.89)	38(18.91)	4(1.99)
Mubi-North	58(16.66)	18(5.17)	36(17.91)	12(5.97)
Michika	56(16.1)	16(4.59)	34(16.96)	9(4.47)
Total	348	141(40.51)	201	77(38.31)

The prevalence of human cystic echinococcosis in relation to age indicated that the maximum infection occurred amongst volunteers within the age group of 31 – 40 (17.02%). This may be due to the vulnerability of members of the age group to the risk factors associated with human cystic echinococcosis. The finding of this study were in agreement with findings of Bitrus *et al.* (2020) and Khabisi *et al.* (2021) respectively, but contrary to the findings of Andrabi *et al*. (2020). The findings of this study on the prevalence of human cystic echinococcosis in relation to socio-economic status of the participants was in agreement with the findings of Hezarjaribi *et al.* (2017), but contrary to the findings of Ahmed *et al.* (2010) and Khabisi *et al.* (2021). The high prevalence of human cystic echinococcosis with respect to occupation in the study area may be due to exposure to multiple risk factors. Some risk factors including dog contact/ownership and dog meat consumption were major risk factors taken into consideration in this study as indicated by the high prevalence of 141(40.51%), 77(38.31%) with regards to dog contact/ownership and dog meat consumption respectively. Prevalence from the different local government areas showed high infection rate with regards to contact/ownership as 39(11.2%), 24(6.89%), 23(6.60%) 21(6.03%), 18(5.17%), 16(4.59%) in Guyuk, Yola-North, Lamurde, Hong, Mubi-North, Michika respectively and dog meat consumption prevalence of 24(11.94%), 20(9.95%), 12(5.97%), 9(4.47%), 8(3.98%), 4(1.99%) in Lamurde, Guyuk, Mubi-North, Michika, Hong and Yola-North respectively.

High prevalence of the infection was recorded in local government areas with considerable number of risk factors. The findings of the present study was similar to the findings of Chaâbane-banaoues *et al.* (2016) in Tunisia who reported high prevalence of human cystic echinococcosis (26.0%) in the study areas with multiple risk factors.

Conclusion: This research work has shown that the prevalence of human cystic echinnococcosis can be associated with the established risk factors in the study areas. The result obtained from the present and other available studies have emphasize on the public health implication of human cystic echinococcosis, especially in regions where cases of both human and animals have been reported and factors enhancing transmission, information on risk factors and epidemiology is under-investigated regardless of its high zoonotic potentials.

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