

Prevalence and Risk Factors of Taeniasis in the Bunkpurugu-Yunyoo District of Northern Ghana

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Abstract

Although *Taenia solium* infestation and cysticercosis have been documented as the main causes of acquired epilepsy and their recognition as important public health hazards has risen over the past 10 years, there is lack of information on the disease burden due to Tape worm infestation and its associated risk factors in the rural communities of northern Ghana. This study was conducted to evaluate the prevalence of Taeniasis and document its associated risk factors. The study describes the results of a cross-sectional survey involving 494 participants, selected by a village-based random sampling method from a population of 99,729 in 4 villages. Stool samples from selected people were examined by the Kato-Katz method for worm eggs/ova. Eggs were detected in 65 people (13.15%) of the Kato smears. Four factors were observed to be associated with Taeniasis infestation on multivariate analysis. A history of a family member ever contracting the disease and pork consumption were the main implicated factors for infestation (P-value = 0.003 & 0.001 respectively). Among the pork consumers, those who opted for mealy pork and people who took pork light soups prepared in the markets were observed to have higher probabilities of getting infected. Also, *Taenia* cysts were observed in 18.8% (22/117) of pigs slaughtered for consumption in the area. These carcasses were either consumed or smoked and transported to towns in the southern sector for sale. Whilst pig rearing was mostly done by the women in the area to supplement household incomes, the husbandry practices (food and feeding habits) were observed to be unsatisfactory. Health education on the need for sanitary and hygienic practices and mass anthelmintic drug administration in the area are recommended.

Introduction

Tapeworms are long, flat thin worms with segmented bodies. They lack digestive organs and absorb food through their entire body surface as they attach themselves to the lining membrane of the intestine of the human or animal host [1]. Two distinct types of disease are caused by *Taenia solium* (pork tape worm) depending upon whether it is the larvae or eggs of the worm that are ingested by the human host [2,3]. The life cycle of *T. solium* includes pigs as the normal intermediate hosts. Humans can also serve as the intermediate host and develop the cystic form by accidental ingestion of *Taenia* eggs [4], which frequently affects the central nervous system and causes cysticercosis or acquired epilepsy [5].

Whereas transmission of taeniasis to pigs occurs rapidly due to human faeces being eaten by pigs that have access to defecation sites or latrines [7], infestation with human taeniasis is acquired by eating inadequately cooked pork which contains viable larvae of the pork tape worm [8].

According to Parija and Gireesh [9], approximately 50 million people are infected with *T. solium* and about 50,000 deaths occur due to this disease worldwide every year, with not less than 20 million cysticercosis infections. Although literature on human tapeworm infestations in Ghana is virtually non-existent, studies on intestinal helminthic infections in Ghana have indicated relatively low prevalence of *Taenia* species infection [10]. A study on Soil-Transmitted Helminths by Humphries et al. [11] observed a low prevalence level (1.1%) of *Taenia solium*. In this study the prevalence of Taeniasis in the Bunkpurugu-Yunyoo District of northern Ghana is established and the transmission dynamics elucidated.

Materials and Methods

Study area

This study was conducted between October 2009 and September

2010 with the approval of the Ethics Committee of the Nugochi Memorial Institute for Medical Research, University of Ghana in the Bunkpurugu-Yunyoo District of the Northern Region of Ghana. The district occupies an area of about 70,383 square kilometers and is the largest region in Ghana in terms of land area.

The Bunkpurugu-Yunyoo district is one of the eighteen districts of the Northern Region and located at the north-eastern corner of the country. Bimobas, Konkombas and Mamprusis are the major inhabitants of the area, with a total population of 99,729 (Ghana National Census; 2000). There are over two hundred and forty communities (240) most of which are small except Bunkpurugu, Bimbagu, Nakpanduri, Nasuan, Yunyoo, Binde, Najong, Jimbale and Kambatiak. The main economic activities are farming, rearing of animals and trading.

Study design and sample size

The sample size for this study was determined taking into consideration the estimated prevalence of the variable of interest, the acceptable margin of error (5%) and the desired level of confidence [95% Confidence level]. The sample size required was calculated as follows:

$$N = \frac{Z^2 p(1-p)}{m^2}$$

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Where;

N = required sample size

Z = confidence level at 95%

p = estimated prevalence of Taeniasis in the study district

m = margin of error at 5%.

At the end of the field work, the realized sample sizes were 494 and 412 for the parasitological studies and questionnaire administration for demographic data respectively even though the estimated sample size was 407.

Data collection

A questionnaire survey was carried out to collect information on the pig-farming system and to identify potential risk factors for *Taenia solium* Taeniasis infection in pigs. Meat inspections were done on 117 slaughtered pigs with to establish the prevalence of *T. solium* cysts in the animals. Identified refuse dumps in the study villages were visited 12 times each (once every month) to ascertain the suitability or otherwise of these areas as suitable forage sites by free-ranging pigs. Also, routine visits were paid to pens and pig-housing units and their owners interviewed to ascertain the common and/or preferred food given to these animals. This was done for the two main seasons (dry and rain/wet) of the year. Reasons for the choice of food (pito mash, leftovers and fresh grasses) given to the animals was also documented.

The socio-cultural and economic activities of the people that could promote transmission of the disease such as funeral grounds, markets places, weddings and marriage ceremonies were documented.

Stool sample collection and examination

Stool samples were collected over a four month period from a random representative sample of 494 community members aged 10 years and above from all the four sub-districts (Bunkpurugu = 146; Yunyoo = 98; Nakpanduri = 167 and Binde = 83). This age group was particularly targeted because they are the most likely members of the community who could attend and actively participate in occasions where under-cooked pork may be eaten. With respect to participants aged 10–18

years, consent was sort not only from them, but also their parents.

Stool sample collection was done by recruited and trained research staff. All eligible participants were identified through a random selection of compounds/houses in selected communities using community registers. Stool sample containers were distributed to study participants in their homes a day before sample collection for them to provide samples the next morning. Fifty to sixty stool samples were collected in a day to allow for processing within 24 hours. Samples were appropriately labeled with the date of collection, identification and house numbers.

The collected samples were transported in ice-chests on ice parks to the Bimbagu Junior High School and processed the same day. Prepared slides were stored in a refrigerator and later transported to the parasitology laboratory of the Department of Animal Biology & Conservation Science, University of Ghana for examination by qualified laboratory personnel.

The Kato-Katz technique (cellophane faecal thick smear) was employed for the determination of the level of intestinal *Taenia solium* oval eggs in collected stool samples. The infestation was determined by microscopically examining 41.7mg of faecal material and systematically counting the eggs in the faecal specimens. To increase the visibility of the parasite eggs, the cellophane was soaked in a 3% methylene blue for 24 hours before usage. However, this technique cannot distinguish between *Taenia* species, and some of these cases may have been due to *Taenia saginata*. Quality control on 10% of the prepared slides (both positive and negative) was later done by an independent technologist.

Questionnaire administration

A short structured questionnaire was administered to a random representative sample of 412 community members aged 10 years and above in the study communities. Demographic data of the people as well as pork consumption patterns and other activities that could promote Taeniasis transmission in the communities was collected. The questionnaire was administered by trained field staff who spoke both the local languages/dialects and English. The collected data was analyzed using SPSS version 16.0 for Tape worm infestation by village, age,

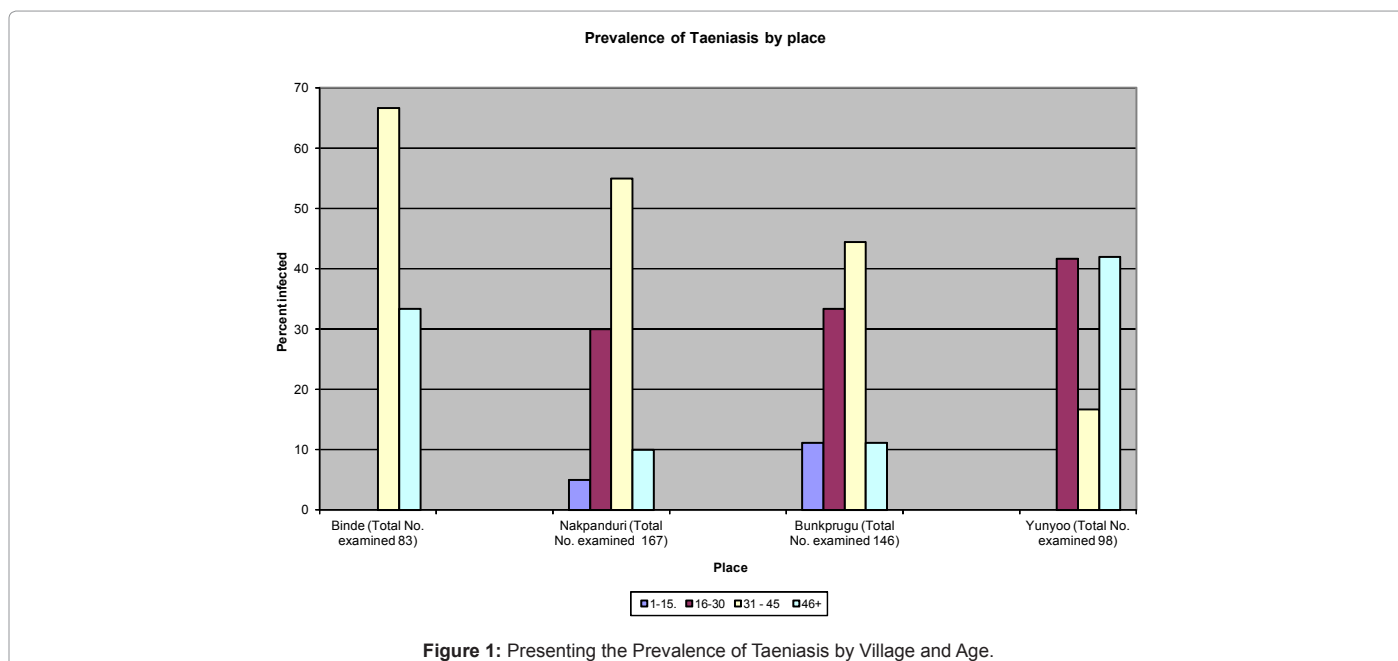


Figure 1: Presenting the Prevalence of Taeniasis by Village and Age.

Age (years)	No. examined	No. infected	Percentage infected
10 – 15	120	7	5.8
16 – 30	131	18	13.7
31 – 45	125	31	24.8
46+	118	9	7.6
Occupation			
Farmer	206	21	10.2
House wife	101	9	8.9
Trader	41	1	2.4
Civil servant	72	14	19.4
Student	74	8	10.8
Educational level			
Illiterate	211	32	15.2
Primary/JSS	120	6	0.05
SHS	85	8	9.4
Tertiary	84	7	8.3

Table 1: Presenting the Prevalence of Taeniasis Demographic Factors.

sex occupation, educational status and pork consumption practices of the participants.

Data from the survey study was analyzed with the aid of EPI INFO 6.0 (CDC, Atlanta), with statistical differences between groups calculated using Chi-Square with probability (P) and Yates Correction for small samples sizes. Further analysis of suitable data was done using odds ratios with associated 95% confidence limits and probability (P) values. The values obtained for each test were then used to determine risk factors for transmission of parasites.

Results

Of the total 494 faecal samples examined by microscopy, (191 males & 203 females), the eggs/ova of *Taenia* spp. were demonstrated in 65 subjects (13.15%) representing 26 males and 39 females. The percentage of infections were, however, very low all through the age groups with a range of 5.8 – 24.8. Generally the 31- 45 year age group recorded the highest prevalence of parasite egg in all the communities (Table 1). There was no statistical association between gender or age group and infestation status ($P>0.05$). The place of residence was not also associated to the possibility of infestation (OR, 1.25; CI, 0.58–3.28) (Figure 1).

With respect to the food and feeding habits of pigs in the study area, it was observed that the most common feeds of the animals included Pito mash, left-over foods from the kitchens and cut grasses (mostly in the rainy season). It was also unearthed that the pigs are often free-roaming during the dry season when there are no gardens/farms around the houses. These free-roaming animals feed freely on human faeces deposited around the houses and the near bushes. This attitude is further buttressed by the fact that there are no toilet facilities in the villages and people defecate very close to their homes in the surrounding farms and/or bushes.

The main reasons advanced by the local people for keeping pigs were economic. The mature animals are sold to butchers (or butchers contracted to slaughter and sell) and the proceeds used to pay school fees, finance marriages of their children, buy clothing or fetch household utensils. In this part of the country, pigs are bred by women mostly and pig husbandry is traditional and involves mainly local breeds which receive mostly domestic waste and no feed supplement.

Discussion

Soil-transmitted helminths have been observed to be widespread in its distribution in under-developed countries, with infection rates

high in regions with high temperature [12]. The present study was in such an environment and revealed a Tape worm infestation prevalence rate of 13.15%. This is the first time that a full-scale investigation of the prevalence of Taeniasis has been carried out in the district. These results corroborate reports of various researchers in many countries of the world like in India where Prasad et al. [13], observed an alarming 38.0% prevalence of Taeniasis in a pig farming community. Likewise, Kumar et al. [14] observed a 30.3% infection elsewhere. The overall prevalence of 13.15% in the present study though lower than these earlier findings, is still substantially higher than other previous reports such as those of Sanchez et al. [15] who found seropositivity for antibodies to *T. solium* cysticerci by Enzyme-linked Immuno-electrotransfer Blot (EITB) in 17% of the population and 2.5% showed *T. solium* eggs in their faecal samples in a rural community of Honduras.

As postulated by Garcia et al. [16], the study also showed that the nature of the occupation of individuals influenced the infection rate. Thus, whilst the overall prevalence was 2.4% among House wives, it was as high as 19.4% among Civil servants. The socioeconomic and behavioural factors are critical in the perpetuation of the taeniasis life cycle. Hence, domestic pig rearing with poor animal husbandry could be the most important of these factors. The risks associated with this activity, however, are difficult to estimate because of confluent factors such as poor sanitary conditions and poor knowledge of the parasite life cycle, resulting in sustained consumption of infested pork.

This study, demonstrated that pork handlers and their immediate family as well as people who specialized in pork preparations are especially at risk of infestation with Taeniasis ($P = 0.005$). Hence, most infestations were demonstrated in men who sold pork or their immediate family members. The increased risk of infection observed in food handlers was especially severe in females (60% of all infestation), perhaps because they handled raw, infected pork more frequently than did males.

Conclusions and Recommendations

From this study, it is evident that infestation with Taeniasis is not only a major public health problem in the study district, but also could cause losses of revenue to pig breeders. The customs, traditions and practices of the local people as well as the food and feeding habits of the pigs could play major roles in the persistence and spread of the disease in the district. Some of the beliefs and practices pertain to the lack of latrines and others to pork consumption practices. The relative importance of *T. solium* in the transmissions of Taeniasis in humans and cysticercosis in both humans and pigs in the district cannot be over emphasized as almost 19% of pigs killed were observed to have hydatid cysts. These situations call for preventive measures to control both Taeniasis in humans and pig cysticercosis in not only the district, but the whole country as some of the pork was often smoked and transported to other towns down south for or sale.

The probable association between an increased risk of tapeworm infestation and frequent contact with infected pork ($P = 0.003$) may suggest that pork sellers and processors should be screened routinely for tapeworms and treated appropriately. Prevention can also be achieved by the proper cooking and inspection of pork and by sanitary disposal of faeces. Health education and community sensitization on the need for sanitary and hygienic practices and mass anthelmintic drug administration in the area are recommended to control transmission of taeniasis in the district.

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