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PREVALENCE, CO-PREVALENCE AND RISK FACTORS OF PULMONARY PARAGONIMIASIS AND PULMONARY TUBERCULOSIS IN NIGERIAN CHILDREN IN THE NIGER DELTA AREA
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ABSTRACT

***Background*: Nigeria has the highest burden of paragonimiasis in Africa and it is also among the high burden countries with tuberculosis. The true prevalence of these re-emerging diseases is unknown in the country.**
***Objective*: To determine the prevalence and co-prevalence of these re-emerging diseases among children in a rural Nigerian community.**
***Design*: Descriptive cross-sectional study.**
***Setting*: Ewang, a rural fishing community in Mbo Local government Area of Akwa Ibom State, Nigeria.**
***Subjects*: Primary and secondary school children aged 5-18years living in Ewang village, Mbo Local government Area of Akwa Ibom State, Nigeria.**
***Results*: A total of 204 children were examined: 91(44.6%) were males, while 113(55.4%) were females. Ten of the subjects were sputum positive for paragonimus eggs, giving an overall prevalence rate of 4.9%, while six children were sputum positive for pulmonary tuberculosis with a prevalence rate of 2.9%. There was no case of co-infection. The peak age prevalence of paragonimus ova-positive and Acid and Alcohol fast positive subjects was recorded in the five to nine year old age group with prevalence rate of 5.6% and 7.4% respectively. There was a female preponderance among the paragonimus ova-positive subjects (90%) and the AAFB positive subjects (66.7%).**
***Conclusions*: The findings show that paragonimiasis is an emerging/ re-emerging disease in southern Nigeria and further confirmed that the prevalence of tuberculosis is still on an upward rise.**

INTRODUCTION

Paragonimiasis is one of the re-emerging public health diseases. Recently, the number of new cases of Paragonimus westermani has gradually increased (1). Most of the presenting symptoms of pulmonary paragonimiasis are similar to that of tuberculosis (TB) (2). From a clinical perspective, the striking similarities between the symptomatologies of TB and paragonimiasis constitute a major reason for the frequent misdiagnosis of one for the other (2). Furthermore, in patients with pulmonary paragonimiasis, TB may coexist in as many as 0.91% (3).

Paragonimiasis is a food-borne parasitic disease, caused by the trematode Paragonimus, a lung fluke, with about ten species associated with morbidities in man (4). The most common specie in man is *P. westermani*. Others include *P. uterobilateralis* and *P. africanus*, which are endemic in Africa (5). Human infection is acquired by the consumption of raw or partially cooked crustaceans (including crayfish and crabs),(1) as well as boars in Japan (4). Human infection consists of an acute and a chronic phase. The chronic phase consists of pulmonary and extra-pulmonary disease. The pulmonary infection is characterised by cough, haemoptysis, chest pain and radiographic abnormalities, which may even persist for several years after adequate treatment (6) However, the most reliable diagnosis of pulmonary paragonimiasis is frequently based on the presence of the parasites eggs in sputum and/or faeces (7), especially in children who usually swallow their sputum (8).

The life cycle of Paragonimus species is complex, involving two intermediate hosts which may be a snail and a freshwater crab or crayfish and one definitive host (4). Human infection occurs when these contaminated crustaceans are eaten raw, or poorly cooked.

South-south Nigeria, which includes Akwa Ibom State has a lot of similarities with those areas that paragonimiasis had earlier been described. This geo-political zone (South-south Nigeria) lies along the banks of the Atlantic Ocean and has a high annual rainfall with the consequent generation of numerous fresh water bodies (9). Furthermore, crab hunting is a favourite past time of school-aged children of these communities. Most of the crabs caught by children are frequently roasted, and it is not inconceivable that these may not be well cooked before consumption. Tuberculosis is also a major problem in this region (3).

It was against the foregoing background that the current study was designed to determine the prevalence, and risk factors associated with pulmonary paragonimiasis among school children in Mbo Local Government Area (LGA) of Akwa Ibom State Nigeria, as well as the prevalence of pulmonary TB in the same population.

MATERIALS AND METHODS

Study area: The study was conducted in Ewang village in Mbo LGA of Akwa Ibom State, Nigeria. Ewang is a rural community in the southern part of Mbo LGA. It has a distinct rainy season between May - October and a dry stretch from November – April, the peak annual rainfall is 75 cm, recorded between June and September. The elected study environment is characterised by many swift flowing rocky streams and rivers.

The major occupation of the local population comprise fishing, hunting and peasant farming, but snail hunting and crab catching constitute a favourite past time of the children of this predominantly rural community. The crab is usually roasted, and may not be properly cooked before eating. With the high cost of beef and fish relative to the income of the local population, a large proportion of inhabitants of the area depend on game for their supply of animal protein. The local tradition of eating fresh water crab, and a low level of hygiene in the population was why Mbo LGA was identified as a suitable site for this study.

Two hundred and forty children aged 5-18 years were selected by stratified random samplings from two public schools in the community.

Ethical clearance was obtained from the ethical committee of University of Uyo Teaching Hospital (UUTH), while community approval was given by the Mbo LGA council, and the Akwa Ibom State Ministry of Education. In addition, collective informed consent was obtained from the head teacher and the principal of the selected primary and secondary schools. Also, informed consent was obtained from the individual parent(s) of each of the subjects, as well as the older children / adolescents.

The inclusion criteria were: 1) Children aged 5-18 years. The choice was premised on the logistic convenience of a greater likelihood of obtaining the required sputum only from children who are five years and above (2). Children who had lived in the community for one year and above, in view of the fact that the average incubation period of the infection is six months (3). Children who had not taken anti-paragonimus medications in the preceding one year (4). Children, whose parents gave consent for their children / wards to participate in the study. Children with chronic respiratory allergies especially asthma with or without allergic rhinitis were excluded. An interviewer administered questionnaire was used. Information was obtained from the older children and parents of the younger children. Information obtained in the questionnaire included the socio-demographic data of the children, clinical parameters suggestive of pulmonary paragonimiasis and TB (cough, haemoptysis, chest pain, difficulty in breathing and fever,), past or current family history of tuberculosis and other severe illnesses. Also, a positive history of ingestion of crabs, snail and crayfish was explored in each potential subject. Methods and duration of preparation and cooking of these items before ingestion were also taken and recorded. Similarly, a history of ingestion of praziquantel, was taken to serve as an exclusion criteria. A thorough examination of the respiratory system was carried out.

Sputum was collected from each subject in a snap-cap container with formalin as a preservative and analysed. About 1.5 ml of sputum was added to 3ml of 4% sodium hydroxide. This was followed by adequate mixing and centrifugation at 1500rpm for five minutes. The resulting sediments were transferred into two microscope slides. One was observed under a light microscope at 10X and 40X magnification for the presence of paragonimus ova, while the other was stained 100X magnification for the presence of Mycobacterium tuberculosis. Those with paragonimiasis received free praziquantal 25mg / kg t.i.d for three days under supervision, while those who were acid fast bacilli positive were referred to their Local Government Directly Observed Therapy Short-course (DOTS) unit for anti-tuberculous chemotherapy.

The data were analysed with STATA 10 software, produced by STATA corp. Texas USA. The results are expressed as means, standard deviations (SD) as well as percentages. Statistical significance of difference was tested using the student t-test for continuous

variables and the X2-test for discrete variables, while the Fisher's exact test (FET) was used for variables with small numbers as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 204 children constituted the study population, comprising 91(44.6%) males and 113(55.4%) females. The male to female (M:F) ratio was 1:1.2 and there was no significant difference in the gender distribution in the study population (p=0.054). The mean age (± SD) of the subjects was 11.6 (±3.1) years. Fifty-four (26.5%) of the selected children were aged five to nine years, while 113(55.4%) were aged 10-14 years. Thirty-seven (18.1%) were adolescent subjects, aged 15-18 years.

The mean duration of stay in the community (±SD) was 9.8(±4.0) years with a range of 1-18 years. The sputum microscopy examination for paragonimus ova was positive in 10(4.9%) subjects [95% confidence interval (CI), 1.9% to 7.9%], while the ZN stain for AAFB was positive in six (2.9%) of the study participants. There was no demonstrable case of co-infection.

The peak age prevalence of paragonimus ova-positive and AAFB positive subjects was recorded in the five to nine year old age group (5.6% and 7.4% respectively), closely followed by the 5.3% and 1.8% recorded among subjects in the 10-14 year age bracket. On the other hand, the 15-18 years age group had the lowest prevalence of 2.7% and 0%. These observations are shown in Table 1.

Table 1
Age-range specific prevalence of paragonimus ova-positive and AAFB positive subjects

Age range (N)	Paragonimus	ova-positive	AAFB positive	subjects	p-value
	Subjects	prevalence	Subjects	prevalence	
5-9 (54)	3	5.6%	4	7.4%	0.70
10-14 (113)	6	5.3%	2	1.8%	0.16
15-18 (37)	1	2.7%	0	0%	0.31
Total (204)	10	4.9%	6	2.9%	0.30

N = total number of subjects in the age group

Females accounted for 90% of paragonimus ova-positive subjects. The gender-specific prevalence of paragonimiasis was 8.0% for females, and 1.1% for males, and this difference was significant (p=0.024, FET). While females accounted for 66.7% of AAFB positive subjects

The mean age(±SD), weight(±SD), height(±SD), weight for age and body mass index(BMI) of children with pulmonary paragonimiasis were 11 (±2.3)years, 26.1(±4.9)kg, 139.9(±15.9)cm 72% and 14.2(±1.4) respectively, while the corresponding values for the subjects who were AAFB sputum positive were 9.5(±2.0)years, 24.3(±5.2)kg, 130.9(±12.0)cm, 79% and 14.1(±1.2) respectively. The values were lower for AAFB sputum subjects compared to paragonimus ova positive subjects but they were not significantly different. However, all the anthropometric indices of the paragonimus ova positive and AAFB positive subjects were lower than that of the uninfected subjects, although only the BMI was of statistical relevance.

As shown in Table 2, hunting of snails / crabs, method of preparation (of the snails / crabs), cooking duration and method of washing the eating utensils were not significantly different between subjects who were paragonimus ova-positive and those whose sputum were negative. Similarly, there was no significant difference in the spitting habit, method of sewage disposal and the use of raw crab, (as an ingredient of medicinal drinks), between subjects with paragonimus ova-positive sputum and those with a negative sputum.

Cough, haemoptysis, fever and chest pain were common symptoms in both the paragonimus ova positive subjects and the AAFB positive subjects. However difficulty in breathing was observed only in the AAFB positive subjects. Four (66.7%) of AAFB positive subjects had clinical signs on respiratory system examination while only two (20%) of the paragonimus ova positive subjects had clinical signs on respiratory system .

Table 2
Relationship between socio-cultural, hygiene-related risk factors, and paragonimus ova-positivity in subjects.

Socio-cultural risk factors	All subjects	Sputum microscopy				
				OR#	95% CI	p
		Positive N = 10 n(%)	Negative N=194 n(%)			
Hunting of snails/ crabs	172	8(80)	164(84.5)	0.73	0.14-7.14	0.70
Cooking method						
Roasting	40	2(20)	38(19.6)	3.00	0.29-30.20	
Frying		22	1(10)	21(10.8)	1.76	0.10-29.60
Boiling	38	2(20)	36(18.6)	1.00	1.00	
Boiling and roasting	41	2(20)	39(20.1)	2.92	0.29-29.30	
Boiling and frying	11	0(0)	11(5.7)			
Frying and roasting	14	2(20)	12(6.2)	2.80	0.17-48.90	
Frying, boiling and roasting	38	1(10)	37(19.1)	1.00	0.06-16.60	
Cooking duration						
<15mins	167	10(100)	157(80.9)			
≥15mins	37	0(0)	37(19.1)			
Washing of utensils						
Water only	139	9(90)	130(67.0)			
Water plus soap and sponge	65	1(10)	64(33.0)			
Spitting habit						
Floor	109	4(40)	105(54.1)			
				1.77	0.40-8.78	
*Others	95	6(60)	89(45.9)			
**Method of sewage disposal						
Pit Toilet	65	2(20)	63(32.5)			
Bush	139	9(90)	148(72.5)			
Waterfront	54	3(30)	57(27.9)			
Use of raw crab for herbal medicine	2	0(0)	2(1.0)			

*Include spitting in the hand, use of handkerchief and combination of spitting habit**Some subjects disposed sewage using a combination of methods #Odds Ratio

DISCUSSION

The present study has identified the prevalence of Paragonimus infection among primary and secondary school children in Ewang, Mbo Local Government Area of Akwa Ibom State to be 4.9%. The current prevalence of 4.9%, is consistent with those of earlier reports in school children in other parts Nigeria (10,11). Ochigbo *et al* (10) had earlier identified a comparable prevalence rate of 5.5% in school children aged six to ten years in Oban, Akamkpa LGA, Cross River state, while Umoh *et al* (11) had earlier reported a prevalence rate of 7.7% in children aged one to ten years, with 5.4% in those aged 11-20 years. This is hardly surprising as Ewang and Oban have comparable environmental and ecologic factors favouring the transmission of paragonimiasis (1,9). The current prevalence of 4.9% is however relatively higher than the 2.6% recorded earlier in the south-east Cameroonian town of Kumba, (6)_ with which Ewang shares the same latitude. The apparent disparity in the prevalence rates may be attributed to the institution of control measures. The current prevalence of 4.9% could be ascribed to the increasing cost of fish (the main source of protein), which is currently being sold to generate income. This has led to an increasing dependence on crabs and snails as a source of dietary protein. This observation is consistent with those of Nwokolo (7) who noted a rise in prevalence of paragonimiasis during the Nigerian civil war, when the local inhabitants had to resort to eating improperly cooked crab as a result of food scarcity.

It is also noteworthy that Song *et al* (12) in their study in the Laos People Democratic Republic had recorded a prevalence of 14.5% in school children using skin test, as against the prevalence of 4.9% in the present study. In the former report (12), egg positive sputum was seen in only four of 128 total skin reactors. Given its reported high specificity and sensitivity, (2) skin testing for paragonimus ova is conceivably more likely to detect the infestation, much earlier than sputum examination even before the eggs become recoverable from sputum. In addition, the higher prevalence in the earlier report by Song *et al*, (12) may also be ascribed to the larger sample size used in their study (12). Also, the possibility of the skin test remaining positive for a long period even after complete recovery (2) should also be considered as a reason for the high prevalence rate in the study by Song *et al* (12).

This finding can be corroborated by several studies (6,8,10) that had identified a low egg excretion rate in paragonimiasis. Moyou-somo *et al* (6) recorded a detection rate of 2.56% in primary school children in the Cameroon, while Yoonuan *et al* (13) had a prevalence rate of 6.3% which rose to 10.9% when serologic methods were used.

The peak prevalence of infection in the present study was recorded in the five to nine year old group. This is consistent with the earlier findings of Ochigbo *et al* (10) who identified similar peak prevalence in the five to ten year olds. This is probably because children in this age group are more likely to hunt for and consume improperly cooked crabs. On the other hand, Nwokolo (7) had recorded peak prevalence in the 10-14 year old age group. This may be ascribed to the fact that while in the current study the children went in search of crabs as snacks, in the series by Nwokolo, it was a purposeful search for food by older children during the dangerous period of the Nigerian civil war of the late '60s, and this was left to the older children.

In the present study, the prevalence of infection is higher in females, compared with their male counterparts. The female preponderance in the current study is nevertheless consistent with those of earlier reports (10,14,15). This may be related to the subsisting Nigerian tradition of females doing virtually all the domestic chores, including household-related cooking. This female preponderance was also noted in a similar study in Cameroon (16). This was however, attributed to the traditional belief of the Bakossi tribe, (who constitute the major ethnic group in that Cameroonian region), that crabs are an invaluable aid to fertility in females. On the other hand, Umoh *et al* (11) in Oban, Cross River state, had earlier recorded a male preponderance in their study. This was attributed to the fact that males usually bite the legs of crabs after removing the traps (to prevent them from escaping), with the corresponding greater risk of mechanical contamination by live metercercaraie.

There was no difference in the kitchen in the kitchen habits and hygiene practices between ova positive and negative subjects. This is due to generally poor kitchen and sanitary habits in the community as a whole.

Use of raw crab for medicinal purposes was not a major socio-cultural factor in the present study as only two subjects in the current study admitted to using raw crab juice along with other herbs as a treatment for diarrheoa. In contrast, some Korean communities not only eat partially roasted crab, but also use fresh crab juice as a traditional cure for measles (17,18). Cough, haemoptysis, fever, and chest pain were recorded in the paragonimus ova-positive subjects and these findings were similar to those recorded in some Laotian refugee children (19).

The prevalence rate of sputum positive tuberculosis of 2.9% in the current study is higher than the 1% obtained by Ibanga *et al* (3) in children aged 5-16years and the 1.8% in the general population (3). This is however not surprising considering the rising prevalence of TB, which has been attributed to the continuing HIV pandemic, multidrug resistance, poor uptake of immunisation and increasing "endemic" poverty (20). The clinical features in the affected

children are characteristic. It should however be noted that the sensitivity of Ziehl-Neelsen staining for the diagnosis of pulmonary tuberculosis is grossly compromised when the bacterial load is less than 10,000 organisms / ml sputum sample (paucibacillary TB) and this is seen in children (20). Some studies have estimated the sensitivity and specificity of Ziehl-Neelsen staining to be between 32-94% and 98-100% respectively (21,22). This low sensitivity may account for low prevalence rate of pulmonary tuberculosis seen in this study.

Co-infection of the two diseases was not seen in the current study despite the fact that Nigeria has the highest burden of paragonimiasis in Africa (23) and is also a high burden country for tuberculosis as reported by the WHO.20 This may be explained by the small sample size and the sensitivity of sputum microscopy for the diagnosis of the two diseases.

In conclusion, it is difficult to differentiate pulmonary paragonimiasis and pulmonary TB, as their clinical presentations appear to be similar. Therefore, a high index of clinical suspicion remains the key to differentiating one (of the two) from the other.

Sputum microscopy to detect the paragonimus ova and the tuberculous bacilli used in this study, may have underestimated the true prevalence of the disease. Future research is therefore needed on the potential value of serological diagnosis and fluorescent microscopy on a larger sample size in estimating the true burden of these diseases in this and similar communities.

RECOMMENDATIONS

Health education on mode of transmission of paragonimiasis and good hygienic practices is essential to halt the spread of the disease in this community.

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