Investigation of crab-eating influence on Paragonimiasis infection in six communities of Abayong from Cross River State Nigeria.

Running Title: Investigation of Crab-eating influence on paragonimiasis.

Abstract

Background: The investigation of paragonimiasis infection was carried out among inhabitants of Abayong communities in Cross River State, Nigeria.
Aim: The study was aimed at investigating Crab-eating influence on paragonimiasis.
Material and Methods: Crab-eating behaviour of the people was observed and sputum samples examined for eggs/ova of *Paragonimus uterobilateralis*
Statistical Analysis: Infection between males and females was compared using Chi-square test, while Analysis of variance was used to compare infection between Age groups, occupation and location.
Results: Out of 830 sputum samples examined consisting 67 (19.2%) males and 56 (11.6%) females, an overall paragonimiasis prevalence of 14.8% was recorded. There were more males infected than females with evidence of significant difference ($p < 0.001$) between them. Higher frequency of crab-eating revealed more intensity of infection. The intensity of infection revealed that 56.96%, 33.3% and 1.0% persons showed low, moderate and high intensity respectively, of eggs/ova counts per 5ml of sputum.
Paragonimiasis infection was highest (24.9%) in Ijom Abayong and lowest (5.2%) in Abrijang. Risk exposure of each occupation to paragonimiasis revealed that Food vendors had the highest risk ratio of 1.025. Teachers, Farmers, Fishermen, Students and Artisans have 70%, 14%, 34%, 67% and 35% respectively of the risk of their non-exposed members to contract paragonimiasis.
Conclusion. This study revealed that paragonimiasis is a food-borne parasitic zoonosis ravaging the six communities of Abayong. Mass education of the inhabitants is advocated to create awareness of the consequences of eating improperly cooked crab meals, to reduce infection and re-emergence of paragonimiasis.

Key-words: Abayong Crab-eating influence on paragonimiasi

Introduction. Paragonimiasis is a foodborne parasitic zoonosis caused by lung fluke species of the genus Paragonimus.[1] The disease is endemic in East and South East Asia, West Africa, and south America.[2, 3] In Africa, paragonimiasis is geographically clustered around the intertropical zone,[4] as 80% of the 10 countries in the continent where paragonimiasis has been reported are located in this zone. Paragonimiasis is a sub-acute to chronic inflammatory disease of the lungs.[5] The disease is acquired as a result of consumption of raw or improperly cooked or prickled fresh water crabs,[1] or crayfish harbouring metacercariae cysts.[4, 6, 7] *Paragonimus westermani* is the most common human pathogen in Asian countries.[1] In West Africa, *P. uterobilateralis* and *P. africanus* have been incriminated.[4, 8, 9] About 200 million persons are at risk of being infected, while 20 million

are already infected, aggravating the public health and socioeconomic indices in the endemic areas.[10] A wide range of fresh water snails and crabs as well as crayfish serve as first and second intermediate hosts respectively of *Paragonimus* species.[11,12] Paragonimiasis is a neglected but re-emerging parasitic zoonotic infections in Nigeria, [7, 13], and has not been a public health concern in Nigeria before 1964 when it was recorded.[9] But the civil war in Nigeria (1967-1970) which caused a collapse in socioeconomic indices helped to make the disease a public health problem, with very many cases in Nigeria.[9] The severe shortage of traditional protein source and poor cooking facilities during the Nigerian civil war led to the greatly increased consumption of inadequately cooked crabs.[8] In effect, the *Paragonimus* parasite sojourning naturally inside the common crabs were still very much alive when they gained ready entrance into the many beleaguered bodies.[14] The parasites infected the lungs, grew and matured naturally and the resulting cough was coupled with copious bloody sputum or even frank bleeding.[14] Following well planned efficient and effective programme at the end of the war in Nigeria, the disease was reported to be eradicated by 1980. No case of paragonimiasis was reported from 1980 to September 2007.[9] Incidentally, re-emergence of the disease was reported in 2007 and until recently only sporadic cases had been reported in Upper Igwun Basin.[13, 15] Endemic foci had been reported in Enugu and the areas around the Imo and Cross River, and their tributaries,[15] Igwun River and Iduma including Abam, Arochukwu, Bende, and Ohafia towns among others.[13] Paragonimiasis infection has a gradual onset and is characterized by low grade fever, excruciating chest pain, diarrhoea and blood stained sputum.[16, 17] The prevalence of *Paragonimus uterobilateralis* have been reported in Cross River Basin by several authors: 5.5%,[18] 8.6%,[19] 9.6%,[20] and 12.27%.[21.] Uttah[7] recorded 13.2% prevalence in South Eastern Nigeria, and Udonsi[7] had 16.8% in upper Igwun Basin, Nigeria. Confirmation of patients with paragonimiasis is carried out in testing their sputa or faeces in the laboratory. Observation of the characteristic golden yellow opercolated eggs of *Paragonimus* in the samples identify positive sample.[6] This study was aimed at determining the prevalence of paragonimiasis among the inhabitants of Abayong in Biase Local Government Area of Cross River State Nigeria.

Materials and methods. This study was carried out in six communities of Abayong in Biase Local Government Area of Cross River State, Nigeria. The communities are Ijom Abayong, Abapia, Abredang, Abrijang, Abamba and Abaribara, located in the north western part of the Local government Area, sharing a common boundary with Abia State. These communities are rural in setting with various occupations such as teachers, farmers, Fishermen, food vendors, students, health workers and artisans. A major geographical feature in the area is Cross River and most of the inhabitants are engaged in crab hunting and fishing in all the beaches along the river. The vegetation is tropical rain forest and thickly forested in areas where man's activities are not very pronounced. Crab hunting by the school-age children and preparation of delicacies with it for consumption is one of their food habits. Fish, crabs and other farm produce from this area are transported to other localities through the Cross River and its tributaries.

Collection of samples The village heads of the six communities investigated were informed before sample collection commenced. This enhanced proper education of their subjects on the importance of the study. Individuals who consented to this study were recruited and labelled specimen vials with biodata sex (male or female) and occupation given to them for their morning sputum collection. Morning sputum samples are ideal for a direct wet smear examination of the parasite ova. The rusty brown or blood-stained sputum usually contain

numerous *Paragonimus* ova.[22] These sputum vials were retrieved from them the following morning for examination.

Sample size A total of 830 sputum samples were collected and analyzed, comprising of 481 (58%) females and 349 (42%) males.

Sputum examination using concentration techniques All the retrieved sputum samples were brought to the laboratory and examined in search of *Paragonimus* eggs/ova. Because of the sensitivity concerns of sputum examination for analysis of eggs, seven sputum examinations per person were carried out as recommended.[10] Five millilitres (5ml) of sputum sample was dropped into a centrifuge and 5ml of 10% caustic soda solution added and allowed to stand for 10 minutes. Mucus in the sputum samples dissolved and the red blood cells lysed by caustic soda solution, after centrifugation at 2000 rounds per minute, for 10 minutes, leaving the sputum clear. The supernatant was discarded and the wet preparation of the residue was viewed under 10X and 100X magnifications in search of the presence of *Paragonimus* eggs/ova. It should be noted that though the eggs of both species are morphologically identical, those of *P. africanus* are significantly smaller.[23] Observation of the characteristic golden yellow operculate eggs of *Paragonimus* in the sample confirmed positive sample.

Learning influence of crab consumption on paragonimiasis. A structured questionnaire was distributed to consenting inhabitants for this study to provide answers on their regularity of crab consumption; either yearly, every six month, monthly, weekly or occasionally.

Intensity of Paragonimus infection. To determine the intensity of paragonimiasis infection, 5ml of sputum was placed into sterile petri dish using a 5ml pipette. The petri dish and its content were viewed on an illuminating microscope stage and the total egg count determined per 5ml sputum.

Ethical clearance Ethical clearance was obtained from Cross River University of Technology Calabar, ministry of health in Biase Local Government Area, and individuals who consented to this study.

Data analysis was carried out on the differences of prevalence of infection between age groups and sex using chi-square test. Comparism of infection between age groups and intensity of infection and between occupation and location was made by the analysis of variance. P-value < 0.05 was considered statistically significant.

Results The study was carried out to determine the prevalence of paragonimiasis among inhabitants of six endemic communities in Abayong of Biase Local Government Area from Cross River State. Out of the 830 sputum samples examined consisting of 67 (19.2%) males and 56 (11.6%) females, an overall paragonimiasis prevalence of 14.8% was recorded (Table 1). There were more males infected than females. There was evidence of significance difference (P = 001) in the infection rate between males and females (Table 1).

Table 1. Prevalence of *Paragonimus uterobilateralis* infection in relation to sex and location in Abayong, Biase Local Government Area Nigeria.

Location	Male		Female		Total	Number
	Number Examined	Number positive (%)	Number examined	Number positive (%)	Number examined	Positive (%)
Ijom	72	22 (30.6)	121	26 (21.5)	193	48 (24.9)
Abapia	54	9 (16.7)	81	8 (9.9)	135	17 (12.6)
Abredang	80	15 (22.5)	90	12 (13.3)	170	27 (15.9)
Abrijang	25	2 (8.0)	52	2 (3.8)	77	4 (5.2)
Abamba	58	7 (12.1)	65	3 (4.6)	123	10 (8.2)
Abaribara	60	12 (20.0)	72	5 (6.9)	132	17 (12.9)
Total	349	67 (19.2)	481	56 (11.6)	830	123 (14.8)

Table 2 revealed the intensity of *Paragonimus uterobilateralis* eggs/ova counts per 5ml of sputum samples in relation to age in Abayong. The intensity of infection ranged from the highest 46 (25.6%) in children less than 10 years to the lowest 4 (2.9%) in adults more than 50 years of age. There was progressive decline in the intensity of infection from children to adults. The intensity of egg counts between 1—50 per 5ml of sputum was considered to be low, 51-100 counts per 5ml of sputum viewed as moderate, and above 150 egg counts was regarded as being high. In view of this, a total of 70 (56.96%) persons showed low intensity of egg counts, 4 (33.3%) persons were observed to have moderate intensity of egg counts, while 9 (1.0%) had high intensity of egg counts (Table 2).

Table 2. Intensity of *Paragonimus* eggs/ova counts in relation to age in Abayong, Biase Local Government Area Nigeria

Age (Years)	Number examined	Number positive (%)	Intensity of infection per 5 ml sputum			
			1 – 50	51 – 100	101 – 150	>150
< 10	180	46 (25.6)	25 (13.9)	12 (6.7)	6 (3.3)	3 (1.7)
11 – 20	120	30 (25.0)	20 (16.7)	5 (4.2)	3 (2.5)	3 (2.5)

21 – 30	160	23 (14.4)	14 (8.8)	4 (2.5)	3 (1.9)	2 (1.25)
31 – 40	130	12 (9.2)	6 (4.6)	3 (2.3)	2 (1.5)	1 (0.77)
41 – 50	100	8 (8.0)	3 (3.0)	3 (3.0)	2 (2.0)	0 (0.0)
> 50	140	4 (2.9)	2 (2.9)	2 (2.9)	0 (0.0)	0 (0.0)
Total	830	123 (14.8)	70 (8.4)	29 (3.5)	16 (1.9)	9 (1.0)

Tabe 3 showed the evaluation of the risk of exposure of each occupation to paragonimiasis compared to any other occupation in Abayong communities. An Odds ratio (OR) is a measure of association between an exposure and an outcome. The Odds ratio and Risk ratio of Food vendors in this study were 1.027 and 0.023 respectively, greater than 1 (one) and therefore the association was positively related to the disease paragonimiasis. The Odds ratios of Teachers, Farmers , Fishermen, Students and Artisans are 0.32, 0.83, 0.57, 0.29, and 0.58 respectively, while the Risk ratios of Teachers, Farmers, Fishermen, Students and Artisans are 0.30, 0.86, 0.66, 0.33 and 0.65 respectively. These mean that the exposed Teachers, Farmers, Fishermen, Students and Artisans have 70%, 14%, 34%, 67% and 35% respectively of the risk of their non-exposed members to contract paragonimiasis.
The association between frequency of crab eating and paragonimiasis infection is shown in

Table 3. Evaluation of the risk of exposure of each occupation to paragonimiasis compared to any other occupation in Abayong, Biase Local Government Area Nigeria.

Occupation	Odds ratio	Risk ratio
Teachers	0.32	0.30
Farmers	0.83	0.86
Fisher men	0.57	0.66
Food vendors	1.027	1.025
Students	0.29	0.33
Artisans	0.58	0.65

Table 4. The risk of infection of inhabitants who ate crabs weekly was 15 times more than those who ate yearly, 5 times more than those who ate every six months, 3 times more than

those who ate monthly and 7 times more than those who ate occasionally. The higher the frequency of crab consumption was the more the risk of paragonimiasis infection. Thus, it was observed that children were more among inhabitants who ate crabs weekly and so more infected than adults.

Table 4. Comparism between the frequency of crab consumption and paragonimiasis infection in Abayong, Biase Local Government Area, Nigeria.

Frequency	Crab eating individuals	Number infected	Prevalence (%)
Yearly	25	1	4
Every six months	220	28	12.7
Monthly	200	37	18.5
Weekly	78	46	59
Occasionally	127	11	8.7
Total	650	123	18.9

Figure 1 represent distribution of paragonimiasis in Abayong in relation to occupation *Paragonimus uterobilateralis* infection was highest (7.8%) among Food vendors, followed by Fishermen (7.3%), Artisans (5.2%), Farmers (2.9), Teachers (2.4%) and finally Students (Fig. 1).

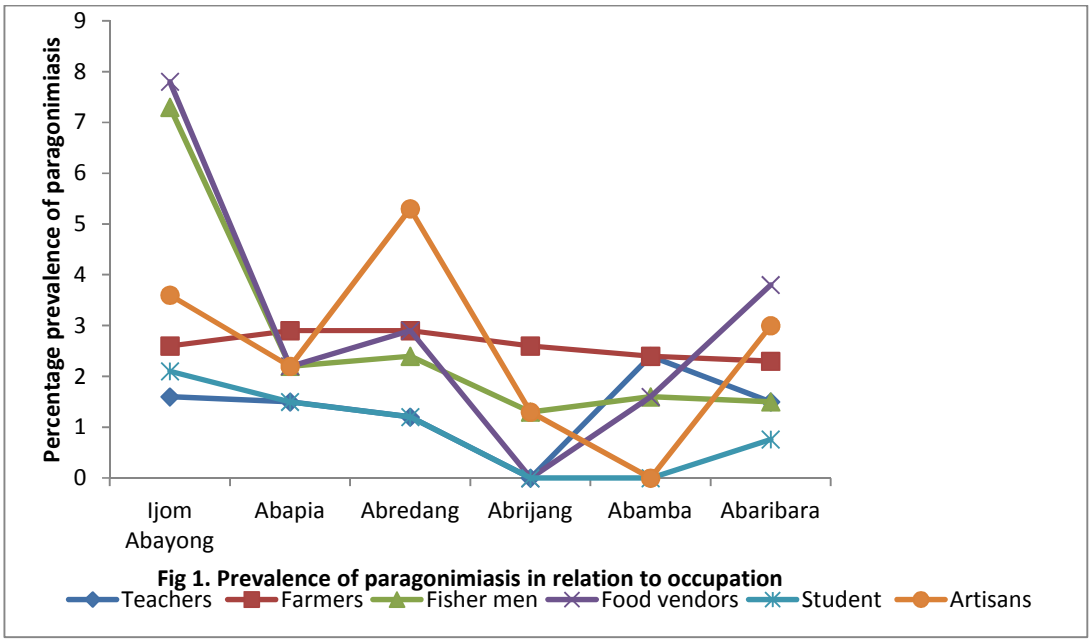

Fig 1. Prevalence of paragonimiasis in relation to occupation

The prevalence of paragonimiasis among communities ranged from 24.9% at Ijom Abayong to 5.2% in Abrijang (Fig 2).There was evidence of significant difference (P = 001) in prevalence of paragonimiasis between communities as exemplified by the various levels of infection (Fig 2.). The order of infection recorded was Ijom Abayong 24.9%, Abredang 15.9%, Abapia and Abaribara 12.9% each, Abamba 8.1% and finally Abrijang 5.2% (Fig. 2).

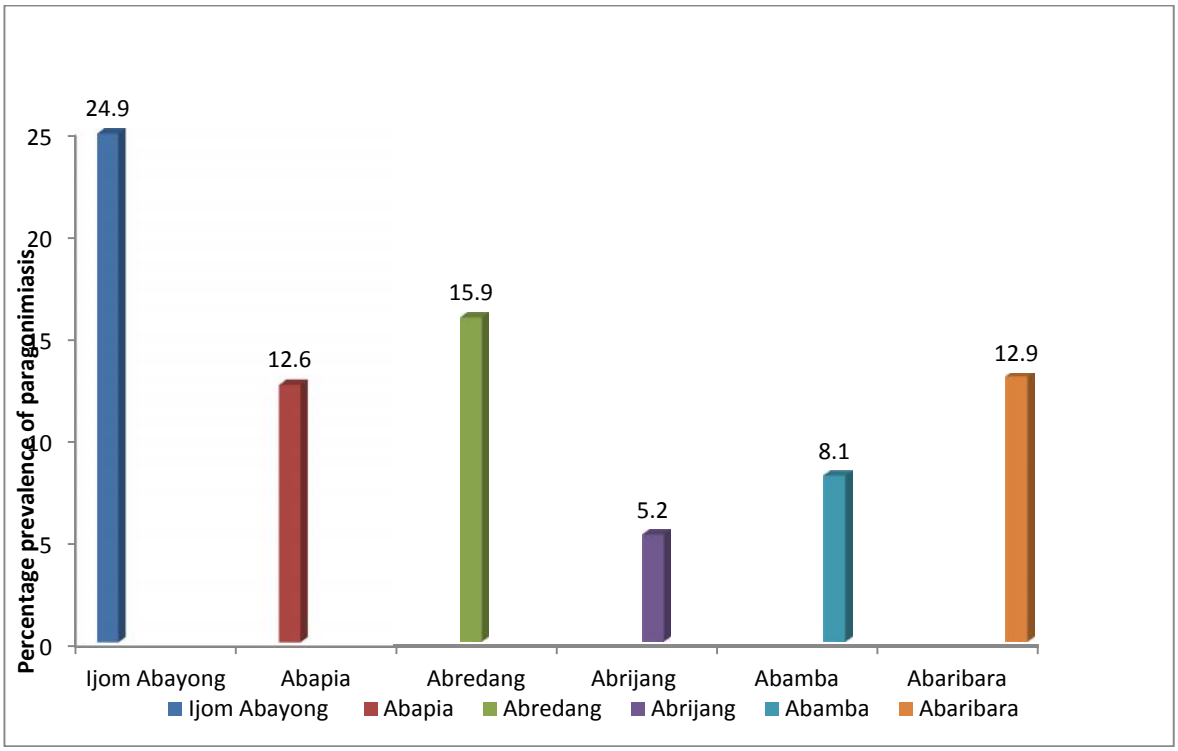

Fig 2. Prevalence of paragonimiasis among communities.

Discussion The wide spread of paragonimiasis in most communities of the world is due to change in food habit, cultural influences and extremely successful parasites which are widely geographically distributed.[3,9,24] During the Nigerian Civil War of 1967-1970, the Federal Government blockade of traditional protein sources to the secessionist Eastern region, resulted in a desperate shift to the consumption of Crabs as substitute.[8] Consequently, the conservative cultural habits of preparing crab meals and eating improperly cooked crabs precipitated the re-emergence of paragonimiasis during and after the war.[9] *Paragonimus* species are extremely successful parasites and are widely geographically distributed, being endemic in Asia, the Americas and Africa.[3] It has been estimated recently that 293 million persons are at risk of infection of *Paragonimus uterobilateralis*[25], while over 22 million persons were infected yearly.[24]

In this study, the reported 14.8% prevalence of paragonimiasis is greater than 2.56% and 5.2% observed by,[18,23] among school children in Cameroon and South Eastern Nigeria respectively. The high prevalence of *P. uterobilateralis* in the study area is also confirmed by the infection rates of 9.36% and 12.27% earlier recorded in Cross River State. [19, 21] However, this finding is comparable with the 14.4% and 16.8% reported in Okigwe, [20] and in Igwun River Basin.[13] It was observed that more males (19.11%) were infected than females (11.6%) with evidence of significant difference (P = 001) in infection between them. This finding is in consonance with several reports, [13, 23, 24] but in sharp disagreement with some other work, [7, 20, 27], who observed more infection in females than males. That more males are infected than females buttressed the fact that males hunt for crabs and carry out

fishing activities, thus more exposed to improperly cooked crab meals than females. This study reported the highest intensity of *P. uterobilateralis* infection 25.6% among children below 10 years of age, compared with the lowest (2.9%) in adults. This finding is certainly an underestimate of the actual situation in the study area, considering the suboptimal sensitivities of the use of eggs/ova in sputum, compared to the stringency of standard diagnostic method such as ELISA used to identify typical operculated ova in sputum. This observation is in line with the reports of some researchers. [23, 28, 29] Such tools were unfortunately not employed in this study due to their cost. However, the repeated sputum examination per person adopted in this study is known to improve the sensitivity of the parasitological Method.[10] There was evidence of significant difference (*P* = 05) between *P. uterobilateralis* infection and age. Furthermore, prevalence of paragonimiasis among communities showed that Ijom Abayong recorded the highest infection rate (24.9%) and the least (5.2%) by Abrijang. There was evidence of significant difference (*P* = 001) in infection rate between communities. However, prevalence among occupation indicated that Food vendors have the highest (7.8%) infection rate, followed by Fishermen (7.3%). There was no evidence of significant difference ($p > 0.05$) in infection rate among occupations. The risk of paragonimiasis posed by each of the occupation compared to other occupations in this study showed that there was strong association between Food vendors and paragonimiasis as against Fishing and river-food processing earlier reported. [26] The risk ratio of food vendors in this study is greater than 1 (one) and therefore the association is positively related to the disease paragonimiasis. The risk ratio of Teachers, Farmers, Fishermen, Students and Artisans are 0.30, 0.86, 0.66, 0.33 and 0.65 respectively. These mean that the exposed Teacher, Farmers, Fishermen, Students and Artisans have 70%, 14%, 34%, 67% and 35% respectively of the risk of their non-exposed members to contract paragonimiasis. This study revealed that there was association between the frequency of crab eating and paragonimiasis infection among inhabitants of Abayong. It wass observed that the higher the frequency of crab consumption, the more was the risk of paragonimiasis infection. Weekly crab eaters had the highest risk of paragogonimiasis infection. This finding is in consonance with previous report. [7]

It should be borne in mind that the high prevalence of paragonimiasis in the study area, which is contiguous to the endemic Eastern region of former Biafra, is its overlap with tuberculosis and its consequent diagonistic confusion. [30] Proper identification of *Paragonimus* eggs/ova requires skill technicians and standard diagnostic methods which are lacking in most rural communities of the state. Furthermore, due to the high cost of wide-scale screenings for this disease, training of technicians in anti-tuberculosis centres would be the most realistic attitude to detect mycobacteria and or Paragonimus eggs/ova during the same sputum examination. [4]

In conclusion, this study has revealed that paragonimiasis is a food borne parasitic infection, vectored by *Sudanautes africanus* which ravages the six communities of Abayong in Biase Local Government Area of Cross River State. There is therefore the need for proper education of the inhabitants, to create awareness on the consequences of eating improperly cooked crab meals in the study area, to reduce infection and re-emergence of paragonimiasis.

References.

1. Singh TS, Hiromu S, Devi KR, Singh WA. First case of *Paragonimus westermani* infection in a female patient in India. PubMed 2015; 33 (5): 156 – 159.
2. Peter W, Giles HM. Color atlas of tropical medicine and Parasitology. London Wolfe, Medicla Publication, 4th edition, 1977.
3. Procops GW. ''North American paragonimiasis (caused by *Paragonimus killicotti*) in the context of global paragonimiasis.'' Clinic Micro Rev. 2009; 22: 415 – 446.
4. Aka NA, Adoubryn K, Rondelaud D Dreyfuss G. Human paragonimiasis in Africa. Anals of Afri Med. 2008; 7 (4): 153 – 162.
5. Liu Q, Wei F, Liu W, Yang S, Zhang X. Paragonimiasis: an important food-borne zoonosis in China. Trens Parasitol. 2008; 24: 318 – 323. View at Google Scholar. View at Scopus.
6. Nworie O, Reginald Ao, Chukudi A, Ogbuinyas EE, Chukwudum SO, etc. (2013). Prevalence of paragonimiasis infection. Am J infectious Dis. 2013; 9 (1): 17 – 23.
7. Uttah EC (2013). Paragonbimiasis and renewed Crab –Eating Behaviour in six communities from Two Ethnocultural clusters in Southeastern Nigeria. Infectious *Dis. 2013;* Article ID 569485. 5 pages. Doi.org/10.5402/2013/569485.
8. Nwokolo C. Endemic paragonimiasis in Africa. Bull Wrld Health Org. 1974; 50 (6): 569 – 571.
9. Eke RA, Nwosu UM, Enwereji EE, Emerole CV. Paragonimiasis re-emergence in Nigeria: Predisposing factors and recommendations for early Intervention and everlasting eradication. Infectious Dis. 2013; Article ID 257810, 4 pages doi.org/10.5402/2013/257810.
10. Toscano C, Hai YS, Mott KE. ''Paragonimiasis and tuberculosis, diagnostic confusion: a review of literature,'' Trop Dis Bull. 1985; 92 (2): R1 – R27.
11. Miyazaki I, Hirose H. Immature lung flukes first found in the muscles of the wild boar in Japan. J Parasitol. 1976; 62: 836 – 837.
12. Fried B. Abruzzi A. ''Food-borne trematode infections of humans in United States of America,'' Parasitol Res. 2010; 106 (6): 1263 – 1280. View at Google Scholar- View at Scopus.
13. Udonsi JK. ''Endemic *Paragonimus* infection in upper Igwun Basin, Nigeria: a preliminary report on a renewed outbreak,'' Annals Trop Med Parasitol. 1987; 81 (1): 57 – 62. View at Google Scholar – View at Scopus.
14. Onuigbo WIB. The pathogenesis and Kwashiorkor as infective malnutrition diseases during the Nigerian Civil war. Inter J clinical and case. 2017; 1 (5): 99 – 101.
15. Nwokolo C. ''Outbreak of paragonimiasis in Eastern Nigeria,'' The Lancet. 1972; 1 (7740): 32 - 33. View at Google Scholar. View at Scopus.
16. Heath HW, Marshall SG. Pleural paragonimiasis in a laotian child. Pediatric Infect Dis. J. 1997; 16: 1182 – 1185. PMID: 9427469.
17. Cheesbrough M (2005). District laboratory Practice in Tropical countries. 2nd Edn., Cambriage University Press, 2005; ISBN-10: 0521676304, 462.

18. Ochigbo SO, Ekanem EE, Udo JJ. Prevalence and Intensity of *Paragonimus uterobilateralis* infection among school children in Oban village, South Eastern Nigeria. PubMed. 2007; 37 (4): 224 – 6.
19. Ibanga ES, Arene FOI, Asor JE. Association of pulmonary paragonimiasis with active pulmonary tuberculosis in rural Yakurr community in Cross River Basin,Nigeria. Mary Slessor J Med. 2003; 3: 19 – 23.
20. Asor JE, Ibanga ES, Arene FOI. *Paragonimiasis uterobilateralis*: peak period of egg output in sputum of infected subjects in Cross River Basin, Nigeria. Mary Slessor J Med. 2003; 3: 24 – 27.
21. Arene FOI, Ibanga ES, Asor JE. Epidemiology of paragonimiasis in Cross River Basin, Nigeria: prevalence and intensity of infection due to *Paragonimus uterobilateralis* in Yakurr Local Government Area. Pub Health. 1998; 112 (2): 119 – 122.
22. Singh TS, Sugiyama H, Rangsiruli A (2012). *Paragonimus* and paragonimiasis in India. Indian J Med Res. 2012; 136 (2): 192 – 204. View Google Scholar.
23. Moyou-Somo R, Kefie-Arrey C, Dreyfuss G, Dumas M. An epidemiological study of pulmonary paragonimiasi among pupils in peri-urban zone of Kumba town, Meme Division, Cameroon. BMC Pub Health. 2003; 3: 40.
24. Singh TS, Mutum SS, Razaque MA. ''Pulmonary paragonimiasis: clinical features, diagnosis and treatment of 39 cases in Manipur.'' Trans Roy Soc Trop Med Hyg. 1986; 80 (6): 967 – 971.
25. Keiser J, Utzinger J. ''Emerging foodborne trematodiasis,'' Emerging infect Dis. 2005; 11 (10): 1507 – 1514). View at Google scholar. View at Scopus.
26. Uttah EC, Etim SE, Ibe DC (2013). Familial and occupational clustering of paragonimiasis in a Riverine community in Eastern Nigeria. Trans J Sci Tech. 3 (1): 25 – 34.
27. Ibanga ES, Arene FOI, Asor JE. Association of pulmonary paragonimiasis with active pulmonary tuberculosis in rural Yakurr community in Cross River Basin, Nigeria. Mary Slessor J Med. 1997; 3: 19 – 21.
28. Ikeda T, Oikawa Y, Nishiyama T. ''Enzyme linked immunosorbent assay using cystine proteinase antigens for immunodiagnosis of human paragonimiasis.'' Am J Trop Med Hyg. 1996; 55 (4): 434 – 437.
29. Nkouawa A, Okamoto M, Mabo AK, Edinga E, Yamasaki H. et al., ''Paragonimiasis in Cameroon: molecular identification, serodiagnosis and clinical manifestations,'' Trans Roy Soc Trop Med Hyg 2009; 103 (3): 255 – 261.
30. Narain K, Devi KR, Mahanta J. ''Pulmonary paragonimiasis and smear-negative pulmonary tuberculosis: a diagnostic dilemma,'' Inter J Tubercu Lung Dis. 2004; 8 (5): 621 – 622.