Original Research Article

EMERGING PARASITES AMONG APPARENTLY HEALTHY SCHOOL AGED CHILDREN IN ADAMAWA STATE, NIGERIA

ABSTRACT

Aim: This study examines the prevalence of *Fasciola hepatica*, *Paragonimus westermani* and *Schistosoma intercalatum* among school aged children across the geopolitical zone in Adamawa state, Nigeria.
Study Design: A cross sectional study designed was used and the study was conducted between October 2019 – March 2020. The study population include school age children studying between 7 – 25 years, studying in government schools across the geopolitical zones in Adamawa state
Method; A total of 1500 primary and secondary school students from 15 local government areas were enrolled for this study, residual stool samples were collected from each participant and immediately preserved in 10% formalin before taking to the laboratory where it is processed using concentration techniques and observed under the microscope.
Result: A total of 0.80% % of the children were found to be positive for at least one of the three parasites, with *Fasciola hepatica* being the most prevalent 0.47%, followed by *Schistosoma intercalatum* 0.27% and *Paragonomus westermani* 0.07%. High prevalence of these emerging parasites was observed in the southern senatorial zone than central and none was reported from northern zones.
Conclusion: This study reported for the presence *Paragonimus westermani* and *Schistosoma intercalatum* for the first time in Adamawa state, highlighting the need for further and a robust study to unravel the epidemiology of these parasites as well as other helminths associated with human infection in the state. This is critical for the design of intervention strategies.

Keywords: Prevalence *F. hepatica, P. wastermani, S. intercalatum*, *Emerging parasite*

1. INTRODUCTION

Changes in natural and anthropogenic environments influence the spread and emergence of diseases in any given area. Factors such as climate change, population growth, globalization which has increased rate of travels, agricultural intensification, human encroachment into wildlife habitats represent important drivers for spread, prevalence, and epidemiological dynamics of parasitic infections [1].
Fasciola spp and *Paragonimus spp* and *Schistosoma intercalatum* are medically important pathogens that can cause serious infections and diseases in humans, such as fascioliasis, paragonimiasis and intestinal schistosomiasis. Fasciola and Paragonimus are foodborne

parasites and are generally found in contaminated drinking water and foods, and account for considerable morbidity if left untreated. They constitute important zoonotic infection of humans, domestic and wild animals [2]. Human Fascioliasis has been reported in 12 African countries, namely Algeria, Angola, Cape Verde, Egypt, Ethiopia, Ghana, Morocco, Nigeria, Senegal, South-Africa, Tanzania and Tunisia. In Nigeria, several studies carried out since 1939 shows that out of a total of 7105 patients or biological products examined, 25% were affected by fasciolosis and/or showed the presence of Paragonimus eggs [3]. Human fascioliasis only started to receive some considerable attention from the 1990s onwards [4,5]. Globally 2.6 million people are estimated to be infected with Fasciola spp and about 180 million are at risk [6]. Human Fascioliasis is an emerging disease [5] and a further increase in incidence might be expected due to the influence global warming could exert on intermediate host abundance and parasite transmission [7] In response to this emerging threat pose by fasciolosis, World Health Organisation has included fasciolosis in the list of Neglected Tropical Disease (NTD) destined for eradication [8].

Paragonimiasis is a poorly known infection and highly neglected disease that infect a range of mammal including human, where symptoms are synonymous with tuberculosis infection [9]. In West Africa data describing the epidemiology of paragonimiasis are limited to Nigeria and Cameroon, however few case reports from Liberia, Benin Republic and Cote d'Ivoire have been documented. While *P. westermani* and *P. heterotremus* are the commonly reported species worldwide, only P. africanus and *P. uterobilateralis* have been found [9]. In Nigeria Paragonimiasis occurred mostly in the Eastern part and its high prevalence has been associated with events that occurred during the Biafra war (1967-1970). Owing to total collapse in socioeconomic indices as a result of the war, feeding habit of several hundred people were modified, particularly by ingesting uncooked crabs; an intermediate host of paragonimus. *Paragonimus uterobilateralis* have been identified in clinical samples collected from children [10] and reports have also demonstrated that paragonimiasis was endemic the districts of Kiwi and Umuahia located in the Eastern part of Nigeria. Furthermore, Sachs and Voelker, stated that the two factors favouring parasitosis extension were local habits to eat crustaceans and the poor sanitary and hygiene standard of these populations [11]. Although a well thought and efficiently planned programme at the end of the war, led to the eradication of paragonimus by 1980. This gain is being rolled back by the reemergent trends of this parasite in in the country [12]. Recent studies observed cases of paragonimiasis in Igwun and Cross River basin, where a strong increase of the prevalence, particularly in children and adolescents was noted [13,14,15,16,17].
Schistosoma intercalatum; a species known to cause intestinal schistosomiasis have been rarely reported in Nigeria. Among the few available reports on this parasite in Nigeria is a study conducted in the Niger Delta area. This study reported emergence of *Schistosoma intercalatum* in the urban city of Port Harcourt, Nigeria [18]. Most of the report available limited Schistosoma intercalatum to the western and Central African countries to which Cameroon belongs [19,20]. In Republic of Sao Tome and Principe, *Schistosoma intercalatum* instead of *S. haematobium* has been reportedly the only endemic schistosomal species for nearly two decades [20].
Fasciola spp, Paragonimus spp and *Schistosoma intercalatum* helminth species have been rarely reported in Northeaster Nigeria. In addition to dearth of information on helminthisis in Adamawa state, there are fewer to no reported cases of these emerging parasites in humans and their distribution within the state. Therefore, this study seeks to unravel the prevalence of these parasites and their distribution within the geopolitical zones among school aged children in Adamawa state.

2. MATERIAL AND METHODS / EXPERIMENTAL DETAILS / METHODOLOGY

2.1 Study Area

Adamawa State is located on latitude 9° 19' 60.00" (1016'8.040"N), longitude 12°29'59.99"E and about 592m above sea level. Topographically, it is a mountainous land crossed by large river valleys of Benue, Gongola and Yedsarem [21]. The valleys of the Mount Cameroon, Mandara Mountains and Adamawa Plateau form part of the landscape. Adamawa State has a total land area of thirty-eight thousand seven hundred square kilometers (38,700 Km^2) with. The state is divided into three geopolitical zones namely, Northern senatorial zone comprising of five local government (Madagali, Michika, Mubi North, Mubi South, Maiha). Central senatorial zone comprising seven local government (Hong, Gombi, Song, Girei, Fufore, Yola North, Yola South) and Southern senatorial zone comprising nine local government (Toungo, Ganye, Jada, Mayo-belwa, Numan, Demsa, Lamurde, Shelleng and Guyuk) [22]. Adamawa state experiences two seasons; the dry season between November and April and wet season between May and October. The average rainfall is about 211 mm, mean annual temperature is 25.9 °C [23,24] and vegetational zones include Northern Guinea Savannah, Southern Guinea Savannah, and Sudan Savannah [22].

2.2 Sample Size Determination

A cross-sectional study design was adopted in data collection to determine the prevalence. The study population include children attending government schools in Adamawa and within aged brackets of 7-25 years.

The sample size was estimated using a formula for survey sample size estimation at 95% level of confidence. $\mathrm{N} = \frac{Z^2\,(1-\mathrm{P})}{2\mathrm{L}^2}$ [25].

Where N = the required sample size

Z = value of the standard normal distribution (1.96) corresponding to a significance level of 0.05 for a 2-sided test.

L = margin of error (0.05)

p = prevalence from previous study (41% based on study conducted by [26].

Sample size (n) = 684, However, a total of 1500 children were enrolled for the study.

Schools within Adamawa state was stratified into senatorial zones and students were enrolled into the study from secondary and primary schools randomly selected from each senatorial zone. A total of 15 schools were randomly selected for the study across the senatorial zones. These include seven schools from Southern senatorial zone, five from North and three from Central zone. In each school selected for the study, 50 females and 50 males were randomly selected for inclusion in the study, to give a total of 100 participants selected from each school. Samples were collected from participants after explaining the purpose of the study, obtaining ethical clearance and informed consent.

2.3 Sample Collection and Analysis

Stool sample was collected in the morning using a wide mouth, tight and leak proof sample bottle with aid of a spatula. The bottles were labelled with the participant's identification number, sex, age, time and date of collection. The specimen was preserved with 10% formalin and transported within 6 hours to the laboratory. The stool was processed using formol ether concentration technique and viewed under microscope (Swift microscope led/screen model Motican 2 FCCID; pvemoticamt2) at magnifications of x10 and x40 [27]. Two separate slides per sample were prepared and viewed under microscope by separate technicians. *Fasciola spp, Paragonimus spp* and *Schistosoma intercalatum* were identified by comparing key indicators of image observed with ova of the parasites on a map. Further confirmation of *Schitosoma intercalatum* was done by acid fast staining [27].

2.4 Data Analysis

Descriptive statistic such as simple percentages, and tabular presentations were used in analysing data generated

3. RESULTS

Fasciola spp, Paragonimus spp and *Schistosoma intercalatum* were identified from the stool sample analysed for parasites (Plate 1, 2, and 3 respectively)

Plate1 *F. hepatica*

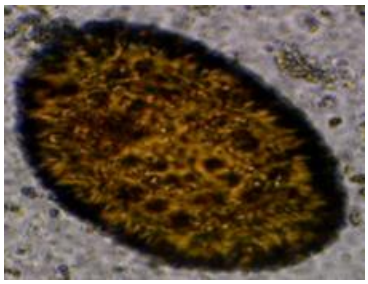

Plate 2 *P. westermani*

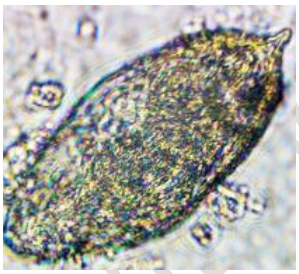

Plate 3 *S. intercalatum*

The study revealed a combined prevalence of 0.80% (12) for the liver, lung and blood flukes. Of these flukes, *F. hepatica* (0.47%) had the highest prevalence among the school aged children, followed by *S. intercalatum* (0.27%), and *P. westermani* (0.07) (Table 1).

Table 1 Prevalence of Parasite among School Aged Children in Adamawa State

Parasites	No. Examined	No. Infested	% Prevalence
Fasciola hepatica	1500	07	0.47%
Paragonimus westermani	1500	01	0.07%
Schistosoma intercalatum	1500	04	0.27%

While none of these flukes was recovered from subjects in the Northern senatorial zone, only one participant was infested with *F. hepatica* in the Central zone and all the parasites were present in the southern zones (Table 2). In the Southern zone, *F. hepatica* had the highest prevalence of 0.86%, followed by *S. intercalatum* (0.57%) *and P. westermani* (0.14%)
Table 2 Distribution of emerging Liver, Lung and Blood Flukes Among School Age children by Senatorial Zone

Table 2: Distribution of Parasite Across Geopolitical Zones in Adamawa State

Senatorial Zone	No. Examined	*F. hepatica*		*P. westermani*		*S. intercalatum*	
		No. Infest	% Prev.	No. Infest	% Prev.	No. Infest	% Prev.
Northern	500	00	00	00	00	00	00
Central	300	01	0.33	00	00	00	00
Southern	700	06	0.86	01	0.14	04	0.57

The *F. hepatica* recovered from the Central zone was from Hong local government, while Ganye, Jada and Toungo local government in the Southern zone had subjects infested with one or more of these flukes (Table 3)

Table 3: Distribution of emerging Liver, Lung and Blood Flukes Among School Age children by Local Government Area

	No Examined	*F. hepatica*	*P. westermani*	*S. Intercalatum*

Local Government		No. infest.	% Prev.	No. infest.	% Prev.	No infest.	% Prev.
Ganye	100	04	4.00	00	00	02	2.00
Jada	100	01	1.00	01	1.00	01	1.00
T**o**ngo	100	01	1.00	00	00	01	1.00
Hong	100	01	1.00	00	00	00	00

4. DISCUSSION

Newly emerging health threats globally are being generated by emergence of parasitic disease due to the influence of rapid globalisation, heightened insecurity and climate change. In this study, we identified *Fasciola hepatica, Paragonimus westermani* and *Schistosoma intercalatum* from stool samples obtained from aged children in Adamawa State. This finding highlights the importance of continue surveillance in order to monitoring the trend of helminths parasites distribution within the state and to track parasite that may be quietly spreading within the population.

An overall prevalence 0.47% for *Fasciola hepatica*, 0.07 for *Paragonimus westermani* and 027% for *Schistosoma intercalatum* were reported in this study. Although the prevalence were low, it could increase if adequate measures to mitigate spread of these emerging parasites are not put in place. Studies have reported a higher prevalence of *Fasciola spp* in Bauchi, Yola and Zaria [28,29,30], however *Paragonimus spp* and *Schistosoma intercalatum* parasites have been rare reported in the Northern part of Nigeria. The presence of these parasitic among subjects in this study indicates emergence of these flukes in Adamawa state. This underscores the need to embark on a robust study in order to track the scale of spread of this parasite among humans. Interestingly, these parasites may have been in the environment and spreading unknowingly among the population, but because studies targeting these parasites are not being carried out, they will remain unreported. Worthy of mentioning is the case of *Paragonimus spp* in the Southeast Nigeria. This lung fluke was hitherto endemic in that part of the country but was eradicated through a well thought and implemented control programme, however, a re-emerging trend of this parasite has been observed within community in the region [12]. Similarly, *Schistosoma intercalatum* have been reported in the Southwestern parts of Nigeria [18,31], However there is little to no reported case of this Schistosomiasis causing parasites from the Northern part of Nigeria, particularly in the Northeast where Adamawa state is located.

The emergence of *Paragonimus westermani* and *Schistosoma intercalatum* in these communities may depend on the availability of the intermediate host such as crab and snails that houses metercercaria for the parasites and also the introduction of the parasite into the environment either by human and other mammalian definitive host, or other anthropogenic factors. A major limitation of this study is that we did not comb the environment for presence of intermediate host of these parasites after observing their presence. However, we reported high rate of urinary schistosomiasis in this area in an earlier study, indicating the presence of *Bolinus spp* within the environment. This implies that if *S. intercalatum* is introduced into the environment, transmission can occur. Similarly, it is a common knowledge that children in the area in Southern senatorial zones particularly in Ganye, Jada and Toungo roast and eat crab, which is an intermediate host to *paragonimus westermani*. The attitude predisposes human to

infection where the parasite has been introduced into the environment. Cray fish sold in the market may also introduced metacercaria of Paragonimus. Other factors such as internal and international displacement of people due to insecurity and globalization that has led to ease of travels across far distance can influence the emergence of these parasites. Displace person or travellers leaving from endemic areas to where these parasites are not found may contribute to their spread. Remarkably, *Schistosoma intercalatum* was reported in Jada, Ganye and Toungo town, while *Paragonimus westermani* was reported in Jada. These are local government/town in the Southern senatorial district of Adamawa state bordering the Southwestern part of neighbouring Cameroon where these parasites have been reported [32,33]. Furthermore, cross border interaction among inhabitants of these town and their counterpart on the Cameroon side may contribute to the spread of the disease. Therefore, we speculate that the *Paragonimus westermani* and *Schistosoma intercalatum* were brought into the areas by infected individual that travel to this community from endemic areas or where the infection abounds. Otherwise, the parasite may have been in the environment unnoticed. There is need for epidemiological survey of parasites in this area, and particular targeting *Paragonimus spp* from sputum sample.

There are very few reported cases of fasciolosis in North and in Adamawa State [28,29,30,] and most of the available reports are on animals [34]. In this study, we reported *Fasciola hepatica* from samples obtained from three local government/towns (Ganye, Jada and Toungo) in Southern senatorial zone and one (Hong) in Central senatorial zone. Fasciolosis has been reported among patients attending two medical centers in Yola, Adamawa state [29], however the identification of *Fasciola hepatica* from apparently healthy subjects from five local governments underscores the importance of this fluke as an emerging parasite.

5. CONCLUSION

This study reported the presence of *P. westermani* and *S. intercalatum* for the first time in Adamawa State, highlighting the emergent status of this parasites in the region.The emergence of these flukes in this region calls for further study, particularly on *Paragonimus spp.* using sputum samples.

ETHICAL APPROVAL (WHERE EVER APPLICABLE)

2.3 Ethical Considerations

Ethical clearance was obtained from the Ministry of Health, Adamawa State (S/MoH/1131/I) and permission to conduct study in schools was obtained from the respective school administrators. Additionally, informed consent was sought after the participants had understood all the matters surrounding the study before proceeding with data collection.

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