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Fresh Water Snails (Bulinus and Lymnaea) in Canals in Imo State, Nigeria: Their Public Health Importance and Implications for Control

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ABSTRACT

Introduction: Researchers have emphasized the need to adopt feasible strategies that will reduce repeated human contacts with freshwater snails in contaminated water so as to protect humans against infection. This study is aimed to identify strategies that are capable of protecting humans from being infected by snails in contaminated freshwater canals along dwellings areas in Imo State, Nigeria.

Materials and Method: Freshwater snails were collected for morphological identification using long plastic spoons with the hand-picking method. The Physico-Chemical parameters of the freshwater canals were determined using appropriate instrument. A total of one thousand four hundred and nine (1409) freshwater snails were collected for the study. The snails were collected once a week for three months May, June and July 2021.

Results: The species of the 1409 snails collected were mainly Lymnaea and Bulinus. This was made up of Bulinus 533(37.8%) and Lymnaea 876(62.2%). The relative percentages of the snails collected each month were 43.9% for May; 29.9% for June and 26.2% for July. The monthly infectivity rates of the snails collected were 69.2% for May, 50.1% for June and 33.6% for July. The snails with the highest infection were in May. In all, 764 (54.2%) of the snails collected were infected. Dissolved oxygen (DO), Biological oxygen demand (BOD) and PH were found to significantly influence snail distribution in the site ($p<0.05$).

Also during the study, a good number of individuals including school children were observed swimming in the water canals as well as picking the snails probably for consumption. Others including women were seen washing food items, clothes, and cars as well as fetching water in cans.

Conclusion: The fact that some residents in the study areas have regular contacts with freshwater canals and the snails, suggest that a good number of them may be at risk of infections associated with Bulinus and Lymnaea snail species and their attendant pathological effects on humans. Therefore, health education that will emphasize the benefits of improved hygienic conditions around the canals as well as reduced contacts to encourage disease prevention and health promotion will be necessary. There is need to reduce contacts with the infective flukes of Bulinus and Lymnaea in fresh water canals so as to minimize the risks of their infections.

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Background

Bulinus and Lymnaea species of freshwater snails are intermediate hosts of highly infective fluke (trematode) larvae of the genus Schistosoma which causes schistosomiasis also known as bilharziasis [1,2]. Some ecological factors like water quality, temperature, microphytes, and human settlements contribute significantly to the distribution of these intermediate hosts of Schistosoma. Freshwater snails are intermediate hosts and the sexual stages of the parasites are found in man while the snails harbour the asexual stage. Humans serve as vectors by contaminating the environment [3,4]. Transfer of the infection requires no direct contact between snails and humans, but rather, the disease is acquired by repeated contacts with freshwater snails [5-7]. Therefore, researchers have shown that the prevalence and distribution of schistosomiasis are dependent on the presence and spreading of the intermediate snail host in natural freshwater bodies [8-11]. Snail infectivity is influenced by some environmental factors such as pH, temperature, salinity, dissolved oxygen, water hardness, habitat conditions, the presence of predators and competitors, and others. However, increased hydrogen ion concentration in the aquatic habitat could affect the growth and physiology of the parasitic stage (miracidia), by reducing the survival rates and the infectivity of the freshwater snails . High temperature increases snail infectivity, while low dissolved oxygen in the aquatic environment results in low snail infectivity [8].

Urinary schistosomiasis, caused by Schistosoma haematobium which has snail host specie of aquatic freshwater Bulinus snails, is one of the neglected tropical diseases very common in Nigeria, with some States having very high prevalence especially in the southeastern part of the country [12,13]. Urinary schistosomiasis

constitutes a major infection of public health importance in Nigeria and affects mainly the rural poor and disadvantaged urban populations [14-16]. It is characterized by haematuria, dysuria, bladder wall pathology, hydronephrosis (swelling of kidney due to build-up of urine), and can also present with squamous cell carcinoma [17-19]. In adults, the infection can result to genital ulcers and other types of lesions that can cause poor reproductive health with sexual dysfunction and infertility. These pathological effects often occur mainly among school-age children, adolescents and young adults are serious public health problems that must be controlled and/or prevented [20-25].

Apart from reports on the prevalence of schistosomiasis there is the scarcity of research on how to minimize the risk factors associated with this infection among individuals especially those resident in the South East regions of the country including Imo State [26-32]. This lack of information on the prevention and/or control of risk factors has been shown to constitute limitations in the health workers' efforts to provide relevant intervention programmes. Realizing that availability of such information is crucial in identifying and implementing effective control measures to prevent infection [33-35], this study intends to identify feasible strategies that will protect residents in the study area from infections from Bulinus and Lymnaea snails. However, studies have shown that the complex schistosome life cycle and the intricate interactions that are encountered with the host immune system make it difficult for neither drugs nor vaccines to adequately control schistosomiasis [35-38].

Studies, especially in Nigeria, have noted that the disease control measures that are available for schistosomiasis are mainly provision of potable water and population-based chemotherapy. Further, that little or no emphasis has been made on maintaining the environmental sanitation practices on the surroundings of water canals to reduce the breeding of snails. And also that the major problem is that most of the available control measures lack baseline data on the types and distribution of the host snails [39-43]. This study therefore, will examine the common types of snail species, their distributions and infective rates in the area of study. It will also identify the variables in the freshwater canals that encourage snail breeding so as to identify feasible intervention strategies that could minimize the extent to which residents in the study area are exposed to the risks of schistosomiasis infection.

This study is of interest because the findings will create awareness to the residents on the benefits of reducing the risks of schistosomiasis infections especially among school children, adolescents and others who use water from the canals for several domestic activities including swimming and cooking. Also, awareness will be created on the risks of consuming Bulinus and Lymnaea snails as sources of protein and means of raising money for sustenance. It is as a result of the increased exposure of people living close to these canals that the researchers after identifying the snail species, their distribution and infectivity rates deemed it necessary to find relevant intervention strategies that will protect individuals in rural areas from likely infections that could result to disease conditions.

The study is unique because it will contribute added information that will assist researchers to realize the public health objective of eradicating pathogens that prevent their environmental biodiversity. Therefore, this study will contribute a quota to the achievement of the World Health Assembly (WHA) resolution on the elimination of schistosomiasis as a public health problem by the year 2025. If this goal is realized, millions of individuals will be protected from likely pathological effects of infections from flukes of Bulinus and Lymnaea snail species which can result in disease conditions.

This study provides baseline data on the distribution of Bulinus and Lymenae genera, their infectivity rates, as well as the variables in the freshwater canals that enhance snail breeding. The data so generated will assist health workers in planning adequate interventions to prevent and control the spread of schistosomiasis and fascioliasis among the residents in the areas including the area studied.

Materials and Method

Study Area

The study area is Okigwe. It is the zonal capital of Okigwe district in Imo State of Nigeria. The district is made up of six Local Government Areas namely: Isiala Mbano, Ihitte Uboma, Ehime Mbano, Onuimo, Obowo and Okigwe. The study area lies between latitude 5°30-5°57N and longitude 7°04-7°26 E (covering a land area of about 1,824 km^2. (www.maplandia.com).

The main occupation here is peasant farming and petty trading, The major source of protein for most individuals is snail consumption. Some individuals also trade on snails as sources of income for sustenance. Freshwater canals are common sources of water for several domestic activities, while the source of drinking water is from bore holes which are strategically located for commercial purposes. Most residents travel few kilometers to purchase their drinking water.

Snail Collection and Identification

Snail collection was carried out by the research team for three months, from May to July 2021. The study site was visited weekly to collect snails. The snails were collected using a long plastic spoon and hand gloves. The sites where the snails were collected were mainly in places where there were constant human activities like school compounds, farming sites, and residential areas. Three plastic containers for keeping the collected freshwater snails were labeled for each monthly collection. Later, the labeled plastic containers were covered with nets so as to allow ventilation and air passage to prevent the snails from dying.

At the end of the collection, the collected snails were taken to the Department of Animal and Environmental Biology laboratory, Abia State University for sorting and identification of the snail species using morphological characteristics such as the shape of the body, the number of whorls on the body, standard key as described by Gillie (1986). Later, the identified snails were counted and recorded.

Human water contact activities were observed on weekly basis. This was done between the hours of 10am and 2pm each day during the sample collection, which coincided with the time the freshwater snails usually secret the cercariae.

Snail Infectivity

The snails were later put in three Petri dishes with a little quantity of water in each dish. Thereafter, the dishes with the little quantity of water were placed under the sun. The petri dishes were monitored for cercariae shedding at intervals of 30 minutes using a dissecting microscope and hand lens. The number of snails that shed in each dish was recorded and those unable to shed also recorded. The water quality index of the freshwater canal was determined using the methods described by Association of Official Analytical Chemistry (AOAC, 2005).

Water Quality Analysis

Some physicochemical properties of water such as pH turbidity and water temperature, Biological Oxygen Demand were measured in situ using pH meters, turbidity meters and thermometers. The results were compared with the Federal Environmental Protection Agency (FEPA) standard

Results

A total of one thousand four hundred and nine (1,409) snails was collected from drainage systems around the residential areas close to the Iyiechu Stream Okigwe. The snails collected were identified as Lymnaea and Bulinus genera as shown in Table 1.

Table 1: Snail species collected Monthly

Snail Genera	May (%)	June (%)	July (%)	Total
LYMNAEA	318 (53.1)	309 (73.4)	249(67.5)	876(62.2)
BULINUS	301(48.63)	112(26.6)	120(32.5)	533(37.8)
TOTAL	619 (43.9)	421(29.9)	369(26.2)	1,409(100%)

P<0.05

Table 1 Shows the snail species collected in each month from the study area.

From this table, there is a marked variation in the number of snails collected. In the first month of snail collection, (May), 619 snails were collected, in June 421 snails were collected while in July, 369 were collected. In May, the snail species collected consisted of 318 (53.1%) Lymnaea, and 301 (48.63%) Bulinus. This represented the largest collection made during the period of study. For the second month, June, the snail species collected were made up of 309 (73.4%) Lymnaea, 112 (26.6%) Bulinus, while in July, being the third month, the snail species collected were 249 (67.5%) Lymnaea, and 120 (32.5%). For all the collections made during the period of study, 876 (62.2%) were of Lymnaea genera, while 533 (37.8) were of Bulinus genera.

Plate 1: A Picture of the Snail Species Collected from the Study Area

Table 2: Months and the Infectivity rates of Freshwater snails collected from the canals

Months	Total number	Infected	% Infected
May	619	428	69.2
June	421	211	50.1
July	369	124	33.6
Total	1409	764	54.2

p<0.05

Table 2 contains the proportions of fresh water snails that shed cercariea representing those that were infected. From this table, out of 619 fresh water snails collected in May, 428 (69.2%) of them were infected. In June, out of 421 snails collected, 211(50.1%) of them shed cercariea and were infected while in July, out of 369 snails collected 124(33.6%) of them were infected. That is, out of a total of 1,409 snails collected for the study, 764(54.2%) of them were infected showing that 645(45.8%) were not infected.

Table 3: Parameters and the Physico- chemical analysis of the freshwater canal studied

Parameters	Result in mean	Federal Environmental Agency Standard (0035 limit)
pH	7.0	5 - 9 (Domestic water), 6 -9(fresh water), 6.5 - 8.5 (marine). FEPA: 6-9
Temperature	26.5	FEPA:<40°C in 15ml of out fall.
BOD (Biological oxygen demand)	1.2	Federal Environmental Protection Agency (FEPA:50mg/l)
DO (dissolved oxygen)	4.6	100ug/l, marine

P<0.05

Table 3 contains physico-chemical parameters of the analysis of the freshwater canals where the snails studied were collected. From the mean physico-chemical analysis on this table, dissolved oxygen (DO) with 4.6, Biological oxygen demand (BOD) 1.2 , with temperature 26.5 and PH 7.0 , significantly influenced snail distribution in the area studied (p<0.05).

Discussion

The fact that the snails collected were more in May and June when the rains are not yet heavy than the ones collected in July when rainfalls are heavy, shows that snails breed less during heavy rains than other periods. That snail breeding was less during the rainy season could probably be due to the decrease in human activities with the water canals. During rainy season there is usually a reduction in human movements. However, during rainy seasons, most residents in the study area resort to the use of rainwater and bore holes for domestic and other activities thereby, decrease the extent to which freshwater canals are polluted with animal and human wastes which arguably encourages snail breeding. The finding that the reduction in the extent to which the water canals are polluted with human and animal wastes during the rainy season negatively affect the levels of biological oxygen demand (BOD) and other parameters that support snail breeding agrees with the findings of [9,42] which noted that reductions in the levels of BOD will contribute to low snail breeding species as also noted during the study. The result of the study showed the abundance and diversity of freshwater snail intermediate hosts in the water canals during the dry season than in the rainy season. This abundance and diversity of freshwater snail hosts are of public health importance because of the increased risks to human infections. This finding corroborates with that of [1,18] which argued that because of the increased presence of freshwater snails during the dry season, that public health professionals should, as of optimal importance, health educate residents living near water canals on the need to reduce regular contacts with freshwater canals during dry season. This is to minimize the parasitic transmission of diseases including schistosomiasis.

The high proportion of cercariae shed by both Lymneae and Bulinus genera reflects the extent to which consumers of these snail species and those with regular contacts with the freshwater canals including school children are exposed to infections. This agrees with earlier studies in Otukpo Benue State and Egbu Owerri Imo State, Nigeria which found 33.3% prevalence of urinary schistosomiasis among school children who had regular contacts with parasite infested water especially during dry season [42,43]. Regular contacts with freshwater canals presuppose poor environmental sanitation around the canals showing increased risks for infections. This suggestion is also in line with those of [32, 35] in which they recommended that human and animal excreta should be reduced so as not to pollute freshwater and produce some organic matters that increase the concentration of detritus thereby, support the proliferation of algae that form the diets for planorbid and prosobranch snails. In this study, few planorbid snails were also noted.

The fact that in the study, some of the infected freshwater snails identified were of Bulinus specie which serves as intermediate host to highly infective larval trematode of the genus Schistosome shows that Schistosomiasis infection may be common in the study area especially among school children who had the habit of swimming in the canals near their school premises as well as picking snails for food. Also in the study, majority of the freshwater snails that were infected belong to the Lymmeae specie which according to studies by [2,8] is the chief intermediate host of Fasciola which predisposes human and animals to liver disease (fascioliasis), showing that some individuals in the study area may be infected with fascioliasis. Realizing the fact that snails formed the main source of protein and avenue for generating revenue for sustenance among some residents in the area of study, presupposes that a significant proportion of the residents may have continuous contacts with the definitive host which would influence the occurrence of disease conditions like fascioliasis, schistosomiasis and others.

Other human activities that were observed around the canals during the study included: farming, bathing, swimming, washing of clothes, cassava and vehicles may have contributed to the poor environmental conditions of the freshwater canals noticed. These numerous human activities suggest regular contacts with various parasites that occur on aquatic plants that serve as food and shelter to freshwater snails. However, it is the increase in the number and diversity of freshwater snails that make them easily available on semi dried soils where they are readily picked by individuals. Nonetheless, one of the striking observations made in this study is the habit of most individuals walking barefooted when picking the snails. This finding has also been confirmed by studies which pointed out that walking barefooted will add to the predisposing factors to schistosoma and Fasciola infections [6,10].

The finding that dissolved oxygen (DO), Biological oxygen demand (BOD) and PH levels are the significant parameters that influence snail breeding in the study area agrees with that of [11,24]. This finding shows that freshwater snails increase the biomass of filamentous green algae thereby, decrease the biomass of periphyton which will invariably reduce the DO of the freshwater needed by aquatic organisms for their existence. This shows that the more the presence of snails, the more the biomass of periphyton is reduced.

The findings in this study informed the researchers on the need to develop a health education, disease prevention and health promotion intervention programmes that will concentrate on educating the residents including the school children on strategies to prevent schistosoma and Fasciola infections. This intervention programme will be conducted, monitored and evaluated for six working weeks. During this intervention, information education and communication (IEC) materials will be used to health educate the participants. Though this intervention will be capital intensive, the researchers will source for likely funders to enable them carryout a comprehensive intervention programme. This is necessary since the result of this study has provided the researchers with baseline data to work with.

Conclusion

Inhabitants in the area depended largely on water from the canal for several domestic activities probably because potable water from most bore holes are sold. As a result, those who cannot purchase bore hole water due to lack of money to buy water for drinking and for other domestic activities, resort to water from the canal which is free of cost. This regular activities could facilitate infections from these snail species as well as the continuation of their life cycles.

Since most people in this area use freshwater snails as sources of protein and means of sustenance, and realizing that the infective larvae (cercariae) develop within freshwater snails which when released penetrate the skin of a human/mammalian body that is in contact with the water, it may be right to conclude that a good number of individuals resident here, who have no knowledge on the consequences of regular contacts with the freshwater canals and the snail species may be infected with schistomiasis and fascioliasis. Therefore, there is urgent need to health educate residents on the need for hygienic practices, provision of accessible potable water, less contacts with freshwater canals, and to avoid the consumption of freshwater snails as some of the preventive measures to infections associated with freshwater snail species and their attendant pathological effects on humans.

Therefore, providing interventions to residents in the study area, after the findings, will generate results that contribute a quota to support the WHA resolution which aims to maintain a world free of schistosomiasis by controlling its morbidity and eliminating schistosomiasis as a public health problem by the year 2025. It is thereby suggested that, after the health education programme, that further studies should be carried out on female genial schistomiasis bearing in mind the types of snail species identified and also the extent to which females interact with the freshwater canals since a good number of them use water from the canals for numerous domestic activities in the study area.

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