Journal of Science Research (2014) Vol. 13: 151-156

Trematode Infections in Freshwater Snails and Rainfall Patterns in Ibadan North Local Government Area, Oyo State, Nigeria

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Abstract
The extent and intensity of parasitism is known to be affected by climatic conditions. Climate changes among other factors have been confirmed to exert more influence on helminths and thus, on the diseases caused by helminths. Freshwater snails serve as specific intermediate hosts for trematodes of medical and veterinary importance and snail ecology is important in the transmission of the parasites. Snail-borne trematodiasis are heavily dependent on the environment for dissemination and are greatly affected by climate. Correlating rainfall patterns, snail abundance and trematode infection have been known to aid in the design of control models for snail-borne diseases. Freshwater snail samples were collected from August to December in years 2012 and 2014 to determine abundance and prevalence of trematode infection. Rainfall data for the study period was obtained from the Department of Geography, University of Ibadan. A total of 550 freshwater snails samples were collected in 2012 and 480 in 2014. The snails identified were *Physa*, *Lymnaea*, *Bulinus* and *Melanoides* species. Examination for trematodes cercariae was carried out using the crushing method. In 2012, 18 snails out of 550, (3.3%) were infected with trematode species with evidence of cercariae release while 0% was recorded in 2014. The total recorded rainfall for the study period in 2012 and 2014 was 35.20mm and 303.40mm respectively. This result showed that rainfall has an effect on the survivability and availability of freshwater snails and thus could be a factor in determining the prevalence of snail-borne infections.

Key words: Freshwater snails; Trematode infections; Ibadan North Local Government Area; Rainfall pattern.

Introduction

Snails are coelomate invertebrates and heamaphrodites which include not just the land snails but also thousands of species of sea snails and freshwater snails [1, 2]. There are numerous species of freshwater snails which include *Plarnorchis*, *Lymnaea*, *Bulinus Physa* and *Melanoides* species [3,4]. They harbour different parasites, most especially trematodes that occur worldwide [5]. Apart from serving as vectors of parasites freshwater gastropods are regarded as being essential in the maintenance of the aquatic system. Decline in the population size of freshwater gastropods could have a detrimental impact on both the stability and productivity of aquatic systems [6], hence factors that regulate and affect the population such as rainfall are generally of great concern. Rainfall affects water movements and temperature, thereby, affecting the distribution and density of the aquatic snails and the rate of trematode development in the snail host [7, 8]. Snail intermediate host are intolerant of strong currents, and breeding colonies are not found in swift flowing streams or water bodies; they are usually found in areas where the velocity of flow is below 40 cm/s [9]. When the velocity is extremely high, the snails are unable to relax and hold to the vegetation and, therefore, cannot move or feed and can no longer maintain themselves [10]. It has been shown through an experimental study that increasing water velocity beyond 40 cm/s kept *Bulinus truncatus* population density low in Morocco [11]. Analysis of the effect of wet and dry period on snail species abundance showed an expansion of snail population density during the dry season and the contraction of snail population density during the rainy season. Thus, water habitats protected from excessive drying and over flooding during the rainy

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ISSN 11179333

season tend to show a more stable snail population all year round [12]. However, such control of water body level is lacking in most of the freshwater habitats such as ponds and burrow pits that dry up during dry periods leaving the snails exposed to excessive drying resulting in death.

Snail-transmitted diseases are one of the major group of helminth parasitic diseases which have been established by trematode parasites. In man these include shistoso-miasis, fascioliasis, paragonimisis and clonorchiasis [13]. Trematodes also known as flukes, also cause infections in animals [14, 15]. Waterborne trematode infections inflict considerable morbidity on health and may cause life-threatening diseases among immunocompromised and immunosuppressed animals. These infections are common, easily transmissible, and have a worldwide distribution [16]. The transmission of these trematodes is enhanced by cultural practices of eating raw or inadequately cooked food, socio-economical factors, and wide zoonotic and sylvatic reservoirs of these helminthes [17, 18] as well as the availability of the freshwater snail intermediadte host.

Rainfall patterns have been established as a factor influencing the prevalence of trematode infections [19]. Although various control methods have been employed in the control of snail transmitted trematode infections, central to these efforts is the control of the snail intermediate host. Factors that affect the survival of the freshwater snails such as rainfall and other meterological data such as relative humidity and moisture level have been used successfully to forecast the abundance of snails and the possible prevalence and time of trematode disease outbreaks [17]. To develop such models and to enable the application of control measures at the appropriate period it is necessary that the effect of rainfall on identified snail species population be studied. We embarked on this study to investigate snail abundance and trematode infections in the freshwater snails in relation to the rainfall pattern in the study area.

Materials and Methods

Ibadan North LGA exists between longitude 30^{O} 531" and 30^{O} 561" East of Greenwich Meridian and latitude 70^{O} 231" and 70^{O} 291" North of Equator with a total land area of about 145.58km^2. Ibadan North LGA is bounded in the north by Akinyele LGA, in the south by Ibadan South-West LG, Ibadan South-East LGA and Oluyole and Ona-Ara LGA and in the west by Ibadan North-West LGA and Ido LGA, in the east by Lagelu LGA and Egbeda LGA. The population of the LGA based on the latest 2006 national census is 306,795 [20]. The major rainy season starts from the latter part of April and reaches its peak in July. The minor rainy season is from the end of September to early November with cool and dry weather during the August break and towards early September. The long dry season extends from November to mid-April [21].

Sample Collection

The samples were collected over a period of five months (August to December) in two different years (2012 and 2014). Snail sampling was conducted at a weekly interval from five streams. Long (1.5m) wooden handled scoop made from net with a mesh size of 2x2mm supported on an iron frame was used to collect the snails. Vegetation around the sites and major substrates such as boulders and woods were inspected visually and hand-picking of snails was done. The samples were then transferred into a plastic bowl containing water from the same water body from which the samples were collected. The samples were brought to the laboratory and placed in an aerated jar containing water from the aquatic system until they were processed. The samples were collected at regular periods of the day (8-11 am) throughout the duration of sample collection. Also, rainfall data for the study period was obtained from the Department of Geography of the University of Ibadan.

Laboratory Identification of Snails and Cercariae Collection

Samples were first identified to genus level using freshwater mollusc identification guides [22, 23]. The snails were processed using the crushing method as previously described [13]. The snail shell was broken with tweezers and soft tissue was placed between two glass slides and squashed. The preparation was examined under a stereo-microscope for emerging cercariae.

Data Analysis

Data were analysed using Pearson correlation and multiple regression.

Results

A total of 550 and 480 freshwater snails were collected in 2012 and 2014. Four species of freshwater snails, *Lymnaea*, *Physa*, *Bulinus* and *Melanoides* were recorded in this study. All species showed variation in abundance among sites with *Melainodes* and *Bulinus* each being absent in all the sites in 2012 and 2014 respectively. The highest number of snails was recorded in the month of September year 2012. Human activities around the sampling sites included farming, bathing, washing of clothes and water-fetching. Vegetation ranged from dense to sparse while none of the sites had appreciable canopy-cover.

Table 1: Prevalence of the Trematodes Cercariae in Freshwater Snails and the Rainfall Pattern in Ibadan North Local Government Area of Oyo State (2012)

Month	Rainfall data (mm)	No of snails collected	Specie of freshwater snails collected			Cercariae recovered
			Physa	***Lymnaea***	***Bulinus***	
August	8.80	35	27	6	2	-
September	0.20	300	233	54	13	10
October	21.80	15	11	3	1	-
November	1.80	130	101	23	6	6
December	2.60	70	54	13	3	2
Total	35.20	550	426	99	25	18

Table 2: Prevalence of the Trematodes Cercariae in Freshwater Snails and the Rainfall Pattern in Ibadan North Local Government Area of Oyo State (2014)

Month	Rainfall data (mm)	No of snails collected	Specie of freshwater snails collected			Cercariae recovered
			Lymnaea	***Physa***	***Melanoides***	
August	67.20	-	-	-	-	-
September	74.60	-	-	-	-	-
October	145.60	-	-	-	-	-
November	16.00	50	30	19	1	-
December	0.00	430	262	159	9	-
Total	303.40	480	292	178	10	-

The percentage of snail samples collected for 2012 was *Physa* (77.7%), *Lymaea* (18%) and *Bulinus* (4.3%) while those for 2014 was *Lymnaea* (61%), *Physa* (37%) and *Melanoides* (2%).

During the sampling period, an average rainfall of 7.4mm per month was observed in 2012 with maximum and minimum values of 21.80mm (October) and 0.20mm (September) (Table 1) while the average rainfall for 2014 was 60.68mm per month with maximum and minimum values of 145.60mm (October) and 0.00mm (December) respectively (Table 2). Total recorded rainfall for the two years was 128mm in 2012 and 609mm in 2014. A negative correlation was obtained for rainfall and snail abundance in 2012 (r= -0.67742); rainfall and snail trematode infection (r= -0.67742); rainfall and snail abundance in 2014 (r= -0.65769). A significant association between rainfall, snail abundance and cercariae was obtained for the two years (p = 0.005). However, no significant association was detected between the three in 2012.

Discussion

Freshwater snails have been known to carry parasites which can affect both animals and man [24, 25], thus, studying them could be informative on controlling trematode infections generally. The uneven distribution of abundance of snail samples during the sampling period (Tables 1 and 2) could be attributed mainly to the rainfall pattern observed from the data collected. It was observed that there was about four times more rainfall in 2014 compared to that in 2012, which must have had a strong influence on the wide variation in the abundance of freshwater snails during the periods studied [7, 8]. The lowered sample size during the 2014 period (Table 2) when compared to the 2012 period (Table 1) was due to the persistent high rainfall and long rainy season extending as far as late October which significantly affected the abundance of snail samples during the period.

The presence of *Melanoides* spp and absence of *Bulinus* spp in 2014 (Table 1) quite normal as it has been documented that *Melanoides* can withstand some level of high rainfall current compared to *Bulinus* spp which cannot withstand such high rainfall pressure [9, 11, 26]. The absolute negative infection status recorded can be attributed to the high rainfall that occurred in 2014 because certain duration of time is required to allow newly hatched snail colonies to mature and become infected [27, 28]. This could also account for the presence of cercariae in the snails collected in 2012 as the rainfall was not high and snails have the required maturation period without being washed away by water current and the cercariae could develop and mature [9]. Although, Preston and Castelino [29], reported that the snail population increased during the rainy season, this finding has been negated by our findings and the reported decrease in snail populations during heavy rains along the river, stream banks and flood plains thus lowering the levels of schistosomiasis at such periods in Kenya and China [19, 30].

The presence of human excrement in some of the sites where the samples were collected especially in 2012 could have favoured the presence of cercariae as low rainfall would not wash away these excreta as much as can be seen in high rainfall period and these excrement which contributes organic wastes could be an important factor in the infectious lifecycle of most trematodes [31]. Also, the abundance of organic matter increases growth and abundance of algae, known to be the best food for most snails [32]. This is also of major public health importance.

In conclusion, climatic factors' effects on population dynamics, life cycle and disease transmission can have a direct impact on infectious diseases that have a development stage in the environment and/or in an invertebrate intermediate host or vector [33, 34]. This study revealed that the specific abundance of freshwater snails in rivers

within the Ibadan North Local Government and the relative infection status is directly affected by the pattern of rainfall. Our result showed that the infection rate of freshwater pulmonates with trematodes larval stages is low; however, being able to successfully predict its abundance and infection risk using the variations in rainfall patterns may play an important role in snail control and subsequently control of snail-borne diseases and zoonosis in man and animals respectively.

Acknowledgements
The authors wish to acknowledge the assistance rendered to the team by Dr. J.O. Abiola during the field work.

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