Schistosomiasis Infection in School-Aged Children in Ghana

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Abstract

Schistosomiasis is a Neglected Tropical Disease caused by a parasitic blood fluke. There are currently over 240 million people affected globally. Humans become infected after coming into contact with water containing the infectious stage of the parasite. Our data consists of egg counts for S*chistosoma haematobium* and S*chistosoma mansoni* collected from school-aged children in Tomefa, Ghana, a marginalized informal community, between 2014 and 2019. Our research explores whether or not reinfections and continuous infections were occurring over the six-year period. Although the government conducts periodic mass drug administration, reinfections are likely given the social and environmental conditions in the community. Families move in and out of the community, and children may stop attending school if they are unable to pay the fees. Prolonged infections in children can lead to malnutrition, anemia, and delayed development. We are looking at reinfection rates for both species, including both replacements and substitutions of the species as well as concurrent infection.

Introduction

Schistosomiasis is a parasitic disease that affects humans. Freshwater snails are an intermediate host and are important to understanding its lifecycle. Snails get infected through miracida, which hatch from eggs, they develop in the snail as sporocysts. Infected snails then release larva, called cercariae, into the water. If an individual comes in contact with infected water, the cercariae will enter its host through penetrating the skin. Once inside, it develops into a schistosome adult worm. *Schistosoma mansoni* (*S.m.*) resides in the mesenteric venules of the bowel and *Schistosoma haematobium (S.h.)* in the venous plexus of the bladder depending on the species. Eggs are released from the worms and exit through the host's urine or feces, allowing the egg to continue its life cycle. Due to the nature of snails as an intermediate host, water is very important in understanding this infection in humans. Tomefa is a community that heavily relies on their water source for daily activities such as fishing, fetching water, washing clothes, swimming, or traveling. This community has a high population of the intermediate host snails, *Bulinus and Biomphalaria spp.* (Anyan, W.K., et al, 2019). It is accepted that the morbidity of schistosomiasis is from the eggs, they can become stuck in the intestines or bladder, which can induce a large inflammation immune response in the host (Colley, D. G., et al, 2014). An acute infection is categorized by fever, abdominal pain, fatigue, or headache. Overtime, infections can lead to rectal bleeding, blood in urine, increased risk of cancer, or obstruction within the ureter or bladder. In females, infections can lead to fertility issues due to inflammation of the ovaries, cervix, and fallopian tubes (Colley, D. G., et al, 2014) In children, either species of schistosoma can lead to anemia, malnutrition, and developmental delays with learning (Colley, D. G., et al, 2014). Having a continuous inflammation response in the body leads to trouble growing, and can affect cognition. We were interested in seeing how many students had a continuous infection with either, or both species from year to year, how many were reinfected or had a replacement infection. From 2014 to 2019, yearly data was collected from a school in Tomefa, Ghana. Egg counts in urine and stool samples were analyzed and values were documented. In order to properly determine how often students were suffering from long term infections, we had to first find how many students were present in the data for two or more years.

Methods

Egg counts in feces and urine samples were collected from school-aged children during SUNY Geneseo's study abroad trip in Ghana each year from 2014 to 2019. This data was collected by assigning each student an identification number and recording the value of the egg counts. We were given data in which each student had received a different identification number each year for six years. The first step to analyzing collected data was to match each student's name with their age over six years to find students who continued education for two or more years at the school. There were a total of 657 students who had samples collected during this period. Matching the names was the most protracted process in data analysis due to discrepancies in spelling, ages, and ID numbers. Once all the names were matched, we identified 126 students who had documented samples for two or more years. They were assigned a new number for identification in our research. We then cross-referenced each name to the biological data that contained the egg counts for both species in the samples to determine which students were infected. Once determining which students were infected, we looked to see what type of infection was occurring in each individual. Our categories that students fell into are as followed: Continuous *S.m.*, Continuous *S.h.*, Continuous Concurrent, Reinfection *S.h.*, Reinfection *S.m.*, Reinfection Concurrent, Replacement Continuous, and Replacement Reinfection. A continuous infection is defined by two or more consecutive years with the same species infection. Continuous concurrent infections are defined as having both species at the same time for two years or more. Reinfection concurrent infections occur when an individual has both species simultaneously with a year or more gap between infection times. Reinfection occurs when a student has a single species infection one year, clears the infection for a year or more, and then the same infection returns. Similarly, replacement reinfection is defined as a student clearing an infection and being reinfected with a different species. Infected students that did not show a long-term infection were also placed into a category. Students were placed into one or more of these categories for analysis.

Results

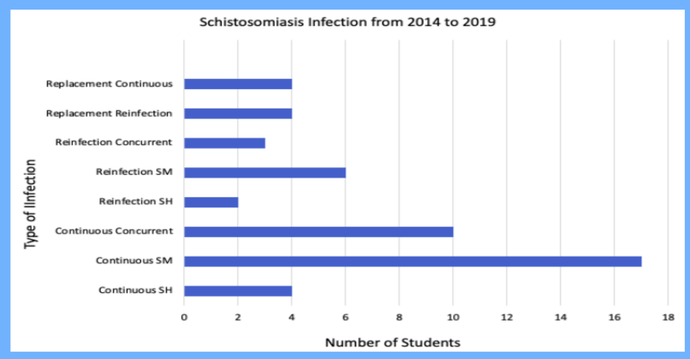

Table 1.Percentage of students out of 86 individuals who had one or more types of infection over the years 2014-2019.

Type of infection	Percentage of Students
Continuous *Schistosoma mansoni*	20.23%
Continuous *Schistosoma haematobium*	4.76%
Continuous Concurrent	11.90%
Reinfection *Schistosoma haematobium*	2.38%
Reinfection *Schistosoma mansoni*	7.41%
Reinfection Concurrent	3.57%
Replacement Reinfection	4.76%
Replacement Continuous	4.76%
No long term infections seen	47.61%

Discussion

After analyzing our results, we saw out of 126 students, 84 had a positive infection with one or both *Schistosoma spp.* At the time of data collection. Of the 84 students, 44 of these students fell into one or more categories of infection. Many students fell into more than one category, such as having a continuous infection of one species and reinfection with another. Out of 84 infected students, 20.23% had a continuous *S.m.* infection, 7.67% had a continuous *S.h.* Infection and 11.90% had a continuous concurrent infection. Long-term infections in any form have harmful effects on children; they can harm their development and ability to learn. Children with long-term infections can have anemia, growth stunting, cognitive impairment, or decreased ability to do aerobic activities (Colley, D. G., et al., 2014). If the infection persists throughout childhood without being prevented or suppressed, some disabilities can become irreversible (Colley, D. G., et al., 2014). 2.38% of the students were reinfected with *S.h.*, 7.41% were reinfected with *S.m.*, and 3.57% were concurrently reinfected with both species. 4.76% of students had replacement reinfection, and 4.76% had a continuous infection. Having a reinfection multiple times has similar long-term outcomes as a continuous infection. When defining the categories, it is important to remember that the students in our study are supposed to receive an antiparasitic drug every year at school. Still, we can not confirm that they received the medication or how often they receive it at home. Also, the testing sensitivity is not 100%, more students could be infected, and the test does not indicate it. Children in this community are most likely infected through helping with water-based activities such as washing clothes, fishing, fetching water, or swimming. Tomefa does not have improved sanitation or water, which perpetuates the disease through human waste entering water sources and allows for disease transmission (Anyan, W.K., et al., 2019). As a Neglected Tropical Disease, it is understudied, often occurs with other types of infections, and is more prevalent in areas affected by poverty. Our results show that long-term infections are occurring in children in this community, which indicates a need for more research and public health interventions to help treat and ultimately prevent this infection.

Citations

Colley, D. G., Bustinduy, A. L., Secor, W. E., & King, C. H. (2014). Human schistosomiasis. *Lancet (London, England)*, *383*(9936), 2253–2264. https://doi.org/10.1016/S0140-6736(13)61949-2

Anyan, W.K., Abonie, S.D., Aboagye-Antwi F., Tettey M.D., Nartey L.K., Hanington P.C., Anang A.K., Muench S.B. (2019) Concurrent Schistosoma mansoni and Schistosoma haematobium infections in a peri-urban community along the Weija dam in Ghana:- A Wake up call for effective National Control Programme, Acta Tropica https://doi.org/10.1016/j.actatropica.2019.105116