Schistosomiasis: A Review of Other Public Health Interventions

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Neglected tropical diseases are left, as their name suggests, abandoned without proper public health interventionist tools within afflicted communities. Millions of people globally interact with neglected tropical disease schistosomiasis (bilharzia), which can cause an immense burden depending on the region, the individual's socioeconomic status, and the infrastructure established to help combat the conditions within the country. This article focuses on a literary review of three intervention points for reducing the risk of people coming into contact with schistosomiasis: a health education campaign, a downscaling farming strategy through market gardening, and differing water-based intervention approaches. Driving awareness and public health efforts toward reducing initial infection and reinfection for endemic schistosomiasis is a proposal that is often last considered due to accepted drug treatments when infected. Therefore, these recommendations are based on minimizing the infection rate and reinfection in endemic areas rather than preventing and treating schistosomiasis.

Keywords

schistosomiasis • neglected tropical disease • public health • education • intervention • endemic

Neglected Tropical Disease: Schistosomiasis

Neglected tropical diseases are persistent across the globe, posing a public health threat to millions. With an emphasis on neglect, the diseases deemed "neglected" usually present within poor socioeconomic populations, therefore receiving little to no public health attention for intervention and treatment. Neglected tropical disease schistosomiasis poses a global toll on individual health, healthcare,

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and economic systems regardless of financial status. According to the Centers for Disease Control and Prevention's Global Health and Division of Parasitic Disease and Malaria (2018b), schistosomiasis, otherwise known as bilharzia, is second only to malaria as the most devastating parasitic disease afflicting people worldwide. More than 200 million people globally are infected with schistosomiasis, and the disease symptoms can appear months after initial infection (Global Health & Division of Parasitic Disease and Malaria, 2020).

Schistosomiasis is a tropical and subtropical disease caused by a parasitic worm called schistosomes. The species of schistosomes that are infectious to humans are urogenital *Schistosoma haematobium*, intestinal *Schistosoma mansoni*, and *Schistosoma japonicum*. Freshwater becomes contaminated with the parasite when an infected animal or human urinates or defecates in it, releasing the parasitic eggs, which hatch and survive only in water. According to Colley, Bustinduy, Secor, and King (2014), *Schistosoma* can follow a life cycle as such: a male and female trematode parasite reproduce fertilized eggs within the veins of a human host. The eggs can either be vacated through stool or urine or be retained. If retained, inflammation in the body occurs, and the host potentially dies. However, when the eggs exit the body, if reaching freshwater, they may hatch and infect a snail host, thus undergoing asexual reproduction shedding thousands of cercariae, which are infectious to humans. Cercariae can remain infectious within freshwater for one to three days. Once they penetrate the skin of a human host, it takes five to seven weeks to mature before becoming adults, able to produce eggs and repeat the cycle (Colley et al., 2014).

Chronic schistosomiasis, resulting from repeated exposure to infectious cercaria or development from an untreated initial infection, is endemic in many world regions. Without treatment, chronic schistosomiasis can persist for years and may include abdominal pain, an enlarged liver, blood in the stool or urine, problems passing urine, and an increased risk of liver fibrosis or bladder cancer (Global Health & Division of Parasitic Diseases and Malaria, 2018a). The global burden of schistosomiasis is primarily within Africa, South America, the islands of North America, and the Middle East; it is localized within the Asian countries China and the Philippines (Colley et al., 2014). Furthermore, the prevalence of chronic schistosomiasis is high as the initial infection occurs at a very early age. According to D. G. Colley et al. (2014), the first infection is usually a child at age two years. However, almost every long-term resident within an endemic region becomes infected with *Schistosoma* at some point in their life (Colley et al., 2014). While the highest prevalence is among children, other populations who frequently come into contact with water for daily activities such as laundry, bathing, and fishing are at risk of infection and developing chronic schistosomiasis.

Schistosomiasis carries a substantial burden on individual health, communities, and leadership. Thus, this parasite requires medical interventions and approachable civilian interventions. Disability due to communicable disease is the leading cause of disease burden in low-income countries, which is preventable. Schistosomiasis recorded 1.7 million disability-adjusted life years (DALYs) per year due to organ damage, hemorrhage, and cancer resulting from infection (King, 2010). However, a recalculation of DALYs using a conservative 2% disability weight yielded a more realistic DALY of 13–15 million in 2004 (King, 2010). Therefore, schistosomiasis intersects as a public health medical problem in addition to a public health environmental problem. The following sections examine multiple solutions to reduce the prevalence of schistosomiasis, not to eliminate the parasite. Most global public health organizations are focusing on treatment measures post-infection. Still, there must be further considerations to decrease human contact with infectious cercariae and host snails, potentially minimizing the ongoing infection cycle, reinfection, and chronic schistosomiasis.

A Continuous Health Education Campaign

Health education is defined as "providing health information and knowledge to individuals and communities and providing skills to enable individuals to adopt healthy behaviors voluntarily" (Kumar & Preetha, 2012). According to the World Health Organization (2020), schistosomiasis is a global health threat to more than 700 million people. Therefore, educating the public within and in surrounding endemic areas about the neglected tropical disease is vital.

Health education involves understanding learned experiences that can help individuals and communities improve health outcomes through gained knowledge and influencing attitudes (Kumar & Preetha, 2012). Before researchers can conduct health education campaigns, they aim to understand the health literacy of people's knowledge, attitudes, and practices or conduct a knowledge, attitude, and practices (KAP) survey among the population studied. Through KAP surveys, the theory is that knowledge is the foundation for changing behavior and requires time knowledge-based formulation (Xu et al., 2019). A KAP survey reveals misconceptions and misunderstandings that may present barriers to behavior change through a formatted standardized questionnaire. The predefined questions allow researchers to evaluate qualitative and quantitative information and may reveal breaches in behaviors and knowledge on behaviors.

Limited or insufficient health literacy is associated with reduced protective behaviors and understanding how one becomes infected. Therefore, student health education about schistosomiasis should be constantly carried out and preserved, ultimately improving student cognition through long-term indoctrination on infection and transmission (Xu et al., 2019). However, this includes setting up special health education classes if countries do not have them already. Overall, children are the ideal canvas for instilling health behaviors that can benefit community outreach and change, leading to healthier communities in the long term.

An example of a continuous health education campaign is introducing material into the school curriculum. In Kenya, schistosomiasis was taught at school within the science subject as "bilharzia—a water-borne disease" (Takeuchi et al., 2019). In Tanzania, a health education campaign was encouraged by teachers to improve child personal hygiene relevant to the control of schistosomiasis, including the importance of clean drinking water, handwashing, and using latrines, through classroom teachings and health messages throughout the classroom (Lansdown, 2002). Health education within the school is essential to consider, given how young people become infected. The younger the intervention participants, the earlier the intervention can help lower the prevalence of chronic schistosomiasis.

Market Gardening Strategy

The links between poverty and neglected tropical diseases are widely understood: it is an economic burden. However, providing for one's family was more of value for many people than working in jobs that posed a high risk of infection. Family members who work as fishermen, farmers, irrigation workers, and those collecting freshwater frequently exposed themselves to cercariae in endemic areas (Lund et al., 2019). There is a cycle within underdeveloped countries where living within endemic areas hinders income generation because income is mainly through physical labor resource–dependent livelihoods (Lund et al., 2019). Therefore, theoretically, schistosomiasis may be an important barrier to economic development, given that many physical labor jobs include

farming and fishing, which work closely with freshwater. Thus, this gives rise to a relationship that cannot break with schistosomiasis infection if one's livelihood is of more importance than one's health outcomes. For example, schistosomiasis leads to a severe health disparity in rural communities, especially among farmers. Farmers are aware of the risk of exposure, yet they have no alternative but to come into contact with freshwater for irrigation. Since irrigation ditches are prime snail habitats, scaling down farm sizes may be a tool to help reduce snail vector distribution into where people live and work.

A suggestive strategy to release people from becoming reinfected with contaminated water and help support the local economy all while building community is market gardening. According to Bachmann (2009), a market garden is "the commercial production of vegetables, fruits, flowers and other plants on a scale larger than a home garden, yet small enough that many gardening principles are applicable. The goal, as with all farm enterprises, is to run the operation as a business and to make a profit." Implementing a large-scale garden makes the point blatant: to drive money directly into the farmers' pockets, given that the earnings will be going straight back into their pockets. Market gardening can also serve as a community garden where locals can pay for fresh produce like community-supported agriculture (CSA).

The market gardening strategy is a suggestion highlighted for areas with other public health crises such as food insecurity, malnutrition, and vitamin deficiencies. Comorbidities are likely to present across hyperendemic regions of schistosomiasis. Therefore, introducing a possible solution to provide fresh produce with the potential to gain local capital is a step in a nontraditional direction in tackling a neglected tropical disease. Given the prevalence of neglected tropical diseases among poor socioeconomic climates like rural areas, introducing a solution to minimize poverty and schistosomiasis exposure is not the ultimate solution but the development toward a progressive outcome.

Water-Based Approach

The further point is that farmers and civilians should eliminate outside contact with contaminated water sources, given schistosomiasis is a waterborne disease. In short, mass drug administration with praziquantel is the most popular control of schistosomiasis morbidity (Evan Secor, 2014). Given schistosomiasis has a life cycle presence central in water, targeting interventions to environmental approaches is a crucial component to highlight for public health. A past public health approach used a biological agent such as a chemical to interact and kill host snails, which ultimately proved toxic to aquatic animals, causing a loss of food supply for people within the endemic area (Evan Secor, 2014).

The most well-received intervention is introducing endod, the soapberry plant *Phytolacca dodecandra*, lethal to snails that may host schistosomiasis (Evan Secor, 2014). Other biological control approaches in reducing snail populations include introducing a predator prawn *Macrobrachium vollenhovenii*, a crayfish *Procambarus clarkii*, and other predatory fish indigenous to areas where host snails of schistosomiasis transmission are high (Evan Secor, 2014). Given this, evaluating geography, the species of the schistosomiasis, and the various host snail species is essential when introducing predatory species. Therefore, introducing nonindigenous species is a consequence to avoid. Furthermore, snail habitats are crucial to understanding disease transmission. Studies have shown that habitat correlates appeared to be effective predictors of snail abundance, such as mud, emergent

vegetation, and non-emergent vegetation (Wood et al., 2019). By using "precision mapping" such as drone or satellite observations, scientists can identify high-risk areas that may drive transmission (Wood et al., 2019). Identifying high-risk areas can expedite removing the vegetation that supports snails or introducing predatory species, which may help eliminate the snail clusters and reduce the rate of infection. However, these less invasive water interventions have not been as successful due to participation rates and low maintenance (Evan Secor, 2014).

Overall, it is vital to have safe, non-contaminated drinking and potable water in any community. The goal is to limit the overall contact an individual has with contaminated schistosome water to reduce the prevalence of infection or reinfection. To help with this goal, providing less infectious schistosomiasis water is vital. The ultimate achievement is providing communities with a safe and cost-effective treatment process that rids water of cercariae. Cercariae are present dead when stored in water for more than one to three days, depending on the temperature (Braun, Grimes, & Templeton, 2018). There are numerous ways to filter cercariae out of the water, including filter mediums, chlorination, and ultraviolet lighting. Still, the results have been presented variable and require further research to obtain reproducible information (Braun et al., 2018).

Future Considerations

For decades, schistosomiasis has been applied with the same strategies, utilizing mass drug administration and supplemental support to aid chronically ill patients. The future of care for this neglected tropical disease is to angle support toward public health applications that directly impact the people and that are not medicine-based. Helping, treating, and preventing the disease spread in masses of people do not define medicine but define the components of public health and what public health relationships with treatment can accomplish. It is time to continuously utilize interdisciplinary approaches, possibly even broader than those used now, to try and combat schistosomiasis. A system may include but isn't limited to initiating interventions for health education for youth, scaling down farms, and utilizing multiple water-based interventions to reduce the transmission of schistosomiasis.

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