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Schistosomosis and its Impact on Water Shed Agricultures (Short Review)

Nabon Debela

National Institute for the Control and Eradication of Tsetse Fly and Trypanosomosis,
Akaki Kaliti Sub-City, P.O. Box: 19917, Addis Ababa, Ethiopia

Abstract: Schistosomiasis caused by infection with blood flukes of the genus *Schistosoma*, at least five trematode species known to infect humans and animals. These are *S. haematobium, S. intercalatum, S. japonicum, S. mansoni* and *S. mekongi*. This disease have great and complicated impact on rural development specifically related with water shed agriculture systems including lakes, waterways, dams, irrigation schemes and reclamation projects in many areas of the world. Dam and irrigation projects are potential sites for outbreaks of schistosomiasis. Movements of populations with schistosomiasis, for example from rural to urban areas, can cause the spread of schistosomiasis. Seasonal migrations of employees can also lead to outbreaks of schistosomiasis infections and refugees can contribute to the outbreaks of this disease as well. The control of schistosomiasis based on large-scale treatment of at-risk population groups, access to safe water, improved sanitation, hygiene education and snail control. WHO strategy for schistosomiasis control focuses on reducing disease through periodic, targeted treatment with praziquantel through the large-scale treatment (preventive chemotherapy) of affected populations. Therefore, this review solely focused on discussing about Schistosomiasis infection and its impact on water shed agriculture system.

Key words: Schistosomosis · Watershed Agriculture · Impact

INTRODUCTION

Schistosomosis caused by infection with blood flukes of the genus *Schistosoma*, at least five trematode species known to infect humans and animals. These are *S. haematobium, S. intercalatum, S. japonicum, S. mansoni* and *S. mekongi* [1, 2]. Schistosomiasis infects more than 230 to 250 million people annually and 779 million people are at risk of infection. This disease causes 280, 000 deaths annually and a worldwide burden of 3.3 million disability-adjusted life years [3]. Schistosomes exist in many developing countries of Africa, Asia, South America, several Caribbean islands and in non-endemic areas which can be spread through water-based development projects and irrigation [4]. In sub-Saharan Africa, prevalence levels, particularly of *S. mansoni*, have increased due to water resources development projects, population increase or displacement, migration and competing priorities in the health sector [5].

Water has a key role in schistosomiasis transmission and spread. Human-to-environment transmission occurs when infected people contaminate freshwater bodies with their excreta containing parasite eggs. Environment-to-human transmission occurs when people exposed to infested water during routine activities, ranging from agricultural to domestic and from occupational to recreational. Therefore, the disease is especially prevalent in rural communities. Lack of hygiene and certain play habits make school-aged children particularly vulnerable to infection, an aspect which must be regarded with care, because schistosomiasis may induce severe health consequences in absence of adequate treatments [6].

Therefore, the current review intended on discussing about shistosomiasis and its impact on watershed agricultures.

Schistosomiasis: Schistosomosis is an acute and chronic parasitic disease caused by blood flukes (trematode worms) of the genus Schistosoma. At least five trematode

Corresponding Author: Nabon Debela, National Institute for the Control and Eradication of Tsetse Fly and Trypanosomosis, Akaki Kaliti Sub-City, P.O. Box: 19917, Addis Ababa, Ethiopia.

species known to infect humans and animals, these are *S. haematobium, S. intercalatum, S. japonicum, S. mansoni* and *S. mekongi*. Estimates show that at least 229 million people required preventive treatment in 2018. Preventive treatment, which should be repeated over a number of years, will reduce and prevent morbidity. Schistosomiasis transmission has been reported from 78 countries [2].

Pathogenesis and Clinical Sign: People infected when larval forms of the parasite released by freshwater snails penetrate the skin during contact with infested water. Transmission occurs when people suffering from schistosomiasis contaminate freshwater sources with their excreta-containing parasite eggs, which hatch in water. In the body, the larvae develop into adult schistosomes. Adult worms live in the blood vessels where the females release eggs. Some of the eggs passed out of the body in the faeces or urine to continue the parasite's lifecycle [7].

Symptoms of Schistosomosis caused by the body's reaction to the worms' eggs. Intestinal schistosomiasis can result in abdominal pain, diarrhoea and blood in the stool. Liver enlargement is common in advanced cases and is frequently associated with an accumulation of fluid in the peritoneal cavity and hypertension of the abdominal blood vessels. In such cases, there may also be enlargement of the spleen. The classic sign of urogenital schistosomiasis is haematuria (blood in urine) [8].

Fibrosis of the bladder and ureter and kidney damage sometimes diagnosed in advanced cases. Bladder cancer is another possible complication in the later stages. In women, urogenital schistosomiasis may present with genital lesions, vaginal bleeding and pain during sexual intercourse and nodules in the vulva. In men, urogenital schistosomiasis can induce pathology of the seminal vesicles, prostate and other organs. This disease may also have other long-term irreversible consequences, including infertility [9].

Life Cycle: Schistosoma eggs excreted from the human host into a fresh water environment through urine or feces. Once an egg encounters fresh water, it hatches and releases a miracidium, a free-living and ciliated form, which remains infective for 6-12 hours. The miracidium swims by ciliary movement toward the snail intermediate host and penetrates its soft tissue. Different fresh water snails that serve as their intermediate hosts transmit the *Schistosoma* species: *Biomphalaria*, *Bulinus* and *Oncomelania* for *S. mansoni, S. haematobium* and *S. japonicum*, respectively [10]. After a period of multiplication of 4-7 weeks in the snail, the next larval stage, the cercariae, emerge and are now able to infect humans (or other animals). A single miracidium can develop into as many as 100 000 cercariae. Between 48 hours after leaving the snail, the cercariae are capable of boring through the skin of the definitive host and transform into schistosomula that migrate through the lungs and liver where they mature. After 6-12 weeks, they pair and move via blood vessels to their final position, where they begin to produce eggs. An average couple will produce eggs for 2-5 years, but have been known to live for up to 30 years [11]. The schistosomules leave the dermis via the venous or lymphatic vessels and migrate to the heart and lungs [12]. Schistosomules then migrate to the portal or vestibule circulation where they mature into adult worms. Adult *S. japonicum, S. mekongi* and *S. intercalatum* worms stay in the portal and mesenteric vessels while *S. haematobium* worms live in the vesical plexus. Mating of the adult worms also occurs in these locations. During mating, the male adult schistosomes embraces the female worm into its gynecophoric canal [13].

Link Between Water Resource Development and Infection: Dam and irrigation projects are potential sites for outbreaks of schistosomiasis. Movements of populations with schistosomiasis, for example from rural to urban areas, can cause the spread of schistosomiasis. Seasonal migrations of employees can also lead to outbreaks of Schistosomosis infections and refugees can contribute to the outbreaks of this disease [14]. A clean water supply, sanitation, vector control and health education can interrupt the spread of schistosomiasis. Furthermore, Braun, *et al*. [15] indicated that water treatment could help to reduce schistosomiasis.

Control and Prevention: Schistosomosis infection can occur during the human daily necessary activities associated with fresh water working, bathing, washing, fishing and recreation. The disease condition related to schistosomiasis caused by heavy infections. Health education as part of morbidity control is important in helping the population to modify behavior to prevent the disease, to understand the meaning of health in contrast to disease, to recognize the symptoms of schistosomiasis and to use appropriately the available health facilities; health education should also encourage community involvement in control programs with a view to social

action. The success of intervention measures that have a direct impact on morbidity such as chemotherapy, water supply and sanitation, environmental management and environmental modification all require the active participation of the population [16].

The control of Schistosomosis is based on large-scale treatment of at-risk population groups, access to safe water, improved sanitation, hygiene education and snail control. The WHO strategy for schistosomiasis control focuses on reducing disease through periodic, targeted treatment with praziquantel through the large-scale treatment (preventive chemotherapy) of affected populations. It involves regular treatment of all at-risk groups. In a few countries, where there is low transmission, the interruption of the transmission of the disease should be aimed for [7].

Groups Targeted for Treatment Are:

- School-aged children in endemic areas.
- Adults considered to be at risk in endemic areas and people with occupations involving contact with infested water, such as fishermen, farmers, irrigation workers and women whose domestic tasks bring them in contact with infested water.
- Entire communities living in endemic areas.

WHO also recommends treatment of preschool aged children. Unfortunately, there is no suitable formulation of praziquantel to include them in current large-scale treatment programs. The frequency of treatment is determined by the prevalence of infection in school-age children. In high-transmission areas, treatment may have to be repeated every year for a number of years. Monitoring is essential to determine the impact of control interventions [8].

The aim is to reduce disease morbidity and transmission: periodic treatment of at-risk populations will cure mild symptoms and prevent infected people from developing severe, late-stage chronic disease. However, a major limitation to schistosomiasis control has been the limited availability of praziquantel. Data for 2018 show that 42.4% of people requiring treatment were reached globally, with a proportion of 62.6% of school-aged children requiring preventive chemotherapy for schistosomiasis being treated [17].

Praziquantel is the recommended treatment against all forms of schistosomiasis. It is effective, safe and low-cost. Even though re-infection may occur after treatment, the risk of developing severe disease is diminished and even reversed when treatment is initiated and repeated in childhood [18].

Schistosomosis control has been successfully implemented over the past 40 years in several countries, including Brazil, Cambodia, China, Egypt, Mauritius, Islamic Republic of Iran, Oman, Jordan, Saudi Arabia, Morocco, Tunisia, etc. In Burundi, Burkina Faso, Ghana, Niger, Rwanda, Sierra Leone, the United Republic of Tanzania and Yemen, it has been possible to scale-up schistosomiasis treatment to the national level and have an impact on the disease in a few years. An assessment of the status of transmission is required in several countries [7].

Impact on Water Shed Agricultures: Both large and small-scale water resources development projects are often established to satisfy agricultural production and energy needs for growing populations. Such initiatives for human and economic development, unfortunately, often lead to increased morbidity for local populations [19, 20]. Schistosomiasis can be regarded as one of the most sensitive and obvious indicator diseases of environmental change following the establishment of lakes, waterways, dams, irrigation schemes and reclamation projects in many areas of the world. If preventive measures and health services are insufficient or non-existent, infections appear a year [21].

Accurate and valid data on disease prevalence before and after the development of water resources are rarely available. Governments are often not interested in publishing figures showing that health has deteriorated following initiatives for large-scale water resources development [22]. Nevertheless, the available literature convincingly documents the link between water resources development and the spread of schistosomiasis. Evidence for the link has been particularly persuasive from Africa [23]. A study that discusses this link more in detail found in a recent meta-analysis of 24 studies (including 35 datasets) from Africa. The same review estimates that of the 779 million people worldwide at risk of infection in mid-2003, 13.6% were at risk because they lived near large dam reservoirs and irrigation schemes [24].

Large-scale water resources development schemes receive most of the attention when it comes to increased risk of schistosomiasis however, small local impoundments constructed for fishing, water supply, cattle and livestock watering, irrigation and flood control may play an even more significant role in disease

transmission. These smaller schemes, which are often created for the benefit of locals, as opposed to the larger schemes [25], rarely include plans for adjusted health-care needs [19]. The increase of diseases due to small dams for agricultural development is not transient, but permanently entrenched in the regional disease ecology [26].

CONCLUSION

Schistosomosis caused by infection with blood flukes of the genus *Schistosoma*, at least five trematode species known to infect humans and animals. These are *S. haematobium, S. intercalatum, S. japonicum, S. mansoni* and *S. mekongi*. Dam and irrigation projects are potential sites for outbreaks of schistosomiasis. Movements of populations with schistosomiasis, for example from rural to urban areas, can cause the spread of disease. Seasonal migrations of employees can also lead to outbreaks of schistosomiasis infections and refugees can contribute to the outbreaks of this disease. Control of the disease based on large-scale treatment of at-risk population groups, access to safe water, improved sanitation, hygiene education and snail control. WHO strategy for schistosomiasis control focuses on reducing the disease through periodic, targeted treatment with praziquantel through large-scale treatment (preventive chemotherapy) of affected populations.

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