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Review article

Impact of human schistosomiasis in sub-Saharan Africa



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ABSTRACT

Schistosomiasis, a neglected tropical disease of poverty ranks second among the most widespread parasitic disease in various nations in sub-Saharan Africa. Neglected tropical diseases are causes of about 534,000 deaths annually in sub-Saharan Africa and an estimated 57 million disability-adjusted life-years are lost annually due to the neglected tropical diseases. The neglected tropical diseases exert great health, social and financial burden on economies of households and governments. Schistosomiasis has profound negative effects on child development, outcome of pregnancy, and agricultural productivity, thus a key reason why the “bottom 500 million” inhabitants of sub-Saharan Africa continue to live in poverty. In 2008, 17.5 million people were treated globally for schistosomiasis, 11.7 million of those treated were from sub-Saharan Africa. This enervating disease has been successfully eradicated in Japan, as well as in Tunisia. Morocco and some Caribbean Island countries have made significant progress on control and management of this disease. Brazil, China and Egypt are taking steps towards elimination of the disease, while most sub-Saharan countries are still groaning under the burden of the disease. Various factors are responsible for the continuous and persistent transmission of schistosomiasis in sub-Saharan Africa. These include climatic changes and global warming, proximity to water bodies, irrigation and dam construction as well as socio-economic factors such as occupational activities and poverty. The morbidity and mortality caused by this disease cannot be overemphasized. This review is an exposition of human schistosomiasis as it affects the inhabitants of various communities in sub-Saharan African countries. It is hoped this will bring a re-awakening towards efforts to combat this impoverishing disease in terms of vaccines development, alternative drug design, as well as new point-of-care diagnostics.

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Introduction

Human schistosomiasis otherwise called bilharzia, is a freshwater snail transmitted intravascular debilitating disease resulting from infection by the parasitic dimorphic *Schistosoma* trematode worms, which lives in the bloodstream of humans.^{1,2} The World Health Organization (WHO) regards the disease as a neglected tropical disease, with an estimated 732 million persons being vulnerable to infection worldwide in renowned transmission areas.³ Steinmann and co-workers documented that over 200 million individuals from Africa, Asia, and South America are infected with this disease.¹ The WHO further estimated that schistosome infections and geohelminths accounts for over 40% of the world tropical disease burden with the exclusion of malaria.⁴ Humans get infected with this disease when they make contact with water contaminated with the skin-penetrating cercariae. Prevalence of schistosomiasis, at present, is still high in sub-Saharan Africa. In 2008, 17.5 million people were treated globally for schistosomiasis, 11.7 million of those from sub-Saharan Africa only.³ Approximately 120 million individuals in sub-Saharan Africa have schistosomiasis-related symptoms while about 20 million undergo hardship as a result of chronic presentations of the disease.⁵

Schistosomiasis has been successfully eliminated in Japan and Tunisia. Morocco and some Caribbean Islands countries have made significant progress on controlling the disease while Brazil, China, and Egypt are taking steps towards elimination of the disease.⁶ Schistosomiasis is more rampant in poor rural communities especially places where fishing and agricultural activities are dominant. Domestic activities such as washing clothes and fetching water in infected water expose women and children to infection. Recreational activities like swimming and poor hygiene also make children vulnerable to schistosomiasis.³ Humans are usually infected by five species of schistosomes, namely *Schistosoma mansoni*, *Schistosoma haematobium*, *Schistosoma japonicum*, *Schistosoma mekongi*, and *Schistosoma intercalatum*, but the main burden of disease in sub-Saharan Africa is usually attributed to two species, namely, *S. mansoni* and *S. haematobium* and are referred to as the major human schistosomes.⁶

Biomphalaria snails are responsible for the transmission of *S. mansoni* which is the source of hepatic and intestinal schistosomiasis in places like the Arabian countries, South America, and Africa. *Bulinus* snails transmit *S. haematobium* which is the chief cause of urinary schistosomiasis in Africa and in the Arab world.² The *Biomphalaria* snails comprise many species including *B. alexandrina*, *B. sudanica*, *B. pfeifferi*, and *B. hoanophala*, while the genus *Bulinus* comprises the following species; *B. tropicus*, *B. globosus*, *B. truncatus*, *B. forskalli*, and *B. africanus*.⁷ *Schistosoma japonicum* is spread by the freshwater snail *Oncomelania* and it is responsible for intestinal and hepatosplenic schistosomal infections in Indonesia, Peoples Republic of China, and the Phillipines. It is a zoonotic parasite infecting animals including pigs, dogs, cattle, and rodents. Some other species of schistosome are parasites of different animals, but occasionally infect humans. *S. mansoni* can also be found in primates and rodents but the main host are human beings.²

Matured schistosomes are usually greyish or white worms with a length of 7–20 mm, having a cylindrical shape with two ending suckers, a blind digestive tract, a complex tegument, and reproductive organs. A distinguishing feature in this trematode compared with other trematodes is its existence in two sexes. The male has a gynecophoric channel or a groove, wherein it grips the female which is usually longer and thinner. The male and female schistosomes live as permanently embraced couples in the perivesical venous plexus (in *S. haematobium*) or in the mesenteric venous plexus (in *S. mansoni* and *S. japonicum* species). The schistosomes get nourishment from the host blood and globulins by means of anaerobic glycolysis and excrete the waste back into the body of the hosts.² A female schistosome has the capacity to produce hundreds of eggs per day as discovered in the African species, and about thousands of eggs per day in the oriental species. The individual ovum is home to miracidium larva with cilia that produce proteolytic enzymes which aid the eggs to move either towards the lumen of the bladder or towards the host intestine.²

Subsequently, the parasites eggs are released into the faeces or urine where they remain alive for about seven days. When they get into freshwater, the miracidium is released from the egg. With the aid of chemical stimuli and light, the miracidium seeks the freshwater snail which is its intermediate host. On locating the snail, the miracidium penetrates it and undergoes asexual reproduction to produce multicellular sporocytes which develop to cercarial larvae having embryonic suckers as well as a two-branched tail.² After 4–6 weeks of infecting the snail, the cercariae leave the snail and gyrate around for about 72 h looking out for the skin of a prospective host. Once released from the snail the cercariae are instigated by light mainly during the day time. On locating a human host skin, the cercariae burrow into it, migrate into the blood through the liver and lungs and undergo transformation into schistosomula also called young worms.²

The schistosomula mature within 4–6 weeks inside the portal vein, mate, and migrate to their destination, which is either the perivesicular or mesenteric venous plexus, to start the cycle again (Fig. 1). A single infected snail has the potential of shedding thousands of cercariae daily for many months. An adult schistosome has an average lifespan of between three to five years, but it can as well live for 30 years. A single schistosome pair has a theoretical reproduction potential of up to 600 billion schistosomes.² The intermediate freshwater snail inhabit calm or slowly moving freshwater lakes, rivers, ponds, or streams. The rate of infection in human increases with the duration of time spent in contaminated water.⁸ Microscopic examination of stools and urine is the gold-standard for detection (diagnosis) of schistosomal infection. The schistosome eggs are easily seen and identified on microscopy due to its peculiar size and shape, and possession of a lateral or terminal spine.⁸

Schistosomiasis: a neglected tropical disease of poverty

Neglected tropical diseases (NTDs) are generally referred to as a collection of chronic, disabling, and physically disfiguring infectious diseases that are found mostly among poor rural

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