

## The Egyptian liver and schistosomiasis in 5000 years: The liver and river story

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### REVIEW ARTICLE

**Background:** The Nile River and the liver disease schistosomiasis share a dramatic story that unites them. Egypt is the Nile's gift to the world, as it gives it goodness and growth. On the other hand, it brings to Egypt the oldest disease in its history, schistosomiasis. **Aim:** We aimed to review the 5 thousand years history of *Schistosoma* in Egypt, its relation to the Nile River, and its effect on Egyptian life and health, as well as to shed light on the efforts of the Egyptian Ministry of Health to control it in the last century, current situation, and perspectives. **Results:** *Schistosoma* in ancient Egyptian mummies proved the disease was present over 5000 years ago. Theodor Bilharz, a German professor after whom the disease is named, discovered the *Schistosoma* in 1850. In 1937, studies found that schistosomiasis affected more than 60% of the population in rural areas. In 1926, the government initiated mass treatment and snail control programs and campaigns to combat schistosomiasis and it continued for the past 100 years, leading to a decline in the prevalence of schistosomiasis from 60% in 1937 to approximately 0.2% in 2016. Recent studies have revealed an increase in incidence in certain areas of Egypt, which raises serious concerns. **Conclusion:** The story of the schistosomiasis in Egypt extends more than 5000 years and despite the efforts of the state for more than a hundred year; this requires the continuation of research, treatment and control campaigns especially in the most endemic and widespread places in Egypt.

**Keywords:** Egyptian mummies, River Nile, Schistosomiasis, schistosoma treatment in Egypt.

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## INTRODUCTION

The story of the Egyptian liver and Schistosomiasis is an old story started more than 5000 years ago in an intimate relation with the tallest river in the world the Nile River and extends its chapters to today (Contis, 1996). The Nile River provided Egypt with life and development throughout history, but it also provided it with the serious schistosomiasis disease. Schistosomiasis is a parasitic disease of poverty caused by blood flukes (trematodes). More than 200 million individuals are infected with schistosomiasis worldwide. *Schistosoma* was named by Weinland 1858 from the two Greek words *schistos* that means split and *soma* that means body and it is related to the shape of the male worm (Santos, 2021). Schistosomiasis is considered one of the most important diseases prevalent in the tropical and subtropical countries. It is considered as the second most important parasitic disease after malaria affecting social life, economic state and public health. (Yameny, 2017). Cercaria, the larval form of schistosome, is released by freshwater snails. Infection occurs when an individual is exposed to water containing cercaria such as swimming, irrigating land or washing clothes and utensils in the river; Cercaria then penetrates the skin and passes to reach the mesenteric circulation in the intestinal tract where it becomes an adult worm. Depending on the type of adult worm, they will take residence

in the adult worms' veins of the liver, intestine or urinary tract. The adult worms will then live in the veins of liver and intestines or urinary tract according to the type. The adult form lay eggs that become trapped in the tissues causing a bodily reaction that leads to hepatic fine periportal fibrosis and granuloma. In the urinary tract the granuloma is followed by excessive fibrosis stricture, stenosis and may be complicated by cancer bladder due to chronic irritation in the urinary bladder. As shown in Figure 1, eggs pass in urine and stool according to type of infection. (Barsoum, 2013, Shaker, 2014) Intestinal schistosomiasis is caused by (*Schistosoma*) *S. mansoni*; in Africa, the Middle East and South America, *S. intercalatum*; Central and West Africa, *S. mekongi*; in Cambodia and Lao and *S. japonicum*; in Japan, China and Indonesia. Urogenital schistosomiasis caused by *S. haematobium* endemic in Africa and Middle East, and India (Colley, 2014).

## AIM OF THE WORK

This study aims to review the history of *Schistosoma* in Egypt over more than 5,000 years, exploring its relation to the Nile River and its impact on health, life span, child growth, and the national income of Egypt.

Additionally, the study seeks to highlight the Ministry of Health's programs for the control and eradication of schistosomiasis over the past 100

years, as well as the current situation and prospects of the disease.

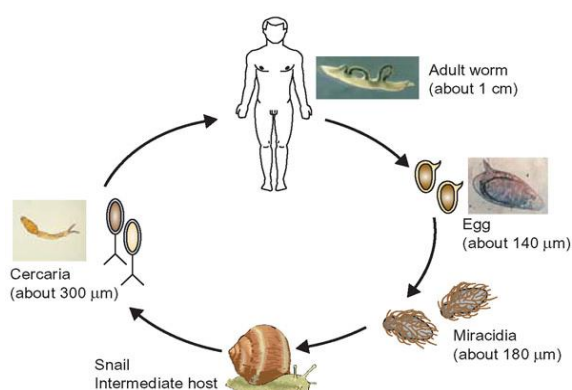


Figure 1. A of schistosomiasis. (Hoffmann K, 2003).

### History of Schistosomiasis in Pharaonic Era

In 1851, a German professor named Theodor Bilharz who worked in Kasr Al Ainy Hospital in Cairo teaching students and treating patients detected a blood fluke in the portal vein during an autopsy of a young Egyptian man which was later named *Schistosoma*. It causes hematuria and hematemesis in Egyptian patients since ancient times (Eldib, 2019). We would never have known how far back schistosomiasis dates until the calcified bilharzial ova were discovered in the liver and kidneys of the old Egyptian mummies more than 5000 years old (David, 1997). Marc Ruffer 1910 president of the Sanitary, Maritime and Quarantine Council of Egypt in Alexandria was the first to diagnose *S. Haematobium* infection from Egyptian mummy's kidneys from 1250 BC by identifying calcified *S. haematobium* ova in microscopic sections (Di Bella S, 2018).

Diagnosis of schistosomiasis in mummies is done by x-ray examination of mummies to detect the pathological calcification that occurs in liver or kidney and urinary bladder according to the type of schistosomiasis, direct microscopic examination of rehydrated small samples of the mummy tissues, ELISA testing (Enzyme Linked Immunosorbent Assay) and DNA analysis by PCR (Polymerase Chain Reaction) examination (David, 2000) (Figures 2, 3) Matheson et al 2014 detected *S. haematobium* and *mansoni's* DNA in liver and intestinal samples from old mummies 3900 BP using PCR test (Matheson et al., 2014). The (a,a,a) disease is recorded more than 3500 years ago in several medical papyri and many authors suggest that it is related to schistosomiasis. In these old medical papyri farmers and fishermen were advised to avoid polluted water to prevent the disease.



Figure 2. Examination of an ancient Egyptian mummy. (Matheson, 2014).

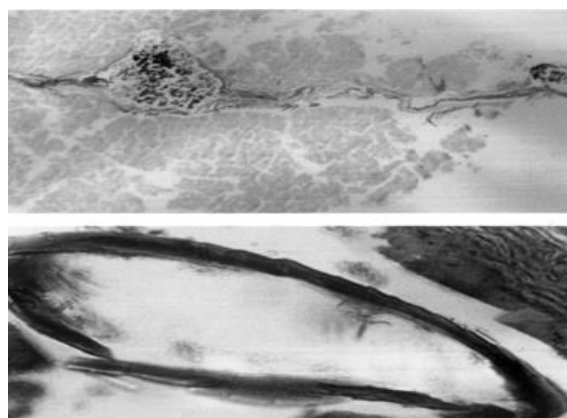


Figure 3. *Schistosoma haematobium* in the liver of Egyptian mummy. (Zimmerman, 1990).

It is associated with passing abnormal discharge from phallus which is linked to hematuria occurring in schistosomiasis. They treated it by antimony and honey as described in Hearst Papyrus. Antimony treatment is used in the early 20<sup>th</sup> as a treatment for schistosomiasis (Leake, 1952, Hanafy et al., 1974).

### Schistosomiasis in the Modern Era

In 1581, Prospero Alpinian Italian physician who was the physician of the consul of Venice in Cairo was the first European physician that noticed and recorded a high amount of hematuria in Egyptians (Santo, 2013). 200 years later, in 1798, during Napoleon's campaign a physician called Renault described the Egyptian's men as the only men who menstruate as regard to the high rate of hematuria in the *S. haematobium* infected Egyptian males (Sarant, 2017). In 1937, Scott et al found that 60% of the population in the rural areas of north and east delta of Egypt were infected with *S. mansoni*, 85% were infected with one or both species and only 6% of the population in the southern part of delta were infected with *S. mansoni*. 60% of the population in the north, east and south delta were infected with *S. haematobium*. They also found that the south delta was irrigated by perennial irrigation and had *S.*

*haematobium* infected more than 60 % of the rural population while it infected less than 5% in the Nile Valley south of Cairo as it is irrigated by basin irrigation (Scott, 1937).

#### **Effect of High Dam on *Schistosoma***

The High Dam, was completed in 1967, played a role in increasing schistosomiasis as it converted the basin irrigation to perennial irrigation which favors *Schistosoma* infection. The High Dam caused a decrease in the current water velocity which led to an increased number and infection of the intermediate snails. With the completion of the High Dam an increase in human activity near and in the Nile all over the year after the High Dam due to the low, clean, and slow water for swimming, fishing and washing purposes that resulted in increased Schistosomal infection (Malek, 1975).

#### **Effect of schistosomiasis on life and economy**

The life span of ancient Egyptian was known to be short as they lived to an average 33 years of age and females about 35-37 years of age. (Janssen, 1996). The low life span may be related to factors including schistosomiasis as chronic schistosomal infection is associated with sustained inflammation and injury of the intestinal and liver parenchyma, bleeding from upper gastrointestinal tract, anemia, spontaneous bacterial peritonitis, liver fibrosis and high level of mortality and disability. *S. haematobium* eggs precipitated in the wall of the urinary bladder causes irritation, inflammation, hematuria and bladder cancer. Studies related to life expectancy of advanced schistosomiasis showed about 20 years lower in patients with schistosomiasis than in normal population (Jiang et al., 2023). Schistosomiasis caused urinary bladder cancer to be the most common cancer in Egypt (more than 30% of all cases of cancer) until the eighties of the last century (Mostafa et al., 1999). Due to these lifelong impacts, schistosomiasis has huge hazards on health, social and financial state of the patients, Schistosomiasis also affects children causing anemia, stunting and cognitive deficits. Additionally, it has a major impact on the agricultural workforce and on national economic productivity, especially in low- and middle-income countries. Schistosomiasis can cause loss of more than 6.5% of agriculture production and up to 32% in the areas of high intensity disease infection therefore its prevention and control is a must to advance the economy and health status of the country (Mostafa, 2021).

#### **History of treatment and control of *Schistosoma* in Egypt**

The first planned control project for schistosomiasis was in 1926 and it composed of mass treatment of

the population in the highly infected areas with tartar emetic and control snails with copper sulphate (Khalil, 1927). From 1953 to 1985 the strategy of Egypt in control schistosomiasis in all programs done continued mainly to control transmission to humans through snails' control and supplemented by ant bilharzial treatment (Webbe, 1990). From the 1960s to the 1980s the Egyptian Ministry of Health assumed a large campaign and treated millions of Egyptians in the rural with 10-12 injections course of intravenous tartar emetic (Hotez, 2017). Unfortunately, they used glass rather than single-use syringes which led to the spread of hepatitis C virus infection and the beginning of another dramatic chapter of the story of the Egyptian liver. Within two decades Egypt had become the country with the highest prevalence of hepatitis C virus in the world (Elgazzar et al, 2024).

Treatment by oral antischistosomal Praziquantel began in the 1970s and a large shift their focus from intravenous injection treatment to oral treatment era began. The strategies after 1984 shifted their focus to decreasing the intensity and prevalence of infection which was high in young school children. New more accurate tests were developed and the use of the new oral drug praziquantel with less side effects and high safety (Barakat, 2013). The prevalence of *S. haematobium* and *S. mansoni* declined from 1989 to 1996 from 11.9 to 5% and from 16.4 to 11.9% respectively. At early 2005 *S. mansoni* declined to 1.9% in the Nile Delta and *S. haematobium* declined to 1.6% in Upper Egypt, further prevalence declines in 2012 occurred and rate of both infections reached less than 0.5% (Youssef, 2005). A large decline in the prevalence of *S. haematobium* all over the country especially in the Delta but it is still the most common type in the upper Egypt (Talaat et al., 1997). The Ministry of Health reported that the prevalence of *S. mansoni* and *S. haematobium* is less than 0.2 in 2016 as in (Yameny, 2017).

Two factors influenced the prevalence rate of schistosomiasis in Egypt in the last 100 years. The type of irrigation was the first factor affecting the prevalence rate as the perennial irrigation is associated with higher rate of infection and prevalence while the basin irrigation had lower rate of infection and prevalence, the Aswan Dam and the High Dam resulted in conversion of irrigation from the basin to the perennial irrigation. The second factor is the effort of the ministry of health in control schistosomiasis through different programs used in the last century (Barakat, 2013).

#### **Current situation and prospective**

Despite the large efforts of the Ministry of Health in Egypt and its programs to eradicate schistosomiasis by 2020 after the decline of the prevalence in the report of Ministry Of Health at 2016 to less than 0.2%, there was still areas of high rate of infection in some governates as detected in several studies (Ghazy et al., 2022, Ahmed et al., 2021, Taman et al., 2014,). This may be due to: a) drug resistance to the praziquantel used for more than 50 years in mass treatment of schistosomiasis and this need to be studied thoroughly to shift to another drug or to be combined with other drugs if resistance rate is high, b) lack of hygiene and bad habits like swimming, fishing, cleaning utensils in infected water, dumping sewage into river and this need awareness through media and keeping sewage away from the liver, c) insufficient snail control and increase river temperature due to climate changes which is favorable to snail life and infectivity, d) Ministry Of Health in Egypt and the World Health Organization were preoccupied with COVID-19 to minimize its hazards and this affected a lot the campaigns and programs for schistosoma control and eradication in the last years. For all this Egypt is in need to new programs and campaigns for diagnosis and treatment of the rural Egyptians especially the school-aged children and farmers and programs for snail control using new modalities in diagnosis and control.

## CONCLUSION

The story of the schistosomiasis in Egypt extends more than 5000 years and despite the efforts of the state for more than a hundred year; this requires the continuation of research, treatment and control campaigns especially in the most endemic and widespread places in Egypt

## CONFLICT OF INTEREST: NONE

## FINDING: NIL

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## الكبد المصري والبلهارسيا في 5000 سنة: قصة الكبد والنهر

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### الملخص:

التمهيد: قصة نهر النيل والبلهارسيا التي تصيب الكبد هي قصة درامية مثيرة. مصر هبة النيل وهو مصدر الخير والنماء للمصريين كما انه كان مصدرا لأقدم مرض معروف اصيب به المصريون في تاريخهم وهو مرض البلهارسيا. الهدف من البحث: الهدف من البحث: هو مراجعة تاريخ البلهارسيا في مصر الممتد خلال ٥٠٠٠ عام وعلاقتها بنهر النيل وتأثيرها علي حياة المصريين وصحتهم والقضاء الضوء على جهود وزارة الصحة المصرية لمكافحة المرض خلال المئة عام الاخيرة والقضاء الضوء على الوضع الحالي والمأمول تحقيقه في المستقبل. نتائج البحث: اثبت وجود البلهارسيا في المومياوات المصرية القديمة وجود مرض البلهارسيا منذ أكثر من ٥٠٠٠ عام ويعتبر تيودور بلهارس العالم الالماني هو مكتشف طفيل البلهارسيا في العام ١٨٥٠م واثبتت الدراسات التي اجريت في عام ١٩٣٧ ان نسبة الاصابة بالبلهارسيا في الريف المصري تجاوزت ٦٠٪ من السكان وقد بدأت الحكومة المصرية مكافحة البلهارسيا من العام ١٩٢٥ عن طريق علاج سكان الريف و مكافحة قواقع البلهارسيا واستمرت حملات وبرامج مكافحة البلهارسيا طوال المائة سنة الماضية والتي اسفرت عن نجاح كبير في السيطرة علي مرض البلهارسيا في الريف المصري وانخفاض معدل انتشار المرض من ٦٠٪ من سكان الريف الي حوالي ٢٪ خلال الفترة من ١٩٢٥ الي ٢٠١٦ م ولكن المفاجئ في الامر انه خلال السنوات القليلة الماضية وجد زيادة في معدل انتشار البلهارسيا في بعض الاماكن الريفية في محافظات مختلفة معطية تحذير وتنبيه هام يستلزم البحث والاهتمام. الاستنتاج: قصة نهر النيل والبلهارسيا والكبد قصة قديمة تمتد لأكثر من ٥٠٠٠ عام لازالت مستمرة بالرغم من جهود الدولة ووزارة الصحة لأكثر من مئة عام وهذا يستدعي استمرار الابحاث وحملات العلاج والمكافحة في مصر خاصة في الاماكن الاكثر توطنا وانتشارا.

الكلمات المفتاحية: مرض البلهارسيا، عدوي، إصابة، الكبد، مصر، النهر، الحضارة المصرية القديمة