Schistosomiasis in Iraq: A mini-review of literature

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Received: 29-12-2023 **Accepted: 29-2-2024**

Abstract

Schistosomiasis is widespread in Egypt and portions of Iraq where rice crops are grown. Urinary schistosomiasis spreads across different regions of the world, including Iraq. High infection rates have been documented in Iraq since the 1930s, it presents a serious risk to the country's health. The infection rates in the provinces of Maysan, Basra, and Thi-qar were 84%, 80%, and 80%, respectively. For the last several years Iraq has been free from the incidences of schistosomiasis Some reports mentioned that Iraq has applied a Schistosomiasis control and elimination program resulting in reduced prevalence of the disease. In 2003 and 2010, schistosomiasis was still not eliminated, with prevalence rates at 0. 1%). According to the information received in this paper, the mountainous regions of the country are risk-free. Some Cases of Schistosomiasis have been documented throughout the whole river systems of the Euphrates and Tigris (up to Samarra in the north), as well as their tributaries, irrigation canals, marshlands, and urban areas. There are isolated cases in the Nineveh Governorate's Telkef area and the Al Qa'im (Al-Anbar Governorate). Some studies mentioned that the national control programs ensured that Iraq was schistosomiasis-free in 2020. Research has found a correlation between schistosomiasis-associated infections and bladder cancer the studies concluded that schistosomiasis-associated bladder cancer still is a problem in Iraq as well as other endemic countries.

Keywords: Schistosomiasis, Schistosoma haematobium, snail.

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Introduction

Schistosomiasis , also mentioned as bilharziasis, is a parasitic disease caused by flatworms from the Schistosoma genus. It is most prevalent in tropical and subtropical regions, affecting 77 countries. The disease has infected over 200 million individuals in Africa, Asia, and South America, with another 600-779 million at risk of contracting it (1, 2, 3, 4). The WHO aims to eradicate schistosomiasis by bringing the proportion of heavy infections down to 1% by 2030 as part of its public health initiatives (5). The larvae of Schistosoma, known as cercariae, are discharged from snails found in freshwater sources when people encounter contaminated water, they become infested with the Schistosomiasis (6, 7).

Schistosomiasis is a prevalent infection in poor rural communities, especially in areas where fishing and agriculture are the main activities. Women and children are often exposed to infection when they perform household tasks such as washing clothes and fetching water from infected sources. Poor hygiene and recreational activities such as swimming also increase the risk of children contracting schistosomiasis (8). Schistosomiasis is caused by five species of schistosomes that infect humans. The five species include *Schistosoma mansoni*, *Schistosoma haematobium*, *Schisosoma japonicum*, *Schistosoma mekongi*, and *Schistosoma intercalatum*. However, two species, *S. mansoni* and *S. haematobium*, are known as the major human schistosomiasis (5). *S. haematobium* causes urogenital schistosomiasis, while *S. mansoni* causes

intestinal schistosomiasis (9). The common method for diagnosis of schistosomiasis is finding eggs by microscope in urine (*S. haematobium*) or stool (*S. japonicum*, *S. mansoni*) (10).

Schistosomiasis is widespread in Egypt and parts of Iraq where rice crops are grown. However, significant progress has been made in controlling the disease in Morocco and some Caribbean Island nations, while Brazil, China and Egypt are taking steps towards eliminating it. Japan and Tunisia have succeeded in eliminating schistosomiasis. The incidence of the disease is relatively low in remote areas of Saudi Arabia (11). Urinary schistosomiasis has been spreading across different regions of the world, including Iraq. High infection rates have been documented in Iraq since the 1930s, and it presents a serious risk to the country's health. The infection rates in the provinces of Maysan, Basra, and Thi-qar were 84%, 80%, and 80%, respectively (12, 13). *Biomphalaria* snails are responsible for transmitting *S. mansoni*, which is the major reason for hepatic and intestinal schistosomiasis in regions such as Arabian countries, South America, and Africa. On the other hand, *Bulinus* snails transmit *S. haematobium*, which is the main cause of urinary schistosomiasis in Africa and the Arab world (14). The parasite's life cycle comprises asexual replication in the snail intermediate host and sexual reproduction in humans. Granulomas and fibrosis are the results of an immunological response triggered by the eggs, which causes schistosomiasis. This may result in damage to the urinary tract for S. haematobium or the gastrointestinal tract for intestinal schistosomiasis (15, 16).

Methodology

Iraq is a republic in southwest Asia, in the Middle East. According to the latest United Nations data, Iraq is home to over 40 million people. According to the World Population Review website, the UN estimates the July 1, 2024 population at 46 million. Iraq is separated into 18 provinces (Figure 1). Baghdad, with a population of more than 6 million, the capital city, is the largest city in Iraq in terms of population. The following are other major states: Basra (2.3 million people), Erbil (2 million people), Sulaymaniyah (1.6 million people), Mosul (1 million people) and Kirkuk (1 million people). Approximately 70% of Iraq's population lives in urban parts, and the country has several large cities that reflect this fact (17). Iraqi map with eighteen provinces divided into the four main areas hilly area or Kurdistan region of Iraq: Sulaymaniyah, Erbil, and Duhok, rise and fall region: Kirkuk, Diyala, and Mosul, or Ninevah Al Anbar, Baghdad, Salah ad Din, Karbala, Najaf, Al-Muthana, are in the desert region. Alluvia Region: Babil, Basra, Maysan, Thi-qar , Wasit, and Al-Qadisiyah Figure 1 (18, 19). On the way to effectively control schistosomiasis in Iraq, it is important to build on past and present experiences of schistosomiasis epidemiology, pathology and control. To realize this, we constructed a systematic review based on PubMed, Google Scholar, Springer, and other databases for the period of 2005-2023. The study period is from May 1 2023 to December 20 2023. We performed a historical overview using the following keywords: 'Schistosomiasis', '*Schistosoma*', '*Schistosoma haematobium*', and 'Snail'. Our search included studies that focused on human schistosomiasis. To search for information on Schistosomiasis in Iraq, we first looked at the history of the disease in the country. We collected important briefs from various sources, including articles, reports, websites, and personal communications. Our search was focused on the objectives and outcomes of schistosomiasis studies in Iraq, as well as other relevant criteria.

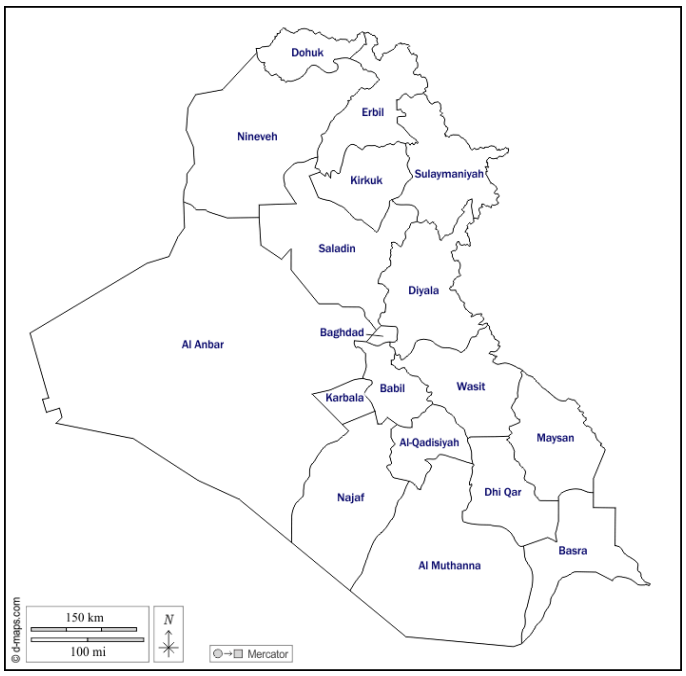

Figure 1: Iraqi map with eighteen provinces divided into the four main areas north region or Kurdistan region: Sulay-maniyah, Erbil, and Duhok, rise and fall region: Kirkuk, Diyala, and Mosul, or Ninevah Al Anbar, Baghdad, Salah ad Din, Karbala, Najaf, Al-Muthana, are in the desert region. Alluvia Region: Babil, Basra, Maysan, Thi-qar , Wasit, and Al-Qadisiyah (18, 19).

The history of Schistosomiasis in Iraq

Urinary schistosomiasis is a parasitic infection caused by the blood worm *S. haematobium*. This disease affects the urinary system and causes changes in it. It's worth noting that in Iraq, the disease is caused only by *S. haematobium*, and not by other groups of the parasite such as *S. mansoni* and *S. japonicum* (20). A study was carried out in 1919 to find out how common a particular illness was among Arab men. 20% of the 174 males who had been examined and living in 7 districts showed positive, according to the data. The intermediate host vector of the illness was found to be the *Bulinus truncatus* snail, and the highest risk locations were determined to be the rice field areas along the Euphrates River banks (12) It was found in 1925 that schoolchildren's risk of infection varied based on their cultural and religious affinities. It was shown that young Muslim schoolchildren had a 57% frequency of infection, compared to 30% and 27% for Jewish and Christian boys. In the years 1936–1937, the prevalence rates of S. haematobium infections were 80%, 80%, and 84% in the Thiaquar, Basra, and Maysan regions, correspondingly (12). Urinary schistosomiasis in Iraq is considered an endemic historical disease (21). Between 1990 and 1994, the number of cases of the disease gradually decreased from 60 cases to 20 cases for every 100,000 people. The Tigris and Euphrates River basin was an endemic region for the disease (22, 23). During the 20th century, it was discovered that irrigation expansion had a significant impact on the transmission of schistosomiasis. Studies have shown that in certain areas where perennial irrigation was introduced, the prevalence of schistosomiasis increased from 2% to 75%. The Greater Masayyeb Project in Iraq is an example where mismanagement of irrigation schemes has led to the worsening of the disease (24). *S. haematobium* is a common parasite in Iraq, particularly in areas where rice crops are grown (11). Since 1991, the cultivated area and irrigation canals in Iraq have increased. However, only 50% of people living in cities and 33% of the rural population have access to clean drinking water supplies. As a result, 0.5 million tons of sewage are dumped into Iraqi rivers every day, which are still the main source of drinking water in the country. Iraq has been experiencing an extremely dry season similar to that of 1934, since 1998. The temperature is high, and the summers are hot, leading to a reduction of about 80% in the water level over the past three years. In Iraq, bacterial diarrhea, hepatitis A, and typhoid fever are listed as major food or waterborne diseases, with water-contact diseases of leptospirosis and schistosomiasis. (20, 25, 26).

The first national control effort launched by the Endemic Diseases Control Centre began in 1953, based on extensive testing and treating infected schoolchildren and applying molluscicides to snail habitats, after which a low prevalence was reported

(27). Snail control has been highly effective in Iraq. In 1958, 42% of streams (out of 1400 investigated) were infested with Bulinus snails. However, by 1980, only 1.5% of streams (out of 5,270 investigated) were found with Bulinus snails. Since at least 1964, molluscicide of snail habitats with sodium pentachlorate in highly endemic areas in Iraq has been extensive, with support from The Endemic Diseases Control Centre. The national control effort was launched in 1953 and involved extensive testing and treatment of infected schoolchildren, as well as the application of molluscicides to snail habitats. As a result, there has been a low prevalence of the disease reported by the World Health Organization (28). Until recently, the snail was found only in the southern regions of the country on swampy ground. However, due to the deliberate drying of wet soil, the local fauna and flora perished (22, 23).

Intravenous antimony tartrate was used to treat people who sought therapy for the illness in the 1920s (12). After Iraq started molusciciding snail habitats in 1965, the Endemic Diseases Control Center turned its attention to treating schoolchildren with chemotherapy as a means of containing endemic infections (29). From 1990 to 1994, prevalence rates in Iraq fell from nearly 0.06% to nearly 0.02% due to medical treatment and improved sanitation, but the extent and details of any active control measures are unclear (11).

The Studies conducted between 2005 and 2023:

1-The prevalence of Schistosomiasis.

Urinary schistosomiasis, caused by *S. haematobium*, is a significant disease that can lead to irritation and damage of the urinary tract as well as other systems and tissues. *S. haematobium* is a common pathogen, mainly in Egypt and portions of Iraq where rice crops are cultured (11). In the 1990s years, the degree of infection was much reduced in contrast to previous revisions, the degree of infection amplified after 2003. (30, 31).

In this study, we summarize research conducted in various regions of Iraq over the past 17 years. With a rate of 33.4%, the third sector in the southern Iraqi city of Samawah had the highest frequency of schistosomiasis, according to (32). The Muthanna Health Directorate and the Ministry of Health provided the researchers with unpublished information related to 2020. In Balad Rouz town, Diyala province, 1550 urine samples from homes and schools were collected between October 2005 and December 2006, and the samples were tested for urinary schistosomiasis. It was discovered that 2.13% of people were infected with *S. haematobium*. Tests were performed on the serum and urine of all 33 infected people (33). 131 individuals (20.4%) of the 643 urine samples obtained from patients at Al-Yarmuk Hospital in Baghdad were positive for the parasite. Compared to females, whose infection rate was 6.8%, men had a higher rate of 26.1%. The group under 25 had the greatest infection rate (31%), while the group over 50 had the lowest incidence (10.5%). Autumn had the greatest infection rate, at 24.6 percent, while winter had the lowest infection rate, at 7.2 percent (34). In 2010, a study was conducted on 191 urine samples from residents of Al-Rusafah in Baghdad. The age range of the participants was 1-82 years, and the total infection rate was found to be 9.42%. The highest infection rate was observed in males (12.64%) while females had a rate of 6.73%. Furthermore, participants under the age of 18 had the highest infection rate (35). In Babylon province, a study carried out between 2016 and 2017 discovered that only 2 of the 592 patients (0.4%) had S. haematobium infection (36).

2- Schistosomiasis and cancer

Research has found a correlation between schistosomiasis-associated infections and bladder cancer in Africa and the Middle East (37). The World Health Organization and the International Agency for Research on Cancer classified S. haematobium as carcinogenic (38).

A study conducted in Baghdad Governorate by (39), dealt with the calcium and magnesium levels in the serum in the course of infection with S. haematobium. The study also investigated the immunosuppressive state associated with this disease, which may have a role in the development of bladder cancer. The investigators concluded that variation in calcium and magnesium levels may be one of the reasons involved in the development of bladder cancer in patients with schistosomiasis. This is because calcium and magnesium are important in immune responses. Investigating schistosomiasis in individuals with pathological bladder and the contribution of epithelial cells to schistosomiasis-associated bladder cancer among patients in Baghdad. This study concluded that schistosomiasis-associated bladder cancer still has cases in Iraq, in addition to its spread in endemic countries according to a study in 2008(40). two studies that were carried out in Baghdad governed, focused on estimating some biomarkers of bladder cancer the first one by (41) focused on IL-8and BLCA-4 in urine, and Compared it in patients at different cancer grades, invasion, and relation with risk factors, urine IL8, and BLCA4 have a role in discrimination between some cases such as recently diagnosed vs reappearance, little grade vs great grade, muscle attack vs non-muscle attack), but not linked to some risk factors like smoking, Schistosomiasis, Urinary tract infection, stones and family past of cancer, the second (42), focused on MMP-9 in urine and was conducted to assess the significance of differences in urinary MMP-9 levels and tissue biopsies in the advance of tumors in bladder cancer individuals. MMP-9 was examined in the urine of 48 bladder cancer patients and 40 healthy individuals by ELISA, as well as in 57 bladder cancer biopsies and 40 normal urothelial tissues by immunohistochemistry. The results indicate that urinary MMP-9 has high efficiency in detecting bladder cancer patients and plays a role in distinguishing between newly infected patients versus recurrence of the disease). Risk factors such as schistosomiasis also played a role in the elevation of MMP-9, which was elevated in patients compared to healthy controls, with a statistically significant difference.

3- Snail control

The national control effort was launched in 1953 and involved extensive testing and treatment of infected schoolchildren, as well as the application of molluscicides to snail habitats. As a result, there has been a low prevalence of the disease reported by the World Health Organization (28).

In the current review we have collected some independent studies conducted by researchers with the aim of snail control: Nicotiana tobacco extract used as a molluscicide for biological control of snails by (43), the study presented the ability of leaf extract to control B. truncates. In a study conducted by (44), Determination of the toxicity of extracts of the aquatic plant Thymus Vulgaris combined with copper sulphate against B. truncatus. Samples of snails were collected from a site in the town of Al-Rashid, south of Baghdad. The lethal concentration for T. vulgaris and copper sulphate for B. truncatus were (18.7 and 2.2 g/L), in that order. The study showed that T. vulgaris extracts were less effective than CuSO4. The results were improved by the fact that the toxicity of the extracts was dependent on concentration and time. The study presented by (45) searched for the ability to use sufficient extracts in the regulator of the intermediate host. This study is a contribution to determine the weakness of the snail *B. truncatus* to the crude aqueous solution of *Citrus aurantium L*. leaves and stems. It was found that the lethal concentration was (4 mg ml) of the crude solution of leaves on the first day of the action and was (2.5mg ml) and (4mg ml) of the crude solution of stems correspondingly on the first day of the treatment.

Discussion

Iraq has had a period of several years without experiencing any cases of Schistosomiasis.

According to certain sources, Iraq has implemented a program aimed at controlling and eliminating schistosomiasis, which has led to a decrease in the infection's prevalence. Schistosomiasis was still present in 2010 and 2003, with a prevalence incidence of 0.1% (20,46; 47). However, as of 2013, the (WHO) described that no one in Iraq demanded treatment for infection. As of the most recent update in 2020, the World Schistosomiasis Risk Chart is a companion publication to the IAMATs (48); the northern region of the country that is risk-free also Iraq has implemented a Schistosomiasis control and elimination program resulting in a reduction prevalence of infection. Cases of Schistosomiasis have been documented throughout the whole river systems of the Euphrates and Tigris (up to Samarra in the north), as well as their tributaries, irrigation canals, marshlands, and urban areas. There have been isolated cases in the Nineveh Governorate's Telkef area and the Al Qa'im (Al-Anbar Governorate). We have made a "personal communication," with Iraqi prof Sabeeh H. Al-Mayah, he confirmed that infection with Schistosomiasis had not been recorded in the northern region due to the absence of intermediate host and explained that " as a result of rapid flow of water in the rivers " (personal communication, October 25, 2023). A study carried out in 1958 by the WHO Bilharziasis Control Project staff in Iraq stated that the continuous change in water flow may be a factor limiting *B. truncatus* settlement in Basra south of Iraq (49). In the Undulated Area Balad – Rooz located in Diyala province is considered as one of the endemic foci of Schistosomiasis according to (25) in 2008. this consideration may be due to; 1. Geographic Site: Balad Rouz is situated in the eastern Diyala state of Iraq, which is a region described by numerous irrigation systems and water figures. The existence of these water forms, such as rivers and canals, delivers a suitable home for the snail intermediate hosts of the schistosome worm. 2. Agricultural application: The district of Balad Rouz has an agricultural-based budget, with a significant dependence on irrigation for crop agriculture. The structure of irrigation channels and canals increases the risks of water contamination with snails, thus facilitating the spread of schistosomiasis.

In a review (50), the authors mentioned that due to the national control programs, they ensured schistosomiasis has not been reported in any Iraqi governorates since 2020. In the present time, we see that the rate of infection tends to be very low compared with past years. In the southern region, this low infection may be due to different reasons, such as the absence of an intermediate host in some regions because of drought in recent years and water loss, which in turn increases the salinity of the water and becomes an unfavorable environment for *Blinus*. Also, the national control programs in the past played an important role in declining infection.

Recommendation:

Because urinary schistosomiasis is a parasitic infection, there is an intermediate host for transmission of the parasite, the decrease in infection may be due to the environmental and climatic conditions that affected this host in the last decades. Therefore, we recommend further studies on the host because it may be a measure of the extent to which the environment and climate are affected by the phenomenon of pollution, global warming, or hidden aspects.

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داء البلهارزيا في العراق: مراجعة مصغرة للأدبيات

الخلاصة: ينتشر داء البلهارزياعلى نطاق واسع في مصر وأجزاء من العراق حيث زراعت محاصيل الأرز. يمتد داء البلهارسيات البولية في مناطق مختلفة من العالم، بما في ذلك العراق. وقد تم توثيق معدلات الإصابة المرتفعة في العراق منذ ثلاثينيات القرن الماضي، مما يشكل خطراً من الناحية الصحية على البلاد. وبلغت معدلات الإصابة في محافظات ميسان والبصرة وذي قار ٨٤٪، ٨٠٪، و٨٠٪ على التوالي. خلال السنوات ا الماضية، كان العراق خاليًا من حالات الإصابة بداء البلهارزيا. وذكرت بعض التقارير أن العراق قام بتطبيق برنامج لمكافحة داء البلهارزيا بهدف القضاء عليه مما أدى إلى انخفاض معدل انتشار المرض. الجدير بالذكر انه بين عامي ٢٠٠٣ و٢٠١٠، أظهرت التقاريربانه لم يتم القضاء على داء البلهارزيا بصورة كلية بعد، حيث بلغت معدلات انتشاره (0.1%) . ووفقاً للمعلومات الواردة في هذه الورقة، فإن المناطق الجبلية في البلاد خالية من المخاطر. وقد تم توثيق بعض حالات داء البلهارزيا في جميع أنحاء أنظمة نهري الفرات ودجلة (حتى سامراء في الشمال)، بالإضافة إلى روافده وقنوات الري والأهوار والمناطق الحضرية. وتوجد حالات معزولة في منطقة تلكيف بمحافظة نينوى والقائم في محافظة الأنبار. وذكرت بعض الدراسات أنه بفضل برامج المكافحة الوطنية، ضمنت خلو العراق من داء البلهارزيا في عام ٢٠٢٠. وقد وجدت الأبحاث وجود علاقة بين الالتهابات المرتبطة بالبلهارزيا وسرطان المثانة، وخلصت الدراسات إلى أن سرطان المثانة المرتبط بالبلهارزيا لا يزال يمثل مشكلة في العراق وغيرها من البلدان الموبوءة.