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Epidemiological and Entomological Aspects of Schistosomiasis in Saudi Arabia: A Narrative Review

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Abstract

Schistosomiasis is a parasitic disease of global public health concern, caused by blood flukes of the genus Schistosoma. It is particularly prevalent in tropical and subtropical regions, where it poses significant challenges to healthcare systems. This narrative review examines the epidemiological and entomological dimensions of schistosomiasis in Saudi Arabia, focusing on historical records, control measures, and current disease prevalence. The role of freshwater snails as intermediate hosts and the influence of environmental factors on transmission dynamics are also explored. Despite the implementation of effective control programs, persistent cases in certain regions underscore the necessity for ongoing surveillance and integrated health strategies. This review aims to provide a comprehensive overview of schistosomiasis in Saudi Arabia, offering valuable insights for future research and policy formulation.

Keywords

Schistosomiasis, Epidemiology, Entomology, Freshwater Snails, Disease Control, Saudi Arabia

1. Introduction

Schistosomiasis is a parasitic disease caused by trematode worms of the genus Schistosoma [1]. This infection occurs when larval forms of the parasite, released by freshwater snails, penetrate human skin during contact with contaminated water. Transmission is further exacerbated when infected individuals contaminate freshwater sources with feces or urine containing parasite eggs, which subsequently hatch in aquatic environments [2]. Within the human body, the larvae mature into adult schistosomes, which reside in blood vessels. Female worms release eggs, some of which are excreted in feces or urine to continue the parasite's lifecycle, while others become trapped in tissues, triggering immune responses and causing progressive organ damage [1].

Schistosomiasis is predominantly found in tropical and subtropical regions, particularly in impoverished communities lacking access to safe drinking water and adequate sanitation. Africa bears the highest burden, accounting for approximately 90% of global cases requiring treatment [1] [3]. The disease manifests in two primary forms: intestinal schistosomiasis, caused by *Schistosoma mansoni, Schistosoma japonicum,* and *Schistosoma mekongi*, and urogenital schistosomiasis, caused by *Schistosoma haematobium* and *Schistosoma guineensis* [1].

Globally, an estimated 264.3 million people across 50 countries required preventive chemotherapy for schistosomiasis in 2022, reflecting an increase of 11.2 million cases from the previous year [2]. In Saudi Arabia, two species of schistosomes, *Schistosoma mansoni* and *Schistosoma haematobium*, are endemic [3].

Research activity on neglected tropical diseases (NTDs) in the Arab world has seen significant growth. A bibliometric analysis of contributions from Arab countries between 1971 and 2020 revealed that researchers from the 22 Arab nations contributed to the global knowledge base. Egypt led with 2677 documents (41%), followed by Saudi Arabia with 1019 documents (16%). Notably, Saudi Arabia's annual publication output experienced a steep increase after 2010, surpassing that of Sudan and Egypt [4].

Saudi Arabia has implemented a range of public health interventions to control schistosomiasis effectively. These strategies include preventive chemotherapy, snail control programs, community education, and robust surveillance.

One of the core strategies is preventive chemotherapy, where the Ministry of Health (MoH) conducts mass drug administration (MDA) campaigns, ensuring the distribution of praziquantel to high-risk populations such as school-aged children and residents in endemic regions. These efforts aim to reduce morbidity and prevent further transmission [1].

The government has also initiated snail control programs to target the parasite's intermediate hosts. These programs involve the application of molluscicides in endemic water bodies, environmental management strategies to reduce breeding sites, and modification of irrigation systems to limit snail proliferation [3].

In addition, health education and community engagement play a critical role in schistosomiasis control. Educational campaigns have been launched to increase awareness about the disease's transmission, prevention, and treatment. These initiatives emphasize the importance of avoiding contact with contaminated water and promoting the use of safe water sources to reduce infection rates [5].

Saudi Arabia has also focused on surveillance and research, integrating epidemiological studies and real-time monitoring systems to assess the prevalence and distribution of schistosomiasis. These surveillance efforts help guide targeted interventions, optimize resource allocation, and refine public health policies [6].

2. Materials and Methods

The data presented in this narrative review were obtained through an extensive literature search conducted on PubMed and Google Scholar. The search terms included "Schistosomiasis" and "Saudi Arabia", which yielded approximately 150 articles. These articles were subsequently filtered to ensure relevance to the scope of this review. Duplicate studies and papers deemed irrelevant to the focus of this work were excluded. This review synthesizes the key findings of research conducted locally, providing a comprehensive overview of the epidemiological and entomological aspects of schistosomiasis in Saudi Arabia.

3. History of Schistosomiasis in Saudi Arabia

References to hematuria in the medical texts of renowned Arabian physicians, such as Ibn Sina (Avicenna), suggest that urinary schistosomiasis was endemic in the Arabian Peninsula between the tenth and thirteenth centuries [7]. The first documented cases of human infection with Schistosoma haematobium in Saudi Arabia (then known as Hejaz) were reported by Hatch in 1887. Hatch diagnosed and treated the disease in twelve Indian Muslim pilgrims who had returned from Makkah. However, Hatch assumed that the pilgrims contracted the infection in Hejaz, overlooking the possibility of exposure in other regions along their journey to and from Makkah [7].

The first comprehensive epidemiological study of schistosomiasis in Saudi Arabia was conducted by Alio in 1967. This study also examined the geographical distribution patterns of snail intermediate hosts. The findings revealed the presence of *S. mansoni* infections in the northern and south-central regions, while both *S. mansoni* and *S. haematobium* were detected in the northwest, midwest, southwest, and north-central areas. Notably, no cases were reported in the eastern part of the country. An estimated overall prevalence was 17% at the time [7].

In 1971, the Ministry of Health (MoH) of Saudi Arabia established a specialized unit for schistosomiasis to conduct extensive regional surveys. This unit identified 12 disease foci in regions including Hail, Riyadh, Jouf, Madinah, Makkah, Taif, Baha, Bisha, Abha, Mahael, Jazan, and Najran. Prevalence rates ranged from 5% to 20%, with some districts reporting rates as high as 50%. Between 1973 and 1974, the MoH established seven regional schistosomiasis control centers to oversee control programs. In 1977, a national control program was launched, focusing on case detection and treatment of infected individuals [7].

A revised control strategy was introduced in 1986, following advancements in understanding transmission dynamics and improved population coverage (approximately 80%). This strategy replaced area-wide molluscicide application with focal treatment and introduced praziquantel as the primary antischistosomal drug, replacing older medications. The goal was to reduce the prevalence of schistosome infections to below 1% within 2 - 5 years. This approach proved effective, as the overall prevalence in endemic foci declined from 11% in 1983 to 1.9% in 1987. By 1989, the MoH recommended integrating schistosomiasis control operations into the primary healthcare (PHC) system [8]. However, annual health reports from 1983 to 1987 indicated that prevalence rates in Asir Province remained relatively unchanged. The 1985 report documented prevalence rates of 4.6% for *S. mansoni* and 2.2% for *S. haematobium* in this region [5]. In 1987, the first case of *S. japonicum* was reported at Al Mubarak Hospital in Riyadh. A Filipino expatriate presented with symptoms of acute appendicitis, and histological examination of the appendix revealed numerous Schistosoma ova, some with granulomata, alongside acute inflammatory changes. The ova were suspected to be those of *S. japonicum* [9].

4. Epidemiology of Schistosomiasis in Saudi Arabia

A 1976 study by Arfaa examined urine and stool samples collected primarily from school-aged children in 15 localities across Saudi Arabia. Of the 1091 urine samples tested for *S. haematobium* and 1171 stool samples tested for *S. mansoni*, the highest prevalence rates were 57% for *S. haematobium* in a village in Madinah and 75% for *S. mansoni* in the same province [10]. Infections with *S. mansoni* were predominantly found in the highlands of the western, central, and northern regions, while *S. haematobium* cases were concentrated in the Tehama Assir and lowland coastal plains of the south [3]. Data from schistosomiasis control stations between 1983 and 1984 revealed that out of 230,802 individuals examined, 15,106 tested positive for either *S. mansoni* or *S. haematobium*, yielding an overall prevalence of 6.5%. The highest prevalence (13%) was recorded in Al Baha [11]. Key determinants of transmission include the suitability of habitats for snail vectors, the abundance of these vectors, and the lifestyle of the local population. The disease predominantly affects younger age groups and males more than females.

A retrospective analysis of MoH annual reports from 2014 to 2020 revealed that the highest number of cases was detected in 2015, nearly double the number reported in 2020 (OR = 1.93; 95% CI: 1.36 - 2.74) [6]. Both intestinal and urinary schistosomiasis were reported, accounting for 79.6% and 20.4% of cases, respectively. Schistosomiasis was documented in seven of the thirteen regions, with Mecca reporting the highest number of cases (OR = 5.57; 95% CI: 2.49 - 12.47). In contrast, the Eastern Province had the lowest number of cases (OR = 0.09; 95% CI: 0.02 - 0.39) compared to Najran ($p < 0.001$). The majority of cases were among males (70.6%) and expatriates (83.6%). Intestinal schistosomiasis was the most common clinical form, particularly in Mecca, Al-Bahah, and Madinah, while urinary schistosomiasis predominated in Jazan, Aseer, Najran, and the Eastern regions ($p < 0.001$). Approximately 75.5% of cases occurred in individuals aged 15-39 years. Al Baha had the highest cumulative incidence at 16.4 cases per 100,000 population (OR = 2.49; 95% CI: 1.09 - 5.69) [6].

As of 2012, the prevalence rate of schistosomiasis in the Kingdom of Saudi Arabia (KSA) was 2.2 cases per 100,000 population. Among these cases, 33.4% were attributed to urinary schistosomiasis caused by *S. haematobium*, while 66.6% were due to intestinal schistosomiasis caused by *S. mansoni* [12]. Although infections with *S. japonicum* were diagnosed in some non-Saudi residents, the parasite was not believed to have completed its life cycle in the country due to the absence of a suitable snail host [3]. By 2007, regions such as Madinah, Riyadh, Hail, Tabuk, Jouf, and Najran were declared disease-free. Since 2010, heterochthonous cases (imported infections) have progressively outnumbered autochthonous cases (locally acquired infections). Recent reports classify Saudi Arabia's regions into three categories: disease-free, transmission-interrupted, and low-transmission areas (with a general prevalence of less than 1%) [3]. According to the 2022 statistical yearbook published by the Ministry of Health, the prevalence of schistosomiasis in the Kingdom from 2018 to 2022 was 0.32, 0.16, 0.12, 0.23, and 0.06 cases per 100,000 population, respectively. Intestinal schistosomiasis remained the dominant form throughout these years. Notably, mixed infections (both intestinal and urinary schistosomiasis) were reported in 2022, a phenomenon not observed in the previous four years. The disease predominantly affected males and non-Saudis, except in 2022, when Saudis accounted for 58% of reported cases. A total of 19 cases were reported in 2022, with 9 cases from Jazan, 5 from Al Baha, and 5 from Taif [13]. **Figure 1** illustrates the historical trend of schistosomiasis cases reported in Saudi Arabia since 2012.

Another epidemiological study indicates a significant decline in schistosomiasis prevalence in Saudi Arabia. A retrospective analysis of 4,371,481 individuals tested for schistosomiasis between 2014 and 2020 identified 680 positive cases, with a cumulative incidence rate of 2.155 per 100,000 population. The data revealed a downward trend in reported cases over the study period. Among the identified cases, urinary schistosomiasis accounted for 79.6%, while intestinal schistosomiasis comprised 20.4%. Males were predominantly affected, constituting 85.9% of the total cases [6].

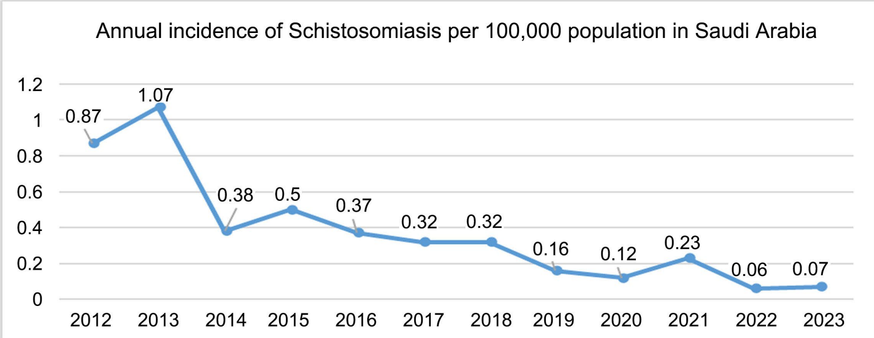

Figure 1. The trend of schistosomiasis cases reported in Saudi Arabia since 2012 (according to MOH data).

5. Geographical Distribution of Schistosomiasis in Saudi Arabia

5.1. Central Regions

In 1985, a study examined 23,516 stool specimens from patients attending three medical centers in Riyadh. Of these, 5737 (24.4%) tested positive for intestinal parasites, with *S. haematobium* infections accounting for only 25 cases (0.1%) [14].

5.2. Western Regions

A study conducted in the western region investigated the potential role of hamadryas baboons (*Papio hamadryas*) as reservoir hosts for schistosomiasis. Captured from Al Baha area, these baboons demonstrated high susceptibility to a Saudi Arabian human isolate of *S. mansoni*, suggesting their potential role in maintaining the parasite's lifecycle [15]. In 1996, another study examined natural infections of free-ranging *P. hamadryas* with *S. mansoni* in four localities: Al-Baha, Turabah, Al-Taif, and Al-Rahat. Schistosome eggs were detected in fecal samples from baboons only in the Al-Baha area, with a prevalence rate of 2.5% - 4.0% [16]. A 1995 study in the Hijaz highlands reported a mean prevalence rate of 6.09% (range: 0.5% - 20.1%) among 2792 individuals (1490 males and 1302 females). Prevalence was higher in males (8.06%) than in females (3.79%), with peak rates observed in males aged 11 - 15 and 31 - 50 years [17]. In 1997, a study in the Al-Hijaz highlands reported a *S. mansoni* infection prevalence of 10.2% based on fecal examinations [18].

5.3. Southern Regions

A 1979 survey in the Al-Baha area examined 122 stool samples, revealing a *S. mansoni* infection rate of 0.8% [19]. In 1983, six family members in Dammam presented with diarrhea after swimming in Baljurashi. Stool analysis confirmed *S. mansoni* infections in all cases [16] [20]. A 1991 study in Abha examined stool specimens from 1282 schoolchildren aged 5 - 13 years. The overall prevalence of intestinal infections was 24.4%, with *S. mansoni* detected in 0.2% of cases (three children, two Yemeni and one Saudi). These infections were likely acquired in the lowland Tihamat Asir or neighboring Yemen [21]. A retrospective analysis of 217 schistosomiasis cases at Asir Central Hospital (1990-1999) revealed that the urinary tract was the most commonly affected site (44% of cases), followed by the appendix, liver, large bowel, and female genital tract. Males accounted for 86% of cases, and expatriates (55%) outnumbered Saudis (45%). Most non-Saudi patients were Egyptians (56%) or Yemenis (42%), with a median patient age of 33.5 years [22]. In 1999, a study in Al Baha reported a *S. mansoni* prevalence of 8.57% (15 of 175 individuals). Prevalence correlated with water contact, peaking at 8% - 20% in individuals aged 6 - 20 years and declining to 4% in those aged 30 years [23].

Surveys in Jazan in 2002, 2003, and 2004 detected 513, 197, and 161 cases, respectively, representing a 62% reduction between 2002 and 2003 and a 69% reduction between 2002 and 2004. The prevalence in 2003 and 2004 was significantly lower than in 2002 ($p < 0.0001$), though the decline between 2003 and 2004 was not statistically significant ($p > 0.1$) [24]. In 2015, a case series from King Abdullah Hospital in Bisha reported nine pediatric schistosomiasis cases from Al-Aataf village. Most cases were among school-aged children (6 - 13 years), with males more commonly affected (7 boys and 2 girls) [25]. A 2014 seroepidemiological study in Najran screened 180 participants for Schistosoma antibodies using an indirect hemagglutination assay (IHA). Antibodies were detected in 20% of participants, predominantly males aged 20 - 40 years. Prevalence was higher among individuals with primary-educated fathers (40%) and non-Saudi residents (32%) compared to Saudis (7%) [26].

Certain areas in Saudi Arabia continue to report schistosomiasis cases, necessitating targeted intervention efforts to reduce incidence on a national level. A priority-based approach is essential to address these persistent challenges. Figure 2 highlights the regions requiring focused intervention.

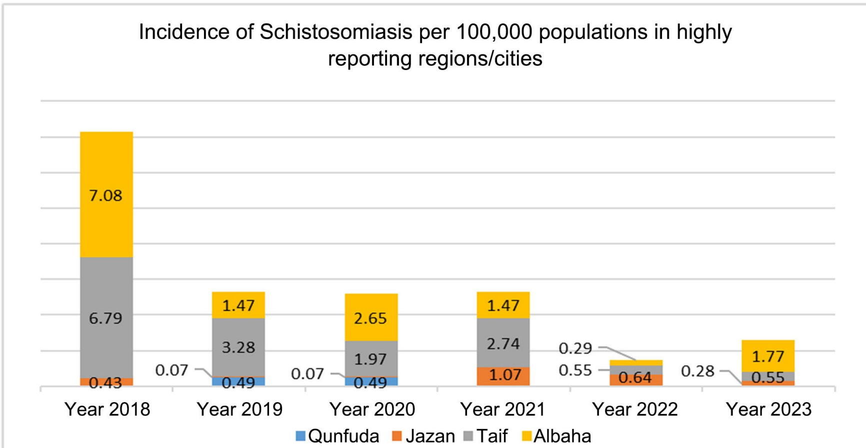

Figure 2. Incidence of Schistosomiasis per 100.000 population in highly reporting regions/cities (according to MOH data).

6. High-Risk Populations and Hard-to-Reach Areas

Saudi Arabia is geographically situated between two major global schistosomiasis-endemic regions: the Nile River Valley and the Tigris-Euphrates Valley. Historical evidence suggests that schistosomiasis has been endemic in Egypt for over 3000 years and in Iraq for more than 6000 years [11]. Children are considered a high-risk population due to their excessive mobility and frequent exposure to contaminated freshwater sources during activities such as swimming, playing, or fetching water for domestic use. Poor personal and environmental hygiene further exacerbates their vulnerability. Family members often share water-related activities, such as swimming, washing, and playing, leading to similar exposure risks [25].

Reports indicate that schistosomiasis prevalence is clustered in the Eastern and Southwestern provinces of Saudi Arabia, primarily due to favorable environmental conditions. Additional contributing factors include the large number of expatriates from endemic regions [12]. However, Al Subaie's survey highlighted that the Eastern Province remains free from snail vectors and the disease, likely due to the protective sand belt separating it from the rest of the country and the high soil salinity. This sand belt effectively delineates the disease distribution: to the west (including the African continent and western/central Arabia), schistosomiasis is endemic, while to the east (including the Eastern Province and most of Asia), the disease is rare except for small foci in Iraq and Iran. In the Far East, different species of parasites and their vector snails are found [11].

In the Asir Region, traditional agricultural practices contribute to the persistence of schistosomiasis [22]. In the Western Region, transmission is intensified by agricultural and irrigation projects, with 23 dams and nearly 2 million people at risk of infection. A notable example is the Al-Sadr Dam in Al-Baha, completed in 1981. Within three years, both *Biomphalaria arabica* and *Bulinus truncatus* were found in the dam's reservoir and downstream areas. By 1985, 8 of the 14 dams in Al-Baha were infested with snail intermediate hosts [11]. Recreational activities account for the majority (70%) of water contact, compared to occupational (19%) and other activities (11%). Most water contact (72%) occurs during midday, further increasing transmission risks [23]. One of the major challenges for schistosomiasis control in Saudi Arabia is the presence of animal reservoir hosts. Wild and domesticated animals, including hamadryas baboons, have been reported as natural hosts for human schistosomes. These baboons inhabit a wide range from Yemen to northern Saudi Arabia and share water sources with humans, facilitating disease transmission [7] [11]. Another challenge is the uncontrolled population movement from Yemen, where schistosomiasis prevalence is among the highest in the Middle East and control efforts are less established compared to Saudi Arabia [7] [11].

7. Entomological Aspects of Schistosomiasis Transmission

7.1. Overview

Four species of freshwater snails transmit human schistosomes in Saudi Arabia: *Biomphalaria pfeifferi* (the sole host for *S. mansoni*) and *Bulinus beccarii, Bulinus truncatus,* and *Bulinus wrighti* (hosts for *S. haematobium*) [3]. In 1976, Arfaa identified *Biomphalaria arabica* as the primary intermediate host for *S. mansoni* in endemic areas. For *S. haematobium*, three snail hosts were identified: *Bulinus wrighti* in the northeast (Riyadh Province), and *Bulinus truncatus* and *Bulinus beccarii* in the west [10]. Al Subaie's 1988 survey confirmed the presence of four snail vector species in Saudi Arabia. *Biomphalaria arabica*, closely related to Egypt's *B. alexandrina*, is the primary host for *S. mansoni* and is found in central, northern, and southwestern regions. *Bulinus truncatus* (western region), *Bulinus wrighti* (central region), and *Bulinus beccarii* (central and southwestern regions) serve as hosts for *S. haematobium*. The distribution of schistosomiasis closely follows that of these snail vectors [11]. A 1980 survey recorded *Physa acuta* in the central region for the first time. Although not naturally infected, laboratory tests confirmed its susceptibility to *S. haematobium*, with 10 out of 40 snails shedding cercariae after exposure to miracidia. Thus, *Biomphalaria arabica* is the primary host for *S. mansoni*, while *Bulinus beccarii* and possibly *Physa acuta* serve as hosts for *S. haematobium* [27].

A 1989 study evaluated the role of three *Bulinus* species in schistosomiasis transmission based on susceptibility to *S. haematobium*, geographical distribution, and habitat types. The overall infection rate was 0.6%, with snails showing susceptibility only when exposed to pooled miracidia [28]. The biochemical profile of snails plays a critical role in the schistosome life cycle, influencing disease prevalence [12]. A 2007 study in Taif examined factors affecting the susceptibility of *Biomphalaria* snails to *S. mansoni*, including miracidial density, water temperature, snail size, and light conditions. Of 100 field-collected snails, 15% were naturally infected. Infection rates increased with miracidial density and were higher in light conditions, though these findings were not statistically significant [29].

To explore the coexistence of susceptible and non-susceptible snail populations, a 2007 study analyzed genomic DNA from 100 snails collected in southwestern Saudi Arabia. Results identified a genetic component present in susceptible snails but absent in non-susceptible ones, suggesting the potential for future genetic interventions to produce non-susceptible snails for field introduction [30]. Drought and salinity significantly impact the survival of *Biomphalaria arabica*. Snails can tolerate up to 5% NaCl concentration, but 100% mortality occurs at 7.2%. Additionally, snails cannot survive complete dryness beyond 36 - 48 hours, even with food sources [31].

Seasonal variations also affect snail populations and infection rates. Higher numbers of *B. arabica* and increased *S. mansoni* infections are observed during spring, summer, and autumn. Conversely, low water temperatures, flooding, and high turbidity during heavy rainfall reduce snail populations and infection rates [23]. A 2013 study analyzed molecular variations among *B. arabica* populations in southern Saudi Arabia. Five populations from Asser and Al-Baha showed nearly identical DNA band patterns, with minor variations detected using RAPD primers [32].

7.2. Snail Vector Ecology in Schistosomiasis: Distribution, Abundance, and Susceptibility to Infection

7.2.1. Distribution and Habitat Suitability

The geographical distribution of schistosomiasis in Saudi Arabia is closely linked to the habitat suitability of these snail vectors. The country's diverse geography, consisting of the Red Sea coastal plains, Sarawat mountains, central Arabian plateau, and sand deserts, creates various water sources where snails thrive. Freshwater bodies such as streams, small canals, springs, pools, and irrigation wells provide ideal breeding grounds for these vectors [12]. The Sarawat mountains, in particular, with their natural water streams and seasonal monsoons, serve as a major natural habitat for these snails, facilitating their spread through flood routes [10]. Human-made water sources such as irrigation canals, reservoirs, and cisterns have further contributed to the persistence of snail populations, increasing the risk of schistosomiasis transmission [31].

7.2.2. Abundance and Environmental Factors

The abundance of these snail species is influenced by multiple environmental factors, including temperature, water chemistry, and human activities. Snails thrive in freshwater bodies with a pH range of 6.5 to 8.5 and moderate salinity levels, while pollution and excessive salinity can significantly reduce their populations [5]. Climatic conditions such as seasonal monsoons play a crucial role in determining snail abundance, as heavy rains can create new snail habitats while extreme droughts can limit their populations [3]. Additionally, human activities such as dam construction, irrigation expansion, and agricultural development have provided new habitats for snails, leading to their increased abundance in certain regions [33].

7.2.3. Susceptibility to Schistosoma Infection

The susceptibility of snails to Schistosoma infection varies across species and environmental conditions. Studies have shown that *B. arabica* populations from different regions of Saudi Arabia are highly susceptible to *S. mansoni* strains from neighboring countries such as Egypt and Yemen [32]. Laboratory experiments have demonstrated that snails from regions such as Al-Baha, Riyadh, Abha, Taif, Gizan, Najran, and the Tihama area become infected with *S. mansoni* and start shedding cercariae approximately 38 to 40 days post-exposure [15]. Similarly, *B. truncatus* and *B. wrighti* have been found to be effective intermediate hosts for *S. haematobium*, facilitating the transmission of urinary schistosomiasis [16].

By integrating ecological knowledge into schistosomiasis control programs, it is possible to target the disease at its source, thereby reducing transmission and ultimately working towards elimination. Sustained research into snail-vector dynamics, combined with environmental management and public health interventions, will be essential in achieving long-term schistosomiasis control. By integrating ecological knowledge into schistosomiasis control programs, it is possible to target the disease at its source, thereby reducing transmission and ultimately working towards elimination. Sustained research into snail-vector dynamics, combined with environmental management and public health interventions, will be essential in achieving long-term schistosomiasis control.

8. Conclusions

Schistosomiasis remains a significant public health challenge in Saudi Arabia, despite considerable progress in its control and management over the past decades. This narrative review has highlighted the historical, epidemiological, and entomological aspects of the disease, shedding light on its persistence in certain regions and the factors contributing to its transmission. The disease's distribution is closely tied to the presence of freshwater snail intermediate hosts, environmental conditions, and human activities, particularly in rural and agricultural areas. While effective control programs, such as the integration of schistosomiasis management into primary healthcare systems and the use of praziquantel, have significantly reduced prevalence rates, challenges remain. These include the presence of animal reservoir hosts, such as hamadryas baboons, and the continuous influx of expatriates from endemic regions, particularly Yemen.

The review underscores the importance of sustained surveillance, targeted interventions, and community education to address the persistent pockets of transmission. High-risk populations, such as children and individuals in rural areas, require special attention due to their frequent exposure to contaminated water sources. Additionally, the role of environmental factors, such as irrigation projects and climate conditions, cannot be overlooked, as they influence the habitats of snail vectors and the lifecycle of the parasite. Moving forward, a multi-faceted approach is essential to achieve the ultimate goal of schistosomiasis elimination in Saudi Arabia. This includes strengthening diagnostic capabilities, enhancing public health infrastructure, and fostering regional collaborations to address cross-border transmission. Furthermore, continued research into the genetic and biochemical profiles of snail vectors, as well as the development of innovative control strategies, will be crucial in overcoming the remaining barriers to eradication.

In conclusion, while Saudi Arabia has made remarkable strides in controlling schistosomiasis, the journey toward its complete elimination is ongoing. By addressing the socio-economic, environmental, and biological determinants of the disease, and by fostering a collaborative approach involving government agencies, healthcare providers, and the community, Saudi Arabia can pave the way for a schistosomiasis-free future. This review serves as a call to action for policymakers, researchers, and public health practitioners to remain vigilant and proactive in their efforts to combat this persistent parasitic disease.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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