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Review of Bilharzia in Saudi Arabia, Health Reports and Solutions

Najia A. Al-Zanbagi*

Biological Science Department, Faculty of Science, King Abdulaziz University, Jeddah, Saudi Arabia,
P.O. Box 42626 Jeddah 21551,
E-mail: nalzanbagi@kau.edu.sa

Abstract

Bilharzia is an endemic illness caused by the Schistosoma worm, a genus of digenean trematodes. The *Schistosoma* life cycle contains two hosts, a human body which plays as definitive host and a mollusc as an intermediate host. Bilharzia prevalence is widely and more than 200 million people are infected annually. The adult worms inhabit the blood veins that drain certain organs of the human abdomen. The infection with *S. mansoni* and *S. japonicum* causes the intestinal Bilharzia while urinary Bilharzia resulted from *S. haematobium* infection. *S. mekongi* and *S. intercalatum* are both reported for causing Bilharzia but they are less commonly. Urinary Bilharzia has been documented in Saudi Arabia since 1887 and both *S. haematobium* and *S. mansoni* were reported as endemic. In 1967, more than million people were expected to be as Bilharzia infected in different Saudi regions. In 1973, the Saudi Ministry of Health established the Bilharzia Control Centers in the endemic provinces for control programs depend on chemotherapy, snails control and health education. The annual Saudi health reports recorded a significant decrease in the Bilharzia incidence in Saudi Arabia as a noticeable result for the control efforts.

Keywords: Bilharzia; Saudi Arabia; Schistosoma sp.; Bilharzia control; snail control.

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* Najia Al-Zanbagi.
E-mail address: nalzanbagi@kau.edu.sa.

1. Introduction

Bilharziasis is an equatorial sickness happened by the genus *Schistosoma*. According to the World Health Organization, 200-300 million nations, almost children, were infected with Bilharzia [1], and about 200,000 may die annually from this disease. Approximately 779 million infected people exist in the Middle East, South America, Caribbean, Southeast Asia and mainly in the sub-Saharan Africa [2,3]. *S. mansoni* is considered mainly widespread and transmitted by *Biomphalaria* snails, while *S. japonicum is* transmitted by *Oncomelania* and widespread in the Far-east, they both play a role in the prevalence of intestinal Bilharziasis. *S. haematobium* is responsible for urinary Bilharzia and the *Bulinus* play a role in the disease transmission [4-6].

There are two different geographical strains of *S. mansoni*, Puerto Rican and Egyptian strains [7-9], by using scanning electron microscope, some differences were noticed between Egyptian strain and Saudi Arabian strain [10,11]. The study of genotype level by Random Amplified Polymorphic DNA (RAPD) for isolates of *S. mansoni* from Egypt, Saudi Arabia and Puerto Rico, resulted in that Egyptian strains were strongly correlated to Saudi strains but Puerto Rico strains related to unlike group [12]. The traditional diagnostic strategies depend on finding *Schistosoma* eggs in stool or urine and on detection procedures for antibody and antigen. Lier and his colleagues [13] stated that there is no favorable "gold standard" diagnostic test for detection low intensity of Bilharzia infections [3].

Saudi Arabia occupies approximately 80% of Arab Peninsula and lies at the Southwestern Asia, the total area of Saudi Kingdom is about 2,250,000 square Kilometer. It surrounds by seven countries and three bodies of water (Figure 1), the Red Sea on West side, Oman and Yemen on South side, United Arab Emirates and Qatar and the Arabian Gulf on East side, Kuwait, Iraq and Jordan on North side [14]. The country is divided into 13 administrative regions composed of districts [15]. Regarding to the Royal Embassy of Saudi Arabia, Saudi Arabia's population is 27 million, including 8.4 million foreign residents according to census of 2010 [16]. The total population in 2012 was 29,195,895 individuals scattered in all regions, Saudi people were 19,844,632 and the Non-Saudi persons were 9,351,263. The Ministry of Saudi Health operates 259 hospitals and 2,259 Primary Health Care Centers [17]. Both *S. haematobium* and *S. mansoni* infections were recorded in the kingdom, but all are not homogenously distributed which corresponds greatly with the geographical distribution of snail intermediate hosts. In 1967, more than one million was identified Bilharzia infected people in different regions of Saudi Arabia [18-21].

A total of 97 water habitats in 46 places were inspected for Bilharzia snails in Saudi Arabia, *Biomphalaria pfeifferi* plays as intermediate host for *S. mansoni*, while *Bulinus truncatus*, *B. beccarii* and *B. wirghti* are considered the *S. haematobium* intermediate hosts [22]. Different foci of intestinal and urinary Bilharzia were mapped in Saudi Arabia in 1956 (Figures 2&3), S. *mansoni* was recorded in Al-Jawf region, in

1960, it identified in Taif, Makkah and Riyadh, in 1974, disease recorded in Khaybar, Turabah, Tayma, in 1980, it mentioned in Riyadh, Najran and Asir region. Urinary Bilharzia was also recorded in 1960 in Al-Hijaz region, Tabuk and Tayma, in 1977, Gizan region, Najran and North of Riyadh were added, in 1980, infection was extended to reach Abha region [19]. Bilharzia is common in Asir Region owing to the extensive practice of the

traditional agriculture [23]. The temporal and spatial variations in Bilharzia prevalence was studied in two areas of Asir region, Abha and Tihamah over eight year's period, it showed that the disease prevalence in Tihamah was less significantly than in Abha region [24]. A study of 217 Bilharzia cases from surgical and biopsy files of Asir Central Hospital resulted in that it was more common between the emigrant populations than Saudi people [25]. The World Schistosomiasis Risk Chart [26] mentioned that *S. haematobium* and *S. mansoni* are predominant and considered as highly endemic in Saudi Arabia except in Al-Ahsa plain, north of Al-Nafud desert and the southern region of Al Rub al Khali.

Figure1: A map of the Kingdom of Saudi Arabia

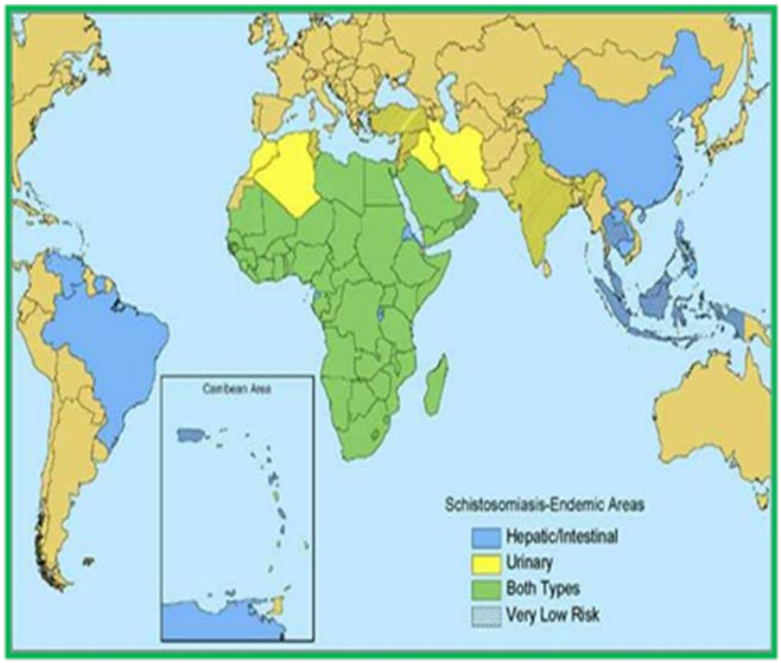

Figure 2: Map showing Schistosomiasis Endemic Areas, (Allam, 2012)

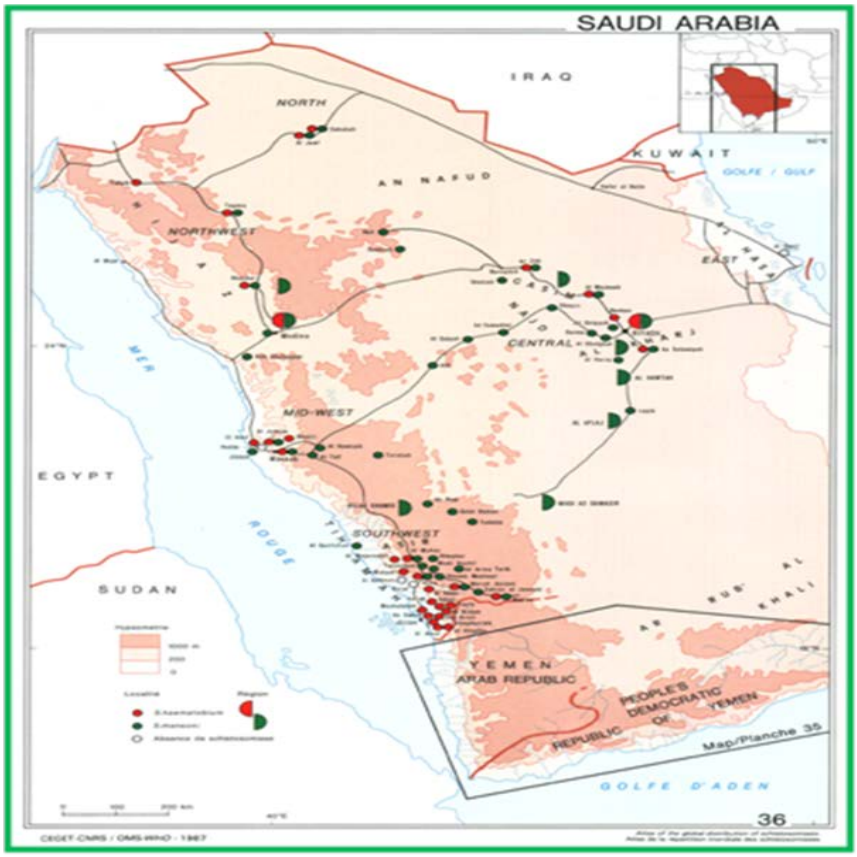

Figure 3: A map of Saudi Arabia showing the distribution of *S. haematobium* and *S. mansoni* in 1965, (Doumenge et al. 1987)

The understanding of snail genetic basis receptivity to *S. mansoni* may be helpful in evolution new strategies for Bilharzia control [27]. The polymorphic bands were discovered in snail samples from Riyadh and Hofuf which showed some genetic variations between samples, and should be useful for further analysis [28]. The study approved that the snail genetic profile is critically significant for Schistosomes life cycle success [29,30].

The Purpose of this review is to emphasize the two types of Bilharzia in Saudi Arabia and the different factors affect their distribution in the country, and to focus on the Kingdom great efforts to control the diseases prevalence.

2. Current Status

Bilharzia mainly is the second socioeconomically destructive parasitic illness after Malaria, it has been recognized in Saudi Arabia within 78 countries all over the world. In the developing countries most people get Bilharzia infection because they lacking the suitable water and hygiene services. Despite Bilharzia has small mortality rate, but it can harm human internal organs, also the growth and cognitive progress in children [17].

Incidence of Bilharzia cases in the endemic regions of Saudi Arabia during 2006 to 2011 is documented in Table (1). The highest positive cases of Bilharzia in 2006 was in Bishah and Jazan (0.148), but in Jazan it decreased in 2007 (0.11). In 2008, Al-Qunfudah recorded the highest disease incidence as 0.261 while Najran showed the least incidence from 2006 to 2008. In Taif region, the positive Bilharzia cases were (0.147) in 2007,

(0.19) in 2009 and (0.072) in 2010. In 2011, Al-Bahah recorded the least incidence as 0.003 [31-36].

Table 1: The incidence of notified schistosomiasis cases in endemic provinces in the Kingdom of Saudi Arabia during the period of 2006–2011

Year	The incidence of notified schistosomiasis cases							
	The highest Incidence		Higher incidence		High incidence		The least incidence	
	Region	+cases%	Region	+cases%	Region	+cases%	Region	+cases%
2006	Bishah &Jazan	0.148	Taif	0.102	Al-Bahah	0.098	Najran	0.003
2007	Taif	0.147	Jazan	0.11	Bishah	0.09	Najran	0.002
2008	Qunfudah	0.261	Taif	0.255	Bishah	0.17	Najran	0.001
2009	Taif	0.19	Aseer	0.059	Qunfudah	0.052	Medinah	0.004
2010	Taif	0.072	Bishah	0.053	Al-Bahah	0.018	Jazan	0.004
2011	Bishah	0.184	Taif	0.171	Makkah	0.026	Al-Bahah	0.003

The prevalence rate of Bilharzia in period from 2002–2011 was reported in Table (2). The prevalence rate/100,000 population was decreased gradually from 5.5 - 0.6 in the successive mentioned years. According to disease type, urinary Bilharziasis was recorded as the highest percentage of infection in 2002 as (59.3), but in years from 2003 to 2011, the intestinal Bilharziasis was the highest incidence as 53.4 to 84. Regarding patients nationality, it was mentioned that Saudi patients were suffered from Bilharzia disease showing fluctuate percentage of infection [33], from 2009 to 2011, the non–Saudi people were recorded as the highest hostile for the Bilharziasis parasites to be as 54.3, 61.7 and 81.5 respectively [34-36]. It was found that males were the best host preferred, giving an infection percentage as 76.8 in 2002 and 88.1 in 2011. Also, the patients age from 15-39 years was the highest Bilharzia incidence, it was 54.9 in 2006 and 77.4 in 2011 [36].

The water resources which inhabited by *Schistosoma* snails and the notified Bilharzia cases in different regions of Saudi Arabia during 2006 to 2011 were mentioned in Table (3). *Schistosoma* snails were decreased from 2.6% in 2006 to 0.6% in 2010 [31-35], it increased in 2011 to be 2.34%. Snails completed the urinary Bilharzia life cycle were inhabited Makkah, Jeddah, Medinah, Jazan, Aseer, Allaith, Adham and Qunfudah, but that *Schistosoma* snails responsible for intestinal Bilharziasis were distributed mainly in Taif, Jeddah, Al-Bahah, Bishah, Najran, Hail, Tabouk and Adham [36].

The last Saudi Health Statistics Annual Book [17] declared 254/799,765 individuals were reported as positive cases (0.032%), Makkah and Medinah regions were considered as the endemic zones with 130 and 83 positive cases respectively. The urinary Bilharziasis was widespread in Medinah, Jazan, and Aseer, whereas intestinal type was prevalent in Makkah, Medinah, and Al-Bahah (Figure 4). Intestinal Bilharziasis was 86.2% and urinary Bilharzia was 13.8% compared by years from 2008 to 2011, the intestinal Bilharzia cases were increased from

75% to 86% of all cases (Figure 5). The prevalence rate in 2012 was 0.9/100,000 population of Saudi Kingdom, it was higher than in 2010 (0.5/100,000 population), nevertheless, there was 83.6% drop (5.5/100,000 population) in disease prevalence rate in 2002. The percentage of Bilharzia cases in Saudis patients was decreased, showing an obvious drop from 55.5% to 18.9% of total cases and the disease cases was mentioned among males as 59.1% (Figures 5&6), which mean that males are mainly exposed to disease according to their work in agriculture or swimming.

Table 2: Schistosomiasis prevalence rates in the Kingdom of Saudi Arabia and the percentage of infection according to the disease type, nationality, sex and age during the period of 2002–2011

Year	No. of infected cases	Prevalence rate/100,000 population	Percentage of infection										
			disease type			Nationality		Sex		Age in years			
			Uri.	Int.	Mix	Saudi	Non	M.	F.	<5	5-14	15-39	>40
2002	1159	5.5	59.3	39.6	1.1	57.8	42.2	76.8	23.2	*	*	*	*
2003	938	4.5	46.3	53.4	0.3	57.9	42.1	82.4	17.6	*	*	*	*
2004	639	2.9	43.3	56.3	0.3	61.2	38.3	82.0	18.0	*	*	*	*
2005	497	2.2	40.8	58.8	0.04	70.8	29.2	82.1	17.9	*	*	*	*
2006	515	2.2	33.4	66.6	0	62.9	37.1	82.3	17.7	0.2	31.4	54.9	13.4
2007	370	1.52	33.8	66.2	0	72.2	27.8	84.1	15.9	0.27	36.7	49.7	13.2
2008	699	2.78	24.6	75	0.4	55.5	44.5	82.1	17.9	0.28	22.2	62.1	15.4
2009	282	1.1	15.6	83	1.4	45.7	54.3	91.5	8.5	0	9.9	72.3	17.7
2010	120	0.5	11.7	86.6	1.7	38.3	61.7	85	15	0.8	12.5	68.3	18.3
2011	168	0.6	16	84	0	18.5	81.5	88.1	11.9	0	6.5	77.4	16.1

* No data related to the patients age in years from 2002 – 2005.

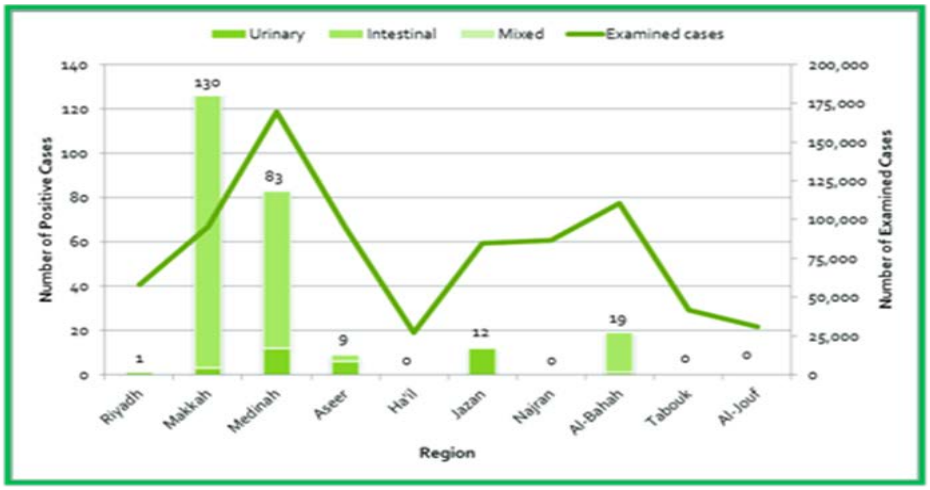

Figure 4: Reported Bilharzial cases by region in Saudi Arabia in 2012, (Health Statistics Annual book, 2012)

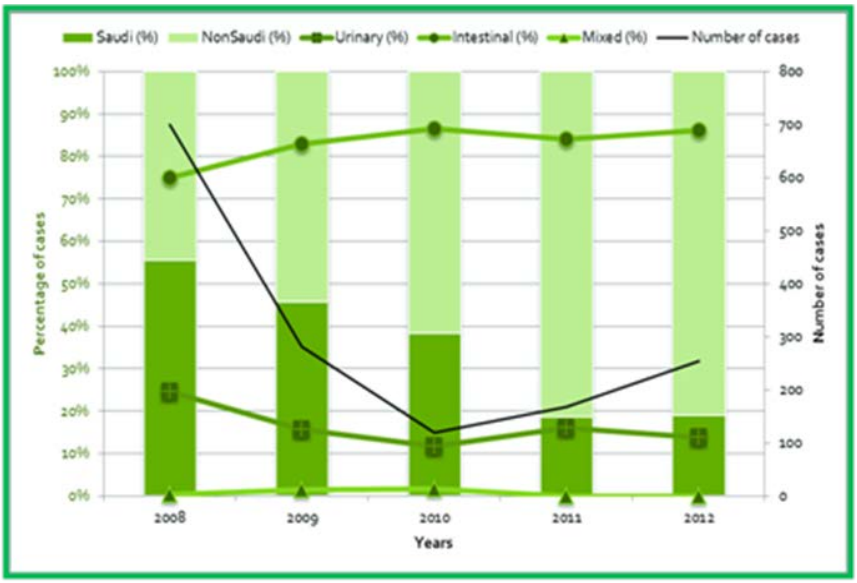

Figure 5: Reported schistosomiasis cases by type of disease and nationality in the Kingdom of Saudi Arabia from the period of 2008-2012, (Health Statistics Annual book, 2012)

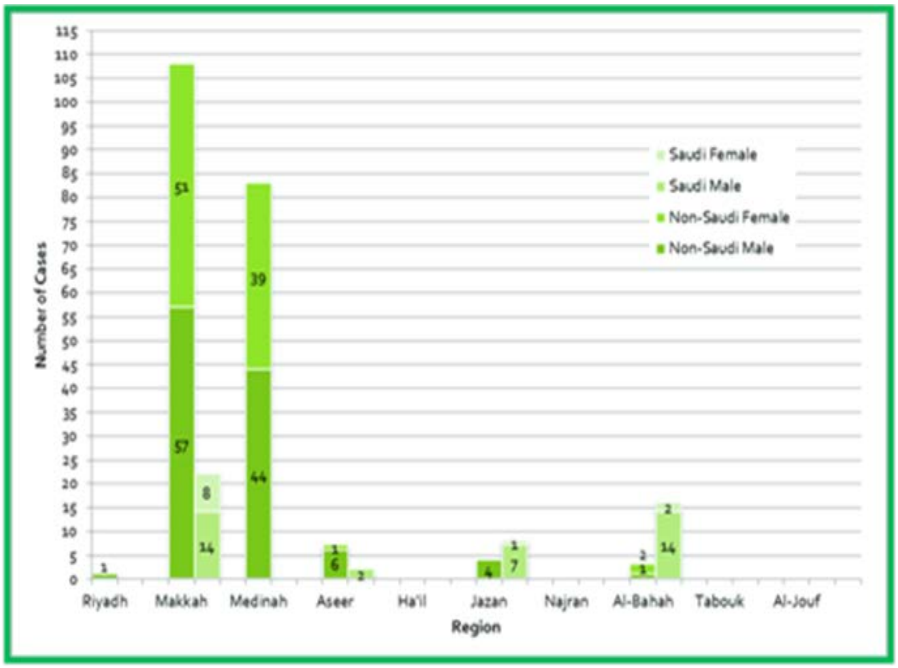

Figure 6: Reported schistosomiasis cases by region, nationality and gender in Saudi Arabia in 2012, (Health Statistics Annual book, 2012)

The disease cases distributed at different age groups (Figure 7) which revealed that the age group of 15 -39 years was the highest percentage of Bilharzia cases as (84.3%), this is followed by the patients of 40 years old or older to gave a disease percentage as (9.8%), in addition, there was an increased in the disease prevalence in Makkah and Medinah that there were more cases discovered among the young and middle-aged people. The patients age group of 15-39 years was the highest percentage of Bilharzia cases as (84.3%), followed by patients of 40 years old or older (9.8%), in addition, more cases were discovered among young and middle-aged people in Makkah and Medinah [17].

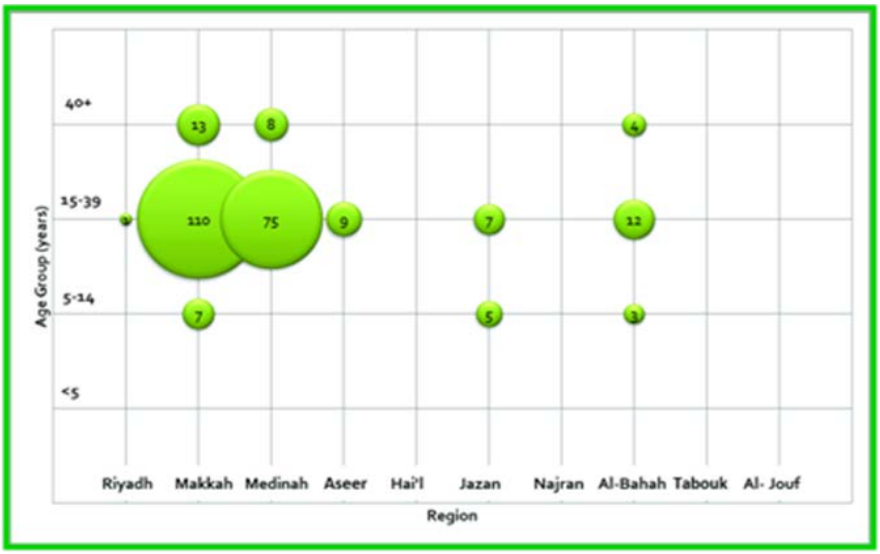

Figure 7: Reported Bilharzial cases by region and age group in Saudi Arabia in 2012, (Health Statistics Annual book, 2012)

Table 3: The percentage of water resources inhabited with *Schistosoma* snails and the incidence of notified schistosomiasis cases in endemic provinces in the Kingdom of Saudi Arabia during the period of 2006 – 2011

Year	No. of water resources examined	No.of water resources inhabited with *Schistosoma* snails (%)	Geographical distribution of intermediate host	
			Urinary schistosomiasis	Intestinal schistosomiasis
2006	31672	810 (2.6%)	Makkah, Jazan, Aseer and Jeddah	Taif, Al-Bahah, Aseer, Bishah, Jazan, Najran, Makkah, Medinah and Hail
2007	44540	742 (1.7%)	Makkah, Medinah, Jazan, Aseer and Allaith	Taif, Al-Bahah, Aseer, Bishah, and Jeddah
2008	35140	610 (1.7%)	Makkah, Medinah, Jazan, Aseer and Allaith	Taif, Al-Bahah, Aseer, Bishah, Najran, Makkah, Medinah, Hail Jeddah and Jazan
2009	49451	585 (1.2%)	Jazan and Aseer	Taif, Al-Bahah, Aseer, Bishah, Najran, Makkah, Medinah, Jeddah and Jazan
2010	72635	405 (0.6%)	Jazan and Aseer	Taif, Al-Bahah, Aseer, Bishah, Najran, Makkah, Medinah, Jeddah and Jazan
2011	22575	528 (2.34%)	Jazan and Aseer	Taif, Al-Bahah, Aseer, Bishah, Najran, Makkah, Jeddah, and Adham

3. Disease Control

In the past, Bilharzia and snail control concerned only biologists and their assistants, but recently in which societies contribution is considered essential, this requests the multidisciplinary processes [37].

In the latest years, notable decrease in disease prevalence in many endemic countries has been noticed [38,39], many countries of Eastern Mediterranean Region, namely Egypt, Iraq, Syria, Libya, Oman and the Kingdom of Saudi Arabia have attained low Bilharziasis endemicity, any deficiency in the well planned prevention and control in the eradication programs could initiate to appearance or resurgence of disease [3].

The World Health Organization adopted a decision for the low disease transmission areas, to afford effective control actions in order to eradicate Bilharziasis [40], but in these countries, the ordinarily techniques used for detection infection may lack important sensitivity to determine accurately Bilharzia prevalence or the parasite burden [41,42]. According to the WHO, Bilharziasis has been effectively restricted in the past 20 years in several countries, including Brazil, Cambodia, China, Egypt, and Saudi Arabia [17].

In 1973/74, the Saudi Ministry of Health established centers for Bilharzia control in the endemic areas to encourage control programs that depend on snail control, chemotherapy and health education which was led to considerable decrease in most regions of Saudi Arabia [43,20,44]. In 1989, Bilharzia control activities were incorporated into the Primary Health Care system. Numerous schools in different areas were participated by observation *Schistosoma* ova in the schoolchildren and adjacent communities as well as by preparing health education sessions [44].

Human infection with *S. haematobium* was kept very low at Jazan region in Saudi Arabia as a result for sustained control efforts which depend on case detection, treatment of infected persons, and snail's elimination by using chemical and environmental control. The entire removal of snails should be probable if the health system in bordering areas can be convinced to accept a comparable disease control strategy [45].

Chemotherapy with orally administered antischistosomal medicine still the favorable method for *Schistosomes* infected people. However, this is considered an expensive approach [46]. The first record for using chemotherapy against Bilharzia was started in 1912 which used either intravenously or intramuscularly. The old anti-schistosomal medicines, Tartarate emetic, Niridazol and Hycanthone were used since 1974, they were replaced by Oxamniquine and Praziquantel in 1982 [43]. The three successes and wide spread antischistosomal medicines were Praziquantel, Metrifonate and Oxamniquine, all used orally [47,48]. Nowadays, Praziquantel in a single dose is the lonely medicine used in all *Schistosoma* species either in acute level or in people with extremely hepatosplenic involvement [49,20].

Role of human behavior and health education in Bilharzia control was studied [50]. Article clarified the responsibility of human activities in Bilharzia transmission and its control with relation to health education. Many literatures were reviewed to recognize the related behaviors and to observe the development and the restrictions in health education by the primary health care procedures. After mapping the water bodies in each prevalent region of Saudi Arabia, the snail control approach were exploratory depend on search and devastate by

using the Niclosamide compounds. In some areas, using of molluscicide was completed periodically in the predictable transmission sites. In general, the schedule molluscicide programs manage to remain the snail population densities at exceedingly low levels, but it may be at an unnecessarily high price [20].

Of the three conventional approaches which are environmental, chemical and biological for snail host control, the most importance has been known that for using biological molluscicides. Environmental snail control comprises increasing the flow water speed, controlling the water level, regulating the water streams and eliminating the supplementary habitats [51]. Chemical control remains the most important tool for snail destruction and many reviews on the molluscicides role in Bilharzia control were prepared [52,53,51].

The rising costs of molluscicides and availability for synthetic molluscicides has led to the increasing interest in study the plant molluscicides [54,5]. Some Saudi plants from family Euphorbiaceae were tested as plant molluscicides against intestinal Bilharzia snail, *Biomphalaria pfeifferi.* A reasonable sequence of experiments confirmed some plant molluscicides were toxic to *Schistosoma* snails. It was obvious from findings that dry leaves chloroform extract of *Jatropha gluaca*, dry leaves methanol extract of *Euphorbia helioscopia* and dry stems methanol extract of *E. schimperiana* showed strong molluscicidal actions against the snail *B. Pfeifferi* [5]. *E. schimperiana* methanol extract was proved as a larvicidal agent against *Schistosoma mansoni* larvae, miracidia and cercariae [55], also it has an antischistosomal action against *S. mansoni* adult worms [6]. Methanol extract of *E. schimperiana* was proved to be safe for using in biotic field with attention in handling and application after conducting the toxicity tests for *E. schimperiana* following the Organization of Economic Cooperation and Development "OECD" guidelines [48].

4. Conclusion

The accomplishment achieved in Bilharziasis control in Saudi Arabia is the obvious confirmation that Saudi plan is greatly effective in that depends on diagnostic cases and treatment patients accompanied with using molluscicides to control Schistosomes snails. The general development in Saudi Arabia arising the living standards and improving the sanitation, as well as the rural regions urbanization and the considerable raise in medical care services, all these are contributed to decrease Bilharziasis prevalence and stop their transmission between scattered infected foci. Furthermore, replacing water in rural areas from streams, springs and ponds by water comes from drilled wells and accessing sanitary water supply in the urban regions, this all controlled the disease prevalence. The appropriately designed preventive Bilharzia control actions such as improving water supplies, perfect sanitation, health education and environmental management will decrease risks not only for Bilharziasis prevalence but for other numerous parasitic diseases as well. Because of the local nature of disease cycle in Saudi Arabia, so the recommendation depends on the total elimination of Bilharzia disease, the hygiene education. Also, the sanitary engineering and concentrated efficient treatment could eliminate disease completely from the whole Arabian Peninsula.

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