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Review article

Schistosomosis in Burkina Faso: review on 60 years' research

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ABSTRACT. Schistosomosis is a common neglected helminthic disease in the tropics and sub-tropics particularly in sub-Saharan countries including Burkina Faso. It is the second world parasitic endemic disease after malaria. The two prevalent species infecting human in Burkina Faso are *Schistosoma haematobium* and *Schistosoma mansoni* which cause respectively the urogenital schistosomosis and the intestinal schistosomosis. This review aimed at providing an historical perspective of research on schistosomosis from 1960 to 2020 and shedding some light on the gaps in knowledge useful for the disease control and the elimination efforts in Burkina Faso. Formal systematic review was not followed for this review. Published studies on the schistosomosis in Burkina Faso over the period from 1960 to 2020, were search in Medline, PubMed, Google Scholar, EMBASE and the libraries of main universities in Burkina Faso namely: Joseph Ki-Zerbo University and Nazi Boni University. The following keywords used were: schistosomiasis, schistosomosis, *Bilharzia*, *Bulinus*, *Biomphalaria*, Upper-Volta and Burkina Faso. Over a period of 60 years, a total of 87 scientific research documents were identified. The original scientific research articles represent the majority of the scientific documents found (65.52%). Urinary schistosomosis was the most common from the documentation. There has been a gradual decrease in the prevalence, more significantly since the implementation of the National Schistosomiasis Control Program (NSCP). The effectiveness of the NSCP could therefore contribute to the elimination of schistosomosis in Burkina Faso.

Keywords: schistosomosis, bilharziosis, *Schistosoma*, *Bulinus*, *Biomphalaria*, Burkina Faso

Introduction

Schistosomosis or bilharzia is one of the most widespread parasitic diseases in the world. Schistosomosis is the second world parasitic endemic after malaria. Nearly 800 million people around the world are at risk of infection [1]. Schistosomes are responsible for 800,000 deaths per year worldwide. In 52 countries of the world, 230 million people need annual treatment, i.e., 80 to 90% live in Africa [1]. In 2003, in sub-Saharan Africa, 70 million individuals with hematuria and

32 million of those with dysuria were infected with *Schistosoma haematobium*. *Schistosoma mansoni* is believed to be the cause of diarrhea in 0.78 million people, melena in 4.4 million cases and hepatomegaly in 8.5 million cases [2]. These schistosomoses are endemic in 76 countries, most of which are located in Africa. Thus, urinary schistosomosis caused by *S. haematobium* affects 54 countries in Africa and the eastern Mediterranean basin [3]. WHO stated in 2006 that some 200 million people are infected with schistosomosis in 76 developing countries around the world and that about 80% of cases come from Africa [4]. In Burkina Faso, in the years 1997–1998, the overall prevalence of urinary bilharzia was about 30% [5]. Concerning intestinal bilharzia, its prevalence varied between 36–79% in the 1980s [6].

Taking into account the creation of water reservoirs in the hydraulic installations development (large dams, irrigation networks, small community dams) for agricultural and or energy needs, and the increase in anthropogenic pressure, man creates ecological disturbances that can lead to the proliferation of initially rare biological species; in particular the intermediate host molluscs of schistosomes [5,7,8]. For this purpose, we can estimate the population reached by all forms of bilharzia to be 3 million people in Burkina Faso [9]. Although, the lethality associated with schistosomosis is low in Burkina Faso (rate of 0.34%) [10], the extent of this disease is measured particularly in developing countries where poverty evolves in parallel with malnutrition, lack of safe water and precarious health infrastructure [11–13]. Diseases by extension, the importance of bilharzia is however underestimated in public health: their distribution in the population is very heterogeneous and they remain clinically asymptomatic or discrete for a long time, limited to hematuria for the urinary form or diarrhea for the intestinal form. Many works have been carried out by authors on schistosomosis but still under exploited. The aim of this work is therefore to contribute to the popularization of the results of research on schistosomosis in Burkina Faso from January 1960 to December 2020.

Methods

Our present review study is concerned only with schistosomosis in Burkina Faso; a landlocked country located in the heart of West Africa. It covers an area of approximately 274,200 km^2 and is located between latitudes 9°20’ and 15°05’ North and longitudes 5°30’ West and 2°20’ East. Burkina Faso, is a Sahelian country bounded to the Est by Niger, to the North and West by Mali, to the South by Ghana, Côte d’Ivoire, Togo and Benin. The main rivers of the country are the Mouhoun river, the Nakambe river, the Nazinon river and the Comoe river. The rivers are connected to three main basins: the Volta, Comoe and Niger basins. The vast majority of the Burkinabe population, about 77.3%, lives in rural areas with agriculture as their main activity [14].

This is a retrospective study based on the review of scientific documents that addressed schistosomosis in Burkina Faso from January 1960 to December 2020. The review took place from January to December 2021**.** Our study included any scientific document related to schistosomes and their intermediate hosts in Burkina Faso published online or available in libraries from January 1960 to December 2020. We concluded the study on 31st December 2021. Finally, we considered the studies eligible only if they met the following inclusion criteria: a) schistosomosis and other pathologies in Burkina Faso, b) schistosomosis both Burkina Faso and other countries.

Our data has been collected using the search database such as: Medline, Google Scholar, PubMed, EMBASE and the libraries of our various universities namely: Joseph Ki-Zerbo University and Nazi Boni University. The key words used were: schistosomiasis, schistosomosis, bilharzia, *Bulinus*, *Biomphalaria,* Upper-Volta and Burkina Faso.

The informations were collected using individual collection sheet for each listed scientific document. The following variables were considered: a) quantitative variables: the prevalence and year of publication, b) qualitative variables: title of the documents, the type of the document, the nationality of the authors, the sources of funding, the species of schistosomes and their intermediate hosts, the regions, the provinces and the study sites, the populations of the study, the parasitological, immunological and anatomopathological techniques carried out.

The prevalence rates were calculated using SPSS version 17 software. The histograms and pie charts were generated using Excel 2010 software.

Results

Inventory of scientific documents on schistosomosis according to their nature from January 1960 to December 2020

Over a period of 60 years (1960 to 2020), we have identified 87 scientific documents on schistosomosis that meet the inclusion criteria. The nature of the documents listed was dominated by original scientific research articles (65.51%) (Fig. 1).

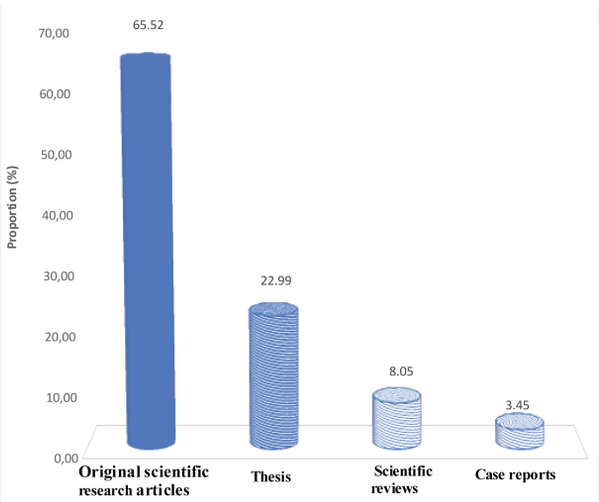

Figure 1. Distribution of scientific documents on schistosomosis according to their nature from January 1960 to December 2020

Number of documents listed by decade

We have noted an increase in the number of scientific documents addressing schistosomosis over the time from 1960 to 2020 (Tab. 1).

Table 1. Number of documents listed by decade

Period	Number (n=87)	Proportion (%)	References
1960–1969	01	1.15	[15]
1970–1979	05	5.75	[16–20]
1980–1989	14	16.09	[21–34]
1990–1999	16	18.39	[35–50]
2000–2009	24	27.59	[51–74]
2010–2020	27	31.03	[75–101]

Distribution of documents according to the subject of the study and the study population

Despite the multiplicity of intermediate hosts, the majority of the studies (60.92%) conducted were focused on schistosomes. It is to be noted that 29.89% of the documents addressed schistosomes and intermediate hosts, while very few scientific documents (4.60%) were interested in studying the behavior of intermediate hosts (Tab. 2).

During the period covered by the study, 49.40% of the scientific documents mentioned surveys were carried out on the population in general regardless of age or gender.

Table 2. Distribution of documents according to the study population and the study subject

Biologic examination	Number of documents	Proportion (%)	References
Study population	83	100	
Population in general	41	49.40	[1–4,6,8,9,12,15–18,20–23,25–27,29,35,37,38,41,47,49,51,54, 56, 58,59,64,69,78,83,85,86]
Children	35	42.17	[19,29,30,31,34,35,37,38,41,43, 47,49,51,54,56, 58,59,64,69,72, 76,77,79,81,82,83, 84,87,89,91,93,99,103]
Women	04	4.82	[74–76,102]
Traveller	03	3.61	[48,58,62]
Study subject	87	100	
Schistosomes	55	63.21	[1–4,6,9,11,12,15–19,21,23 ,25,27,29,30,31, 34,35,37,38,43, 47–54,56–59, 63,65,66,67,74,78,79, 82,84, 87,91,93,96,97,98,101, 102,103]
Schistosomes and intermediate hosts	27	31.03	[26,41,42,45,55, 60,68,69,75,76,77,80,81,83,85,86,88,89, 90,92, 94,95,97,99,100]
Intermediate hosts	5	5.74	[20,22,40,44,46]

Distribution of documents according to schistosome species

Three species of the genus *Schistosoma*, namely *S. mansoni*, *S. haematobium* and *S. intercalatum*, all parasites of humans, were highlighted in studies carried out in Burkina Faso from 1960 to 2020. The documents concerning both *S. mansoni* and *S. haematobium* had the highest percentage (50.60%). Individually, *S. haematobium* was the most studied species with a percentage of 37.35. This distribution is illustrated in Figure 2.

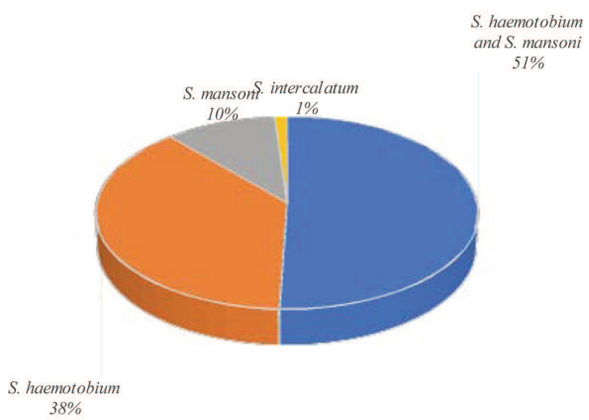

Figure 2. Distribution of documents according to the species of schistosomes

Distribution of documents according to biological and anatomopathological diagnostic techniques

The urinary filtration and Kato-Katz techniques were more associated in scientific documents with 48.19%. Individually, the urinary filtration technique was the most diagnostic method applied with 30.12% (Tab. 3).

Distribution of documents according to intermediate hosts found by region

The following species: *Bulinus truncatus*, *B. senegalensis*, were found in 13 regions of Burkina Faso, including respectively 12 and 11 documents that mentioned the Mouhoun Loop. *Biomphalaria pfeifferi* was found sporadically in 12 regions of Burkina Faso (Tab. 4).

Distribution of documents according to the molecules evaluated

Out of the total of 83 documents, we observed only 6 (6.89%) that mentioned evaluated molecules. Praziquantel was the most experimented molecule with 3 out of the 6 documents listed (50%), followed by oxamniquine with 2 documents (33.33%) and metrifonate with one document (16.67%).

Distribution of documents according to the state and funding source

Only 13 studies out of the 87 noticed (14.94%) had been funded. Regarding the funding sources, the AUF and the USAID are the first founding institutions with 5 investigations funded each (38.46%) (Tab. 5).

Table 3. Distribution of documents according to biological and anatomopathological diagnostic techniques

Biologic examination	Number	Proportion (%)	References
Urinary filtration and Kato-Katz	40	48.19	[9,16,19,23,25,27,29,37,38,41,43,47,48,49,51,54,55,57, 58, 59,64 ,67,68,74,75,77, 81,83,85,86, 89,90–95,97–99]
Urinary filtration	25	30.12	[18,21,28,30,31,34–36,50,52, 53,60,63,66,69,73,76,79, 80,83,84,96,100–102]
Kato-Katz	07	8.43	[15,17, 26,56 ,63,78,82]
Anatomopathology	04	4.82	[32,50,72,87]
Indirect hemagglutination	02	2.41	[12,71]
Indirect immunofluorescence	02	2.41	[24,71]
Immunohistochemistry/PCR	02	2.41	[12,65]
ELISA test	01	1.21	[65]
Total	83	100	

Table 4. Distribution of documents according to intermediate hosts found by region

	Regions and number of documents												
	Hauts- bassins	Cascades	Sud-ouest	Boucle du Mouhoun	Centre	Plateau central	Centre-nord	Centre-sud	Centre-ouest	Centre-est	Est	Nord	Sahel
Intermediate hosts	n	n	n	n	n	n	n	n	n	n	n	n	n
Bulinus truncatus	2	3	1	12	3	4	4	1	2	2	3	1	1
B. senegalensis	2	2	1	11	3	2	2	1	2	1	2	1	1
B. globosus	3	1	1	–	2	1	2	1	1	2	2	1	1
B. forskalii	1	1	1	4	1	1	1	1	1	1	1	1	–
B. umbilicatus	–	–	–	–	1	1	1	1	1	1	2	–	–
B. genius	1	–	–	–	–	–	–	–	–	–	–	–	–
B. tropicus	–	–	–	–	–	–	1	–	–	–	–	–	–
B. jousseaumei	1	–	–	–	–	–	–	–	–	–	–	–	–
B. pfeifferi	3	2	1	7	1	2	1	1	1	1	2	–	1

Table 5. Distribution of documents according to their financing status

	Number of documents	Proportion (%)
Status	87	100
Mention of financing	13	14.94
No mention of financing	74	85.05
No mention of financing		
Funding sources	13	100
AUF	05	38.46
USAID	05	38.46
DBL	02	15.38
APARET	01	7.70

Average prevalence of schistosomosis in Burkina Faso by decade according to the documents used

AUF: Agence Universitaire de la Francophonie; USAID: United States Agency for International Development; DBL: Danish Bilharziasis Laboratory-Institute for Health Research and Development; APARET: African Program for Advanced and Research Epidemiology Training

We have observed a gradual decrease in the prevalence of schistosomosis over the years in Burkina Faso. *S. haematobium* and *S. mansoni*, being the two most frequently found species, each showed a clearly declining prevalence after these 60 years (Fig. 3).

Discussion

Our study is a literature review on schistosomosis in Burkina Faso from the year of independence (1960) to 2020, i.e. 60 years of existence. Eighty-seven (87) documents on schistosomosis have been identified during these 60 years in Burkina Faso. Our values are close to those of Makaula et al. [102] in Malawi in 2014 who identified 89 documents on schistosomosis over a period of 31 years. The establishment of the National Schistosomiasis Control Program (NSCP) in 2002 [97], the increase in the number of skills (doctoral students, researchers) and the sponsors' interests to the schistosomosis (NGOs, Research

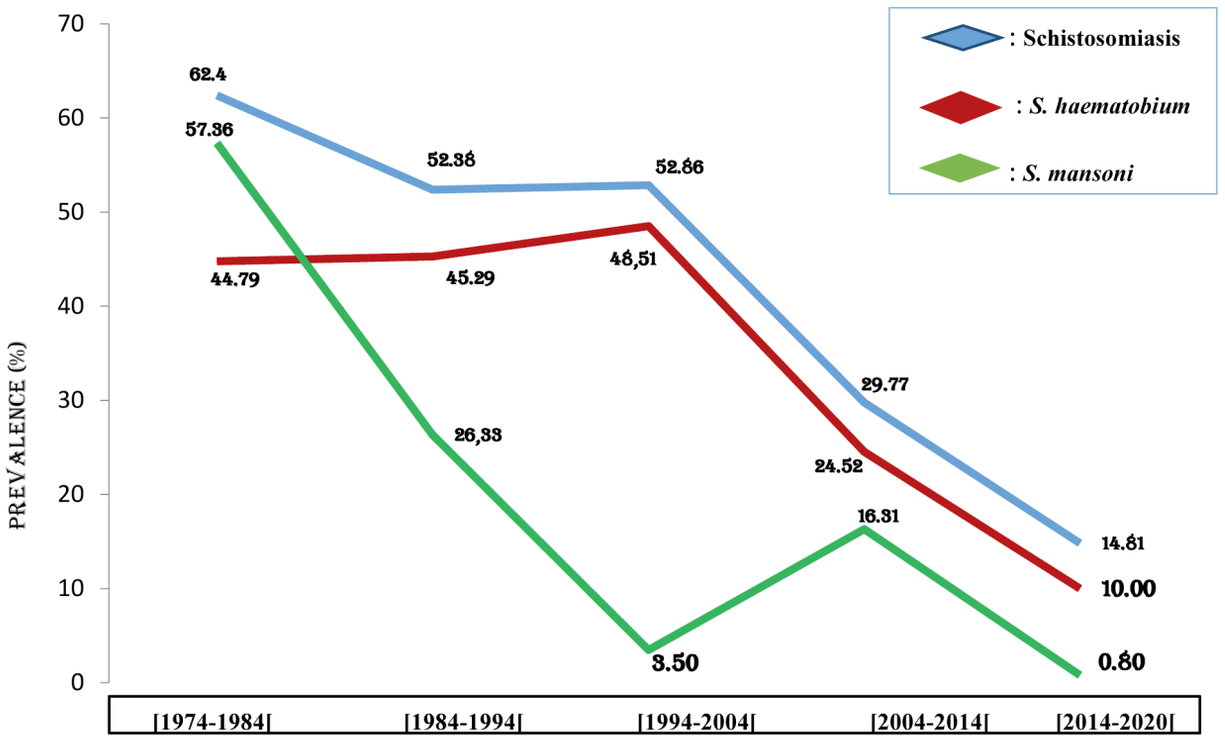

Figure 3. Evolution of the average prevalence of schistosomosis and *Schistosoma* species in Burkina Faso by decade

institutes) would have contributed to obtaining this documentary plurality on schistosomosis in Burkina Faso. Original scientific research articles were the most frequently encountered type of document as evidenced by our results (65.52%). This could be explained by the easier access route (Internet) of scientific research results associated with their frequency of production compared to other types of documents observed.

Schistosomes were more studied than their intermediate hosts. This could be explained by the relative simplicity of the interventions on the definitive host (human) than on the intermediate host. In addition, this work on schistosomes in general has made it possible to identify the corresponding species and clinical forms. It allowed the scientific community to determine the prevalence and evolution of this neglected disease around water points. It also contributed to knowing and monitoring the level of schistosomosis endemicity in the different regions of Burkina Faso. Most of the studies in our documents focused on the population in general (49.40%). The studies that were carried out on the population in general aimed to identify population groups at risk in order to better guide interventions from the national program. Indeed, Ouedraogo [34] in 1984, had demonstrated that in Kaya, Burkina Faso, the schistosomosis contamination risk was high for populations who practiced water collection, sale of brickyard water, livestock watering, market gardening, rice cultivation, maintenance of canals. And that, this risk was higher in those who were involved in swimming and fishing games. The studies conducted on children were not so negligible (42.17%). This is because children would be the most vulnerable population group.

The majority of the work (50.60%) concerned both urinary and intestinal schistosomosis. This would be justified by the researchers' interest in comparing at the same time the prevalence of the two predominant forms of schistosomosis on sentinel sites, but also in studying the prevalence of bi parasitism linked to the two species of schistosomes that are prevalent in Burkina Faso. It has been observed that urinary schistosomosis has received much more attention from the scientific community in comparison with intestinal schistosomosis. Indeed, 37.35% of the documents had to exclusively deal with urinary schistosomosis against 10.84% of the documents for intestinal schistosomosis. Then, it can be anticipated that urogenital schistosomosis still remains a serious health problem in certain regions of Burkina Faso [101]. These results are similar to those of Makaula et al. [102] who found in their study more

documents concerning urinary schistosomosis than intestinal schistosomosis.

Urinary filtration as a diagnostic technique was the most used in the first documents found, followed by the Kato-Katz technique. Indeed, these techniques remained essential for researchers because they would make it possible to better conduct mass surveys and obtain good results. This idea is supported by the WHO which recommends the use of methods with lower sensitivity but very fast and less expensive [3].

The most listed intermediate hosts of *S. haematobium* and *S. mansoni* are the genus *Bulinus* and *Biomphalaria*, respectively. *Bulinus truncatus*, *B. globosus* and *B. senegalensis* have been identified in all ecological zones. *Biomphalaria pfeifferi* are found preferentially in the southern half of the country, which, with the exception of the Sourou hydro-developments, confirms the observation that the 14th northern parallel would be the limit of northern extension of these two species [6]. *B. umbilicatus* found in 1994 in a few regions (Centre, Plateau central, Centre-Nord, Centre-Sud, Centre-Ouest, Centre-Est, Est) is inconstent because it is no longer found in the studies that followed [102]. *B. jousseaumei* and *B. genius*, found in the Hauts-bassins region respectively in 1987 and in 2012, *B. tropicus* found in the *Centre-Nord* region in 1992 are intermediate hosts of *S. haematobium* but very rarely found in Burkina Faso. Moreover, they were no longer found in the studies that followed [6].

According to the molecules tested, only six studies (6.89%) evaluated the molecules used in the schistosomosis management. But among the research that has been interested in molecules, it is the impact of treatment with praziquantel that is the most evaluated, by 50% of these studies. It is the only molecule combined with albendazole that is currently used by the NSCP. So, any subsequent investigation of the program consists of evaluating the impact of praziquantel treatment.

The literature review revealed that only thirteen (13) scientific documents (15.66%) on schistosomosis in Burkina Faso had mentioned their funding source. Our results are different from Makaula et al. [102] who found that in Malawi, 98% of the research carried out on schistosomosis were funded. In terms of funding sources, of the thirteen documents, USAID and AUF were the main ones. Although the challenge of schistosomosis in Burkina Faso was first a national public health problem before being international, local funding was almost non-existent. This low declination of identities by sponsors who supported the research in Burkina Faso, would be justified by political and strategic reasons.

At the national level, the prevalence of schistosomosis increased from 62.4% in the 1970s to 52.86% just before the implementation of the program in 2002 and significantly decreased over the years. Toure et al. [103] in 2015 in Burkina Faso noted a considerable decrease in the national prevalence of *S. haematobium* infection. This rate was 59.6% before 2004. Two years after the implementation of the program among children from 5 to 15 years old, it decreased to 7.7%. All this shows the impact that the NSCP generates in the process of schistosomosis control and elimination in Burkina Faso.

Our study that aimed at giving a general idea of the work which was carried out on schistosomosis in Burkina Faso showed that original scientific research articles were the most frequently found types of documents over the period from 1960 to 2020. Most of the studies were conducted by Burkinabe authors. Urogenital schistosomosis and intestinal schistosomosis with their respective etiological agent attracted very much drew the authors' attention. References to sources of funding were rarely included in the documents. Overall, we noted a decrease in the prevalence of schistosomosis probably largely related to the NSCP implementation. The NSCP effectiveness could therefore contribute to the elimination of schistosomosis in Burkina Faso.

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