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Scientific Research

Schistosoma mansoni and *Schistosoma heamatobium* Infection and Nutritional Status of Children in the Hydro-Agricultural Complex Zone of Sourou, Burkina Faso

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Abstract

In developing countries, efforts to face food insecurity were revealed by construction of dams and hydro-agricultural managements. This study aimed to establish sanitary consequences in a hydro-agricultural zone. Methods: Data from 1847 children were analysed. Kato-Katz and concentration in MIF were used for intestinal parasites; research of microscopic haematury was used for urinary schistosomiasis. Nutritional status was estimated by WHZ and HAZ indexes. Association between malnutrition and independents variables was measured in univariate and multivariate analysis. Results: Among children, 80.1% were infested by at least one parasite, 30.8% by *S. mansoni* and 49.6% by *S. haematobium*. Prevalence of emaciation and prevalence of stunting were respectively, 32.6% and 25.5%. In the multivariate analysis: Age: (1 - 3 y age group, OR = 2.92, 4 - 6 y age group OR = 1.85, $p < 0.001$); *S. mansoni* (OR = 1.27, $p < 0.027$) and *S. haematobium* (high OR = 1.53, low OR = 1.44, $p = 0.008$), were associated with emaciation. Age: (4 - 6 y age group, OR = 1.78, 7 - 11 y age group OR = 2.55, $p < 0.001$) and *S. haematobium* (high OR = 1.58, low OR = 1.28, $p = 0.005$), were associated with emaciation. Conclusion: Development of bilharziasis (urinary and intestinal) with increased morbidity and malnutrition, attenuate benefits expected from hydro-agricultural managements. It is important to invest in the control of water-related diseases, which are amplified by hydro-agricultural managements.

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Keywords

***Schistosoma*, Nutritional Status, Children, Hydro-Agricultural Complex**

1. Introduction

One of the indispensable conditions to solve the African food deficits is to concentrate efforts on the use and control of water abilities. In Burkina Faso, these efforts were revealed by the construction of dams and hydro-agricultural managements. Some consider these amenities as a "weapon against hunger", and others worry about the negative impacts on environment and health of populations especially, on the amplification of water-related diseases. Chronic infectious diseases, poverty, and malnutrition compromise the growth and development of children [1]. It is estimated that a third of the cases of low growth can be assigned to diarrhoea and equal infections, even in the case of a sub-clinical infection [2]. Among the parasite infections, other than malaria, infections by *Schistosoma mansoni* and *Schistosoma heamatobium* are frequent and serious in the developing countries [3]. *Schistosoma heamatobium* is responsible of urinary complications, bladder cancer, and anaemia while *Schistosoma mansoni* is assigned to hepatosplenomegaly and portal hypertension. The infection can be severe with a high lethality. Some authors reported that *Schistosoma mansoni* is associated with a deficient nutritional statute among adults [4], and children [5] [6]. This study on *Schistosoma mansoni* and *Schistosoma heamatobium* infections and nutritional status in the hydro-agricultural zone of Sourou aims to establish a balance of the main sanitary consequences.

2. Material and Methods

2.1. Study Design and Site

We carried out cross-sectional study from the zone of Sourou, characterized by a north-Soudanian climate with a rainfall inferior to 900 mm. The water resources comprise the Mouhoun, the reserve of Sourou, the ponds and temporary rivers in the villages. Sourou was an affluent distributary of the Mouhoun River until the construction of the Lery Dam in 1976. In 1985, the installation of a foundation raft on the Mouhoun River and the opening of a canal led to the transit of water of Mouhoun coming from the western south towards the Sourou. Thus, this installation allows the mobilization of a great quantity of water throughout the Sourou region for the irrigation of cultures. Therefore, between the traditional villages of Lanfiera and Di large cooperatives were progressively established nixing the irrigated perimeters at Guiedougou, Niassan, and Debe in 1967, 1986, and 1996, respectively, with the installation of producers coming from different regions of the country.

2.2. Study Population

Parasitological surveys were carried out by a multidisciplinary team including epidemiologists, biologists, and medical assistants for the epidemiological control of water-related diseases in the hydro-agricultural complex of Sourou. For the investigations in the different villages, the administrative, sanitary, and village authorities were informed and their support requested. Children upper ≥1 year old were systematically included in the sample for examination. For this analysis, data from 1847 children were used.

2.3. Parasitological Analysis

For urinary schistosomiasis, research of microscopic haematury with the reactive strips Hémastix® of Bayer has been used. This method, which is adapted to large-scale investigations, is convenient, and allows defining high and medium levels of haematury. A positive result indicates an infestation by *Schistosoma haematobium*. The method was validated in comparison with the urines filtration method [7]. For stools examination, sterilized plastic pots were distributed. From the sample obtained, a fraction of about 2 - 3 grams was taken and added to 10 ml of physiologic serum, then filtrated through 2 paper-filter layers, and centrifuged. The precipitate was dissolved in a mixture consisting of 10 ml Methiolate-Iodure-Formol (MIF), 3 ml ether, then, centrifuged. The technique of Kato-Katz and the method of concentration in MIF were used to analyse the stools for the presence of intestinal parasites including *Schistosoma mansoni*.

The stools and urines examinations were performed at the field as described above, using a mobile laboratory.

Children positive for haematury and/or *Schistosoma mansoni* have received an adapted treatment with Biltricide.

2.4. Nutritional Status Evaluation

The nutritional status evaluation was performed base on anthropometrical indicators. Children height and weight were measured with a height gauge and scales adapted to the child age, respectively. The measurements were performed by medical doctors and medical assistants. Weight-for-Height Z-score (WHZ) and Height-for-Age Z-score (HAZ) indexes, for respectively acute malnutrition (emaciation) and stunting, were calculated using the Epinut software program. The index were expressed in Z-score and compared to the NCHS/CDC/WHO reference [8]. Each index was categorized in two groups: children with an index <–2 SD under the median of the reference population were considered in malnutrition (emaciation or stunting).

2.5. Statistical Analysis

Usual statistics methods were applied. We used Pearson's Chi square test or Fisher's exact test to compare proportions. Malnutrition (emaciation and stunting) Odds ratio with their confidence interval (CI 95%) were estimated. Adjusted Odds ratio and their CI 95% were derived from the final model without interactions, from the logistical regression method. The *p* values used for the final model variables were those corresponding to the Chi 2 of Wald. The following lower and upper standard deviation (SD) boundaries have been used: WHZ (−4, +6), HAZ (−6, +6) and WAZ (−6, +6). The data were analyzed using SPSS software.

3. Results

Of the 1847 children, the proportion of male was 54.4%, the median age was 6 years with minimum and maximum age respectively, 1 and 10 years. Among these children, 80.1% were infested by at least one parasite (helminthe or other parasite), 30.8% by *S. mansoni* and 49.6% by *S. haematobium*. The prevalence of acute malnutrition (emaciation) and stunting (chronic malnutrition) were respectively, 32.6% and 25.5% (**Table 1**).

Table 1. Repartition of children according to demographic characteristics, type of parasite, nutritional status in Z-score weight/height and Z-score height/age.

	n	Percentage
Sex		
Boys	1005	54.4
Girls	842	45.6
Age (year)		
1 - 3	555	30.0
4 - 6	902	48.8
7 - 11	390	21.1
At least one parasite[a]		
Present	1480	80.1
Absent	367	19.9
Schistosoma haematobium		
High	333	18.0
Low	584	31.6
Absent	930	50.4
Schistosoma mansoni		
Present	568	30.8
Absent	1279	69.2
WHZ		
≤–2 DS	602	32.6
>–2 DS	1245	67.4
HAZ		
≤–2 DS	471	25.5
>–2 DS	1376	74.5

[a]"at least one parasite" includes helminthes, *S. mansoni* and *S. haematobium*.

In the univariate analysis: Age: (1 - 3 y age group, OR = 2.6, 4 - 6 y age group OR = 1.75, $p < 0.001$); at least one parasite (OR = 1.60, $p < 0.001$); *S. mansoni* (OR = 1.42, $p = 0.001$) and *S. haematobium* (high level OR = 1.58, low level OR = 1.37, $p = 0.001$) were associated with emaciation. Age (4 - 6 y age group OR = 1.66, 7 - 10 y age group OR = 2.3, $p < 0.001$); at least one parasite (OR = 1.48, $p = 0.006$), *S. mansoni* (OR = 1.39, $p = 0.004$) and *S. haematobium* (high level OR = 1.61, low level OR = 1.43, $p = 0.001$) were associated with stunting (**Table 2**, **Table 3**).

In the multivariate analysis: Age: (1 - 3 y age group, OR = 2.92, 4 - 6 y age group OR = 1.85, $p < 0.001$); *S. mansoni* (OR = 1.27, $p < 0.027$) and *S. haematobium* (high level OR = 1.53, low level OR = 1.44, $p = 0.008$), are associated with emaciation. Age: (4 - 6 y age group, OR = 1.78, 7 - 11 y age group OR = 2.55, $p < 0.001$) and *S. haematobium* (high level OR = 1.58, low level OR = 1.28, $p = 0.005$), are associated with stunting (**Table 2**, **Table 3**).

4. Discussion

Some authors reported a significant influence of hydro-agricultural managements on bilharziasis evolution [9]-[16]. These managements favour the installation of molluscs, intermediate hosts of schistosomiasis, and the increase of the human-parasite contact [9] [14] [15]. In the hydro-agricultural complex of Sourou, the prevalence of uro-genital bilharziasis has been increasing from 19% in 1954 to more than 70% in 1998 [14]. The digestive bilharziasis, almost absent until 1987, reached a prevalence rate of 69% in some villages of Sourou [9] [11]-[16]. This study confirms the results obtained in other studies regarding the high parasite prevalence observed for young child, especially for *S. mansoni* [11]-[16].

We observed that 80% of children were infested by at least one parasite (helminthe or other type of parasite). The use of latrines to eliminate excreta remains very limited, do to: on the one hand the absence of installation, and on the other hand to none adapted socio-cultural practices. For waste treatment, in general there is no efficient system. In rural area, living conditions are precarious and the cohabitation between domestic animals and human create promiscuity situations. All these situations lead to the development of faecal peril-related pathologies. Nutritional status is a result of several factors: eating behaviours, food disposability, environment healthiness, infectious and parasitic diseases, education and socio-economic standards. Thus, nutritional standard can be considered as a "global indicator of development" [10]. From the results we obtained on children nutritional status (32.5% of emaciation, and 25.5% of stunting), it appears clearly that the impact of the Sourou hydro-ag-

Table 2. Risk factors for emaciation (unadjusted and adjusted OR).

Variables			Univariate		Multivarite	
	n	% Emaciation	Unadjusted OR [IC 95%]	*p*	Adjusted OR [IC 95%]*	*p***
Age (year)						
1 - 3	555	41.3	2.6 [1.93 - 3.49]		2.92 [2.16 - 3.95]	
4 - 6	902	32.2	1.75 [1.32 - 2.32]	<0.001	1.85 [1.39 - 2.46]	<0.001
7 - 11	390	21.3	1.00		1.00	
Sex						
Girls	842	32.1	0.96 [0.79 - 1.16]	0.65		
Boys	1005	33.0	1.00			
At least one parasite						
Present	1480	34.5	1.60 [1.23 - 2.07]	<0.001		
Absent	367	24.8	1.00			
Schistosoma mansoni						
Present	568	38.0	1.42 [1.15 - 1.75]	0.001	1.27 [1.02 - 1.58]	0.027
Absent	1279	30.2	1.00		1.00	
Schistosoma haematobium						
High	333	38.7	1.58 [1.21 - 2.05]		1.53 [1.16 - 2.01]	
Low	584	35.4	1.37 [1.10 - 1.71]	0.001	1.44 [0.96 - 1.53]	0.008
Absent	930	28.6	1.00		1.00	

*Adjusted OR of the logistic regression final model for the association between the socio-demographic variables, parasite infections (n = 1847), and emaciation (n = 602). **Chi 2 of Wald constant = −1.93.

Table 3. Risk factors for stunting (unadjusted and adjusted OR).

Variables			Univariate		Multivarite	
	n	% Stunting	Unadjusted OR [IC 95%]	*p*	Adjusted OR [IC 95%]*	*p***
Age (year)						
1 - 3	555	16.9	1.00		1.00	
4 - 6	902	25.3	1.66 [1.22 - 2.25]	<0.001	1.78 [1.31 - 2.43]	<0.001
7 - 11	390	31.9	2.30 [1.67 - 3.16]		2.55 [1.84 - 3.53]	
Sex						
Girls	842	25.1	0.96 [0.78 - 1.18]	0.69		
Boys	1005	25.9	1.00			
At least one parasite						
Present	1480	26.9	1.48 [1.12 - 1.96]	0.006		
Absent	367	19.9	1.00			
Schistosoma mansoni						
Present	568	29.9	1.39 [1.11 - 1.73]	0.004		
Absent	1279	23.5	1.00			
Schistosoma haematobium						
High	333	30.9	1.61 [1.22 - 2.14]		1.58 [1.18 - 2.11]	
Low	584	28.4	1.43 [1.13 - 1.82]	0.001	1.28 [1.00 - 1.64]	0.005
Absent	930	21.7	1.00		1.00	

*Adjusted OR of the logistic regression final model for the association between the socio-demographic variables, parasite infections (n = 1847), and stunting (n = 602). **Chi 2 of Wald constant = −1.93.

ricultural complex on the development of the principal actors (farmers and their families) looks not good. This situation shows well the unsuitability between the results expected (increase of production) and the effect of the transformed environment. According to the type of management, some authors reported three different situations: a nutritional status improvement in Sri Lanka and Gambia [17] [18], an intermediary situation in Senegal [19], and finally an aggravation of the nutritional status [20].

In Burkina Faso, the medical authorities were constantly alerted by a high under five mortality rate. This mortality could be related to the high malnutrition proportion, which is increased by the considerable importance of *S. mansoni* and *S. haematobium* infections in hydro-agricultural complex as confirmed by our study. Malnutrition, parasite infections (helminthe or other parasite), and schistosomiasis have harmful consequences on children intellectual development. At economic level, studies proved that stunting occurred during infancy leads at adult age to a reduction of the productive capacity. Parasite infections and bilharziasis are also responsible of the reduction of production due to the induced morbidity. At medical level, in addition to the reduction of living quality caused by parasite morbidity, malnutrition is responsible of more than 60% infanto-juvenile mortality, and *S. mansoni* is responsible, through complications, of a high risk of death among children.

5. Conclusion

The development of bilharziasis (urinary and intestinal) with increased morbidity and mortality risk, and also malnutrition risk, attenuate the benefits expected from hydro-agricultural managements. Therefore, all actors are challenged to implement these important projects by constant epidemiological surveys and especially the realization of measures for environmental and food hygiene, more particularly the disposability of drinking water. It is important to invest in the control of water-related diseases, which are amplified by hydro-agricultural managements.

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