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First reports of urogenital schistosomiasis in the Ndikiniméki health district, Center Cameroon

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ABSTRACT

Objectives: Schistosomiasis is still a public health problem in sub-Saharan Africa, particularly in Cameroon. In this context, a cross-sectional study was carried out from June 2023 to July 2023 in the Ndikiniméki subdivision, with the aim of knowing the status of this locality in relation to *Schistosoma haematobium* infection.

Methods: A parasitologic analysis of *S. haematobium* eggs was carried out on urine samples using the sedimentation technique.

Results: A total of 402 urine samples were collected from households. The age range of participants was 1-96 years, with the most signified age group being 1-9 years. Women were the most represented, with a proportion of 56.47%. Of the 402 people examined, 18 (4.45%) were affected, with an average intensity of 54.43 ± 85.30 eggs/10 mL urine. Women were the most affected, with a prevalence and average parasite intensity of 3.73% and 53.10 ± 131.27 eggs/10 mL of urine. The most affected age group was 10-19 years, with a prevalence and intensity of 4.60% and 49.49 ± 67.00 eggs per 10 mL of urine, respectively. Of those infected, 72.22% were lightly infected and 27.28% were heavily infected.

Conclusions: This study indicates that this locality is a risk area for urinary schistosomiasis despite its low prevalence.

Introduction

Neglected tropical diseases are a diverse group of diseases prevalent mainly in Africa, Asia, and the Americas, where they affect more than a billion people [1]. The World Health Organization estimates that at least one case of neglected tropical diseases (NTDs) had been reported in 179 countries worldwide [2]. Although most of these diseases are not fatal, the people most affected and their families can incur considerable health costs and become less economically productive. Schistosomiasis is considered one of the world's most important NTDs because it is ranked the second most endemic parasitic disease in the world after malaria [3]. It is a chronic parasitic condition caused by flatworms of the genus *Schistosoma*. Infestation occurs when parasite larvae released by freshwater gastropods enter the skin of a person in contact with infested water as part of their agricultural, domestic, occupational, or recreational activities [4]. There are an estimated 251.4 million cases worldwide in 78 countries, with 90% of infected people living in Africa [4]. In Cameroon, more than 2 million people are affected by this disease, and, in that country, urogenital schistosomiasis is caused by *S. haematobium*. This disease is characterized by dysuria, increased urinary frequency, and the presence of blood in urine [5]. Chronic infestation leads to fibrosis of the bladder and urethra, which can evolve into hydronephrosis, creating conditions conducive to the development of bladder cancer [6]. In women, it can cause vaginal bleeding, pain during intercourse, and nodule formation in the vulva [4]. In January 2021, the World Health Organization launched a new roadmap to guide action against NTDs and set targets to be achieved by 2030, including the elimination of schistosomiasis as a public health problem in all endemic countries such as Cameroon. Recognizing the public health importance of this disease, there is a commitment to implement control strategies to reduce the disease burden [7]. In Cameroon, *S. haematobium* schistosomiasis is widespread, occurring in large foci in the far north, center, littoral, west, and east regions. As a result, deworming activities have been extended throughout Cameroon since 2007 [8]. This strategy has contributed to a decrease in the prevalence of these parasitosis in endemic areas, notably, in the west, where the work of [9]

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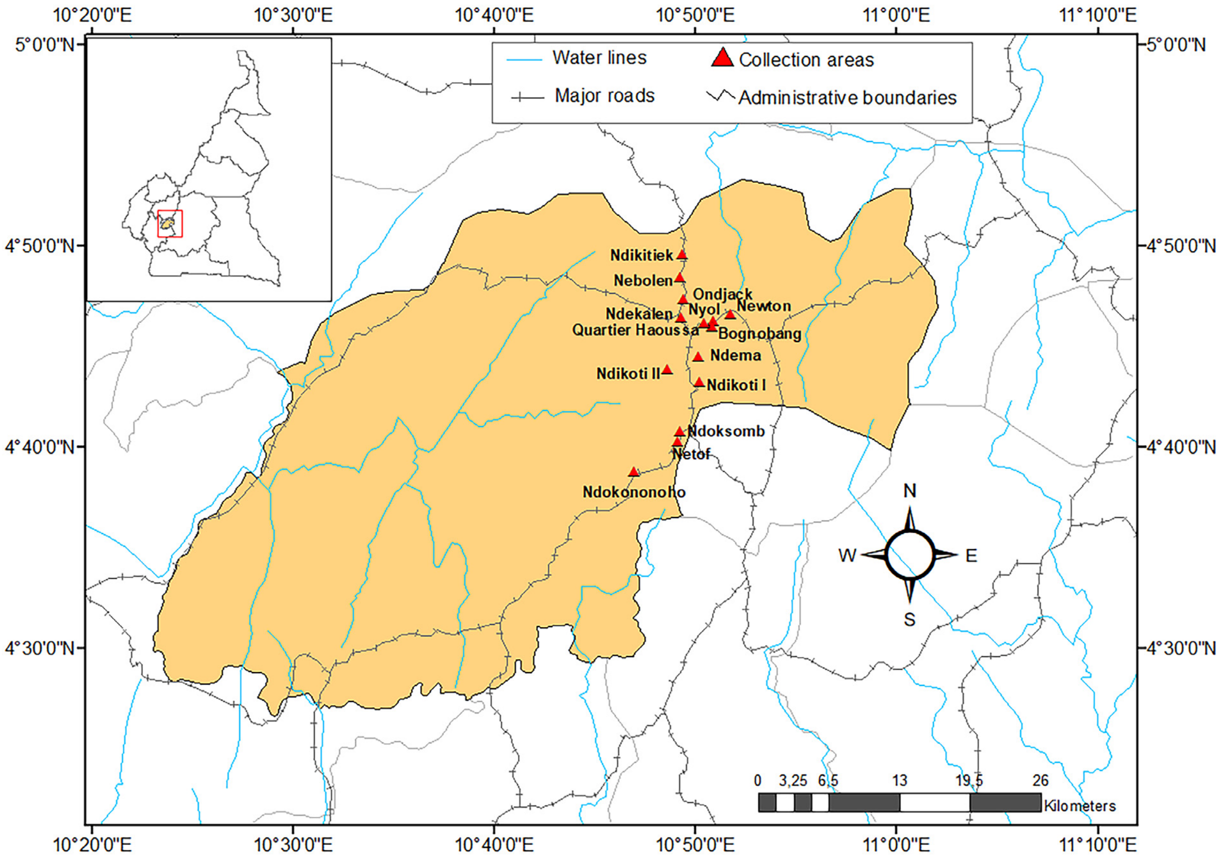

Figure 1. Map of Ndikiniméki subdivision showing sampling sites.

showed a drop in prevalence compared with that of [10], who reported an increase in schistosomiasis transmission. However, the regular lack of drinking water, resulting in the constant contact of populations with contaminated watercourses who are content to use this water of dubious potability for their needs, as well as inadequate sanitation, could be a consequence of a rise in the prevalence of these diseases. Moreover, the mass treatments administered to school-aged children have not yet led to the elimination of these parasitosis. This is the case in the arrondissement of Ndikiniméki, in the center Cameroon region, where, despite the measures implemented, there still is a high transmission of *S. mansoni* schistosomiasis, with a maximum prevalence of 46.94% [11]. However, no cases of *S. haematobium* schistosomiasis have been reported in this locality. Our study was conducted with the aim of determine the prevalence of urinary schistosomiasis in the Ndikiniméki area.

Methodology

Study site

Our study was carried out in Ndikiniméki district located between latitudes 4º and 5ºN and longitudes 10º and 11ºE, in the Mbam et Inoubou division of the center Cameroun region (Figure 1). Ndikiniméki is located 178 km from Yaoundé, the political capital of Cameroon, and linked by an asphalt road that crosses the entire division to reach the west region. The rainy period lasts 11 months in this zone, from mid-February to mid-December. The dry period runs from mid-December to early February. The hydrographic network is dense and crossed by several watercourses. The district also has natural water sources and rivulet that serve as household water supplies, encouraging the development of water-borne diseases such as schistosomiasis.

Type of study, collection period, and studied populations

A cross-sectional, descriptive study was carried out in Ndikiniméki district population. Urine was collected from households between June and July 2023. Based on the prevalence of intestinal schistosomiasis in this locality, we obtained a sample size of 383 participants in the Ndikiniméki selected sites. Participants living in the various selected villages were aged at least 1 year, regardless of sex. All individuals living in the study area, those present on the day of the survey, and those who gave informed consent were included in the study. Individuals taking antiparasitic treatment during the study or having taken it a fortnight before the study were not included in the study.

Data collection

Socio-demographic and geographical data were recorded from the various heads of household. After that, sterile jars were given to all participants belonging to the household, regardless of sex or age, who had given their informed consent or that of the parent/legal guardian in the case of children on the day before collection to collect the first urine of the day after the survey day. Urine samples were recovered between 9 a.m and 10 a.m, placed in ice-bag coolers and transported to the laboratory for analysis. To identify the eggs of *S. haematobium*, 10 mL of urine from each sample was collected and introduced into Falcon tubes, then centrifuged at 400 g for 5 minutes. The supernatant from the samples were then discarded and a volume of around 0.5 ml of the pellet was retained. This was homogenized using a Pasteur pipette and 15 µL of the suspension was removed and placed on a slide where it was covered with a coverslip. Finally, the suspension was observed under a light microscope with a 10× and 40× objective successively.

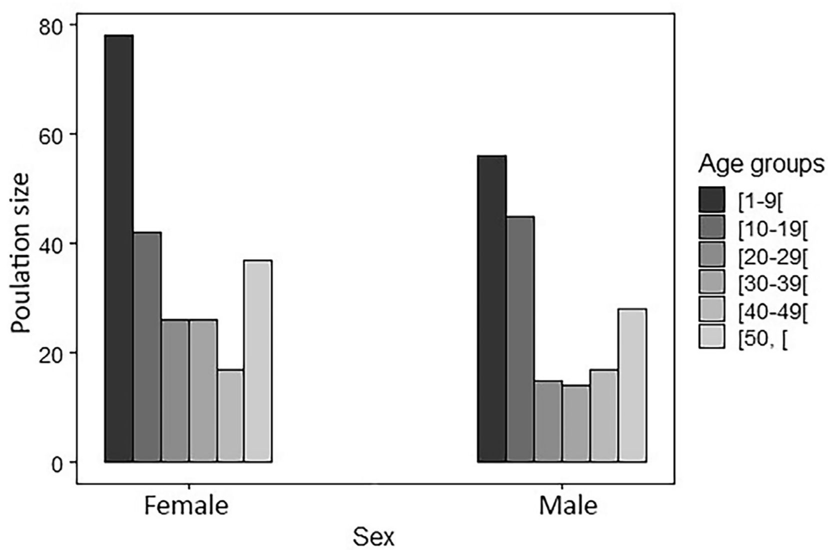

Figure 2. Distribution of individuals according to sex and age groups.

Data analysis

The probabilistic technique was used for urine collection. Sample size was obtained according to the following Lorentz formula: $n = z^2 \times p \times (1 - p) / m^2$, with n as the minimum sample size for obtaining significant results from the study at a fixed level of risk, z as the confidence level (the typical value of the 95% confidence level is 1.96), p as the estimated disease prevalence in the studied population, and m as the margin of error (generally set at 5%). The total number of parasites (eggs or larvae) was the overall parasite load (X) in urine, expressed in eggs per 10 mL of urine, according to the formula of [12], i.e. $X = y \times Vx/Vy$, where the integral volume (Vx) of the pellet is recorded; after homogenization of the pellet, a precise volume (Vy) is taken and divided into different test tubes. The final portion of each tube is distributed on slides, then the number (X) of parasites obtained in 10 mL of sample is calculated by multiplying the value obtained (y) on all the slides by the fraction Vx/Vy, and the result is finally reduced to the milliliter. Parasite intensity was calculated by "geometric mean" using PAST version 3 software. All consumables such as tubes and slides were obtained from Intraco Llc New York, USA. Parametric tests, such as Pearson's chi-square and Fisher's exact test, were applied to compare studied population prevalences between parameters or variables, respectively, using R software. Data were considered significant at $P < 0.05$. Infection intensity was classified as light (<50 eggs/10 mL urine) or heavy (≥50 eggs/10 mL urine), as previously described by [13].

Results

Socio-demographic data

A total of 402 urine samples were collected from participants in households in four urban quarters and 10 villages in Ndikiniméki. Figure 2 shows that women are predominantly represented compared with men (227 vs 175, respectively), with a sex ratio of 0.77. The studied participants' ages ranged from 1 to 96 years, with an average age of 24.5 ± 21.07 years. The most represented age group was 1-9 years, i.e. 33.58% of the participants.

Parasite prevalence and intensity

Of the 402 participants studied, 18 (4.45%) were infected with *S. haematobium*, with a geometric mean parasite intensity of 54.43 ± 85.30 eggs/10 mL urine. These eggs of *S. haematobium* were oval-shaped, with a thin terminal spur. Parasite intensity ranged from 0 to 500 eggs/10 mL urine. Of the infected individuals, 72.22% had light infection intensities vs 27.28% with heavy infection intensities. According to sex (Table 1), the prevalence was higher in females (3.73%) in whom a significant difference was observed with the chi-square test ($P < 0.05$). Similarly, the geometric mean of parasite intensity was high in females. Based on the age groups, we noted that at least one individual per age group was affected by the disease. The most affected age group was 10-19 years, followed by 1-9 years. However, no significant difference in the proportions of infected individual according to age groups was observed using Fischer's exact statistical test, with $P > 0.05$. On the other hand, we observed a significant difference in the proportion of infected individuals aged under 30 years compared with those aged between 30 and 96 years using the chi-square statistical test, with $P < 0.05$.

Based on the studied sites in the Ndikiniméki area (Table 2), it can be seen that cases of urinary schistosomiasis were recorded in most of these sites, with the exception of the villages Ndema, Ndékalen, Netof, and Ondjak, one of the district in the local urban center. Furthermore, the highest prevalence (15.38%) was recorded in the village Ndoksomb, with a geometric mean parasite intensity of 116.56 ± 213.22 eggs/10 mL urine, followed by the village Ndikoti I, with a geometric mean parasite intensity of 133.50 ± 140.71 eggs/10 mL urine. However, the Fischer's exact statistical test ($P > 0.05$) showed no difference in the proportion of infected people between villages.

Discussion

The subdivision of Ndikiniméki has long been considered as an active focus of *S. mansoni* intestinal schistosomiasis, as shown by previous studies. However, cases of urinary schistosomiasis had never been reported in this area before our study. The present analyses revealed that, in socio-demographic terms, the female sex was the most represented. This result can be explained by the fact that women are more present in households than men. In terms of age, the 1-9 years age group was the main group of our studied population. This observation reveals the fact that the population is predominantly young, with a high growth rate. In addition, the vacation period favors the presence of children of this age group in the village's households. These observations are similar to those of [14] in Nigeria. According to the literature, the cases of schistosomiasis revealed so far in the Ndikiniméki subdivision were only those of *S. mansoni* intestinal schistosomiasis [11,15]. In addition, *S. haematobium*–susceptible intermediate hosts had never been highlighted in this locality until we noted the presence of *Bulinus forskalii* in a local stream.

Table 1
Parasite prevalence and intensity by sex and age.

		N	Prevalence (%)	*P*-value	Geometric mean in eggs/10 mL ± SD	Arithmetic mean in eggs/10 mL ± SD
Sex	Female	227	15 (6.61)	0.02	53.10 ± 131.27	90.86 ± 131.27
	Male	175	3 (1.71)		41.78 ± 19.63	44.63 ± 19.63
Age groups	1-9	135	6 (4.44)	0.98	33 ± 0.00	33 ± 0.00
	10-19	87	4 (4.60)		49.49 ± 67.00	66.50 ± 67.00
	20-29	41	2 (4.87)		128.45 ± 330.22	266.50 ± 330.22
	30-39	40	1 (0.02)		267 ± 0.00	267 ± 0.00
	40-49	34	1 (0.03)		33 ± 0.00	33 ± 0.00
	≥50	65	4 (0.06)		47.02 ± 19.63	50 ± 19.63

N: population size; SD: standard deviation.

Table 2
Parasite intensity and prevalence according to studied sites.

	Site	N	Geometric mean in eggs/10 mL ± SD	Arithmetic mean in eggs/10 mL ± SD	Prevalence (%)	*P*-value
Villages	Ndekalen	14	0	0	0	0.20
	Ndema	20	0	0	0	
	Ndikitiek	35	33 ± 0.00	33 ± 0.00	2 (5.71)	
	Ndikoti I	18	133.50 ± 140.71	166.50 ± 140.71	2 (11.11)	
	Ndikoti II	15	33 ± 0.00	33 ± 0.00	1 (6.66)	
	Ndoksomb	26	116.56 ± 213.22	191.75 ± 213.2	4 (15.38)	
	Ndokononoho	36	33 ± 0.00	33 ± 0.00	1 (2.77)	
	Nebolen	30	33 ± 0.00	33 ± 0.00	2 (6.66)	
	Netof	33	0		0	
	Nweton	37	33 ± 0.00	33 ± 0.00	3 (8.11)	
Quarters of urban's center	Bognobang	56	33 ± 0.00	33 ± 0.00	1 (1.78)	
	Ondjack	30	0		0	
	Haoussa quarter	18	33 ± 0.00	33 ± 0.00	1 (5.55)	
	Nyol	34	33 ± 0.00	33 ± 0.00	1 (2.94)	
Total		402	51.02 ± 120.64	83.11 ± 120.64	18	

N: population size; SD: standard deviation.

This suggests that the *S. haematobium* cycle has been completed by the importation of the parasite. In addition, climate change would have favored the current installation of *S. haematobium* intermediate hosts in addition to the importation of the parasite. During our study, an overall prevalence of *S. haematobium* urinary schistosomiasis of 4.45% was recorded. This result suggests the presence of *S. haematobium* in this endemic area for *S. mansoni*, with a low transmission rate. The disease may be imported by people from the greater North Cameroon area, which is an endemic area for urinary schistosomiasis. The latter migrate to this area for trading. The installation *S. haematobium* urinary schistosomiasis could also be due to the presence in this locality of displaced people from the socio-political crisis in the northwest and southwest regions of Cameroon, an endemic area for urinary schistosomiasis. This result differs from the work of [16] in Barombi Mbo and Barombi Kotto in the southwest Cameroon region. The prevalence was significantly higher in women than in men. This can be explained by the fact that women are more often in contact with contaminated water through the various activities they carry out in these waterways, notably, washing up, washing clothes, and extracting palm oil, which is particularly carried out by women in this locality. A similar observation was made by [17] in the village of Abarma in northwestern Nigeria. Individuals under the age of 30 years were the most affected, with a significant difference in results. Although the freshwater visitation in this locality concerns all age groups, the under 30 years age group, children, teenagers, and young adults are more exposed to the infection because of their increased frequent presence in the water. They go there for recreational activities, such as swimming, and for household activities, such as farming and fishing. Older people frequent these waterways less often because the activities in question are generally attributed to younger people. This suggests that the transmission of this disease occurs at any stage of life when people are exposed to contaminated water. The number of infected people was recorded at almost every site in our study area. This observation can be explained by the fact that Ndikiniméki is an area with a very dense hydrographic network and the presence of susceptible intermediate host of *S. haematobium* in water. Indeed, Ndikiniméki is crisscrossed by several watercourses, most of which are close to houses and serve as water supplies for several households.

Conclusion

This study shows that Ndikiniméki is a high-risk area for mixed infection of urinary and intestinal schistosomiasis, despite its low prevalence of urinary schistosomiasis observed in this study. This calls not only for government mobilization but also for the participation of the local population in the control, prevention, and eradication of the disease. It is, therefore, important to maintain awareness and preventive measures to avoid further infection, as well as infestation of water bodies, to stop the transmission of *S. haematobium* schistosomiasis in this locality.

Declarations of competing interest

The authors have no competing interests to declare.

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Ethical clearance

The research protocol received approval from the Comité Régional d'Ethique de la Recherche pour la Santé Humaine du Centre-Cameroun under ethical approval document N°-00427/CRERSHC/2023, signed on July 11, 2023. Administrative authorities and household heads gave their authorizations for the study at subdivision and community levels, respectively. All participants signed a consent to participation form after being informed of the purpose and objectives of the study.

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Author's contributions

All the authors mentioned in this paper have significantly contributed to this research. They contributed to setting up the study design, performing the laboratory analyses, and collaborating on the written and proofreading parts of the final document.

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