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Evidence of urinary schistosomiasis in nomadic pastoralists of northern Cameroon and disparities in health knowledge and practices between local and foreign nomadic groups

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Abstract

The nomadic pastoralists of northern Cameroon settle periodically in the Logone floodplain, a wetland reputed highly infested by cercariae of Schistosome and visited also by their counterparts from neighbouring countries. This study was undertaken to determine the importance of schistosomiasis in these communities and gain knowledge of the perception they have of their health in general and, their knowledge and practices towards the disease. Two cross sectional surveys were carried out between 2023 and 2024 in Mindif and Vele health districts. Urines samples were collected then analysed microscopically to detect eggs of *Schistosoma haematobium*. A questionnaire was administered to adults and adolescents on their knowledge and practices towards UGS; another questionnaire was addressed to group leaders and/or heads of extended families to sample their perception of community health. Of the 226 local nomadic participants tested, an infection rate of 7.08% (95% IC 4.23–11.45%) was found; participants with hematuria were significantly more infected than those without it (X^2=14.815 p=0.0001). Nearly all of pastoralists were aware of the disease. Unlike local pastoralists, almost all foreign pastoralists consider UGS unpreventable (96.08%; 49/51). We found that 71.79% (28/39) of local pastoralists believe to have a lower health condition than the sedentary counterparts, whereas a relative majority of foreign pastoralists (46.43%; 13/28) believe the contrary. This study reveals the presence of cases of UGS among nomadic pastoralists of northern Cameroon and calls for more investigations to assess the risk of its dispersion across borders.

Keywords *Schistosoma haematobium*, Infection rate, Nomadic pastoralists, Northern Cameroon, Knowledge, Perception

1 Introduction

Schistosomiasis or bilharzia is a parasitic disease caused by six blood-dwelling flukes: *Schistosoma haematobium* responsible for urogenital schistosomiasis (UGS) while *Schistosoma guineensis*, *S. intercalatum*, *S. mansoni*, *S. japonicum*, and *S. mekongi* are responsible for intestinal schistosomiasis [1, 2]. Fresh water snails of the genus *Biomphalaria* and *Bulinus* present in slow-moving or still freshwater such as irrigation ditches, lakes, and canals are the intermediate hosts of these parasites [3]. Humans get infected when they come in contact with cercariae, the infective form of the parasites which are released in water by the snails [3].

There are about 779 million people affected worldwide by schistosomiasis and the majority of them come from the African region where nearly two thirds of all infections are caused by *Schistosoma haematobium*. Generally, infections result in abdominal pain, diarrhoea, blood in the stool and haematuria (blood in urine); in some cases, vaginal bleeding, pain during sexual intercourse and nodules in the vulva may occur in women, whereas in men pathology of the seminal vesicles and prostate can be observed [4, 5].

Disease prevention and control rely on avoiding contacts with contaminated freshwater, improving access to water, sanitation, and hygiene (WASH), information, education, and communication (IEC), snail control, environmental management and treatment [6]. In 2020 WHO member states endorsed a new roadmap for the elimination of schistosomiasis by 2030. This roadmap recommends regular preventive treatment of all at-risk populations by using Praziquantel [7]. Unfortunately, some of these populations are more difficult to reach than others and pose a serious challenge to the achievement of the disease elimination [8].

Mobile pastoralists are among the hard-to-reach communities disproportionately affected by communicable diseases. They are estimated to be as large as 200 million people distributed worldwide. Mobility, daily labour requirements of managing livestock, culture and language are some of the factors preventing their inclusion to health programming, making them a blind spot in the surveillance of diseases with consequences on the accuracy of progress made towards the control or elimination [9–13]. Moreover, the mobility of these communities may facilitate the spread of infections to new areas and/or maintain transmission in endemic areas.

In the far north region of Cameroon, there is an important community of nomadic pastoralists whose health condition has not received sufficient research attention [14]. Their transhumance cycle comprises a long stay in the Logone floodplain during the dry season and short stays in rainy season pasture lands of the region or in neighbouring countries (Chad and Nigeria). The region is reputed to be one of the most affected in the country by schistosomiasis [15]. Malacological surveys in water bodies of the floodplain exploited also by nomadic pastoralists from neighbouring countries have revealed the presence of intermediate host such as *Biomphalaria pfeieri*, *Bulinus truncatus*, *B. tropicus*, and *B. globosus* sheading cercariae of *Schistosoma* spp [16]. In addition to that, local pastoralists settle periodically in many schistosomiasis foci of the region during transhumance, thus increasing their risk to get infected [15, 17]. Unfortunately, up to now the occurrence of contamination has not yet been investigated in these communities. Schistosomiasis has already been reported among mobile pastoralists of Nigeria and Chad [18–20], but to our knowledge, there is no epidemiological data on the disease in their counterparts from Cameroon.

A preliminary study was undertaken to assess the importance of UGS among nomadic pastoralists of northern Cameroon, determine the perception they have of their health in general and compare their knowledge and practices towards the disease.

2 Methodology

2.1 Study site and pastoralist movements

The study was carried out in Mindif and Vele health districts located respectively in Mayo Kani and Mayo Danay divisions, Far-North region, Cameroon. They belong to the soudaneo sahelian zone and are characterized by two main seasons: a short rainy season (June–October) and a long dry season (November–May). The Mindif health district is among the most important places where local Fulbe, Arab and Musgum nomadic pastoralists settle during the rainy season. At the start of the dry season, these communities travel through the transhumance corridors and enter into the Logone floodplain [17, 21]. They are joined every year by their counterparts from Chad, Nigeria and Niger [21]. In the course of dry season, a number of pastoralists move southwards to an area of the floodplain called Ndiyam Shinwa where they stay in until the beginning of the rainy season. Logone floodplain is a flooded area that offer pastoralists fodder and water resources during the long and difficult dry season. Part of Ndiyam Shinwa is located in the Vele health district and receives periodically pastoralists.

2.2 Study design

We conducted two cross-sectional surveys in September 2023 and March 2024. The first survey was carried out in four seasonal campsites situated in Mindif Health district namely Arde Zelaki, Gagadje, Mayel Barka and Mayel Bodeyel, Taparel forrou, (Fig. 1). Information meetings were held on livestock market days to inform group leaders on the purpose of the survey and the procedures. Once their consent to participate in the investigation was obtained, leaders were requested to propose a suitable date to meet them in their campsite. Experienced health workers delegated by the Health Districts were trained. They explained to participants the survey purpose and procedure in the local languages, Fulfulde and Arab. Pastoralists were allowed to ask any question and

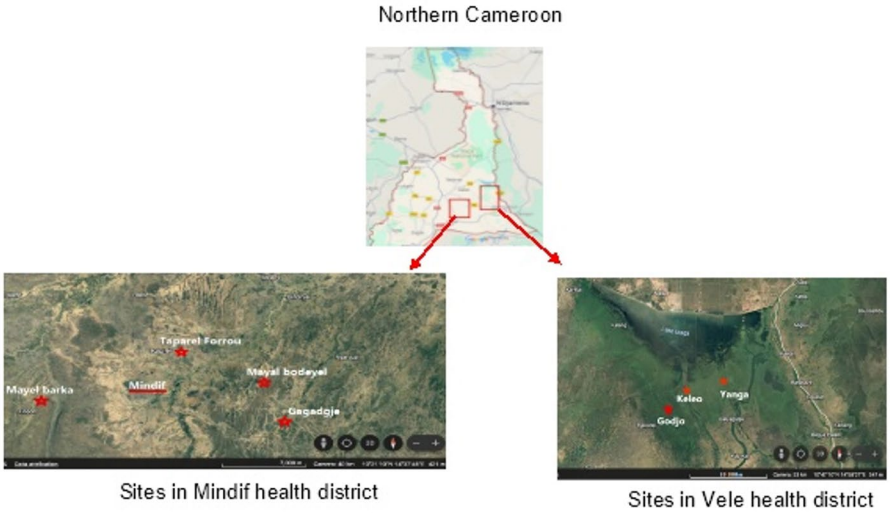

Fig. 1 Sampling sites in Mindif and Vele Health Districts

only those who signed a consent form were included in the survey that comprised two parts: a parasitological test and questionnaire administration on health knowledge and practices. Participants were free to choose only one part of the survey to participate in. Parent/guardian provided consent for children aged between 6 and 11 years. A signed consent form from adolescents aged between 12 and 20 years was required with that of their parent/guardian to include them in the survey. In each household made of a husband, wife/wives and children, a questionnaire designed to collect data on participants' knowledge and practices towards schistosomiasis was administered. The husband, one of the wives if many and one or two adolescent children if present in the household were selected for the interview. Campsites comprise usually several sub-families of the same ethnic group and/or families of different ethnic background that come together because they have the same mobility pattern. In each surveyed campsite the Ardo (group leader) and all heads of families (constituted of at least two households) were administered and additional questionnaire to sample their perception of community health. Urine samples were collected and tested for schistosome infections; all discussion with pastoralists were conducted in the local languages. The second survey targeted both local and foreign pastoralists from Chad, Nigeria and Niger, and was carried out in three Ndiyam Shinwa campsites: Godjo, Keleo and Yanga. For the administrations of the two questionnaires, camp members who approved to participate in the survey were selected as mentioned above and asked questions in their respective language.

2.2.1 Parasitological survey

All individuals aged above 5 years who consented to participate in the survey and accepted to provide urine samples were selected. The sample size was calculated using the following formula [22, 23]: N= 〖1.96〗 ^2 x P(1-P)/d² where N is the population size, P the expected prevalence and d the precision. Assuming a schistosomiasis prevalence of 0.20 (i.e. 20%) among pastoralists [24] and a precision of 0.04 (i.e. 4%) with a probability of 95%, the minimum number of participants was 385. The urine produced around noon, when excretion of *S. haematobium* eggs is known to be maximal [25], was obtained tested for schistosome infections. A reagent testing strip was used to check haematuria and the result classified as negative, mild and severe haematuria as indicated in the test manual (Urinalysis Reagent Strips 11 Panel QTEST). Next, 10 ml of urine sample was collected using a syringe and filtered through a 13 mm Polycarbonate membrane filters (20-µm) place in filter holder (Sterlitech Corporation, United States). The membranes were examined subsequently microscopically for the presence of *S. haematobium* eggs. The intensity of infection was determined according to the following 3 categories defined by the WHO: no infection (0 eggs/10 ml of urine), mild infection (1–49 eggs/10 ml of urine) and severe infection (50 eggs or more/10 ml of urine).

2.2.2 Qualitative survey

The first and second questionnaires contained open and close-ended questions translated into fulfulde and Arab by experienced community health workers (CHW). In the first questionnaire, information such as awareness of schistosomiasis, clinical discrimination, transmission, type of treatment sought and level of satisfaction and, relationship to water bodies in the floodplain were collected. The topics covered in the second

questionnaire included global perception of health condition, factors affecting health condition, listing of health problems of major importance and vulnerable groups.

2.3 Statistical analyses

All data were entered in Excel, Microsoft Office Professional version 2016 and used to produce graphics. The infection rates expressed in proportions were calculated by dividing the number of cases confirmed microscopically by the total number of people tested. The chi-square test was performed using the XLSTAT 2024.2.2.1422 version to compare proportions and statistical significance was set at $p < 0.05$.

3 Results

3.1 Parasitology survey

Urine samples were obtained from 226 local nomadic pastoralists during the first survey and because adhesion was almost nil during the second survey, sedentary populations that settled permanently in the floodplain were included. They were 153 (93 from Yanga, 49 from Keleo and 11 from Godjo) and all belong to the Musgum ethnic group and practice mainly agricultural activities and fishing for subsistence. The infection rates were 7.08% (95% IC 4.23–11.45%) in pastoralists and 10.46% (16/153 6.54–16.31%) in sedentary populations. Cases of heavy infection were observed only among the sedentary participants (18.75%; 3/16). Children (10.12%; 8/79) were twice more infected than adolescents (5.40%; 2/37) and Adults (5.45%; 6/110) in pastoralists. The tendency was completely different in the sedentary group where children were found at least twice less infected than the other age groups, but no significant difference was found when comparing proportions (Table 1). Women were as infected as Men in both groups. One-quarter (25.66%; 58/226) of nomadic pastoralists had leukocyturia, whereas this paraclinical sign was not observed among the sedentary participants. Infection rates were not different significantly (X^2=0.054; $P = 0.815$) between participants with leukocyturia (8.62%; 5/58) and those without it (6.55%; 11/168).

Table 1 Comparison of UGS infections by gender, age group and haematuria status in local and sedentary participants

			Infected (%)	Non infected (%)	X^2 (*P*-value)
Local pastoralists ($n = 226$)	Gender	Male	10 (6.94)	134 (93.06)	0.011 (0.916)
		Female	6 (7.32)	76 (92.68)	
	Age group	Children	8 (10.12)	71 (89.88)	1.7141 (0.424)
		Adolescents	2 (5.40)	35 (94.60)	
		Adults	6 (5.45)	104 (94.55)	
	Hematuria	Positive	8 (21.22)	28 (77.78)	14.815 (0.0001)
		Negative	8 (4.21)	181 (95.79)	
Sedentary participants ($n = 153$)	Gender	Male	6 (8.11)	68 (91.89)	0.845 (0.358)
		Female	10 (12.66)	69 (87.34)	
	Age group	Children	3 (5.36)	53 (94.64)	2.834 (0.242)
		Adolescents	6 (15.79)	32 (84.21)	
		Adults	7 (11.86)	52 (88.14)	
	Hematuria	Positive	13 (12.50)	91 (87.50)	0.1446 (0.2290)
		Negative	3 (6.12)	46 (93.88)	

3.2 Knowledge and practices towards schistosomiasis among sedentary populations, local and foreign nomadic pastoralists

A total of 178 participants responded to questions on knowledge and practices towards schistosomiasis. They were distributed as follows: 84 local pastoralists, 51 foreign pastoralists (21 from Chad, 18 from Nigeria and 12 from Niger) and 43 members of the sedentary villages (37 from Keleo and 6 from Godjo). All foreign pastoralists were Peuhl, whereas 65.45% of local pastoralists were Peuhl against 21.43% and 13.09% of Arab and Musgum, respectively. Nearly all interviewees knew about schistosomiasis (100% of sedentary participants, 100% of local pastoralists and 98.04% of foreign pastoralists) and they call it « til-lé nangé », meaning literally urine excreted when the weather is hot (around noon). Blood in urine and abdominal pains were by far the most reported UGS symptoms by the foreign pastoralists (94.16%; 48/51). The large majority of sedentary participants considered blood in urine as a key clinical manifestation of UGS. Among the local pastoralists pains while urinating (77.38%; 65/84) was the most frequently mentioned symptoms (Fig. 2).

Concerning the source of contamination, water of the floodplain was mentioned by most participants of the three groups: 89.47% of sedentary participants, 68.8% of local pastoralists and 56.86% of foreign pastoralists. For more than 4/5 of sedentary participants, bathing in the water bodies of the floodplain was pointed out as the mean of contamination and only 58.14% (25/43) of them believed that contamination could be prevented. For local pastoralists, 2 out of 5 persons considered this activity as the mean of contamination, meanwhile a little more than half of the foreign pastoralists shared the same opinion. The disease is preventable to 75% (63/84) of the local pastoralists and unpreventable to almost all foreign pastoralists (96.08%; 49/51) (Fig. 3).

Among sedentary participants, of the 25 respondents who considered schistosomiasisa preventable health problem, 88% of them said “I do not know how to prevent contamination”, the rest of them said “avoiding walking in dirty water prevents infection”. For local pastoralists for whom the disease is preventable, avoiding contacts with dirty water bodies (38.09%; 24/63) was the most frequent preventive measure against UGS, other measures included consulting in hospitals (15.88%; 10/63), using traditional medicine (6.35%; 4/63), consuming sugar (9.52%; 6/63), using western medicine (7.94%; 5/63), prayers (1.58%; 1/63), the rest of participants (20.63%; 13/63) did not have any idea on how to prevent the disease. A good number of those who considered avoiding contacts with water of the floodplain equally mentioned as a second mean of disease prevention avoiding walking under the sun (66.67%; 16/24). Surprisingly, when interviewed on how frequent they are in contact with water of the floodplain, most interviewees recognized having regular contacts with them either through bathing, drinking and/or through other activities and are aware that the water points might contain disease-causing microbes (Table 2).

About the types of treatment used against UGS, the preferences vary among the three groups. For sedentary participants, there are only two treatment options: western medicines or traditional medicines. All those who use western medicines reported being always satisfied whereas most of the participants that use traditional medicines are sometimes satisfied. In local pastoralists, the majority of respondents use a combination of traditional and western medicines and more than 3/5 of them are at least satisfied very often. This category is followed by those who used western medicine alone, they

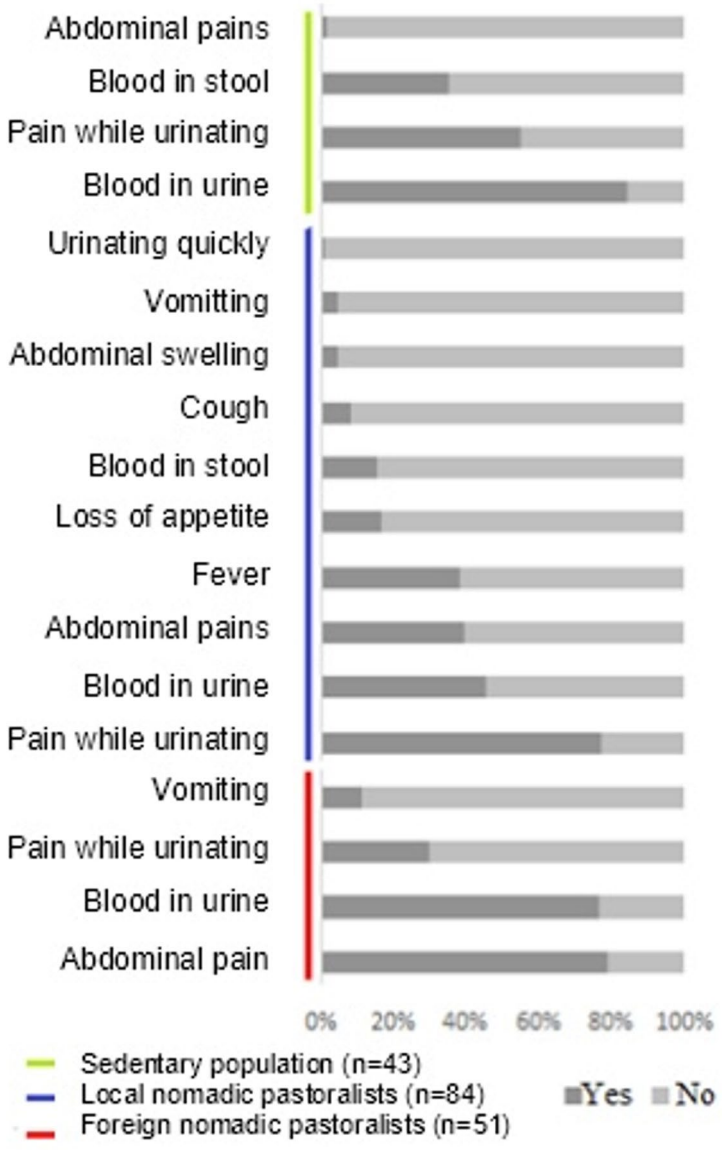

Fig. 2 Frequency of symptoms associated with UGS according to study groups

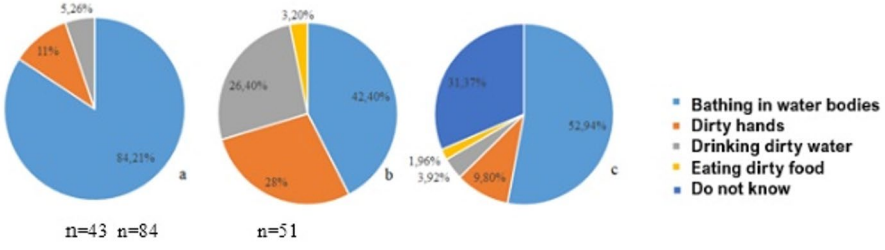

Fig. 3 Means of contamination by schistosome according to study populations **a** sedentary population, **b** local pastoralists, **c** foreign pastoralists

Table 2 Relationship of the study populations with water bodies of the floodplain and awareness of the presence of microbe in the water

Parameters		Sedentary populations	Local Pastoralists	Foreign pastoralists
Bathing in water bodies	Yes (%)	43 (100%)	73 (89.02%)	51 (100%)
	No (%)	0 (0%)	9 (10.98%)	0 (0%)
Drinking water of the floodplain	Yes (%)	35 (81.39%)	73 (89.02%)	51 (100%)
	No (%)	8 (18.61%)	9 (10.98%)	0 (0%)
Other water related activities: washing clothes and dishes	Yes (%)	43 (100%)	82 (100%)	51 (100%)
	No (%)	0 (0%)	0 (0%)	0 (0%)
Suspecting the presence of microbes in water bodies of the floodplains	Yes (%)	28 (65.12%)	76 (92 0.68%)	51 (100%)
	No (%)	0 (0%)	6 (7.32%)	0 (0%)
	Do not know (%)	15 (34.88%)	0 (0%)	0 (0%)

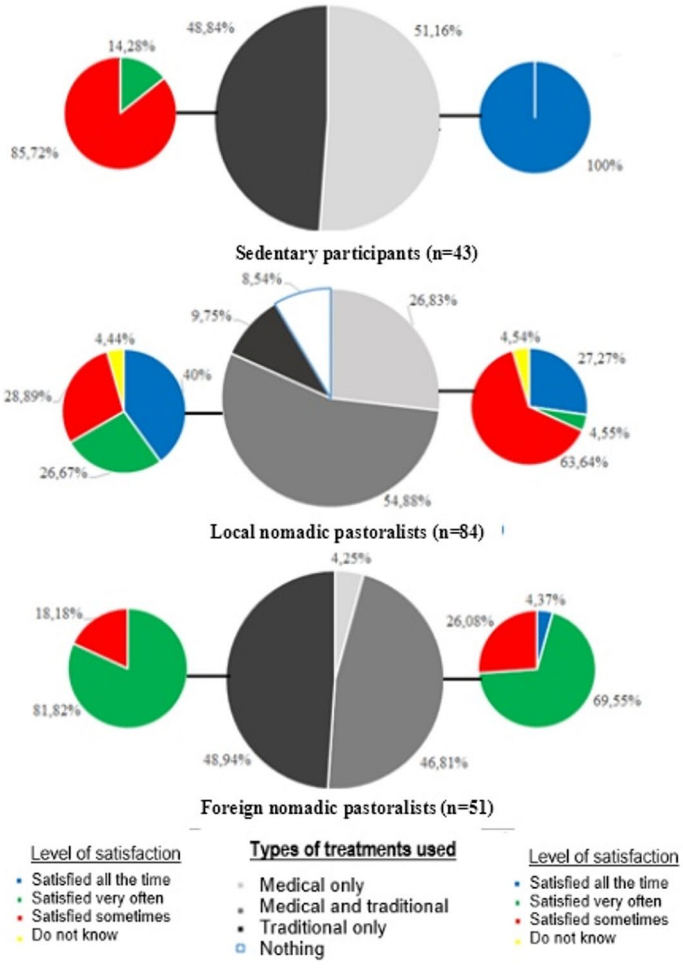

Fig. 4 Treatment options against UGS among the study populations and level of satisfaction

represent 25% of the respondent and less than 1/3 of them declared being at least satisfied very often. The two most popular treatment approaches for foreign pastoralists are: use of traditional medicines only and use of both traditional and western medicines; the majority of users of the two approaches being satisfied of them very often (Fig. 4).

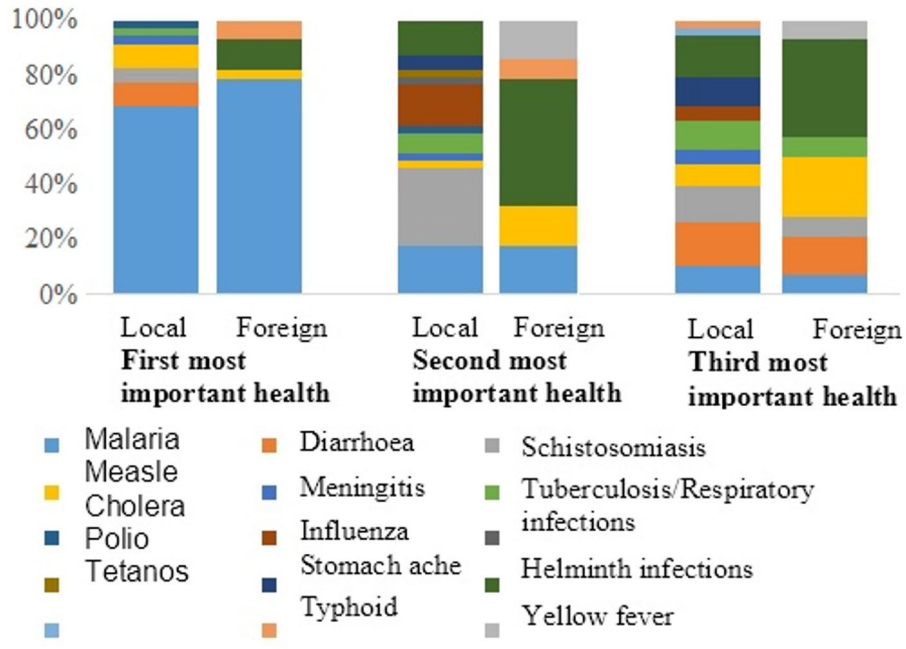

Fig. 5 Perception of the three most important health problems between local and foreign nomadic pastoralists

3.3 Perception nomadic pastoralists have of their health condition

A total of 67 group leaders and/or heads of extended families (39 local pastoralists and 28 foreign pastoralists) were interviewed to gain knowledge of the perception they have of their health condition. The local pastoralists were distributed as follows: 23.08% of Arab, 23.08% of Musgum and 53.84% of Peuhl. They believed in their majority (71.79%; 28/39) that sedentary populations have a better health condition than theirs, only 15.93% (6/39) of them considered themselves better than sedentary population and 12.82% (5/39) of the respondents said they could not qualitatively compare their health condition with that of the other group. The tendency was different in foreign pastoralists; here 46.43% (13/28) of people considered themselves better than sedentary populations against 39.28% (11/28) of people for whom sedentary populations have a better health status and finally 14.28% (4/28) of the persons interviewed deny to make the comparison. The mode of life or consequences of the later were reported by 85.71% (24/28) of the local pastoralists as the reason of lower health condition; they cited in order of importance: living in bushes (45.83%), no access to hospital, medicine and vaccines (25%), mobility (20.83%) and lack of assistance from the government (8.33%). Among foreign pastoralists who consider themselves less healthy than the sedentary people, mode of life was also mentioned (90.91%, 10/11) as a decisive factor.

When interviewed on the three most frequently encountered health issues in the course of their mobility cycle, respondents named altogether total of 15 diseases of which 93.33% (14/15) were experienced by local pastoralists and 53.33% (8/15) by the foreign pastoralists. Malaria was mentioned by the majority of pastoralists as the number one health problem (Fig. 5). The community leaders of the two groups did not have the same perception about the age group most affected by the disease. In local pastoralists, 76% (19/25) of leaders considered malaria to affect all members of the community with no distinction of age group, whereas for most foreign pastoralists (75%; 21/28)

children are the most vulnerable group. The identity and frequency of the second and third health issues affecting pastoralists the most varied between the two groups (Fig. 5). For instance, in local pastoralists, schistosomiasis emerged as the most frequent of all diseases proposed as the second health problem of major importance; meanwhile for foreign pastoralists it is yellow fever and, schistosomiasis did not even rank among the top three diseases proposed as third health problem of major importance. According to them, areas where the risk for UGS is the highest in the course of their mobility are Yaeree zina in the Logone floodplain (33.33%; 15/45), seasonal settlements in Chad (28.88%; 13/45), rainy season campsites of northern Cameroon (22.22%; 10/45) and Ndiyam shinwa (15.55%; 7/45).

4 Discussion

The current study confirms the existence of cases of UGS among local nomadic pastoralists of the far north region of Cameroon. The infection rate was found lower than 10% and suggests low levels of transmission within this community. Manasset et al. [24] reported in 2011 such low infections in some areas of the region and attributed it to the intensification of mass drug administration (MDA) campaigns against the disease. These interventions might have caused a decrease in the prevalence of infected snails leading to lower expositions to the infective form of the parasite in some water bodies. This is probably true of the area where pastoralists camped during the rainy season. However, with a reportedly high risk of contamination in the water bodies of Logone floodplain and the fact that no MDA has so far reached nomadic pastoralists, more cases of UGS were expected in our survey [15, 24]. The very low participation to the second parasitological survey carried out in the floodplain, hindered our endeavour to assess the transmission level of this parasitosis in this area.This situation underscores challenges often encountered in obtaining the consent from populations who are not always familiar with research or western science practices [26].

The cases of UGS detected in the sedentary populations demonstrate that transmission of the disease effectively occurs in the floodplain. It likely that the low infection rate observed here is due to the fact that praziquantel was distributed to villagers one month before the parasitological survey was undertaken. The percentage of cases with heavy infections was higher in this population than the recommended 2020–2030 global NTD elimination target further demonstrating the existence of weaknesses in the implementation of the elimination strategy [7]. According to the CHWs involved as facilitators in our study, the MDA coverage is often low in the villages because medicines are frequently insufficient. The infection rates did not vary according to gender and age groups in the study populations, a comparable observation was made by Dankoni et al. in the same region [27]. Contrary to our findings, previous studies in the Centre, West, South west, and East regions of the country found infection rates that are completely different among age groups [28–31]. These contrasting patterns indicate that the frequency of water related occupational and/or recreational activities leading to contamination among communities may vary across the country.

The majority of participants of the study heard about UGS and had a good knowledge of symptoms associated with the disease; unlike sedentary population, an important fraction of nomadic pastoralists falsely identified the mean of disease contamination as they link it to drinking dirty water and or keeping dirty hands. This marked difference

between pastoralists and sedentary populations highlights a gap in knowledge among the study populations. Nevertheless, the level of UGS awareness among pastoralists was higher than that found by Sumbele et al. [32] in Tiko and by Folefack et al. [33]in Ekombe Bonji in southern Cameroon. This tendency is in accordance with a previous study carried out across the national territory by Kamga et al. [34]; because the northern regions concentrate most of the foci of the country, sedentary populations of these regions must have received consistent health attention over years leading to a greater level of awareness of the disease than in the southern regions [35] and local nomads certainly gained awareness of the disease through their multiple contacts with sedentary populations. While a large number of the study populations heard about UGS and knew its symptoms, the proportions of people with correct knowledge on disease prevention were very low when compared with the overall knowledge score of the northern regions on this particular aspect [34]. For example, local nomadic pastoralists believed that avoiding walking under the sun, consuming salty or sweetened water could prevent infection. Worse, almost all foreign pastoralists and sedentary participants considered UGS contamination unpreventable. Several other studies across the African continent revealed the existence of misconceptions in communities [35–38]. Our study equally shows a clear paradox between the awareness the study groups have of the risk to health that water of the floodplain represents and their practices (drinking and bathing), a situation that is indicative of their vulnerability to water borne diseases in general [39].

About treatment strategy, a difference was observed between local and foreign nomadic pastoralists. Globally, foreign nomads rely on traditional medicine and nearly half of them sometimes couple it with western medicine and expressed a good satisfaction over both approaches. This perception suggests that they hold validated treatment protocols against the disease. Among local pastoralists, a little more than 50% use preferentially traditional medicine in combination with western medicine. The tendency to integrate traditional and western strategies in the management of UGS is largely adopted by both groups of pastoralists. This practice has been reported among other nomadic communities elsewhere [21, 40] and it is supported by cultural considerations [21]and an increase access to western medicines at Markets. As it is also the case for the management of animal diseases [41], nomadic pastoralists are continuously seeking effective methods to manage their health problems and are quick to adopt practices and preparations from outside sources that are proven efficacious [42].The noticeable discrepancies between the two groups suggest that they might have different ethno bothany knowledge and/or that health knowledge exchange among them is slow because of their ethnicity or country of origin. The treatment behaviour of sedentary participants highlights their total satisfaction over western medicine most likely to be praziquantel received during MDA. The traditional approach here could be an alternative treatment to praziquantel adopted presumably only by those who could not have access to the later.

A large proportion of local nomadic pastoralists considered themselves to be more vulnerable to health problems than their sedentary counterparts because of their mode of life. This perception reveals the awareness they have of the link between their mobility, the precarious conditions of their periodic settlements and distance to health facilities and, the occurrence of health problems. This opinion, exacerbated by climate change, is shared by other nomadic pastoralists of the African continent [10, 43]. However, in this study a relative majority of foreign pastoralists thought otherwise and considered

themselves better. It is possible that, contrary to other pastoralists, they have adapted better to changes and situations that might affect their health status in general or simply that they do not view sedentarization as beneficial to them as nomadism. Malaria was the most important health problem that pastoralists experienced throughout the year. Taking advantage of our UGS survey, a malaria screening using Rapid Diagnostic Test was performed by the CHW on 48 persons among local nomadic people who reported suffering from the disease. An infection rate of 56.25% was established thus supporting the perception this community has of the parasitosis. For both groups of pastoralists malaria is a concern to everyone and the most vulnerable group for foreign pastoralists are children. A similar answer was obtained mong Arab, Fulani and Daza nomadic pastoralists in Chad [44]. Schistosomiasis does not have the same epidemiological importance for both groups of pastoralists and the risk of transmission is unevenly distributed across the floodplain. Because contamination happens also out of the floodplain in neighbouring countries there is a high risk of cross-border transmission disease with potential implications on control strategies [18, 19].

5 Conclusion

This preliminary study presents evidences of urinary schistosomiasis among local nomadic pastoralists of northern Cameroon and confirms the occurrence of contaminations in the Logone floodplain, a seasonal destination for hundreds of nomadic pastoralists from the Lake Chad basin. The infection rate was inferior to 10% but more investigations should be carried out to ascertain the transmission level of the disease in different parts of the area and within both local and foreign nomadic groups. Despite being all aware of UGS, its cardinal signs and the source of contamination, pastoralists have misconceptions on its prevention, thus underscoring the need for health education. Our study demonstrated also that pastoralists rely desperately on water bodies of the floodplain for nearly all their activities regardless of the knowledge they have of the risk to infection; they consider their mode of live to contribute to their health vulnerability and malaria to be the number one of all health problems. Our findings underscore the need to evaluate the accuracy of nomadic pastoralists in disease reporting in general, determine the risk for the dissemination of this disease to neighbouring countries and finally to advocate for the development of sustainable strategies at regional level involving all Lake Chad Basin member states to provide these community with access to safe water and to basic health services.

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Author contributions
PFS conceptualized the study. PFS and CN were involved in the study design and investigation. PFS supervised the study with DB and both analyzed the results. PFS wrote the original draft while all authors were involved in reviewing and editing the final manuscript.

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Data availability
Data is available upon reasonable request from the corresponding author.

Declarations

Ethics approval and consent to participate

The study protocol was approved by the *Comité National d'Ethique de la Recherche pour la Santé Humaine* (Reference: N°2023/08/1564/CE/CNERSH/SP) and by the regional delegation for the Ministry of Health, Far North region (N° 378/L: MINSANTE/SG/DRSPEN/SAG). The research followed the ethical guidelines contained in the Helsinki Declaration. All the participants gave an informed consent prior to participating in the study.

Consent for publication

The authors provided their consent to publish this original research work.

Competing interests

The authors declare no competing interests

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References

1. Sturrock R. The parasites and their life cycles. Hum Schistosomiasis 1993:1–32.
2. Brooker S, Kabatereine NB, Smith JL, Mupfasoni D, Mwanje MT, Ndayishimiye O, Lwambo NJ, Mbotha D, Karanja P, Mwandawiro C. An updated atlas of human helminth infections: the example of East Africa. Int J Health Geogr. 2009;8:1–11. https://doi.org/10.1186/1476-072X-8-42.
3. Gaye PM, Doucouré S, Sow D, Sokhna C, Ranque S. Freshwater snail-borne parasitic diseases in Africa. Trop Med Health. 2024;52(1):61. https://doi.org/10.1186/s41182-024-00632-1.
4. Santos LL, Santos J, Gouveia MJ, Bernardo C, Lopes C, Rinaldi G, Brindley PJ. Costa jmcd: urogenital schistosomiasis—history, pathogenesis, and bladder cancer. J Clin Med. 2021;10(2):205. https://doi.org/10.3390/jcm10020205.
5. Peng D, Zhu Y, Liu L, Zhang J, Huang P, Bai S, Wang X, Yang K. Schistosomiasis Burden and Trend Analysis in Africa: Insights from the Global Burden of Disease Study 2021. Trop Med Infect Dis. 2025;10(2).
6. Grimes JE, Croll D, Harrison WE, Utzinger J, Freeman MC, Templeton MR. The roles of water, sanitation and hygiene in reducing schistosomiasis: a review. Parasites Vectors. 2015;8:1–16. https://doi.org/10.1186/s13071-015-0766-9.
7. WHO: Ending the neglect to attain the Sustainable Development Goals: a road map for neglected tropical diseases 2021–2030: World Health Organization. 2020. Accesed: May.23, 2025. [Online]. Available: https://www.who.int/publications/i/item/9789240010352
8. Muchiri G, Okwii M, Bukuluki P, Willems J, Amanyi-Enegela JA, Yibi M, Sankar G. Challenges and strategies for the uptake of mass drug administration among pastoralist communities in South Sudan. Front Trop Dis. 2023;4:1007480. https://doi.org/10.3389/fitd.2023.1007480.
9. Adams MW, Sutherland EG, Eckert EL, Saalim K, Reithinger R. Leaving no one behind: targeting mobile and migrant populations with health interventions for disease elimination-a descriptive systematic review. BMC Med. 2022;20(1):172. https://doi.org/10.1186/s12916-022-02365-6.
10. Gammino VM, Diaz MR, Pallas SW, Greenleaf AR, Kurnit MR. Health services uptake among nomadic pastoralist populations in africa: a systematic review of the literature. PLoS Negl Trop Dis. 2020;14(7):e0008474. https://doi.org/10.1371/journal.pntd.0008474.
11. Montavon A, Jean-Richard V, Bechir M, Daugla D, Abdoulaye M, Bongo Naré R, Diguimbaye-Djaibé C, Alfarouk I, Schelling E, Wyss K. Health of mobile pastoralists in the S ahel–assessment of 15 years of research and development. Trop Med Int Health. 2013;18(9):1044–52. https://doi.org/10.1111/tmi.12147.
12. Münch AK. Nomadic women's health practice: Islamic belief and medical care among Kel Alhafra Tuareg in Mali. Schwabe Basel; 2012.
13. WHO: Integrating neglected tropical diseases into global health and development: fourth World Heqlth Organization report on neglected tropical diseases: World Health Organization. 2017. Accesed: May.23, 2025. [Online]. Available:https://www.who.int/publications/i/item/9789241565448
14. Wild H, Mohammed Ali S, Bassirou B, Tschopp R, Barry M, Zinsstag J. Mobile pastoralists in africa: a blind spot in global health surveillance. Trop Med Int Health. 2020;25(11):1328–31. https://doi.org/10.1111/tmi.13479.
15. Tchuem Tchuenté LA, Rollinson D, Stothard JR, Molyneux D. Moving from control to elimination of schistosomiasis in sub-Saharan africa: time to change and adapt strategies. Infect Dis Poverty. 2017;6(1):42. https://doi.org/10.1186/s40249-017-0256-8.
16. Siama A, Eteme Enama S, Kalmobe J, Abah S, Foutchou A, Njan Nloga AM. Abundance, Distribution, and Diversity of Freshwater Snail and Prevalences of Their Infection by Cercaria of Fasciola gigantica and Schistosoma spp at Mayo-Vreck River, Far North Region of Cameroon. *J Trop Med.* 2023, 2023:9527349https://doi.org/10.1155/2023/9527349
17. Xiao N, Cai S, Moritz M, Garabed R, Pomeroy LW. Spatial and Temporal characteristics of pastoral mobility in the Far North region, cameroon: data analysis and modeling. PLoS ONE. 2015;10(7):e0131697. https://doi.org/10.1371/journal.pone.0131697.
18. Ajakaye O, Dagona A, Haladu A, Ombugadu A, Lapang M, Enabulele E. Contrasting epidemiology of urogenital schistosomiasis among pastoral communities surrounding three Ramsar wetland in Nigeria. J Parasit Dis. 2022;46(3):637–42. https://doi.org/10.1007/s12639-022-01478-2.
19. Moser W, Batil AA, Ott R, Abderamane M, Clements R, Wampfler R, Poppert S, Steinmann P, Allan F, Greter H. High prevalence of urinary schistosomiasis in a desert population: results from an exploratory study around the Ounianga lakes in Chad. Infect Dis Poverty. 2022;11:1–11. https://doi.org/10.1186/s40249-021-00930-4.
20. Greter H, Batil AA, Ngandolo BN, Alfaroukh IO, Moto DD, Hattendorf J, Utzinger J, Zinsstag J. Human and livestock trematode infections in a mobile pastoralist setting at lake chad: added value of a one health approach beyond zoonotic diseases research. Trans R Soc Trop Med Hyg. 2017;111(6):278–84. https://doi.org/10.1093/trstmh/trx051.

21. Moritz M, Ewing D, Garabed RB. On not knowing zoonotic diseases: pastoralists' ethnoveterinary knowledge in the Far North region of Cameroon. Hum Organ. 2013;72(1):1–11. https://doi.org/10.17730/humo.72.1.726726425 76gw247.
22. Lemeshow S. Sample size determination in health studies: a practical manual. World Health Organization; 1991.
23. WHO: The social context of schistosomiasis and its control: an introduction and annotated bibliography: World Health Organization. 2008. Accesed: May.23, 2025. [Online]. Available: https://www.who.int/publications/i/item/9789241597180
24. Massenet D, Toukour A, Kamwa Ngassam R, Djao R, Portal J, Tchuenté LT. Changes in the distribution of human schistosomiasis in Far North province, cameroon, since 1986. Ann Trop Med Parasitol. 2011;105(4):325–8. https://doi.org/10.1179/136485911X12987676649746.
25. Doehring E, Feldmeier H, Daffalla AA. Day-to-day variation and circadian rhythm of egg excretion in urinary schistosomiasis in the Sudan. Ann Trop Med Parasitol. 1983;77(6):587–94. https://doi.org/10.1080/00034983.1983.11811757.
26. Fitzpatrick EF, Martiniuk AL, D'Antoine H, Oscar J, Carter M, Elliott EJ. Seeking consent for research with Indigenous communities: a systematic review. BMC Med Ethics. 2016;17:1–18. https://doi.org/10.1186/s12910-016-0139-8.
27. Dakoni N, Saotoing P, Tchawe R, Koe V, Ndikwé J, Nlôga AN, Somo RM. Epidemiological survey on schistosomiasis caused by Schistosoma haematobium and Schistosoma mansoni in primary schools in the Sub-Division of Taïbong-Dziguilao, Far-North region Cameroon. J Appl Biosci. 2015;90:8397–407.
28. Ndamukong K, Ayuk M, Dinga J, Akenji T, Ndiforchu V, Titanji V. Infection pattern of Schistosoma haematobium in primary school children of the Kumba health district, South-West Cameroon. Afr J Health Sci. 2000;7(3–4):98–102.
29. Njunda AL, Ndzi EN, Assob JCN, Kamga HF, Kwenti ET. Prevalence and factors associated with urogenital schistosomiasis among primary school children in barrage, Magba sub-division of Cameroon. BMC Public Health. 2017;17(1):618. https://doi.org/10.1186/s12889-017-4539-6.
30. Ntonifor H, Green A, Bopda M, Tabot J. Epidemiology of urinary schistosomiasis and soil transmitted helminthiasis in a recently established focus behind Mount Cameroon. Int J Curr Microbiol Appl Sci. 2015;4(3):1056–66.
31. Tchuem Tchuenté LA, Kamwa Ngassam RI, Sumo L, Ngassam P, Dongmo Noumedem C, Nzu DD, Dankoni E, Kenfack CM, Gipwe NF, Akame J, et al. Mapping of schistosomiasis and soil-transmitted helminthiasis in the regions of centre, East and West Cameroon. PLoS Negl Trop Dis. 2012;6(3):e1553. https://doi.org/10.1371/journal.pntd.0001553.
32. Sumbele IUN, Tabi DB, Teh RN, Njunda AL. Urogenital schistosomiasis burden in school-aged children in tiko, cameroon: a cross-sectional study on prevalence, intensity, knowledge and risk factors. Trop Med Health. 2021;49:1–10. https://doi.org/10.1186/s41182-021-00362-8.
33. Folefac LN, Nde-Fon P, Verla VS, Tangye MN, Njunda AL, Luma HN. Knowledge, attitudes and practices regarding urinary schistosomiasis among adults in the Ekombe Bonji health area, Cameroon. Pan Afr Med J. 2018;29(1):1–9. https://doi.org/10.11604/pamj.2018.29.161.14980.
34. Kamga H, Njunda I, Assob N, Bi-Suh A, De F, Weledji P, Nsagha D. Schistosomiasis in cameroon: an assessment of community knowledge pattern. East Afr J Public Health. 2011;8(1):25–7.
35. Onyeneho NG, Yinkore P, Egwuage J, Emukah EC. Perceptions, attitudes and practices on schistosomiasis in Delta state, Nigeria. Tanzan J Health Res. 2010;12(4):278–82. https://doi.org/10.4314/thrb.v12i4.60123.
36. Acka CA, Raso G, N'goran EK, Tschannen AB, Bogoch II, Séraphin E, Tanner M, Obrist B, Utzinger J. Parasitic worms: knowledge, attitudes, and practices in Western Côte d'ivoire with implications for integrated control. PLoS Negl Trop Dis. 2010;4(12):e910. https://doi.org/10.1371/journal.pntd.0000910.
37. Odhiambo GO, Musuva RM, Atuncha VO, Mutete ET, Odiere MR, Onyango RO, Alaii JA, Mwinzi PN. Low levels of awareness despite high prevalence of schistosomiasis among communities in Nyalenda informal settlement, Kisumu city, Western Kenya. PLoS Negl Trop Dis. 2014;8(4):e2784. https://doi.org/10.1371/journal.pntd.0002784.
38. Rassi C, Kajungu D, Martin S, Arroz J, Tallant J, Zegers de Beyl C, Counihan H, Newell JN, Phillips A, Whitton J. Have you heard of schistosomiasis? Knowledge, attitudes and practices in Nampula province, Mozambique. PLoS Negl Trop Dis. 2016;10(3):e0004504. https://doi.org/10.1371/journal.pntd.0004504.
39. Gorham TJ, Yoo J, Garabed R, Mouhaman A, Lee J. Water access, sanitation, and hygiene conditions and health outcomes among two settlement types in rural Far North Cameroon. Int J Environ Res Public Health. 2017;14(4):441. https://doi.org/10.3390/ijerph14040441.
40. Bawa S, Afolabi M, Abdelrahim K, Abba G, Ningi A, Tafida SY, Tegegne SG, Warigon C, Nomhwange T, Umar SA, Aron A, Fanti A, Ahmed B, Nsubuga P, Adamu U, Braka F, Wondimagegnehu A, Shuaib F. Transboundary nomadic population movement: a potential for import-export of poliovirus. BMC Public Health. 2018;18(Suppl 4):1316. https://doi.org/10.1186/s12889-018-6190-2.
41. Healy Profitós JM, Moritz M, Garabed RB. What to do with chronically sick animals? Pastoralists' management strategies in the Far North region of Cameroon. Pastor Res Policy Pract. 2013;3:1–11. https://doi.org/10.1186/2041-7136-3-8.
42. Martin M, Mathias E, McCorkle CM. Ethnoveterinary medicine: an annotated bibliography of community animal healthcare; Intermediate Technology, 2001;611 pages.
43. Tugjamba N, Walkerden G, Miller F. Adapting nomadic pastoralism to climate change. Clim Change. 2023;176(4):28. https://doi.org/10.1007/s10584-023-03509-0.
44. Moukénet A, Moudiné K, Ngarasta N, Hinzoumbe CK, Seck I. Malaria infection and predictor factors among Chadian nomads' children. BMC Public Health. 2024;24(1):918. https://doi.org/10.1186/s12889-024-18454-5.

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