European Journal of Biotechnology and Bioscience
www.biosciencejournals.com
ISSN: 2321-9122
Received: 06-11-2021, Accepted: 23-11-2021, Published: 08-12-2021
Volume 9, Issue 4, 2021, Page No. 22-29

Epidemiological profile of digestive and urinary parasitosis caused by helminths, protozoa and sporozoa in the western logone and tandjilé basins from 2015-2020, chad

Bessimbaye Nadlaou[1, 2*], Bakarnga-Via Issakou[2], Mbanga Djimadoum[2], Choua Oucheimi[2], Nicolas Barro[3]

[1] Laboratory of the National Reference University Hospital (CHURN) of N'Djamena, Chad

[2] Faculty of Human Health Sciences (FSSH), University of N'Djamena, Chad

[3] Laboratory of Molecular Biology, Epidemiology and Surveillance of Bacteria and Viruses Transmitted by Food (LaBESTA) / Doctoral School of Sciences and Technologies, University of Ouaga 1 Joseph KI-ZERBO, 03 BP 7021 Ouagadougou, Burkina Faso

Abstract
Urban and rural areas face a real public health problem in view of the population explosion, overcrowding, lack of drinking water and sanitation facilities that prevail in some villages and cities.
The aim of this study was to determine the epidemiological profile of digestive and urinary parasitosis in the population in the provinces of Western Logone and Tandjilé in Chad.
This is a prospective cross-sectional study with an analytical, quantitative and qualitative aim on digestive and urinary parasitosis in two provinces on a sample of the population aged 3 to 90 years suffering from digestive or urinary disorders Selected by cluster sampling or coming consulted. In one of the health facilities of the two localities. Each patient underwent at least one simple parasitological examination including a reading in the fresh state, after Lugol staining and finally after the Kato-Katz technique for stool, urine filtration and circulating cathodic antigen test. For detecting schistosomes in urine.
Eight thousand three hundred and eighty-nine (8,389) people with an average age of 46.5 years with extremes ranging from 3 to 90 years voluntarily performed at least one parasitological screening examination of stool and urine, including 1231 (15%) parasites were found. Our study also included 1750 children (3 to 14 years) of which 611 (50%) were found. Significant differences were observed between the proportions of Participants men (57.14%) and women (43%), between the age group of 9-14 years (43.13%) and 87-90 years (2%) with the probabilities of 0.001 and 0.001 respectively.
Among the parasites encountered, Trematodes were in the majority with 55.40% followed by Protozoa (27.05%) and Nematodes (9.1%). *Schistosoma haematobium* (49%) appeared to be the most dominant parasite in the urine examined followed by *Entamoeba histolytica* (13.4%), *Trichomonas intestinalis* (7%) and *Giardia intestinalis* (7%) found in stool.
From the city to the countryside in the two provinces, the prevalence of intestinal and urinary parasitism is not negligible, we must always insist on strict compliance with the rules of food and personal hygiene and periodic and regular deworming in the surveyed areas. Which could reduce or cut the chain of transmission as well as carrying out similar studies in other provinces to draw a more precise epidemiological profile of intestinal parasitosis in Chad.

Keywords: parasitosis, digestive, urinary, western logone, tandjilé, Chad

Introduction
In developing countries and particularly in Chad, digestive and urinary parasitosis constitutes a major public health problem in towns and villages [1, 3, 4, 28]. Two groups of parasites can colonize the digestive tract: protozoa and helminths. If the protozoa develop very quickly after contamination in the intestine, many helminths carry out a development cycle in the organism and are not found in the intestine until several weeks after the contamination, justifying, in case of suspicion of helminthiasis, repetition of examinations after several weeks. Helminths can cause eosinophilia, especially during their life cycle in the body, which is not the case with protozoa. There are different species of helminths that can be distinguished in two large groups: nematodes or roundworms**.** According to WHO, parasitic diseases are endemic in 76 countries, including 42 in Africa; 700 million people are exposed to it worldwide; Out of 207 million people infected, 85% live in Africa. Children bear the heaviest burden of infection. This parasitosis is contracted from water polluted by the fecal hazard and the ejection of contaminated urine. In Europe, the practitioner is most often confronted with these pathologies in patients who have stayed in the tropics, namely migrants or travelers [17, 18]. Some parasitosis can persist for years, sometimes they are diagnosed very late after infection and other parasitosis remain cosmopolitan and can be acquired in our latitudes [16, 19]. The population explosion in urban and rural areas, the lack of personal and food hygiene, open defecation are the contributing factors [7, 27]. In the vast majority of cases, intestinal parasitosis remains asymptomatic. However, they can cause severe disease in immunocompromised patients, whether with advanced HIV infection or when taking immunosuppressive drugs, especially corticosteroids [2, 20].
The objective of the study is to have data allowing to have a better understanding of the extent of transmission of pathogenic digestive and urinary parasites, and the behavioral factors determining the level of contamination in the provinces of Western Logone and Tandjilé. in Chad.

Material and Methods
Study framework
Our study took place in the provinces of Tandjilé and Western Logone, located about 400 and 500 km respectively in the southwest of Chad. The two provinces are adjacent to the Republic of the Central African Republic (CAR) and

Cameroon.

Climate-Hydrography-Vegetation.
With a South Sudanese type climate, the two provinces are humid and green. Precipitation varies between 1,100 and 1,200 mm during the rainy season which runs from June to October, while the dry season runs from November to May.
The province of Western Occidental includes important rivers: Lake Wey, Lake Taba, Lake Bombaya and the Logone River, an important river in Chad. We can also find a few smaller water points scattered around the province, such as the water reservoirs in the town of Moundou, the capital. The soils are on the whole very rich and the vegetation consists of wooded savannah.
The province of Tandjilé is also crossed by the Logone River and the Tandjilé itself a smaller river. We can also find some smaller water points scattered around the province such as the water reservoirs in all the towns (Kelo, Béré, Laï and Dono Manga). The soils are on the whole very rich and the vegetation consists of wooded savannah.

Population
The population of Western Logone was identified at 683,293 inhabitants and that of Tandjilé at 682,817 inhabitants in 2009 [27]. Apart from a small number of traders and officials posted in the two provinces, the inhabitants are predominantly farmers.
From an economic point of view, agriculture and animal husbandry are the dominant activities. The farm is family-run and most often produces food crops. Animal husbandry is as important an activity as agriculture.
Handicrafts are reduced to a few main types: forge, masonry, pottery.

Type and period of the study
This is a cross-sectional prospective study with an analytical, quantitative and qualitative aim that took place over a period from March 01, 2015 to March 01, 2020 in the Provinces of Western Logone and Tandjilé in Chad. The study was designed to identify pathogenic parasites in the stool and urine.

Study population
Our study concerned any consenting person of any age suffering from digestive and urinary disorders residing in the two provinces of Western Logone and Tandjilé.

Collecting samples
A test for digestive and urinary parasitosis was performed in people aged 3 to 90 years at the study sites and with informed consent.
Stool collection and was performed at each site with sterile vials. Each sample is documented with a survey sheet containing information about the patient (locality, name, first name, age, sex, profession and address).

Sampling
Sampling for convenience in relation to the duration of the study.

Data processing.
The collected data was entered and analyzed using Word 2013 and Excel 2013 software. Statistical analysis used the chi-square (χ^2) test to compare two qualitative variables. The p-value ≤ 0.05 was considered significant.
Analysis methods [21, 25, 28]
We used the following techniques:
1. macroscopic examination (assessment of the appearance and consistency of the stool);
2. direct microscopic examination: reading the Kato-Katz slides, the fresh state of the stool and the urine slides after the urine filtration technique (the form: eggs and pathogenic parasites);
3. Circulating cathodic antigen test for the detection of schistosomes in the urine (CCA). The test was performed according to the manufacturer's instructions;
4. 4-The Smartphone was used to record the geographic coordinates (Global Position System: GPS) of the towns and villages surveyed and to record the questionnaires.

Results
Mapping of cities and villages surveyed in the Western Logone and Tandjilé basins
Figure 1 illustrates the cities and villages surveyed in the two Provinces. Geographically, the two Provinces are located in swampy areas that could contain hosts for transmission of parasites. Both urinary and intestinal schistosomiasis are contracted from water polluted by fecal hazard and the ejection of contaminated urine.

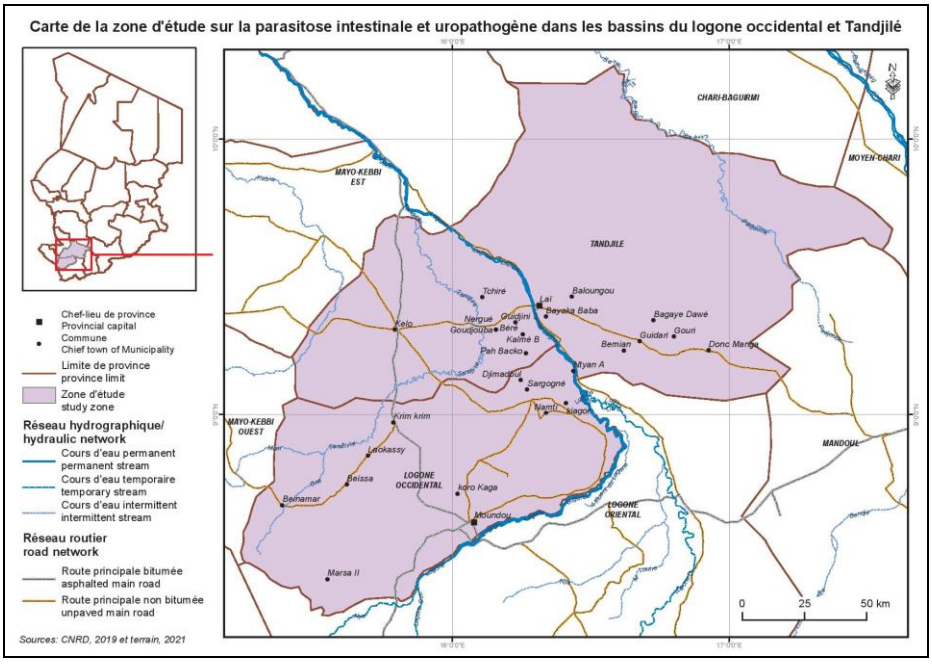


Fig 1: Mapping of cities and villages surveyed in the Provinces of Western Logone and Tandjilé

Study population, laboratory parameters and patient demographics

The study involved 8389 examined subjects, aged 3 to 90 years, comprising 4794 (57.14%) men and 3595 (43%) women (x^2 = 53.13> x^2_0> 3.84, p = 0.001, dof = 1, significant difference in favor of the participation of men in the survey). The mean age of the patients was 46.5 years with the extremes of 3 to 90. All age groups (children, adolescents and adults) were represented in this study with proportions of 21%, 54% and 25, 33% respectively (Table 1).

Table 1: Distribution of the population examined by sex and social age group

Sex	Social age group			
	Child	Teenager	Adult	Total (%)
Male	918	2578	1298	4794 (57,14)
Female	832	1936	827	3595 (43)
Total (%)	1750 (21%)	4514 (54%)	2125 (25,33%)	8389 (100)
Sex ratio	1,1	1,3	1,5	1,3

Distribution in number of stools and parasites by year

Figure 2 illustrates the distribution in number of stools and parasitized subjects according to the years.

The specific parasite index (SPI) is the percentage of subjects with parasitized stools out of the total number of subjects examined. Of the 8389 subjects examined, 1231 parasites were found 1231/8389 (15%). The parasitic indices according to the years of the study varied between 12.84% in 2016-2017 and 18.09% in 2017-2018 (Figure 2).

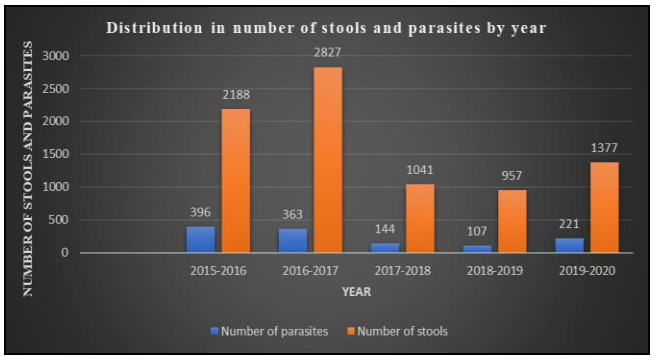


Fig 2: Distribution in number of stools and parasites by year

Distribution by parasite group

The prevalence of *Entamoeba histolytica* vegetative forms responsible for dysentery was 13.4% of all protozoa found (27.05%). *Schistosoma haematobium* were found in 49% of the cases of parasites of all the helminths detected (55.40%) (Table 2).

Incidence of the various associated parasites found in 1231 parasites

Polyparasitism is the coexistence in the same person of two or more parasites.

Out of 1231 parasitized stools, we obtained 114 (9.26%) polyparasitism stools. These cases of polyparasitism are distributed as follows: 103 protozoa and 11 mixed infestations (protozoa + helminth + Sporozoa). The parasitic association indicates a very low level of sanitary, food, fecal hygiene and unfavorable living conditions. We found that parasite associations were less frequent in cities than in villages (Table 3).

Table 2: Incidence of the various parasites found in 1231 parasites

Group of parasites	Number of parasite	Percentage of parasite in relation to total parasites (%)
Protozoa		
Entamoeba histolytica	167	13.4
Trichomonas intestinalis	84	7
Giardia intestinalis	82	7
Total1	333	27.05
Sporozoa		
Cystoisospora belli	35	3
Total2	35	3
Helminths		
Cestodes		
Hymenolepis nana	34	3
Taenia solium	35	3
Total 3.1	69	6
Trematodes		
Schistosoma mansoni	81	5.58
Schistosoma haematobium	601	49
Total 3.2	682	55.40
Nematodes		
Ascaris lumbricoides	35	3
Trichuris trichiura	17	1.4
Ancylostoma duodenale	60	5
Total 3.3	112	9.1
Total 1+2+3.1.2.3	1231	1

Incidence of the various associated parasites found in 1231 parasites

Polyparasitism is the coexistence in the same person of two or more parasites.

Out of 1231 parasitized stools, we obtained 114 (9.26%) polyparasitism stools. These cases of polyparasitism are distributed as follows: 103 protozoa and 11 mixed infestations (protozoa + helminth + Sporozoa). The parasitic association indicates a very low level of sanitary, food, fecal hygiene and unfavorable living conditions. We found that parasite associations were less frequent in cities than in villages (Table 3).

Table 3: Incidence of the various associated parasites found in 1231parasities

Number of associated parasites	Protozoa (%)	Mixed infestations : Protozoa / Helminths (%)	Total (%)
2	71 (6)	9 (0.73)	80 (6.5)
3	30 (2.43)	2 (0.16)	32 (2.6)
4	2 (0.16)	0 (0)	2 (0.16)
Total (%	103 (8.37)	11 (1)	114 (9,26)

Distribution of parasites according to localities

Table 4 shows the distribution in number of people surveyed and parasitic agents found according to the localities.

A total of 8389 people were screened, including 1231 parasites found in stool and urine. Of the 1231 parasites found, 516/1231 (42%) were detected in the Western Logone basin and 715/1231 (58.08%) in the Tandjilé basin. The pathogenic parasites found were: *Trichomonas intestinalis*, *Giardia intestinalis*, *Taenia solium*, Entamoeba histolytica, *Hymenolepis nana*, *Trichuris trichiura*, *Shistosoma mansoni*, *Schistosoma haematobium*, *Cystoisospora belli* and *Ankylostoma duodenale* (Table 1, 4). In the Western Logone basin, Schistosoma haematobium led the way followed by *Entamoeba histolytica* and

Trichomonas intestinalis with prevalence of 34.49%, 20% and 10.07% respectively. In the Tandjilé basin, *Schistosoma haematobium* were also in the lead followed by *Entamoeba histolytica* with the prevalence of 59.16% and 9.09% respectively. Overall, in the two basins of Logone and Tandjilé, *Schistosoma haematobium* were in the lead followed by *Entamoeba histolytica* with prevalence of 48.74% and 13.36% respectively. In the Western Logone basin, the localities most affected by *Schistosoma haematobium* were: Beinamar followed by Benoye, Moundou and Laokassy with their respective villages. In the Tandjilé basin, the localities most affected by *Schistosoma haematobium* were Béré followed by Laï, Dono Manga and Kelo with their respective villages (Table 4).

Table 4: Distribution of parasites according to localities

Locality			**Digestive and urinary parasites**										
	Nombre Personne dépistée	**Nombre Parasite**	***E. histolytica***	***T. intestinalis***	***G. intestinalis***	***C. belli***	***H. nana***	***T. solium***	***S. mansoni***	***S. haematobium***	***A. lumbricoides***	***T. trichiura***	***A. duodenale***
Western Logone													
City													
Moundou	1200	143	72	17	9	7	6	4	2	10	3	5	8
Laokassy	500	36	4	6	2	0	0	3	0	14	2	0	5
Krim-Krim	500	91	21	14	18	6	2	4	16	6	2	2	0
Beinamar	500	59	2	0	0	0	0	0	24	33	0	0	0
Benoye	500	18	3	4	3	1	2	0	0	1	0	1	3
Total City 1 (%)	3200	347 (11)	102 (29.4)	41 (12)	32 (9.2)	14 (4.0)	10 (3)	11(3.2)	42(12.1)	64 (18.4)	7 (2.0)	8 (2.3)	16 (4.6)
Village													
Koro-Kaga	100	43	10	4	6	0	2	4	0	6	5	4	2
Beissa	100	15	4	2	1	0	0	0	0	6	1	0	1
Massa II	100	12	5	3	2	0	0	0	0	0	1	1	0
Namti	100	36	0	0	0	0	2	4	0	26	2	1	1
Tyan	100	21	4	0	0	0	0	0	0	17	0	0	0
Kiagor	100	5	2	1	1	0	0	1	0	0	0	0	0
Saargoen	100	25	0	0	2	0	0	0	0	23	0	0	0
Djimadoul	100	12	0	0	0	0	0	0	1	11	0	0	0
Total Village1 (%)	800	169 (21.1)	25 (15)	10 (6)	12 (7.1)	0 (0)	4 (2.3)	9 (5.3)	1 (0.6)	89 (52.6)	9 (5.3)	6 (3.5)	4 (2.3)
Total1(%)	4000	516 (5.4)	127 (26.6)	51 (10)	44 (8.5)	14 (3)	14 (3)	20 (4)	43 (8.3)	153 (29.6)	16 (3.1)	14 (3)	20 (4)
Tandjilé													
Ville2													
Kelo	589	58	7	4	6	0	0	4	0	31	4	2	0
Béré	600	51	6	1	0	0	0	0	2	35	7	0	0
Laï	1200	77	4	8	2	8	0	0	5	34	6	1	9
Guidari	500	55	2	1	0	0	0	0	2	45	1	0	4
Dono-Manga	500	92	3	17	19	7	15	9	2	20	0	0	0
Total City 2 (%)	3389	333 (10)	22 (6.6)	31 (9.3)	27 (8.1)	15 (4.5)	15(4.5)	13 (4)	11 (3.3)	165 (49.5)	18 (5.4)	3 (1)	13 (4)
Village2													
Bayaka Baba	100	35	3	2	5	2	2	0	6	9	0	0	6
Bagaye Dawé	100	45	2	0	0	0	0	0	7	32	0	0	4
Guidjina	100	41	0	0	0	3	3	2	2	31	0	0	0
Kalmé	100	39	5	0	2	0	0	0	2	30	0	0	0
Pa Backo	100	52	4	0	0	0	0	0	3	45	0	0	0
Tchiré	100	42	4	0	0	0	0	0	1	37	0	0	0
Baloungou	100	44	0	0	0	1	0	0	2	40	1	0	0
Bemian	100	33	0	0	4	0	0	0	0	22	0	0	7
Gouri	100	45	0	0	0	0	0	0	4	33	0	0	8
Koro	100	6	0	0	0	0	0	0	0	4	0	0	2
Total Village2 (%)	1000	382 (38.2)	18 (5)	2 (0.5)	11 (3)	6 (1.6)	5 (1.3)	2 (0.5)	27 (7.0)	283 (74.1)	1 (0.2)	0 (0)	27 (7.0)
Total2 (%)	4389	715 (16.3)	40 (5.6)	33 (4.6)	38 (5.3)	21 (3)	20 (2.7)	15 (2.1)	38 (5.3)	448 (62.6)	19 (2.6)	14 (2)	40 (5.6)
Total 1+2 (%)	8389	1231 (14.7)	167 (13.5)	84 (7)	82 (6.6)	35 (3)	34 (2.7)	35 (3)	81 (6.5)	601 (49)	35 (3)	17 (1.4)	60 (5)

%: percentage, *E. histolytica*: *Entamoeba histolytica*, *T. intestinalis: Trichomonas intestinalis*, *G. intestinalis: Giardia intestinalis*, *C. belli: Cystoisospora belli*, *H. nana: Hymenolepis nana*, *T. solium: Taenia solium*, *S. mansoni: Schistosoma mansoni*, *S. haematobium*: *Schistosoma haematobium*, *A. lu mbricoides: Ascaris lumbricoides*, *T. trichiura*: *Trichuris trichiura*, *A. duodenale*: *Ankylostoma duodenale*.

Table 5 shows the distribution of parasites by age group. The most affected age group was 9-14 years (43.13%) followed by 15-20 years (12.42%). Children between 9 and 14 years old were the most affected by intestinal and urinary parasitosis (43.13%) compared to 2% of elderly people between 87 and 90 years old ($x^2 = 9.75 > x^2_0 > 3.84$, $p = 0.001$, dof = 1, significant difference).

Table 5: Distribution of parasites by age group

Parasites	**N**	**Age range**														
		3-8	**9-14**	**15-20**	**21-26**	**27-32**	**33-38**	**39-44**	**45-50**	**51-56**	**57-62**	**63-68**	**69-74**	**75-80**	**81-86**	**87-90**
Entamoeba histolytica	167	9	32	56	27	14	7	3	4	2	1	3	2	2	3	2
Trichomonas intestinalis	84	10	13	16	11	9	5	2	3	4	3	2	2	2	2	0
Giardia intestinalis	82	6	10	8	4	12	13	3	3	2	9	1	1	2	5	3

Cystoisospora belli	35	0	0	0	0	6	10	5	4	2	3	1	2	1	0	1
Hymenolepis nana	34	0	6	3	8	4	2	1	2	1	1	3	0	1	0	2
Taenia solium	35	2	3	7	5	3	1	1	0	3	2	1	0	1	0	6
Schistosoma mansoni	81	0	46	12	3	2	4	2	2	1	1	1	2	1	2	2
Schistosoma haematobium	601	35	401	36	23	15	21	11	13	17	8	6	3	4	4	4
Ascaris lumbricoides	35	8	11	4	1	1	1	1	1	2	2	1	1	1	0	0
Trichuris trichiura	17	3	5	2	2	4	1	0	0	0	0	0	0	0	0	0
Ancylostoma duodenale	60	7	4	9	4	2	2	2	2	5	2	3	4	5	6	3
Total (%)	1231	80 (6.49)	531 (43.13)	153 (12.42)	88 (7.14)	72 (6)	67 (5.44)	31 (2.51)	34 (3)	39 (3.16)	32 (2.59)	22 (2)	17 (1.38)	20 (2)	22 (2)	23 (2)

% percentage, N: Number

Distribution of intestinal and urinary parasitosis by profession

Globally, 37% of Farmers were parasitized followed by 29.32% of Breeders, 18.27% of Others (Civil servants, workers, truck drivers) and 15.51% of traders respectively. These proportions could be explained by the fact that the majority of Farmers and Breeders claimed to have defecated in the open in their respective environment. The very high prevalence of helminths among farmers and breeders (Table 6).

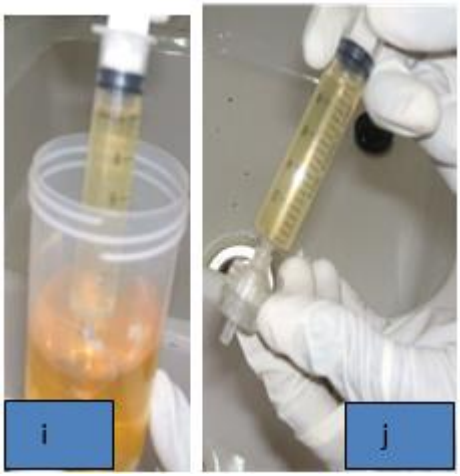
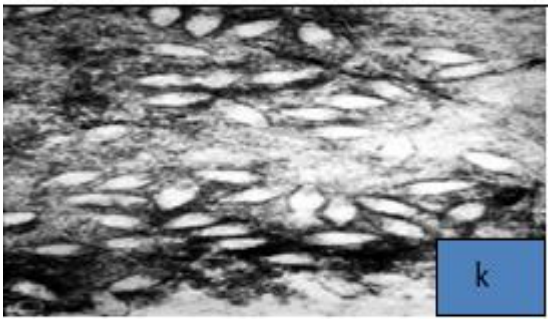
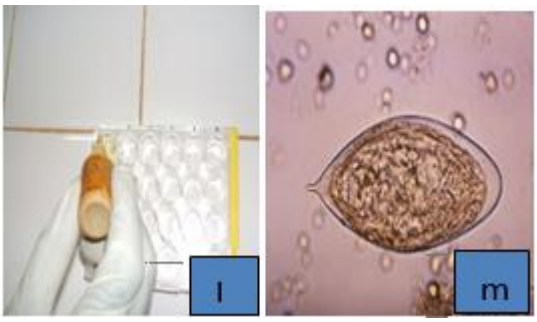
Table 6: Distribution of the prevalence of intestinal and urinary parasitosis by profession

Parasites		**Profession**			
	N	Farmers (%)	Breeders (%)	Traders (%)	Others (%)
Entamoeba histolytica	167	57 (34.13)	51 (30.54)	33 (18)	27 (16.17)
Trichomonas intestinalis	84	29 (34.52)	25 (30)	19 (23)	11 (13.1)
Giardia intestinalis	82	28 (34.15)	24 (29.27)	18 (22)	12 (15)
Cystoisospora belli	35	3 (8.57)	6 (17.14)	11 (31.42)	15 (43)
Hymenolepis nana	34	14 (41.18)	12 (35.29)	2 (6)	6 (18)
Taenia solium	35	12 (34.28)	16 (45.71)	4 (11.43)	3 (8.57)
Schistosoma mansoni	81	30 (37.04)	27 (33.33)	8 (10)	16 (20)
Schistosoma haematobium	601	237 (39.43)	156 (26)	89 (15)	119 (20)
Ascaris lumbricoides	35	13 (37.14)	15 (43)	2 (6)	5 (14,28)
Trichuris trichiura	17	6 (35.29)	5 (29.41)	1 (6)	5 (29.41)
Ancylostoma duodenale	60	26 (43.33)	24 (40)	4 (6.67)	6 (10)
Total (%)	1231	455 (37)	361 (29.32)	191 (15.51)	222 (18.27)

% = percentage, N = number, Others = (Civil servants, workers, truck drivers).

Table 7: Macroscopic and microscopic characteristics of stool and urine

1	a : Registration, information on collection instructions and delivery of sterile vials for stool and urine samples to survey participants. b : Delivery of stool and urine by participants for analysis.		
2	c : preparation of stool and urine for performing Kato-Katz techniques (stool), urine filtration and macroscopic examination (appearance, consistency and turbidity of stool and urine). d : Receipt and codification of samples.		

3	e : cloudy hematuric urine. f : mucus-bloody stools. g : microscopic observation and recording of results.		
4	h : Interpretation of CCA test results - Two red lines: positive test - A red line: negative test. i : Urine intake through the 10cc syringe, assembly of the filter on the syringe and urine filtration. j: urine filtration		
5	k : *S. haematobium* eggs observed in urine at X10 magnification with the optical microscope. l : Lugol depot m : *S. haematobium* eggs observed in urine at X40 magnification with the optical microscope..		

Discussion

Unlike the other provinces of Chad, the factors determining the transmission of digestive and urinary parasitosis and especially helminthiasis in two provinces concerned by the study were: population growth, immigration, climatic conditions, low socio-economic level, precarious hygiene, the humid climate, ethnic diversity, agricultural activities, also the contact of the population with animals. The individual characteristics of households, the mother's level of education, the nature of urban sites and the source of water supply have also been indexed as risk factors for parasite contamination [3, 4, 14, 15, 17]

Overall, the prevalence of intestinal and urinary parasitosis in our examined population was 15%. The digestive and urinary parasitosis affect all age groups (children (9 to 14 years), adolescents (15 to 20 years)) and adults were represented in this study with proportions of 21%, 54% and 25.33%. respectively (Table 1). Very high rates diagnosed by other techniques have been reported elsewhere [4, 12]. These rates could be explained by the fact that children and adolescents have a more active community life (communities: schools, nurseries, etc.) and observe less hygiene rules. Several studies show that people under 18 are the most infested [5, 18, 19].

Protozoa and helminths were the most common parasites found in our study, with prevalence's of 13.4% and 55.4 respectively (Table 2). Urinary helminths (*Schistosoma haematobium*) were the most common with an overall prevalence rate of 49% of parasitized subjects. Giardia intestinalis and *Trichomonas intestinalis* were also the most frequently found pathogenic parasites. These parasites are believed to be the main causes of severe complications such as anemia, weight loss, dehydration and failure to thrive observed in (children, adolescents and adults) during our survey. Similar results have been reported by previous studies [6, 8, 10, 11, 31]. *Schistosoma haematobium* could be the causes of male and female infertility which would be at the base of fertility decline which would in turn lead to lower agricultural productivity in the two provinces and especially the province of Tandjilé (Figure 1 and Table 5). The participants in this study had claimed to travel at a minimum distance of 7 km to be diagnosed and treated or hospitalized in the health facilities of the two localities. This could further weaken their low socio-economic level.

In our study, 7.36% of subjects examined were parasitized by *Trichuris trichiura*. This rate is relatively high compared

to those reported elsewhere with prevalence of 2.13% and 0.95% respectively [32, 39]. Ascaris lumbricoides and *Ankylostoma duodenale* were found at low rates in our population with rates of and 3%, and 5% respectively. In addition, studies carried out with the same techniques and others with better performance have yielded similar and higher rates of 3% and 70% respectively [4, 17, 26, 32].

Conclusion

The geographical study of digestive and urinary parasitosis in the Western Logone and Tandjilé basins in Chad presents, on a small scale of the country, many aspects of the growth of the cities of the two provinces, their relations with the pathology and their consequences on the level of health of the populations. The medical literature indeed links the endemicity of this pathology to the poor environment and living conditions of the populations, both in town and in the countryside.

The digestive and urinary parasitosis are present in this geographical area with a high incidence and a high morbidity both among breeders and farmers. Prevention is of great interest; it is based on the disinfection of water and periodic deworming of the population. Information and sensitization of users and health personnel should contribute to better attendance at health facilities in the event of digestive and urinary disorders. Continuous training of health personnel on neglected tropical diseases would also reduce the complications and disabilities associated with infertility caused by urinary schistosomes.

Acknowledgments

The authors wish to thank the Ministry of Public Health for authorizing this research. We are very grateful to the microbiology laboratory staff of the different district and regional hospitals especially to Gentlemen: Bamé Dakanga Christophe, Dingambé Nathaniel, Mbaitogro Nathaniel for their valuable efforts in collecting samples. Thanks, are also sent to the World Health Organization for its invaluable support in laboratory reagents and consumables and to Mr. Philémon Tchoua for preparing the study card.

Conflicts of interest, ethical and administrative considerations

There are no conflicts of interest. Our study previously received:

- Authorization from the Chadian Ministry of Public Health;
- Verbal consent of each patient or his beneficiary to whom we have explained the procedure and the importance of the study and their participation.

References

1. Lehman LG, Kouodjip Nono L, Bilong Bilong CF. Diagnostic des parasitoses intestinales à l'aide de la microscopie à fluorescence. Medécine Afrique Noire,2012:59:377-385.
2. Lamand V, Spadoni S, Bohand X. Médicaments antiparasitaires. (Paludisme exclu). EMC Maladie infectieuse,2014:11(3) :1-10.
3. Abir Y. Parasitoses intestinales chez les migrants originaires d'Afrique subsaharienne. Thèse Doctorat Pharmacie Nº 25, Faculté de Médecine et Pharmacie, Univ. Mohamed V de Rabat, 2021, 164.
4. ANOFEL (Association Française des Enseignants de Parasitologie et Mycologie). Polycopié national, 2014, 411.
5. Tligui H, Agoumi A. Prévalence du portage parasitaire intestinal chez les enfants scolarisés à Tifelt (Maroc). Rev Franc des laboratoires,2006:36(386):65-68.
6. Basma B. Épidémiologie des parasites flagellés intestinaux au Service de Parasitologie de l'Hôpital Militaire Avicenne de Marrakech Maroc. Thèse Doctorat médecine Nº 181, Faculté de Médecine et Pharmacie, Univ. de Marrakech, 2020, 111.
7. Ould ASCB, Bent MA, Ousmane BA et al. Prévalence des parasitoses intestinales chez les écoliers dans les Wilayas du Gorgol, Guidimagha et Brakna (Mauritanie). Revue Française de Laboratoire,2012:42(440):75-78.
8. Ndiaye, N-M, Diagne-Guèye, Soko T-O, Ndiaye A-R, Klotz F. « Amoebose intestinale EMC Gastro-entérologie,2017:0(0):1-10.
9. Soko TO, Ba PS, Carmoi T, Klotz F. Amibiase (amoebose) hépatique. EMC Hépatologie,2016:0(0):1-9.
10. Choudhuri G, Rangan M. Amebic infection in humans. Indian Journal Gas-troenterology,2012:31(4):153-162.
11. Patrice B, Dahane C, Resende P et al. Les cestodes et leur diagnostic au laboratoire. Revue Française des laboratoires,2012:42(440):67-73.
12. Aka AM. Profil épidémiologique des parasitoses intestinales chez les enfants malnutris à abidjan. Thèse Doctorat pharmacie Nº 1728, Univ. Felix Houphouët Boigny, 2015, 195.
13. Intissar EA. Parasitose intestinale chez l'enfant. Université Mohamed V de Rabat. Thèse Doctorat Médecine Nº 110, 2020, 154.
14. Favennec L. Épidémiologie et diagnostic de la giardiose humaine : quoi de neuf : Dossier Scientifique. Revue Française des Laboratoires,2012:2012(440):35-38.
15. Deschiens R. L'amibiase et l'amibe dysentérique : Masson, 1965, 77-115.
16. Nozais J. Maladies parasitaires et péril fécal : les maladies dues aux helminthes. Bulletin Société Pathologie Exotique,1998:91:416-422.
17. ANOFEL. Bilharzioses. Université Médicale Virtuelle Francophone,2014:(3):1-25.
18. Guillaume D, Jacques C. Nématodoses intestinales : aspects épidémio-cliniques et diagnostic. Revue Française des Laboratoires,2012:42(440):39-55.
19. Bachi F. Cours de coprologie parasitaire. Institut Pasteur d'Algérie, Service Biologie Parasitaire,2014:20-25.
20. Testa J, Kizimandji-Coton G, Delmont J et al. Traitement de l'anguillulose, de l'ascaridiose et l'ankylostomiase par l'Ivermectine (Mectizan) à Bangui (RCA). Medécine Afrique Noire,1990:37:283-284.
21. Ahmed NH. Cultivation of parasites. US National Library of Medicine National Institutes of Health Search. Tropical Parasitology,2014:4(2):80-89.
22. Yera H, Poirier P, Dupouy-Camet J. Classification et mode de transmission des parasites. EMCŔ Maladie infectieuse,2015:12(3):12-21.
23. Desoubeaux G, Hai Douong T. Parasitoses intestinales cosmopolites. Actualités pharmaceutiques,2011:50(509):24-29.
24. Cinquetti G, Massoure M-P, Rey P. Traitement des parasitoses digestives (amoebose exclue). Elsevier

Masson, Paris,2019:8-518-A-15.
25. Ge Univ. Felix Houphouët Boigny ntilini M, Danis M, Brucker G, Richard-Lenoble. Diagnostic en parasitologie, 2ème édition Masson, Paris, 1998, 132.
26. Nadlaou B, Adelsalam T, Khadidjia G, Brahim B O, Guelmbaye N, Lassana S, Barro N, Traore A. Gastro-entérites en milieux des réfugiés au Tchad. International Journal Biololgical Chemical Sciences,2013:7(2):468-478.
27. RGPH 2. Deuxième Recensement Général de la Population et de l'Habitat. N'Djamena. INSEED, 2009, 189.
28. OMS. Aide-mémoire sur le taeniasis – cysticercoses. REH,2018:93:630-632.
29. Kassi RR. Profil des parasitoses intestinales au cours de la malnutrition protéique et énergétique de l'enfant de 6 à 36 mois à l'Institut National de Santé publique (I.N.S.P) d'Abidjan, 2015, 102.
30. Koye KLB. Recherche de cryptosporidies dans les selles diarrhéiques à Rotavirus positif chez les enfants de 0 à 5 ans de la ville d'Abidjan. Thèse Doctorat Pharmacie N°1756, Univ. Felix Houphouët Boigny, 2016, 148.
31. Mostafi J, Idriss B, Mohamed EL Kostali et al. Prévalence des parasitoses intestinales chez les enfants adressés pour coprologie parasitaire à l'hôpital Moulay Abdallah de Salé (Maroc). Revue Mondiale de la Recherche Biologique,2007:1:1-5.
32. Koffi-akoua G, Ferly-Therizol et al. Cryptosporidies et Candida dans les diarrhées infantiles à Abidjan. Bulletin Société Pathologie Exotique,1989:82(4):451-457.
33. Yongsi BN, Salam G, Bruneau J-C. Épidémiologie géographique des maladies diarrhéiques à Yaoundé,2008:89:1-17.
34. ICMSF. Microorganisms in Food: Characteristics of Microbial Pathogens. London: Blackie Academic and Professional, 1996, 4.