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Persistence of *Tenia solium* amongst others human Gastro-intestinal parasites in Bamboutos locality (West region-Cameroon)

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ABSTRACT

Objectives: This study aimed to evaluate the prevalence of intestinal parasites and identify risk factors of their transmission in the population of Bamboutos Locality (west Cameroon).

Methodology and results: The survey was carried out from 1st of August to 30th of September 2017 on 240 residents from Batcham and Mbouda districts. Participants were invited to provide a stool sample, and interviewed about socio-demographic aspects, hygiene behaviours, regular deworming. Each stool sample was analyzed by three different methods: direct examination, Formol-ether method and Kato Katz method. Microscopic analyzes revealed six species of intestinal parasites distributed as follow: two Protozoa: *Entamoeba histolytica* with a prevalence of 41.7%; *Giardia intestinalis* (2.5%) and four Helminths: *Tænia solium* (8%), *Ascaris lumbricoides* (5%), *Trichuris trichiura* (0.8%) and *Enterobius vermicularis* (0.4%). Protozoa were the majority with a proportion of 44.2% against 14.2% of Helminths. A total of 116 individuals carried at least one species of parasites, an overall prevalence of 48.3%.No statistical difference was found between the two sexes. The infestation was high in the age group 6 to 10 years. Parasitic carriage was mainly related to educational level and hygiene behaviours.

Conclusion and application of results: The study showed a high prevalence of intestinal parasitosis in Bamboutos locality and their relation with several endemic factors that are the non-compliance with hygiene rules such as use of poor quality water for consumption, consumption of unwashed raw vegetables, irregular use of toilets, cleaning the anal area with green leaves… The study also revealed a focus of *Tenia solium* and efficiency of diagnosis additional techniques (formalin-ether concentration technique and Kato Katz quantitative technique) comparing to direct microscopic method. This work highlights the need to educate community members, particularly those in rural areas, about the hygiene measures necessary to limit the spread of intestinal parasites and the education of medical staff about the use of additional techniques for the certainty diagnosis of gastrointestinal parasitoses.

Keywords: Prevalence, human parasitosis, gastro-intestinal, West-Cameroon, Protozoa, Helminths.

INTRODUCTION

Currently, little attention is given to gastro-intestinal parasitic diseases compared to other diseases like HIV/ AIDS, malaria and atypical pneumonias. However, these infections constitute in tropics a major public health problem because of their high frequency and the large number of asymptomatic carriers (Laamrani *et al*., 1999; Hamit *et al*., 2008). More than 3.5 billion people were infested in the World in 2002 by digestive parasites and 450 million were symptomatic (OMS, 2001).The epidemiology of intestinal parasitic infections shows that they affect every age group and in both sexes. However, the most affected are school-aged children in whom they can generate nutrient deficiency, dehydration, intestinal malabsorption, nervous disturbance, lateness of physical and mental development and mortality (OMS, 1988; Dianou *et al*., 2004; Kettani et Azzouzy, 2006; Mbuh *et al*., 2010). In adults, they contribute to reduce work capacity and constitute a major cause of iron deficiency anaemia in pregnant women (Rodriguez *et al*., 2006; Ostan *et al*., 2007). Despite recent years' scientific and technological advances, intestinal parasites remain a peculiarity of tropical and subtropical regions where gastroenteritis control actions are made difficult by the cost of infrastructure and lack of population awareness-building projects(Peruzzi *et al*., 2006, Ouermi *et al*., 2012; OMS, 2017). Their prevalence is particularly high in rural areas because of favourable weather conditions for the proliferation of parasites, poor living conditions and hygiene, inadequate sanitation and finally poverty (Dianou *et al*., 2004; Tagajdid *et al*., 2012; Benouis *et al*., 2013).Although many studies have been done in this field in Africa (Ouermi *et al*., Tagajdid *et al*., 2012; Benouis *et al*., 2013) and Cameroon (Mbuh *et al*., 2010; Fouamno *et al*., 2011; Lehman *et al*., 2012), in the Bamboutos Division, a predominantly rural and densely populated locality, no studies in the field have been carried out. This study was therefore conducted in order to determine the prevalence of gastrointestinal parasitosis and identify risk factors related to their appearance and their maintenance in this area.

MATERIALS AND METHODS

Study area: Bamboutos Division (5°37'60" N, 10°15'0" E) is one of the eight divisions the Western Region of Cameroon. The climate is Cameroonian type characterized by two seasons: one dry season (from November to March) and one rainy season (from March to October), with maximum (200 to 300 mm) rainfall on July- August. Department has a population of nearly 350,000 inhabitants, on a total area of 1155 km², a density of about 300 inhabitants per km².The main economic activities of the locality: agriculture, barnyard breeding and trade (Anonyme, 2017). The survey was conducted in two districts: Batcham (5° 32' N, 10° 14' E) and Mbouda (5° 37' N, 10° 15' E) chosen because of the high density of population.

Study type, period and population: The study was prospective, descriptive and analytic and lasted for a period of 2 months: from August 1 to September 30, 2017. Eligible participants were anyone, of any age and both sexes living in one of the 2 districts and not on any antiparasitic drugs for at least one month before the study.

Samples collection: Participants were selected through a simple random sampling. In order to cover the entire borough, prospecting was carried out in different quarters and the households selected at random. In each registered household, 1 to 3 individuals were randomly selected, each individual having the same probability to be included in the study. After free and informed consent of the respondent (parent for children), a survey sheet was given for filling. The sheet contains two sections which included: Demographic and socio-economic information (age, gender, residence, location and family size), hygienic and environmental factors (housing conditions, ownership and use of latrines, hand washing practice before eating or after defecation, provenance of drinking water). At the end of this interrogation, sampling technique was well detailed and a sterile, labelled, transparent and hermetically sealed plastic pot was delivered to everyone for stool sample. Stool collection was done next morning between 07H and 08H using a cooler and samples were transported to Batcham or Mbouda district hospital laboratory for immediate examination.

Laboratory Procedures: In the laboratory, each stool sample was subjected to 04analyzing methods:

macroscopic examination, direct microscopic examination, Kato-Katz technique and formalin-ether concentration technique (Katz, 1972; OMS, 1983; OMS, 1993; Guillaume, 2007).

Statistical analysis: The collected data were registered in an Excel table (Microsoft EXCEL 2007) and exported to SPSS version 20.0 for further analysis. Differences in proportions were determined using the Chi-squared test, level of significance set at $P < 0.05$.

RESULTS

Socio-demographic characteristics of study subjects: A total of 240 individuals (146 women and 94 men) aged from 4 months to 70 years were controlled during this investigation. They were divided into 14 age groups with a step of 5 years. The mean age was 24.60 years and the most strongly represented age group was the 6-10 years. The largest number was observed at Batcham with 127 subjects examined against 113 in Mbouda.

Overall and specific prevalence: Overall, intestinal parasitic infection prevalence rate was 48.3% (116/240). Both helminth and protozoan were found. Overall, intestinal helminth prevalence rate was lower than protozoan infection prevalence (Table 1). Six species were identified as follow: two Protozoa: *Entamoeba histolytica, Giardia intestinalis* and four Helminths: *Tænia solium* (more prevalent), *Ascaris lumbricoides, Trichuris trichiura* and the last prevalent *Enterobius vermicularis* (Table 1). Mixed infections of two or three parasites occurred in 9.5% of participants. These associations were: *E.histolytica/T. solium (4.6%)*, *E. histolytica/A.lumbricoides (2.5%)*, *E. histolytica/G.intestinalis (1.6%)*, *A.lumbricoides/T.solium (0.4%)* and *E. histolytica/G.intestinalis/T.solium (0.4%)*.

Tableau 1: Prevalence of identified parasite species.

Groups	Species	Prevalence (%)
Protozoa (44.2%)	*E. histolytica*	41.7
	G. intestinalis	2.5
Helminths (14.2%)	*T. solium*	8
	A. lumbricoides	5
	T. trichiura	0.8
	E. vermicularis	0.4

Impact of socio-demographic factors on the prevalence of intestinal parasitosis

Influence of the district: no significant difference between the two districts were showed (χ^2=1.427; ddl=1; p=0.23; Table 2), therefore, analysis will continue regardless of the district.

Influence of age: age had no significant influence on the overall prevalence, even ifage group 6-10 years appeared more parasitized than others (χ^2= 10.930; ddl=13; p=0.62; Table 2). Specifically, the species *E.vermicularis* was significantly encountered in a single age group (31-35) unlike others that were ubiquitous.

Influence of sex: No significant difference was observed in the overall parasite prevalence by gender (Table 2; χ^2=0.022; ddl=1; p=0.88). Nevertheless, the species *T. trichiura* was only encountered in the male gender, unlike other species.

Influence of occupation: No significant difference was also obtained among people from different occupations (χ^2=24.256; ddl=3; p=0.135ns; Table 2).

Influence of school level: individuals with a higher level of education were statistically less parasitized (22.2%) than those with primary and secondary school levels with respective rates of 53.4% and 50.5% (χ^2=8.355; ddl=3; p=0.048; Table 2).

Impact of hygienic factors on the prevalence of intestinal parasitosis

Influence of drinking water source: individuals drinking well water were significatively more parasitized (67.1%) than those drinking faucet one whose infection rate was 29% (χ^2=23.479; ddl=4; p<0.01; Table 3).

Hand washing practice before eating: this hygiene practice showed a significant influence on the overall prevalence (χ^2=5.902; ddl=2; p=0.04). Individuals who do not wash their hands before eating were the most affected with an infection rate of 60.9% compared to those who wash their hands with soap and without whose respective rates were 36.4% and 51.7% (Table 3).

Raw vegetables washing before consumption: individuals washing raw vegetables before consumption

were less parasitized (37.8%) compared to those who do not wash with a prevalence of 63.9%.This difference of infestation rate is highly significant (χ^2=15.833; ddl=1;p <0.01; Table 3).

Type of toilet used: individuals living in concessions without toilets were more infected with a rate of 100%.The least parasitized were those using modern and semi-modern toilets whose infection rates were 43.8% and 36.6%.This infestation rate is very significant (χ^2=24.231; ddl=3; p<0.01; Table 3).

Hand washing practice after defecating: People who did not wash their hands after defecating were more infested during the study with an infestation rate of 83.3% compared to 25.5% and 49.7%, respective prevalence for people washing their hands with and without soap. This hygiene practice showed a very significant influence on the overall prevalence (P<0.01).

Influence of anal area cleaning: individuals who use green leaves for the anal area cleaning were more parasitized (68.3%).The less parasitized individuals were those using both water and paper for this purpose (28.3%).This infestation rate was very significant (χ^2=14.746; ddl=3; p <0.01; Table 3).

Impact of regular deworming practice on the prevalence of intestinal parasitosis:

Individuals who regularly use preventive chemotherapy were less infested (29.1%) than those who did it only after medical prescription (64.6%). This practice showed a very significant influence on the overall prevalence (χ^2=30.111; ddl=1; p<0.01; Table 3).

Variation of the infestation index according to different diagnostic techniques: Direct microscopic examination alone revealed an overall positivity rate of 31.25% (75/240) during the study. The additional techniques therefore allowed recovery of 41 samples falsely negative to this first method. In absence of these complementary techniques, the error rate is then 35.30%.

Table 2: Influence of socio-demographic factors on the overall prevalence

Variables	Positive cases		Negative cases		Total		Chi-square test
	N	%	N	%	N	%	
District							
Mbouda	50	44.2	63	55.8	113	47.1	χ^2=1.42; ddl=1;
Batcham	66	52	61	48	127	52.9	p=0.23ns
Age group							
[4M-5]	17	48.6	18	51.4	35	14.6	
[6-10]	25	59.5	17	40.5	42	17.5	
[11-15]	19	57.6	14	42.4	33	13.7	
[16-20]	11	57.9	8	42.1	19	8	
[21-25]	5	38.5	8	61.5	13	5.4	
[26-30]	6	30	14	70	20	8.3	
[31-35]	3	33.3	6	66.7	9	3.7	χ^2= 10.930;
[36-40]	5	50	5	50	10	4.2	ddl=13;
[41-45]	7	41.2	10	58.8	17	7.1	p=0.62ns
[46-50]	5	55.6	4	44.4	9	3.7	
[51-55]	5	38.5	8	61.5	13	5.4	
[56-60]	1	33.3	2	66.7	3	1.2	
[61-65]	4	51.1	3	42.9	7	3	
[66-70]	3	30	7	70	10	4.2	
Gender							
Female	70	47.9	76	52.1	146	60.8	χ^2=0.022;ddl=1; p=0.88ns
Male	46	48.9	48	51.1	94	39.2	
Occupation							
Students	65	57.1	49	42.9	114	47.5	χ^2=24.256; ddl=3;
Traders+resourcefuls	15	50	15	50	30	12.5	p=0.135ns
Famers+house keepings	25	38.5	40	61.5	65	27.1	
Civil servants	11	35.5	20	64.5	31	12.9	
School level							
Uneducated	4	28.6	10	71.4	14	5.8	χ^2=8.355; ddl=3;
Primary	55	53.4	48	46.6	103	42.9	p=0.048*
Secondary	53	50.5	52	49.5	105	43.8	
Higher	4	22.2	14	77.8	18	7.5	
Total	**116**	**48.3**	**124**	**51.7**	**240**	**100**	

Table 3: Influence of hygienic factors on the prevalence of intestinal parasitosis

Variables	Positive case		Negative case		Totals		Chi-square test
	N	%	N	%	N	%	
Drinking water source							
CDE	19	29.2	46	70.8	65	27.1	
Drilling	14	60.9	9	39.1	23	9.6	χ^2=23.479; ddl=4;
Well	49	67.1	24	32.9	73	30.4	p<0.01*
Marigot	7	58.3	5	41.7	12	5	
Others	27	40.3	40	59.7	67	27.9	
Hand washing							
With soap	24	36.4	42	63.6	66	27.5	χ^2=5.902; ddl=2;
Without soap	78	51.7	73	48.3	151	62.9	p=0.04*
No	14	60.9	9	39.1	23	9.6	
Raw vegetables washing							
Yes	54	37.8	89	62.2	143	59.6	χ^2=15.833; ddl=1;
No	62	63.9	35	36.1	97	40.4	P<0.01*
Type of toilet							
Modern	7	43.8	9	56.2	16	6.6	
Traditional	53	67.9	25	32.1	78	32.5	χ^2=24.231; ddl=3;
Semi-modern	52	36.6	90	63.4	142	59.2	p<0.01*
Absent	4	100	0	0	4	1.7	
Anal region cleaning							
Hygienic paper	71	42	98	58	169	70.4	
Water+paper	2	28.6	5	71.4	7	3	χ^2=14.746; ddl=3;
Tissue	0	0	1	100	1	0.4	p<0.01*
Green leaves	43	68.3	20	31.7	63	26.2	
Regular deworming							
Yes	32	29.1	78	70.9	110	45.8	χ^2=30.111; ddl=1;
No	82	64.6	46	35.4	130	57.2	p<0.01*
Total	**116**	**48.3**	**124**	**51.7**	**240**	**100**	

DISCUSSION

The main objective of this study was to determine the prevalence of intestinal parasites in this locality using three methods, including a direct microscopic examination, the Kato-Katz method and the formalin-ether concentration technique. These microscopic analyses revealed 116 individuals carrying at least one species of parasites, an overall prevalence of 48.3%. This value is similar to those obtained by Fouamno *et al*. (2011) which were 50.9% and 51.5% respectively in Kake and Barombi, two localities of Southwest Cameroon. Otherwise, these results are higher than those presented by Mbuh *et al*. (2010) who obtained a prevalence of 21% in Buea urban areas and those obtained by Lehman *et al*.(2012) who found a prevalence of 26.6% for intestinal parasites in the city of Douala and its rural area (Njombé). On the other hand, other studies have reported higher prevalences than this value: 60.82% in Ouagadougou, Burkina Faso (Ouermi *et al*., 2012) and 73.35% in the population of N'Djamena (Kostoingue *et al*., 2002).This difference could be because the diagnosis or study methods used are not the same. In addition, study periods and study frameworks are different. The most common parasite species identified in this study was *Entamoeba histolytica* with a prevalence of 41.5%, followed by *T. solium* (8%).This observation is similar to that made by Hamit *et al*. (2008) in N'Djamena who obtained during their survey a predominance of *Entamoeba histolytica* with a prevalence of 30.3%. Similarly, Faye *et al*. (1998) in Dakar and Ouermi *et al*. (2012) in Ouagadougou obtained a preponderance of *Entamoeba histolytica* with respectively 47.7% and 39.88%. The high rate of this parasite could be due to the presence of resistant cysts in the environment as well as abundance of flies, incriminated in their dissemination during the study period (rainy season).The high frequency of *T. solium* will probably be due to the enhanced consumption of undercooked pork in the locality. The study secondly aimed to identify risk factors associated to the transmission of intestinal parasitosis in Bamboutos Division. Based on the districts, no significant difference was found between infestation rates. This insignificance can be justified by the free movement of people between the two boroughs and permanent exchanges (markets, obsequies, agricultural self-help groups) that would consequently make that department a homogeneous entity regarding intestinal parasitosis. According to age groups, although the difference of observed infection rate was not significant ($p = 0.62$), the most infected individuals were those aged from 6 to 10 years (59.5%).These results are in line with those obtained by Mbuh *et al*. (2010) in Buea and those of Lehman *et al*. (2012) in Douala who note in their studies that, most parasitized age groups were 6 to 12 years and 6 to 10 years respectively. This observation could be explained by the fact that at this age, children become less and less overseen by parents and are engaged in activities that would expose them to more infections. Based on occupation, statistical analyzes revealed no significant difference in infestation ($P = 0, 135$).This observation could be explained by absence of a clear separation between occupations in the area. In fact, individuals of all professional categories recognized during the study also engaging in agricultural activities. A significant difference was observed in parasite prevalence by study level ($p = 0.04$).The least infected were people with a higher education level with a prevalence of 22.2%.This low rate in upper-level individuals could be explained by the fact that they are aware of risks due to exhibition to parasites. The analysis of infestation rate according to drinking water source showed that individuals who consume well water were more parasitized with prevalence of 67.1%, followed by those who consume borehole water whose prevalence was 60.9%.This result corroborates that of Adoubryn *et al*. (2001) who observed during their study in Toumodi that the most affected individuals were those who consume well water and river water (41.2% and 43.75% respectively) ; because the surrounding environment is often very unclean, there is stagnant water that infiltrates the soil and ensures the contamination of these water sources. In addition, most of these water points are built near septic tanks. Regarding the type of toilet used, a high prevalence was noted in individuals living without toilets (100%) while people with modern toilets were parasitized only on 43.8%. These observations join those of Aksoy *et al*. (2005) in Turkey and Soumana *et al*. (2016) in Niger who realized in their studies that families without latrines were significantly more infested than others. Similar studies in Morocco have shown that the presence of a septic tank (modern toilet) has a protective effect against intestinal parasites (Laamrani *et al*., 1999). The cleaning of the anal area and hand washing after defecation, studied in this work showed very significant differences ($p <0.01$). In fact, individuals using green leaves for faecal hygiene and those who did not wash their hands after defecation were more parasitized with respective rates of 68.3% and 83.3%. This observation is related to the very close contact

between the fingers and the faecal matter. Individuals who regularly deworm had low prevalence (29.1%), compared to those who rarely or never do it (64.6%). Statistical analysis of these results made it possible to note a positive relationship between parasite index and deworming. Although weak, the presence of infested individuals among those who are deworming could be explained by the fact that most of drugs used were anthelmintics. Complementary techniques (formalin-ether concentration technique and Kato Katz quantitative technique) resulted in the recovery of 41 false-negative direct examinations. This observation is similar to that made by Hamit *et al*. (2017) in two ecological Chad zones. They found that the direct observation method only covered 65.3% of the efficiency of Kato Katz method. This study confirms the fact that additional methods are recommended for mass surveys (Tchuem Tchuenté *et al*., 2012; Knopp *et al*., 2008 and WHO, 1983) and lead to suggest their systematic application in different hospitals.

CONCLUSION

This study shows high prevalence of intestinal parasitoses for dwellers of Bamboutos locality, with very heavy parasite loads being concentrated in a few individuals. Parasitism was mainly related to several endemic factors, such as: substandard living conditions and lack of personal hygiene, both at the individual and the community level and chemotherapy. This work therefore highlights the need to educate members of the community, especially those in rural areas, on the preventing methods of transmission and spread of human intestinal parasite infections.

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