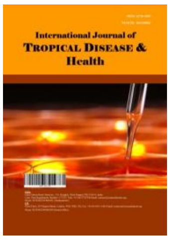

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The Prevalence, Intensity and Risk Factors of Gastrointestinal Parasitic Infections in Outpatients in Bafoussam II, West Region, Cameroon

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Gastrointestinal parasitic infections remain a public health problem in tropical and subtropical countries. This study aimed at assessing the prevalence and density of gastrointestinal parasites and to identify the risk factors of their transmission.

Methodology: A hospital-based cross-sectional study was carried out from June to October 2020, on outpatients visiting the Djeleng Sub divisional medical centre in Bafoussam II. All consenting participants provided a stool sample and completed an open-ended questionnaire. Stool samples were examined simultaneously as fresh wet mounts, formal-ether concentration technique and modified Zieihl Neelsen staining technique. Data was analysed using SPSS version 20.0.

Results: Results obtained from this study revealed that the overall prevalence and mean intensity of parasite infection was 29.1% (94/323) and 1464±314 ppg respectively. Parasites recovered were: *Entamoeba histolytica* 54.26% (51/94), *Trichomonas intestinalis* 21.28% (20/94), *Entamoeba coli* 19.15% (18/94), *Cryptosporidium spp* 3.19% (3/94) and *Trichuris trichiura* 2.13% (2/94). Prevalence was slightly higher in males 31.76% (27/85) than females 28.15% (67/238) and the

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difference was not statistically significant (p=0.364). The prevalence was higher among individuals aged 21-30 years 35.22% (31/88). Most infected individuals resided in Djemoun 40.0%(4/10) and this prevalence was significant (p=0.025). Hair dressers harboured the highest rate of intestinal parasites 60.0% (6/10) and the difference was not statistically significant (p=0.235). Hand washing practices, washing of fruits, walking bare footed, toilet cleaning, screening of houses, pet possession, and frequency of nail trimming were not identified as risk factors associated with gastrointestinal parasitic transmission (p>0.05).

Conclusion: Provision of health education, improving personal and communal hygiene, and community based deworming with addition of antiprotozoal drugs should be of major focus to prevent and control these infections.

Keywords: Gastrointestinal parasites; prevalence; intensity; risk factors; Bafoussam.

1. INTRODUCTION

Gastrointestinal parasitic (GIP) infections are fecally-derived diseases that mostly affect the impoverished communities in low and middle income countries of tropical and subtropical regions [1]. Discoveries from WHO uncovered that more than three billion of the world's population are infected by either one or more intestinal parasites, especially: *Ascaris lumbricoides*, *Trichuris trichiura* and hookworm [2].

Gastrointestinal parasitic infections are often neglected because they usually cause mild symptoms but they are of major concern due to the gastrointestinal disorders and malabsorption syndromes which can be serious especially in children and in immune compromised people. The foremost predominant morbidity associated with gastrointestinal parasitic infections are abdominal discomforts, dysentery and fatigue [3].

Although GIP infections are thought to be mostly prevalent in rural areas, they may also arise in other settings where the population have poor access to sanitation and poor hygienic conditions [4]. A related study on GIP infections in Tonga-Cameroon revealed a prevalence of 26.4% [5]. Another study in Buea-Cameroon revealed the prevalence of intestinal protozoan *E. histolytica* to be 24.4% and *G. lamblia* was 0.6% [6].

Most of these infections tend to be asymptomatic or mild. However, pathogenic forms of gastrointestinal parasites (*Entamoeba histolytica*, *Giardia intestinalis, Isospora belli, Cryptosporidium parvum, Cyclospora cayetanensis, Microsporidium spp,* etc) can cause severe symptoms such as diarrhoea and dysentery especially in children and immune compromised persons.

Millions of cases of diarrhoea occur each year. Negative effects on growth of children are due to malabsorption of fat and vitamin B12, Vitamin A deficiency and other nutritional deficiencies [7].

Age and sex-related behavioural propensities, eating propensities, financial status as well as insufficient access to sanitation, clean water and individual cleanliness are the most frequent risk factors cited for GIP infections [3].

Despite the numerous studies carried in other parts of Cameroon with a prevalence range of 4.4% - 26.4% [8] [5], little or no study has been carried out in this locality. Therefore, this study seeks to investigate the rate of infection and intensity of GIP infections and evaluates risk factors through questionnaires.

Data obtained from the study will reduce the morbidity associated with GIPs and thus resolve or improve the health situation of the people. Our result will also act as baseline data for other research avenue.

2. MATERIALS AND METHODS

2.1 Study Design, Site, Population and Sample Size

This cross-sectional study of 323 participants was carried out from June to October 2020 at the Djeleng Sub divisional health centre. All patients attending this hospital and consenting to participate were included in the study and interviewed through a pre tested, close ended questionnaire. The questionnaire included information on demographic and socio-economic characteristics, sanitary situation, and hygienic behaviours.

The participants were given a screw-capped plastic bottle for collection of a faecal sample. Each bottle was properly labelled with the patient's identification code.

This study was carried out at the Djeleng Sub Divisional health centre in Bafoussam. Bafoussam has an urban population of 347,517 inhabitants (2008 census data, unpublised). It is the centre of trade, and agriculture where the people farm crops like coffee, potatoes, maize, beans etc. [9].

Participants of all age groups and both sexes who consented were enrolled in the study. Excluded from the study were the mentally ill and those did not consent.

Assuming a prevalence of 28% obtained from a similar study [10], the minimum sample size was 310 individuals calculated using the Cochran's formula ($n=Z^2pq/e^2$ where n= sample size, e= margin of error [0.05], p= the proportion of the population [0.28], q=1-p [0.72], and the z-value if found in a Z Table [1.96]).

2.2 Sampling Processing

Fresh stool specimens from 323 outpatients of both sexes and in all age groups were collected and examined macroscopically for consistency, texture, presence of blood and mucus. The samples were then examined microscopically by direct wet mount to detect the presence of trophozoites, eggs and cysts of intestinal parasites. In addition, the formal-ether concentration technique was performed to detect and enumerate parasite eggs and cysts and modified Zieihl-Neelsen (ZN) method was also performed to detect and enumerate coccidian species.

2.2.1 Direct smear examination

A parcel of stool sample was examined by direct wet saline mount preparation (0.90% sodium chloride solution) to observe and enumerate motile intestinal parasites, eggs and trophozoites under the light microscope at 10X and 40X magnifications. In addition, Lugol iodine staining technique was also performed to observe cysts of the intestinal protozoan parasites [11].

2.2.2 Formal-ether concentration technique

Each stool sample was also processed using the formal-ether concentration technique [6]. The slides were viewed under the light microscope at 10X and 40X magnifications. A little portion of the stool samples were also preserved in 10% formalin for repeating the tests when need be.

2.2.3 Modified Zieihl-Neelsen staining technique

Thin smears were made from fresh or sediments of concentrated stool samples, air-dried, and fixed with absolute methanol for 5 minutes. The slides were stained with carbol-fuchsin for 10 minutes and washed with tap water. The slides were then decolorized with 1 % hydrochloric acid-ethanol for 2 minutes and counter stained with 0.25 % methlyene blue for 1 minute and air dried [12]. Finally, the stained smears were examined using oil immersion (100X) objective to detect and enumerate oocysts of some protozoans.

2.3 Statistical Analysis

Data obtained during the study was exported to SPSS version 20.0 for further analysis. Descriptive statistics were presented as counts, percentages, means and standard deviations. Differences in proportions (for sex, age groups, locality and occupation) were determined using the Chi-squared test and differences in group means (for diagnostic methods) determined using the Fischer's test. The Mann Whitney U test and Kruskal Wallis test were used to compare means between sex and age groups respectively. Logistic binary regression was used to test the strength of the association between risk factors and transmission of gastrointestinal parasites. The level of significance was set at $P < 0.05$.

3. RESULTS

3.1 Prevalence of Gastrointestinal Parasites

Out of the 323 (238 females and 85 males) patients examined for gastrointestinal parasites, a total of 94 (29.10%) tested positive. Four protozoans which included: *Entamoeba coli*, *Entamoeba histolytica*, *Trichomonas intestinalis*, and *Cryptosporiduim spp* with specific prevalences of 19.15% (18/94), 54.26% (51/94), 21.28% (20/94), and 3.19% (3/94) respectively and one nematode species *T. trichiura* 2.13% (2/94) were recorded during the study (Fig. 1, Table 1).

Our data indicates that more males (31.76%, 27/85) were infected than females (28.15%, 67/238), however, this difference was not statistically significant (p=0.364). With respect to age, the study revealed that, the highest prevalence of 35.22% (31/88) was observed in individuals aged between 21-30 years, closely followed by the 31-40 years age group with 31.58% (11/57).

The prevalence of *E. coli* and *T. intestinalis* were higher in patients between 11-20 years of age with a prevalence of 23.81% (5/21) and 33.33% (7/21) respectively. *E. histolytica* and *Cryptosporiduim spp* highest prevalence was seen in age group ≥41 years with 62.5% (5/8) and 12.5% (1/8), while *T. trichiura* highest prevalence 31-40 years (5.56%, 1/18) respectively. As shown in Table 1, the difference in prevalence amongst age groups was not statistically significant (p=0.475).

Parasites were recovered in each month (June to October) during the study. The peak prevalence was observed in October (40.0%, 14/35) and lowest in June (13.24%, 9/68). The difference in prevalence of intestinal parasites with respect to months was not statistically significant (p=0.082). Among the positive cases, highest prevalence of *E. coli* was observed in June 44.44% (4/9) and *E. histolytica* in July 72.0% (18/25). Highest prevalence of *T. intestinalis* and *T. trichiura* were seen in September 38.89% (7/18) and 11.11% (2/18) respectively, *Cryptosporidium spp* peak prevalence was observed in August (7.14%, 2/28) and October (7.14%, 1/14).

As observed in Table 1, among these parasites species infected, there was a significance difference in the monthly prevalence of *E. histolytica* (p=0.032). The prevalence among locality differed significantly (p=0.025). Specifically, among positive cases, infection with *E. coli* was higher in Djeleng with 33.33% (2/6), *E. histolytica* was most prevalent in quartier Hausa 100% (1/1). *T. intestinalis* infection rate was higher in Ngouache (40%, 2/5), *Cryptosporiduim spp* peaked in Tougang (8.33%, 1/12) and *T. trichiura* was exclusively prevalent in Kouogouo (4.88%, 2/41). As observed, the prevalence of each intestinal parasite species did not differ significantly among locality (p>0.05) as shown in Table 2.

Most infected with gastrointestinal parasites were hairdressers with 60% (6/10), followed by traders (44%, 11/25) and housewives (34.04%, 16/47). Infection rate varied but had no significant difference according to occupation (p=0.235). Housewives harboured all the five intestinal parasites recovered during the study. Among positive cases, prevalence of *E. coli* was relatively high in tailors (50.0%, 1/2). The rate of infection with *E. histolytica* was higher in traders (72.73%, 8/11). Both *T. intestinalis* and *Cryptosporidium spp* peak prevalence were recorded among teachers with 66.67% (2/3) and 33.33% (1/3) respectively, and *T. trichiura* rate of infection was higher in patients practising other professions as shown in Table 2.

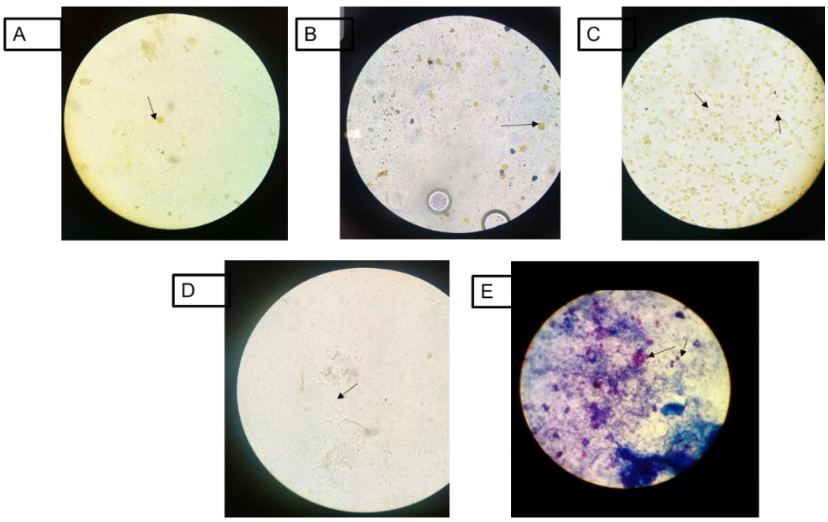

Fig. 1. Different parasites recovered during the study (A= *E. coli*, B= *E. histolytica*, C= *T. intestinalis*, D= *T. trichiura*, E= *Cryptosporidium spp*)

Table 1. Prevalence of GIP in relation to sex, age group, month and locality

Description	No examined	No Infected (%)	Species infected (Prevalence %)				
			E. coli	*E. histolytica*	*T. intestinalis*	*Cryptosporidium spp*	*T. trichiura*
Sex							
Females	238	67 (28.15)	10 (14.93)	39 (58.21)	14 (20.90)	3 (4.48)	1 (1.49)
Males	85	27 (31.76)	8 (29.63)	12 (44.44)	6 (22.22)	0	1 (3.70)
Total	323	94 (29.10)	18 (19.15)	51 (54.26)	20 (21.28)	3 (3.19)	2 (2.13)
χ^2		0.824	3.231	0.242	0.149	0.719	0.582
p-value		0.364	0.072	0.622	0.699	0.379	0.445
Age group (years)							
≤10	64	16 (25.0)	2 (12.50)	9 (56.25)	5 (31.25)	0	0
11-20	82	21 (25.61)	5 (23.81)	9 (42.86)	7 (33.33)	0	0
21-30	88	31 (35.22)	6 (19.35)	17 (54.84)	5 (16.13)	2 (6.45)	1 (3.23)
31-40	57	18 (31.58)	4 (22.22)	11 (61.11)	2 (11.11)	0	1 (5.56)
≥40	32	8 (25.0)	1 (12.5)	5 (62.5)	1 (12.5)	1 (12.5)	0
Total	323	94 (29.10)	18 (19.15)	51 (54.26)	20 (21.28)	3 (3.19)	2 (2.13)
χ^2		6.574	2.145	6.008	2.804	5.374	2.685
***p*-value**		0.475	0.951	0.539	0.903	0.614	0.913
Months							
June	68	9 (13.24)	4 (44.44)	5 (55.56)	0	0	0
July	80	25 (31.25)	7 (28.0)	18 (72.0)	1 (4.0)	0	0
August	79	26 (32.91)	3 (10.79)	13 (46.43)	9 (32.14)	2 (7.14)	0
September	61	18 (29.51)	3 (16.67)	6 (33.33)	7 (38.89)	0	2 (11.11)
October	35	14 (40.0)	1 (7.14)	9 (64.29)	3 (16.67)	1 (7.14)	0
Total	323	94 (29.10)	18 (19.15)	51 (54.26)	20 (21.28)	3 (3.19)	2 (2.13)
χ^2		8.260	2.560	10.595	14.803	4.688	8.644
***p*-value**		0.082	0.634	0.032	0.05	0.321	0.071

Table 2. Prevalence of GIP in relation to the locality and occupation

Variable	No examined	No infected (%)	Parasitic species (%)				
			E. coli	***E.h***	***T.i***	**C. spp**	***T.t***
Locality							
Djeleng	43	6 (13.96)	2 (33.33)	2 (33.33)	2 (33.33)	0	0
Djemoun	10	4 (40.0)	0	3 (75.0)	1 (25.0)	0	0
Haoussa	11	1 (9.10)	0	1 (100.0)	0	0	0
Kamkop	14	5 (35.71)	1 (20.0)	4 (80.0)	0	0	0
Kouogouo	111	41(36.94)	10(24.39)	21(51.22)	6 (14.63)	2(4.88)	2 (4.88)
Ngouache	13	5 (38.46)	0	3 (60.0)	2 (40.0)	0	0
Tougang	47	12(25.53)	2 (16.67)	5 (41.67)	4 (33.33)	1(8.33)	0
Tyo-ville	36	8 (22.22)	1 (12.5)	4 (50.0)	3 (37.5)	0	0
Others	38	12(31.58)	2 (16.67)	8 (66.67)	2 (16.67)	0	0
Total	323	94(29.10)	18(19.15)	51(54.26)	20(21.28)	3(3.19)	2 (2.13)
χ^2		30.239	15.997	21.691	10.700	3.844	3.844
P-value		0.025	0.524	0.197	0.827	1.000	1.000
Occupation							
None	20	3 (15.0)	1 (33.33)	2 (66.67)	0	0	0
Hairdressers	10	6 (60.0)	2 (33.33)	3 (50.0)	1 (16.67)	0	0
Housewives	47	16(34.04)	2 (12.5)	10(62.50)	1 (6.25)	2(12.50)	1 (6.25)
Scholars	154	41(26.62)	7 (17.07)	22(53.66)	12 (29.27)	0	0
Tailors	14	2 (14.29)	1 (50.0)	1 (50.0)	0	0	0
Teachers	12	3 (25.0)	0	0	2 (66.67)	1(33.33)	0
Traders	25	11 (44.0)	2 (18.18)	8 (72.73)	1 (9.09)	0	0
Others	41	12(29.27)	3 (25.0)	5 (41.76)	3 (25.0)	0	1 (8.33)
Total	323	94(29.10)	18(19.15)	51(54.26)	20(21.28)	3 (3.19)	2 (2.13)
χ^2		34.105	46.749	29.702	38.445	11.818	42.072
P-value		0.235	0.020	0.429	0.113	0.998	0.055

E.H: Entamoeba Histolytica, C. SPP: Cryptosporidium Species, T.I: Trichomonas Intestinalis, T.T: Trichuris Trichiura

Table 3. GIP counts from each laboratory analysis method

Method	Parasitic species				
	E. coli	***E. histolytica***	***T. intestinalis***	**C. spp**	***T. trichiura***
DMW					
Count	107 cysts	248 cysts	162 flagellates		4 eggs
Mean count	0.33±3.018 cysts	0.77±3.024 cysts	0.5±2.293 flagellates		0.1±0.176 eggs
F	0.379	1.143	0.940		0.320
p-value	0.91	0.194	0.329		0.945
FECT					
Count	246 cysts	698 cysts			9 eggs
Mean count	0.76±5.408 cysts	2.16±7.707 cysts			0.03±0.356
F	0.259	2.082			0.412
p-value	0.969	0.045			0.895
M-ZN					
Count				10 oocysts	
Mean count				0.02±0.283	
F				0.740	
p-value				0.638	

Dmw: direct wet mount, fect: formal ether concentration technique, m-zn modified zieihl neelsen staining, c. Spp: cryptosporidium species

Table 4. Mean parasite density of gastrointestinal parasite according to sex and age

Sex	***E. coli***	***E. histolytica***	***Cryptosporidium* spp**	***T. intestinalis***	***T. trichiura***	**TOTAL**
	GMCD±SEM	**GMCD±SEM**	**GMOD±SEM**	**GMFD±SEM**	**GMED±SEM**	**GMPD±SEM**
Males	1323±1696	2617±1089	0	2008±655	1050±0	2074 ±7 81*
Females	1140±956	1039±333	815±361	1999±395	900±0	1269 ± 296*
Total	1224±929	1278±370	815±361	2001±331	973±75	1464 ± 314
Sig	*p* = 0.918	*p = 0.02*	ND	*p* = 0.494	*p* = 1.000	*p* = 0.055*
Age group (years)						
≤ 10	7349±7500	1416±673	0(0)	2256±880	0 (0)	2030 ± 1034*
11 – 20	1299±1722	1009±378	0 (0)	1897±451	(0)	1295 ± 566*
21 – 30	1162±497	868±542	1352±150	1853±865	1050-0	1167 ± 422*
31 – 40	948±154	1491±799	0 (0)	1775±300	900-0	1372 ± 518*
41 – 50	150±0	5428±2801	300±0	3000±0	0 (0)	3070 ± 2111*
≥ 51	0 (0)	2850±0	0 (0)	0 (0)	0 (0)	2850 ± 0*
Sig.	*p* = 0.152	*p* = 0.142	*p* = 0.667	*p* = 0.913	*p* = 1.000	*p* = 0.317*

N: indicate total number of participants examined for each category

GMCD: Geometric mean cysts density; GMED: Geometric mean egg density; GMOD: Geometric mean oocyst density; GMFD: Geometric mean flagellate density; GMPD: indicates total geometric parasite density in the population irrespective of species. SEM: Standard error of mean.

** indicate probability values for the Mann Whitney U test and Kruskal Wallis Test that were used to compare means between sex and age groups respectively*

Among the parasitic species, the prevalence of only *E. coli* had a significant difference in relation to occupation (p=0.020). The prevalence of each parasite species infected according to occupation varied as shown in Table 2.

3.2 Intensity of Gastrointestinal Parasites

The formal-ether concentration technique (FECT) recovered the highest number of parasites (exact number of parasite stage observed under the microscope per 100 fields) while direct wet mount (DWM) recovered the highest number of parasitic species. The difference in the mean counts of the parasitic species recovered by direct wet mount was not statistically significant (p>0.05) as shown in Table 3. For the FECT, *E. histolytica* had a significantly (p=0.045) high mean count (2.16±7.707) than *E. coli* and *T. Trichiura. T. intestinalis* and *Cryptosporiduim spp* were only recovered by DWM and modified Zieihl Neelsen staining technique respectively (Table 3).

The overall GMPD (geometric mean parasite density=1464 ± 314ppg) was not statistically significant according to gender (p=0.055).

From Table 4, males had higher geometric means (2074±781 ppg) than females (1269±296 ppg). However, there was a significant difference in the geometric mean cyst density (GMCD=1278±370 cpg) of *E. histolytica* with respect to gender (p=0.02).

Variations in the total GMPD with respect to age was not statistically significant (p>0.05), however, the age group 41-50 years had the highest GMPD (3070±2111 ppg) and the 21-30 years had the lowest GMPD (1167±422 ppg). It was also observed that, the highest geometric mean intensity for *E. coli* was among individuals aged ≤10 years (7349±7500 cpg), *E. histolytica* and *T. intestinalis* highest mean intensity was among the 41-50 years (5428±2801 cpg and 3000±0 fpg respectively), geometric mean intensity for *Cryptosporidium spp* and *T. trichiura* peaked among individuals aged 21-30 years (1352±150 opg and 1050±0 epg respectively).

The differences in GMPD of the various parasites according to month was not statistically significant (p>0.05) (Table 5). However, *E. histolytica* and *Cryptosporidium spp* had their highest geometric mean density in the month of October with 2399±683 cpg and 1200±0 opg respectively. *E. coli* geometric mean cyst density (GMCD) was highest in July (3000±0 cpg). *T. trichiura* was only recovered in September with a geometric mean egg density (GMED) of 972±75 epg.

3.3 Association of Risk Factors and Prevalence of GIP

As shown in Table 6, results obtained from the questionnaire survey uncovered that factors such as hand washing before meals (β = -0.039, OR: 0.962), hand washing after using the toilet (β= -0.190, OR: 0.827), hand washing after touching contaminated objects (β= -0.705, OR: 0.340), trimming of nails weekly (β= -0.689, OR: 0.502), and trimming of nails daily (β= -1.600, OR: 0.202) influenced the transmission of GIPs. Periodic water treatment was found to have more impact on the prevalence of GIPs compared to other risk factors. We observed that risk factors were not significantly associated with prevalence of GIPs (p>0.05).

Table 5. Monthly mean parasite density

Months	***E. coli***	***E. histolytica***	***T. trichiura***	***T. intestinalis***	***Cryptosporidium* species**
	GMCD±SEM	GMCD±SEM	GMED±SEM	GMFD±SEM	GMOD±SEM
June	2404±3285	567±358	0	0	0
July	1015±1491	914±410	0	3000 ±0	0
August	735±189	1945±1140	0	1660±306	671±600
September	982±477	1513±1054	972±75	2035±743	0
October	1678±1500	2399±683	0	2952±954	1200±0
Total	1224±929	1278±370	0	2002±331	815±361
P-value.	0.555	0.098	ND	0.333	1.000

Table 6. Logistic Binary regression to explore the relationship between human attitude and outcome of parasitic infection

Independent variable (Predictors)	Independent variable = intestinal parasite infection							
	β	S.E.	Wald	Df	*p - value*	Odd Ratio (OR)	95% C.I. for OR	
							Lower	Upper
Hand washing before meal	-0.039	0.888	0.002	1	0.965	0.962	0.169	5.479
Hand washing after toilet	-0.190	0.837	0.052	1	0.820	0.827	0.160	4.261
Water treatment	20.386	27122.074	0.000	1	0.999	713434874.642	0.000	-
Water treatment with Cl	-1.782	1.470	1.470	1	0.225	0.168	0.009	3.000
Washing of fruits/vegetables	0.333	0.648	0.264	1	0.607	1.395	0.392	4.964
Walking barefoot	0.612	0.596	1.054	1	0.305	1.845	0.573	5.937
Daily cleaning of toilet	0.556	0.467	1.417	1	0.234	1.744	0.698	4.355
Stagnant water around house	0.105	0.525	0.040	1	0.841	1.111	0.397	3.108
Screening of house vent	1.206	1.181	1.043	1	0.307	3.340	0.330	33.805
Possession of pet	-0.454	0.641	0.503	1	0.478	0.635	0.181	2.230
Hand washing after touching contaminated object	-0.705	0.740	0.909	1	0.340	0.494	0.116	2.106
Trimming nails monthly	Reference		4.417	2	0.110			
Trimming nails daily	-1.600	0.947	2.851	1	0.091	0.202	0.032	1.293
Trimming nails weekly	-0.689	1.085	0.403	1	0.525	0.502	0.060	4.211

β: values for the logistic regression equation for predicting the dependent variable from the independent variable; S.E : standard error; df: degree of freedom; OR: odd ratio; C.I: confidence interval

4. DISCUSSION

The main interest of this study was to determine the prevalence and intensity of GIP infections. The overall prevalence of 29.1% obtained in this study is similar to earlier studies from Tonga (26.4%) [5] and 28% in Nigeria [10]. However, the prevalence was higher when compared with studies from Douala (15.2%) and Uttarakhand in India (11.6%) [13,14].

Results of this present study are lower when compared with studies from Burkina Faso and Ethiopia, who recorded a prevalence of 65.3% and 46.2% respectively [15,16]. The contrast in the findings observed in this study may be due to distinctive socio-economic conditions in the study population, personal behavioral habits of the selected study group, quality of drinking water supply, sanitation and other natural conditions in the area.

The prevalence of intestinal parasites by sex showed that males were slightly more infected than females with a rate of infection of 31.76% and 28.15% respectively. This finding is in agreement with those from other parts of Cameroon [6,17]. This can be explained by the fact that men in this locality are frequently engaged in agro-pastoralism and thus are comparatively more exposed to contaminated soil and water, a major predisposing factor for infection.

Males had a higher mean intensity of infection with 2074±781 ppg than females with 1269±296 ppg but the difference was not significant. This finding contradicts that of Buea where females had a higher intensity of infection than males [6]. This could be due to the fact that males are more exposed to farming activities, trading and usually tend to be negligent towards basic hygienic practices such as washing of hands before eating.

With regard to the distinctive species of parasites identified, *E. histolytica* showed a relatively higher prevalence and mean intensity of infection than the other parasite species observed. These results are similar to those reported in Buea [6]. The high rate of infection of *E. histolytica* observed in our study could be due to the existence of favorable transmission factors such as poor hygienic practices and/or abundance of mechanical vectors in our study area.

With respect to the time of stool sampling and examination, the month of October had the highest prevalence of intestinal parasites (40%) while the highest mean parasite density was observed in August. Lower infection rate in the light rainy season (June and July) could be explained by the fact that, harshness of the weather during this period generally contributes to reducing the infection rate to a considerable extent. With the coming of heavy rains in August, conditions for transmission become more favorable. Infection may easily be picked when carrying out farming activities.

Eating of raw vegetables, like carrots, lettuce and cabbage used in salad, may be contaminated and similar to fruits like pears, guavas, oranges and mangoes when in season. The sanitary condition of greens and vegetables on sale in our local markets are a common source of parasitological contamination. These and other factors may be responsible for the build-up of infection in the body.

The increased contact with contaminated soil during farming in the rainy season, facilitates infection by STHs, leading to increased number of people infected during this period with low worm burdens. Infection rate of *E. histolytica* was significantly affected by the month of sampling. This finding is in line with another one from Kumba where the period of sampling affected the prevalence of gastrointestinal parasites [18].

The high rate of infection and mean intensity observed in the age group 21-30 years was an indication that, individuals within this age group are more exposed. They are usually more active and frequently involve themselves fully in activities (such as leisure, farming, keeping long nails for esthetic purposes and poor hygienic practices due to their occupations) that bring them in contact with sources of infection and they tend to be negligent towards basic hygiene and sanitation practices. This finding is in agreement with that of Tonga [5] and different from that in Nigeria and Dschang [19,20].

Lower rate in the other age groups ≥ 41 years, can be explained by the sedentary state of life style and also immunity against intestinal helminths increases with age due to higher level of acquired immunity in the older ones [21].

The prevalence of gastrointestinal parasitic infections varied significantly between the different localities with Djemoun harboring most of the parasites. This could be attributed to some social habits as well as the standard of personal and environmental hygiene.

In the present study, prevalence with respect to principal activity revealed that the rate of infection with gastrointestinal parasites among hair dressers (60%) were higher compared to those among traders (44.0%), house wives (34.04%) and scholars (26.62%). The reason for this finding may be due to uniform exposure to GIP infections across all members of the population irrespective of their occupations. Also, most of the inhabitants practice farming irrespective of their occupation.

The count of gastrointestinal parasites was observed to be higher using formal ether concentration technique than using direct wet mount except for the recovery of *T. intestinalis*. This was surely due to the fact that in the course of processing stool by the FECT method, the flagellates were damaged which made identification under the microscope difficult. Effectiveness of FECT over DWM was surely due to the higher quantity of stool used and also in the course of filtering, stool debris were eliminated making parasite enumeration easier.

Periodic water treatment was observed to have more impact on the prevalence of GIPs and this could be explained by the fact that treating water by boiling and chlorination tend to destroy GIPs present. Handwashing practices was observed not to affect the infection rate. Information collected in this study were reports from participants, hence untrue affirmations may have been given by some participants. A reliable assessment could be undertaken to highlight whether participants systematically washed hands or not.

Occurrence of reinfection was the most proper interpretation since hygienic conditions like hand washing before eating as well as after defecation or touching contaminated objects was not respected by some participants. However, drug intake was associated with reduced likelihood of GIP infections though not statistically significant.

Trimming of nail greatly affect the prevalence of GIPs but this difference was not significant. This finding may be due to the fact that nails can serve as storage sites for dirt and may also accidentally store stool particles while cleaning the anus after defecation, favoring reinfection.

5. CONCLUSIONS

Our study revealed that, the overall prevalence of gastrointestinal parasites was 29.1% and the most prevalent parasitic species was *Entamoeba histolytica* (54.26%). This study also revealed that GIP infections are prevalent among outpatients in Bafoussam II and associated (though not significantly) with various biological, social, behavioral and environmental factors like poverty, lack of personal hygiene and poor sanitation practices and thus calls for prompt and intermittent control and preventive measures at individual and communal levels.

CONSENT

Informed written consent was obtained from each study participant and from the parents/guardian of participant less than 18 years old. Participants were free to pull back their consent at any moment and participants' information was treated as confidential.

ETHICAL APPROVAL

This study was carried out with the approval of the Regional delegation of public health for the West Region, District health service of Mifi, and Djeleng Sub divisional health centre. Equally, Ethical clearance was obtained from the ethical review board of the Faculty of Science, the University of Bamenda.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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