

Gastrointestinal Parasites Amongst Epileptic and Non-Epileptic: Prevalence and Associated Risk Factors of Gastrointestinal Parasites Amongst Epileptic and Non-Epileptic Individuals in Batibo Subdivision, Northwest Region of Cameroon: A Community-Based Cross-Sectional Survey

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ABSTRACT

The aim of this study was to investigate the prevalence of gastrointestinal parasites and establish the relationship between the prevalence of these parasites and epilepsies amongst the population and associated risk factors. This cross-sectional survey was carried out in Batibo Health District from April 2021 to July 2021. A total of 402 stool samples were collected and examined using the Formol-Ether concentration technique to detect the presence of helminth eggs. A well-structured and pretested questionnaire was administered to collect socio-demographic data and to assess the risk factors. Data was analyzed using SPSS vs 23. P values ≤ 0.05 were considered significant. Ages ranged from 3-72 years and the highest number of participants were females 275 (68.4%). Results obtained showed that the overall prevalence of persons with intestinal helminths was 12.4% (50/402). *Taenia* spp was the most prevalent parasite 4.2% (17/402) followed by *Ascaris lumbricoides* 4.0% (16/402), *Entamoeba coli* 3.0% (12/402) and the least prevalent species was *Ancylostoma/Necator* spp, 2.2% (09/402). Two participants (0.5%) each had multiple infections with *Ascaris* /*E coli* and *Ascaris*/hookworm infection. Parasitic infections were significantly higher in participants of age group 15-24 years (29.5%; $p=0.0001$), and insignificantly higher in females (13.5%; $p=0.363$) and students (32.1%; $p=0.070$). Parasitic infections were also significantly ($p=0.004$) higher in epileptic participants 34.04% (16/47) who were more infected with *Taenia* spp 17.02% (8/47). Multivariate analyses showed significant predisposing social factors of intestinal parasites identified in this study such as source of water (boreholes, 0.041 and streams, 0.018), frequency of deworming (twice yearly, 0.043), lack of latrines (0.034) and geophagia (0.023). Multivariate analyses also showed that the use of boreholes 2.815 (0.849-9.3), streams 4.329 (1.29-14.5), deworming once in six months 0.28 (0.08-0.98), geophagia participants 1.02 (1.24-10.45) and participants who eat pork or beef 0.034 (0.58-1.0) were risk factors for the development of intestinal parasites. Thus, the prevalence of gastrointestinal parasites has increased considerably over the years although the rate is not alarming.

Keywords: Gastrointestinal Parasites, Epilepsies, Formol-Ether, Intestinal Helminth, *Taenia* Spp, *Ascaris* /*E Coli*, *Ascaris Lumbricoides*, Multivariate Analysis.

INTRODUCTION

Epilepsy is a neurological disorder characterized by sudden, recurrent, and unpredictable interruptions of normal brain function [1-5]. This condition results in chronic morbidity and considerable mortality in resource-poor populations because of its high prevalence and inadequate and late treatment [6-10]. One of the leading causes of seizures and epilepsy in developing countries is neurocysticercosis (NCC), a helminthic disease of the central nervous [11, 10]. Trauma, genetic predisposition, other infections, social and cultural factors contribute to epilepsy prevalence worldwide [12].

Major public health problems in developing countries are caused by intestinal helminthes and protozoans [13-15]. About two billion people worldwide are estimated to be affected by Geohelminthiasis, caused mainly by *Ascaris lumbricoides*, *Ancylostoma/Necator* spp. and *Trichuris trichiura*. A further 50 million are infected by *Entamoeba histolytica* and 2.8 million by *Giardia duodenalis* [16-18]. These infections have common characteristics; they are highly endemic in populations with low socio-economic status and poor hygiene, favouring larval skin penetration and oral faecal transmission [18-22]. The parasites are important causal agents of gastrointestinal disorders such as diarrhoea, dysentery, vomiting, lack of appetite, haematuria, abdominal distension and sometimes mentally related disorders [23, 22]. Moreover, heavy chronic infections with *Ascaris lumbricoides* and hookworms (*Ancylostoma doudenale* or *Necator americanus*) may cause malnutrition and anaemia in high-risk groups [24,20,25].

Intestinal parasitic infections (IPIs) are among the most prevalent neglected tropical diseases (NTDs) affecting one third of the world's population and rely mainly on poor hygiene and sanitation living conditions [26]. Highest IPIs prevalence are reported mostly across Sub-Saharan African countries where transmission is favoured primarily by scattered and overcrowded settlements aggravated by lack of safe drinking water and adequate hygiene practices, improper sanitary habits, poor faecal disposal systems and poor socioeconomic status [27]. Despite significant progress made in most African countries to improve sanitation and access to potable drinking water, in 2012 only 74% and 45% of the Cameroonian population use improved drinking water sources and improved sanitation respectively, the remaining population therefore use poor sanitation conditions and doubtful drinking water source [27] thereby giving the way to poor hygiene-related infectious diseases.

Cysticercosis caused by the larval forms of *Taenia solium* remains a major public health problem in lower-income and some industrialized countries. It is reported as one of the major causes of epilepsy in the tropical [28-29].

In Africa, the importance of human cysticercosis is unclear because of the lack of well-developed medical infrastructures or diagnostic facilities [30]. But, epidemiological studies of the disease have been conducted in several countries, like Benin, the Island of Reunion, Madagascar, Togo and Burundi [31].

In Cameroon, cases of human cysticercosis were first reported in 1985 in the Western Province [32]. In a sero-epidemiological study carried out in Menoua Division (West Province), [33] reported a sero prevalence of 2.4%. Today, there are indications that human cysticercosis remains a serious public health problem [34].

Culture has a great influence on people's beliefs about illness and treatment of disease. From antiquity, people with epilepsy (PWE) have been subject to much stigma and discrimination. This situation severely compromises their access to treatment and, consequently, their quality of life. In Cameroon, the prevalence of epilepsy is about 6.0%, among the highest rates reported in the world [35]. This makes epilepsy a major public health problem in Cameroon. With more than 250 ethnic groups, Cameroon provides an ideal setting for possible variations in the perceptions of epilepsy. Although many etiological and risk factors for epilepsy have been demonstrated in Cameroon [36], traditional indigenous medicine still plays an important role in epilepsy management, as up to 25% of epileptic patients seek traditional treatment [37]. Many sociocultural factors including stigma and discrimination are often to blame for the epilepsy treatment gap and poor quality of life of the patients. However, these factors have not been well studied in Cameroon. To our knowledge, not much work has been done in the domain of knowledge, attitudes, and practices with respect to the disease. Previous research has reported a high level of awareness of epilepsy among secondary school students in the Batibo Health District, but also a relatively high level of stigma and discrimination against people with epilepsy in this district, traditional beliefs appearing to be the determinant [38].

The Moghamo people are known for various cultural practices which revolve around pig production and consumption. Most pig farming households do not follow the necessary sanitary procedures to keep themselves protected from the numerous parasites that accompany the production and consumption of pork mostly intestinal parasitic infections. It is for this reason that it is necessary to investigate the various intestinal parasites prevalent among the population and also to establish the cultural and socio-risk factors associated with the prevalence of these infections and the development of clinical epileptic symptoms in this area. To effectively determine the prevalence and risk factors associated with intestinal parasites among epileptic and non-epileptic participants in the Batibo subdivision, we were guided by the following questions;

1. What is the prevalence of intestinal parasites among the population and what species of intestinal parasites are prevalence among the Moghamo people of the Batibo subdivision?
2. What are some of the socio-demographic characteristics that may affect the prevalence of intestinal parasites in the population?
3. Is the prevalence of intestinal parasites higher in epileptic participants compared to non-epileptic participants and which parasites are common among participants with epilepsy?
4. What are the risk factors responsible for the prevalence of intestinal parasites among the population?

This study will bring significant input in the following ways:

Provide useful information to

- Health authorities on the various types of intestinal parasites prevalent among the population of the Moghamo clan.
- Provide useful information about the cultural practices among the population responsible for *Taenia solium* prevalence.
- Help local health authorities plan educational and deworming campaigns based on the data made available from the findings.

- Published data from this study will help future scholars and will also create avenue for further research if need be.

MATERIAL AND METHODOLOGY

Study Setting



Studied Population

Participants included villagers who had been living in the village for more than three months, gave their consent to participate and who provided stool samples as instructed by the researcher. A clean dry, air tight container was used for the collection of early morning faecal samples. An average of 50 samples were collected weekly and transported in a cooler to laboratory (People's Clinic Laboratory at Ngomgham) for analysis. Access to the villages was facilitated by the chief of the health centers of Kulabei, Kuruku, and Kugwe.

Data Collection, Instruments, Methods, and Techniques

Collection of Qualitative Data:

The socio-demographic information of the participants was collected through the administration of a pretested, well-structured questionnaires based on the known risk factors of intestinal parasites (Appendix 6). The questionnaire addressed socio-demographic information such as age, sex, level of education, marital status etc, and risk factors associated with the infection such as hand washing habits, source of drinking water, type of latrine, fruit and vegetable washing habits. The questionnaire was purposeful and prepared in English Language. Participants who could read and write completed the questionnaire, while those who couldn't were assisted by the researcher and an interpreter for those who could speak only the native tongue language. Each questionnaire had the participant identification number. A total of 402 questionnaires were successfully administered on the field.

Laboratory Procedures at the People's Clinic Ngomgham

Formol Ether Concentration Technique:

The formol ether technique was used as described by [39]. Two to five grams of stool was used for each test. The stool was first poured onto a double layer of wetted gauz taking special care not to include any blood or mucus.

Ten (10) ml of a preparation of either normal saline or 0.1MNaOH were mixed. The mixture was left for 1 hour before centrifugation for 5 minutes at 2000 rpm. The supernatant was poured off and then 10 ml of reagent (either normal saline or 0.1MNaOH) and centrifuged at the same rate and duration. The supernatant was again poured out and 7 mls of 0.1% formaline was added. The mixture was left for 10 minutes. Three mls of diethyl ether was then added and the tube was closed and shaken vigorously for 30 seconds. The supernatant was poured off and the sediment was used for slide preparation. (The slide well cleaned with cotton wet with normal saline, specimen placed on it, then covered with another slide and examined microscopically for parasitic forms).

Data Management and Analyses

Data collected was edited, coded and entered into the computer using Microsoft Excel software. Back up storage was done in a flash drive and all raw data were stored safely. The data was then exported to SPSS version 23.0 for statistical analysis.

Calculation of Parasitological Indices:

The obtained data was analysed using the formula.

$$P = (n/N) \times 100$$

where

P= prevalence

n= number of infected participants

N= number of sampled participants

The parasitic load was computed when the egg counts were available as arithmetic means

Data Analyses:

Proportions were compared between ages and sexes as well as between the community survey and past record subgroups using chi-square test while the mean intensities of infection were compared using the Mann Whitney or Kruskal Wallis test. The sampling fluctuations were estimated using standard deviations (s.d). The factor was determined using univariate and multivariate analysis regression. The threshold for significance was set at 5%.

RESULTS AND DISCUSSION

Results

The study recorded a total number of N=402 participants of both sexes. Out of this number, 127 (31.6%) were males and 275(68. 4%) were females. The mean (SD) of the age was 28.87 (19.37) and ranged from 3-72years.

The study population was further divided into 5 different age groups. Out of 402 participants, the highest came from the <15 years (37.1 %, n=149) while the least number was from the >65 years age group (4.7%, n=19). As concerns occupations, the highest number 229 (57.0%) were farmers and the least number were civil servants 13(3.2%) as shown on table 1.

A total of 50 participants were positive for intestinal parasites giving a total prevalence of 12.4%. Out of the 50 positive cases, 12 (3.0%) were carriers of *E. coli* (the only intestinal protozoan encountered), while 38(9.4%) were positive for intestinal helminths. Also 2 (0.5%) participants were positive with polyparasitism for *Ascaris* and *E. coli* and 2 (0.5%) for *Ascaris* and hookworms. Out of the 42 carriers of intestinal helminths, *Taenia* species recorded the highest prevalence of 17 (4.2%) and the least were participant with hookworms 9 (2.2%) as shown on table 2.

Table 1: Socio-demographic characteristics of the study population.

Characteristics	Number of individuals	Frequency (%)
Age group(years)		
<15	149	37.1
15 - 24	37	9.2
25 - 44	115	28.6
45 - 64	82	20.4
≥65	19	4.7
Total	402	100
Gender		
Males	127	31.6
Females	275	68.4
Total	402	100
Occupation Farming	229	57
Non-worker	48	11.9
Student	28	7.0
Trading	37	9.2
Skilled workers	30	7.5
Apprentice	17	4.2
Civil servant	13	3.2
Total	402	100

Table 2: Prevalence of intestinal parasitic species among the study population

Parasitic species	Number examined	Number infected	Prevalence
Protozoan species			
Entamoeba coli		12	3.0
Intestinal helminths			
Ascaris lumbricoides	402	16	4.0
Hookworm species		9	2.2
Taenia species		17	4.2

Sex-related Prevalence of Intestinal Helminths Among the Population:

With regards to sex, females were more infected 13% (37/275) than males 10.23% (13/127) and this difference was not statistically significant ($p=0.346$).

With respect to the individual intestinal parasites, males were more infected than females for *Ascaris lumbricoides* (4.7% vs 3.6%) and Hookworm spp. (2.4% vs 2.2%). On the contrary, more females were infected than males for *E. coli* (3.6% vs 1.6%) and *Taenia* spp. (4.7% vs 3.1%) as shown on table 3. However, the differences were not significant $p < 0.05$.

Age-related Prevalence of Intestinal Parasites Among the Population:

Participants between the ages of 15-24 years recorded the highest infection rates 13(35.1%) while the age groups ≥ 65 years recorded no infection for any of the intestinal parasites. This difference was statistically significant at $p = 0.000$ as shown on table 3. With the exception of *E. coli* that showed a significant difference ($p = 0.007$) within the different age groups, there was no significant difference ($p < 0.05$) among the different age groups and the other intestinal parasitic species.

Assessing Intestinal Parasites Among Epileptic Patients:

Out of the 402 participants enrolled for this study, 47 (11.69%) were epileptic while 355 (88.31%) were non-epileptic. In figure 10, a significant ($p = 0.004$) higher infection rate was registered among participants that were epileptic 34.04% (16). With respect to the individual parasites, all the parasites except for *Ascaris lumbricoides* ($p = 0.013$) showed no significant difference ($p \geq 0.05$) in infection rates between epileptic and non-epileptic participants as shown on Table 5.

Distribution of Disease Burden Among the Study Population

The disease burden ranges from 10-462.00epg with mean (standard error of mean) of 462.00(12.88) epg. The distribution of the disease burden among the study population with regards to sex was not statistically significant ($p = 0.240$) though females recorded a higher disease burden than males as shown on table 6. Similarly, the distribution was not also statistically significant with respect to age groups ($p = 0.510$) though participants in the age group of 45-64 years of age recorded the highest disease burden while participants 15-24 years of age recorded the lowest burden.

Risk factors Associated with Intestinal Helminths

Assessing risk factors of intestinal helminths occurrence at 95% confidence intervals showed in the univariate regression analyses, intestinal helminthes was insignificantly ($p = 0.46$) higher in females $n = 32$ (14.6%) and significantly ($p = 0.018$) highest in the age group 15-24 years $n = 13$ (39.4%). Similarly, participants that were apprentice $n = 14$ (20.3%) showed an insignificant ($p = 0.295$) high level of parasites infection while the rate of parasitic infection was significantly ($p = 0.024$) highest 4(16.0%) in participants that uses tap water as their source of water. Furthermore, deworming once in a year or more than once in a year recorded highest prevalence 11(39.3%) which showed a significant difference ($p = 0.034$). washing of vegetable ($p = 0.639$) and the presence or absence of toilet did not show any significant difference ($p = 0.522$). However, those who washed their fruits sometimes 40(14.8%) and those without toilets 4(14.7%) recorded the highest prevalence of parasitic infection. Even though the prevalence of intestinal helminths was insignificantly higher 38(15.1%) in those who were geophagia (eat soil, calabar chalk, mud block etc.) and those who consumed pork or beef 35(15.2%), the association was not significant ($p = 0.45$) and ($p = 0.255$) respectively (table 7).

In the multivariate analyses, use of boreholes and streams were a risk factor of intestinal helminthes, the risk became higher [(2.815 (0.849-9.3) and 4.329(1.29-14.5)] respectively) after controlling for other variables. Deworming once in six months was also found to be a significant predictor of intestinal helminthes in this study. At the multivariate analyses, the risk of developing intestinal helminthes, in participants who dewormed after every six months decreased to 0.28(0.08-0.98) after controlling for the other variables. Furthermore, geophagia and participants who ate pork or beef had a higher risk of being infected with parasitic infections. However, after controlling for the other variables the risk decreases in geophagia participants 1.02 (1.24-10.45) and participants who ate pork or beef 0.034(0.58-1.0) as shown in table 7.

Table 3: Distribution of intestinal parasitic species based on sex and age

Parameters	Number examined	<i>E. coli</i> n (%)	<i>A. lumbricoides</i> n (%)	Hookworm spp n (%)	<i>Taenia</i> spp n (%)
Sex					
Males	127	2 (1.6)	6 (4.7)	3 (2.4)	4 (3.2)
Females	275	10 (3.6)	10 (3.6)	6 (2.2)	13 (4.7)
Chi square value		1.275	0.269	0.013	0.534
P value		0.259	0.604	0.91	0.465
Age groups (years)					
< 14	149	0 (0.0)	6 (4.0)	2 (1.3)	6 (4.0)
15 - 24	37	4 (10.8)	2 (5.4)	3 (8.1)	4 (10.8)
25 - 44	115	4 (3.5)	4 (3.5)	2 (1.7)	5 (4.3)
45 - 64	82	4 (4.9)	6 (4.9)	2 (2.4)	2 (2.4)
≥ 65	19	0 (0.0)	0(0.0)	0 (0.0)	0 (0.0)
χ^2		14.005	1.234	6.952	5.464
P value		0.007	0.872	0.138	0.243

n/N: proportion of population infected

Table 4: Distribution of intestinal parasitic species based on profession

Profession	Number examined	<i>E. coli</i> n (%)	<i>A. lumbricoides</i> n (%)	Hookworm species n (%)	<i>Taenia</i> species n (%)	Total N (%)
Farming	229	7 (3.1)	5 (2.2)	3 (1.3)	5 (2.2)	20 (8.7)
Non workers	48	0 (0.0)	2 (4.2)	2 (4.2)	2 (4.2)	6 (12.5)
Students	28	2 (7.1)	4 (14.3)	2 (7.2)	1 (3.6)	9 (32.1)
Trading	37	3 (8.1)	0 (0.0)	0 (0.0)	4 (10.8)	7 (18.9)
Skilled workers	30	0 (0.0)	2 (6.7)	1 (3.3)	3 (10.0)	6 (20.0)
Apprentices	17	0 (0.0)	3 (17.6)	1 (5.9)	0 (0.0)	4 (23.5)
Civil servants	13	0 (0.0)	0 (0.0)	0 (0.0)	2 (15.4)	2 (15.4)
χ^2		0.213	7.010	0.103	3.612	2.361
P value		0.241	0.043	0.100	0.067	0.070

Table 5: Epilepsy-related prevalence of intestinal parasites species

Parasite	Epileptic		non-epileptic	Chi	P value
	Infected	Non	Infected Non	square	
	n(%)	infected	n(%) infected		
		n(%)	n(%)		

<i>Ascaris</i>	5(10.6)	42(89.4)	11(3.1)	344 (96.9)	6.174	0.032
<i>Iumbricoides Hookworms</i>	2(4.3)	45(95.7)	7(2.0)	348(98.0)	0.989	0.32
<i>E. Coli</i>	1(2.1)	46(97.9)	11(3.1)	345(96.9)	0.135	0.713
<i>Taenia spp</i>	8(17.02%)	39(82.9)	9(2.5)	346(97.5)	12.409	0.012

Table 6: Distribution of Gastrointestinal Parasites disease burden among the study population

Parameters	Pmed (epg)	±Sd	F value	P value
Gender				
Females	88.16	14.56	1.412	0.24
Males	122.2	26.82		
Total	97.61	12.88		
Age groups (years)				
≤ 14	123.5	29.55	0.781	0.51
15 - 24	68.615	14.05		
25 – 44	92.866	21.4		
45 – 64	104.75	35.67		
Total	97.61	12.88		

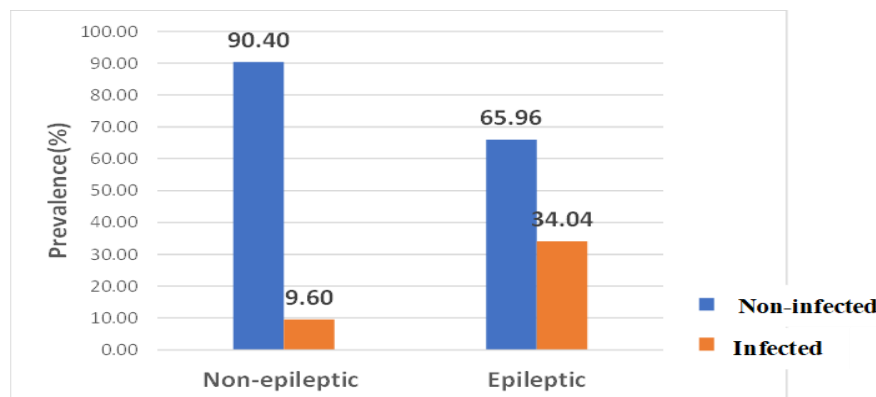


Figure 1: Prevalence of intestinal parasites between epileptic and non-epileptic participants

Discussion

The overall prevalence of intestinal parasites recorded in the survey was 12.4% with only four species of intestinal parasites found after stool examination. Only one species of intestinal protozoans was recorded. The parasites identified in this survey were similar to those found by [40] in the south region of Cameroon. It was however different from the findings of [41] in a slum in Nigeria.

The prevalence of intestinal helminths was higher 42 (10.4%), than the prevalence of intestinal protozoans 12 (3.0%) and the highest intestinal helminth recorded was *Taenia spp* 17 (4.2%). This prevalence is similar to the 14.3% prevalence obtained in Kasoa, Ghana [42]. It was however far higher than the 4.9% prevalence observed in Bazou, Bangante sub division of Cameroon by [43].

One of the factors that might be directly responsible for the spread of intestinal helminths in the Batibo subdivision is the lack of proper sanitation among the denizens. Toilets are completely absent in some homes and bushes or pig styles are used to defecate. This has further been worsened by the socio-economic crises rocking the two Anglophone regions of Cameroon in which this study area belongs. Community health workers who used to go around inspecting toilet facilities in the community and ensuring they are properly maintained are no longer available due to the crises. Lack of or availability of poor sanitation facilities in many environments, both in rural and urban localities account for a large number of intestinal infections on a global scale (square). Poor sanitation also leads to the endemicity of such infections as ancylostomiasis, ascariasis, trichuriasis, giardiasis, balantidiasis, necatoriasis and coccidiosis among other intestinal infections [44-45].

Also, most of the communities in the Batibo subdivision are suburban communities with very little or no sources of portable water available to the members of these communities. Villagers rely mostly on streams and springs for drinking, cooking and washing which are not always in good conditions. This creates a favorable portal for the transmission of intestinal helminths. This also explain why source of water was a risk factor in this study.

The lack of proper personal hygiene is a great factor responsible for the transmission of soil transmission helminths in the Batibo subdivision. Villagers rarely wash their hands before and after meals and also hardly wash their hands after using the toilet. Villagers do not also have the habit of wearing shoes while working on the farm, increasing their risk of contracting soil transmitted helminths.

To add up to the lack of potable water and sanitation, the socio-political crises rocking the two regions of the nation have also been an important factor promoting the transmission of soil transmission helminths. This is because the mass deworming campaigns that go on around the Country do not take place in these regions especially in the suburbs due to insecurity. Our data are ascertaining to this because deworming was also identified as a risk factor. Also, the awareness campaigns that used to take place in the community on regular basis no longer do so unlike Bazou which has been actively involved in mass drug administration campaigns for more than a decade. Though this prevalence was higher compared to other areas where mass drug administration is effectively implemented, it is not considerably high given the circumstances surrounding the study area. This is likely due to the hygienic implementations brought about by the corona virus era, one of which involves mandatory washing of hands always and this barrier measure happens to be a very important tool in the breaking of the transmission cycle of so many diseases including intestinal parasites. This can be proven by the higher prevalence of 31.5% obtained by of intestinal parasites for all the parasites except for *Taenia* spp. Participants in the age group 14-24 years of age recorded the highest prevalence of *E. coli* and hookworms. This is likely due to the active nature of this age group, as they are actively involved in a wide range of activities creating more exposure. Another possible reason may be the care free nature of this age group making basic hygienic rules very difficult to follow, since this is the age of puberty and early adulthood. The age group <14 years recorded the highest prevalence of *Ascaris* infections. This age group depicts childhood and at these age participants are unaware of some of the dangers of inhygienic practices and would probably eat without washing their hands and use the toilet without washing their hands. They are likely to engage into playtime activities that involves the use of soil. All these make them vulnerable

to eggs of *Ascaris* and vulnerability to the diseases as shown in Nigeria by [46]. Participants in the age group greater than 65 years of age recorded no infections of intestinal helminths for all the observed parasites among the study population. This is likely because of some level of immunity to these infections this group of people have come to develop over time after repeated exposure to the parasites [47] in Ngie when the corona virus was still unknown.

The low level of maternal education among the Moghamo tribe in the Batibo sub division is also a contributing factor to the transmission of intestinal helminths among the population. This is because mothers are unable to understand basic hygienic procedures responsible for interrupting transmission cycles of intestinal helminths. [48]. Data in this study revealed that the prevalence was high among those who do not wash fruits and vegetables. To ascertain this facts, aspects of hygiene like hand washing before meals or after using the toilet or washing fruits before consumption are not really taken into consideration thereby exposing the population to intestinal parasites.

Among all the observed gastrointestinal parasites in the survey, *Taenia* species was the most prevalent with a prevalence of 4.2 %. This might be as a result of the cultural practices of the Moghamo people in the Batibo subdivision. The people of the Moghamo clan have the culture of consuming pork during cultural festivals and during celebrations such as weddings, burials and naming ceremonies. This meat is usually not inspected by the sanitary officer and which is not well cooked predisposes to the parasite above. Also, some of those who rear pigs feed their pigs directly with human excrement making the spread of parasites like *Taenia* spp very likely. The practice of free grazing pigs and no meat inspection before slaughter and consumption is another probable reason for the high prevalence of *Taenia* spp in the study area. This is in conformity with the findings of [49] as well as [50].

Also, in the course of the consumption of pork meat during festivals and ceremonies, there is no proper hand sanitation practiced. There is a common bowl used by the celebrants to wash their hands starting from the elders to the least. This makes the chain of contamination very likely since if one person is infected up the chain, it is easy to transfer the eggs and ova down the chain as the bowl is being used.

The disease burden among the participants was low though higher than that observed in Bazou by [43]. It was also higher compared to that obtained from studies in Bamenda by [51]. This might probably be as a result of the absence of deworming programmes that would have lowered disease burdens as postulated by the findings of [52] in North Western Tanzania who reported that in areas where STHs are targeted for mass elimination through annual deworming programmes, high worm burdens are not very common and most of the individuals infected excrete only a low number of eggs.

With regards to sex, there was no significant difference between prevalence and sex for all the parasites except for *Entamoeba coli*, in which females recorded a higher rate of infections than males. The likely reason for this could be as a result of exposure. Women in the study area have as main economic activity, farming and these farms which are always far away from their homes usually lack good sources of drinking water and as such the women are obliged to drink from dirty streams and also wash their hands in these dirty streams before eating with them. Unlike females, males are concerned with other activities away from farming such as palm wine

tapping, brick laying, driving etc, which reduces their exposure to dirty and contaminated water. These findings however differ from the findings of [47] in Ngie where males recorded a higher prevalence of infection with intestinal parasites than females.

With regards to age, there was a significant difference in the prevalence of intestinal parasites for all the parasites except for *Taenia* spp. Participants in the age group 14-24 years of age recorded the highest prevalence of *E. coli* and hookworms. This is likely due to the active nature of this age group, as they are actively involved in a wide range of activities creating more exposure. Another possible reason may be the care free nature of this age group making basic hygienic rules very difficult to follow, since this is the age of puberty and early adulthood. The age group <14 years recorded the highest prevalence of *Ascaris* infections. This age group depicts childhood and at these age participants are unaware of some of the dangers of inhygienic practices and would probably eat without washing their hands and use the toilet without washing their hands. They are likely to engage into playtime activities that involves the use of soil. All these make them vulnerable to eggs of *Ascaris* and vulnerability to the diseases as shown in Nigeria by [53]. Participants in the age group greater than 65 years of age recorded no infections of intestinal helminths for all the observed parasites among the study population. This is likely because of some level of immunity to these infections this group of people have come to develop over time after repeated exposure to the parasites.

With regards to occupation, none of the occupations was significantly linked to the prevalence of intestinal parasites statistically except for *Ascaris* that saw a significant link with prevalence statistically with apprentices and students being the most infected with *Ascaris lumbricoides*. This can be explained by the fact that this group of participants are the most active among the other participants and also the most care free having very loose respect for personal hygiene which is a very important factor in the transmission of *Ascaris*. Their active nature also makes them exposed to this infection more than the other professions.

Most participants with epileptic symptoms, were tested positive for Taeniasis even though they were either on chemotherapy or traditional medication. Although the participants were on treatment and were advised not to eat pork, implies that the medications being used were not very effective against the cysticercus of *Taenia* spp or the people might have developed some resistant since they were constantly on drugs. However, these requires further investigation.

CONCLUSIONS

The global prevalence of intestinal parasites in the survey was 12.4% (50), the intestinal parasitic species identified were: *E. coli* 3.0% (12), *Ascaris lumbricoides* 4.0% (16), Hookworms 2.2% (9) and *Taenia* spp 4.2% (17).

With regards to age; sex and occupation, parasitic infection was significantly higher in participant of the age group 15-24 years (29.5%), and insignificantly higher in females ($p=0.363$) and students (32.1%).

Parasitic infection was significantly higher in epileptic participants 34.04% (16) compared to non-epileptic participant (9.6%).

Risk factors associated with intestinal parasites identified in this study were the use of boreholes and streams as water source; deworming once in six months, geophagia participants, participants who eat pork or beef and epileptic participants.

Consent Informed Statement: The study aims and procedures were explained to all participants in the language of their choice and signed or thumb-printed informed consent was obtained from participants, parents or care-givers.

Data Availability Statement: The datasets generated during and/ or analysed during the current study are available from the corresponding author on reasonable request.

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