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Prevalence of Schistosomiasis among children in Yaoundé four years after the Intervention Control and Prevention

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1. Abstract

Schistosomiasis is a debilitating disease affecting over 200 million people, with the highest burden of morbidity and mortality in African countries. A Cameroon plan for the control of schistosomiasis and soil-transmitted helminths launch the 2019 National Deworming Campaign. The purpose of this study was to determine the prevalence and intensity as well as the factors associated with Schistosomiasis among people aged 5 years and above attending two hospitals in Yaoundé, four years after the National Deworming Campaign. We conducted a cross-sectional hospital-based study among 178 participants aged 5 years and above between February and April 2023. A semi-structured questionnaire was used to collect information on demographics, clinical and predisposing factors. The urine filtration technique and formal ether concentration technique were used to analyse urine and stool samples. The Pearson chi-square was performed as part of the statistical analyses. The overall prevalence of Schistosomiasis among the study participants was 1.69%. In relation to the age group, the highest prevalence rate of 3.1% (3/65) was obtained among participants aged below 21years. In addition, 8 other species of parasites were identified from both stool and urine specimens of the study participants; 6 species were identified as protozoans, and the other 2 species were helminths. The prevalence of Schistosomiasis among the study participants was low after the National Intervention control and prevention. There is a need to expand the control method to enhance the effectiveness of the eradication of this disease.

2. Introduction

Schistosomiasis also known as bilharzia or blood flukes is a common neglected tropical disease that is caused by parasitic trematodes of the genus Schistosoma. About 207 million people are infected world-wide; 93% of this population live in Sub-Saharan Africa (SSA) with the largest numbers in Nigeria (29 million) and Tanzania (19 million) respectively [1, 2]. Democratic Republic of Congo and Ghana contribute 15 million cases each to the burden of Schistosomiasis globally [2]. Schistosomiasis causes an immense negative impact on health and socio-economic life of households in affected countries [1, 2]. The most affected group of people in terms of morbidity and mortality are school-age children (SAC) and young adults [2]. The infection is more prevalent in poor communities without potable water and inadequate sanitation, characteristics of most developing countries in Africa, Asia and South America. In tropical countries, Schistosomiasis is second only to malaria as the most important parasitic disease with the greatest economic impact [3]. Schistosomiasis can be grouped into two categories based on the organ affected, which are urogenital Schistosomiasis and intestinal Schistosomiasis.

The most vulnerable group of people infected with these species of parasites are mostly school-age children and young adult's reason being that; they have certain social play habit factors such as swimming and fishing in contaminated fresh-water bodies.

Schistosomiasis is associated with many severe pathologies and complications when not treated and not aware of. Such compli-

cations may include urinary. In 2017, Cameroon committed for the second strategic plan for the control and elimination of schistosomiasis in line with MINISANTE [4], which involved moving beyond morbidity control towards interrupting transmission. This commitment was discussed at the "Towards Elimination of Schistosomiasis" (TES) Conference in Yaoundé in March 2017, which brought together experts and stakeholders to discuss strategies for a paradigm shift.

Other studies have showed a general decease in schistosomiasis prevalence following the national deworming campaigns. Some regions may still experience persistent transmission, particularly in areas with poor sanitation, as schistosomiasis prevalence can vary significantly between different regions and even within districts. This study aims to determine the prevalence of schistosomiasis in two hospitals in Yaoundé five years after the national deworming campaigns.

3. Materials and Method

3.1. Study area and Setting

This study was conducted in two hospitals Yaoundé. The hospital is located at the Faculty of Medicine and Biomedical sciences Melen. It is well equipped and has the facilities with services such as Internal medicine, Paediatrics, Surgery, Laboratory, Haemodialysis and Pharmacy that were all required for this research. Whereas the second hospital is located at the heart of camp SIC, in the Cite Verte health area.

3.2. Study Design and Period

This study was a cross- sectional, hospital-based study, which was carried out from February to April 2023.

3.3. Study Population

The study population included all healthy adults; school aged children, young adults and patients aged from 5 years and above attending two hospitals in Yaoundé. Participants were randomly selected and enrolled. Informed ascent and consent form were asked to be completed alongside with questionnaires, which consisted of socio-demographic and personal details, history of present illness, clinical signs, etc.

3.4. Inclusion and Exclusion Criteria

Participants aged from 5 years and above, who were enrolled into any of the two hospitals in Yaoundé and those who gave their ascent and consent were included to the study. Participants and patients who took anti-parasitic drugs within the period of study were all excluded from the study.

3.5. Sample Size Calculation

The sample size was calculated using the Lorenz formula for Cross Sectional Study [5] given by;

sample size, n=(z^2 pq)/d^2

Where;

n=Minimum sample size

z= Standard normal deviate (at 5% type 1 error ($p<0.05$) which is 1.96) p= Expected proportion in population based on previous similar study [6] having a prevalence of 13.4%. q= 1-p = 1-0.134, d= absolute error or precision (d=5%=0.05)

3.6. Numerical Appreciation

Sample size, n = (1.96)2(0.134) (1-0.134)/ (0.05)2

n = 178

Hence, 178 participants were enrolled into the study in anticipation of incomplete data entry, loss of data, voluntary withdrawal and for superior precision.

3.7. Ethical Consideration

A letter of introduction was gotten from the Head of Department of Medical Laboratory Sciences, Faculty of Health Sciences, University of Buea (Ref No: 2023/035/UB/HOD/MLS/FHS). Administrative authorization obtained from the Director of Yaoundé University Teaching Hospital (Ref No: 3850/R/MINSANTE/DRSC/DSCV/DHCV). Participants were given consent forms to sign after they had been explained the details of the study. The participants were free to withdraw from the study at any time they pleased. To ensure confidentiality, codes were assigned in place of names and other relevant information. The consent forms were kept separate from the data collection form and secured. Questionnaires were checked to ensure correct entry of information. Data was entered into the computer.

3.8. Sampling Method

Participants were recruited by consecutive convenient sampling as they came to the hospital. The participants were approached during sample collection, informed about the study, and recruited after obtaining written informed consent. A total of 178 participants were recruited into the study after being consented. Sample size was attained since most of my participants were all interested in the study.

4. Pre-Analytic Phase

4.1. Enrollment of Participants and Data Collection

The study participants were educated on the purpose and procedure of the research, those who accepted to participate were given consent, and ascent forms to sign. After that, questionnaires were given after obtaining their consent and assent, which included the socio-demographic data, medical and social history, behavioural characteristics and risk-exposure. Participants that were not willing to be part of the study were strictly put in to consideration and were free to withdraw out of the study. Lastly, all eligibility criteria were respected alongside with the ethical consideration that was also put in practice.

4.2. Sample Collection

Here, stool and urine samples were the samples of interest for this research. Sterile stool and urine cups were given to the study participants with guides and procedures on how to collect their specimens to avoid contamination of the samples most especially and any other risk factor. The provided samples were coded with their identification numbers, sex and age. Lastly, the samples were all transported in the laboratory for analytical procedures.

4.3. Transportation of Samples

Samples were transported in the laboratory with the help of a sterile carton for analytical procedure. Stool samples most especially was transported in the lab on limited time intervals since most of these parasites gets inactive at a particular time interval to be viewed under the light microscope. Lastly, verifications of the samples were made to make sure that the samples were coded with participant's identification number, sex and age before it was being transported to the laboratory.

5. Analytical Phase

5.1. Quality Control Methods

Here, reagents (Formal and ether) and analytical equipment's (light microscope and centrifuge) were all control for their efficacy, sensitivity and specificity. The reagent's year and date of expiration was strictly monitored. The analytical equipment and reagents were controlled by using positive and negative control samples, manufacturer guidelines and biomedical personnel intervention.

5.2. Microscopic Analysis of Specimens

Here, formalin ethyl acetate concentration technique and the filtration technique were used in the analytical laboratory diagnosis of the specimens. The concentration technique was used in the analytical examination of stool samples (intestinal Schistosomiasis) with the sensitivity and specificity of 78.3% and 63.2% respectively. Whereas the urine filtration microscopy technique [urine wet mount] was used in the examination of urine samples [urinary Schistosomiasis] with the sensitivity and specificity of 37.1% and 74.6%, respectively. Materials such as the light microscopes, glass slides, cover slides; centrifuge, glass test tubes, formol and ether reagents etc were all used throughout the analytical process. The 10x and 40x objectives of the light microscope was used in the identification of the Schistosomiasis infection. Professional laboratory personnels were recruited during this phase to ensure good positive results and to be assured of the sensitivity and specificity of the working materials.

5.3. Procedure of the Concentration Technique

Firstly, gloves were worn when handling stool specimens. In a suitable clean container, a portion of the stool specimen with the help of a glass rod of approximately 1g was thoroughly emulsified into a 10 ml of 10% formalin. The emulsified stool was filtered through a wire sieve and the sieved suspension was transferred into a clean beaker. Seven ml of the transferred sieved suspension was later on transferred into a 15ml centrifuge tube made up of polypropylene. 3ml of diethyl ether was added, coked and mixed vigorously for about 1 minute using a vortex mixer. The sample mixture was later on centrifuged at 3000rpm for 5 minutes with the help of a centrifuge machine. After the centrifugation process was done, four different layers inside the tube appeared which are; the ether and dissolved fat layer, the fecal debris layer, the formalin layer and lastly the sediment containing the parasites. The first three layers were all discarded and one drop of the last layer (sediment), normal saline and iodine was transferred in a clean glass side and covered with a cover slit after the sediment was mixed using a clean glass rod. Lastly, the slide prepared was examined microscopically by using the 10X objective with the condenser iris closed to give good contrast whereas the 40X objective was to determine the eggs of the parasites.

5.4. Procedure

After a urine sample is collected, 3ml to 4ml is transferred in a clean test tube and centrifuged at 3000 rpm for 5 minutes using a centrifuge machine. The machine separates the urine sample into the urine liquid and sediment which of solid components such as mineral crystals, blood cells and parasites where these solid components are therefore under a light microscope. 10ml of well-mixed urine was transferred into a clean test tube and centrifuged using a centrifuged machine at 3000rpm for 5 minutes to sediment the parasites. The supernatant fluid was discarded and later on one drop of the sediment was transferred on a clean glass slide after the sediment was has being well mixed with the use of a glass rod. The prepared slide was then later on covered with a cover slit and examined microscopically using the 10X and 40X objectives with the condenser iris closed.

5.5. Conservation of Specimens

Here, specimen conservation was highly placed into strict consideration. Stool samples was conserved using 10% formalin leaving the sample in good state especially the parasites which could be found inside the stool sample and kept at room temperature whereas the urine samples were conserved in a fridge at 32 degrees Celsius.

5.6. Interpretation of Results

Here, results were interpreted based on the specie of Schistosomiasis (parasitic eggs) analysed and viewed under the 10x and 40x objective of the light microscope. The results were keyed and registered with respect to the age, sex and specie of the parasitic infection of the study participant. The most abundant species of Schistosomiasis available in the sub-Saharan Africa with Cameroon most in particular are Schistosoma japonicum having a lateral knob on their eggs, Schistosoma mansoni having a lateral spine on their eggs and lastly Schistosoma haematobium having a terminal spine on their eggs. The diagnostic stage of this parasitic infection can be characterized in the following image in Figure 1.

6. Post Analytical Stage

6.1. Data Management

Data was entered into Epidata 3.1 and exported to Statistical package for Social Sciences (SPSS) for statistical analysis. Categorical variables: such as Sex, age and the specie of the helminthic parasite were summarised using counts and percentages and presented using pie charts and tables. Comparisons between groups were made using Student's t-test for continuous variables and Chi-square test for categorical data with their respective 95% confidence intervals (CI) calculated with P-value ≤ 0.05.

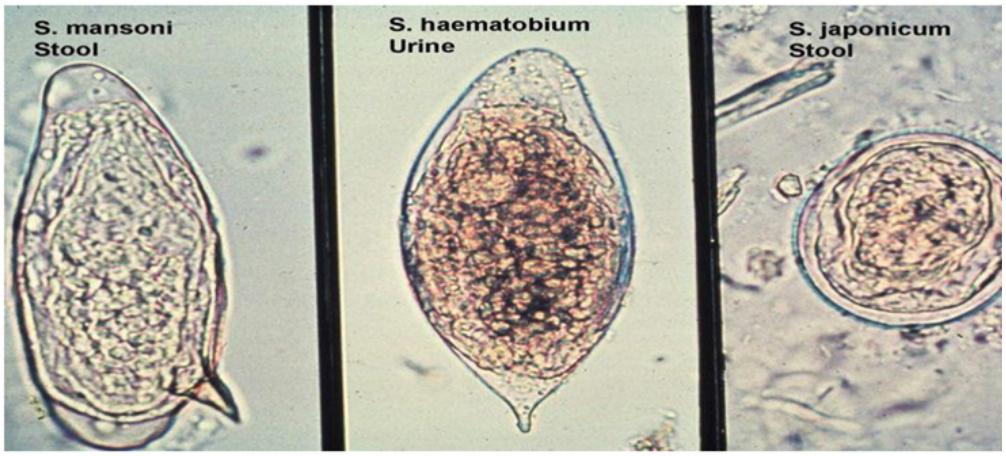

Figure 1: Diagnostic stages of Schistosomiasis [6].

6.2. Waste Management

Waste was discarded following the biosafety measures stated by the world health organization. Waste was definitely separated into infectious, non-infectious and sharps. Infectious and non-infectious waste were kept in two separate disposable plastics while the sharps was preserved in an enclosed and well safe guarded container, all three wastes were disposed through the process of incineration by the janitor.

6.3. Issue of Participant's Results

Results were issued to the study participants in confidentiality with respect to the diagnosis. Participant's results were printed on A4 paper and handed to them individually. Participants that were not present were reached through a phone call.

6.4. Data Analysis

All data from this study were analysed using R software version 3.6.1. Significant differences between categorical variables such as age, sex, occupation, level of education and others were summarised using frequency and percentages and the categorical variables were determined using the Chi-Square test at a 95% confidence interval. $P<0.05$ was considered statistically significant.

7. Results

7.1. Socio-Demographic Characteristics of Participants

A total of 178 participants age above 5 years old were include in this study, age varying between 5 to 86 years old. The mean age of the study population was 29.6 years (Standard Deviation= 18.49). The participants in this study were categorized with respect to their socio-demographic characteristic as shown in Table 1 below; most of the study participants were aged below 21 years old representing 36.5% of the total study population. More than half (62.9%) were females and 37.1% (66/178) consisted of male participants. Majority of the participants were Christian (93.3%, 166/178) and had the central region as their region of origin (64.6%, 115/178). One hundred and twenty-eight (71.8%) of the study participants had forage as a source of drinking water followed by tap water with 12.9% (23/178). With respect to their occupation, 26.4% were pupil, 20.8% were student, 18.0% were employee, 13.5% were unemployed and 7.3% were retired.

Table 1: Socio-demographic Characteristics of study participants.

Characteristics	Total (n= 178)	
	Participants (n)	Percentage (%)
Age-group	**Mean ± SD** (29.6 ± 18.49)	
< 21	65	36.5
21-30	34	19.1
31-40	34	19.1
41-50	16	9.0
>50	29	16.3
Sex		
Female	112	62.9
Male	66	37.1
Religion		
Christian	166	93.3
Islam	12	6.7
Region of origin		
Center	115	64.6
West	32	18.0
North	10	5.6
Littoral	6	3.4
Northwest	5	2.8
South	4	2.2
Southwest	3	1.7
Foreigners	3	1.7
Source of drinking water		
Forage	128	71.9
Tap	23	12.9
commercial water	17	9.6
Spring	10	5.6
Occupation		
Pupil	47	26.4
Student	37	20.8
Employed	32	18.0
Unemployed	24	13.5
Retired	13	7.3
Other	25	14.0

7.2. Prevalence of Schistosomiasis Infection in the Study Population

Out of the 178 clinical samples analysed (stool and urine), 3 (1.69%) were found positive for Schistosoma haematobium infection, while 175 (98.31%) were found free from S. haematobium (Figure 2).

7.3. Distribution of Other Parasitic Infections

A total of 8 species of parasites were identified from both stool and urine specimens of the study participants; 6 species were identified as protozoans and the other 2 species were helminths. Intestinal protozoan was among the most common parasites identified, which included Entamoeba histolytica at 17.42% (31/178), Blastocyst hominis at 6.74% (12/178), Entamoeba coli 6.74% (12/178), Endolimax nana 3.93% (7/178), Trichomonas intestinalis 1.68% (3/178) and Gardia lambia 1.12% (2/178). Pathogenic helminthic infections were identified as Schistosoma haematobium 1.69% (3/178), and Necator americanus 0.56% (1/178). The types of intestinal parasitic infections are shown in Figure 3.

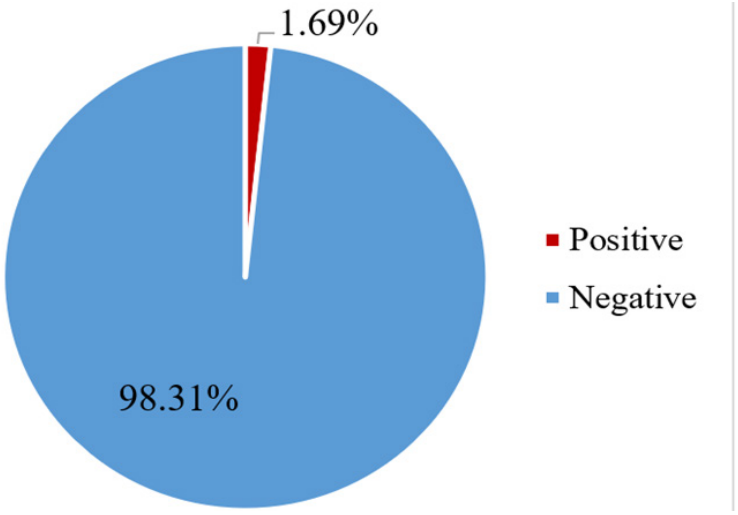

Figure 2: Prevalence of Schistosomiasis infection in the study population.

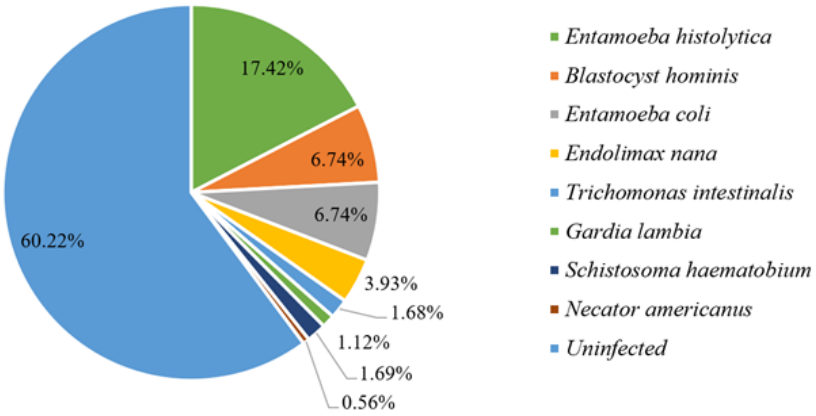

Figure 3: Prevalence of parasite infections other than Schistosomiasis among the 178-study population.

7.4. Risk Factors Associated with Schistosomiasis Infection of The Study Population

In relation to the age group, the highest prevalence rate of 3.1% (3/65) was obtained in among participants aged below 21years, followed by participants aged between 21-30years old. No positive case was observed in participants aged above 30 years old and no significant association was observed between age and S. haematobium (p=0.656). With respect to gender, the male participants had a higher prevalence rate of 16.7% (2/66) while the female participants had a lower prevalence rate of 0.9% (1/112). However, no significant association was observed between gender and S. haematobium (p=0.035). However, there was a statistical significant association between religion and prevalence of S. haematobium with a p-value of <0.001 (Table 2). Base on the suspected sign and symptoms, the prevalence rate was higher in symptomatic participants (22.2%, 2/9) than those presenting no signs and symptoms (0.6%, 1/169). Again, there was a significant association between suspected signs & symptoms and the prevalence of S. haematobium. Similarly, there was a significant association between region of origin and prevalence of S. haematobium (p=0.001). Furthermore, occupation (p=0.141), frequency of stream visit (p=0.114), Last anti-parasitic drug consumption (p=0.097) did not affect significantly the occurrence of S. haematobium infection with p value greater than 0.05 (Table 3).

Table 2: Sociodemographic factors associated with S. haematobium infection among the 178 study participants.

Factor	Participants	Positive (%)	Negative (%)	X^2	p-value
Age-group					
< 21	65	2 (3.1)	63 (96.9)		
21-30	34	1 (2.9)	33 (97.1)	2.437	0.656
31-40	34	0	34 (100)		
41-50	16	0	16 (100)		
>50	29	0	29 (100)		
Sex					
Female	112	1 (0.9)	111 (99.1)	1.145	0.285
Male	66	2 (3.0)	64 (97.0)		
Religion					
Christian	166	1 (0.6)	165 (99.4)	17.429	**0.001**
Islam	12	2 (16.7)	10 (83.3)		
Region of origin					
Center	115	0	115 (100)		
West	32	1 (3.1)	31 (96.9)		
North	10	1 (10.0)	9 (90.0)		
Littoral	6	0	6 (100)	24.986	**0.001**
Northwest	5	0	5 (100)		
South	4	0	4 (100)		
Southwest	3	0	3 (100)		
Foreigners	3	1 (33.3)	2 (66.7)		
Occupation					
Pupil	47	1 (2.1)	46 (97.9)		
Student	37	0	37 (100)		
Employee	32	0	32 (100)	8.291	0.141
Unemployed	24	2 (8.3)	22 (91.7)		
Retired	13	0	13 (100)		
Other	25	0	25 (100)		
X^2 = Chi square					

Table 3: Risk factors associated with schistosomiasis infection of the study population.

Factor	Participants	Positive (%)	Negative (%)	X^2	p-value
Suspected Sign /Symptoms					
None	169	1 (0.6)	168 (99.4)	24.128	**0.001**
Yes	9	2 (22.2)	7 (77.8)		
Frequency of going to the stream					
Rare	129	2 (1.6)	127 (98.4)		
Once a week	5	0	5 (100)		
Twice a week	7	1 (14.3)	6 (85.7)	7.441	0.114
Everyday	1	0	1 (100)		
Never	36	0	36 (100)		
Last anti-parasitic drug consumption					
< 5 months	116	1 (0.9)	115 (99.1)		
5-8 months	46	1 (2.2)	45 (97.8)	6.325	0.097
9-12 months	8	1 (12.5)	7 (87.5)		
>12 months	8	0	8 (100)		
Source of drinking water					
Forage	128	3 (2.3)	125 (97.7)		
Tap	23	0	23 (100)	1.192	0.755
commercial water	17	0	17 (100)		
Spring	10	0	10 (100)		
X^2 = Chi square					

8. Discussion

Due to effective intervention programmes on the control and prevention of Schistosomiasis in the study area, there is still continuous resurgence and outbreak of the parasite at certain parts of the regions of Cameroon. The overall specific objective of this study was to determine the prevalence of Schistosomiasis infection among people from 5 years attending two hospitals in Yaoundé and its associated risk factors in order to contribute to the clinical management of the infection, generate baseline data, raise awareness through evaluation of knowledge of the disease as well as identifying predisposing risk factors to enable strategic planning of control programs making use of limited resources. This objective was achieved by microscopically examining urine sediments and stool samples while identifying which sample is positive or negative for Schistosomiasis and comparing with its predisposing risk factors. The prevalence of urinary Schistosomiasis observed in this study was 1.69% while 98.31% were found free from S. haematobium and other Schistosoma specie. The prevalence of US observed in this study was however lower as compared to the overall prevalence of Schistosomiasis reported in the West Region [7] and in other areas of Cameroon: 1.7% in Kékem in West Cameroon [8], 32.1% in Kumba South West Cameroon [9] and 22.9% in Maroua Far North Cameroon [10]. Moreover, this prevalence was quiet much lower as compared to that obtained by Hajissa et al. [11] among schoolchildren in Um-Asher Area, Khartoum, Sudan with a prevalence of 12.9%. Ntonifor et al. in 2015 [12] among communities in the Munyenge municipality Cameroon with a prevalence of 40.27%. Green et al. [13] at Tiko health district Cameroon with a prevalence of 31.5% in 2021, Sumbele et al. [14] in 2021 among school aged children in Tiko Cameroon with a prevalence of 37.0%. However, the prevalence obtained in our study was significantly higher as compared to that obtained by Tonga et al. in 2019 [15] among pregnant women at the Njombe-penja health district Cameroon with a prevalence of 0.35%. The significant low in prevalence of this study is due to first step eradication campaign that was carried out in the study area between 2010 to 2016. Indeed, the prevalence dropped from 41% to 0% at the GPS Nkolbisson and Obobogo Yaoundé du to the national control programs for NTDs in Cameroon followed by an agreement signed between the ministry of public health and ministry of basic education through the oral administration of 40mg praziquantel (MINISANTE, 2017).

Risk factors such as source of drinking water, area of defecation, chores done in streams and rivers, bathing in streams, frequency of going to the stream(p-value=0.114) showed a very low prevalence with Schistosomiasis attesting the fact that there was no significant association between them and the infection in the study. However, there was a statistical significant association between religion (p-value<0.001), suspected signs and symptoms, region of origin (p-value=0.001) and prevalence of S. haematobium infection similar to the work done by Hajissa et al. [11]. In addition, occupation (p=0.141), frequency of stream visit (p=0.114), Last anti-parasitic drug consumption (p=0.097) did not impart significantly the occurrence of S. haematobium infection with p value greater than 0.05. Lastly, it will be so interested to know that out of the specific and general objectives of this study that was carried out, other parasitic infections were observed mostly composed of intestinal protozoans. The prevalence of these intestinal protozoans obtained in this study was 17.42% for E. histolytica, 6.74% for B. hominis and E. coli, 3.93% for Endolimax nana, 1.68% for Trichomonas intestinalis, 1.12% for Gardia lambia and 0.56% for Necator americanus. The prevalence of this IP observed in this study was however higher as compared to the overall prevalence obtained by Ntonifor et al. [12] among HIV positive and negative patients in Northwest Region, Cameroon with a prevalence of 11% in 2022. A 6.18% of parasitic co-infection was observed between E. histolytica and E. coli and with a case of B. hominis and S. haematobium.

9. Conclusion

The prevalence of Schistosomiasis within the two hospitals in Yaoundé was low (1.69%) and being statistically significant with religion, signs, symptoms and region of origin. No statistical significant association was observed with occupation, frequency of stream visit and last antiparasitic drug taken. Moreover, 7 species were identified as intestinal protozoans with an overall prevalence of 38.19% and a total of 11 cases of poly-parasitism were observed in this study, accounting a prevalence of 6.18% with the most common association observed between E. coli and E. histolytica (7 cases) and a case of Blastocyst hominis and S. haematobium. The low prevalence of Schistosomiasis among the study participants is due to the National Intervention control and prevention. Therefore, there is a need to expand the control method to enhance the effectiveness of eradication of this disease.

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