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Transmission Pattern of Neglected Tropical Diseases (STHs and amibiasis) in a Rural Community of South Cameroon: A Need to Involve All Age Groups in Control Strategy

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Abstract

A study conducted on community members aged 1 to 95 years in a rural community of the South region, Cameroon aimed to determine the transmission pattern of intestinal. Stool samples collected from 273 participants from five villages in March 2017 were analyzed using the quantitative Kato-Katz and the concentration formalin ether techniques. Globally, 117 (42.9%) persons were infected by atleast one parasite. Single infections (27.5%) was significantly high than multiple infections (15.4%) (P<0.05). Parasites diagnosed were *A. lumbricoïdes* (11.0%), *T. trichiura* (26.4%), hookworms (12.5%), *E.coli* (10.6%) and *E. histolytica /E. dispar* (1.5%). Infections rates varried significantly for *A. lumbricoides*, Hookworms and *E. histolytica/E. dispar* (P<0.05) between villages. Female sex participants were significantly more infected than male sex for *A. lumbricoïdes* and *E. coli* (P<0.05). Infection rates increase with age with significant difference observed for *A. lumbricoïdes* in individuals from 60 years old (P<0.05). Infection intensity ranged from 24 to 38.280 eggs, 24 to 3888 and 24 to 1584 eggs per gram of stool respectively for *A. lumbricoides*, *T. trichiura* and Hookworms. Participants of 31 years old and above had significantly high egg loads, same as for *T. trichiura* between villages (P<0.05). Generally, light infection was significantly high for *A. lumbricoïdes* and hookworms same as for *T. trichiura* in the female sex (P<0.05). In conclusion, transmission of intestinal parasites is active in all age groups in the Ngovayang community of the south region. In order for the WHO to achieve its global target which is focused on eliminating morbidity by 2020, there is a need for the donors of anthelminthic drugs to make it available for all age groups. Also, the non-negligible infection rates of amibiasis requires it to be included in the control strategy.

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NTDs; Geohelminthiasis and Amibiasis; Transmission Pattern; Community Members; Cameroon

Introduction

Intestinal parasites refer to parasites species which can colonise the digestive tube of humans and preferably live in the intestine. They are at the origin of many diseases known as intestinal parasitosis and constitute a major public health problem, posing a permanent obstacle on socioeconomic developement in less developping countries (Gambari, 2013). Among these human intestinal parassites can be found geoheminths egually known as STHs (*Ascaris lumbricoïdes* Linné, 1758, *Trichuris trichiura* Linné, 1771, *Ancylostoma duodenale* and *Necator americanicus* Stiles, 1902) and intestinal protozoans (*Entamoeba histolytica/Entamoeba dispar, E. coli, Giardia intestinalis* Lambi, 1859) (Aminata, 2006). They are among the most common infections worldwide, which heavily affect the poorest and most deprived communities where sanitation is inadequate and water supplies are unsafe (WHO, 2012).

Estimates show that 3.5 billions persons are infected with intestinal parasites worldwide, among which 450 millions persons are in the chronic phase of the disease (Mengistu *et al.,* 2014) with approximately 2 billions people being infected with STHs infections (WHO, 2015). *A. lumbricoïdes, T. trichiura* and hookworms infect respectively more than 1 billion, 795 millions and 740 millions persons, while amibiasis constitutes the third cause of dead among parasitic diseases with 40 to 100.000 cases of dead declared each year (Haque *et al.,* 2007). Intestinal parasitic infections (IPIs) occupy an important place among parasitic diseases with some being considered as Neglected Tropical Diseases (NTDs) amomg which can be found schistosomiasis, STHs and amibiasis (WHO, 2015). The control of NTDs has been overcome by other health problems such HIV AIDs, tuberculosis and malaria making them to be referred as silient pests. IPIs in general and helminthiasis in particular can be controlled or eliminated, despite the tremendous diability and suffering they inflict. According to the recommendations of WHO (2012, 2015) the control of STHs is based on periodic single-dose Albendazole (400 mg) or Mebendazole (500 mg) deworming of the population at risk living in endemic areas (preschool-age children, school-age children, women of reproductive age (including pregnant women in the second and third trimesters and lactating mothers) and adults who are exposed to STHs infections (agriculture profesionals). The WHO global target is to eliminate morbidity due to STHs in children by 2020, through regular treatments of at least 75% of the 873 millions children living in endemic areas (WHO, 2015). The success of this strategy depends on an improvement in sanitation and health education since these could help in reducing transmission and reinfection. Provision of adequate sanitation is however important but very challenging in resource-constrained settings (WHO, 2008). The WHO recommendations could somehow be limited as control efforts are mainly focused on school children as schools provide an important entry point for an appropriate deployment of control activities (periodic deworming, health education, sanitation), the other high risk groups (adults) are being somehow neglected. Nevertheless, anthelminthic drug donations are only available for the treatment of school-age children (Hotez, 2009). Other age groups than school-age children can have similar exposure risk to infection (Addiss, 2015; Hollingsworth, 2015), thus the need to broaden treatments across all age classes if one needs to interrupt transmission (Anderson *et al.,* 2015).

In Cameroon, schistosomiasis and STHs beside other NTDs constitute important risk for human health. About 2 millions and 10 millions persons are infected respectively by schistosomiasis and STHs which heavily affect the poorest and most deprived communities in rural areas where sanitation is inadequate, unsafe water supplies, inaccesibility to basic health services and essential medications (PNLSHI, 2016). Control strategy for these infections is focused on school aged children by administering annual treatment with less attention paid on other age groups, rendering enormous limitations to the sucess of control strategies as recommended by the WHO (2012, 2015). In the south region, about 17% of chidren do not go to school (PNUD, 2010), and do not beneifit from the annual MDA in this area of the country. Egually, the South region has shown persistence of some IPIs with relatively high prevalences and intensities of *A. lumbricoides* and *T. trichiura* infections compared to other regions, despite the annual mass drug administration (Tchuem Tchuenté *et al.,* 2012; 2013). Epidemiological data on intestinal infections in the South region as a whole mainly concerns school aged children (Tchuem Tchuenté *et al.*, 2013; Nkengazong *et al.*, 2016; Ngo Ngué *et al.*, 2017). Data involving all age groups are totally inexistence. However, a study conducted in the East region in the different age groups showed that adults could maintain the transmission of infections in a given community, even if an important percentage of children are effectively treated (Bopda *et al.*, 2016). Thus, parents could play an important role in the transmission and maintenance of intestinal parasites in the absence of treatment.

For a better follow-up of at risk population, the present study aims in evaluating the level of IPIs in the Ngovayang community of the South region. The work aimed specifically to identify the different parasites with their prevalence in relation to sex, age groups and village, evaluate the infection intensity and classify infection intensity according to the different classes. The results of this study could be important in strengthening control measures against these infections in endemic areas.

Materials and Methods

Study area

The study was conducted on the entire population (aged 1 to 92 years) belonging to 5 villages in the Ngovayang community of the health District of Lolodorf (Ngovayang 3, Bingambo, Mvile, Bikala et Mbikiliki). At the moment that this study was carried out, these villages had not been recently included in any MDA program at the school level. The area was selected based on previous level of IPIs infections in the South region globally, and more specifically on the most recent epidemiologial data obtained on intestinal parasites in the Ngovayang area which have mainly be focused on school children (Tchuem Tchuente *et al.*, 2013; Nkengazong *et al.,* 2016).

The area is a rural locality with a tropical humid climate which has four seasons: a long dry season that extends from November to mid-March; a long rainy season which moves from mid-August to November; a short dry season that covers mid-June to mid-August and a short rainy season that begins from mid-March to mid-June. The annual average temperature varies between 24°C and 28°C. The community members practice agriculture work, fishing, hunting and trading (CVUC, 2014). Access to potable water constitutes a major problem to the community members with the main water sources being wells and rivers. There are no concrete sites for garbage disposal at the level of each village and garbages are disposed hazardously around the houses and along the road sides. Defecation is equally done in bushes around houses, streams and school premises. The habit of walking barefooted and eating raw food is a common practice by inhabitants of the study area. School aged children included in the study benefit from annual MDA for STHs infections.

Study subjects

The study was conducted from January to March 2017. The study population was made up of children and adults aged 1 to 92 years. Of the 325 persons who voluntarily accepted to participate in the study, 273 (125 boys: 45.79% and 148 girls: 54.21%) provided stool samples giving an overall participation rate of 80.0%. On the basis of the sampled population structure, 6 classes of age interval were deducted with respect to minimal equitability in the number of persons in each age group: 1-5 years; 6-15years; 16-30 years; 31-45 years; 46-60 years; and 60 years and above.

Ethical considerations

This study was ethically approved by the Ethical Committee of the Institute of Medical Research and Medicinal Plant Studies (IMPM) of the Ministry of Scientific Research and Innovation, Cameroon and the Ethics Review Committee of Lolodorf hospital. Permission to conduct the study was obtained from the community leaders who were duly informed on the objectives and benefits of the study. Parents/guardians were informed about the aim and the procedure of the entire clinical trial. Participants included in the study gave informed consent either as a parent or children parents/ guardians. Participants were recruited on a voluntary basis and their personal information was treated privately and was not divulged to a third party. Participant found infected following samples analysis were administered free treatment with mebendazole 100 mg (2 tablets taking two times per day for 3 days consecutively) under the direct supervision of a clinical nurse.

Samples collection and processing

Registration of participants was done in their various homes in the evening followed by the distribution of one sterile 50 ml screw-cap vial having each an identification code. One stool sample was collected from each participant the following day between 6 am and 8 am. The samples were conserved in a cooler containing ice blocks and were transported to the Ngovayang health center of the area where Kato slides were prepared using a portion of each stool sample according to Cheesbrough (2005) and examined for the identification of helminthes eggs following their morphology (*A. lumbricoides, T. trichiura* and hookworms), estimation of infection intensity and evaluation of the occurrence of the different classes of infection intensity.

The remaining portion was each fixed with 10% formalin and transported to the Parasitology laboratory of the Medical Research Centre of IMPM in Yaounde where they were subsequently processed using the qualitative concentration formol ether technique to identify helminthes eggs and protozoan cysts (Cheesbrough, 2005). To avoid complete degeneration of hookworm eggs, all Kato slides were prepared and read the same day following samples collection. Eggs were counted under a light microscope at 10X magnification and their number expressed in eggs per gram of stool (epg). Intensity of helminthes infection was evaluated according to WHO (2008).

Data Analysis

Parasitological data were analyzed using Statistic logistic SPSS Version 21 and SX and Microsoft Excel 2007. The Chi square test was used to compare the prevalence of parasites in relation to sex, age groups and villages. One - way ANOVA or Kruskal-Wallis tests were used to compare the parasite intensity in relation to sex, age groups and villages. The Kruskal-Wallis test was used when the conditions of parametric ANOVA were not fulfilled. The level of statistical significance was at 95% (P <0.05) (Sokal and Rohlf, 1981).

Results and Discussion

Parasites infection rates

A total of 117 (42.9%) persons haboured atleast one parasite species identified, with single infections (27.5%) being significantly high compared to those with multiple infections (15.4%). The different parasites diagnosed belonged to the group of helminthes (49.8%): *A. lumbricoïdes* (11.0%), *T. trichiura* (26.4%) hookworms (12.5%); and Protozoans (12.1%): *E.coli (*10.6%) and *E. histolytica /E. dispar* (1.5%) (Table 1). Transmission trend of the different parasites in the different villages varied from 15.6% (Ngovayang 3) to 63.0% (Mbikiliki). Infection rates were above 40.0% in any of the villages with the exception of Ngovayang 3 where this value was 15.6%. As regards the different parasites species, these values varied from 0.0% to 11.9% (*A. lumbricoides*), 11.1% to 33.8% (*T. trichiura*), 2.2% to 26.1% (Hookworms), 5.8% to 15.2% *(E. coli)* and 0.0% to 8.7% *E. histolytica/E. dispar*. Significant differences were observed for *A. lumbricoides* (P=0.01), Hookworms (P=0.01) and *E. histolytica/E. dispar* (P=0,001). Globally, participants of the female sex (48.7%) were significantly more infected compared to those of the male sex (35.2% : P=0,04), precisely for *A. lumbricoïdes* (P=0.04) and *E. coli* (P=0.04) (Table 1). For the factor age, infection rates globally increase with age from 22.2% (1-5years) to 49.3% (> 60 years) (Figure 1). These values were more important in participants of 16 years old and above irrespective of the different parasites. Individuals of 60 years and above were the most infected compared to those of other age groups with significant difference observed for *A. lumbricoïdes* (P= 0.04). Among all the parasites identified, *T. trichiura* was found to infest all age groups, more importantly those aged 1-5 years and 6-15 years, while no individual was infected by hookworms for those aged 1-5 years and 6-15 years. The amoeba species identified were totaly absent in 1-5 years and 6-15 years old participants exception being for *E. coli* which was only absent in those aged 1-5 years and importantly present in all the other age groups compared to *E. histolytica/E. dispar*.

Infection intensities

Globally, intensity of infection ranged between 0 and 38.280epg (mean: 5898.8 ±9479.9) for *A. lumbricoides*, 0 and 3888epg (mean: 358,8 ±686.5) for *T. trichiura*, and 0 and 1584 epg (mean: 312 ±420.2) for Hookworms. The mean egg load was quite variable between the villages with high values observed in Mbikiliki for *A. lumbricoïdes (*7860 ± 10810.2) Bingambo for *T. trichiura* (870,5 ± 1357.6) and Mvilé for Hookworms (600±562.2). Significant differences were recorded for *T. trichiura* (P=0.03) in Mvilé compared to other villages. For age group, the egg load was importantly high in participants of 31-45 years and above, though with no significant differences, same as in males and females (Table 2).

For the different classes of infection intensity, light infection which vary significantly for *A. lumbricoïdes* (P=0.01 and hookworms (P=0.03) was more observable for the three parasitic helminths identified than moderate infections. High infections was not noted in any of the infection. Equally, for any of the classes of infection intensity, female participants had high values of light infections same as moderate infection, exception being noted for *T. trichiura* and in those aged 16 years and above. Significant values of light intensity were observed for *T. trichiura* (21.6%) in females (Figure 2).

This work whose global goal was to evaluate the level of IPIs transmission in the Ngovayang community shows that the area which was known as a high risk area of infection (75.9%: Nkengazong *et al.*, 2016) has moderate infection risks (42.9%) characteristics (WHO, 2008) for *A. lumbricoïdes*, *T. trichiura*, hookworms, *E.histolytica / E. dispar*, and *E. coli*. This drop in infection rate might probably be due to the annual administration of antihelminthc drugs in shool age children which could have importantly contributed to a reduction of the disease transmission. This observation is in line with the results obtained in southWest Cameroon where a considerable reduction of infection rates was noted following systematic treament from 26.4% and 31.0% in 2010 to 14.5% and 16.8% in 2014 respectively for *A. lumbricoïdes* and *T. trichiura* (Nkengazong *et al.*, 2010). The infection rate obtained during this study is however high compared to the results obtained in Douala (15.2%:

Kuete *et al.*, 2015), Yoro (35.5% : Nkengazong *et al.*, 2015) and Babadjou (8.5% : Payne *et al.*, 2017). These difference observed could be attributed to variations in socioeconomic conditions, individual behaviour, the analysis techniques used, sample size, duration of the study (Mengistu *et al.*, 2014) and probably the parasite strain concern in transmission.

The parasites diagnosed during our study were dominated by the group of helminthes (49.8%). This could reflect the climatic conditions of this geographical area that might favour the development and maintenance of the biological cycles of these parasites. Similar results have equally been obtained in West Cameroon (Tchouyabe, 2012). However, other studies revealed the unique presence of parasitic Protozoans (Elqaj *et al.*, 2009).

Infections due to *T. trichiura* (26.4%) dominated in the study with the infections rate increasing with age. This observation may not mainly be due to antihelmintic resistance in school aged children (Nkengazong *et al.*, 2010), but also to the absence of mass drug administration to individuals of 16 years and above, what could likely lead to accumulation of infections. Also, the high number of eggs laid by the female worms that lead to continuos contamination of the environment and high resistance of eggs in the environment (more than 5 years) could also explain the predominance of this parasitic helminths in the study (ANOLFEL, 2005). The prevalence of hookworms (12.5%) is comparable to the results obtained in the same area in school children two years ago (Nkengazong *et al.*, 2016) but far high compared to the results obtained in Yoro (2.3% : Nkengazong*et al.*, 2015) and in Babadjou (1.9% : Payne *et al.*, 2017). These differencs might probably be due to some environmental factors that favor the viability of the infesting forms of the parasite and to a lesser extend linked to individual behaviour. Hookworms infections which was completely absent in children aged 1-5years and 6- 15 years showed a ligth progressive increase with age in participants of 16 years and above. This situation may be linked to a difference in exposure risks to hookworms infections. Studies have revealed agricultural profession as a risk factor of transmission with transmission prevalence increasing with age (WHO, 2015).

Among the amoeba species identified, *E. coli* dominated (10.6%) over *E. histolytica/E. dispar* and with homogenous occurrence in individuals of 6 years old and above. Many other studies have shown the predominance of *E. coli* (Mbuh *et al.*, 2011; Nkengazong *et al.*, 2014, 2015, 2016) with some evidence of pathological effects like the ingestion of red blood cells and indigestion (Saritha Pujari, 2015), leading to a reduction of haemoglobin concentration (Richardson *et al.*, 2011, Nkengazong *et al.*, 2014, 2015). Also, the presence of *E. coli* in idividuals has led to increase of infection risk of some helminthes parasite. This show that this amoeba species may be having non negligeable pathogenic effect and the resistance of its cyts in the environment could explain its dominance over *E. histolytica/E. dispar* (Nkengazong *et al.*, 2016).

Fig.1 Variation of global infection rate by age

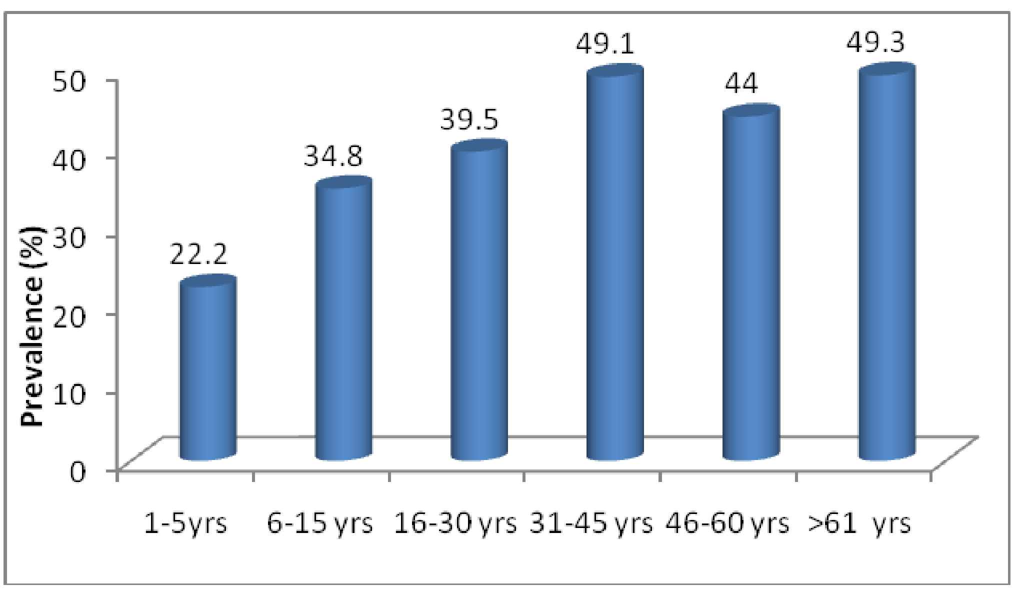

Fig.2 Frequency of the different classes of infection intensity by sex : (a) Light intensity; b) Moderate intensity

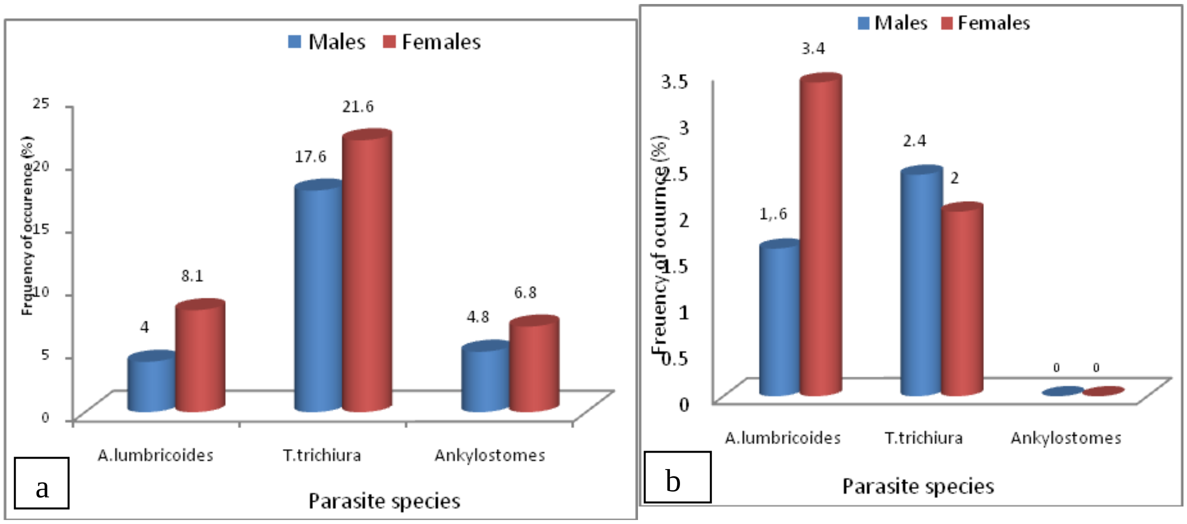

Table.1 Infection rates of the different parasites by sex, age and village (%)

Variables	NE	Parsite species				
		A. lumbricoïdes	***T. trichiura***	**Hookworms**	***E.coli***	***E. histolytica/ E. dispar***
Sexe						
Masculin	125	10(8)	29(23.2)	16(13)	8(6.4)	0(0.0)
Féminin	148	20(13.5)	43(29.1)	18(12.2)	21(14.2)	4(2.7)
Total	**273**	**30(11)**	**72(26.4)**	**34(12.45)**	**29(10.6)**	**4(1.5)**
p-value	**0.04**	**0.3**	**0.9**	**0.04**	**0.06**	**0.04**
Age						
[1-5]	27	2(7.4)	5(18.5)	0(0.0)	0(0.0)	0(0.0)
[6-15]	23	0(0.0)	5(21.7)	0(0.0)	6(26.1)	0(0.0)
[16-30]	38	5(13.2)	11(29)	5(13.2)	4(10.5)	1(2.3)
[31-45]	53	4(7.6)	14(26.4)	8(15.1)	6(11.3)	1(1.9)
[46-60]	57	4(7)	13(22.8)	9(15.8)	7(12.3)	0(0.0)
>60	75	15(20)	24(32)	12(16)	6(8)	2(2.7)
Total	**273**	**30(11)**	**72(26.4)**	**34(12.5)**	**29(10.6)**	**4(1.5)**
p-value		**0.04**	**0.7**	**0.1**	**0.1**	**0.7**
Villages						
Mvilé	59	7 (11.9)	16 (27.1)	9 (15.3)	8(13.6)	0(0.0)
Bikala	71	13 (18.3)	24 (33.8)	7 (9.9)	7 (9.9)	0(0.0)
Bingambo	52	8 (15.4)	12 (23.1)	5 (9.6)	3 (5.8)	0(0.0)
Ngovayang 3	45	0(0.0)	5 (11.1)	1 (2.2)	03 (6.7)	0(0.0)
Mbikiliki	46	2 (4.4)	15 (32.6)	12 (26.1)	7 (15.2)	4(8.7)
Total	**273**	**30 (11)**	**72 (26.4)**	**34 (12.5)**	**28(10.3)**	**4(1.5)**
p-value		**0.01**	**0.07**	**0.01**	**0.45**	**0.001**

Table.2 Mean egg load and standard deviation of the different helminths species by sex, age and village

Variables	Parasite species		
	A. lumbricoïdes	***T. trichiura***	Hookworms
Sexe			
Masculin	9256 ± 15444.4	468,5 ± 956.7	108 ± 183.3
Féminin	80136 ± 6581.3	280,5 ± 395.6	434,4 ± 480.9
Age			
[1-5]	384 ± 0.0	35.75 ± 39	-
[6-15]	-	84 ± 91	-
[16-30]	5264 ± 8868.4	61.7 ± 41.2	24 ± 0
[31-45]	8168 ± 13318.2	458.2±790.1	54 ± 60
[46-60]	7264.6 ± 10391.5	168 ± 220.7	252 ± 322.4
>60	7174.2 ± 10455.1	195.6 ± 197	528 ± 495.8
Villages			
Mvilé	5496±5813	369,6±311.8	600±562.2
Bikala	7405.3±12493	176±410.4	230.4±210.3
Bingambo	3915 ± 8018.4	870.5 ± 1357.6	-
Ngovayang 3	-	54 ± 60	-
Mbikiliki	7860 ± 10810.2	252 ± 322.1	48 ± 53.7

Individuals of female sex were significantly more infected and had high occurrence of light and moderate infections than those of the male sex. In our study area, females are more engaged in farm work and have the habit of working barefooted with unprotected hands, (Nkengazong *et al.,* 2016), what expose them to high infection risks than males.

Also, the habit of eating raw fruits, vegetables and soil is more pronounced in females, what increase their infection risks to infesting forms of the parasites (Mbuh *et al.,* 2010; Nkengazong *et al.,* 2010).

Eventhough no significant difference was observed among the different age groups for the global infection rate, it can be noted that participants aged 16 years and above were the most infected irrespective of the different parasites with a predominance in those above 60 years. This should reflect the absence of periodic mass drug administration of the people in this age group compared to those under 16 years. Part of the sample population included in this study (children) do not go to school (PNUD, 2010) and same like parents do not benifit from mass drug administration.

These individuals may constitute potential source in the maintenance and transmission of infections. This could explain the non negligeable prevalence of parasitic helminths *A. lumbricoïdes* and *T. trichiura* in 1-5 years and 6-15 years old participants.

The present study equally revealed high egg load of *A. lumbricoïdes* followed by *T. trichiura* and hookworms in some villages. This might be due to high number of egg laid by the female worms (*A. lumbricoïdes* and *T. trichiura*), leading to an increase of infestation risks. The period of parasite infection could explain the differences in egg load observed between the different villages (Nkengazong *et al.,* 2010; Tchuem Tchuenté *et al.,* 2012).

Low frequency of ligth infection observed in individuals below 16 years should be attributed principally to the annual drug administration given by the national control program (PNLSHI, 2016). High frequency of light and moderate infections observed in individual of 16 years and above may likely reflect the non involvement of people of this age group in mass drug adminstration, since the targed population concerns mainly school aged children (Hotez, 2009). Light and moderate infections were the only classes of infection intensity noted. This could reflect the effect of auto medication taken at individuals levels combine to the above annual drug administration (PNLSHI, 2016; Nkengazong *et al.,* 2010). This study did not hightlight on the environnemental and risk factors at individual level which could favour the maintenance of parasites transmission nor the viability of infesting forms of parasites in the environnent. The absence of these informations could constitute major limitations for this study.

The results obtained in this work show that transmission of IPIs due to the helminthes *A. lumbricoïdes, T. trichiura,* and hookworms and protozoans *E. coli* and *E. histolytica/E. dispar* is still active in the Ngovayang community of the Lolodorf district health area. The increase of infection rate with age is mainly linked to the non involement of adults in the mass drug administration program for these infections. These infections might be linked to many endemicity factors like poor sanitation practices due to lack of sanitation education at the community and school level. For better implementation of control strategy against these parasitic infections, it will be necessary to conduct studies involving the evaluation of the endemicity level coupled to KAP studies, sensitize the community members on their knowledge on KAP studies coupled with intensive mass treatment at the level of entire community followed by re-evaluation of the different intervention strategies and finally associate intestinal parasitic protozoans like amibiasis in control strategy.

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