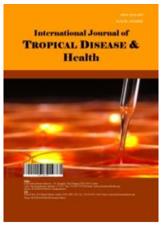

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Transmission Dynamics of Intestinal Parasites Infection in Children under Anthelminthic Treatment Residing in a High-Risk Area in Cameroon

Arnol Bowo-Ngandji[1], Djabidatou Ousmanou[2], Atembeh-Noura Efietngab[2] Nkengazong Lucia[1,2*], Halmata Mohamadou[2] and Ngonde Marie Chantal[2]

[1]Laboratory of Microbiology, Faculty of Science, University of Yaoundé I, P.O.Box 812, Cameroon.
[2]Institute of Medical Research and Medicinal Plants Studies (IMPM /P.O.Box 13033), Yaoundé, Cameroon.

Authors' contributions

This work was carried out in collaboration among all authors. Author NL designed the study. Authors NL and ABN wrote the protocol. Authors ABN, DO, ANE and HM handled samples collection and experimental process, while authors ABN, ANE and DO managed literature research and statistical analysis. Authors NL and ABN managed administrative contacts before and during the survey. Building up of the manuscript was done by authors NL, ABN, ANE, DO, NMC and HM. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Intestinal parasites continue to pose an important public health problem in low-income countries with children being the most affected, thus justifying their therapeutic follow up.
Objective: This work aimed to update the epidemiological base data and evaluate transmission dynamics of intestinal parasites at one and three months post treatment following the administration of multiple doses of mebendazole 100mg in children of the Lolodorf health district, South Region.
Methods: 381 stool samples were collected from participants and analysed using the kato-katz and formol ether technicsand each participant treated with multiple dosesof mebendazole within three days. Samples were collected at one and three months post treatment from same individuals. Two indicators were used to evaluate transmission dynamics: reinfection rate and number of newly infected individuals.

**Corresponding author: Email: nkenglu@yahoo.com;*

Results: A global infection rate of 65.3% involving *Ascaris lumbricoides* (23.1 %), *Trichuris trichiura* (35.2 %), hookworms (7.9 %), *Hymenolepis diminuta* (0.3 %), *Entamoeba histolytica/E. dispar* (5.8 %), *Entamoeba coli* (19.2 %), *Entamoeba hartmanni* (0.3 %) and *Candida sp* (26.0 %) was registered. Single infection (53.6%) was significantly higher than multiple infections (46.4%) (*P*=0.04). Significance was in favour of male sex for hookworm infections (*P*=0.04). Transmission dynamics of the different groups of parasites showed a reduction of helminths and protozoan parasites infections with complete absence of *Candida sp.* after treatment. The global reinfection rate obtained at three months post treatment was 7.3% with high values observed for *T. trichiura* (6.1%). The proportion of newly infected individuals varied from 6.2% to 8.9% at one and three months post treatment.

Conclusion: These results showed persistence in active transmission of various intestinal parasites in the study area. Hence, stakeholders in charge of controlling theseinfections shouldreinforce specific intervention measures against these diseases such as the implication of control measures at all levels of the transmission chain (individual and environmental level).

Keywords: Intestinal parasites; transmission dynamics; mebendazole 100mg; ngovayang health area; South Cameroon.

1. INTRODUCTION

The World Health Organisation still places Intestinal parasitic infections as major public health problem in less developed countries [1]. Among the pathogenic agents, diseases caused by Soil Transmitted Helminths ((STH): Ascariasis, Trichuriasis and hookworms))and rhizoflagellates (Amoebiasis and Giardiasis) constitute the principal group of medical importance [2]. Infections caused by STH is estimated at 24%, representing 1.4 billion persons worldwide [3]. Amoebiasis, which has remained the third cause of mortality due to parasitic infections after malaria and schistosomiasis in the world for several years infects approximately 50 million persons with 40000 to110000 deaths per year [4]. Yeast cells of the genus*Candida*are fungi present both in the environment and in the intestinal flora of humans and can become pathogenic under certain conditions leading to intestinal candidiasis [5]. A 40% mortality rate is estimated in patients with systemic candidiasis caused by *Candida sp* [6]. These parasitic infections are linked to poor hygienic conditions and infect mostly children. More than 270 million preschool and 600 million school children live in areas with active transmission [1]. Following the repercussion these infections have on academic performance, physical and mental growth more attention has been focused on their control for the past years [7], using anthelminticdrugs [8].

This situation is a reality in Cameroon. The number of infected school children that stands at 10 million persons nationwide [9], has not shown a regressive trend for the past 10 years. Nevertheless, the endemicity level fluctuates across the country. Recent studies have shown that the South Region has thehighest infection rate (52.8%) [7] with the Ngovayang health area situated in the Lolodorf Health District characterized as an area with high transmission risks (75.9 %) [10]. Till date, control of intestinal parasitic infections in general and STHs in particular is done in Cameroon by annual free deworming for school children using Albendazole 400 mg or Mebendazole 500 mg [9]. So far, other studies have revealed that reinfections and new cases of infections rapidly increase after anthelminthic treatment especially with infestations concerning STH where prevalence becomes almost the same as that observed before treatment [11]. Even though some epidemiological studies have been conducted in the Lolodorf Health district during the past 3 years [10,12,13,14], none of them have explained transmission dynamics following anthelminthic treatment.

The present study aims to evaluate reinfection dynamics and proportion of newly infected individuals among school pupils on anthelminthic drugs in the Ngovayang health area. More specifically, it aims to:

(i) Determine the prevalence and egg load of different parasites before treatment,
(ii) Evaluate parasitic association before and after treatment, and
(iii) Determine reinfection rate and the proportion of newly infected cases after treatment.

2. METHODS

2.1 Study Area

The prospective longitudinal study was conducted from November 2019 to February

2020 in six primary schools of the Ngovayang community of the health District of Lolodorf (Government primary schools Bikala, Bingambo, Mbikiliki, Mougue, Ngovayang II and Catholic mission school Ngovayang). 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 studies which have showed it to have active transmission of intestinal parasites for the past four years [10,12,13]. 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 [15]. Access to potable water constitutes a major problem to the community members with the main water sources being wells and rivers. Garbage are disposed hazardously around the houses, school premises and along the road sides. Defecation is equally done in bushes around houses, streams and school premises what favour contamination and propagation of parasites resistant forms in the environment. 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.

Mbikiliki (3°10.147'N, 10°32.572'E), Bikala (3°11.850'N, 10°34.934'E), Ngovayang 2 (3°14.783'N, 10°38.550'E), Bingambo (3°13.709'N, 10°38.254'E) and Mougue (3°13.332'N, 10°36.982'E) are characterized by the absence of water sources, pit toilets with poor maintenance and garbage piles on which children play on and; Ngovayang Mission(3°13.067'N, 10°36.221'E) which is situated beside the unique health center of the area andis characterized by the presence of forages, adequate toilets and a site for garbage disposal.

2.2 Study Subjects

The study population was made up of children aged two to 15years. Of the 408 school pupils who voluntarily accepted to participate in the study, 381 (198 boys: 53.8% and 168 girls: 46.2%) provided stool samples during the first survey. During the follow up surveys, 364 (196 boys: 53.8% and 168 girls: 46.2%) and 361 (186 boys: 51.5% and 175 girls: 48.5%) participated for the second and third prospection. Three classes of age interval were deducted with respect to minimal equitability in the number of persons in each age group: 1-5 years; 6-10years; 11-15 years. Fig. 1 gives detail information on the number of children censured, recruited, lost, added and included in statistical analysis during all the study phases.

2.3 Sample Collection and Processing

Stool samples were collected during three different phases: baseline survey and two control surveys (one month and two months after baseline survey) from November 2019 to February 2020 insix selected primary schools. Collection of samples was done during two days by three groups of persons (one group per village) comprised of two persons per group. Following registration, onestool sample was collected from eachparticipant in 50 ml screw-cap vials between 7 :30H and 10 H. Each stool sample was then divided into two portions. In one portion was added 10 % formalin to conserve parasites for subsequent analysis using the qualitative formalin ether technic. The other portion reserved for kato katz technic was conserved in a cooler at 4°C and transported to the Ngovayang Mission health center where kato katz slides were prepared and read by two technicians within 12 hours following collection for the identification of helminths eggs based ontheir morphology [16]. Samples fixed with formalin were transported to the Parasitologylaboratory of the Medical Research Centre (IMPM, Yaoundé). Eggs werecounted under a light microscope at 10Xmagnification and their number expressed ineggs per gram of stool (epg). Stool samples were collectedand analysed following the same procedure during the other survey phases (Fig. 1).

2.4 Data Management and Statistical Analysis

Parasitological data were treated and analysed using Statistic logistic SPSS version 21 and SX, and by Microsoft Excel 2016 logistic. Transmission dynamics of parasites was appreciated using 2 indicators: Reinfection rate (RR) and proportion of newly infected cases (PNIC).

Reinfection rate (expressed in percentage) was calculated as individuals who were infected during the first survey but were diagnosed negative during the second follow up and positive during the third follow up.

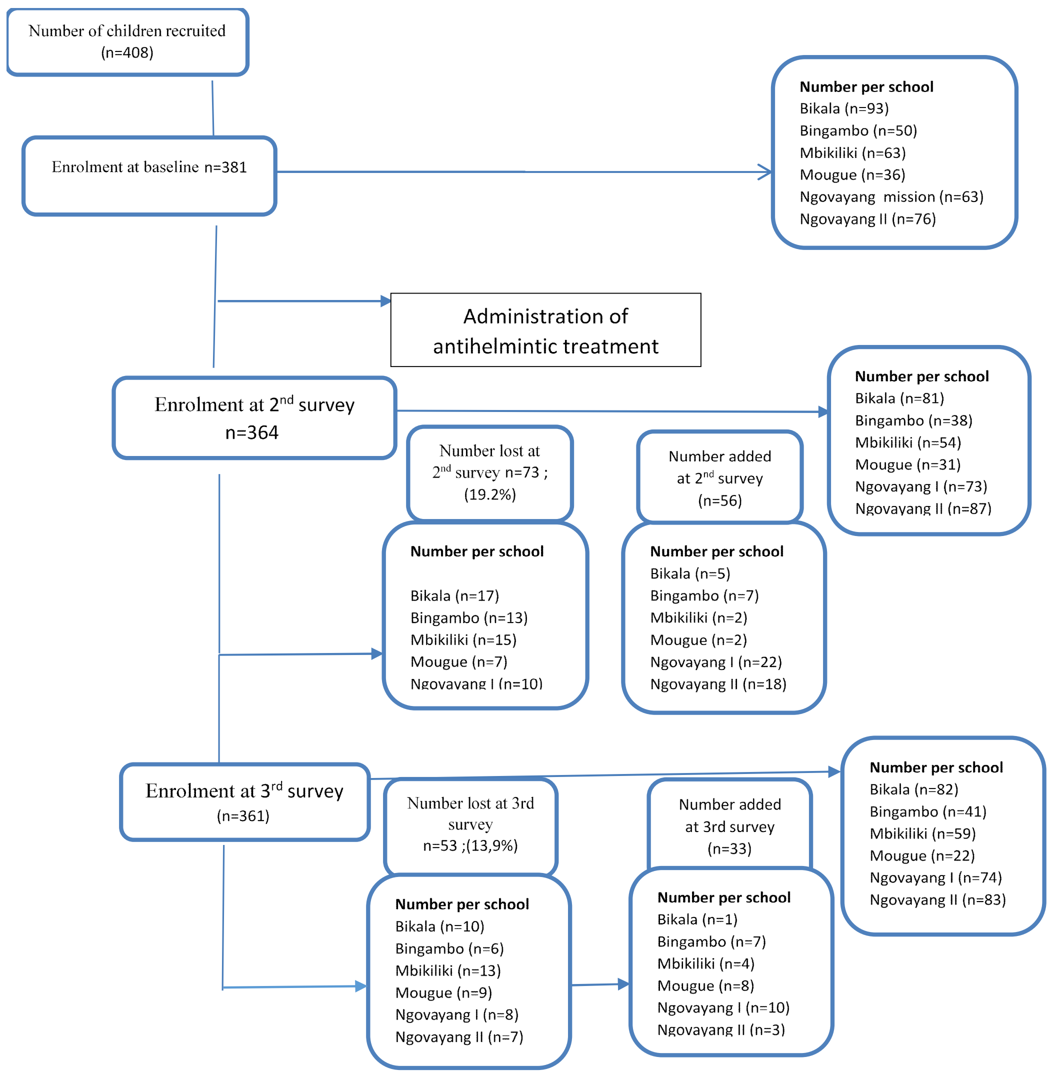

Fig. 1. Trial diagram showing the number of subjects recruited, enrolled, lost at follow-up and included in the statistical analysis during the study

RR= (N° of positive cases at third survey but negative at second survey/ N° of positive cases at first survey) X 100

Proportion (express in percentage) of newly infected case corresponded to the number of individuals who were diagnosed negative at baseline but acquire an infection at follow up surveys (one month and two months after baseline survey).

PNIC= (Number of new cases of infection at second and third survey/ Number of infected cases at baseline) X 100

The Chi-square test was used to compare the prevalence of parasites in relation to sex, age groups and school. The Mann-Whitney U testpermitted us to compare egg load according to sex while the Kruskal-Wallis test was used to compare egg load in relation to age groups and schools. Statistical significance was situated at 95% (P <0.05).

3. RESULTS

3.1 Baseline Prevalence

Out of the 381 stool samples analysed, 249 (65.3%) were positive for either *A.lumbricoides* (23.1 %), *T. trichiura* (35.2 %), hookworms (7.9 %), *H. diminuta* (0.3 %), *E. histolytica/E. dispar*(5.8 %), *E. coli* (19.2 %), *E. hartmanni* (0.3 %) and *Candida sp* (26.0 %) (Table 1). Infection rates varied from 53.9% (Ngovayang II) to 86.0% (Bingambo). Almost all schools presented infection rates above 60.0% with exceptions observed for Ngovayang mission (57.1 %) and Ngovayang II (53.7 %). Infection rates varied significantly between schools for *A.lumbricoides* (P=0.0001), *T. trichiura* (P=0.0001), *E.histolytica* (P=0.001) and *E. coli* (P=0.004). Male participants were significantly more infected compared to females for hookworms (*P*=0.02). As regards age groups, infection rates varied from 60.7 % (11-15) to 68.5 % (6-10). Equal infection rates were observed for all the parasite species in age groups 6-10and 11-15with the age group 6-10 being more infected by *A. lumricoides, T. trichiura* and hookworms (Table 1).

3.2 Egg Load Variation by Sex, Age and School

The mean egg load were 6023.7 epg of stool, 801.5 epg of stool, 566.1 epg of stool and 312.0 epg of stool for A.*lumbricoides,T. trichiura*, hookworms and *H. diminuta*respectively.As regards sex, no difference was observed between males and females exception being for *H. diminuta* which was observed only in females.

Participants of 6-10 years presented the highest egg load for *A. lumbricoides*.For the different schools, the egg loads were situated between 53.9epgof stool (Ngovayang II) to 2317.04 epgof stool (Bingambo) for*A. lumbricoides*; 80.0 eggs per gram of stool (Ngovayang II) to 182.2 epg of stool (Bikala) for*T. trichiura* ; 0.4 epg of stool (Mbikiliki) to 88.4 epg of stool (Ngavayang mission) for hookworms and 0.0 epg of stool (Bikala) to 8.9 eggs per gram of stool (Mougue) for *H. diminuta.*Significance difference was observed for*T. trichiura* (P=0.03) between schools (Table 2).

3.3 Profile of Transmission Dynamics

A significant reduction in prevalence was observed for all the parasites species but with relatively high values observed for *T. trichiura* compared to other parasite species. At base line, a high value was observed for *T. trichiura* (35.2 %), *Candida sp* (26.0 %) and *A.lumbricoides* (23.1 %). A significant drop in prevalence was observed at one month post treatment for*A. lumbricoides* (4.1 %:*P*=0,0001), *T. trichiura* (17.2 % : *P*=0,0001) and hookworms (2.7 % *P*=0,02).An increase in prevalence was noted at three months post treatment with significance in favour of *A.lumbricoides* (*P*=0.0001)*, T. trichiura* (*P*=0.001) and hookworms (*P*=0.03) (Fig. 2). Egg load decreased during the study periods for all the parasite species with significant difference observed for *A. lumbricoides* at post treatment values (T_0 +1 month: 1114.7 epg,*P*=0,02; T_0+3 months: 914.3 epg, *P*=0.01) compared to baseline value (6023,7 epg). However, a slight increase was observed at three months post treatment compared to that obtained at one month post treatment for*T. trichiura* and hookworms (Fig. 3).

3.3.1 Occurrence rate of parasites species by infection type during the study periods

Single infections were significantly higher compared to multiple infections during all the study periods (*P*=0, 0001). Also, singleinfection prevalence decreased from pre-treatment (35.2%) to one month (25.3%) and three months (28%) post treatment though with a slight increase observed at 3 months compared to one month post treatment. The same variation trend was observed for multiple infections (46.6 %, 9.8 % and 16.5 % respectively) (Table 3).

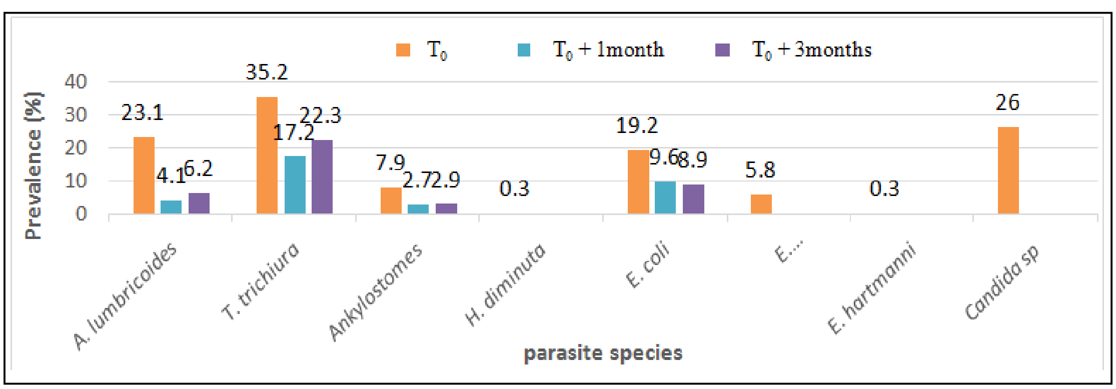

Fig. 2. Prevalence variation of parasites species at pretreatment and post treatment

Table 1. Infection rate by school, sex and age group

Variables	NE	Parasites species							
		A. lumbricoides	***T. trichiura***	**Ankylostomes**	***H. diminuta***	***E.histolytica/ E.dispar***	***E. coli***	***E. hartmanni***	***Candida sp***
Sex									
Male	198	49 (24.7)	75 (37.9)	21 (10.6)	0 (0.0)	14 (7.1)	43(21.7)	1 (0.5)	56 (28.2)
Eemale	183	39 (21.3)	59 (32.2)	9 (4.9)	1 (0.5)	8 (4.3)	30(16. 4)	0 (0.0)	43(23.5)
Total	381	88 (23.1)	134 (35.2)	30 (7.9)	1 (0.3)	22 (5.8)	73 (19.2)	1 (0.3)	99 (26.0)
P-value		0.4	0.2	0.04	0.2	0.2	0.1	0.3	0.2
Age									
1-5	6	0 (0.0)	1 (16.6)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (16.6)
6-10	268	65 (24.2)	102 (38.1)	21 (7.8)	1 (0.4)	15 (5.6)	48(17.9)	0 (0.0)	74(27.6).
11-15	107	23 (21.5)	31 (29)	9 (8.4)	0 (0.0)	7 (6.5)	25(23.4)	1 (0.9)	24(22.4)
Total	381	88 (23.1)	134 (35.2)	30 (7.9)	1 (0.3)	22 (5.8)	73 (19.2)	1 (0.3)	99 (26.0)
P-value		0.3	0.1	0.7	/	0.7	0.2	/	0.5
Schools									
Bikala	93	22 (23.6)	34 (36.5)	3 (3.2)	0 (0.0)	3 (3.2)	12(12.9)	0 (0.0)	24 (25.8)
Bingambo	50	17 (34.0)	27 (54.0)	6 (12.0)	0 (0.0)	6 (12.0)	6 (12.0)	0 (0.0)	15 (30.0)
Mbikiliki	63	27 (42.8)	24 (39.0)	5 (7.9)	0 (0.0)	3 (4.7)	8 (12.7)	0 (0.0)	12 (19.0)
Mougue	36	10 (27.7)	17 (47.2)	7 (19.4)	1 (2.7)	7 (19.4)	13(36.1)	1 (2.7)	9 (25.0)
Ngovayang mission	63	7 (11.1)	16 (25.4)	5 (7.9)	0 (0.0)	0 (0.0)	19(30.1)	0 (0.0)	13 (20.6)
Ngovayang II	76	5 (6.6)	16 (21.0)	4 (5.3)	0 (0.0)	3 (3.9)	15(19.7)	0 (0.0)	26 (34.2)
Total	381	88 (23.1)	134 (35.2)	30 (7.9)	1 (0.3)	22 (5.8)	73 (19.2)	1 (0.3)	99 (26.0)
P-value		0.01	0.01	0.05	/	0.01	0.04	/	0.3

Table 2. Egg load variation by school, sex and age

Variable	Subclass	Parasite specie			
		A. lumbricoides	***T. trichiura***	**Ancylostomes**	***H. diminuta***
Sex	Male	7404,3±10310,5	994,6±2197,4	696,0±350,92	/
	Female	4108,6±6020,4	539,0±1398,7	254,5±1517,1	312,0±0,0
Age groups (years)	1-5	/	48,0±0,0	/	/
	6-10	6091,6±8906	956,0±2144,2	624,0±1468,4	312,0±0,0
	11-15	5796,7±9030,9	314,6±521,2	378,0±381,1	/
School	Bikala	7288,4±12066,2	614,2±1315,3	224,0±304,8	/
	Bingambo	7907,0±7105,6	250,4±263,3	592,0±430,2	/
	Mbikiliki	6502,8±6729,5	2413,1±3693,8	24,0±0,0	/
	Mougue	1093,7±1033,8	225,6±279,1	200,0±123,1	312,0±0,0
	Ngovayang mission	7193,1±12826,1	651,2±971,5	1113,6±2409,6	/
	Ngovayang II	1224,0±1121,2	375,0±561,7	492,0±356,3	/

Epg: eggs per gram

Table 3. Occurrence rate of parasites species by infection type during the study periods

Infection type	Parasite species involve	Study periods		
		Pre treatment NE= 381	**1 month post treatment NE=364**	**3 months Post treatment NE=361**
Single infections	Al	21 (5.5)	8 (2.2)	11 (3)
	Tt	47 (12.3)	50 (13.7)	59 (16.3)
	Hw	3 (0.8)	3 (0.8)	3 (0.8)
	Ec	21 (5.5)	31 (8.5)	28 (7.7)
	Can	42 (11)	/	/
Double infections	Al+ Tt	29 (7.6)	2 (0.5)	9 (2.5)
	Al + Hw	1 (0.3)	/	/
	Al+ Hd	1 (0.3)	/	/
	Al+ Ec	1 (0.3)	1 (0.3)	/
	Al+ Can	3 (0.8)	/	/
	Tt + Hw	1 (0.3)	5 (1.4)	6 (1.7)
	Tt + Ec	4 (1)	1 (0.3)	4 (1.1)
	Tt + Can	10 (2.6)	/	/

Infection type	Parasite species involve	Study periods		
		Pre treatment NE= 381	1 month post treatment NE=364	3 months Post treatment NE=361
	Hw +Can	2 (0.5)	/	/
	Eh+Ec	4 (1)	/	/
	Eh + Can	1 (0.3)	/	/
	Ec + Ehart	1 (0.3)	/	/
	Ec+ Cand	11 (2.9)	/	/
Triple infections	Al + Tt+Hw	9 (2.4)	1 (0.3)	1 (0.3)
	Al +Tt + Ec	4 (1.5)	/	/
	Al + Tt + Can	6 (1.6)	/	/
	Al + Eh +Ec	2 (0.5)	/	/
	Tt + Hw + Ec	2 (0.5)	/	/
	Tt + Hw+ Can	1 (0.3)	/	/
	Tt + Eh + Ec	3 (0.8)	/	/
	Tt + Ec + Can	1 (0.3)	/	/
	Hw + Ec + Cand	3 (0.8)	/	/
	Eh + Ec + Cand	2 (0.5)	/	/
Infections with ≥4 parasites species	Al + Tt + Hw + Ec	1 (0.3)	/	/
	Al + Tt + Ec + Cand	2 (0.5)	/	/
	Tt + Hw + Ec + Cand	3 (0.8)	/	/
	Tt + Eh + Ec + Cand	3 (0.8)	/	/
	Al +Tt +Hw + Eh + Ec	1 (0.3)	/	/
	Al + Tt + Ec + Eh + Cand	1 (0.3)	/	/
	Tt + Hw + Eh + Ec + Cand	1 (0.3)	/	/
	Al+ Tt + Hw + Eh + Ec + Cand	2 (0.5)	/	/

Al= A. lumbricoides; Tt= T. trichiura ; Hw= Ancylostomes ;Hd= H. diminuta ; Eh= E. histolytica / E. dispar; Ec= E. coli ;Ehart=E. hartmanni ; Can=Candida sp

3.3.2 Proportion of newly infected individuals registered at different study phases

New infections, mainly observed for *T. trichiura* (5.6% and 8.6% at 1 and 3months post treatment respectively) were more registered at 3months post treatment (8.9%) compared to one month post treatment (6.2) (Fig. 4). Reinfection rate of 7.3% was observed at 3 months post treatment for *A. lumbricoides* (3.7%), *T. trichiura* (6.1%) and hookworms (1.1%) (Fig. 5).

4. DISCUSSION

The present study which evaluated the infection dynamics of children on anthelminthic drugs reveals that the Ngovayang health area in the South region of Cameroon is still very endemic

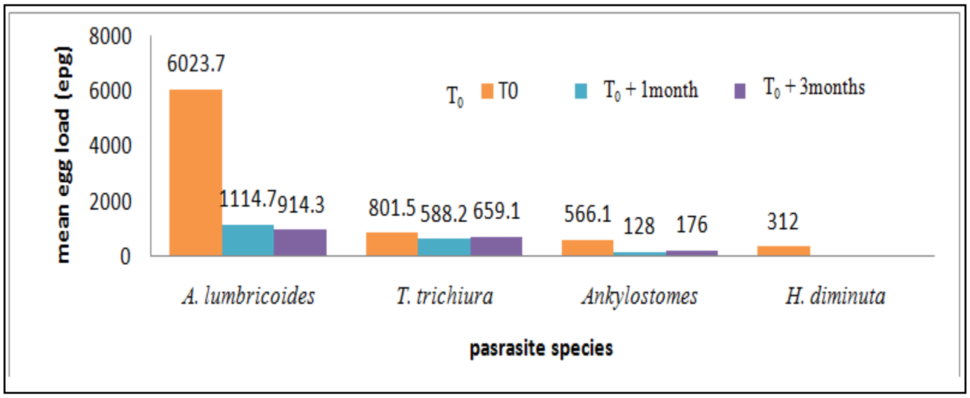

Fig. 3. Egg load variation of parasites species at pre-treatment and post treatment

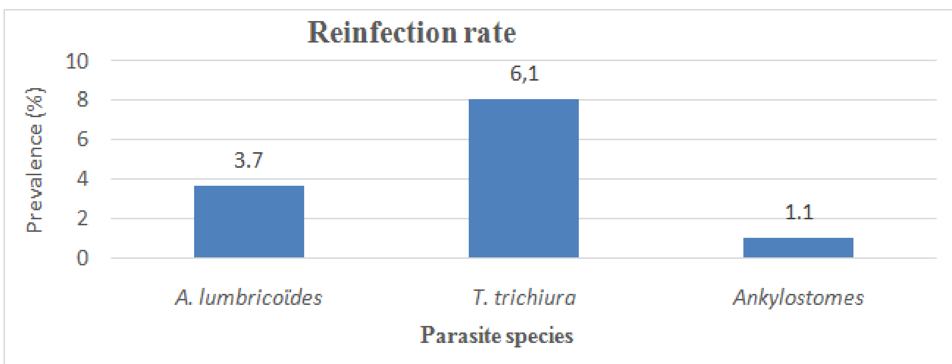

Fig. 4. Reinfection rate according to parasite species

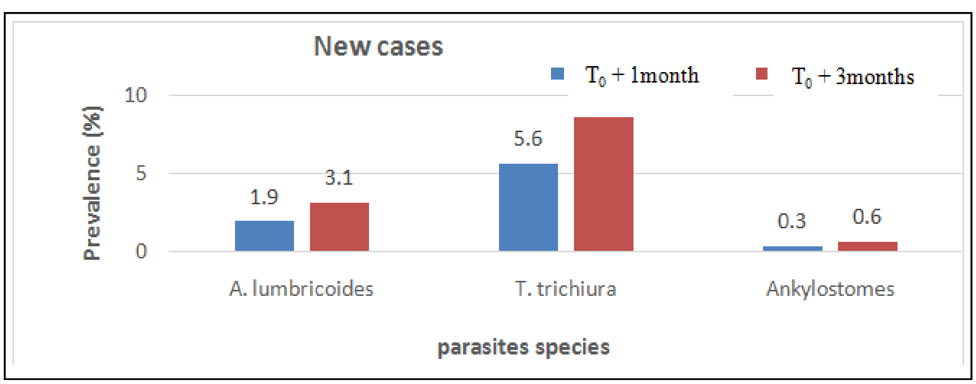

Fig. 5. Proportion of new cases according to parasite species

for intestinal parasitic infections. The infection rate obtained during this study (65.3%) confirms previous observations that revealed the study area to be a zone of high risk of infection (75.9%) [10]. This result also confirms the classification made by [7], who showed that the South region of Cameroon was the most endemic for intestinal helminths infections. It is quite known that the South region registeredabout 17% of children who do not go to school [17]. This fraction of the population could have a great impact in maintaining the propagation of parasite resistant forms since they do not benefit from annual mass drug administration given in schools. There is a persistence in the different parasites (helminths: *A. lumbricoides*, *T.trichiura*and hookworms; protozoans: *E. histolytica/E. dispar* and *E. coli*) in the study area [10,13]. This could reflect variety of factors including biological factors (high number of eggs laid by adult worms and egg shell that protect them from environmental shock for *A. lumbricoides* and*T.trichiura,* drug resistance for *T.trichiura,* and environmental factors like climate, soil type, temperature, and others which favour environmental resistance of parasite infesting forms.Resistance of some helminths like *T.trichiura* could also explain the persistence in endemicity. In this study, an infection rate of 35,2% was observed for *T.trichiura*to the detriment of others, which is in conformity with other studies [18,19]. Male participants were more infected by hookworms, which shows that transmission is not only linked to agricultural activities where infection increases with age and certain habit like walking barefooted [20]. This result is in contrast to previous results which showed no difference in hookworm infection by gender [10]. The difference observed could simply be related to a difference in contamination time since inhabitants of the Ngovayang area have the habit of walking barefooted, thus exposing both sex to equal contamination risk [10]. A reduction of infestation rate of parasitic protozoan (*E. histolytica/E. dispar* and *E. coli)* observed may be due to some inadequate environmental features for the survival of their resistant forms. Nevertheless, *E. coli* was more prevalent supporting the hypothesis that its cysts could be more resistant in the environment than those of other amoeba species [10]. Variation of infection rate in favour of malesis in contrast to previous results obtained in same study areas and other localities that show that both males and females are exposed to equal risk of infections [21,10,13]. This difference could be linked to contamination time (recent and old infections) and the aptitude of individual defensive systemto overcome infection.Single infections (53.6%) as well as multiple infections (46.4%) were observed during this study. Many studies have underlined the fact that parasitic coinfection could lead to antagonistic or synergistic relationship, causing adverse morbidity in infected children [22]. Contrary to Bethony et al., [23], this study shows that an increase in *T. trichiura* and *E. coli*infection led to subsequent increase of *Candida sp*. infection. This might be due to the absence of treatment given against opportunistic infections like *Candida sp*. during deworming campaigns. Thus, it has been shown that the use of chemotherapy against *Candida sp*. could have a regressive impact on intestinal parasites prevalence in HIV infected persons [24].

The initial egg load situated at 24-53400 eggs per gram of stool indicates intensive infection due to high number of eggs laid by helminths parasites 20000 and 30000 eggs per day respectively for *A. lumbricoides* and T. *trichiura* [10]. Early acquisition of parasites has showen to influence positively the number of eggs laid by female worms. This could explain the high egg load observed in the males for *A. lumbricoides, T. trichiura* and hookworms [18].

According to Aubry et al., [25], the important factor of treatment is reinfection and the study of transmission dynamics and incidence after treatment administration could be an important factor in following up infections during a given period [26]. Many authors have situated the time interval to evaluate transmission dynamics following treatment extending from two weeks to 18 months [18,11,19]. In the present study the global reinfection rate of 7.3% obtained at three months post treatment is high compared to that obtained in previous studies in the same locality [26], but low compared to the results obtained in Tanzania at 18 months post treatment using Albendazole [11]. Factors such as the physical environment, level of education and hygiene can explain this disparity. Reinfection rates of 6.1%, 3.7% and 1.1%observed respectively for *T. trichiura, A. lumbricoides* and hookwormscould reflect the high number of eggs laid by the female worms of these parasites (*T. trichiura* and *A. lumbricoides),*their resistance in the environment same as easy attachment of eggs on fruits, vegetables and dust particle. [13,27], leading to progressive environmental contamination and consequently individual contamination. This reinfection pace noted just at three months post treatment might indicate the initial prevalence could be reached and even go beyond at the end of one year. This time limit (three months post treatment) seems to be the critical common period for these parasites during which a second deworming intervention could be indispensable. Recommendations from previous studies have showed the necessity of deworming after every three months in hyper-endemic areas [18,19] which is inline with the recommendation of the WHO which emphasizes on mass deworming twice a year in areas where the prevalence goes above 50% [26].

Evaluation of new infections was done at three-time interval following treatment. New cases were mostly observed for *T. trichiura* (8.6%) mainly due to the resistance of the parasite eggs in nature [25], inadequate environmental hygiene conditions and the maintenance of transmission chain by the human population who are not involved in annual mass deworming program. The persistence of *E. coli* could reflect the resistance of its cysts in the study area. No correlation has showed the disappearance of *Candida sp* in persons on anthelminthic treatment [27]. However, the drug action might have reinforced the immune system of the individuals, leading thus to the disappearance of opportunistic parasites like *Candida sp*. Also, [28], showed that *E. coli* feeds on some fungi and flagellates during their developmental cycle.

5. CONCLUSION

The results of this study indicate persistence in the transmission of intestinal parasitic infections in children on anthelmintic drugs of the Ngovayang health area. The global prevalence of 65.3% shows the study area is still exposed to high risk of parasitic infections including soil transmitted helminths, amoeba parasites and yeast cells of the genus *Candida.* The initial egg load situated at 24-53400 eggs per gram of stool indicates intensive infection. The follow up of transmission dynamics during the three months post treatment revealed a rapid pace of newly infected cases as from one month post treatment with high rate of reinfection observed at three months post treatment. However, extended studies that can cover at least one year at different time interval are indispensable inorder to better appreciate infection dynamics. Although the study of incidence is better appreciated at yearly interval, information from this study could throw more light on the critical infestation period, permitting a readjustment and reinforcement of specific control measures against these affections. This will be more credible only if the transmission chain is attacked at all levels: environmental impact on maintaining transmission, the sensitization of the community on sanitation education and the respect of environmental, individual and collective sanitation measures by the entire community.

CONSENT AND ETHICAL APPROVAL

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 gave their approval for the study. The National Ethical Committee of Research on Human health gave the final authorization to conduct the study (reference N°2019/03/10/CE/CNERSH/SP). 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 guardians. Participants were recruited on a voluntary basis and their personal information was treated privately and was not divulged to a third party. All participants 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 during the first survey following stool samples collection. Follow up surveys were done at one and two months post treatment.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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