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Full Length Research Paper

Aetiology of intestinal parasitosis in children suffering from malnutrition in Abidjan, Côte d'Ivoire

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Intestinal parasitosis associated to malnutrition can lead to serious consequences. The aim of this study is to explain the relationship between intestinal parasitic portage and type of malnutrition in Abidjan. It took into account children in the three Teaching Hospitals of Abidjan and in the general hospital of Abobo. Focus was on children over six months old, who were suffering from severe malnutrition (Z- score ≤ -3) or moderate one (Z-score between -3 and -2). Swabs of stool were taken for analysis in parasitology laboratory of the Diagnosis and Research Center on AIDS in Abidjan. Stool samples were examined through microscope and concentration techniques. Helminths were seen in 4.8% of analysis and protozoa in 8.0%. Helminth species were as follow: *Trichuris trichiura* (17.6%), *Ascaris lumbricoides* (8.8%) and hookworms (8.8%). Protozoa were identified in the following form*: Giardia intestinalis* (23.5%), *Entamoeba coli* (16.5%), *Endolimax nana* (11.8%) and *Pseudolimax bustchili* (2.9%). There was no correlation between parasitic portage and the severe or the moderate feature of malnutrition (p = 0.78). This study helped shed light on most well-known parasites in children suffering from malnutrition in Abidjan hospitals.

Key words: Intestinal parasitosis, malnutrition, children, Abidjan.

INTRODUCTION

Intestinal parasitosis constitute one of the first causes of morbidity rate in tropical Africa. They attack the digestive track - a sign of their particular tropism for poor regions – (Mostafi et al., 2012). They are caused by protozoa and geohelminths and are very often linked to the precariousness and the pauperization of the populations. An estimated 12% of children ready to be sent to school are affected in developing countries because of their typical hand-mouth activity, uncontrolled fecal activity and their immature immune system (Awasthi et al., 2003; Sanzaet al., 2013). These parasitic diseases can have a harmful effect on children and adolescents nutrition conditions (Reilly et al., 2012; Zhou et al., 2005) - which is linked to the decrease in the capacity of absorption by bowels (Hesham et al., 2004). The consequences caused by these parasitosis in humankinds are several. They are mainly felt in a decrease in the appetite, the anaemia due to a deficiency in iron in case of diarrhea, vomiting, and dehydration (Stephensons et al., 2000; Nokes and Bundy, 2015). Thus, malnutrition is the underlying cause of more than 50% of infantile deaths in developing countries where climatic conditions are favourable to intestinal parasites (Tyoalumun et al., 2016). It's the

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same situation with some intestinal helminths such as the hookworms which may be the cause of severe anaemia in the affected person (Quihui-Cota et al., 2010).

In Côte d'Ivoire, intestinal parasitosis, particularly helminthiasis raise a public health problem on account of their morbid feature and their contingently high rate in rural areas, which can vary with the type of region. The climatic conditions favor the development and survival of these parasites, the high prevalence results to infection and diseases that are the immediate causes of malnutrition and death in young children (Agbaya et al., 2004; Kassi et al., 2008; Adoubryn et al., 2012; Yapi et al., 2014). In their effort to fight against these parasitosis, some nongovernmental organisations (NGO), the ''Institut National d'Hygiène Publique'' standing for 'the national public hygiene institute' and the PNLSGFL-CI (Programme National de Lutte contre la Schistosomose, les Géohelminthoses et les Filarioses lymphatiquesen Côte d'Ivoire) standing for 'national program against schistosomiasis, Geohelminthiasis and lymphatic filariosis in Côte d'Ivoire' are organizing consciousness-raising campaign and massive treatment among the population. Unfortunately the impact of this parasitosis combination and the nutritional deficit especially in children are not affected by these actions. We find it appropriate to carry out this study which will undoubtedly set a relationship between the intestinal parasitic portage and the corresponding type of malnutrition in Abidjan.

MATERIALS AND METHODS

Type and study setting

It was a transversal survey carried out from October 2012 to August 2013 in the three CHUs- standing for Teaching Hospitals - of Abidjan and in the general hospital of Abobo (figure 1). The climate in Abidjan is of tropical and humid kind with four main seasons - a large rainy season running from march to mid July, and a short and dry one from mid July to mid September. Next is another short rainy season from mid September to the end of November, and the last is the larger dry season which runs from December to March. So for years there has been some modification concerning seasons duration. This causes the season repartition to be now uncertain. The annual average pluviometryis 1703 mm - the maximum is 2432.2 mm and the minimum is 1059 mm. The humidity rate is between 80 and 90%. Some variation in temperature is noticed. It is between 23.6°C and 29.6°C with the annual average which is 26.6°C. However absolutely maximal temperatures can reach 37.4°C. The town is also characterized by a dense vegetation which is gradually being cleared of its trees and replaced by some mangrove swamp on the lagoon and estuary coasts. All these cause Abidjan to become an intertropical area with warm and humid weather, thus open to almost any kinds of parasitic illnesses.

Paediatric, hospitalization and nutritional rehabilitation services on each survey site were visited in this study and stool samples were taken from their respective patients.

Parasitic coprology tests were carried out in the Parasitology laboratory at CeDReS (Centre de Diagnostic et de Recherchesur le Sida et les autres maladies infectieuses), standing for the diagnosis and research center on AIDS and any other infestious illnesses. CeDReS is located at the CHU– standing for Teaching Hospital - of Treichville.

Target population

Any child with severe or moderate malnutrition was a target in this study. The identification of the children suffering from malnutrition was based on the weight / height (W/H) index – the weight of the child was determined by his or her height in order to see how the child was getting too thin. The classification was made by the use of W/H index table which helped to range underacute malnutrition (table 1). Severe and moderate malnutrition were described with a Z-score respectively inferioror equal to -3 (Z-score ≤ -3) between -3 and -2 (Z-score between -3 and -2). Absence of malnutrition was characterized by a Z-score index superior or equal to -1.5 (WHO, 1997).

METHODS

The data collection was through questions put to the mothers of the ill children after these mothers' agreement. Information about sociodemographic and clinical aspects, socioeconomical conditions and the parents' life standard was collected before or after a medical visit. Some clean tubes were distributed to mothers for taking stool swabs the following day. Then these stoolswabs were immediately sent to laboratory for parasitic coprology examination. Each stool sample was thus analyzed through a microscope using direct examination and concentration techniques with simplified Ritchie and Kato- Katz method. A modified Zielh-Neelsen technique was also used to see if there was any *Cryptosporidium* oocyte. Graham anal scotch test in order to identify oxyuris eggs was not carried out. Baermann technique to find out any anguillula larva was not also carried out in this study.

Statistical Analysis

Data were processed and examined on the software of Statistical Package for Social Science (SPSS) IBM version 21.0. All the variables were described in groups

Fig. 1. Map of Abidjan city with the study sites.

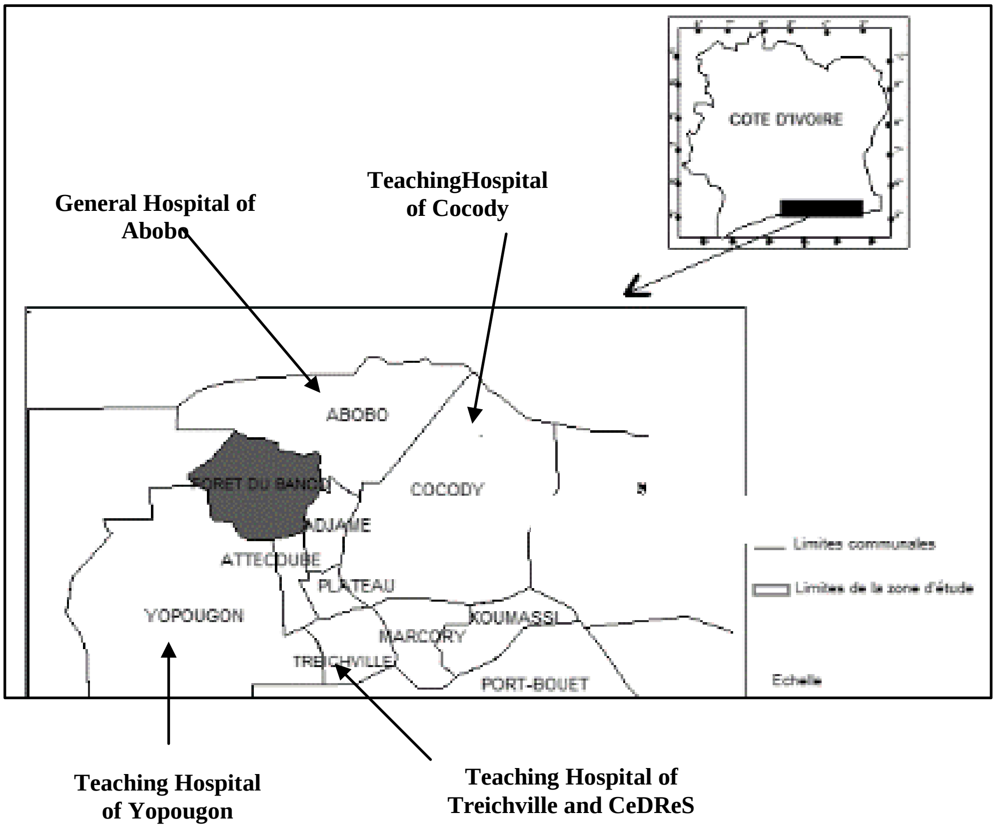

Fig.1. Study setting

Table 1. Table of weight / height reading.

Table of weight for boys and girls size												
Standing up size	*weight Kg – Z-score*						Standing up size	*weight Kg – Z-score*				
cm	*-3*	*-2*	*-1.5*	*-1*	*0*		cm	*-3*	*-2*	*-1.5*	*-1*	*0*
Use standing up height for more than 87cm												
87	9.6	10.4	10.8	11.2	12.2		104	13.0	14.0	14.6	15.2	16.5
87.5	9.7	10.5	10.9	11.3	12.3		104.5	13.1	14.2	14.7	15.4	16.7
88	9.8	10.6	11.0	11.5	12.4		105	13.2	14.3	14.9	15.5	16.8
88.5	9.9	10.7	11.1	11.6	12.5		105.5	13.3	14.4	15.0	15.6	17.0
89	10.0	10.8	11.2	11.7	12.6		106	13.4	14.5	15.1	15.8	17.2
89.5	10.1	10.9	11.3	11.8	12.8		106.5	13.5	14.7	15.3	15.9	17.3
90	10.2	11.0	11.5	11.9	12.9		107	13.7	14.8	15.4	16.1	17.5
90.5	10.3	11.1	11.6	12.0	13.0		107.5	13.8	14.9	15.6	16.2	17.7
91	10.4	11.2	11.7	12.1	13.1		108	13.9	15.1	15.7	16.4	17.8
91.5	10.5	11.3	11.8	12.2	13.2		108.5	14.0	15.2	15.8	16.5	18.0

to facilitate the calculation of rate and averages of the distribution models. Odd-Ratios were determined to study factors which may be linked or not to the illness with 95% of confidence interval (CI 95%). Exact Fisher and Kruskal-Wallis tests were used to compare relative frequencies with average in the groups at a risk of error α equal to 5%.

RESULTS

Population features

In total, 249 children suffering from malnutrition were taken into account in this study with a special focus on male (Sex-ratio = 1.3). Children of 60 months old were the most numerous with an average of 34.68 months (standard deviation= 46.52 months). Sex, age and HIV status were not correlated with the type of malnutrition (table 2).

Clinical signs

The main clinical signs about the interviewee- patients are listed in table 2. The most common signs were linked to fever (52.2%), diarrhoea (14.9%) and ORL infections (14.7%). Diarrhoea was correlated with the type of malnutrition and was most of the time seen in children who were suffering from severe malnutrition (p=0.005).

Parasitology data

The overall prevalence of intestinal parasitosis was 12.8%. Protozoa infections represented 8.0% while helminthiasis had a global frequency of 4.8% (figure 2). Among the helminths, the most represented species were *Trichuris trichiura* (17.6%), *Ascaris lumbricoides* (8.8%) and hookworms (8.8%). In fact the comparison in average numbers of eggs by counting the helminths, showed no significative difference statistically speaking according to the type of malnutrition (figure 3). The most represented protozoa were of the following species: *Giardia intestinalis* (23.5%), *Entamoeba coli* (16.5%) and *Endolimax nana* (11.8%). In addition no significative difference statistically speaking was noticed between the factors such as age, sex, clinical signs and the outbreak of intestinal parasitic infections generally in children suffering from malnutrition (table 3). However signs such as cutaneous-mucous membrane affections in these children were statistically correlated to the outbreak of intestinal helminthiasis (p= 0.009). The table 4 presents the relationship between socio-demographic characteristics and the outbreak of intestinal helminthiasis in malnourished children.

No case of *Cryptosporidium sp*. oocyte was found in our work. The analysis of the type of malnutrition (moderated or severe) according to the discovered intestinal parasites demonstrated that among the helminths the *T. trichiura* species was more noticed in children suffering from moderate malnutrition. But not any significative difference statistically speaking was seen (p=0.18). As far as protozoa were concerned, *G. intestinalis* was the most seen specie in the case of moderate malnutrition, without a statistically significative link: p=0.23 (table 5).

DISCUSSION

The overall prevalence of intestinal parasitosis was lower than what was found with the children in previous studies carried out in Côte d'Ivoire where nutritional status wasn't taken into account (Kassi et al., 2008; Adoubryn et al., 2012). Much effort in Côte d'Ivoire helped to lower the overall prevalence of intestinal parasitosis particularly concerning intestinal helminthiasis. Consciousness-raising campaigns were so organized on systematic parasite elimination. There were also massive treatments of the population with albendazole drug particularly in school premises. Other researchers reported in some documents overall prevalence varying from 62% to 72% (Gutierrez-Jimenez et al., 2013; Mahmud et al., 2013; Verhagen et al., 2013) in children suffering from malnutrition. So, variation in parasitosis prevalence from a population to another one may be explained by behaviour factors concerning the host. (Pullan et al., 2010; Halpenny et al., 2013). The lack in faecal and hands hygiene favors in more than 40% affections in malnourished children (WHO-UNICEF, 2012).

The intestinal parasitosis prevalence was not correlated with the type of malnutrition (moderate or severe) in our study. But in the other hand, Verhagenandal. (2013) demonstrated in their work a high level of frequency in helminths in children suffering from moderate malnutrition. They also showed in this partnership the negative impact of nematodes such as *A. lumbricoides* and *T. trichiura*in case there is malnutrition. These parasites reduce the nutritional contribution in macro and micro nutriments including proteins, energy, iron, thiamin and riboflavin (Papier et al., 2014). A study about the interaction between energy proteinic malnutrition and sensitivity to intestinal infection in pigs brought to light that a low consumption in protein was correlated with a reduction in the immunity of the pig to infections (*Trichurissuis* and *Ascarissuum)*. This can have similar consequences in the humans suffering from protein deficit when exposed to*T. trichiura* (Pedersen et al., 2002). The influence of *T. trichiura* on the taking of intestinal iron was not taken into account in our work. Some other researchers yet demonstrated a high rate of this nematode in malnourished children who were suffering from anaemia due to deficit in iron. (Brito et al., 2006; Zimmermann and Hurrell, 2007). We didn't notice any meaningful relationship statistically speaking between infections linked to nematode and the type of malnutrition in the examined children unlike Quihui-Cota et al. (2010) who saw negative effects with intestinal parasites in a person suffering from malnutrition. Non pathogenic protozoa such as *E. coli*, *E. nana* and *P. bustchili* discovered in our study in relatively high rate proved an insufficient faecal and food hygiene in mothers, which led to a parasitic infection. Other authors documented this fact in their studies (Schmidlin et al., 2013).

Some factors linked to the outbreak of intestinal parasitosis in children suffering from malnutrition were reported by some authors. They wrote mostly an insufficient faecal and food hygiene, the nutritional deficiency (Mahmud et al., 2013), socio-economical con-

Table 2. Population characteristics, clinical signs and type of malnutrition.

Variables	Type of malnutrition (n=249)		Overall	Odds Ratio	95%IC	p-value
	Moderate n (%)	Severe n (%)				
Sex						
Female	74 (29,7)	36 (14,5)	110 (44,2)	1,05	0,62- 1,79	*0,86*
Male	92 (36,9)	47 (18,9)	139 (55,8)			
Age (months)						
<60	134 (53,8)	69 (27,7)	203 (81,5)	0,85	0,42- 1,70	*0,64*
≥60	32 (12,9)	14 (5,6)	46 (18,5)			
HIV infection						
Negative	104 (41,8)	52 (20,9)	156 (62,7)	1,0	0,85- 1,72	*1,0*
Positive	62 (24,9)	31 (12,4)	93 (37,3)			
Fever						
No	77 (30,1)	42 (16,9)	119 (47,8)	0,85	0,50- 1,43	*0,53*
Yes	89 (35,7)	41 (16,5)	130 (52,2)			
Diarrhea						
No	149 (59,8)	63 (25,3)	212 (85,1)	2,78	1,37- 5,67	*0,005**
Yes	17 (6,8)	20 (8,0)	37 (14,9)			
ORL infection						
No	139 (55,8)	66 (26,5)	205 (82,3)	1,33	0,68- 2,60	*0,41*
Yes	27 (10,8)	17 (6,8)	44 (14,7)			
Bronchitis						
No	154 (61,8)	75 (30,1)	229 (92,0)	1,37	0,54- 3,50	*0,51*
Yes	12 (4,8)	8 (3,2)	20 (8,0)			
Cutaneous-mucosal infection						
No	155 (62,2)	80 (32,1)	235 (94,4)	0,53	0,14- 1,95	*0,34*
Yes	11 (4,4)	3 (1,2)	14 (5,6)			

*p value< 5% : Statisticallysignificant association.

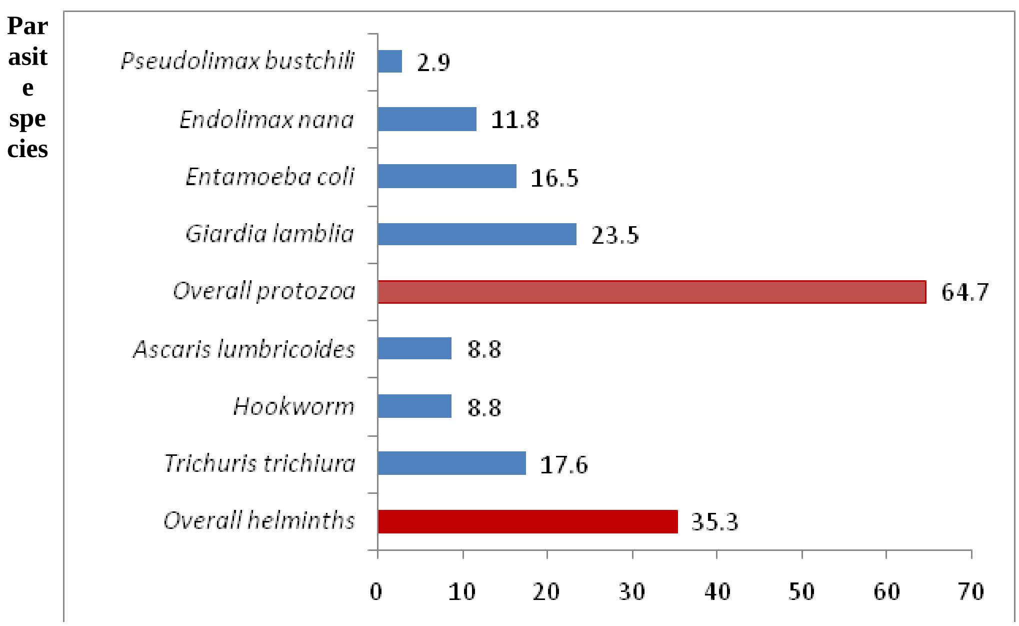

Fig. 2. Protozoa and helminths identified from malnourished children.

ditions and environmental factors concerning helminths which use transcutaneous contamination way (Zonta et al., 2014). In our survey we dealt with some socio-demographical and clinical factors. So, we found that diarrhoea was correlated with the type of malnutrition in the children (p=0.005), while a meaningful difference statistically speaking (p=0.009) was noticed between the outbreak of cutaneous- mucous affection and the type of

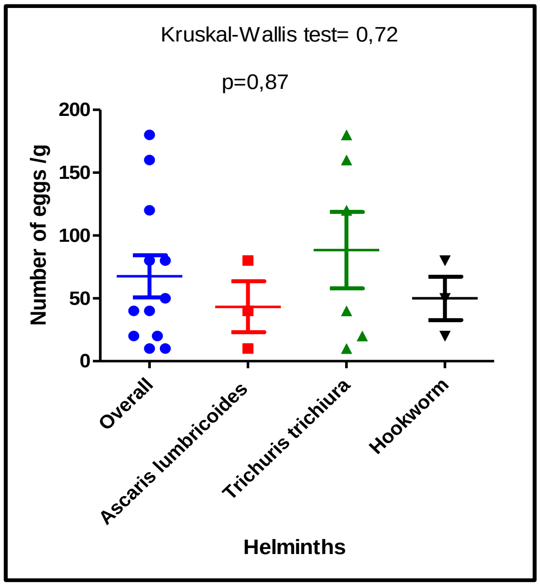

Fig. 3. Number of helmintheggs per gram of stool.

Table 3. Intestinal parasitics infections, sociodemographic and clinicalcharacteristics

Parameters	**Intestinal parasitics infections** Infected n= 32 (%)	No infected n= 217 (%)	**Odds Ratio**	**95%IC**	**p- value**
Sex					
Female	11 (34,4)	99 (45,6)	1,60	0,74- 3,48	*0,23*
Male	21 (65,6)	118 (54,4)			
Age (months)					
<60	27 (84,4)	176 (81,1)	0,80	0,29- 2,20	*6,66*
≥60	5 (15,6)	41 (18,9)			
HIV infection					
Negative	21 (65,6)	135 (62,2)	0,86	0,40- 1,88	*0,71*
Positive	11 (34,4)	82 (37,8)			
Type of malnutrition					
Moderate	22 (68,8)	144 (66,4)	0,90	0,40- 1,99	*0,79*
Severe	10 (31,3)	73 (33,6)			
Fever					
No	16 (50,0)	103 (47,5)	0,90	0,43- 1,90	*0,79*
Yes	16 (50,0)	114 (52,5)			
Diarrhea					
No	24 (75,0)	188 (86,6)	2,15	0,89- 5,27	*0,090*
Yes	8 (25,0)	29 (13,4)			
ORL infection					
No	24 (75,0)	181 (83,4)	1,68	0,70- 4,06	*0,25*
Yes	8 (75,0)	36 (16,6)			
Bronchitis					
No	28 (87,5)	201 (92,6)	1,80	0,56- 5,75	*0,32*
Yes	4 (12,5)	16 (7,4)			
Cutaneous-mucosal infection					
No	28 (87,5)	207 (95,4)	2,96	0,87- 10,1	*0,083*
Yes	4 (12,5)	10 (4,6)			

*p value< 5% : Statistically significant association

malnutrition in patients suffering from infection linked to intestinal helminthiasis. No intestinal cryptosporidiosis was found, it was rather opportunistic parasitosis that were found in the patients with immunodepression and

Table 4. Intestinal helminthiasis, sociodemographic and clinical characteristics.

Variables	Intestinal helminthiasis		Odds Ratio	95%IC	p- value
	Infected n= 12 (%)	No infected n= 237 (%)			
Sex					
Female	3 (25,0)	107 (45,1)	2,47	0,65- 9,35	*0,18*
Male	9 (75,0)	130 (54,9			
Age (months)					
<60	11 (91,7)	192 (81,1)	0,39	0,05- 3,08	*0,37*
≥60	1 (8,3)	45 (19,0)			
HIV infection					
Négatif	10 (83,3)	146 (16,6)	0,32	0,07- 1,50	*0,15*
Positif	2 (1,7)	91 (38,4)			
Type of malnutrition					
Moderate	8 (66,7)	158 (66,7)	1,0	0,29- 3,42	*1,0*
Severe	4 (33,3)	79 (33,3)			
Fever					
No	6 (50,0)	113 (47,7)	0,91	0,29- 2,91	*0,88*
Yes	6 (50,0)	124 (52,3)			
Diarrhoea					
No	11 (91,7)	201 (84,8)	0,51	0,06- 4,05	*0,52*
Tes	1 (8,3)	36 (15,2)			
ORL infection					
No	10 (83,3)	195 (82,3)	0,93	0,20- 4,39	*0,92*
Yes	2 (1,7)	42 (17,7)			
Bronchitis					
No	11 (91,7)	218 (92,0)	1,04	0,13- 8,52	*0,97*
Yes	1 (8,3)	19 (8,0)			
Cutaneous-mucosal infection					
No	9 (75,0)	226 (95,4)	6,84	1,62- 28,9	*0,009**
Yes	3 (25,0)	11 (4,6)			

*p value< 5% : Statistically significant association.

Table 5. Type of malnutrition and intestinal parasites identified.

Parasite species	Type of malnutrition		Odds Ratio	95%IC	p- value
	Moderate n=166 (%)	Severe n=83 (%)			
Helminths					
Ascaris lumbricoides					
Absence	164 (98,8)	82 (98,8)	1,0	0,09- 11,2	*1,0*
Presence	2 (1,2)	1 (1,2)			
Trichuristrichiura					
Absence	162 (97,6)	81 (97,6)	1,0	0,18- 5,58	*0,18*
Presence	4 (2,4)	2 (2,4)			
Hookworm					
Absence	164 (98,8)	82 (98,8)	1,0	0,09- 11,2	*1,0*
Presence	2 (1,2)	1 (1,2)			
Protozoa					
Giardia intestinalis					
Absence	159 (95,8)	82 (98,8)	0,28	0,03- 2,29	*0,23*
Presence	7 (4,2)	1 (1,2)			
Entamoeba coli					
Absence	161 (97,0)	79 (95,2)	1,63	0,43- 6,24	*0,48*
Presence	5 (3,0)	4 (4,8)			
Endolimax nana					
Absence	164 (98,8)	81 (97,6)	2,03	0,28- 14,6	*0,49*
Presence	2 (1,2)	2 (2,4)			

*p value< 5% : Statistically significant association.

generally subject to diarrhoea. When not vaccinated, the patientsespecially malnourished children suffering from HIV can be subject to serious consequences caused by this parasitosis (Vinayal et al., 2015).

CONCLUSION

Next studies will help to compare intestinal parasitosis prevalence between rural areasand city zones, inthe malnourished children, in order to determine risk factors linked to the outbreak of these affections in the target population.

Conflict of interests

No conflict of interests was reported by the authors.

Authors' Contributions

Kpongbo Etienne Angora, Pulcherie Chistiane Marie Kiki-Barroand Kondo Fulgence Kassiare the principal investigators of the study. Abibatou Konaté, Abo Henreiette Vanga-Bosson, Akoua Valérie Bedia-Tanoh, Sébastien Miezan and Vincent Djohan helped to carry out redaction of manuscript. EbyIgnace Hervé Menan, Willam Yavo supervised the study. All authors contributed to the drafting of the paper.

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