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Research Article

Prevalence and Associated Risk Factors of Gastrointestinal Infections Amongst Children in Bambili

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Abstract

Background and Objective: Intestinal helminths and protozoan parasites are major public health problems in developing countries. The main objective of this work was to estimate the prevalence and associated risk factors of gastrointestinal infections amongst children in Bambili. **Material and Methods:** A few schools were selected and from these schools, children who submitted their stool samples were chosen for the study. A field questionnaire form was given to the Head teacher, who distributed them to the children. These forms were completed by their parents back at home and submitted to the Head teacher the next day by the pupils. The same procedure was applied for subsequent stool collection in all the schools sampled. **Results:** The most frequent intestinal protozoans were *E. histolytica*, *E. coli* and *T. hominis*. Meanwhile, the most predominant helminth was A. *lumbricoides*. The prevalence of IPIs was significantly higher in children living in the Mahmishang health zone followed by Ntigi/Akou health zone, than those in Nibie III, Nibie I, Ngophana and Nibie II and there was a significant difference in the overall prevalence of IPIs in the health zones. The *E. histolytica* was the most commonly observed intestinal parasite encountered in the course of this study followed by E. *coli*, *A. lumbricoides* and *T. hominis*. **Conclusion:** This study may provide invaluable statistics needed for planning meaningful public control programs that aim at reducing the prevalence and morbidity of parasitic infections.

Key words: Prevalence, bambili, protozoan, helminths, risk factors

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Gastrointestinal parasites cause gastrointestinal parasitic infections (GIPIs) such as; ascariasis and trichuriasis etc., which are endemic worldwide and have been described as constituting the greatest single worldwide cause of illness and disease[1]. About one third of the world is infected with intestinal parasites[1]. *Ascaris lumbricoides*, *Trichiuris trichiura* and hookworms like *Necator americanus* and *Ancylostoma duodenales*, collectively referred to as soil-transmitted helminths (STHs) are the most common intestinal parasites[2]. Intestinal parasites are ubiquitous and this makes it easier to become infected[3]. Intestinal parasites can be acquired through ingestion of undercooked meat, drinking contaminated water, poor hygiene, contaminated soil and water sources as well as poor sewage disposal[4]. It can also be transmitted through skin penetration by hookworm and *Strongyloides stercoralis* larvae in the soil[5]. Poverty and illiteracy also contribute to the acquisition of GIPs. Intestinal parasitic diseases are among the most common diseases globally and for this reason, it is very important to study their occurrence and degree of risk in contamination. Very little has been done in this domain in the municipality of Bambili, hence the necessity of this study. Careful observations have shown that there are water crisis in some quarters in Bambili. They therefore, resort to other sources of water such as; streams, springs and wells whose quality is not guaranteed. The presence of farmers means contact with the soils. The area is also inhabited by Muslims whose culture of ablution can lead to acquisition of faeco-orally transmitted parasites. Many families in Bambili keep domestic animals like cattle and human-animal interactions as well as animal-animal interactions can increase the prevalence of GIPs. Current research was aimed at estimating the prevalence and associated risk factors of gastrointestinal infections amongst children in Bambili.

MATERIAL AND METHODS

Area of study: The study was carried out between August, 2012-January, 2013 in Bambili. The study took place in Bambili village found in the Tubah sub-division, Mezam division, North West region of Cameroon (Fig. 1). The village is situated some 10 km East of Bamenda, between latitudes 5°59′0″ N, longitudes 10°15′00″E at an altitude of 1,350 m.

Sampling technique and specimen collection: A multistage sampling technique was used in the study because the total number of children per health zone is unknown. Due to convenience and efficiency to the study, a few schools were selected. From these schools, children who submitted their stool samples were chosen for the study. Questionnaires were distributed to the children. These forms were filled by their parents back at home and submitted to us the next day by the pupil. For children who were diagnosed at the hospital, the form was completed for efficiency and time management.

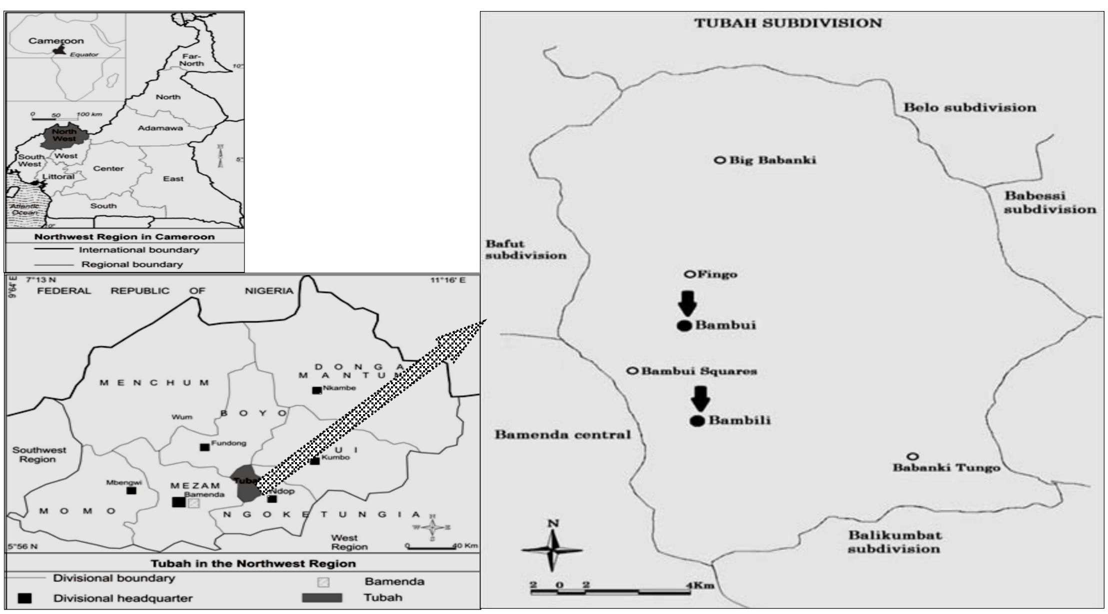

Fig. 1: Study area
Source: Helvetas Cameroon[6]

Children were provided with plastic bags (in which to stool), toilet tissue and clean and dry bottles with tight fitting lids, carrying numerical codes in which it collected and retained the fresh faeces. These numerical codes helped to identify the individual during microscopic examination of the faecal specimens. The bottles were collected and transported in a waterproof plastic bag to the laboratory of the Bambili Integrated Health Centre for analysis. The same procedure was applied for subsequent stool collection in all the schools sampled.

Microscopic examination using the floatation technique: The qualitative concentration technique of parasites is also known as enrichment technique. This simple floatation method (Willis technique) for qualitative analysis was used[4]. This method was used with specific gravity (density) 1.20. The eggs and cysts of parasites rose to the top of the saturated solution (sodium chloride solution), this is due to the difference in weight between cysts and eggs of parasites. This consists of measuring 2 g of faeces that was emulsified in the saturated solution in a beaker containing 60 mL of the NaCl solution.

Statistical analysis: Data collected was entered into the Statistical Package for Social Sciences (SPSS) 12.0 for Windows. Chi-square was used to compare prevalence with respect to health zones, age and gender and the various risk factors. Chi-square was tested at 5% significance level.

RESULTS

Prevalence of Intestinal Parasitic Infections (IPIs) in health zones sampled: From the 800 children who participated in the study, the prevalence rates of intestinal protozoans and helminths were 19.9 and 3.6%, respectively giving an overall prevalence of 23.5% as shown in Table 1 and 2. Thus, a significant difference ($\chi^2 = 66.8$, p = <0.001) existed between the prevalence of intestinal protozoan and helminths. The most frequent intestinal protozoans were *E. histolytica* (8.9%), *E. coli* (7.6%) and *T. hominis* (3.4%). Meanwhile, the most predominant helminth was A. *lumbricoides* (3.6%). However, Table 1 and 2 illustrates that the prevalence of IPIs was significantly higher in children living in the Mahmishang health zone (30.6%) followed by Ntigi/Akou health zone (27.5%), than those in Nibie III, Nibie I, Ngophana and Nibie II with prevalences of 25.6, 24, 17.3 and 16.9%, respectively and there was a significant difference ($\chi^2 = 22.5$, p = <0.001) in the overall prevalence of IPIs in the health zones.

Influence of age on the distribution of intestinal parasites: Table 3 revealed a decrease in rates of infection with increasing age. Children 0-4 years old had the highest prevalence (42.0%) followed by those greater than 5-9 years old (20.9%), whereas, those greater than 10-14 years old had the lowest prevalence of 17.3%. There was however, a significant difference ($\chi^2 = 16.9$ p = <0.001) in the infection rate amongst the 3 age groups.

Entamoeba histolytica was the most commonly observed intestinal parasite encountered in the course of this study (8.9%) followed by *E. coli*, *A. lumbricoides* and *T. hominis* with

Table 1: Overall prevalence of intestinal parasites in health zones sampled

Health zones sampled	Total No. of examined	Total No. of infected	Prevalence (%)
Nibie I	200	48	24.0
Nibie II	160	27	16.9
Nibie III	90	23	25.6
Ntigi/Akou	80	22	27.5
Ngophana	110	19	17.3
Mahmishang	160	49	30.6
Total	800	188	23.5

Table 2: Prevalence (%) of specific intestinal parasites in health zones sampled

Parasites	N I (N = 200)	N II (N = 160)	N III (N = 90)	N/A (N = 80)	Ngo (N = 110)	Mah (N = 160)	Total prevalence (%)
E. histolytica	17 (2.1%)	15 (1.9%)	12 (1.5%)	8 (1.0%)	5 (0.6%)	14 (1.7%)	71 (8.9%)
E. coli	15 (1.9%)	9 (1.1%)	7 (0.9%)	7 (0.9%)	11 (1.4%)	12 (1.5%)	61 (7.6%)
T. hominis	7 (0.9%)	-	1 (0.1%)	6 (0.8%)	2 (0.2%)	11 (1.4%)	27 (3.4%)
Total	39 (4.9%)	24 (3.0%)	19 (2.5%)	21 (2.7%)	18 (2.2%)	37 (4.6%)	159 (19.9%)
A. lumbricoides	9 (1.1%)	3 (0.4%)	4 (0.5%)	-	-	13 (1.6%)	29 (3.6%)
Grand total	48 (6.0%)	27 (3.4%)	24 (3.0%)	21 (2.7%)	18 (2.2%)	50 (6.2%)	188 (23.5%)

N: Number of children examined, N I: Nibie I, N II: Nibie II, N III: Nibie III, N/A: Ntigi/Akou, Ngo: Ngophana, Mah: Mahmishang

Table 3: Age-specific prevalence (%) of intestinal parasites in health zones sampled

Age groups (years)	Total No. of examined	N I (N = 200)	N II (N = 160)	N III (N = 90)	N/A (N = 80)	Ngo (N = 110)	Mah (N = 160)	Total prevalence (%)
0-4	150	16 (10.7)	9 (6.0)	6 (4.0)	6 (4.0)	7 (4.7)	19 (12.7)	63 (42.0%)
5-9	350	19 (5.4)	10 (2.9)	12 (3.4)	7 (2.0)	7 (2.0)	18 (5.1)	73 (20.9%)
10-14	300	13 (4.3)	8 (2.7)	6 (2.0)	8 (2.7)	4 (1.3)	13 (4.3)	52 (17.3%)
Total	800	48	27	24	21	18	50	188

N: Number of children examined, N I: Nibie I, N II: Nibie II, N III: Nibie III, N/A: Ntigi/Akou, Ngo: Ngophana, Mah: Mahmishang

Table 4: Age distribution of specific intestinal parasites

Parasites	Age groups (years) 0-4	5-9	10-14	Total prevalence (%)
E. histolytica	25	28	18	71 (8.9%)
E. coli	23	21	17	61 (7.6%)
T. hominis	9	14	4	27 (3.4%)
A. lumbricoides	6	10	13	29 (3.6%)
Total (%)	63 (7.9)	73 (9.1)	52 (6.5)	188 (23.5%)

Table 5: Gender-specific prevalence of intestinal parasites

	Males (N = 350)		Females (N = 450)		
Parasites	Cases	(%)	Cases	(%)	Total prevalence (%)
E. histolytica	35	10	36	8	71 (8.9%)
E. coli	26	7.4	35	7.8	61 (7.6%)
T. hominis	16	4.6	11	2.4	27 (3.4%)
A. lumbricoides	12	3.4	17	3.8	29 (3.6%)
Total	89	25.4	99	22	188 (23.5%)

N: Number of children examined, E: Entamoeba, T: Trichomonas, A: Ascaris

Table 6: Prevalence of single infections in health zones sampled

Type of infection	N I (N = 200)	N II (N = 160)	N III (N = 90)	N/A (N = 80)	Ngo (N = 110)	Mah (N = 160)	Males infected	Females infected	Total infection
Protozoans									
E. histolytica	14	14	8	3	6	9	23	31	54 (6.8%)
E. coli	13	7	4	4	6	6	17	23	40 (5.0%)
T. hominis	5	-	-	4	1	7	13	4	17 (2.1%)
Total	32	21	12	11	13	22	53	58	111 (13.9%)
Helminth									
A. lumbricoides	8	3	-	-	-	10	8	13	21 (2.6%)
Total	8	3	-	-	-	10	8	13	21 (2.6%)
Grand total	40	24	12	11	13	32	61	71	132 (16.5%)

Table 7: Distribution of multiple infections in health zones sampled

Parasite combination	N I (N = 200)	N II (N = 160)	N III (N = 90)	N/A (N = 80)	Ngo (N = 110)	Mah (N = 160)	Males infected	Females infected	Total infection
E. histolytica+E. coli	3	1	3	6	-	4	12	5	17
E. histolytica+A. lumbricoides	2	2	3	3	5	6	9	12	21
E. coli+A. lumbricoides	1	-	4	-	-	3	4	4	8
T. hominis+E. coli	2	-	1	2	1	4	3	7	10
Total	8	3	11	11	6	17	28 (3.5%)	28 (3.5%)	56 (7.0%)

N: Number of children examined, E: Entamoeba, T: Trichomonas, A: Ascaris, N I: Nibie I, N II: Nibie II, N III: Nibie III, N/A: Ntigi/Akou, Ngo: Ngophana, Mah: Mahmishang

corresponding prevalences of 7.6, 3.6 and 3.4%, respectively (Table 4). Generally, a significant difference ($\chi^2 = 11.3$, p = 0.05) was noticed relative to prevalence in the various age groups. The *E. histolytica* and *T. hominis* were most prevalent in children aged between 4-9 years old. The *E. coli* predominated in those from 0-4 years old, while, *A. lumbricoides* peaked in those greater than 10-14 years old.

Influence of gender on the distribution of intestinal parasites: Table 5 shows that 89 (25.4%) males and 99 (22%) females harbored the eggs and cysts of intestinal parasites. No significant difference (χ^2 = 3.13, p = >0.05) was noticed between the sexes.

Frequency of single and multiple infections: Of the 188 cases of parasitic infections, 16.5% of the children harbored 1 parasite species (Table 6), while 7.0% of them harbored 2 parasite species (Table 7). In cases with single species, *E. histolytica* and *E. coli* recorded the highest prevalence (6.8 and 5.0%), respectively. Of the double infections, *E. histolytica+A. lumbricoides* (2.1%) and *E. histolytica+E. coli* (17%) were the most prominent (Table 7).

DISCUSSION

Generally the most prevalent intestinal parasites were *E. histolytica* (8.9%) and *E. coli* (7.6%). The results of this study agreed with those carried out in Kenya[4], where *E. histolytica*

(11.9%) and *E. coli* (9.7%) had the highest prevalence of IPIs. Also, *A. lumbricoides* (3.6%) was the only intestinal helminth found and as such was most prevalent. This result is in conformity with the results obtained in Cuba[7] in which *A. lumbricoides* (40.5%) was the most predominant intestinal helminth. However, these results contrasted [8] observations in Dschang with *Trichuris trichiura* (19.7%) being the most predominant of intestinal helminth parasites, proceeded by *A. lumbricoides* (17.2%) and hookworm (0.5%), respectively.

The prevalence of IPIs was significantly higher in Mahmishang Health Zone (30.6%) than Ntigi/Akou (27.5%), Nibie III (25.6%), Nibie I (24%), Ngophana (17.3%) and Nibie II (16.9%). This could be due to some poor personal and environmental hygienic habits practiced by children of the Mahmishang Health Zone, such as; playing in dirty surroundings of houses, putting on dirty dresses, playing with fingers on the ground, putting dirty fingers and objects into the mouth, sharing food and toys with friends, not washing fruits and hands before eating, picking food from the ground and eating and moving bare footed. There was ignorance and negligence towards the practice of preventive measures for GITIs by most parents or guardians, since all (100%) of the children sampled were only dewormed during the National Deworming Program offered by the government every year. Poor disposal of garbage piles seen in the Mahmishang Health Zone could serve as a fertile environment for the transmission of intestinal parasites[4]. Pit toilets with poor sanitary conditions were highest in this health zone (48.7%) and lowest in Nibie III (11.8%).

However, the inadequate treatment of GIPs by the Mahmishang natives could be another possible cause of the highest infection rate, because a staggering 100% of those who were dewormed yearly relied on the yearly National Deworming Program offered by the government. The lowest prevalence of GIPs was observed in Ngophana (17.3%) and this could be due to the fact that all children were dewormed atleast yearly and very few of them (5.1%) got drugs from hawkers and medicine stores.

The lowest prevalence observed in children 10-14 years old (6.5%) proved that the children were conscious of their personal and environmental hygienic habits, meanwhile those who got infected could be very playful, in dirty environments, as well as picking food and other objects from the ground into their mouths. The highest prevalence of IPIs observed in children 0-4 years old could have been because they are looser in their activities, play a lot and are less conscious of their personal and environmental hygienic habits. This result agreed with the observation that children 3-10 years old harbor more GIPs than the older age groups[9].

Entamoeba histolytica and *T. hominis* were most prevalent in children 5-9 years old, E. *coli* predominated in those from 0-4 years old, which could be due to insanitary personal and environmental hygienic habits and likewise looser in their activities, while *A. lumbricoides* predominated in those 10-14 years old which agreed with the observation that[9] had where the extent of *A. lumbricoides* infection was higher in older children 12-15 years old as compared with younger children. This, however, contradicted with Gizaw *et al.*[10] and Levecke *et al.*[8] findings where the infection rate of intestinal helminths decreased in children above 12 years old.

Gender didn't influence the prevalence of IPIs in the present study, though females were more infected than their male counterparts, infection could have been through involuntary exposure to contaminated food and water[11]. The low prevalence of multiple infections (7.0%) agreed with Deuyo[12] and Gizaw *et al.*[10] findings where multiple infections had low infection rates of 4.35 and 5.5%, respectively.

Ascaris being the only helminth found could be due to the fact that *Ascaris* eggs are more resistant to adverse conditions as they are dormant under dry conditions. Another possible reason could have been the fact that most of the study was carried out during the rainy season, since results obtained from a comprehensive review of the geographical distribution of ascariasis in parts of West Africa proved that high prevalence of *Ascaris* were observed in areas receiving more than 1400 mm of rainfall annually[13]. However, the age group distribution of *Ascaris* followed the trend reported by Gizaw *et al.*[10] and Levecke *et al.*[8] in Dschang, early acquisition in life (children between 0-6 years old) followed by children in early childhood (>6-9 years old) and then peak in those >9-12 years old.

The present study supported the fact that intestinal protozoa in particular and intestinal parasites at large, are still prevalent in the society. The major intestinal parasites encountered in the course of this study were *E. histolytica* (8.9%), *E. coli* (7.6%), *T. hominis* (3.4%) and *A. lumbricoides* (3.6%). These intestinal protozoa and helminth had infection rates of 19.9 and 3.6%, respectively and a significant difference ($\chi^2 = 66.8$, p = <0.001) existed between them. However, the presence of intestinal protozoa in this survey implies there is a need for government to distribute both anthelminthic and antiprotozoan drugs not only to school children but to all children in the community.

CONCLUSION

The main risk factors for intestinal parasites in this survey were that low socio-economic status and low level of education of parents, poverty, poor personal and environmental hygiene and sanitation, negligence, ignorance or lack of awareness of the health risks or precautionary measures contributed enormously to the vulnerability, acquisition and transmission of IPIs in the Mahmishang health zone that had the highest prevalence of these infections (30.6%).

SIGNIFICANCE STATEMENT

This study discovered the prevalence and associated risk factors of gastrointestinal infections amongst children in Bambili that can be beneficial for invaluable statistics needed for planning meaningful public control programs that aim at reducing the prevalence and morbidity of parasitic infections. This study will help the researcher to uncover the critical areas of gastrointestinal infections that many researchers were not able to explore. Thus, a new theory on the risk factors of gastrointestinal infections may be arrived at.

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