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Growth retardation and severe anemia in children with *Trichuris* dysenteric syndrome

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ABSTRACT

Objective: To document epidemiologic data, clinical manifestations and treatment in hospitalized children with *Trichuris* dysenteric syndrome from Honduras during 2010-2012.
Methods: Severe trichuriasis cases were identified by routine stool examinations from hospitalized patients (12 years old or less). Relevant epidemiologic, clinical and management data were obtained from review of clinical histories in the ward.
Results: Of 122 *Trichuris* infections diagnosed in 11 528 (1.0%) stool samples for all ages, 81 (66.4%) were identified in the age group 2-12 years old, 21 (25.9%) of which were severe (≥ 100 eggs in 2 mg of feces). Thirteen of those 21 patients collaborated in this study. Patients (9 males and 4 females) were of rural precedence, from large poor or very poor families, chronically parasitized, and between 2 and 12 years old. Dysentery of months duration, severe anemia and stunting were common complaints; clinical characteristics associated with heavy *Trichuris* infections included egg counts from 232-3 520 eggs per direct smear, hemoglobin from 3.4-10.8 g/dL, eosinophilia up to 43%, severe malnutrition and growth stunting. Orally administered drugs mebendazole, albendazole, metronidazole, nitaxozanide, and piperazine were prescribed at different dosages and duration other than recommended; no cure or egg excretion control was exercised before patient release. A range of 340 to about 10 000 worms were recovered after treatment from 8 patients.
Conclusions: This report underlines the need for detailed community studies in trichuriasis morbidity, effective treatment assessment and clinical response in severely malnourished parasitized children.

1. Introduction

Trichuris trichiura (*T. trichiura*) together with *Ascaris lumbricoides* (*A. lumbricoides*) and the human hookworms (HHKWs) *Necator americanus* and *Ancylostoma duodenale* are intestinal parasitic nematodes (or soil transmitted helminths) chronically affecting the poorest people living in slow developing countries[1,2]. Global prevalences show staggering numbers of these infections, estimating 1 200 billion infections with *Ascaris*, 464.6 million individuals infected with *T. trichiura* and 740 million parasitized with HHKWs; the highest prevalences are found in some Asian and African countries. In Central America, 26.8% of preschoolers and 26.1% of school age children are at risk of infection[1-4]. Of the estimated 4.98 million years lived with disability globally due to soil transmitted helminths, 13% was attributed to trichuriasis[1].

T. trichiura adult worms live embedded in the first layer of mucosal cells in the large intestine and morbidity is associated with the intensity of infection[5]. It is estimated that 500 worms or more are needed to provoke a full *Trichuris* dysenteric syndrome (TDS), but a few hundred can also cause disease[6]. In endemic regions, the age group 2-10 years old can be the most heavily parasitized, which leads to malnutrition, stunting and anemia, more notable in those individuals already presenting nutritional deficiencies and protein energy malnutrition[6]. Light single *T. trichiura* infections are considered a relatively benign condition; however, even low-intensity infection with multiple parasite species can be responsible for a significant contribution of anemia[7]. Moderate and severe trichuriasis on the other hand are known to cause inflammatory bowel disease, stunting and underweight, which can be aggravated in mixed infections[3,4]. Heavy chronic *T. trichiura* infection in children living in endemic countries causes a TDS characterized by the presence of chronic mucoid diarrhea, iron-deficiency anemia,

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severe malnutrition, rectal bleeding and rectal prolapse in some cases with hundreds or even thousands of worms in the colonic and rectal mucosa[5]. Clubbing of the fingers may also develop[6].

Scant publications in Latin America from México, Panamá and Jamaica describe clinical manifestations and anemia in severe trichuriasis in children[8-10]; published data are lacking from Honduras and other countries in the region. In Honduras, trichuriasis was estimated at more than 50% prevalence showing an irregular distribution pattern in the country[2]. Sporadic observations at the University Hospital Parasitology Service in Honduras indicated that moderate to severe infections were common in children, with very few and light infections in adults. To this date, the trichuriasis dysentery syndrome has not been described in Honduras.

The aim of this study was to register the clinical presentation of moderate or severe *T. trichiura* infections in children attending the University Hospital (UH), Honduras. It was intended as well to compare egg counts with the number of adult worms recovered post treatment whenever possible. The corroboration of TDS in children already infected with other parasites, who are also malnourished and anemic may be a powerful reason for renewed commitment and strengthens the efforts to control these infections in Honduras and other countries with similar problems in the coming decade.

2. Materials and methods

2.1. Study site

The study was based at the Parasitology Service (PS) of the Department of Clinical Laboratory of the UH in Tegucigalpa, Honduras. The UH was a 1055-bed tertiary level care public hospital serving patients from all over the country as well as providing ambulatory care in outpatient clinics for different specialties. The Department worked in three shifts: the morning shift (7: 00 am to 2: 00 pm) received approximately 4 000 stool samples from all ages a year for microscopic examination and diagnosis and the two remaining shifts were not under the PS quality control supervision and were not included here.

2.2. Ethical considerations

This study did not involve any health-related patient interventions, being observational and descriptive in nature. It was approved by the Chief of the Pediatric Department as well as Chiefs of the Pediatric wards where children were hospitalized, and conducted in accordance with the principles and guidelines expressed in the Declaration of Helsinki (Edimburg 2000) revision. The observations and data collection lasted 24 non-consecutive months from March 2010 to September 2012. Written consent forms were not required; however, specific information regarding the importance of the study was offered to parents or guardians of all children identified with heavy *Trichuris* infections and once agreement to collaborate was received, they were instructed on how to collect 24 h stools from each patient after completion of specific anthelminthic treatment prescribed by the attending physician. It was desired to collect and count the adult worms expelled to better understand the meaning of heavy egg counts in relation to trichuriasis dysenteric syndrome.

2.3. Case definition and study population

Selection of patients was not random. Only children with egg counts of one hundred or more *T. trichiura* eggs in a direct smear identified during routine stool examinations were included, who also met with the following criteria: children of either sex, no older than 12 years, hospitalized in any of the pediatric wards and accompanied by a parent or guardian. Children who had high *Trichuris* egg counts seen as outpatients but not hospitalized were excluded due to difficulty in treatment verification and follow-up evaluations. Epidemiological and clinical data such as place of origin, schooling of parents, family size, socio-economic status, duration of illness, signs and symptoms at consultation, as well as laboratory results from hemogram values were taken from the clinical file. Dose and duration of anthelminthics prescribed were verified for compliance from the nurse notes, when available, from the clinical files of those parasitized children. Psychomotor development and cognitive function were evaluated by one of us. The child was tested once for motor, affective, language and cognoscitive abilities in a test room, alone or accompanied by the mother, at no specific time but preferably at midmorning.

2.4. Laboratory examination and data collection

Fresh stool samples sent to the PS were received during the morning hours and processed following the protocol for diagnosis of parasitic infections. Samples were examined macroscopically to determine consistency, presence of mucus, blood, adult parasites or segments, followed by a microscopic examination of a direct smear (2 mg of feces) in physiologic saline solution and another in Lugol's solutions. Egg counts per direct smear (2 mg of feces) (EDS) were routinely performed and reported whenever soil transmitted infections were identified to estimate intensity of infection. The intensity of infection was calculated as of light (0-9 EDS), moderate (10-49 EDS) and heavy (50 or more EDS) since no Kato-Katz method to calculate eggs per gram was used in our clinical setting[11]. Identification of trichuriasis cases prompted a visit to the respective ward to alert the physician in charge and proceed with data collection. No sigmoidoscopy was performed on any one case. Once anthelminthic therapy was started in the ward, clean plastic bags in sufficient quantity were provided to the parent or guardian of each child along with instructions to collect 24 h stools, free of urine or water, for a period of 4 to 5 days. The patient would defecate directly into the plastic bag or in a clean and dry bedpan, transfering stools to the bag. Each morning, stool bags were taken to the parasitology laboratory for stool examination and worm recovery. No egg counts were repeated at this point. Stools were sieved through different pore-size metal sieves and washed under a soft and constant water stream to clear stools from worms. When worms were traped in abundant mucus, small portions of this mucus were placed in a container with 2.5% NaOH solution for about 5 min under constant shaking to dissolve mucus and allow easier undamaged worm recovery; sieving with clean water was continued, retrieving worms with fine brushes, placing them in physiologic saline solution, counted and later preserved in 10% formalin. When worms exceeded thousands, 500 worms were counted, placed in 25 mL capacity glass vials with 10% formalin and then estimated remaining worm number by comparison with vial. Daily reports of results were submitted to the respective wards.

2.5. Data analysis

Because of the nature of the study with small number of cases and patients not randomly selected, the findings were presented as descriptive data. Laboratory data were manually analysed, obtaining arithmetic measures of central tendency for hemoglobin, eosinophil count and *Trichuris* egg counts. Relevant information of individual cases are presented in Tables 1, 2 and 3.

3. Results

3.1. Laboratory registry data

During 2010-2012, a total of 11 528 fecal samples were examined at the PS; of those, 4 138 (35.8%) samples were from children 0-12 years old (Table 1). A total of 122 (1.0%) *Trichuris* infections were diagnosed during that period, of which 81 (66.4%) were identified in the 0-12 age group; 23/81 (28.4%) infections were heavy with more than 100 eggs per 2 mg of feces; 2/23 severe cases (2.5%) were recognized in adults. Of 21 trichuriasis cases who met the definition criteria, 17 were available for the study protocol. Of those, two were excluded due to incomplete data collection, and one was discharged before completion of observations; one case of severe trichuriasis and acute amebic dysentery was identified in a 17 years old leukemic girl during ambulatory care, but not interned in a ward and was lost for study. The remaining 13 patients were described in this report. Five heavy infections were in individuals 2 to 5 years old, four in children ages 6-8 years old and five in those 9-13 years old, respectively; one child was severely retarded. The range of *Trichuris* egg counts differed according to year of examination, the highest count range (1-3 420) in 2011 in children 0-12 years old as presented in Table 1. Child No. 6 in Table 2 was seen in three different occasions as an outpatient and at each examination *Trichuris* egg counts had increased. *A. lumbricoides* was most prevalent parasitic co-infection, with a total of 40/122 (32.7%) cases, with 25 (62.5%) heavy infections (100 or more eggs per 2 mg direct smear) in the 2-12 age group (Table 2); one patient had malaria and in one head lice were reported. Also present in this age group were HHKW (6 cases), [*Strongyloides stercoralis* (*S. stercoralis*) (3 cases)], [*Hymenolepis nana* (*H. nana*) (3 children)], [*Balantidium coli* (*B. coli*) (2 infections)] and [*Giardia duodenalis* (*G. duodenalis*) (5 infections)]; co-infections in the ≥ 13 age group included *A. lumbricoides* (16 individuals) all light infections, HHKW (2 cases), *S. stercoralis* (1 infection), [*Enterobius vermicularis* (*E. vermicularis*) (1 case)] and [*Cystoisospora belli* (*C. belli*) (1 individual)]. Protozoa commensals and coinfecting these patients were not informed in this study.

Table 1

Total stool examinations and total *Trichuris* infections in children 0 to 12 years old and 13 years old or older, *Trichuris* infections with ≥ 100 eggs in 2 mg direct smear in Parasitology Service, University Hospital, Honduras, 2010-2012.

Year	Total exams/exams 0-12 years old (%)	*Trichuris* positive samples (%); egg count range per direct smear	
		0-12 years old	≥ 13 years old
2010	3649/1247 (34.1)		
Total *Trichuris* (%)	46 (1.2)	30 (65.2); 1-2 640	*10 (21.7); 1-30
≥ 100 EDS	8 (17.3)	8 (26.6%)	0
2011	3906/1492 (38.2)	28 (75.7); 1-3420	9 (24.3); 1-1 108
Total *Trichuris* (%)	37 (0.9)		
≥ 100 EDS	14 (37.8)	13 (46.4)	1 (11.1)
2012	3973/1399 (35.2)		
Total *Trichuris* (%)	39 (1.0)	23 (59.0); 1-32	16 (41.0)
≥ 100 EDS	1 (4.3)	0	1(6.2)
Totals	11 528/4138 (35.8)		
Total *Trichuris* (%)	122 (1.0)	81 (66.4)	35 (43.2)
≥ 100 EDS	23 (18.8)	21 (25.9)	2 (5.7)

*in six cases age not registered.

Table 2

Co infections with intestinal parasites in individuals with *Trichuris* infections by age groups and year, Honduras.

Year	2-12 years old		≥ 13 years old	
	Cases	*n*	Cases	*n*
2010	*Ascaris*	15; > 100 EDS: 10 (66.6%)	*Ascaris*	10
	Hookswormm	3	*E. vermicularis*	1
	B. coli	2		
	G. duodenalis	2		
2011	*Ascaris*	13; > 100 EDS: 11 (84.6%)	*Ascaris*	3
	Hookworm	3	Hookworm	2
	S. stercoralis	2	*C. belli*	2
	H. nana	2		
2012	*Ascaris*	12; > 100 EDS: 4 (33.3%)	*Ascaris*	3
	S. stercoralis	1	*S. stercoralis*	1
	H. nana	1		
	G. duodenalis	3		
Totals	*Ascaris*	40; > 100 EDS: 25 (62.5%)	*Ascaris*	16
	Hookworm	6	*E. vermicularis*	1
	S. stercoralis	3	Hookworm	2
	H. nana	3	*S. stercoralis*	1
	G. duodenalis	5	*C. belli*	1

3.2. Epidemiological and clinical characteristics of patients with TDS

Relevant epidemiological, clinical and laboratory details of 13 patients with heavy trichuriasis infections are presented in Table 3. The common denominator for consultation was chronic bloody diarrhea and severe anemia. Only two patients came from peri-urban areas, and the rest lived in rural areas; the majority of the mothers had none or no more than three years of schooling and all were poor (n = 10) or below poverty line. Nine children were males and five were 2 to 5 years old. Family size when reported by parents ranged from a total of 3 to 14 members, adults and children. Six patients were referred from regional hospitals due to no improvement and persistence of symptoms. The number of *T. trichiura* eggs in 2 mg smear ranged from 232 to 3 520; none of the patients had rectal prolapse registered. All patients were severely malnourished, with different degrees of acute and chronic malnutrition and heavy trichuriasis. Hemoglobin levels ranged from 2.8-10.8 g/dL, with a mean of 7.2 and a median of 6.6 g/dL; eosinophilia, considered as such when the number of eosinophils was 450/μL, higher than normal in most patients, with a range of 0.4% to 43%, a mean of 13.3% and a median of 4.5%. We could not characterize the dysentery and diarrhea in its chronicity, frequency and stool volume at defecation time. Eight children were evaluated in their psychomotor development; four revealed important underdevelopment as measured by the test (Table 3).

3.3. Case management

Prescribed commercially available orally administered drugs showed irregularities in dosage, days administered, multiplicity of anthelminthics ordered at the same time even in the presence of single infections. Metronidazole was almost universally prescribed, in one case intravenously despite no findings warranted its use. Piperazine along with albendazole, mebendazole, sometimes nitaxozanide were indicated at unison as stated in the patient file;

Table 3

Sociodemographic, clinical, and worm recovery data, along with psychomotor development in thirteen severe trichuriasis cases from Honduras.

Sex/Age (year)	Urban/Rural	Height (cm)/ Weight (kg)	Symptoms	Stool exam eggs per 2 mg smear	Hemoglobin (g/dL); eosinophils %	Anthelminthic therapy	Worm recovery	Psychomotor development (months)
Male/2	Rural	No reported	Diarrhea 1 week, blood + mucus; vomiting, pale, malnutrition	*Trichuris* 232	8.0; 0.4	Mebendazole 100 mg BID × 3 days, Metronidazole	Mother not cooperative	Not evaluated
Male/3	Rural	70/8.0	Diarrhea 3 months, blood + mucus, adynamia, pale, malnutrition, significant physical underdevelopment	*Trichuris* 429, HHKW 101	4.9; 21.6	Metronidazole 5 days, Mebendazole 100 mg BID × 3 days	Released before completion	Motor 7; Language 8 Affective 7; Cognos 6
Female/3	Rural, referred	85/10.5	Diarrhea and mucus 15 days, fever 1 month, malnutrition, pale, *Plasmodium vivax* malaria	*Trichuris* 336, HHKW 180	4.5; 10.6 Transfusion	Mebendazole 100 mg BID × 3 days	Partial, *Trichuris* 16; no HHKW	Not evaluated
Male/5	Rural	93/14.5	Diarrhea 2 weeks, blood + mucus, edema, malnutrition, pale	*Trichuris* 1116	3.5; 43.0 Transfusion × 2	Nitaxozanide × 2 days, Piperazine × 3 days, Metronidazole × 6 days, Albendazole 400 mg × 5 days	*Trichuris* ± 10000	Motor 36; Language 48 Affective 61; Cognoscitive 36
Female/5	Rural	100/15.0	Diarrhea 10 days, fever 9 days, abdominal mass 8 days, irritable, weak	*Trichuris* 326, *Ascaris* 1006	3.4; 10.0	Albendazole 400 mg, Piperazine × 6 days	*Trichuris* not done; *Ascaris* 32	According to age, no schooling
Male/6	Urbano-marginal, referred	96/13.5	Mother denies any symptoms, "child does not grow", pale, malnutrition, finger clubbing, significant stunting	*Trichuris* 834 Feb, 1408 Apr, 2136 May	10.5; 36.6	Mebendazole 100 mg BID × 3 days, Albendazole 400 mg	*Trichuris* 2531	According to age, no schooling
Female/7	Rural , referred health care	111/15.0	Diarrhea, blood + mucus 3 weeks, abdominal pain, pale, malnutrition, finger and toe clubbing, splenomegaly, head lice	*Trichuris* 408	6.6; 15.0	Albendazole 400 mg, Mebendazole 100 mg BID × 3 days	Partial recovery, *Trichuris* 810	Motor 24; Language 6 Affective 36; Cognoscitive 30
Male/7	Rural	113/16.8	Diarrhea 3 days, vomitting, moderate abdominal pain, brother with severe trichuriasis; 3 years old sister died probably due to severe ascariasis	*Trichuris* 1400, *Ascaris* 368, *Blastocystis hominis*, *Entamoeba coli* cysts	9.0; 24.0	Piperazine 800 mg 6 days, Albendazole 400 mg 5 days, Metronidazole 2 days	Erratic administration of drugs, no recovery of adult worms	According to age, no schooling
Female/8	Rural	104/14.2	Diarrhea 3 days, abdominal pain, pale, edema, malnutrition, spontaneous *Ascaris* expulsion	*Trichuris* 3420, *Chilomastix mesnili* cysts	6.5; 2.1 Transfus	Piperazine 7 days, Albendazole 400 mg	*Ascaris* expelled "in abundance", *Trichuris* 806	Motor 6 years Language 6 years Affective 6 years; Cognoscitive 6 years
Male/8	Rural, referred from regional hospital	127/20.0	Intermittent diarrhea with blood + mucus of 5 years duration, anemia, abdominal pain, weight loss	*Trichuris* 1390, *Ascaris* 250, HHKW 16	6.0; 16.7-21.0	Albendazole 400 mg	Not done	According to age, schooling not recorded
Male/9	Urban-marginal, below poverty	111/14.0	Chronic bloody diarrhea, 11 daily episodes, pale, weight loss, distended abdomen, malnutrition	*Trichuris* 604, Strongyloides larvae, G. *duodenalis* cysts	2.8; 2.0 Transfusion × 3	Metronidazole 5 days, Albendazole 400 mg 3 days	Parcial, *Trichuris*132	According to age, no schooling
Male/10	Rural, referred from regional hospital	112/19.0	Chronic diarrhea 6 months, weight loss, pale, malnutrition, stunting	*Trichuris* 2624	5.6; NR	Intravenous Metronidazole × 6 days, Mebendazole 100 mg BID × 3 days	*Trichuris* ± 10000	Not evaluated, apparent slow mental development, 2 years schooling
Male/10	Rural, below poverty referred from regional hospital	109/19.0	Cerebral paralysis 6 years, worst last days, bloody diarrhea 6 days, chronic malnutrition, pale	*Trichuris* 3520; HHKW 2388; Strongyloides larvae; *B. coli* trophs	10.8; 2.3	Mebendazole 200 mg × 5 days, Albenzadole 400 mg × 3 days, Ivermectin 20 drops/day	*Trichuris* ± 5000, HHKW 62	Unconscious, not evaluated

BID: Twice a day.

verification of nurses notes disclosed frequent omission of days or treatment with incorrect dosage. In consultation with the physician in charge, some patient treatment regimens were modified to include an antiparasitic agent with known effectiveness against the parasites present. About 10000 thousand adult *Trichuris* were recovered from two children (Patients 12 and 4); in four cases worms were recovered in thousands, several hundred were from two patients, for the rest the efforts were unyielding.

4. Discussion

This is the first study attempting to document the clinical severity of heavy *Trichuris* infections as diagnosed in children in a tertiary care hospital in Honduras. Trichuriasis was found concentrated in the age group 0 to 12 years old, alone or with other intestinal parasitic infections as observed in surveys in the community elsewhere[1-4,6]; infections in adult patients when present were very light as a rule. Despite the limitations of the study, the results suggest that trichuriasis along with other intestinal parasitosis was still very prevalent in children consulting at this hospital, one fourth (25.9%) of which were very young, malnourished and severely parasitized. Similar high prevalences of trichuriasis (70%) have been found in urban school children in a southern district in Belize[12], in rural Honduras (overall prevalence 38%, range 3%-86%)[13], in children of urban slums in Sulawesi, Indonesia[14], and in children living near refuse dumps in Uganda[15]. Its presence is taken as an indicator of poverty associated with limited access to health care facilities and unsatisfied basic needs, such as low socioeconomic status in Sao Paulo, Brazil[16], in 39% of school children predominantly Maya Q'eqchi in Guatemala[17] and in 84% of school children with anemia and malnutrition in Orang Asli, Malaysia[18].

The principal signs and symptoms in 13 children with TDS included chronic dysentery and anemia along with severe malnutrition, characteristic of the syndrome due to severe infections[6]. Chronic diarrhea as a result of diffuse colitis accompanied by blood and mucus of weeks, months or years duration is a common observation in intense trichuriasis in children of parents living in poverty or ignorance, delaying search of prompt medical care. This type of severe diarrhea resembles Crohn's disease and ulcerative colitis. It is presumed that blood loss was caused by parasite induced petechial lesions together with inflammatory responses with abundant mucus production and eosinophils in the mucus[5,6]. On the other hand, it seems that intestinal symptoms and malnutrition are not a hallmark of TDS in adults as observed recently in India, but instead patients presented with progressive anemia[5].

Anemia, stunting and malnutrition are common observations in parasitized children; such changes were confirmed in all 13 patients in this study at time of hospitalization. Those three clinical signs of morbidity have multi-factorial risks and cannot be solely attributed to parasitic intestinal infections. It is estimated that 2 billion people in the world suffer from anemia, with the highest percentages in Asia and Africa; about 50% is due to low iron intake[19]. A national survey from 2011-2012 indicated that 23% of Honduran children less than 5 years old suffered from chronic malnutrition and growth retardation, more common among poor homes and with variations according to geographical regions of precedence[20]. Thirty percent of children 6-59 months old and 15% of women 15-49 years old also suffered from anemia; no data on concurrent parasitic infections were investigated and one probable association assumed by the authors related to inadequate supply of micronutrients in the diet[20]. In children in rural Brazil with an adequate intake of iron, no difference was found in anemia prevalence or mean serum hemoglobin regardless of parasitic infections status[21]. Nevertheless, in extremely poor preschool children in Peru lowlands, intestinal parasites were highly prevalent and risk factors for poor nutrient intake, underweight and wasting were associated with moderate-heavy *T. trichiura* infection or hookworm infection, age and education level in the mother[22]. Lower hemoglobin levels ($P = 0.05$) and higher prevalence of anemia ($P = 0.05$) were found in Jamaican children with heavy infection of *T. trichiura*, more than 10000 eggs per gram of stool, but not with less intense infections as compared to controls[9]; in Panamanian school children, blood hemoglobin concentrations were significantly ($P = 0.005$) lower than in uninfected controls; more important, children who remained uninfected during the study period showed significant greater increase in hemoglobin levels[8].

Stunting as a result of chronic nutritional stress has been found highly prevalent in children in the developing world and one of the risk factors identified has been intestinal parasitosis[4,22,23]. In school children of the 5th grade in a community of extreme poverty in Peru, significant independent factors for stunting were only age and moderate and heavy *Trichuris* and *Ascaris* infections[24]. Conversely, it was shown that one time anthelminthic treatment of parasitized school children in Kenya resulted in significant improvement in physical growth and fitness[25].

A few of the children in the study presented with clubbing of the fingers, a condition supposed to be related to circulating hormones or cytokines and associated to a number of diseases[6,26,27]. Although the pathogenesis is unknown, it has been associated with diseases affecting the heart, lungs, cirrhosis, Crohn's disease, ulcerative colitis and celiac disease or idiopathic[26,27]. We cannot explain why not all the TDS patients presented this anomaly; heart, lung or other accompanying disorders were not investigated in this group of patients.

Elevated numbers of eosinophils in blood or tissues has been correlated with helminth infection. In our study, most (8 children) patients presented with high eosinophil persistence as registered in the clinical history. Besides trichuriasis, eosinophilia has been observed in humans infected with *Strongyloides*, HHKW, human toxocariasis and *Ascaris* and is thought to play a role against invading larval stages in skin and lungs, diminishing the number of worms establishing in the intestine[28,29]. Many other causes for eosinophilia besides parasitic infections have been identified, such as pharmacological, allergic in Type I hyper sensibility, neoplasic, endocrine and metabolic alterations, and idiopathic[28]. From a practical point of view, high eosinophilia in blood should not be ignored by the physician, as it can be one of many diagnostic suggestions or hints to include fecal examination to discard an associated parasitic infection and eventually administer treatment.

Effective treatment options against trichuriasis are limited, and both albendazole and mebendazole used alone as recommended have shown low efficacy of cure[30-32]. In a revision of 20 random controlled studies, a single dose of albendazole showed an average cure of 28% and mebendazole of a 36% cure against *T. trichiura*[30], both drugs being the ones commonly available in public health care facilities in developing countries. In a recent double blind trial in 548 multiparasitized school children, combination therapies of mebendazole-ivermectine and albendazole-ivermectine had significantly higher cure rates of 55% and 38% respectively for *Trichuris*, along with egg counts reductions[31]. A 3-drug albendazole combination therapy in 440 children infected with *A. lumbricoides* and HHKW besides trichuriasis obtained greater efficacy against *Trichuris* using albendazole-oxantel pamoate (68.5%); and albendazole-ivermectine was found more effective (27.5%) than mebendazole alone (8.4%)[33]. Most frequent adverse reaction complaints reported in those studies were headache and abdominal cramps, which were also most common complaints before treatment and similar when using a single drug such as mebendazole or albendazole. It was obvious from our observations that no consistent treatment protocol for intestinal helminthiasis was in place in the pediatric department of the UH and that anthelminthics were administered at other than standard recommendation for dosage or duration. The one child with increasing egg counts in a period of 5 months was most likely prescribed ineffective drugs or not treated at all. On the other hand, the random drug combinations used may have been a welcome occurrence given the number of adult worms recovered post treatment from some of the cases; no control stool examinations were ordered before patient release, making it not possible to determine egg-reduction counts or cure rate in any of the observation participants. One recommendation would be to assess which combination drug therapy is most effective and safe for multiparasitized children consulting at the UH in view to standardize treatment protocols that could also have an application in geohelminth control programmes.

This study had several limitations. Our cases were selected from wards in a public health hospital where children are admitted presenting with severe morbidity. Cases were included because of high *Trichuris* egg counts, but non infected children or children with light infections and/or anemia, diarrhea, or malnutrition were not included for comparison. Also, we do not know what level of morbidity was identified in children with light *Trichuris* infections alone or multiparasitized when seen as outpatients. There are missing data on trichuriasis cases from two additional laboratory shifts. Registration of complete socio-demographic information was usually lacking; no other tests for causes of dysentery were investigated. Laboratory results were not always stated in the clinical histories or were incomplete at time of revision as was the omission of the psychomotor development test in four patients with TDS. While these limitations are of importance and may reflect the level of pediatric care in regards to parasitic infections at this UH, the morbidity of TDS in children of rural and peri-urban communities that are also malnourished and anemic warrants further study. Any properly trained laboratory personnel regardless of urban or rural workplace location should be able to recognize and count nematode eggs and write a proper report. This simple measure would improve similar early case management in regional hospitals and rural health centers and avoid unnecessary critical treatment delays and referrals to the UH. It is evident from the observations in this study that heavy *Trichuris* infection and multiparasitism are still a problem in rural Honduran children reflected in hospital admissions and in endemic areas; it could be considered as contributor of anemia, stunting and malnutrition in pre- and school-age children. It became evident that there existed a clear and urgent need for national detailed studies of trichuriasis prevalence and morbidity; moreover, trichuriasis treatment assessment alone or in drug combinations has to be determined considering drug efficacy and safety in severely multiparasitized children. The revisions of existing management protocols, standardization and implementation of management based on evidence and follow-up protocols for children with intestinal parasitic infections at the Pediatric Department in the UH are of urgent need.

Conflict of interest statement

We declare that we have no conflict of interest.

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