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Prevalence and risk factors related to intestinal parasitosis in children under 18 years of age in four populations of Colombia: a cross-sectional study

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Abstract

Objective: To identify the profile of intestinal parasitosis in children of four populations in the municipalities of Quibdó, Apartadó, Guachené, and Granada, Colombia, in 2012.

Material and methods: A cross-sectional study was conducted using a secondary source of information, in which sociodemographic factors associated with the presence of parasites were analyzed in a univariate and bivariate manner.

Results: A total of 240 individuals were analyzed. Two thirds of them were parasitized. The most frequent species were *Entamoeba histolytica/dispar* (22.9%), *Endolimax nana* (19.2%), *Blastocystis hominins* (19.2%), and *Giardia intestinalis* (20.8%). An association between inadequate excreta disposal (latrine or septic tank) and the presence of parasitic colonization was found with a prevalence ratio (PR) of 1.34 [1.14, 1.59] (p=0.005). Similarly, housing construction with wood or bahareque was 1.31 times more frequent in subjects with parasitic forms in their stool samples than those with brick houses.

Discussion: A higher frequency of intestinal parasites was found for the different age groups compared to several reports worldwide and in Latin America. The most frequent species of parasites were similar to those reported in the literature.

Conclusions: Isolated populations in Colombia, such as those studied, have a higher frequency of intestinal parasites than other populations.

Keywords: Parasites, Colombia, Children

Prevalencia y factores de riesgo asociados a parasitosis intestinales en menores de 18 años en cuatro poblaciones de Colombia: estudio transversal

Resumen

Objetivo: Identificar el perfil de parasitosis intestinales en menores de 18 años y las características modificables y no modificables asociadas de cuatro poblaciones en los municipios de Quibdó, Apartadó, Guachené y Granada, Colombia, en 2012.

Material y método: Se realizó un estudio transversal donde se evaluó una fuente secundaria de información obtenida de cuatro municipios de Colombia (Guachené, Quibdó, Apartadó y Granada) sobre la cual se analizaron de manera univariada y bivariada los factores sociodemográficos asociados a la presencia de parásitos.

Resultado: Se analisaron 240 individuos. dos tercios (66.67%) de ellos se encontraron parasitados. Las especies más frecuentes fueron *Entamoeba histolytica/dispar* (22.9%), *Endolimax nana* (19.2%), *Blastocystis hominis* (19.2%), *Giardia intestinalis* (20.8%). Se observó una asociación entre la disposición inadecuada de excretas (letrina o pozo séptico) y la presencia de colonización parasitaria en comparación al uso de sanitario con una razón de prevalencia (PR) de 1.34 [1.14, 1.59] (p=0.005). Similarmente, la construcción de vivienda con madera o bahareque demostró ser un factor 1.31 veces más frecuente en sujetos con presencia de formas parasitarias en el coprológico que aquellos con casas de ladrillo.

Discusión: Se encontró una mayor frecuencia de parásitos intestinales para los diferentes grupos etáreos comparado con varios de los reportes a nivel mundial y en latinoamérica. Sin embargo, no hubo diferencias significativas entre los grupos de edad a diferencia de otros estudios. Las especies más frecuentes de parásitos fue similar a lo reportado en la literatura. Factores asociados a un mayor riesgo de parásitos intestinales como la disposición de excretas ya se han descrito en otros estudios.

Conclusiones: Poblaciones aisladas de Colombia como las estudiadas presentan mayor frecuencia de parásitos intestinales que otras poblaciones comparadas y los factores de vivienda y acceso a servicios públicos permanecen como factores que aumentan el riesgo de parásitos intestinales.

Palabras clave: Parásitos, Colombia, Niños

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Introduction

Intestinal parasitosis is a condition that is particularly relevant in the pediatric population, as it represents a significant burden of morbidity due to decreased height-weight growth, delayed cognitive development, anemia, malnutrition, and systemic inflammation, among others[1]. A large number of patients with intestinal parasitosis are asymptomatic[2], however, globally, approximately 1.1 billion cases of diarrhea occur each year in children under five years of age, and among the etiological agents are viruses, parasites, and bacteria, resulting in approximately half a million deaths in this age group and perpetuating the cycle of poverty[3,4]. One in four people worldwide is colonized by parasites[5]. Parasitosis is more prevalent in low-middle-income countries[6] and is more frequent in tropical and subtropical areas such as Colombia[7]. Historically, some risk factors for developing intestinal parasitosis are known, including poor sanitation of water and waste, and ingestion of contaminated food. Many other possible risk factors are still pending to be demonstrated[8].

In Latin America, where poverty, inadequate sanitation, and malnutrition coexist, up to 20% of the population live with two or more species of parasites as commensals, making parasitosis one of the most common infections on this continent[9]. Although there is a lack of frequency studies that accurately characterize sociodemographic profiles, especially in Latin America, regarding intestinal parasites, it is estimated that 13.9 million preschoolers and 35.4 million school-aged children are at risk of parasitic infection[10]. The situation is not encouraging in Colombia, and some studies have shown higher prevalence than other countries in the region[11]. Characterizing parasitosis by regions is relevant because the variability in species and risk factors is essential for implementing public health policies that can contribute to solving this problem.

After recognizing that around 40% of all pediatric consultations in the municipalities of Guachené, Apartadó, Quibdó, and Granada correspond to transmissible and nutritional conditions in early childhood, it was considered essential to identify the profile of intestinal parasitosis in children under 18 years of age and the modifiable and non-modifiable characteristics of these territories in order to provide data to guide public health actions that improve the health and quality of life of young children in these municipalities[12-15]. Therefore, the present study explores the relationship between modifiable and non-modifiable factors and the presence of parasitic forms in the fecal samples of the studied population.

Materials and methods

The current study is a descriptive cross-sectional observational study with analytical intent that used a secondary database collected in 2012, designed to find the presence of salmonellosis in stool cultures of the pediatric population in four municipalities to determine relationships between specific factors and the presence of gastrointestinal parasitosis.

The reference population was pediatric patients (under 18 years old) in the four municipalities of interest (Guachené, Quibdó, Apartadó, and Granada) and the individuals were selected by convenience as they attended their local emergency services. Plastic containers were later distributed in their homes with instructions for the stool collection to the individuals regardless of their symptoms. Samples were stored and processed following laboratory standardized protocols determined by the World Health Organization. Stool samples were processed by concentration technique and were examined microscopically by experts from the Instituto Colombiano de Medicina Tropical for ova and cysts of parasites. All records from the secondary source were included, and those with at least 20% incomplete data were excluded. Modifiable independent variables such as water source for drinking or food washing, method of excreta deposition, place of feeding, presence of animals at home, number of inhabitants, and housing material were considered, as well as non-modifiable independent variables such as age and sex, to finally analyze the relationship with the presence of parasitic forms in the stool samples of the pediatric population in the four municipalities. Data analysis was performed using STATA version 17.0. Univariate analysis reported measures of central tendency and dispersion for quantitative variables and absolute and relative frequencies for qualitative variables.

To explore the relationship between the presence of parasitic forms and the other qualitative variables in the study, a bivariate analysis was conducted using the chi-square statistic (X2), with the epidemiological measure used being the prevalence ratio (PR). The Mann-Whitney U test was performed for quantitative nature variables due to the absence of normal distribution. A confidence interval of 95% and a significance level of alpha as a limit of error of 0.05 were used. Exploratory analyses were performed comparing the independent variables with the presence of parasite species. The parasitic forms were categorically divided according to their taxonomy for the analysis. Thus, protozoa, nematodes and cestodes were analyzed within the latter.

Results

The study population comprised of 240 individuals under 18 from four municipalities in Colombia: Guachené, Apartadó, Quibdó, and Granada. Of these, 45.8% were female, with a median age of 9 years (IQR 5, 12) without normal distribution. The majority of children were of school age (6 to 11 years old) accounting for 41.3%, followed by adolescents (12 years old or older) with 27.5%, preschoolers (3 to 5 years old) with 23.3%, and finally, infants (0 to 2 years old) with 7.9%. The records were not balanced concerning the place of residence; 95 (39.6%) records came from Guachené, 62 (28.3%) from Apartadó, 62 (25.8%) from Granada, and 15 (6.3%) from Quibdó. The univariate analysis found that out of the 240 cases, 66.67% (160 out of 240) were parasitized. The univariate analysis (Table 1) reports the frequencies of protozoa, nematodes, and cestodes.

Table 1. Frequency of parasites

Parasites	Frequency (%)
Protozoa	149 (62.1)
E. histolytica/dispar	55 (22.9)
Endolimax nana	46 (19.2)
Blastocystis hominis	52 (21.7)
Giardia intestinalis	50 (20.8)
Coccidia	2 (0.8)
Nematodes	34 (14.3)
Ascaris lumbricoides	18 (7.5)
Trichuris trichuria	15 (6.3)
Hookworms	3 (1.3)
Strongyloides stercoralis	2 (0.8)
Enterobius vermicularis	1 (0.4)
Cestodes	2 (0.8)
Hymenolepis nana	2 (0.8)
Taenia solium	0 (0)
Taenia saginata	0 (0)

The bivariate analysis found a median age of 9 years for both individuals with and without parasites. There were no significant differences for age groups, sex, and municipality of residence. Regarding modifiable environmental factors, it was found that the disposal of excreta was related to the presence of parasitic forms found in coprological studies with an PR of 1.34 [1.14, 1.59] (p=0.005), suggesting that the use of more rudimentary systems such as latrines or septic tanks increases the probability of being parasitized compared to those who use toilets. Similarly, it was found that when the house was built with wood or bahareque, it was more likely to have parasitic forms compared to children living in houses made of brick and material with an PR of [1.31, 1.11, 1.55] (p=0.005). In contrast, the presence of domestic animals living with children, the consumption of food outside the home, and the source of drinking water did not show significant differences in terms of intestinal parasite findings, analyzing them with an PR as a risk association method, although prevalence were reported in Table 2 to understand specific conditions in the population.

The types of parasites were discriminated to evaluate the associations with independent variables. For protozoa, it was found that, unlike the combined analysis of all parasites, 68.5% of men were colonized compared to 56.36% of women. Although the p-value is not significant, it is close to the alpha limit (p=0.054). In the case of nematodes, it was found that the excreta disposalwas not related to the presence of eggs or larval forms in the feces. The rest of the analyses for protozoa and nematodes were consistent with the combined analysis. When evaluating by species, the presence of Giardia intestinalis was found to increase significantly as children got younger (X2=11.97, p=0.0005). Twelve (80%) of the 15 cases of Trichuris trichuria were found among school-age children (5-12 years) (X2=10.3, p=0.0165). On the contrary, the other species of parasites did not show a preferential distribution by age group.

Discusion

Intestinal parasites are of great relevance to public health, especially in the pediatric population, and we know that it is strongly influenced by the determinants of health surrounding the individual. The statistical analysis of this study allows us to determine some statistically significant associations between epidemiological variables and the presence of parasitic forms detected in the stool of the evaluated individuals. Contrasting these results with others found in various studies is necessary to approach possible associations with more certainty.

Regarding the population under 4 years of age, three identified studies evaluated the prevalence of intestinal parasite colonization in children attending daycare. In a Dutch prospective study from 2014, a prevalence of 27% was found through surveillance with serial fecal samples[2]; in a Brazilian cross-sectional study from 2011, it was 29.3%, in contrast to a Cuban study from 2012, where the prevalence was 71.1%[16,17]. Our prevalence in infants and preschoolers was 69.3%. However, it is important to mention that only one sample per individual was taken, just like the studies from Cuba and Brazil. The individuals in the present study were selected for in-home visits and not necessarily attending daycares like in the mentioned cohorts. It has been described that attending daycares increases the risk for intestinal parasite colonization by 1.5 times due to high physical contact with other potentially colonized children[18]. On the other hand, in a cross-sectional study in Pakistan, the prevalence was 52.8%, and in this case, the selection of children under four years of age was similar to ours through domicile[19].

Camacho et al. describe 23,535 coprological reports of children under 12 years of age in Bolivia and reported a prevalence of 31% of pathogenic intestinal parasites, which is lower than ours for individuals under 12 years of age (69.5%)[4]. It was found that the presence of parasites was closely related to age; preschoolers and infants had a higher risk compared to older children (OR: 5.296), which is contrary to our analysis where we did not find a significant relationship between these variables. However, we were able to see that in that study, nematodes increased as older age groups of children were observed, similar to our analysis, specifically with *Trichuris trichuria* where we saw a positive trend. Additionally, it is worth mentioning that the frequency of nematodes was strongly associated with tropical climate zones in Camacho et al.'s study, where 15.2% of the colonized children were found in contrast to temperate climates where it was only about 1.5%[4]. Our study is compatible given that it involves four populations in tropical climates with a prevalence of 14.17%.

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In another study in Guatemala, a significantly higher prevalence of enteropathogens was found in rural populations than in urban populations through fecal examination in patients with acute diarrheal disease. The authors mentioned that one of the most determining differences was the availability of adequate excreta disposal 3. Our study's result was

Table 2. Bivariate analysis between demographic conditions and the presence of parasitic forms in coproculture

Variable	Parasitic forms		Total (%)	PR [IC 95%]*	p value
	Present	Absent			
Age, Median [IQR]†	9 [5, 13]	9 [4, 11]	9 [5, 12]		0.542
Age group (years old)					0.425
Infant (0 - 2)	7 (36.84)	12 (63.16)	19 (7.90)		
Preschooler (3 - 5	16 (28.57)	40 (71.43)	56 (23.3)		
School age (6 – 11)	30 (30.30)	69 (69.70)	99 (41.3)		
Adolecent (> 11)	27 (40.91)	39 (59.09)	66 (27.50)		
Sex				0.84 [0.70, 1.01]	
Masculine	33 (27.56)	92 (72.44)	127 (52.9)		
Femenine	43 (39.09)	67 (60.91)	110 (45.8)		
Mulicipality					
Quibdó	5 (33.33)	10 (66.67)	15 (6.30)		
Guachené	26 (27.37)	69 (72.63)	95 (39.60)		
Granada	25 (35.29)	37 (59.68)	62 (25.80)		
Apartadó	24 (35.29)	37 (59.68)	62 (25.80)		
Excreta disposal				1.34 [1.14, 1.59]	0.005
Toilet	73 (37.70)	119 (62.30)	72 (37.70)		
Latrine, septic tank, etc.	8 (16.33)	41 (83.67)	49 (20.40)		
Water source				0.94 [0.79, 1.13]	0.520
Aqueduct	33 (31.13)	73 (68.87)	106 (44.2)		
Rain, well, cistern, etc.	47 (35.07)	87 (64.93)	134 (55.8)		
Domestic animals				1.03 [0.84, 1.27]	0.759
Dogs, cats, birds, etc.	23 (34.85)	43 (65.15)	66 (27.50)		
Denies	57 (32.76)	117 (67.24)	174 (72.5)		
Food consumption				0.97 [0.81, 1.17]	0.779
Home	63 (67.74)	30 (32.26)	93 (38.75)		
Other (school, street, etc)	97 (65.99)	50 (34.01)	147 (58.33)		
House residents					0.017
1	4	7			
2	22	58			
3	31	49			
4	14	16			
5	1	20			
6	8	9			
House material				1.31 [1.11, 1.55]	0.005
Bricks	66 (38.82)	104 (61.18)	170 (70.8)		
Wood, bahareque or others	14 (20.00)	65 (80.00)	70 (29.02)		

* Prevalence ratio is reported with 95% confidence interval

† The median is reported as central tendency and interquartile range as measure of dispersion

Difference in means is reported with confidence interval.

similar; the prevalence ratio regarding excreta management was 1.34 (p=0.005). However, they also mentioned that the public water source is a protective factor against parasites, which we did not find in our analysis. This result can be explained because even though people in these four Colombian municipalities had water supply systems, more is needed to guarantee potable water. In the national parasitism survey of 2015, it was observed that the prevalence of improved water sources in Guachené was 7.2%, Chocó 79.57%, and Granada 75.07%. The access to sewage in Granada was 100% in urban areas and 44.58% in rural areas, Chocó was 49%, and Guachené in its urban area was 73.4% 20.

Research on this topic in Colombia is ongoing, and the available information is limited. The national parasitism survey includes 6045 samples from school-aged children (between 7 and 10 years old), and a study in 9 Andean regions is an adequate reference 8,20. We see that the predominant parasitic species were very similar. However, in our study, almost all protozoa (*B. hominis* and *E. histolytica*) and nematodes are less frequent (30-40%) compared to both reports. Another study in Colombia in adults in the exact locations where our study was conducted showed a high prevalence of intestinal parasitosis in patients with acute diarrhea. The species evaluated in this population were similar to those in our study. This result allows us to assume that these Colombian populations and probably others with similar socioeconomic characteristics have a high prevalence of intestinal parasitosis[5]. A recently published cohort study involving 47 children in a rural Caribbean area reported a very similar prevalence of intestinal parasites (61.7%) and polyparasitism (32.2%). However, the frequencies of specific parasite species differed. For instance, the authors found a higher prevalence of *Trichuris* (36.2% vs. 6.3%) compared to our observations. Conversely, we observed a higher occurrence of *Entamoeba* and *Endolimax*, with rates of 22.9% and 19.2%, respectively, in contrast to their rates of 4.3% and 8.5%. Nevertheless, *Giardia* remained one of the predominant species[21].

Polyparasitism has been frequently associated with chronic morbidities such as malnutrition and growth retardation. In an Argentine study, a frequency of 54%[22] was reported. In Cali, a frequency of 52.1%[23], and in another study in the Amazon region, a frequency of 84%[24], while in the present study it was 37.9%.

We've identified several limitations in the proposed scope. First, the non-randomized sample selection method, based on convenience, introduces a selection bias and restricts generalization to populations beyond the four municipalities. Additionally, our primary data source is from a 2012 macro project, potentially leading to an information bias. Notably, not all parasitic species can be detected by the tests employed, rendering precise conclusions about colonization challenging. Furthermore, the absence of symptom temporality information prevents their inclusion in the analysis, potentially impacting the understanding of intestinal microbiota alterations. A memory bias is also evident in some factors, as individuals may not remember events, such as food consumption outside the home. Some variables lacked thorough evaluation, heightening the risk of information bias. For instance, there is no microbiological evidence regarding tap water quality or food handling practices at home. Moreover, we did not investigate the frequency of boiling water for drinking or food washing, nor did we explore contact proximity of domestic animals to children. Similarly, certain risk factors like toy sharing, ground contact, and hand washing were not addressed within our study's scope.

In conclusion, this study explores the parasitic findings on stool samples of a pediatric population from four municipalities in Colombia, along with an analysis of demographic and environmental factors that are determinants of health. Of the analyzed factors, age (inversely proportional), inadequate excreta disposal, and housing construction with wood or bahareque were associated with the presence of parasitic forms in coprological studies. Conversely, for the studied population, gender, the presence or absence of pets, different water sources, or consumption of food outside the home were not significantly related to the presence of positive coprological tests. Further research is needed to contrast the current results found.

Ethical considerations

This article adhered to the current regulations for medical research outlined in the Colombian legal framework in Resolution 8430 of 1993. The study was approved in the minutes of the Research and Ethics Committees of the CES University, in document number 184.

Protection of persons and animals. The authors declare that for the elaboration of this project, no experiments with humans or animals were carried out.

Confidentiality of the data. The authors declare that they have followed the protocols of the institution of origin of the patients on the publication of data, the document does not contain data that allows them to be identified.

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Conflict of Interest. The authors declare that they have no conflicts of interest for the publication of this manuscript.

Contributions of the authors. NCC participated in conceptualization, obtaining primary information sources, executing the research, designing the methodology, project administration, supervision, review, editing, and approval of the final version. HCR, MRM, MSJ participated in obtaining and processing samples, field trips, and analysis of microbiological results. AB, DV, TH, NM, and DC participated in conceptualization, literature search, executing the research, editing, and approval of the final review. CB participated in data analysis, executing the research, designing the methodology, supervision, review, editing, and approval of the final version.

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