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# Intestinal parasites in children and soil from Turbaco, Colombia and associated risk factors

## Parásitos intestinales en niños y suelo de Turbaco, Colombia y factores de riesgo asociados

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**ABSTRACT**

**Objective** To determine the frequency of intestinal parasites in children and soil from Turbaco- Colombia and associated risks factors.
**Methods** Analytical study in which 390 children between 2 and 12 years old from 10 neighborhoods of Turbaco were included, whose legal representatives gave informed consent. Three serial samples of feces and 10 soil samples were processed. Risk factors were determined through an interview. Physicochemical and structural characteristics of soils were also evaluated.
**Results** Parasites were found in 30.5 % of children. 162 parasites were observed; the most frequent protozoan was *Endolimax nana* (30.3 %) and in terms of helminthes, the most frequent was *Ascaris lumbricoides* (4.9 %). No statistical association between age or sex and intestinal parasites ($p>0.05$) or between risk factors and intestinal parasites ($p>0.05$) was found. Low frequencies of intestinal parasites were encountered in soil samples, being more common *Entamoeba spp*., *Giardia spp*., and *Ascaris lumbricoides*. Neighborhoods of Turbaco had sandy dry soil with low content of ions, low conductivity and low organic matter.
**Conclusion** This study showed a low frequency of intestinal parasites in feces and soils. Despite this, pathogenic parasites were found which can affect the health of the population. Besides this, a high percentage of intestinal parasites that are transmitted through feces were detected indicating fecal contamination and low level of hygiene.

**Key Words**: Parasites, risk factors, soil, feces, child (*source: MeSH, NLM*).

**RESUMEN**

**Objetivo** Determinar la frecuencia de parásitos intestinales en niños y suelos de Turbaco –Colombia y su asociación con factores de riesgo.
**Métodos** Estudio analítico realizado en Turbaco-Colombia. Fueron Incluidos 390 niños

entre 2 y 12 años de 10 barrios, cuyos representantes legales dieron un consentimiento informado. Fueron procesadas 3 muestras seriadas de heces fecales y 10 muestras de suelos. Los factores de riesgo fueron evaluados a través de una entrevista. Además se determinaron las características fisicoquímicas y estructurales de los suelos.
**Resultados** Se encontraron parásitos en 30,5 % de los niños. Se observaron 162 parásitos, siendo *Endolimax nana* (30,3 %) el protozoo más frecuente y *Ascaris lumbricoides* (4,9 %) el helminto más frecuente. No se encontró asociación estadística entre la edad, el sexo y los factores de riesgo con la presencia de parásitos intestinales (p>0,05). Se encontró una baja frecuencia de parásitos en las muestras de suelo, siendo más comunes *Entamoeba spp.*, *Giardia spp*. y *Ascaris lumbricoides*. Los barrios de Turbaco tuvieron suelo arenoso, seco con bajo contenido de iones, baja conductividad y poca materia orgánica.
**Conclusión** Este estudio determinó una baja frecuencia de parásitos intestinales en heces y suelos. Sin embargo, se encontraron parásitos patógenos que pueden afectar la salud de la población. Se detectó un alto porcentaje de parásitos que son transmitidos a través de las heces indicando contaminación fecal y bajo nivel de higiene.

**Palabras Clave***:* Parásitos, factores de riesgo, suelo, heces, niño *(fuente: DeCS, BIREME).*

Intestinal parasites are amply distributed in world and present primarily in developing countries, being children most affected due to their hygienic habits (1,2).

Climatic conditions contribute to this epidemiological situation without forgetting geographical characteristics which can favor the life cycles of parasites. In depressed areas, there are some determiners like outdoor defecation, lack of potable water and hygienic habits that create a convenient environment for soil borne parasites (1).

Parasitic diseases in children can cause learning problems and alterations in cognitive functions. Children are exposed to many intestinal parasites that are ingested by orally or through skin exposed to contaminated soils. Child intestinal parasitism is determined by access to material resources, education and sanitation resources (2).

It's estimated that more 2 billion people, around of third of the world population, is infested with one or more parasites. Of these, close to 300 million suffer from serious clinical manifestations and 155 thousand die every year due to these diseases (3). In Colombia, the prevalence of intestinal parasitic diseases is 12 % in overall population and 28 % in children between 1 and 4 years old. According to the Instituto Nacional de Salud

(INS), in the National Study of Morbidity, performed in 1980, it was established that 81.8 % of people in the country are parasitized, of these 63 % with pathogenic parasites and 18 % with nonpathogenic parasites (4, 5).

In Colombia these diseases are favored by geographical, climate and socioeconomic conditions, maintaining its prevalence over time (6, 7, 8). In our country, studies have been made to determine the frequency of intestinal parasites and their risk factors in the child population, but a correlation of these with the frequency of soil parasites has yet to be done. For this reason, the aim of this study is to determine the frequency of intestinal parasites in feces and soil and its relation to risk factors in children from Turbaco, Bolívar.

## METHODS

Descriptive study realized in Turbaco, Colombia located 10 Km south of Cartagena with a population of 11 280 children between 2 and 12 years old (9). To determine the sample was used formula to population known (e=0.05, z=1.96) and stratified random sampling. 390 children, whose legal representatives gave their permission through an informed consent, were included.

This study was approved by the Ethics Review Board of the Corporación Universitaria Rafael Nuñez.

To evaluate risk factors such as socioeconomic and cultural variables (number of inhabitants, characteristics of dwellings, socioeconomic status, information related to excrement disposal system, potable water supply, electricity and social security) an interview with a member of each family was performed. Furthermore, during the interview, the hygienic characteristic of dwelling and its setting were recorded.

Three serial samples of feces were taken from each child every other day and collected in a sterile container. Samples were preserved in 10 % formaldehyde and processed through microscopic observation with the lugol and concentration technique through sedimentation (10).

To detect intestinal parasites is soil, 10 soil samples of most superficial layer were taken and kept at room temperature until processing, as described previously. The modified Telemann technique was used for parasitic detection (11,12).

As for the environmental risk facts, the physicochemical and structural characteristics of soils from neighborhoods and climatic conditions during the sampling period were evaluated. Physicochemical and structural characteristics of soils were determined in the Unidad de Prestación de Servicios Rafael Ruiz Arango of Facultad de Ciencias Farmacéuticas - Universidad de Cartagena. Temperature, relative humidity and pluviometry were obtained during the sampling period through the IDEAM website (Instituto de Hidrología, Meteorología y Estudios Ambientales).

Statistical analysis of results was realized with software SPSS v. 19 for Windows. Univariate analysis was applied to determine the association of the frequency of intestinal parasites to potential risk factors using the chi-square test, with a p-value ≤0.05 for statistical significance.

## RESULTS

390 children between 2 and 13 years old (7.3±2.3 years) were included. The majority of the children were in the 6 – 9 years age group (52.31 %; 204/390), second, in the 2-5 year age group (27.18 %; 106/390) and finally the 10-13 year age group (20.51 %; 80/390). Most of them were of female sex (51.2 %)

Parasites were found in 119 (30.5 %; CI95 % 26.2-35.2) children. 162 parasites were observed. Of these, 87.6 % were protozoa and 12.4 % were helminthes. *Endolimax nana* (30.3 %) was the most frequent protozoan and the most frequent helminthe was *Ascaris lumbricoides* (4.9 %) (Table 1). 60.5 % (98/162; CI 95% 52.8 – 67.7) of organisms isolated were commensal parasites .

**Table 1**. Frequency of parasites in fecal matters

| Parasites | Frequency (%) | CI (95 %) |
|---|---|---|
| *Endolimax nana* | 43 (26.5) | 20.3 – 33.8 |
| *Giardia lamblia* | 27 (16.7) | 11.7 – 23.2 |
| *Blastocystis hominis* | 25 (15.4) | 10.7 – 21.8 |
| *Entamoeba coli* | 23 (14.2) | 9.7 – 20.4 |
| *Comp. Entamoeba histolytica/ Entamoeba dispar* | 17 (10.5) | 6.6 – 16.2 |
| *Ascaris lumbricoides* | 8 (4.9) | 2.5 – 9.4 |
| *Iodamoeba butschlii* | 7 (4.3) | 2.1 – 8.7 |
| *Trichuris trichiura* | 5 (3.1) | 1.3 – 7 |
| *Uncinaria sp.* | 4 (2.5) | 1 – 6.2 |
| *Hymelonepis nana* | 3 (1.9) | 0.6 – 5.3 |
| Total | 162 (100) | |

Infections by more than one parasite were detected in 33.1 % of children, with a maximum of four parasites per host. Main associations were *Endolimax nana-Blastocystis hominis* (15.4 %) and *Endolimax nana- Giardia lamblia* (10.3 %), being *Blastocystis hominis* (39.5 %) the more usual species in these associations.

No statistical association between age or sex and intestinal parasites was found ($X^2$=0.6933, p=0.7071 and $X^2$=0.3366, p=0.5618; respectively).

Regarding socioeconomic variables like services and infrastructure, the households analyzed had electricity, block walls, cement floors, eternit roof. 99 % of dwellings had bathroom and 1 % had sewers. All dwellings had running water. 83.3 % of children obtained their health services through a private health care (EPS- Empresa Promotora de Salud) and 16.5 % through publicly subsidized healthcare (Sisben).

In terms of education, 57.4 % of legal representatives studied until high school; 26.2 %, elementary school; 12.3 %, technical studies and 3.6 %, studied a university degree. The average family group was made up of 6 people with an average of 3 children per dwelling. Families belong to socioeconomic levels 1, 2 and 3. The most relevant cultural and hygienic variables are in Table 2. Taking into account the variables presented in Table 2, the level of household hygiene is good.

No statistical association was found between risk factors and intestinal parasites (p>0.05) (Table 2).

**Table 2**. Cultural and hygienic risk factors versus frequency of parasites in children from Turbac

| Variable | Infected | Non Infected | $X^2$ | ρ |
|---|---|---|---|---|
| Pets | 50 | 107 | 0.22 | 0.6380 |
| Sharing towels | 48 | 94 | 1.14 | 0.2857 |
| Hand washing before preparing food[a] | 106 | 228 | 1.64 | 0.1999 |
| Playing with soil | 80 | 185 | 0.04 | 0.8396 |
| Hand washing before consuming foods[a] | 111 | 247 | 0.50 | 0.4796 |
| Hand washing after going to the bathroom[a] | 107 | 238 | 0.35 | 0.5513 |
| Stagnant water around dwelling[a] | 38 | 104 | 1.48 | 0.2233 |
| Waste material around dwelling[a] | 22 | 51 | 0.01 | 0.9383 |

[a]Variables for determining level of hygiene

Low frequencies of intestinal parasites were encountered in soil samples (Table 3), being most common *Entamoeba spp*. and *Giardia spp*., with 20.8 % each one and *Ascaris lumbricoides* with 16.7 % (Table 3).

**Table 3**. Frequency of parasites in soils

| Parasites | Frequency (%) | CI (95 %) |
|---|---|---|
| *Entamoeba sp.* | 5 (20.8) | 9.2 – 40.5 |
| *Giardia sp.* | 5 (20.8) | 9.2 – 40.5 |
| *Endolimax nana* | 2 (8.3) | 2.3 – 25.9 |
| *Iodamoeba sp.* | 1 (4.2) | 0.7 – 20.2 |
| *Ascaris lumbricoides* | 4 (16.7) | 6.7 – 35.9 |
| *Trichuris sp.* | 3 (12.5) | 4.3 – 3.1 |
| *Uncinaria sp.* | 1 (4.2) | 0.7 – 20.2 |
| *Hymelonepis nana* | 1 (4.2) | 0.7 – 20.2 |
| *Blastocystis hominis* | 2 (8.3) | 2.3 – 25.9 |
| Total | 24 (100) | |

Soils of neighborhoods of Turbaco during the sampling period had the following physicochemical and structural characteristics: sandy texture, low organic matter content, moderately alkaline pH, low conductivity, a low content of cations and a low percentage of nitrogen.

Climatic variables were registered during the sampling days. Average temperature was 26.58 °C, average precipitation was 61.9 mm and average relative humidity was 85 %.

## DISCUSSION

Intestinal parasites are considered a public health problem in developing countries like Colombia, affecting principally children. These diseases constitute an economic and social loss for any country (1).

Frequency of intestinal parasites in Turbaco was lower than that found in other investigations (6,8,13). This result may be the result of improvement in the infrastructure of dwellings, appropriate sewage disposal, absence of stagnant water around dwellings which constitute factors that protect from intestinal parasites acquisition (14,15).

In this study, frequencies of protozoa and helminths were higher than those described by Tabares in children from Sabaneta, Antioquia (46.8 % and 5.1 %, respectively) (16). Other authors also reported different results to ours (2,17,18,19).

Regarding the most frequently detected parasites in this study, *Giardia lamblia* (27.3 %) and *Endolimax nana* (68.3 %), other Colombian researchers have published a similar percentage of *G. lamblia* (25.9 %) (4,7). On

the contrary, the percentage of *E. nana* in this study was less than that reported by researchers like Agudelo (36 %) and Medina (43.1 %) (4,7,8). *B. hominis* was one of protozoan isolated with the highest frequency in children from Turbaco. It is transmitted through water and foods, and its frequency is related to defecation on the ground, poor environmental sanitation, overcrowding and malnutrition. These conditions weren't found in Turbaco which probably influenced the low percentage of *B. hominis* detected (20). Frequency of this protozoan was lower than prevalence in developing countries (50 %) (21,22).

The most frequent hookworm was *Ascaris lumbricoides* (4.9 %); other authors obtained similar results (23-26), whereas Cardona encountered higher frequencies (18.9 %) (27). Other authors reported different results to ours (28-30). Vegetables, fruits and bad habits of eating fruits without proper washing could be the source of infection of *A. lumbricoides* (26).

A high percentage of commensal parasites were isolated. Cardona found a similar percentage of commensal parasites (66.7 %) (27). Presence of this type of parasite indicates fecal contamination, which can be associated with non-hygienic behavior (1,31,32) of the population from Turbaco, although taking into account information collected through interviews, this population has a good level of hygiene as we will show subsequently.

In this investigation, the most frequent associations between parasites were *B. hominis-E. nana* and *B. hominis-G. lamblia*. Acuña had a similar result in frequency of *B. hominis–G. lamblia* (5.6 %) in children from the state of Carabobo, Venezuela (32). On the other hand, the frequency of association of *B. hominis-E. nana*, was different than that found by other researchers (33,34). These associations are common because they have identical modes of transmission (oral route) and its presence indicates ingestion of contaminated foods and/or water with feces (31,35,36). They bring as a consequence a synergism in mechanism of damage to intestinal epithelium or in their transmission (32).

*B. hominis* and *E. nana* are commensal protozoa; however, *G. lamblia* is a pathogenic protozoan which causes malabsorption syndrome, rapid transit, reduction of bile salts and injury of intestinal mucus (37). Along these lines, it is important to highlight that a high percentage of participants in this study said they washed their hands after using the bathroom, which may indicate that this process is not done correctly, which would explain the high frequency of commensal protozoa reported in this study.

Factors like poverty, deficiency or lack of basic services and social security, the educational level of legal representatives and overcrowding cause health problems to increase, producing a highly parasitized and undernourished (14,15). These characteristics are not present in the Turbaco population. Neighborhoods analyzed have sewage systems, the majority of participants have social security and have completed some higher education; these situations have an impact on the low frequency of intestinal parasites found. Neither of these conditions had a statistical association with frequency of parasites found in individuals studied ($p>0.05$).

In Turbaco, a low frequency of parasites in soils was detected, being mainly isolated *Entamoeba sp., Giardia sp.* (20.8 %, each one), and *Ascaris lumbricoides* (16.7 %). Some of these parasites are of human and animal origin. Cordoba reported similar frequencies of *Giardia sp*. (34.7 %) and *Entamoeba sp.* (27.4 %) in public places of La Plata Argentina, but the frequency of *A. lumbricoides* (73.4 %) was higher than was found in Turbaco (12). The frequency of *Entamoeba sp.* and *Giardia sp.* in Turbaco was greater than was reported by Pierangeli (8.4 % and 7.5 %, respectively) in soils of a suburb of Neuquén city, Argentina (11). Several studies have revealed the presence of different states of these parasites in soils (38,39). Soil contamination with these parasites can happen if contaminated water with feces is used or by using them as fertilizer. Parasitic forms of *Entamoeba sp*. and *Giardia sp*. such as cysts can survive from 1 to 3 months in the environment and eggs of *A. lumbricoides* keep infecting power between 7 and 12 years. These characteristics are important for transmission of parasites to human beings (38).

Neighborhoods of Turbaco had sandy dry soil with low content of ions, conductivity and organic matter level. Similar characteristics are presented in soils of a suburb of Neuquén city, Argentina (11). Gamboa reported similar characteristics in the soil of the province of La Pampa, Argentina that had an impact in low frequency of pathogenic parasites; this researcher evaluated other places with different results (40). Determination of characteristics of soil and climatic conditions are important to the viability and maturation of the external form of intestinal parasites. Well-drained sandy soils and low organic matter level like Turbaco soils favor runoff and retain little water between their particles (17). These characteristics previously mentioned complicate the development and persistence of intestinal parasites, which explains a low frequency of parasites was obtained in soils (11).

However, it is important to emphasize that parasites detected in fecal matter are equal to parasites detected in soil samples that could indicate a role of soils in transmission of these parasites to the child population, although soil conditions in Turbaco are not the best for the development of intestinal parasites (30, 39).

In Turbaco during the sampling period, an average temperature of 26.58 °C, precipitation of 61.9 mm and relative humidity of 85 % were recorded. Other researchers found similar results (11,41). Climatic conditions required for the development of helminthes are an average temperature of 25 °C, a minimum of 50 mm of precipitation and relative humidity between 60 % and 70 %; cysts and oocysts of protozoa are relatively more resistant to unfavorable environmental conditions (11). Relative humidity during the sampling period is unfavorable for the development of helminthes, it impedes the rupture of eggs and causes the death of larvae. Precipitation and temperature recorded did not affect the development of parasites.

In conclusion, this study showed a low frequency of intestinal parasites in feces and soils. Despite this, pathogenic parasites were found which can affect the health of the population. Besides this, a high percentage of intestinal parasites that are transmitted through feces were detected, indicating fecal contamination and low level of hygiene, even though the population expresses the opposite. For this reason, it is necessary to teach people of the importance of implementing measures to improve environmental and sanitary conditions and to show sanitary measures that they can implement, such as proper disposal of waste products of human beings, pets and stray animals.

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