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## ENTEROPARASITOSIS AND THEIR ETHNOGRAPHIC RELATIONSHIP TO FOOD HANDLERS IN A TOURIST AND ECONOMIC CENTER IN PARANÁ, SOUTHERN BRAZIL

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### SUMMARY

This study reports on the occurrence of enteroparasites based on data from an ethnographic study of food handlers in the city of Cascavel, Paraná, Brazil. Fecal material from 343 food handlers of both sexes, between 14 and 75 years of age, was analyzed using Lutz, modified Ritchie and Ziehl-Neelsen techniques. Ethnographic relationships were investigated by means of specific questionnaires. Positive fecal samples were found for 131 (38.2%) handlers. *Endolimax nana* (67.9%) was the predominant species, followed by *Entamoeba coli* (35.9%), *Blastocystis hominis* (28.2%), *Entamoeba histolytica/dispar* (10.1%) and *Giardia duodenalis* (8.4%). Protozoan infections were more common than helminth infections ( $p = 0.00$ ). The positive results for some parasites were associated with the male sex, professional category, and the performance of other activities ( $p \leq 0.05$ ). The high overall occurrence of enteroparasites found indicates improper hygiene and sanitation conditions. Effective educational measures should be implemented to prevent the transfer of pathogenic organisms to food via handling.

**KEYWORDS:** Enteroparasitosis; Food handlers; Ethnographic relationships; Occurrence; Southern Brazil.

### INTRODUCTION

Food-borne diseases extend beyond the domestic environment, affecting increasing numbers of people and representing an important public-health problem in all countries<sup>4,13</sup>. Growing urbanization and lifestyle changes lead people to dine away from home more often, contributing to the unregulated opening of eating establishments that often have inadequate hygiene conditions.

Food handling is one form of dissemination of pathogens<sup>28</sup>, because inadequate hygiene habits, such as the lack of regular hand washing, allow mainly asymptomatic carriers of diseases, including enteroparasitosis, to contaminate the food that they handle<sup>25</sup>. Although it is recognized that locations where large numbers of meals are prepared are more subject to the occurrence of food-borne illnesses, and in spite of the importance and topicality of the subject, few researchers have investigated food services<sup>14</sup> and the presence of enteroparasites in food handlers<sup>4,13,20</sup>.

The state of Paraná, located in relatively prosperous southern Brazil, has many communities that show high prevalences of intestinal parasites<sup>8,15,16,18,24</sup>. However, no study has dealt with the presence of enteroparasites in food handlers in this state. The municipality of Cascavel in western Paraná is an important national and international tourist and economic center, a crossroads for transport of goods and passengers traveling to and from central-western, southeastern and northeastern

Brazil to Paraguay and Argentina. Therefore, it is important to assess the occurrence of food handlers in this region who might transmit food-borne disease agents, in order to assure food safety and to provide useful information to the health authorities. This study aimed to determine the occurrence of enteroparasites and ethnographic relationships for cooks and kitchen helpers, mobile food vendors, school food servers, bakers, and confectioners in the municipality of Cascavel, Paraná.

### MATERIALS AND METHODS

**Study area:** Cascavel is located on the Terceiro Planalto (Third Paranaense Plateau) of the state of Paraná, at an altitude of about 785 meters; the municipality covers an area of 2,091 km<sup>2</sup>. The climate is superhumid mesothermal subtropical, with a mean annual temperature of about 18 °C. The highest mean temperature in January is 28.6 °C, and the lowest mean in July is 11.2 °C, with occasional frosts. The municipality has 245,369 inhabitants, most of whom reside in the urban area. These comprise 50.0% of the economically active population, 51.3% female, 35.0% with basic schooling, and 50.0% with a monthly income of two minimum wages (Census 2000). The Human Development Index (HDI) is 0.810, reflecting good living conditions and degree of development, which places the municipality 15th among those in the state.

**Study population:** This transverse observational study involved 343 food handlers of both sexes, aged from 14 to 75 years (mean 37 years),

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and was conducted from March 2005 to September 2006. In Cascavel, the 366 registered establishments that employ food handlers include 103 restaurants, 96 mobile vendors, 96 public schools, and 71 bakeries. The sample, calculated by proportional stratification by establishment, included 29 restaurants, 41 mobile food-vending businesses, 25 canteens in state and municipal public schools, and 18 bakeries. The participants were classified in occupational categories according to the nature of their duties. We investigated 142 (41.4%) cooks and kitchen helpers, 74 (21.6%) mobile vendors, 69 (20.1%) school food servers, and 58 (16.9%) bakers and confectioners. Each participant signed a consent form approved by the Permanent Committee on Ethics Involving Human Beings (Comitê Permanente de Ética em Pesquisa Envolvendo Seres Humanos, COPEP) of the State University of Maringá (UEM) (Parecer No. 168/2005) and of the State University of West Paraná (UNIOESTE) (Parecer No. 094/2005).

**Fecal parasitological examination:** From each individual, three fecal samples were collected in a single flask with 10% formalin, on alternate days, for a period of seven days. The material was analyzed in the Parasitology Laboratory of the State University of West Paraná by the methods of Lutz<sup>12</sup>, modified Ritchie<sup>12</sup> and modified Ziehl-Neelsen staining<sup>12</sup>.

**Variables studied:** Two specific questionnaires were used to assess the infrastructure and hygiene of each establishment. Questionnaire items included the presence and/or nature of the floor; roof; walls; doors, windows and other openings; lighting; ventilation; climate control; water supply and sewage; method and frequency of cleaning the facilities; sanitary facilities; use of trash containers; pest control; and food storage; and the habits used in food-handling jobs (hand-washing, water quality, fruit and vegetable washing, the presence of symptoms suggestive of parasitosis, wearing a uniform, habit of chewing fingernails, use of tongs to handle food, carrying out other activities besides food handling, and frequency of cleaning the food-preparation surfaces). The education and salary levels of the workers were also investigated.

**Statistical analysis:** For the statistical analysis we used the program Minitab, version 14. A chi-square test was used to identify associations among the variables. The significance level was 5%.

## RESULTS

Of the 343 food handlers investigated, 131 (38.2%) tested positive for at least one parasite (pathogenic and nonpathogenic species of the human intestine) with the different methods used. The occurrence of enteroparasites by species is shown in Table 1. *Endolimax nana* was the predominant species, followed by *Entamoeba coli*, *Blastocystis hominis*, *Entamoeba histolytica/dispar* and *Giardia duodenalis*. The occurrence of *E. nana* was significantly higher ( $p = 0.00$ ) than those of the other species. *Cryptosporidium* sp. was not detected in any of the samples investigated. The rate of infection by protozoans was significantly higher than the rate by helminths ( $p = 0.00$ ). The occurrence of nonpathogenic species was significantly higher ( $p = 0.00$ ) than those of the pathogenic species, not including *B. hominis*.

Table 2 shows the occurrence of enteroparasites according to the sex, age group, degree of education, and salary level of the food handlers. The presence of at least one species of parasite in men was significantly different from that in women ( $p = 0.03$ ). There was no association between

**Table 1**  
Occurrence of enteroparasites in food handlers from the municipality of Cascavel, Paraná, Brazil, from March 2005 to September 2006

Enteroparasites	n	%
<b>Protozoa*</b>		
<i>Endolimax nana</i>	89***	67.9**
<i>Entamoeba coli</i>	47***	35.9
<i>Blastocystis hominis</i>	37	28.2
<i>Entamoeba histolytica/dispar</i>	14	10.1
<i>Giardia duodenalis</i>	11	8.4
<i>Iodamoeba butschlii</i>	5***	3.8
<b>Helminths</b>		
<i>Strongyloides stercoralis</i>	3	2.3
<i>Ascaris lumbricoides</i>	2	1.5
<b>Hookworms</b>	2	1.5

\* Presence of protozoa in relation to helminths  $p = 0.00$ ; \*\* Presence of *E. nana* in relation to other protozoa  $p = 0.00$ ; \*\*\* Nonpathogenic species in relation to pathogenic species  $p = 0.00$ .

age group, degree of education, or salary level of the food handlers and the presence of parasites, but higher occurrences were observed in individuals younger than 18 years (70.0%), with basic education (39.1%), and with a relatively low income, up to three minimum wages (40.1%).

Among the positive individuals, a single parasite species occurred in 77 (58.8%). This was a significantly higher rate than that for more than one species, which occurred in 54 (41.2%) individuals. *E. nana* and *E. coli* occurred together most frequently in the same individual, comprising 81.7% of the protozoans found.

The occurrence of parasites was associated with occupational category ( $p = 0.00$ ). Bakers and confectioners (51.7%) and school food servers (20.3%) contributed most to this association (Table 3). A single species of parasite occurred at higher rates in the mobile vendors (71.4%), and more than one species occurred at higher rates in the cooks and kitchen helpers (59.3%). *E. nana* was the predominant species among cooks and kitchen helpers (23.5%), bakers and confectioners (40.3%), and school food servers (11.4%). *B. hominis* was the predominant species among mobile vendors (36.6%).

The water used by 96.4% of food handlers came from the public supply (Sanepar, Companhia de Saneamento do Paraná). Vegetables were washed only with running water by 48.1% of the food handlers, whereas 51.9% of them used running water and immersion in an aqueous solution of vinegar or bleach. These variables, together with the others studied, showed no association with rates of parasitism, except the variable "carrying out other activities in addition to handling food" ( $p = 0.04$ ). Of the 343 food handlers, 60 who also carried out other activities were positive: 44 (73.3%) did general cleaning of the establishment, and 16 (26.7%) conducted sales, dishwashing or unloading products. In 64.9% of the establishments, general cleaning was done at the beginning and end of business hours. In 46.1%, cleaning was done with soap and water with no bleach added.

**Table 2**  
Occurrence of enteroparasites by sex, age group, educational level, and income in food handlers in the municipality of Cascavel, Paraná, Brazil, March 2005 to September 2006

Variable	Class	Number and percentage of parasitized individuals		Total
		n	%	
Sex	Men	38	48.7*	78
	Women	93	35.1	265
Age group (years)	< 18	7	70.0**	10
	18 to 25	14	35.0	40
	25 to 32	27	40.9	66
	32 to 39	32	46.4	69
	> 39	51	32.3	158
Educational level	Basic	86	39.1**	220
	Intermediate or Higher	45	36.6	123
Income group (monthly minimum wage = US\$ 166.70)	≤ 3	115	40.1**	287
	> 3	16	28.6	56

\*Ratio of men to women,  $p = 0.03$ ; \*\* No association between age group, educational level, and income group, and the presence of parasites,  $p > 0.05$ .

**Table 3**  
Occurrence of enteroparasites in four occupational categories of food handlers in the municipality of Cascavel, Paraná, Brazil, March 2005 to September 2006

Occupation	Examined		Positive		Negative	
	n	%	n	%	n	%
Bakers and confectioners	58	17	30	51.7*	28	48.3
Cooks and kitchen helpers	142	41	59	41.5	83	58.5
Mobile vendors	74	22	28	37.8	46	62.2
School food servers	69	20	14	20.3*	55	79.7
Total	343	100	131	38.2	212	61.8

\*Occupational categories that contributed most to occurrence of parasites  $p = 0.00$ .

## DISCUSSION

The low occurrence of helminths in relation to protozoans observed in the present study, as also found by other investigators<sup>3,13,20</sup>, may indicate changes in the profile of intestinal parasites. This difference may be related to the use of self-medication for helminths, which may fail to eliminate protozoans and also lead to the appearance of immune-mediated diseases (colitis, reactive airway disease, encephalitis and diabetes), since the loss of natural helminth exposure removes a universal Th2 and regulatory immune effect imparted by these organisms (ELLIOTT *et al.*<sup>6</sup>; MULCAHY *et al.*<sup>11</sup>). According to BASSO *et al.*<sup>3</sup> decreases in helminth prevalence are related to improvements in public health, sanitation, housing, and education.

The occurrence of enteroparasites in food handlers in the municipality of Cascavel, in the total population as well in the different occupational categories, is within the range of 13.9 to 46.9% found in studies in

other municipalities of the state<sup>7,8,15,16,18,24</sup>. This rather high occurrence is significant if we consider that this municipality possesses a relatively high IDH for the state, and is located in relatively well-developed southern Brazil. Furthermore, Cascavel lies on the route to the second-most popular tourist destination in Brazil, Foz do Iguaçu, and is an important crossroads for freight carriers traveling among Brazil, Argentina and Paraguay. This high occurrence concurs with previous reports from southern and southeastern Brazil<sup>4,9,13,20</sup>.

Overall, *E. nana* and *E. coli* were the predominant species, as found in previous studies<sup>4,13,25</sup>. *E. nana* predominated among cooks and kitchen helpers, bakers and confectioners, and school food servers; whereas *B. hominis* predominated among mobile vendors. A recent study<sup>3</sup> reported that over a 35-year period, the prevalence of *E. coli* and *E. nana* increased in relation to the other intestinal parasites. This increase may be related to the mode of transmission via infective cysts in feces, which may allow interpersonal contamination even in environments with good sanitation.

Interpersonal contamination could explain why these two species occurred primarily among professionals who work as a team or in groups (cooks and kitchen helpers, bakers and confectioners, and school food servers). The higher occurrence of these two species may also be related to the fact that the presence of cysts of these protozoa in human feces does not mean that the host needs to be treated. According to NOLLA & CANTOS<sup>13</sup>, although *E. nana* and *E. coli* are not pathogenic in humans, their high rate of occurrence in food handlers is worrisome because these are risk groups for transmitting other pathogenic species. *B. hominis*, although its pathogenicity is controversial, was the third most frequent species, and it is often reported in food handlers<sup>2,13,19</sup>. The high prevalence of this species in mobile vendors may be partly related to the fact that *B. hominis* has low host specificity and is spread by digestive secretions and excretions of birds and mammals, to geographical factors, and to still-unknown factors affecting the genetic diversity of this species<sup>22</sup>. These characteristics differentiate *B. hominis* from amoebas, which have similar biological behavior and are less versatile in their propagation. The nature of the workplace of street vendors may be another explanation for this result, because on the streets, insects easily contact food items, thereby increasing the possibility of contamination, since insects have been identified as carriers of parasite eggs and cysts. Furthermore, 35.3% of street vendors carried out other activities in addition to handling food, which is a variable associated with parasitism. Among these activities is handling money: 17% of the mobile vendors handled money, and were the only food handlers to do so. SATURNINO *et al.*<sup>23</sup> observed the presence of intestinal parasites on currency notes. A study in our laboratory showed that, for street food vendors from Maringá Municipality, there was a significant relationship ( $p < 0.00001$ ) between handling money and parasitism: people who handled money were parasitized by more species than those who did not handle money (unpublished data). Moreover, although here it was not associated with parasitism, 73.2% of the mobile vendors washed their hands only with water, perhaps because soap is an additional cost. One hundred percent of people in the other categories washed their hands with soap and water. The high occurrences of these species could be explained by the inadequate hygiene practices food handlers. They are reluctant to change their habits, and neglect the matter of prevention of parasitic diseases.

In the present study, although nonpathogenic parasites occurred in a significantly higher proportion, human pathogenic species such as *Entamoeba histolytica/dispar*, *Giardia duodenalis*, *Strongyloides stercoralis*, *Ascaris lumbricoides* and hookworms were also found, as also observed by different investigators<sup>4,13,19,20,21</sup>. The majority of the individuals that are infected with *E. histolytica/dispar* and *G. duodenalis* are asymptomatic, and eliminate large quantities of cysts that remain viable for long periods of time in the environment, contaminating water and food. The presence of these cysts has been associated with outbreaks of gastroenteritis<sup>5,10</sup>. However, it is difficult to confirm outbreaks of this nature, because generally the parasite transmission forms are present in low numbers in food and cannot easily be detected. Therefore, outbreaks may be under-reported, which impedes health agencies in assessing the problem of food-borne diseases and planning remedial action.

The presence of a single parasite species was the most common finding, as has often been reported previously<sup>25,27</sup>. In relation to occupational categories, there was some variation in the number of species observed. Among mobile vendors, the presence of a single species was most common; and among cooks and kitchen helpers, the

presence of several species was most common. This observation may be related to the high percentage (50.0%) of cooks and kitchen helpers who perform other activities besides food handling, such as general cleaning, sales, dishwashing, or unloading products; the performance of additional activities is associated with the presence of parasites. This association is demonstrated here for the first time, and may be related to the lack of hygienic precautions in hand washing, to the use of the same smock and mask to carry out other activities and handle foods, or to ignorance of how one becomes infected by parasites or carries eggs and cysts of parasites. This observation indicates the importance of maintaining adequate hygiene when handling food and carrying out other activities, and to make the managers of these establishments aware that these duties must be carried out separately rather than at the same time.

The association of the presence of parasites with other activities, including general cleaning, could be related to how often and how these facilities were cleaned. Most establishments were cleaned at the beginning of the workday, and if the food handlers wore the same clothes (aprons, toques, masks, etc.) to handle food, improper use of these garments could be one factor that contributed to the association with the presence of intestinal parasites. SOTO *et al.*<sup>26</sup> reported that among the irregularities found in food-handling sanitation, poor personal cleanliness and the use of uniforms and inadequate clothing were common.

The association between the occurrence of enteroparasites and the male sex is intriguing, because the number of men in the study was much lower (1/3) than the number of women. This result may reflect differences in behavior between the sexes. CAPUANO *et al.*<sup>4</sup> in a study in Ribeirão Preto, São Paulo, also observed a predominance of parasites in men, although other investigators have reported the contrary<sup>1,17,20</sup>.

In our study, individuals with lower incomes and less education were also the most affected, as also observed by other authors<sup>1,4,13</sup>. These results are important for public health, because in large urban centers, persons of low socioeconomic level who live in substandard conditions are increasingly being hired as food handlers<sup>4</sup>.

This study concluded that the occurrence of enteroparasites in food handlers in the municipality of Cascavel is high, and is associated with sex, occupational category, and different kinds of food-handling activities. Therefore, we strongly suggest the need for strict training for food handlers and the owners of eating establishments, emphasizing the potential problems in combining other activities with food handling. There is also a need to enforce routine epidemiological monitoring, with periodic parasitological examinations and specific treatment. The combined implementation of these actions should result in improvements in the quality of service provided to the general public and in the reduction and prevention of food-borne diseases.

## RESUMO

### Enteroparasitoses e sua relação etnográfica com manipuladores de alimentos em rota turística e econômica do estado do Paraná, Sul do Brasil

Este estudo mostra a ocorrência de enteroparasitos e realiza um estudo etnográfico de manipuladores de alimentos do município de Cascavel/Paraná, Brasil. O material fecal de 343 manipuladores de alimentos

de ambos os gêneros e idade entre 14 e 75 anos foi analisado pelos métodos de Lutz, Ritchie modificado e Ziehl-Neelsen modificado. A relação etnográfica foi investigada utilizando questionários específicos. O material fecal foi positivo para 131 (38,2%) manipuladores. *Endolimax nana* (67,9%) foi a espécie predominante seguida por *Entamoeba coli* (35,9%), *Blastocystis hominis* (28,2%), *Entamoeba histolytica/dispar* (10,1%) e *Giardia duodenalis* (8,4%). A infecção por protozoários foi maior do que por helmintos ( $p = 0,00$ ). Foi verificada associação entre a positividade para algum parasito e o gênero masculino, a categoria ocupacional e a realização de outras atividades ( $p \leq 0,05$ ). Estes resultados permitem concluir que a ocorrência de enteroparasitos em manipuladores de alimentos é alta, indicando condições higiênicas inadequadas e que medidas educativas rígidas devem ser aplicadas, para evitar a propagação de agentes patogênicos para os alimentos pela manipulação.

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