

## ORIGINAL ARTICLE

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**DETECTION OF INTESTINAL PARASITES IN PUBLIC  
TRANSPORT BUSES IN BELÉM, PARÁ STATE,  
NORTHERN BRAZIL**

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**ABSTRACT**

The purpose of this study was to investigate the frequency of intestinal parasites in public transport buses in the city of Belém, Pará, Brazil, as well as to compare the frequency of these enteroparasites according to the bus lines, collection sites within the vehicles, and presence of pathogenic and nonpathogenic parasites in the samples. This is a cross-sectional analytical study carried out between February and April 2019, in which 320 samples were analyzed, from 5 bus lines, 8 buses each, collected from 8 different surfaces inside the vehicles, according to Graham's method. Subsequently, the statistical test was performed to evaluate the differences between the variables, considering  $p \leq 0.05$ . The results indicated that 7.8% of the samples were parasitized and the right handrail presented the highest prevalence of parasites, namely 2.2%. The pathogenic parasites corresponded to 26.7% and the non-pathogenic 73.3%. The non-pathogenic parasite most commonly found was *Entamoeba coli* totaling 50%, whereas the only pathogenic parasite was *Giardia intestinalis* in 26.7%. Thus, the presence of pathogenic and non-pathogenic parasites reflects the precarious hygiene of users of this type of transport, presenting a public health issue which needs to be addressed.

**KEY WORDS:** Intestinal diseases; fomites; transmission; pathogenic parasites; enteroparasites

**INTRODUCTION**

Intestinal parasitic diseases or enteroparasitosis are infections caused by helminths or protozoa, which colonize the digestive system of the host and trigger several pathogenic reactions (Vasconcelos et al., 2016). These diseases require control measures as they present serious public health issue, especially in developing countries, in spite of considerable progress in diagnosis and treatment in recent years (Belloto et al., 2011).

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Intestinal parasite infections are prevalent in some regions of Brazil, mainly in low-income populations, due to socioeconomic factors and facilitating conditions such as: precarious basic sanitation, climatic conditions, unhealthy housing, poor or non-existent hygiene practices, malnutrition, as well as the lack of effective public policies (Visser et al., 2011; Belo et al., 2012; Leite et al., 2014; Nunes et al., 2014).

One of the factors that contribute to increase enteroparasites is the propagation of several forms of infection. In this sense, fomites act as an important mode of transmission, since these objects may be contaminated by protozoan cysts and helminth eggs which remain viable on these surfaces for quite a while (Valadares et al., 2014; Lima et al., 2015).

Among the carriers, public transport buses are, therefore, potential transmission sources (Rodrigues et al., 2006). Several studies have been carried out in Brazil to describe the forms of parasite existence in buses. However, there are no studies in the Northern region of Brazil regarding the prevalence of microorganisms in these sites that may contribute to the implementation of prevention measures for the population (Rodrigues et al., 2006; Murta & Massara, 2009; Fernandes et al., 2012; Gomes et al., 2016).

Thus, the aim of this study was to investigate the frequency of intestinal parasites in public transport buses in the city of Belém, Brazil, as well as to compare the frequencies according to the bus lines, collection points within the buses, and pathogenic and non-pathogenic parasites in the samples.

## MATERIAL AND METHODS

### *Delimitation of the study*

The municipality of Belém is located in the northeast of the State of Pará, with approximately 1,393,399 inhabitants according to the Brazilian Institute of Geography and Statistics (IBGE, 2018). The local economy is based on commerce and services, which means a large number of people circulating around the capital city in public transport. (Pará, 2018a). According to the Secretary of Urban Mobility of Belém (SEMOB) there are approximately 1,188 buses circulating daily, with around 188 lines serving the population (Pará, 2018b).

This is a cross-sectional analytical study, in which 320 samples were analyzed, according to Vieira (2013). Therefore, slides were collected from eight buses from each of five public transports lines, in the most populous neighborhoods of the capital.

### *Sample collection*

Samples were collected in each bus, at the end of a week day, from February to April 2019, using the method described by Graham (1941), modified to an object surface (Albano et al., 2016), by positioning transparent adhesive tape (6x5cm), in duplicate, six times on each collection site in an area of ~30 cm. Eight areas in the buses were selected: seats, roulettes, entrance door, exit door, right handrail, left handrail, collector's table and digital reader. The collection on each bus took approximately 30 minutes. Thereafter, each tape was placed longitudinally on a microscope slide.

### *Procedure and analysis*

After collection, each slide was covered individually and transported under refrigeration, at a temperature of 8° C in thermal boxes to the Parasitology sector of the Laboratory of the Centro Universitário Metropolitano da Amazônia (UNIFAMAZ). For analysis, the pieces of adhesive tape were carefully unstuck, stained with Lugol solution (5%), stuck and examined with the aid of an optical microscope (Nikon Eclipse) applying a 10x and 40x objective. The positive slides were photographed and to ensure the reliability of the results, a double observation was performed.

### *Statistical analysis*

Data obtained were organized in a Microsoft Excel program. Statistical analyzes were performed using the Bioestat 5.23 software, through the chi square test and G test to evaluate the existence or not of significant differences between the frequency of enteroparasites according to the bus line, collection site, pathogenic and nonpathogenic parasites. The significance level considered was  $p \leq 0.05$ .

## RESULTS

A total of 40 buses were analyzed on five different public transports lines, with eight buses from each line and eight samples collected from each bus. The results showed that 7.8% (25/320) of the slides were parasitized. Among the bus lines, line 2 presented the highest prevalence of parasites with 2.5% (8/320). However, there was no significant difference among the analyzed lines ( $p = 0.26$ ) (Table 1).

Regarding the collection sites, the right handrail presented a predominance of parasites with 2.2% (7/320), followed by the entrance door with 1.3% (4/320) ( $p = 0.42$ ) (Table 2).

*Table 1.* Frequency of enteroparasites in public transport buses in Belém-PA, according to the bus lines analyzed.

Lines	Positive n (%)	Negative n (%)	p value
1	3 (0.9%)	61 (19.1%)	0.26
2	8 (2.5%)	56 (17.5%)	
3	6 (1.9%)	58 (18.1%)	
4	6 (1.9%)	58 (18.1%)	
5	2 (0.6%)	62 (19.4%)	
Total	25 (7.8%)	295 (92.2%)	

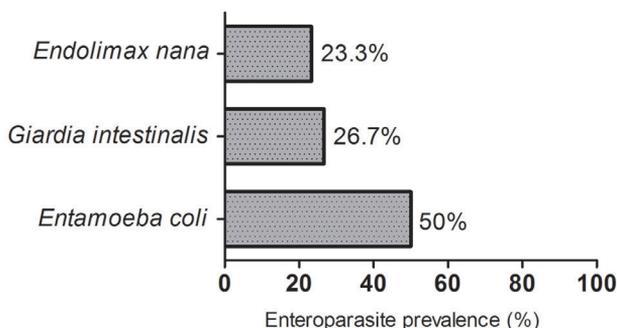
*Table 2.* Frequency of enteroparasites in public transport buses in Belém-PA, according to the collection sites.

Collection sites	Positive n (%)	Negative n (%)	p value
Entrance door	4 (1.3%)	36 (11.3%)	0.42
Exit door	3 (0.9%)	37 (11.6%)	
Left Handrail	3 (0.9%)	37 (11.6%)	
Right Handrail	7 (2.2%)	33 (10.3%)	
Roulettes	1 (0.3%)	39 (12.2%)	
Digital reader	2 (0.6%)	38 (11.9%)	
Collector's table	3 (0.9%)	37 (11.6%)	
Seat	2 (0.6%)	38 (11.9%)	
Total	25 (7.8%)	295 (92.2%)	

Regarding the presence of pathogenic and non-pathogenic parasites on the objects, 26.7% (8/30) of the positive samples presented pathogenic parasites and 73.3% (22/30) non-pathogenic parasites ( $p = 0.74$ ) (Table 3). The most common non-pathogenic parasite was *Entamoeba coli* in 50% (15/30) of the positive samples, whereas the only pathogenic parasite was *Giardia intestinalis* in 26.7% (8/30) of the cases (Figure).

*Table 3.* Prevalence of pathogenic and non-pathogenic enteroparasites in public transport buses in Belém-PA, according to the collection sites.

Collection sites	Pathogenic n (%)	Non-pathogenic n (%)	p value
Entrance door	3 (10%)	3 (10%)	0.74
Exit door	1 (3.3%)	2 (6.7%)	
Left Handrail	1 (3.3%)	2 (6.7%)	
Right Handrail	2 (6.7%)	7 (23.3%)	
Roulettes	0 (0%)	2 (6.7%)	
Digital reader	0 (0%)	2 (6.7%)	
Collector's table	1 (3.3%)	2 (6.7%)	
Seat	0 (0%)	2 (6.7%)	
Total	8 (26.7%)	22 (73.3%)	



*Figure.* Prevalence of enteroparasites by species in the positive samples of the public transport buses of Belém-PA.

## DISCUSSION

Buses are reservoirs of enteroparasites, being an important source of infection to new hosts (Rodrigues et al., 2006; Murta & Massara, 2009). Therefore, the study identified that 7.8% of the samples were parasitized and parasites were found in all bus lines and collection sites.

This was the first study carried out in the Northern region of Brazil regarding the detection of parasites in buses. To date, studies have been conducted in the South and Southeast regions and have shown different prevalence rates of enteroparasites. In this sense, Gomes et al. (2016) analyzed

300 samples on buses from Patos de Minas (MG) and detected a prevalence of 1.3%. Also in the public transport system in Belo Horizonte (MG), 17.3% (57/330) positivity for enteroparasites was noted (Murta & Massara, 2009). These data confirmed our results, considering the sample size.

In addition, Andrade et al. (2017) detected 39.8% positive slides (86/216) from two bus lines in Diamantina (MG). Similarly, Borges et al. (2009) investigated 16 buses from Uberlândia (MG) and identified 6 parasitized buses (37.5%). In contrast, a high prevalence of enteroparasites was observed in buses in Vitória (ES) with 70% (28/40) positive samples (Fernandes et al., 2012).

The present study was performed in buses that circulate in the five most populous neighborhoods of Belém, capital city of Pará. Currently, this city presents one of the ten worst sanitation indices in the country, suggesting that the results observed in the five lines may be related to inefficient basic health services in these districts since less than half the population there has access to adequate sanitation (Instituto Trata Brasil, 2018).

The absence of this service triggers the spread of parasites in Brazil. In this context, in a study with 182 children and youths in Altamira (PA), a direct relationship was observed between the parasitism index of the population and poor sanitary conditions (Baptista et al., 2013).

The same was observed by Bussato et al. (2014), when evaluating the results of parasitological examinations of the population attended at Family Health Centers (FHC) in Chapecó (SC), in which FHCs with a higher prevalence of enteroparasites presented the worst basic sanitation.

Regarding the collection sites, the highest frequency of parasites was on the right handrail in 2.2% of the samples. These results corroborate other studies, which found a higher prevalence of enteroparasites on the right handrail, namely 3.3% (11/330) (Murta & Massara, 2009) and 18.3% (39/216) (Andrade et al. 2017) of the positive samples.

These data suggest that these places present a greater area of contact with the passengers' hands, resulting in their being focal points for these microorganisms (Rodrigues et al., 2006).

Moreover, parasitism in the samples may be associated with inadequate cleaning of the buses as well as inefficient hand washing by the passengers, since the skin is an important means of contamination by pathogens (Proença et al., 2018).

In our study, *G. intestinalis* was the only pathogenic parasite found in 26.7% (8/30) of parasitized samples. This result is similar to the study by Gomes et al. (2016), in which 1.3% (4/300) of the samples were positive for *G. intestinalis*, being the only parasite identified, whereas in Diamantina, 3.6% (6/216) positive samples were found (Andrade et al., 2017).

These data differ from the study carried out in public transport in Curitiba (PR), in which only helminth eggs (*Taenia* sp and *Schistosoma mansoni*) and nematode larvae were detected (Rodrigues et al., 2006) and the study conducted in Vitória (ES), where only protozoans *E. coli*, *Entamoeba histolytica* and *Endolimax nana* were recognized (Fernandes et al., 2012).

The presence of *G. intestinalis* may be due to the prevalence of this protozoan in the population that uses public transport. Studies performed in different regions of Brazil have shown that this is one of the most prevalent pathogenic parasites (Filho et al., 2012; Benitez et al., 2016; Nunes et al. 2016; Banhos et al., 2017).

*E. coli* and *E. nana* represent the highest percentage of parasites, corroborating results found by Andrade et al. (2017) who obtained 52.1% (88/169) and 30.7% (52/169) positive samples for these parasites, respectively. As well as the study by Fernandes et al. (2012), in which 57.5% (23/40) samples were positive for *E. coli* and 10% (4/40) for *E. nana*. In contrast, Borges et al. (2009) demonstrated a low prevalence of the non-pathogenic *E. coli* and detected the presence of *Enterobius vermicularis* eggs.

Among the limitations of the study, the difficulty to obtain authorization to collect the samples inside the buses is highlighted, due to lack of information on the type of investigation and its importance, as well as the guarantee regarding data confidentiality. Another limitation refers to the method used, since no form of helminth was identified, which may be related to its sensitivity to certain evolutive forms or the prevalence of these parasites in the user population (Fernandes et al., 2012).

However, the methodology adopted was based on different studies that detected the prevalence of both protozoa and helminth in bus samples (Borges et al., 2009; Fernandes et al., 2012; Gomes et al., 2016; Andrade et al., 2017), reinforcing the importance of choosing an appropriate method to carry out this type of investigation.

The presence of pathogenic and non-pathogenic parasites in the analyzed sites, therefore, indicates the precarious hygiene of the users and of these means of transport, taking into account the environment and the socioeconomic level as factors that directly interfere in the propagation of these parasites. Therefore, preventive measures are required in order to minimize the risks of transmission and a possible public health problem.

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