HELMINTOS DE INTERESSE PARA A SAÚDE PÚBLICA NA SUPERFÍCIE EXTERNA DE DIPTERA (INSECTA) EM FEIRA DE SANTANA E SALVADOR, BA

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RESUMO

Insetos da ordem Diptera são frequentemente associados a condições de baixa qualidade sanitária, depósitos de lixo e valas de esgotamento sanitário, condições estas em que podem ter contato com estágios de parasitos de interesse em saúde, e então carrear os mesmos em sua superfície corporal, favorecendo a disseminação destes agentes. O objetivo deste estudo foi detectar a presença de helmintos e protozoários na superfície de dípteros muscoides sinantrópicos coletados em Feira de Santana e Salvador, Bahia, Brasil, e avaliar se o local de coleta e as variáveis climáticas influenciam a frequência das famílias de dípteros e a recuperação de estágios parasitários. A coleta das moscas se deu no período de maio de 2012 a agosto de 2014 numa escola pública e num campus universitário em Feira de Santana e num parque com intensa cobertura vegetal em Salvador. Nestes locais foram instaladas armadilhas num total de 15 coletas. Após 48 horas da montagem das armadilhas, o conteúdo foi levado ao laboratório para exame parasitológico. As moscas foram armazenadas individualmente em tubos de ensaio contendo 5 mL de água destilada, agitadas por dois minutos e retiradas. Os lavados das superfícies externas foram centrifugados a 1650 g por cinco minutos, eliminando-se o sobrenadante. Para o exame e identificação dos organismos, 50 µL do sedimento foi observado em microscópio óptico entre lâmina e lamínula, em duplicata. Durante o período de estudo foram capturados 778 exemplares de dípteros para análise, sendo mais frequente Muscidae (60,6%; IC95%:), Fanniidae (20,7%; IC95%:), Calliphoridae (10,3%; IC95%:) e Sarcophagidae (8,3%; IC95%:). Dos 778 lavados, 15 (1,9%; IC95%:) foram positivos ao exame parasitológico, encontrando ovos de *Ascaris* spp. (7; 26,67%), *Schistosoma* spp. (5; 20,00%), *Taenia* spp. (1; 6,67%), *Enterobius* spp. (1; 6,67%), *Strongyloides* spp. (1; 6,67%), *Trichuris* spp (1; 6,67%). e larvas de ancilostomídeos (2; 13,33%). Não houve associação entre as famílias de Diptera e o resultado do exame parasitológico, nem correlação entre temperatura, umidade e índice pluviométrico e a abundância relativa das famílias de moscas. Entretanto, 60% do resultado do exame parasitológico foi influenciado pelas variáveis climáticas, com significância para o índice pluviométrico, que variou entre 0,40 a 29,0 mm nas coletas com moscas carreando parasitos, apontando a participação deste fator na sobrevivência dos ovos de helmintos, bem como na fixação na superfície externa das moscas sinantrópicas seguida da dispersão destes

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Araújo LP, Novais MTNCS, Borges JN, Ferreira KA, Lima EVR, Correia JE, Silva AV. Helmintos de interesse para a saúde pública na superfície externa de Diptera (insecta) em Feira de Santana e Salvador, BA. Vet. e Zootec. 2025; v32: 1-12.

parasitos para outros substratos. O estudo revelou que as famílias Sarcophagidae, Fanniidae e Calliphoridae são vetores mecânicos de parasitos humanos e de outros animais nas áreas estudadas, o que revela a importância do controle destes vetores, o que minimizará os fatores de risco de infecções.

Palavras-Chave: Diptera, parasitos, vetorização, *Ascaris*, *Schistosoma*, ancilostomídeos.

HELMINTHS OF PUBLIC HEALTH INTEREST ON THE EXTERNAL SURFACE OF DIPTERA (INSECTA) IN FEIRA DE SANTANA AND SALVADOR, BA

ABSTRACT

Insects of the order Diptera are frequently associated with poor sanitary conditions, waste deposits, and sewage ditches. Under these conditions, they may come into contact with parasitic stages of health importance and subsequently carry them on their body surface, facilitating the dissemination of these agents. The objective of this study was to detect the presence of helminths and protozoa on the surface of synanthropic muscoid dipterans collected in Feira de Santana and Salvador, Bahia, Brazil, and to evaluate whether the collection site and weather variables influence the frequency of dipteran families and the recovery of parasitic stages. The flies were collected between May 2012 and August 2014 at a public school and a university campus in Feira de Santana, as well as in a park with dense vegetation in Salvador. Traps were set up at these locations for a total of 15 collections. After 48 hours of trap installation, the contents were taken to the laboratory for parasitological examination. The flies were individually stored in test tubes containing 5 mL of distilled water, agitated for two minutes, and then removed. The external surface washes were centrifuged at 1650 g for five minutes, and the supernatant was discarded. To examine and identify organisms, 50 µL of the sediment was observed under a light microscope between a slide and coverslip, in duplicate. During the study period, 778 dipteran specimens were captured and analyzed, with the most frequent families being Muscidae (60.6%; 95% CI:), Fanniidae (20.7%; 95% CI:), Calliphoridae (10.3%; 95% CI:), and Sarcophagidae (8.3%; 95% CI:). Of the 778 surface washes, 15 (1.9%; 95% CI:) tested positive in the parasitological examination, revealing the presence of *Ascaris* spp. eggs (7; 26.67%), *Schistosoma* spp. (5; 20.00%), *Taenia* spp. (1; 6.67%), *Enterobius* spp. (1; 6.67%), *Strongyloides* spp. (1; 6.67%), *Trichuris* spp. (1; 6.67%), and hookworm larvae (2; 13.33%). There was no association between the Diptera families and the parasitological examination results, nor was there any correlation between temperature, humidity, and rainfall index with the relative abundance of fly families. However, 60% of the parasitological examination results were influenced by climatic variables, with significance for the rainfall index, which ranged from 0.40 to 29.0 mm in collections where flies carried parasites. This finding highlights the role of rainfall in the survival of helminth eggs, as well as in their adhesion to the external surfaces of synanthropic flies, followed by the dispersion of these parasites to other substrates. The study revealed that the Sarcophagidae, Fanniidae, and Calliphoridae families serve as mechanical vectors of parasites affecting humans and other animals in the studied areas, emphasizing the importance of controlling these vectors to minimize infection risk factors.

Keywords: Diptera, parasites, vectorization, *Ascaris*, *Schistosoma*, hookworms.

HELMINTOS DE INTERÉS PARA LA SALUD PÚBLICA EN LA SUPERFICIE EXTERNA DE DIPTERA (INSECTA) EN FEIRA DE SANTANA Y SALVADOR, BA

RESUMEN

Los insectos del orden Diptera están frecuentemente asociados con condiciones de baja calidad sanitaria, depósitos de basura y zanjas de drenaje de aguas residuales. En estas condiciones, pueden entrar en contacto con etapas parasitarias de interés en salud y luego transportarlas en la superficie de su cuerpo, favoreciendo la dispersión de estos agentes. El objetivo de este estudio fue detectar la presencia de helmintos y protozoos en la superficie de dípteros muscoides sinantrópicos recolectados en Feira de Santana y Salvador, Bahía, Brasil, y evaluar si el sitio de recolección y las variables climáticas influyen en la frecuencia de las familias de dípteros y en la recuperación de etapas parasitarias. Las moscas fueron recolectadas entre mayo de 2012 y agosto de 2014 en una escuela pública y un campus universitario en Feira de Santana, así como en un parque con densa cobertura vegetal en Salvador. Se instalaron trampas en estos lugares para un total de 15 recolecciones. Después de 48 horas de instalación de las trampas, el contenido fue llevado al laboratorio para su examen parasitológico. Las moscas fueron almacenadas individualmente en tubos de ensayo con 5 mL de agua destilada, agitadas durante dos minutos y luego retiradas. Los lavados de la superficie externa fueron centrifugados a 1650 g durante cinco minutos, eliminándose el sobrenadante. Para el examen e identificación de los organismos, se observaron 50 µL del sedimento en un microscopio óptico entre portaobjetos y cubreobjetos, en duplicado. Durante el período de estudio, se capturaron y analizaron 778 especímenes de dípteros, siendo las familias más frecuentes Muscidae (60,6%; IC95%:), Fanniidae (20,7%; IC95%:), Calliphoridae (10,3%; IC95%:) y Sarcophagidae (8,3%; IC95%:). De los 778 lavados de superficie, 15 (1,9%; IC95%:) dieron positivo en el examen parasitológico, detectándose la presencia de huevos de *Ascaris* spp. (7; 26,67%), *Schistosoma* spp. (5; 20,00%), *Taenia* spp. (1; 6,67%), *Enterobius* spp. (1; 6,67%), *Strongyloides* spp. (1; 6,67%), *Trichuris* spp. (1; 6,67%) y larvas de ancilostomídeos (2; 13,33%). No se encontró asociación entre las familias de Diptera y los resultados del examen parasitológico, ni correlación entre la temperatura, la humedad y el índice de precipitación con la abundancia relativa de las familias de moscas. Sin embargo, el 60% de los resultados del examen parasitológico estuvieron influenciados por las variables climáticas, con significancia para el índice de precipitación, que varió entre 0,40 y 29,0 mm en las recolecciones donde las moscas transportaban parásitos. Esto indica que la precipitación juega un papel en la supervivencia de los huevos de helmintos, así como en su adhesión a la superficie externa de las moscas sinantrópicas, seguida de la dispersión de estos parásitos a otros sustratos. El estudio reveló que las familias Sarcophagidae, Fanniidae y Calliphoridae actúan como vectores mecánicos de parásitos que afectan a los humanos y otros animales en las áreas estudiadas, lo que resalta la importancia del control de estos vectores para minimizar los factores de riesgo de infecciones.

Palabras clave: Diptera, parásitos, vectorización, *Ascaris*, *Schistosoma* e anquilostomas.

INTRODUCTION

MATERIALS AND METHODS

Muscoid dipterans are insects commonly known as flies. With over 150,000 described species, belonging to approximately 10,000 genera and 188 families (1), they are known for utilizing decomposing organic matter for feeding and development of their immature stages, playing an important role as saprophagous organisms. They are of great interest not only from

an ecological standpoint but also from a medical and sanitary perspective, especially those belonging to the families Calliphoridae, Fanniidae, Muscidae, and Sarcophagidae.

Gastrointestinal parasitic infections, particularly those caused by soil-transmitted helminths (geohelminths), remain a major public health concern worldwide, affecting both human and animal populations. These parasites are often transmitted through contaminated soil, water, food, or vectors that facilitate their dispersion. In this context, synanthropic dipterans play a crucial role as potential mechanical vectors, as their frequent contact with decomposing organic matter and human dwellings increases the likelihood of carrying infectious stages of parasites, including protozoan cysts and helminth eggs.

Flies can mechanically transport a large number of pathogenic organisms, including enteroviruses, enterobacteria, protozoan cysts, and helminth eggs. According to Guerra et al. (2), they also provide favorable conditions for the proliferation of these pathogens. Their occurrence, distribution, and predominance in metropolitan areas are important factors in public health (3; 4; 5).

Among the most concerning helminths associated with dipteran transmission are *Ascaris* spp., *Trichuris* spp., and hookworms (*Ancylostoma* spp. and *Necator* spp.), which have direct life cycles involving environmental contamination with eggs or larvae. In the case of *Ascaris* spp., for example, eggs shed in feces require a period of embryonation in the environment before becoming infective. Synanthropic flies may come into contact with contaminated substrates, adhering these infective stages to their external surface, subsequently dispersing them to food, water sources, or human dwellings. Similarly, hookworm larvae can persist in humid environments and may be mechanically transported by flies to areas where human or animal hosts are present. These transmission dynamics underscore the importance of controlling synanthropic dipterans to mitigate the risk of parasitic infections.

One reason why Diptera insects are potential mechanical vectors of pathogens lies in their close contact with humans and their environment. These habits, along with endophilic behavior and great dispersal ability, confer such potential to these organisms. Flies are incriminated as vectors mainly through the isolation of pathogens and the relationship between seasonal peaks in fly abundance and the prevalence of certain diseases (6).

The frequency with which flies are found in almost all human-occupied environments determines their degree of synanthropy. The higher the synanthropic index, the more aggravated the health conditions of that location, potentially enhancing the dissemination of pathogenic and parasitic agents (2). Many factors contribute to the maintenance and population growth of synanthropic flies, including climatic conditions (high temperature and humidity), poor sanitation, improper waste disposal, lack of public awareness, and difficulties in insect control exacerbated by indiscriminate use of insecticides.

The objective of this study was to detect the presence of helminths and protozoa on the surface of synanthropic muscoid dipterans collected in Feira de Santana and Salvador, Bahia, Brazil, and to evaluate whether the collection site and weather variables influence the frequency of dipteran families and the recovery of parasitic stages. By investigating the role of synanthropic flies as potential vectors of helminth eggs and larvae, this study contributes to a better understanding of their impact on the epidemiology of gastrointestinal parasitic infections and highlights the need for integrated control measures to mitigate transmission risks.

Characterization of Collection Sites and Traps

The study was conducted at three distinct collection points: a state school (FS01) and a university campus in Feira de Santana – Bahia (FS02), and a green area (SSA) in Salvador – Bahia. The first sampled area in Feira de Santana (FS01), located in a lower-class peripheral neighborhood of the city, featured an unprotected sports court with low vegetation in its surroundings. The second area (FS02) had a large amount of vegetation and a waste deposit nearby, where traps were placed. In Salvador, the selected collection point (SSA) had a total area of 700,000 m^2 with approximately 250,000 m^2 of green area, due to the incorporation of a secondary remnant of Atlantic Forest. Besides the vast green area, this point had a rich fauna, making it a place visited daily by families and/or school groups (Figure 1).

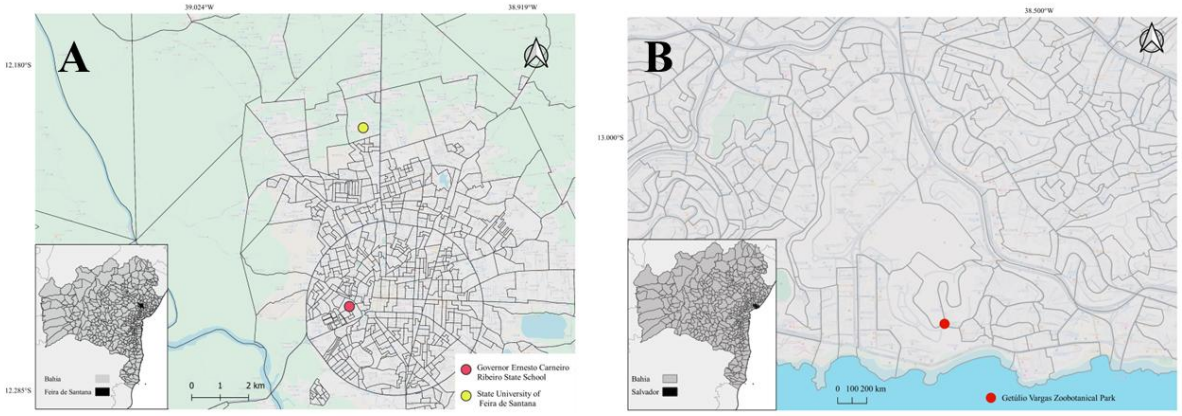

Figure 1. Study areas in Bahia, Brazil. The maps show the three collection points: A) FS01 (red dot) and FS02 (yellow dot) in Feira de Santana, and B) SSA (red dot) in Salvador.

Dipterans were collected using traps made from disposable 2.0 L plastic bottles according to Otsuka (7), deployed in sampling units. Decaying fish (sardine) portions wrapped in gauze were used as baits.

In FS01, eight collections were made between May 2012 and May 2013, with two traps per collection placed in an open space between the sports court and the school's surrounding residences, except during school holidays and teachers' strikes. In FS02, two biweekly collections were made in November 2014, with two traps placed in an open space free of buildings but near the campus garbage dump.

In SSA, eight collections were made between January and August 2014, with eight traps set up at designated points SSA01 to SSA08 each month.

After exposure for 24 to 48 hours, the traps were collected and transported to the laboratory of the Research Group on Zoonoses and Public Health (GPZSP) at the State University of Feira de Santana (UEFS). Biological material collection was authorized by SISBio/ICMBio (Registration 34951-1).

Parasitological Examination and Diptera Family Identification

In the laboratory, the collected flies were killed with ethyl ether and stored individually in test tubes containing 5 mL of sterile distilled water (8). The flies suspended in water were manually shaken for two minutes to detach any parasitic stages from the body surface. The flies were then removed from the test tubes, which were centrifuged at 1650g for five minutes. The supernatant was discarded, and the sediment was resuspended in 150 µL of 5% buffered

formalin. This final suspension was examined under bright field microscopy with 10x, 40x, and 100x objectives to identify parasitic stages. The flies were stored in plastic microtubes in 70% ethanol for further family identification.

Flies stored in microtubes were screened and identified up to the family level using a stereoscopic loupe in the laboratory of the Research Group on Zoonoses and Public Health at UEFS. Specimen identification was based on adult morphological characters according to Monteiro (9).

Data Analysis

Absolute and relative frequencies of collected Diptera families were calculated, regardless of collection points or collections, as well as 95% confidence intervals for relative frequency. These statistics were also calculated for the occurrence of helminths, regardless of families, points, or collections, and also according to families, points, and collections. The influence of humidity, temperature, and rainfall index on the frequency of Diptera families and on the occurrence of helminths was assessed using multiple linear regression analysis. Weather data (temperature, humidity, and rainfall) during collection periods were obtained from the Instituto Nacional de Meteorologia (INMET) website of the Ministry of Agriculture, Livestock, and Supply. Analyses were performed using EpiInfo 7 software (10), considering a significance level of 5%.

RESULTS AND DISCUSSION

Table 1. Absolute frequency (Fi), relative frequency (fi), and 95% confidence interval (CI95%) of parasitological results from examination of surface washes of Diptera exterior surfaces, by collected family of Diptera. Feira de Santana, 2015.

Diptera family	**Negative**		**Positive**				**Total**			
	Fi	**fi**	**Fi**	**fi**	**CI95%**		**Fi**	**fi**	**CI95%**	
Calliphoridae	80	100.0	0	0.0	0.0	4.4	80	10.3	8.3	12.7
Sarcophagidae	62	95.4	3	4.6	1.8	12.7	65	8.4	6.6	10.6
Fannidae	158	98.1	3	1.9	0.7	5.3	161	20.7	17.9	23.8
Muscidae	463	98.1	9	1.9	1.0	3.6	472	60.7	57.1	64.1
TOTAL	**763**	**98.07**	**15**	**1.92**	**1.2**	**3.2**	**778**	**100.0**	**-**	**-**

Table 2. Absolute frequency (Fi), relative frequency (fi), and 95% confidence interval (CI95%) of parasitological results from examination of surface washes of Diptera exterior surfaces, by genus or family. Feira de Santana, 2015.

Parasite genus or family	Fi	fi (%)	CI95%	
Enterobius spp.	1	6.67	0.17	31.95
Strongyloides spp.	1	6.67	0.17	31.95
Taenia spp.	1	6.67	0.17	31.95
Trichuris spp.	1	6.67	0.17	31.95
Ancilostomidae	2	13.33	1.66	40.46
Schistosoma spp.	5	20.00	4.33	48.09
Ascaris spp.	7	26.67	7.79	55.10
TOTAL	**15**	**100.00%**	-	-

It was found that the Muscidae family was the most abundant, accounting for 60.67% of the total collected, which aligns with studies by Zhao et al. (11) in Zhengshou City, China, where they collected 800 flies, 90% of which were muscids, and by Martinez, Aluja, and Gemmell (12) in Tianquizolco, Mexico, where 1,187 flies collected were 98.9% Muscidae. On the other hand, Oliveira, Mello, and D'Almeida (8) captured 41,080 calyptrate flies, with the Calliphoridae being the most abundant at 83.44%, followed by Muscidae at 13.48%, and Fanniidae at 3.07%. Similarly, Monteiro, Silva, and Bravo (13), in collections made in Feira de Santana city, out of a total of 4,818 flies, 2,458 were taxonomically identified as belonging to the Fanniidae family. It was evidenced that 30.80% (95% CI: 16.5-50.2) of the positive samples were obtained from the washes of dipterans collected at the collection point SSA08, followed by SSA07 (5.9%; 95% CI: 1.4-27.3), FS02 (5.7%; 95% CI: 2.0-15.4), SSA06 (4.8%; 95% CI: 1.1-22.8), and FS01 (0.6%; 95% CI: 0.2-2.0), as see in Table 3. Dipteran washes from locations SSA01 to SSA05 were negative for parasitological examination. Collection point SSA08 was characterized as a public space with extensive human traffic during the day, presenting vegetation on its edge, benches for visitor rest, public restrooms, selective waste bins, and street food vending. According to Mello, Queiroz, and Aguiar-Coelho (14), anthropogenic interference in fly population fluctuations was considered due to the presence of houses, farms, and bars in the surrounding areas. This fact favors the accumulation of waste containing discarded food, making the environment suitable for the colonization of species with clearly urban habits, with possible risks of environmental contamination and pathogen transmission (15). Ribeiro et al. (16), when analyzing a subarea very similar to point SSA08, found that the presence of the highest number of identified intestinal parasites and the high quantity of captured dipterans is related to the daily routines of residents living amidst solid waste containers without lids, washing water for dishes near the home, storage of solid waste in backyards and peridomicile, in addition to hygienic practices and low socioeconomic level.

In this study, the families Sarcophagidae, Muscidae, and Fanniidae (Table 1) showed positivity for parasites adhered to the body surface, but Calliphoridae was negative for parasitological analysis. Thyssen et al. (6) did not find parasitic forms on the external surface of the collected dipterans, although several studies report the presence of a variety of pathogens, including parasites such as helminths, associated with various fly species. During the collections, atmospheric weather data from the studied areas were obtained. In Feira de Santana city, the temperature ranged from 20°C to 34°C, humidity from 65 to 86%, and rainfall index from 0 to 4.6 mm. In Salvador city, the temperature ranged from 21°C to 29°C, humidity from 68.75 to 95.25%, and rainfall index from 0 to 29 mm. It can be observed that one of the

collections made in Salvador-BA had the highest percentage of parasites present in fly washes, with 16.67% positivity. The air humidity during this collection was high, 95.25%, while the average temperature of the day was 25°C. It is necessary to emphasize that temperature is one of the main abiotic factors influencing the reproduction and survival of flies, as eggs, larvae, and adults have their development influenced by the air temperature, while pupae are influenced by the soil temperature. This abiotic factor regulates the insect's temperature, as it does not have a thermoregulation system. In tropical areas, air humidity is widely influenced by rainfall (17). Similarly, Batista-da-Silva, Moya-Borja, and Queiroz (18) make it clear that, by presenting relative adaptation to thermal variations (21°C to 38°C) and the ability to remain active in humidities ranging from 47% to 87%, flies reveal their medical-veterinary, ecological, and forensic importance, since these abiotic factors are optimal for the development of pathogenic microorganisms, as well as decomposers.

Table 3. Absolute frequency (Fi) and relative frequency (fi), coordinates and 95% confidence interval (CI95%) of collected Diptera, according to the collection site. Feira de Santana, 2015.

Collection site	Latitude	Longitude	Fi	fi	CI95%	
F01-01	-12.25127	-38.97625	32	4,11%	2,87%	5,82%
F01-02	-12.25127	-38.97625	236	30,33%	27,14%	33,72%
F01-03	-12.25127	-38.97625	36	4,63%	3,31%	6,41%
F01-04	-12.25127	-38.97625	24	3,08%	2,03%	4,62%
F01-05	-12.25127	-38.97625	31	3,98%	2,77%	5,67%
F01-06	-12.19800	-38.96816	33	4,11%	2,87%	5,82%
F01-07	-12.19800	-38.96816	21	2,70%	1,72%	4,17%
F2-01	-12.19800	-38.96816	176	22,62%	19,76%	25,76%
F2-02	-12.19800	-38.96816	119	15,30%	12,88%	18,06%
F2-03	-12.19800	-38.96816	5	0,64%	0,24%	1,58%
F2-04	-12.19800	-38.96816	7	0,90%	0,39%	1,93%
F2-05	-12.19800	-38.96816	12	1,54%	0,84%	2,76%
F2-06	-12.19800	-38.96816	12	1,54%	0,84%	2,76%
F2-07	-12.19800	-38.96816	12	1,54%	0,84%	2,76%
F2-08	-12.19800	-38.96816	23	2,95%	1,93%	4,47%
TOTAL			**778**	**100,00%**	-	-

In the SSA location, the average temperatures remained between 21.0°C and 29.0°C, and the rainfall indices ranged from zero to 29 mm. According to Bélo, Alves, and Pires (19), flies are very sensitive organisms to environmental variations but are also opportunistic organisms; that is, due to the environmental conditions of a specific location, a species can become extremely common in a short period of time. A significant number of collections were unproductive due to traps damaged by wildlife, with this occurrence more frequent in SSA. At this point, the traps were frequently invaded by ants (Hymenoptera: Vespidae and Formicidae), which hindered the identification of families, a fact also reported by Furusawa and Cassino (20). Similarly, some traps were destroyed by opossums (Didelphimorphia: Didelphidae) attracted by the baits. In the FS collection point, problems related to human actions were more evident than in SSA. In FS01, local residents, feeling disturbed by the attractiveness of flies to trap baits, produced smoke nearby to scare away the flies. In FS02, however, some traps were removed and destroyed by campus third-party workers, despite prior authorization from the campus administration, as well as the identification of research work and warning notices

attached to the traps. Furthermore, in the last collections, the entire university campus was subjected to the action of "fogging," an automatic system for controlling urban vectors and pests, hindering the collection of a greater number of specimens.

Although, in this study, no correlation was found between temperature, humidity, and rainfall index and the relative abundance of Diptera (r^2=0.3193; P-value=0.0881) or Diptera families, Rosenthal (21) states that the survival, longevity, and reproductive aspects of dipterans are related to biotic and abiotic factors and their interaction. Temperature, for example, directly influences the speed and rates of development, behavior, feeding, fecundity, dispersion, reproductive potential, and the number of individuals in a population. When evaluating the correlation between environmental variables and the relative frequency of dipteran washes positive for parasitological examination, we found a positive correlation (r=0.7670; P-value=0.0036), which accounted for 59% of the result found. Of the three factors examined, significance was associated with the rainfall index (r=0.3837; P-value=0.0290).

According to Matesco et al. (22), few authors have assessed seasonal variation in the frequency of parasite eggs. In temperate climate regions, the effect of seasonality on transmission rates is related to variations in temperature and humidity. In tropical regions, however, temperature and humidity do not seem sufficient to determine a significant decrease in the transmission rate of most enteroparasites. Increased precipitation may be associated with greater dispersion of parasites on the soil or water surface (23), and in this case favors the contact of flies with parasites, increasing the chance of contamination of the external surface of dipterans. In addition, high rainfall prevents the desiccation of eggs and larvae (24), increasing survival and the possibility of contact and fixation in vectors.

The detection of helminths on the external surface of synanthropic dipterans reinforces the importance of these insects as mechanical vectors of parasitic agents of public health concern. The presence of eggs from *Ascaris* spp., *Schistosoma* spp., *Taenia* spp., *Enterobius* spp., *Strongyloides* spp., *Trichuris* spp., and hookworm larvae suggests significant potential for the dispersal of these parasites in urban and peri-urban environments. These findings corroborate previous studies indicating that insects of the order Diptera play a role in the dissemination of pathogens by mechanically carrying them from contaminated substrates to food, surfaces, and water sources (8, 16).

In particular, the detection of *Schistosoma* spp. eggs in 20% of the positive samples is an epidemiologically relevant finding. Schistosomiasis is a waterborne parasitic disease in which human infection occurs through the active penetration of cercariae into the skin upon contact with contaminated water. The presence of these parasite eggs on the surface of dipterans suggests significant environmental contamination, possibly associated with inadequate sanitation and water sources with a high parasitic load. Although *Schistosoma* eggs excreted in feces are not infective to the human host, their identification on mechanical vectors may indicate areas of high endemicity and suggest a sustained transmission cycle in the environment (24).

Another relevant aspect was the identification of *Ascaris* spp. eggs in 26.67% of the positive samples, making this the most frequently detected species. *Ascaris* eggs are highly resistant to environmental conditions and can remain viable in the soil for long periods. Their presence on the surface of flies suggests that these insects may contribute to the dispersal of these parasites from areas with inadequate sanitation and poor hygiene practices. This finding reinforces the importance of flies in the transmission of soil-transmitted helminthiases and highlights the need for integrated control measures to minimize the risk of human infection.

Hookworm larvae were also found in 13.33% of the positive samples. Unlike eggs, the infective larvae of *Ancylostoma* and *Necator* require a humid environment for their development and can actively penetrate the host's skin. The presence of these larvae on the surface of dipterans suggests a possible role of these insects in the dispersal of these parasitic

stages to locations where direct contact with humans or animals occurs, increasing the risk of infection exposure.

Although no statistical association was observed between Diptera families and parasitological findings, the presence of parasites on the external surfaces of flies indicates that these insects play a relevant role in the passive dissemination of infectious agents. This underscores the need for effective strategies to control the population of these vectors in urban areas, especially those with deficient sanitation infrastructure. Measures such as improved solid waste management, proper sanitation, and educational campaigns on hygiene can significantly reduce human exposure to these parasites.

The findings of this study highlight the importance of continuous epidemiological surveillance of mechanical vector insects, as well as the integrated control of these organisms to minimize the transmission of enteroparasitoses. Furthermore, the detection of Schistosoma spp. in synanthropic insects suggests that further investigations should be conducted to assess the magnitude of this finding and its possible relationship with areas of active schistosomiasis transmission.

The frequent evaluation of the population density and variety of Diptera, as well as their association with parasites of interest in Public Health, is important due to the role of flies as mechanical and biological vectors, and the importance of associated parasites for Human and Animal Health, enabling the planning and implementation of control strategies.

CONCLUSION

In this study, we demonstrated the role of muscoid dipterans from the families Sarcophagidae, Muscidae, and Fanniidae as vectors of helminths. There was no correlation between atmospheric parameters and the abundance of Diptera found in this study, but a positive correlation was found between the frequency of helminths and rainfall, indicating the responsibility of this factor in the survival of helminth eggs, as well as their fixation on the external surface of synanthropic flies followed by the dispersion of these parasites to other substrates.

ACKNOWLEDGMENTS

The authors thank the Bahia State Research Support Foundation (FAPESB) for funding the research project and study grants under the POP Ciências Call; FAPESB and the National Council for Scientific and Technological Development (CNPq) for the Scientific Initiation scholarships associated with PIBIC-UEFS; CNPq for the Productivity in Research scholarship awarded to Aristeu Vieira da Silva; biologist Thaiana Monteiro for assistance during the collections.

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Recebido em: 10/06/2024
Aceito em: 07/04/2025