

Evaluation of parasitological contamination in coastal sands of São Luís (MA)

Avaliação da contaminação parasitológica nas areias costeiras de São Luís (MA)

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Abstract

Beach sand is widely used for leisure; however, it may pose a public health risk due to the possible presence of parasites of medical and veterinary importance. This study aimed to investigate the occurrence of parasites in the sand of beaches located in the municipality of São Luís, Maranhão, contributing to the understanding of environmental contamination and the associated health risks. Samples were collected at six different points (P1 to P6) along the coastline, analyzed at the Environmental Laboratory (LACAM) of Ceuma University, using the Hoffman technique (spontaneous sedimentation) and microscopy with 40x and 100x objectives using immersion oil. The results showed the presence of parasitic forms compatible with *Ancylostoma* spp., *Strongyloides* spp., and *Toxocara* spp. at all points, with varying intensity: high contamination at P1, P2, and P5; moderate at P3; and low at P4 and P6. It is concluded that sand can act as a reservoir for these agents, making parasitological monitoring essential for the prevention of zoonoses and the promotion of public health.

Keywords: Beach sand; Public health; *Ancylostoma* spp.; *Strongyloides* spp.; *Toxocara* spp.

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Resumo

A areia das praias é amplamente utilizada para lazer, porém pode representar risco à saúde pública devido à possível presença de parasitas de importância médica e veterinária. Este estudo teve como objetivo investigar a ocorrência de parasitas na areia de praias localizadas no município de São Luís – MA, contribuindo para o conhecimento sobre a contaminação ambiental e os riscos sanitários associados. Foram coletadas amostras em seis pontos distintos (P1 a P6) da orla, analisadas no laboratório de meio ambiente LACAM da Universidade Ceuma, utilizando a técnica de Hoffman (sedimentação espontânea) e microscopia nas objetivas 40x e 100x com óleo de imersão. Os resultados evidenciaram a presença de formas parasitárias compatíveis com *Ancylostoma* spp., *Strongyloides* spp. E *Toxocara* spp. em todos os pontos, com variação na intensidade: alta contaminação em P1, P2 e P5; moderada em P3; e baixa em P4 e P6. Conclui-se que a areia pode atuar como reservatório desses agentes, sendo o monitoramento parasitológico fundamental para a prevenção de zoonoses e para a promoção da saúde pública.

Palavras-chave: Areia de praia; Saúde pública; *Ancylostoma* spp.; *Strongyloides* spp.; *Toxocara* spp.

INTRODUCTION

The sandy stretches of urban beaches, although widely recognized as spaces for leisure, tourism, and income generation, are still poorly considered in environmental surveillance policies compared to bathing water. The assessment of beach water quality, generally focused on bacteriological indicators, tends to overlook other biological hazards present in the coastal environment, among them parasites of zoonotic importance. This discrepancy between the intensive use of beaches and the limited monitoring of their abiotic components favors the maintenance of silent risks to collective health, especially in densely populated coastal cities.

In the context of parasitic zoonoses, soils and sands function as important reservoirs of infective forms of helminths, capable of persisting in the environment for weeks or months, depending on factors such as humidity, temperature, and solar exposure¹. Studies conducted in squares, parks, sandboxes, and beaches in different regions of Brazil document the recurring presence of parasite eggs, cysts, and larvae in public use areas, with emphasis on *Ancylostoma* spp. And *Toxocara* spp.²⁻⁴.

The city of São Luís, the capital of the state of Maranhão, is located in an important sector of the Brazilian Amazon coast, characterized by a large tidal range, the presence of extensive mangrove ecosystems, and intense urban occupation along its beaches. In these areas, the coexistence of a high flow of bathers, informal commercial activities, and the circulation of companion animals creates a scenario conducive to the contamination of sands by parasites with zoonotic potential. Nevertheless, the available information on the parasitological quality of the coastal sands in the region is still scarce, which limits the understanding of the real risk of exposure for the user population and hinders the planning of integrated environmental and health surveillance actions⁵.

Given this scenario, this study aimed to evaluate the parasitological contamination in sands of urban coastal beaches in São Luís (MA), focusing on the detection of the presence or absence of parasitic structures in samples collected along the sandy strip.

METHODOLOGY

The study area comprised different sampling points distributed along the urban beaches of the metropolitan region of São Luís (MA), in locations characterized by vulnerability to marine intrusion of the local coastal aquifer. The spatial representation of the area and the precise location of the collection points were developed using geoprocessing techniques with QGIS 3.28 software. Basemap cartography was complemented with the demarcation and georeferencing of the six sampling points, which were later validated in the field with the aid of a GPS (Global Positioning System, Garmin Striker® 4 model).

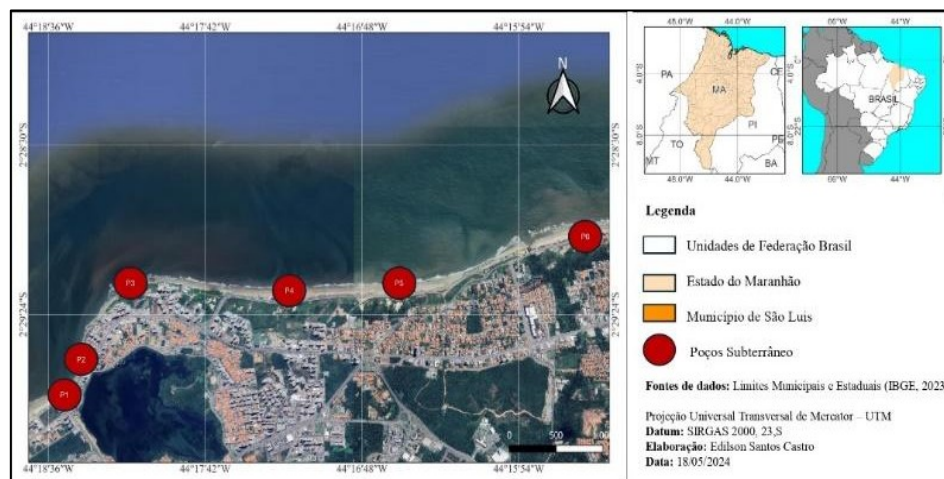


Figure 1. Urban coastal strip of the central beaches of São Luís (MA).
Source: Authors, (2025).

Sand collection was carried out in April 2025, during the characteristic rainy season of the region. Points were selected based on the intensity of bather flow and the degree of anthropic activity. Six sampling points were established: points P1 and P2 are located at Ponta d'Areia Beach; points P3 and P4 are situated in the region comprising São Marcos Beach and the Litorânea area; point P5 is located at Calhau Beach; and point P6 corresponds to Caolho Beach. At each point, a 1 m² area was delimited, from which approximately 200 g of surface sand were collected using sterile plastic spatulas. The samples were placed in identified plastic bags, kept refrigerated at 4°C in thermal boxes, and transported to the Environmental Analysis Laboratory (LACAM) at CEUMA University, where they were processed within 24 hours.

Parasitological identification was performed using the Hoffman spontaneous sedimentation technique, with microscopic examination under 40× objectives and, when necessary, 100× objectives with immersion oil, allowing the detection and morphological identification of eggs, cysts, and larvae of parasites with zoonotic potential. Based on the results obtained, parasitological contamination at each sampling point was categorized semi-quantitatively as low, moderate, or high according to the proportion of positive samples and the frequency of parasite structures observed

in the microscopic fields. A sample was considered positive when at least one egg, larva, or cyst of a zoonotic parasite was identified in the prepared slides. For each beach point, “high” contamination was assigned when 100% of the examined samples presented parasite structures, with constant and abundant observation in multiple microscopic fields; “moderate” contamination was used when between 50% and 99% of the samples were positive, with frequent but not constant detection; and “low” contamination was defined when fewer than 50% of the samples were positive, with sporadic or absent findings in most preparations. This type of semi-quantitative approach to classify environmental contamination has been widely applied in studies on enteroparasites in beach sand and other public recreational areas².

RESULTS AND DISCUSSION

The parasitological analysis of the sands of urban beaches in São Luís revealed contamination by *Ancylostoma* spp., *Strongyloides* spp., and *Toxocara* spp. in all evaluated sections, with spatial variation in the intensity of occurrence among sampling points. At points P1, P2, and P5, incidence classified as high was observed for all three genera, whereas P3 showed moderate incidence, and P4 and P6 showed low incidence or sporadic absence of parasitic structures, indicating a risk gradient along the studied coastal strip. The collection carried out in April 2025, during the rainy season, is compatible with conditions of greater humidity and lower direct radiation on the sandy substrate, factors recognized as favorable for maintaining the viability of geohelminth eggs and larvae in tropical coastal environments¹.

Table 1 summarizes the main clinical characteristics associated with the parasites identified in the sand, showing that, although they do not always result in fatal conditions, all have the potential to cause significant disease in humans, especially in vulnerable groups⁶. *Ancylostoma* spp. is classically associated with cutaneous larva migrans, with intensely pruritic lesions and the possibility of anemia in repeated or intense infections; *Strongyloides* spp. causes chronic infections and, in immunocompromised individuals, can progress to hyperinfection syndrome and disseminated forms with high mortality, often exceeding 60% in severe cases not diagnosed early. *Toxocara* spp. is related to visceral, ocular, and neurological forms of toxocariasis, with the potential for permanent hepatic, pulmonary, and ocular lesions, although overall lethality is relatively low when there is access to diagnosis and treatment⁷.

Table 1. Clinical characteristics of parasites detected in sand samples.

Parasites	Diseases	Clinical Description	Authors
<i>Ancylostoma spp.</i>	Cutaneous Larva Migrans	Pruritic lesions; anemia in intense infections	Silva et al ² , Ramos et al ⁸
<i>Strongyloides spp.</i>	Strongyloidiasis	Chronic infection; severe forms in immunocompromised individuals	Corti ⁹
<i>Toxocara spp.</i>	Toxocariasis	Hepatic, pulmonary, ocular, and neurological lesions	Santarém et al ¹⁰

Source: Adapted from Silva et al², Ramos et al⁸, Corti⁹, Santarém et al¹⁰.

The spatial distribution of contamination, summarized in Table 2, reveals that the beaches of Ponta d'Areia (P1 and P2) and Calhau (P5) concentrated the highest intensity of simultaneous occurrence of *Ancylostoma spp.*, *Strongyloides spp.*, and *Toxocara spp.*, all classified as having high incidence. In contrast, the São Marcos/Litorânea stretch showed a heterogeneous pattern, with moderate incidence at P3 and low at P4, suggesting local differences in the use and management of the sandy strip, while Praia do Caolho (P6) showed low incidence for all parasites, indicating lower contamination pressure in the evaluated period. These results indicate that, even within the same urban coastal sector, micro-scenarios of distinct risk can coexist, compatible with variations in recreational use density, the presence of companion animals, and stormwater drainage conditions identified as determinants in other studies of beach contamination in Brazil¹¹.

Table 2. Parasitological incidence by sampling point on urban beaches of São Luís (MA), April/2025.

Points	Beaches	<i>Ancylostoma</i>	<i>Strongyloides</i>	<i>Toxocara</i>	Classification
P1	Ponta d'Areia	High	High	High	High
P2	Ponta d'Areia	High	High	High	High
P3	São Marcos/Litorânea	Moderate	Moderate	Moderate	Moderate
P4	São Marcos/Litorânea	Low	Low	Low	Low
P5	Calhau	High	High	High	High
P6	Caolho	Low	Low	Low	Low

Source: Uk Data Service¹².

When compared with the literature, the findings of this study align with reports of high positivity for *Toxocara spp.* eggs and *Ancylostoma spp.* larvae in sands of beaches and other public urban spaces in Brazil and other countries, frequently associated with unrestricted access of dogs and cats to leisure areas and the absence of effective waste removal policies⁴. Studies conducted on beaches in Pernambuco, São Paulo, Salvador (BA), and other Brazilian coastal regions have documented significant percentages of sand contamination by zoonotic geo-helminths, notably *Ancylostoma spp.* And *Toxocara spp.*, corroborating the role of these environments as important reservoirs of infective stages. Additionally, environmental surveys in squares, parks, and school sandboxes demonstrate that contamination by these same parasites is frequent in children's play

areas, reinforcing the concept that urban soils and sands constitute a central link in the transmission chain of these zoonoses³.

From an epidemiological point of view, the simultaneous presence of *Ancylostoma* spp., *Strongyloides* spp., and *Toxocara* spp. on beaches densely used for leisure suggests a scenario of cumulative risk, where different exposure pathways can act concurrently¹³. Infection by *Ancylostoma* spp. And *Strongyloides* spp. occurs mainly through transcutaneous penetration of larvae present in moist sand, facilitated by direct contact of bare or exposed skin, while *Toxocara* spp. are typically acquired by accidental ingestion of embryonated eggs adhering to contaminated hands, food, or objects, which makes children, informal sand workers (vendors, attendants), and immunocompromised individuals particularly vulnerable groups. In immunocompromised individuals, especially, the detection of *Strongyloides* spp. in the environment assumes additional relevance, since hyperinfection and disseminated forms present high mortality, often exceeding 60–70%, when there is no timely diagnosis and treatment, which justifies the inclusion of this group in screening and chemoprophylaxis strategies in contexts of high environmental exposure¹⁴.

CONCLUSION

The analysis of sand samples from the urban beaches of São Luís, MA, confirmed the widespread presence of parasites with zoonotic potential, specifically *Ancylostoma* spp., *Strongyloides* spp., and *Toxocara* spp., at all points investigated. The results demonstrate that the sandy environment acts as a significant reservoir for these infectious agents, constituting a tangible public health risk, particularly in areas of high recreational use. The spatial variation in contamination intensity classified as high at Ponta d'Areia and Calhau beaches, moderate at one point in the São Marcos/Litorânea area, and low at others reflects the influence of local factors such as anthropogenic activity, domestic animal circulation, and specific environmental conditions.

This finding underscores the urgent need to integrate parasitological monitoring of beach sand into the city's environmental surveillance policies, going beyond the traditional assessment of water quality. The collection during the rainy season, a condition that favors the viability of parasites, highlights the importance of considering seasonality in risk assessment and monitoring planning. Exposure of the population, especially children, informal workers, and immunocompromised individuals, to these agents can lead to diseases such as Cutaneous Larva Migrans, Strongyloidiasis, and Toxocariasis, whose severe forms carry significant morbidity.

Therefore, it is concluded that the sanitary management of beaches must adopt an integrated approach, combining regular environmental monitoring, control of domestic animal populations, health education for beachgoers, and adequate signage. Implementing these measures is crucial to

transforming these leisure spaces into safer environments and preventing the transmission of zoonoses. Future studies to assess the temporal dynamics of contamination and to expand the sampling area are essential to underpin effective public health promotion strategies on the Maranhão coast.

REFERENCES

1. Ramos ELP, Hernandez CG, Queiroz LG, Moura RGF, Nogueira NP, Ferreira GLS, et al. Parasite detection in sand from bays on the north coast of São Paulo state, Brazil. *J Trop Pathol*, 2020;49(3):191-205. doi: <https://doi.org/10.5216/rpt.v49i3.63783>.
2. Silva PF, Cavalcanti IMD, Irmão JI, Rocha FJS. Common beach sand contamination due to enteroparasites on the southern coast of Pernambuco State, Brazil. *Rev Inst Med trop*, 2009;51(4):217-8. doi: <https://doi.org/10.1590/S0036-46652009000400007>.
3. Nunes CM, Pena FC, Negrelli GB, Anjo CSG, Nakano MM, Stobbe NS. Presence of larva migrans in sand boxes of public elementary schools, Brazil. *Rev Saúde Pública*, 2000;24(6):656-8. doi: <https://doi.org/10.1590/S0034-89102000000600015>.
4. Nunes PHV, Gomes CCM, Arruda ENT. **Monitoring of parasitic contamination in beach sand and public squares in Northeast Brazil: a comparative approach.** *Int J Public Health*, 2021;5:59. doi: <https://doi.org/10.28933/irjph-2021-05-2805>.
5. Hayashi SN, Souza PWM Filho, Nascimento WR Júnior, Fernandes MEB. Status of mangroves land use on the Brazilian Amazon coast from RapidEye imagery and GEOBIA approach. *An Acad Bras Ciênc*, 2023;95(2):1-18. doi: <https://doi.org/10.1590/0001-3765202320210468>.
6. Oliveira CBS, Cardoso ACA, Almeida LBGM, Fernandes LP, Sousa AGBB. Soil contamination in urban squares and beaches by larvae of *Strongyloides* spp. and Hookworm in a tourist town in northeastern Brazil. *South Am J Basic Educ Tech Technol*, 2021;6(2):229-36. <https://periodicos.ufac.br/index.php/SAJEBTT/article/view/2668>.
7. Delai RR, Freitas AR, Kmetiuk LB, Meriguetti YFFB, Ferreira IB, Lescano SAZ, et al. One Health approach on human seroprevalence of anti-Toxocara antibodies, Toxocara spp. eggs in dogs and sand samples between seashore mainland and island areas of southern Brazil. *One Health*, 2021;13:1-7. doi: <https://doi.org/10.1016/j.onehlt.2021.100353>.
8. Ramos ICN, Lima TAR, Ramos NRA, Carvalho GA, Alves LC. **Contamination by nematode eggs of public health importance on tropical beaches.** *Parasitology*, 2022;2(2):95-100. doi: <https://doi.org/10.3390/parasitologia2020010>.
9. Corti M. *Strongyloides stercoralis* in Immunosuppressed Patients. *Arch Clin Infect Dis*, 2016;11(1):e27510. doi: <https://doi.org/10.5812/archcid.27510>.
10. Santarém VA, Ferreira IB, Doline FR, Farinhas JH, Biondo LM, Souza RT Filho. One health approach to toxocariasis in Brazilian indigenous populations, their dogs, and soil contamination. *Front Public Health*, 2023;11:1-12. doi: <https://doi.org/10.3389/fpubh.2023.1220001>.
11. Rocha S, Pinto RMF, Floriano AP, Teixeira LH, Bassili B, Martinez A, et al. Environmental analyses of the parasitic profile found in the sandy soil from the Santos municipality beaches, SP, Brazil. *Rev Inst Med trop*, 2011;53(5):277-81. doi: <https://doi.org/10.1590/S0036-46652011000500007>.

12. UK Data Service. Survey data [internet]. 2025. [cited 2025 Dez 14]. Available from: <https://ukdataservice.ac.uk/learning-hub/survey-data/>.
13. Phasuk N, Kache R, Thongtup K, Boonmuang S, Punsawad C. Soil Contamination with Toxocara Eggs in Public Schools in Rural Areas of Southern Thailand. J Trop Med. 2020;8:1-16. doi: <https://doi.org/10.1155/2020/9659640>.
14. Macedo JP, Alvarenga IM, Castro PH, Costa JO, Barçante TA, Peconick AAP, et al. Larva Migrans: a growing public health problem highlighted by a beach tennis outbreak. Int J Sci Manag Tour, 2023;9(1): 569-83. doi: <https://doi.org/10.55905/ijsmtv9n1-027>.