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Occurrence of enteroparasites before and during the COVID-19 pandemic in Nina Rodrigues, Maranhão, Brazil

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Abstract

Intestinal parasites are infections in the gastrointestinal tract, by protozoa and/or helminths and represent a public health problem, but despite this problem, less were reported than would be expected due to the COVID-19 pandemic. The objective of this study was to verify the occurrence of enteroparasites before and during the COVID-19 pandemic in patients treated at the laboratory of the Nina Rodrigues hospital, Maranhão. A cross-sectional, descriptive, and quantitative study was carried out, analyzing the exams from the years 2019 and 2020, collected from the hospital's information bank in August 2021. The data were entered into the STATA 14.0 program for analysis. In 2019, 632 exams were performed, and in 2020 a total of 161, women and middle-aged adults (31-59 years old) were the ones who most underwent exams, in relation to positive reports, 18.51% and 26.09% had at least one type of parasite in 2019 and 2020, respectively. The most frequent parasite was *Entamoeba coli* and 66.48% of the reports had the presence of more than one parasite, the most observed association being *E. coli* + *Entamoeba histolytica*. It is noted that despite the 2020 pandemic period, fewer fecal parasitological tests were performed compared to the 2019 period, it is possible to verify that there is a reasonable occurrence of enteroparasites in the population of Nina Rodrigues, with a high rate of individuals with biparasitism. Thus, it is necessary to implement measures aimed at diagnosing and treating those infected, and preventive measures to minimize transmission.

Palavras-chave: Parasitic diseases. Epidemiological research. Public health.

INTRODUCTION

COVID-19 (an acronym for CoronaVirus Disease 2019), which started in December 2019, brought significant damage and challenges to several countries around the world[1]. The COVID-19 pandemic declared by the World Health Organization (WHO) in March 2020 had consequences not only for physical health, but also for the social, economic, emotional, and cultural aspects of individuals' lives[2]. These consequences are mainly due to the following items: social isolation, used as a measure to control the spread of SARS-CoV-2 infection (acronym for Severe Acute Respiratory Syndrome CoronaVirus 2); the reduction of the supply of certain healthcare-related services, with the aim of making them available for the management of patients with COVID-19; the population's generalized fear of seeking healthcare services, even when necessary; and

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the difficulty of accessing elective healthcare and procedures for chronically ill people[3,4].

Intestinal parasites are infections that occur in the gastrointestinal tract of animals and humans, caused by protozoa and/or helminths. In the world, there are at least 3.5 billion people infected by at least one type of parasite, and 450 million feel some symptom resulting from such infection, this type of infection is responsible for 2 to 3 million deaths/year, worldwide[5].

Thus, enteroparasitoses represent a global public health problem, but mainly in emerging and underdeveloped countries, with a prevalence rate of up to 90% of the population[5]. Its transmission is directly related to the disorderly urban population growth, accompanied by the lack of basic sanitation, precarious housing conditions, social inequalities, and lack of information[6].

In Brazil, these infections are geographically distributed, affecting both urban and rural environments[7]. The Northeast and North of the country are the regions with the highest prevalence of infections by intestinal helminths and protozoa[8]. Celestino *et al.*[9] in their systematic review, found that in the North and Northeast regions the prevalence was 58% and 50%, respectively.

The prevalence of this type of infection in Brazil is broadly divided into all age groups. Furthermore, children become the most vulnerable and most affected group, as they generally have inadequate hygiene habits, constant interpersonal physical contact, immature immune systems, greater exposure to pathogens, and lack of knowledge[10].

In general, most cases of intestinal parasites are asymptomatic, which is an unfavorable factor in combating this type of infection. However, depending on the parasite load, type of parasite, nutritional status and immune system of the host, the infection progresses to the appearance of clinical manifestations, such as diarrhea, nausea, vomiting, bleeding, obstruction of the gastrointestinal tract, anemia, abdominal pain, malabsorption, and in more extreme cases, death[11].

Depending on the type and degree of infection, the development of intellectual and physical capacities may be compromised, especially in young individuals, since these pathologies may interfere with their nutritional status[12].

Despite knowing the relevance of parasitic diseases for public health, and the harm that these infections can cause to the population, mainly in developing countries, generating high rates of morbidity and mortality, it is noted that parasitological investigations are still neglected, and there is a scarcity of data on the incidence and prevalence of intestinal parasites in many regions of Brazil. This makes it difficult to elaborate effective health policies and programs[13], and with the surgence of the COVID-19 pandemic, this became more evident. Therefore, this work aimed to verify the occurrence of enteroparasites before and during the COVID-19 pandemic in patients attended by the laboratory of a public hospital in Nina Rodrigues, Maranhão.

MATERIALS AND METHODS

This was a retrospective, descriptive cross-sectional study with a quantitative approach.

The study was carried out in the clinical analysis laboratory of the Madalena Fortes Braga municipal hospital, in Nina Rodrigues, in the state of Maranhão, which is located approximately 200 km from the capital of

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Maranhão, São Luís. The municipality has an estimated population of 14,826 inhabitants and an average human development index (HDI) of 0.585[14].

Data were collected in August 2021, from the printed reports, which were organized by month of examination in organizing boxes, in the clinical analysis sector of the hospital. All reports analyzed were prepared from patient samples, obtained using the Hoffman, Pons, Janer, or Lutz method (also called the spontaneous sedimentation method). The data obtained from the exams were: gender, age group, month of the exam, presence or absence, type of parasites, and species associations.

The data were organized in spreadsheets in the Microsoft Excel® 2019 program and entered into the STATA 14.0 program, from which the descriptive analysis was performed using the absolute and relative values shown in the Tables.

The research followed the ethical precepts established by Resolution No. 466/12 of the National Health Council, which deals with research that directly or indirectly involves human beings[15] and was approved by the Ethics Committee in Research with Human Beings of the Ceuma University as the opinion number 3.561.027.

RESULTS

Table 1 shows that in 2019 a total of 632 fecal parasitological exams were performed and in 2020 there were 161 exams. In both years, women were the ones who had the most stool exams, with 455 exams (71.99%) in 2019 and 124 exams (77.02%) in 2020. Regarding the age group, patients aged 31 to 59 years were the ones who most performed exams in the years 2019 and 2020, being 32.44% and 30.43%, respectively.

It is also observed in Table 1 that in the two years (2019 and 2020), some reports were incomplete, lacking information, which in this case was the age of some patients. In 2019, 4.11% of reports did not have the patient's age, and in 2020, 5.59%.

In 2019, the month in which people most underwent parasitological examination of feces was in October, with 102 reports (16.14%). In 2020, March was the month with the most stool tests, with 51 reports (31.58%) as shown in Table 2.

It is noted that in some months of 2020 there was no data, as in January and February the laboratory was under renovation. And in June, August, and September, the laboratory was closed to stool tests, due to the COVID-19 pandemic.

It is observed in Table 2 that in 2019, 117 reports (18.51%) were positive for at least one type of parasite. In 2020, the percentage of positive reports was slightly higher, with 26.09%, equivalent to 42 reports. Both in 2019 and in 2020, protozoa were the most common parasites, in 85 reports (72.65%) in 2019, and 32 reports (76.19%) in 2020.

With regards to parasites, the most common protozoan species in 2019 and 2020 was Entamoeba coli, appearing 81 times (42.19%) and 31 times (41.90%), respectively. Among the helminths, Hookworms were the most evident. In 2019 they amounted to 9.90% and in 2020 to 6.75% of the total parasites found, as shown in Table 3.

It is observed that in 2019 there were no cases of Endolimax nana, while in 2020 there were 2 positive reports (2.70%) for this parasite.

Among the positive reports in the years

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2019 and 2020, 72 reports (61.54%) and 30 reports (71.43%), respectively, had the presence of more than one parasite, as shown in Table 4. Furthermore, the most common association in the two years cited was the biparasitism type, which in 2019 there were 69 reports (58.97%), and in 2020 there were 28 reports (66.66%).

Table 4 alos highlights the most predominant class of associated parasites, which was from two different species of protozoa, with 69 reports (95.83%) in 2019 and 28 reports (93.33%) in 2020.

Regarding the species that associated, it is observed that in the years 2019 and 2020 the association between E. coli and Entamoeba histolytica were the most prevalent, where they corresponded in 2019 to 94.44% and in 2020 to 86.67% of all the parasitic associations, according to Table 4.

Table 1 – Distribution of the gender and age group variables of the individuals analyzed in the parasitological reports of feces from the public laboratory in Nina Rodrigues, Maranhão.

	2019		2020	
VARIABLES	**N**	**%**	**N**	**%**
Gender				
Male	177	28.01	37	22.98
Female	455	71.99	124	77.02
Total	632	100	161	100
Age group				
0 to 11 years	140	22.15	22	13.66
12 to 20 years	102	16.14	33	20.50
21 to 30 years	85	13.45	32	19.88
31 to 59 years old	205	32.44	49	30.43
60 years older	74	11.70	16	9.94
Uninformed	26	4.11	9	5.59
Total	632	100	161	100

N= Absolute value; %= Percentage value

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Table 2 – Arrangement of the variables by month, presence of the parasite, and types of parasites in the parasitological reports of patients assisted by the public laboratory of Nina Rodrigues, Maranhão.

	2019		2020	
VARIABLES	**N**	**%**	**N**	**%**
Month				
January	33	5.22	-	-
February	45	7.12	-	-
March	37	5.85	51	31.68
April	36	5.70	16	9.94
May	65	10.28	11	6.83
June	45	7.12	-	-
July	64	10.13	4	2.48
August	61	9.65	-	-
September	55	8.70	-	-
October	102	16.14	24	14.91
November	55	8.70	36	22.36
December	34	5.38	19	11.80
Total	632	100	161	100
Presence of the parasite				
Yes	117	18.51	42	26.09
No	515	81.49	119	73.91
Total	632	100	161	100
Type of parasite				
Protozoan	85	72.65	32	76.19
Helminth	29	24,78	8	19.05
Protozoan + Helminth	3	2,56	2	4.76
Total	117	100	42	100

N= Absolute value; %= Percentage value

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Table 3 – Arrangement of species of intestinal parasites present in the parasitological reports of patients assisted by the public laboratory of Nina Rodrigues, Maranhão.

	2019		2020	
INTESTINAL PARASITES	**N**	**%**	**N**	**%**
Protozoa				
Entamoeba coli	81	42.19	31	41.90
Entamoeba histolytica	71	36.98	28	37.84
Giardia lamblia	8	4.17	4	5.40
Endolimax nana	-	-	2	2.70
Helminths				
Ancylostomatidae	19	9.90	5	6.75
Enterobius vermicularis	7	3.64	1	1.35
Ascaris lumbricoides	6	3.12	3	4.05
Total	192	100	74	100

N= Absolute value; %= Percentage value

Table 4 – Arrangement of association variables, type of association of parasites, classes, and species of associated parasites in the parasitological reports of patients assisted by the public laboratory of Nina Rodrigues, Maranhão.

	2019		2020	
VARIABLES	**N**	**%**	**N**	**%**
Parasitic association				
Positive	72	61.54	30	71.43
Negative	45	38.46	12	28.57
Total	117	100	42	100
Type of association				
Biparasitic	69	95.84	28	83.33
Polyparasitic	3	4.16	2	16.67
Total	72	100	30	100
Class of associated parasites				
Protozoan + Protozoan	69	95.83	28	93.33
Helminth + Protozoan	3	4.17	2	6.66
Total	72	100	30	100
Species that associated				
Entamoeba coli + *Entamoeba histolytica*	68	94.44	26	86.67

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	2019		2020	
VARIABLES	N	%	N	%
Entamoeba coli + Entamoeba histolytica+ Ancylostomatidae	1	1.39	1	3.33
Enterobius vermiculares + Entamoeba coli	1	1.39	-	-
Ascaris lumbricoides + Entamoeba coli + Entamoeba histolytica	1	1.39	1	3.33
Giardia lamblia + Entamoeba histolytica + Entamoeba coli	1	1.39	-	-
Entamoeba coli + Endolimax nana	-	-	2	6.67
Total	72	100	30	100

N= Absolute value; %= Percentage value

DISCUSSION

Since the efforts of the multidisciplinary teams of hospitals turned to respond to the emergency situation of the COVID-19 pandemic, the performance of a larger number of tests in 2019 compared to 2020 is understandable, because some months of 2020 the laboratory was not operational[16]. Therefore, in view of this pandemic context, as pointed out by Borges *et al.*[17], there were some difficulties in healthcare, such as scheduling appointments, canceling previously scheduled appointments, performing requested tests, and accessing medication, which is information that corroborates the data found in the present study. In addition, the population was aware of the exhaustion of the capacity of the services and had a feeling of fear of being infected in the healthcare centers, which caused many to cancel their appointments and stop monitoring their possible health problems[18].

In the years 2019 and 2020, it was observed that women were the ones who most performed parasitological examinations of feces, corroborating the findings of the research by Santos, Campos, and Firmo[19], where women represented about 74% and men about 26% of the samples analyzed in the laboratory of Alto Alegre do Pindaré, MA. Furthermore, Santos and Merlini[20] who, in their work, evaluated enteroparasitors in the population of Maria Helena, PR, concluded that the female gender was the one that performed the most parasitological examination of feces, with 56.4% of a total of 431 samples. In yet another study, carried out in the municipality of Conde, PB by Oliveira Filho *et al.*[21], women had a prevalence of 67.5% and men, 32.5%. The higher frequency of females can be attributed to two factors, the first is that women seek healthcare services more than men; and the second is that women may be more exposed to environments that promote the dissemination of infectious forms of intestinal parasites, such as daycare centers and contact with babies' diapers[19].

As for age group, there was a predominance of tests performed by individuals aged 31 to 59 years in 2019 and 2020, which are similar to the findings by Visser *et al.*[22], where adults accounted for 46.7% of a total of 362 samples of feces collected in the city of Manaus, AM, as well as the study by Matos e

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Cruz[23] where adults represented 55.66% in relation to the total of 1,658 parasitological reports collected from a laboratory in Ibiacussê, BA. However, there is a contrast with the studies carried out by Bellin and Grazzioti[24] in Sananduva, RS, where children (0 to 10 years old) were the ones who most underwent parasitological examinations of feces, with 49.45% (270 reports) of a total of 546 exams. The greater number of stool exams performed by adults aged 31 to 59 years in our study can be explained by the fact that when human beings reach this stage of life, there is a greater tendency to take care of themselves. Furthermore, people in this age group have autonomy to search for and carry out tests, which does not occur with children, for example.

Regarding the positivity of parasites in the two years of the study, it can be seen that the results are lower than those of Silva *et al.*[25], where in their work analyzing parasitological reports of the population of Chapadinha, MA, they found a positivity of 33.2%, and those of Alexandre *et al.*[26] who, when verifying the frequency of parasites in students from a teaching unit in Vitorino Freire, MA, observed that 42% of the individuals were infected by at least one type of parasite. However, the aforementioned results were superior to those found by Lodo *et al.*[27], who found a rate of 15.69% of parasitized individuals in their studies. Brazil, due to its geographic position, has favorable conditions for the development of intestinal parasites, such as a tropical climate, high temperatures, and humid weather, which explains the high rates of incidence and prevalence of enteroparasitosis throughout the country[6]. Furthermore, variations in infection rates by such microorganisms between regions are explained by differences in health, socioeconomic, and environmental levels in each place[19].

Analyzing the positive reports of the present study, it was observed that in the population of the municipality of Nina Rodrigues, there is a great predominance of intestinal protozoa in relation to helminths. Such data corroborate with those of Silva, Silva, and Rocha[28], who in their work found 98.34% of protozoa in parasitized samples and only 1.66% of helminth species. Freitas *et al.*[29], when carrying out a survey of enteroparasites in the municipality of Barra dos Garças, MT, also found that protozoa were the most common parasites. The inferiority of the occurrence of helminthiasis in relation to infections by intestinal protozoa can be related to the fact that the latter have a simpler biological cycle, and an easier transmission than intestinal helminths, where some species require maturation in the soil (geohelminths)[30].

It was observed that of all the parasites found in our study, the most prevalent species was *E. coli*, found with an average of 42% for both years, corroborating the research done by Matos and Cruz[23], who determined a positivity of 51.15% and 54.62% of *E. coli* in rural and urban areas, respectively. Although this parasite is commensal (a parasite that does not develop pathogenic actions against the human body), the high-frequency rates can serve as a health indicator, since this parasite has the same transmission mechanisms as pathogenic species[31].

The second most predominant species shown in the present work was *E. histolytica*. Alexandre *et al.*[26] found lower *E. histolytica* infection rates (23%) than those found in this study. The same occurred in the study by Silva *et al.*[32], who, when evaluating samples of 367 children and adolescents from a neighborhood in the city of Maceió, AL, observed a frequency of 14.7% of *E. histolytica* positivity.

The high rates of *E. histolytica* found in this study are worrying, as it is the only pathogenic amoeba that causes amoebiasis or amoebic dysentery. Such an infection can be asymptomatic, however, for immunodeficient people or people with comorbidities, children, the elderly, and individuals with low nutritional status, *E. histolytica* represents a risk. In some

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cases, parasites of this species can cause ulcerations in the intestine, severe dysentery, obstruction, and perforation of the intestine, which can affect other organs through systemic dissemination through the bloodstream[33].

Another protozoan found in this study was *Giardia lamblia*, with a lower occurrence than that reported by Lodo *et al.*[27] and Silva *et al.*[25], who found a prevalence of 14.9% and 14.4%, respectively. It should be noted that the results of infection rates by this protozoan may be underestimated since the elimination of more evolved forms of this parasite in feces does not occur continuously[34].

In the present study, the commensal protozoan *E. nana* was observed only in 2020. This finding disagrees with most studies, such as Firmo *et al.*[5] who found that *E. nana* was the most common parasite detected in public and private healthcare services from Estreito, MA, with 65.70% and 39.10% of prevalence, respectively.

Another survey carried out by Seixas *et al.*[35], when evaluating schoolchildren in a neighborhood in Salvador, BA, determined that the most commonly seen parasite was E. nana, comprising 30.22% of all parasites found. The hypothesis adopted to explain the low level of infection by *E. nana* is that it may have been caused by competition between the commensal and other protozoan species, such as *E. coli* and *E. histolytica*, which were the most frequently observed parasites in parasitological reports analyzed.

The high rates of enteroprotozoan infections can be associated with the low socioeconomic level of a population due to precarious housing conditions, contaminated water and food sources, lack of information about intestinal parasites, as well as the precariousness of the healthcare system in the region[26].

In 2019 and 2020, the most prevalent helminths were Hookworms, Enterobius vermicularis, and Ascaris lumbricoides. It is worth mentioning that hookworms as intestinal parasites are represented by two species: *Ancylostoma duodenale* and *Necator americanus*, and these cannot be distinguished by the morphologies of their respective eggs, since they are identical[36].

Melo et al.6 found a prevalence of 6.89% for A. lumbricoides, 1.53% for Hookworms and did not find any evolutionary form for E. vermicularis in their study in the city of Bacabal, MA.

Visser *et al.*[22] when carrying out a survey in Manaus, AM, identified that in the studied population, there was a frequency of 9.82% for *A. lumbricoides* and 1.05% for Hookworms. Another study carried out in the interior of São Paulo by Lodo *et al.*[27], found prevalences of A. lumbricoides, Hookworms, and E. vermicularis at 5.30%, 1.76%, and 4.55%, respectively.

It can then be observed that the percentage of Ascaris found in this study is lower than the findings of the aforementioned research, which must be related to the temperature and humidity of the environment, which do not provide ideal conditions for the development and viability of their evolutionary forms[37].

Regarding Hookworms, the rates identified in Nina Rodrigues are higher than the previous study; however, Souto *et al.*[38] identified a higher infection rate in São Francisco, MG of 14%. Seasonality and geographical differences in each region may favor the appearance of some helminths over others.

As for *E. vermicularis*, the frequency observed in the nineense population was higher than the findings by Visser *et al.*[22] but was lower than the study by Lodo *et al.*[27], which explained that differences in infection rates by this parasite may occur due to the form of oviposition of the females, which is carried out intermittently.

The parasitic association was evident in the years 2019 and 2020, when more than 50% of the positive reports had the presence of two or more parasites. These results are higher than those of Lacerda and Jardim[39], who reported a rate of 2.91%.

Of the types of association observed in the municipality of Nina Rodrigues, biparasitism

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was more frequent, followed by monoparasitism and polyparasitism, which differs from the study by Lima *et al.*[31], who identified a rate of 55% of monoparasitism, 38% of biparasitism, and 7% polyparasitism. It also differs from the study by Machado *et al.*[40], who verified a percentage of 79.66% of monoparasitism, 18.64% of biparasitism, and 1.69% of polyparasitism. The predominance of biparasitism may be related to the host's degree of immunocompetence, and the high frequency with which human beings come into contact with an environment contaminated by different species[20,41,42].

Among the analyzed reports, the most frequent association was between the species *E. coli* + *E. histolytica*. Melo *et al.*[6] claim that individuals with polyparasitism have more severe infections than those with single infections. Therefore, the occurrence of the parasitic association in the nineense population should be better evaluated.

CONCLUSION

Parasitic diseases are a reality in Brazilian municipalities. Despite the easy diagnosis and the existence of effective treatment, it is still difficult to control. During the COVID-19 pandemic the suspension of many non-urgent healthcare services had repercussions on the ideal management of infections caused by intestinal parasites, as shown herein.

Therefore, it is necessary to reestablish healthcare services, especially for non-essential services, since the various common health conditions in the population are still present, with an emphasis on intestinal parasites. Further studies are suggested focusing on the impact of the COVID-19 pandemic on infectious parasitic diseases which are somewhat neglected by health authorities.

Author Statement CREdiT

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