Prevalence of intestinal parasitic infections versus knowledge, attitudes and practices of male residents in Brazilian urban slums: a cross-sectional study

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ABSTRACT

Intestinal parasitic infections (IPIs) are neglected diseases caused by helminths and protozoa, with the relationships between parasite, host and environment having the potential to produce high morbidity and incapacity to work and mortality in vulnerable areas. This study assessed the prevalence of IPIs concerning socio-environmental conditions and analyzed the knowledge, attitudes and practices related to these diseases among men living in the slums of Rio de Janeiro city, Rio de Janeiro State, Brazil. A cross-sectional study was conducted in an agglomeration of urban slums between 2018 and 2019, with men aged between 20 and 59 years. A socioeconomic status questionnaire and an IPIs knowledge, attitudes and practices questionnaire (KAPQ) were applied. Coproparasitological diagnoses (n=454) were performed using four methods and samples of water for household consumption (n=392) were subjected to microbiological and physicochemical analysis. A total of 624 participants were enrolled. About 40% of the households had “water unsuitable for consumption”. Only one Major Area, MA 3 was not statistically significant for IPIs (AOR=0.75; 95% CI: 0.30-1.88; p=0.55). The overall prevalence of IPIs was 23.8%. *Endolimax nana* (n=65, 14.3%) and hookworm (n=8, 1.7%) were the most frequently identified parasites. The analysis of the frequency of responses to the KAPQ has shown that men reported to seeking medical care if they were suspicious of IPIs, and around 35% would self-medicate. The results have shown the need to adopt integrated health education practices targeting male residents in urban slums to qualify the care with water for human consumption and promote self-care about IPIs. The household can be considered strategic for Primary Health Care activities for men.

KEYWORDS: Parasitic intestinal diseases. Protozoan infection. Men. Poverty areas. Health promotion.

INTRODUCTION

Currently, inequalities among people are exacerbated by neglected diseases that produce a vicious cycle of poverty, deficiencies linked to human development and incapacity for work and productivity, which oppose the Sustainable Development Goals of the United Nations.

Intestinal parasitic infections (IPIs) are neglected diseases caused by helminths and protozoa with variable prevalence and geographic distribution. They are
interdependent on human factors, environmental conditions and biology of parasites. They can also reduce adult productivity and cause high morbidity and mortality in vulnerable areas, resulting in a global loss of 39 million disability-adjusted life years (DALYs) per year.

Although infections by *Giardia intestinalis*, *Entamoeba histolytica/dispar* and *Cryptosporidium* spp. are common worldwide, the World Health Organization (WHO) recommends periodic administration of anthelmintics in populations at risk as a prevention and control strategy, without taking into account IPIs caused by protozoa.

Routine coproparasitological screening is limited in Brazil and IPIs are not compulsorily notifiable diseases, which contributes to the lack of knowledge about their general prevalence because estimates are limited to specific epidemiological studies. Despite public policies and WHO recommendations, Brazilian studies have revealed a predominance of IPIs caused by protozoa transmitted through contaminated water or food. These data reinforce the importance of determining the prevalence of IPIs for their correct care and management in Brazil.

Overall, the prevalence of IPIs varies by location and studied population. In Brazil, the areas of Pilar/Alagoas and Curitiba/Paraná were found to have an overall prevalence of IPIs of 87.6% and 24.8%, respectively. A recent study reported that the overall prevalence of IPIs in Rio de Janeiro State (RJ) ranges from 18.3% to 66%. Studies conducted in Brazil have reported a higher prevalence of IPIs in men than in women. Oishi et al. found a prevalence of 25.1% in men and 24.5% in women, while Faria et al. found prevalences of 21.8% and 12.9%, respectively. In Complexo de Favelas de Manguinhos (CFM), the study site of the present study, the overall prevalence of IPIs was 14% (175/1,230), with men being most affected (31.5%) than women (27.8%).

However, few studies published in the last ten years have dealt with IPIs in more detail in populations living in urban slums in Brazil. Moreover, there have been no reports of studies that associate male individuals living in urban slums with IPIs. The latter is probably due to issues inherent to masculinity that contribute to the negligence of self-care and the absence of strategies that include males in the care practices of the Brazilian Unified Health Sistem.

For these reasons, this study aimed to assess the prevalence of intestinal parasites associated with socio-environmental conditions and to analyze the knowledge, attitudes, and practices about these diseases among men living in an urban slum complex in Rio de Janeiro city, RJ, Brazil.

**MATERIALS AND METHODS**

**Study type and ethical aspects**

This study was cross-sectional, analytical, participant-observation and action research with a convenience sample. It was developed with male individuals aged 20 to 59 years living in the CFM, in Rio de Janeiro city, RJ, Brazil. The study was reviewed and approved by the Ethics Committee on Human Research of the Instituto Oswaldo Cruz/Fiocruz (certificate Nº 55512916.3.0000.5248).

**Study scenario**

The neighborhood of Manguinhos is in the metropolitan region of Rio de Janeiro city (22°52′47.04″ S - 43°14′57.18″ W). The climate is hot and humid tropical with episodes of abundant rainfall during summer, producing sporadic overflowing of the Faria Timbo, Jacare, and Canal do Cunha rivers, which contributes to flooding in the neighborhood during this season.

The CFM is subdivided into five Major Areas (MAs) with distinct socio-environmental characteristics, and is currently composed of 18 communities: Parque Oswaldo Cruz (MA 1); Garagem, Greenville, Mandela de Pedra, Nelson Mandela, Parque Carlos Chagas, Samora Machel, Vila Esperanca and Vila Previdencia (MA 2); Comunidade Agricola de Higienopolis and Vila Sao Pedro (MA 3); Conjunto Habitacional Provisorio 2, Parque Joao Goulart and Vila Turismo (MA 4) and; Cooperativa Central dos Produtores de Leite, Deposito de Suprimentos, Ex-Combatentes and Vila Uniao (MA 5).

The CFM is an area with socio-environmental vulnerabilities and its Human Development Index is among the lowest in Rio de Janeiro city. In 2017, there were about 17,000 households and 42,000 inhabitants, of which 14,137 were male and aged 20 to 59 year according to the Prime Saude software (version 2.1.87, Eco Empresa de Consultoria e Organizacao em Sistemas e Editoracao Ltda., Rio de Janeiro, RJ, Brazil). Currently, health and education resources in CFM include two family clinics for primary health care one emergency care unit, nine day-care centers, and six schools.

The participant-observation revealed clusters of households with a predominance of being only partially finished, but there were also precarious housing conditions with irregular land ownership and a risk of collapse. Most households were provided with water, sewage, and electricity, however, there were some irregular and/or clandestine installations, with some pipes being exposed on the street. The presence of stray animals (dogs, cats, rats, horses and pigs), insufficient collection of solid
waste, varied commerce, illegal drug outlets and constant armed conflicts between police and local drug dealers were observed in some communities.

Sample size

The sample size was calculated using the Epi-Info software (version 7.2.5, Centers for Disease Control and Prevention, Atlanta, GA, USA), considering the number of male individuals aged 20 to 59 years who resided in CFM and an estimated 30% frequency of parasitized male individuals, based on a pre-test conducted in 2017, with a 95% confidence level and a 5% margin of error. The sampling procedure has respected the proportions of families/households distributed in each MA.

The study included male residents who met the following criteria: were registered for care by Family Health Strategy teams; agreed to participate in the research by signing the Free and Informed Consent Term and answered the socioeconomic status questionnaire (SSQ) and the knowledge, attitudes and practices questionnaire on IPIs (KAPQ).

Data collection

Data were collected from February 2018 to December 2019. Potential participants were approached, either on the street, in social establishments, or at their households, and provided a description of the research for their participation in the study. Participant registration was then initiated with the signing of the Free and Informed Consent Term, the application of the SSQ, with questions involving education, occupation, family income, household characteristics and environmental risk factors, and the KAPQ, with open and closed questions about IPIs.

Participants were provided a preservative-free universal stool collector, which was appropriately identified, along with guidelines on the procedures required for correct stool collection to avoid contamination and losses. The research team carried out up to three return visits to registered households, when necessary, to collect fresh stool samples, one sample per participant, as sometimes collection was hampered by difficulties related to local violent conflicts. Samples of household water for human consumption were collected from both, the kitchen tap and the filter, when present, for physicochemical and microbiological analyses, in accordance with current legislation (Consolidation Ordinance 5/2017).

Laboratory analysis

Coproparasitological exams were carried out in the Laboratorio de Inovacoes em Terapias, Ensino e Bioprodutos, Instituto Oswaldo Cruz, Fiocruz, using methods of spontaneous sedimentation, with three slides per sample, centrifugal flotation in sucrose medium, positive thermo-hydrotropism and quali-quantitative method for geohelminths, using a Nikon Eclipse E200MVR microscope. The centrifugal flotation in sucrose medium was chosen due to the possibility of reading the slides for longer time intervals after executing the method.

The water samples were analyzed in the Laboratorio de Avaliacao e Promocao da Saude Ambiental (Instituto Oswaldo Cruz, Fiocruz) for total hardness, pH, conductivity, total dissolved solids, chlorides, total alkalinity, N-ammonia, N-nitrite, sulfates, turbidity, total coliforms, Escherichia coli, and Salmonella sp.

Data management and analysis

To perform analyses concerning knowledge, attitudes, and practices, the multiple answers of the participants were distributed by frequency of keywords and categorized according to Rey’s concepts, as described by Ignacio et al.

Descriptive and exploratory analyses of the studied variables were performed, including univariate and multivariate logistic regressions. Variables that showed statistical significance (p-value <0.05) in the univariate analysis were evaluated by multivariate logistic regression using the forward stepwise method. Two outcomes were determined for this analysis: positivity for a parasitic infection and water quality unsuitable for human consumption. An adjusted odds ratio (AOR) was obtained for each variable included in the final model.

The odds ratio (OR) and the Chi-square test of independence were used to evaluate associations between the KAPQ variables and the two previously mentioned outcomes. The Fisher’s test was used in cases where frequencies were less than five. All tests were performed with the IBM SPSS Statistics software (version 24.0, IBM Corp., Armonk, NY, USA), considering a 95% confidence interval.

Delivery of reports and treatment of parasitized participants

Reports of the coproparasitological exams and the analysis of household water for human consumption, as well as medications for the treatment of parasitized participants were provided to residents during household visits by the nurse of the field team. At this time, the participants were informed of integrated and prophylactic measures against IPIs in their household and peridomicile. Parasitized participants were treated by prescription/supervision carried out by local Family Health Strategy physicians.
RESULTS

A total of 624 participants, predominantly in the age group of 30 to 39 years (28.0%), were registered in 586 households. Most respondents reported having an incomplete elementary school education (38.3%), a monthly family income of two to four minimum wages (34.6%), and owning the houses they lived in (66.9%) (Table 1).

Most of the households had a ceramic floor (92.5%), masonry walls with finishing (95.8%), and a toilet with a tank (98.2%). The collection of solid waste was conducted by the municipality (97.3%). The residents informed that they had some water reservoirs in their households (63.4%), with a water tank being the most cited (61.5%) (Table 1) and that the source of water for consumption was from the public system (96.5%) (Table 2).

Table 1 - Socioeconomic characteristics of male residents in the Complexo de Favelas de Manguinhos communities, Rio de Janeiro city, RJ State, Brazil, February 2018 to December 2019.

| Characteristics               | MA1 (n=96) | MA2 (n=207) | MA3 (n=48) | MA4 (n=192) | MA5 (n=81) | Total (n=624) |
|-------------------------------|------------|-------------|------------|------------|------------|---------------|
| **Age group (years)**         |            |             |            |            |            |               |
| 20-29                         | 16 (16.7)  | 49 (23.7)   | 10 (20.8)  | 43 (22.4)  | 11 (13.6)  | 129 (20.7)    |
| 30-39                         | 22 (22.9)  | 58 (28.1)   | 13 (27.1)  | 47 (24.5)  | 35 (43.2)  | 175 (28.0)    |
| 40-49                         | 15 (15.6)  | 61 (29.5)   | 15 (31.3)  | 50 (26.0)  | 23 (28.4)  | 164 (26.3)    |
| 50-59                         | 43 (44.8)  | 39 (18.8)   | 10 (20.8)  | 52 (27.1)  | 12 (14.8)  | 156 (25.0)    |
| **Education**                 |            |             |            |            |            |               |
| Illiterate                    | 3 (3.1)    | 3 (1.5)     | 2 (4.2)    | 2 (1.0)    | 3 (3.7)    | 13 (2.2)      |
| Incomplete elementary school  | 17 (17.7)  | 100 (48.3)  | 12 (25.0)  | 86 (44.8)  | 24 (29.6)  | 239 (38.3)    |
| Complete elementary school    | 22 (22.9)  | 10 (4.8)    | 8 (16.7)   | 16 (8.3)   | 4 (4.9)    | 60 (9.6)      |
| Incomplete high school        | 11 (11.5)  | 38 (18.4)   | 5 (10.4)   | 18 (9.4)   | 12 (14.8)  | 84 (13.5)     |
| Complete high school          | 40 (41.7)  | 48 (23.2)   | 17 (35.4)  | 58 (30.2)  | 24 (29.6)  | 187 (29.9)    |
| Incomplete higher education   | 3 (3.1)    | 4 (1.9)     | 2 (4.2)    | 7 (3.7)    | 4 (4.9)    | 20 (3.2)      |
| Complete higher education     | -          | 4 (1.9)     | 2 (4.2)    | 5 (2.6)    | 10 (12.4)  | 21 (3.4)      |
| **Monthly family income**     |            |             |            |            |            |               |
| < 1 minimum wage              | 3 (3.1)    | 8 (3.9)     | 1 (2.1)    | 12 (6.3)   | 4 (4.9)    | 28 (4.5)      |
| 1 minimum wage                | 27 (28.1)  | 62 (29.9)   | 23 (47.9)  | 57 (29.7)  | 20 (24.7)  | 189 (30.3)    |
| 1-2 minimum wages             | 2 (2.1)    | 69 (33.3)   | 8 (16.7)   | 29 (15.1)  | 16 (19.8)  | 124 (19.9)    |
| 2-4 minimum wages             | 48 (50.0)  | 56 (27.1)   | 9 (18.8)   | 70 (36.5)  | 33 (40.7)  | 216 (34.6)    |
| > 4 minimum wages             | 11 (11.5)  | 9 (4.4)     | 4 (8.3)    | 15 (7.8)   | 6 (7.4)    | 45 (7.2)      |
| Did not answer                | -          | 3 (1.5)     | 2 (4.2)    | 1 (0.5)    | 2 (2.5)    | 8 (1.3)       |
| Did not know                  | 5 (5.2)    | -           | 1 (2.1)    | 8 (4.2)    | -          | 14 (2.2)      |
| **Housing**                   |            |             |            |            |            |               |
| Rented                        | 14 (14.6)  | 88 (42.0)   | 25 (52.1)  | 36 (18.8)  | 14 (17.3)  | 177 (28.4)    |
| Rent free as a favor          | 2 (2.1)    | 1 (0.5)     | 5 (10.4)   | 4 (2.1)    | 2 (2.5)    | 14 (2.2)      |
| Owned                         | 66 (68.8)  | 118 (57.0)  | 18 (37.5)  | 151 (78.7) | 65 (80.3)  | 418 (66.9)    |
| Other                         | 2 (2.1)    | -           | -          | 1 (0.5)    | -          | 3 (0.5)       |
| Did not answer                | 12 (12.5)  | -           | -          | -          | -          | 12 (1.9)      |
| **Flooring**                  |            |             |            |            |            |               |
| Ceramics                      | 89 (92.7)  | 189 (91.3)  | 46 (95.8)  | 174 (90.6) | 79 (97.5)  | 577 (92.5)    |
| Cement                        | 5 (5.2)    | 15 (7.3)    | 2 (4.2)    | 16 (8.3)   | 1 (1.2)    | 39 (6.3)      |
| Wood                          | 2 (2.1)    | 1 (0.5)     | -          | 1 (0.5)    | 1 (1.2)    | 5 (0.8)       |
| Unpaved earth                 | -          | -           | -          | 1 (0.5)    | -          | 1 (0.2)       |
| Did not answer                | -          | 2 (0.9)     | -          | -          | -          | 2 (0.3)       |
Most respondents (71.2%) reported treating water prior to human consumption, with filtration being the most cited technique (66.2%). Despite this concern, the microbiological and the physicochemical analyses showed that 36% of the samples were unsuitable for consumption (Tables 1 and 2).

The water of CFM was found to be acidic (mean pH of 5.5 ± 0.5) and fecal coliforms were present in samples from all MAs (mean 2.8 ± 13.7). E. coli was identified in samples from MA 2 and MA 5, and Salmonella sp. from MA 2 and MA 4. MA 2 had the highest number of unsuitable water samples (48.5%), while MA 1 had the best water quality (82.9%) (Table 2).

The return rate of stool samples was 72.8% (454/624), and the overall IPIs prevalence was 23.8% (108/454). The highest frequency of parasitized individuals was in MA 1 (30.6%) and the commensal protozoa Endolimax nana was the most frequent (14.3%; 65/454) of the other ten species identified, which indicated a higher frequency of infection by protozoa (20.7%; 94/454). The most frequent helminths were hookworms (1.7%, 8/454) and Ascaris lumbricoides (1.5%, 7/454) (Table 3).

Analysis of the frequency of participant responses to the KAPQ questionnaire revealed that: “dirt/lack of hygiene” are the sources of infection (54.3%); “intestine” is the habitat of the parasite in the human body (31.3%); “sewage” is the fate of the parasite when it is eliminated from the human body (48.4%); “diarrhea” (20.5%) and “nausea/vomit” (19.1%) are the symptoms of IPIs; the parasite “dies” when it leaves the human body (45.5%); the parasite “lives” for a long period in the human body (74.0%) and; when there is suspicion of IPIs, they seek medical care (60.9%), although some reported to practice self-medication (34.9%) and “hygiene/hand washing” as a preventive measure (54.6%) (Table 4).

The results shown in Table 5 indicate that only MA 3 (AOR=0.75; CI 95%=0.30-1.88; p=0.55) was not statistically significant for IPIs. The univariate analysis
showed that “illiterate” (OR=2.12; 95% CI: 1.10-4.08; p=0.02), “higher education” (OR=2.53; 95% CI: 1.09-5.84; p=0.03) and “income of 1-2 minimum wages” (AOR=0.45; 95% CI: 0.23-0.90; p=0.02) to be statistically significant for IPIs (Table 5).

The responses to the KAPQ questionnaire were evaluated regarding two outcomes: positivity for IPIs and water quality unsuitable for consumption. For the question “What do people feel when they have worms?”, participants who answered “stomach pain” were 168% (OR=2.68; 95% CI: 1.18-6.11; p=0.01) more likely to be infected and those who answered “itching” were 53% (OR=0.47; 95% CI: 0.23-0.96; p=0.03) less likely for the same outcome. Participants who reported that people get worms from “walking barefoot” and those who reported that worms “go into the sewage” were 77% (OR=1.77;
Table 3 - Distribution of intestinal parasitic infections in male residents of the Complexo de Favelas de Manguinhos communities, Rio de Janeiro city, RJ State, Brazil, February 2018 to December 2019.

| Parasite species                  | Major Areas n (%) | Frequency n (%) |
|-----------------------------------|-------------------|-----------------|
|                                   | MA 1  | MA 2  | MA 3  | MA 4  | MA 5  | n (%) |
| Stool sampling                    | 83 (18.3) | 155 (34.1) | 27 (5.9) | 127 (27.9) | 62 (13.6) | 454 (100) |
| Infections by intestinal parasites| 33 (30.6) | 22 (20.4) | 9 (8.3) | 30 (27.7) | 14 (12.9) | 106 (100) |
| Monoparasitism                    | 17 (20.5) | 17 (11.0) | 8 (29.6) | 26 (20.5) | 12 (19.4) | 80 (17.6) |
| **Protozoan Infections**          |       |       |       |       |       |       |
| Blastocystis hominis              | 2 (2.4) | -     | -     | 1 (0.8) | -     | 3 (0.7) |
| Endolimax nana                    | 6 (7.2) | 7 (4.5) | 3 (11.1) | 18 (14.2) | 8 (12.9) | 42 (9.3) |
| Entamoeba coli                    | -     | 4 (2.6) | 3 (11.1) | 1 (0.8) | 2 (3.2) | 10 (2.2) |
| Entamoeba histolytica/dispar      | 2 (2.4) | 1 (0.6) | -     | 1 (0.8) | -     | 4 (0.9) |
| Giardia intestinalis              | 2 (2.4) | 2 (1.3) | -     | 1 (0.8) | 1 (1.6) | 6 (1.3) |
| Iodamoeba butschlii               | 1 (1.2) | -     | -     | -     | -     | 1 (0.2) |
| **Helminth Infections**           |       |       |       |       |       |       |
| Hookworm                          | 1 (1.2) | 1 (0.6) | 1 (3.7) | -     | -     | 3 (0.7) |
| Ascaris lumbricoides              | 3 (3.6) | -     | -     | -     | 1 (1.6) | 4 (0.9) |
| Hymenolepis diminuta              | -     | -     | 1 (3.7) | 1 (0.8) | -     | 2 (0.4) |
| Strongyloides stercoralis         | -     | 2 (1.3) | -     | 2 (1.6) | -     | 4 (0.9) |
| Trichurus trichiura               | -     | -     | 1 (0.8) | -     | -     | 1 (0.2) |
| **Polyparasitism**                | 16 (19.3) | 5 (3.2) | 1 (3.7) | 4 (3.1) | 2 (3.2) | 28 (6.2) |
| **Two parasites detected**        |       |       |       |       |       |       |
| Blastocystis hominis + Endolimax nana | 1 (1.2) | -     | -     | -     | -     | 1 (0.2) |
| Blastocystis hominis + Iodamoeba butschlii | 1 (1.2) | -     | -     | -     | -     | 1 (0.2) |
| Endolimax nana + Entamoeba coli   | -     | 1 (0.6) | 1 (3.7) | 2 (1.6) | -     | 4 (0.9) |
| Endolimax nana + Entamoeba histolytica/dispar | 1 (1.2) | -     | -     | -     | -     | 1 (0.2) |
| Endolimax nana + Giardia intestinalis | 1 (1.2) | 1 (0.6) | -     | 1 (0.8) | 1 (1.6) | 4 (0.9) |
| Endolimax nana + Iodamoeba butschlii | 4 (4.8) | -     | -     | -     | -     | 4 (0.9) |
| Entamoeba coli + Entamoeba histolytica/dispar | 2 (2.4) | -     | -     | -     | -     | 2 (0.4) |
| **Helminth Infections**           |       |       |       |       |       |       |
| Hookworm + Ascaris lumbricoides    | -     | -     | -     | 1 (0.8) | -     | 1 (0.2) |
| **Mixed infections**               |       |       |       |       |       |       |
| Hookworm + Endolimax nana         | 1 (1.2) | -     | -     | -     | 1 (1.6) | 2 (0.4) |
| **Three parasites detected**      |       |       |       |       |       |       |
| Blastocystis hominis + Endolimax nana + Iodamoeba butschlii | 1 (1.2) | -     | -     | -     | -     | 1 (0.2) |
| **Mixed infections**               |       |       |       |       |       |       |
| Ascaris lumbricoides + Hookworm + Endolimax nana | 1 (1.2) | -     | -     | -     | -     | 1 (0.2) |
| Ascaris lumbricoides + Hymenolepis diminuta + Endolimax nana | 1 (1.2) | -     | -     | -     | -     | 1 (0.2) |
| Hookworm + Endolimax nana + Entamoeba coli | 1 (1.2) | -     | -     | -     | -     | 1 (0.2) |
| Strongyloides stercoralis + Endolimax nana + Entamoeba histolytica/dispar | 1 (1.2) | -     | -     | -     | -     | 1 (0.2) |
| **Four parasites detected**       |       |       |       |       |       |       |
| Blastocystis hominis + Endolimax nana + Entamoeba coli + Entamoeba histolytica/dispar | 1 (1.2) | -     | -     | -     | -     | 1 (0.2) |
| Evaluated parameter | Answers | MA 1 (n=96) | MA 2 (n=207) | MA 3 (n=48) | MA 4 (n=192) | MA 5 (n=81) | Total |
|---------------------|---------|-------------|-------------|-------------|-------------|-------------|-------|
| **Infection source** | Contaminated water | 19 (19.8) | 51 (24.6) | 5 (10.4) | 28 (14.6) | 21 (25.9) | 124 (19.9) |
| | Walking barefoot | 10 (10.4) | 32 (15.5) | 5 (10.4) | 29 (15.1) | 9 (11.1) | 85 (13.6) |
| | Contaminated/dirty food | 41 (42.7) | 68 (32.9) | 17 (35.4) | 62 (32.3) | 26 (32.1) | 214 (34.3) |
| | Dirt/lack of hygiene | 50 (52.1) | 113 (54.6) | 25 (52.1) | 117 (60.9) | 34 (42.0) | 339 (54.3) |
| | Other | 31 (32.3) | 24 (11.6) | 9 (18.8) | 37 (19.3) | 21 (25.9) | 122 (19.6) |
| Did not answer | - | 24 (11.6) | 1 (2.1) | 9 (4.7) | 9 (11.1) | 43 (6.9) |
| Did not answer | - | 24 (11.6) | 1 (2.1) | 9 (4.7) | 9 (11.1) | 43 (6.9) |
| **Habitats in the human body** | Belly | 16 (16.7) | 50 (24.2) | 6 (12.5) | 31 (16.1) | 18 (22.2) | 121 (19.4) |
| | Stomach | 18 (18.8) | 68 (32.9) | 16 (33.3) | 51 (26.6) | 15 (18.5) | 168 (26.9) |
| | Intestine | 40 (41.7) | 54 (26.1) | 15 (31.3) | 60 (31.3) | 26 (32.1) | 195 (31.3) |
| | Blood | 4 (4.2) | 10 (4.8) | 4 (8.3) | 18 (9.4) | 3 (3.7) | 39 (6.3) |
| | Other | 23 (24.0) | 31 (15.0) | 13 (27.1) | 34 (17.7) | 17 (21.0) | 118 (18.9) |
| Did not answer | - | 24 (11.6) | 1 (2.1) | 6 (3.1) | - | 31 (5.0) |
| Did not answer | - | 24 (11.6) | 1 (2.1) | 6 (3.1) | - | 31 (5.0) |
| **Parasite destination site** | Environment | 3 (3.1) | 20 (9.7) | - | 14 (73) | 10 (12.3) | 47 (7.5) |
| | Sewage | 9 (9.4) | 132 (63.8) | 12 (25.0) | 92 (47.9) | 57 (70.4) | 302 (48.4) |
| | Feces | 39 (40.6) | 26 (12.6) | 16 (33.3) | 58 (30.2) | 5 (6.2) | 144 (23.1) |
| | Other | 27 (28.1) | 4 (1.9) | 7 (14.6) | 8 (4.2) | 1 (1.2) | 47 (7.5) |
| Did not answer | - | 28 (13.5) | 1 (2.1) | 5 (2.6) | 8 (9.9) | 42 (6.7) |
| Did not answer | - | 28 (13.5) | 1 (2.1) | 5 (2.6) | 8 (9.9) | 42 (6.7) |
| **Symptomatology** | Itching | 17 (17.7) | 32 (15.5) | 14 (29.2) | 24 (12.5) | 12 (14.8) | 99 (15.9) |
| | Diarrhea | 20 (20.8) | 43 (20.8) | 5 (10.4) | 47 (24.5) | 13 (16.0) | 128 (20.5) |
| | Pain/discomfort in the abdomen | 6 (6.3) | 25 (12.1) | 8 (16.7) | 26 (13.5) | 10 (12.3) | 75 (12.0) |
| | Stomach pain | 7 (7.3) | 12 (5.8) | 2 (4.2) | 10 (5.2) | 4 (4.9) | 35 (5.6) |
| | Nausea/vomit | 14 (14.6) | 33 (15.9) | 7 (14.6) | 48 (25.0) | 17 (21.0) | 119 (19.1) |
| | Other | 53 (55.2) | 78 (37.7) | 18 (37.5) | 90 (46.9) | 41 (50.6) | 280 (44.9) |
| Did not answer | - | 41 (19.8) | 2 (4.2) | 7 (3.6) | 13 (16.0) | 63 (10.1) |
| Did not answer | - | 41 (19.8) | 2 (4.2) | 7 (3.6) | 13 (16.0) | 63 (10.1) |
| **Survival of the parasite outside the human body** | Contaminates another person | 7 (7.3) | 11 (5.3) | 2 (4.2) | 17 (8.9) | - | 37 (5.9) |
| | Dies | 46 (47.9) | 101 (48.8) | 20 (41.7) | 66 (34.4) | 51 (63.0) | 284 (45.5) |
| | Lives | 5 (5.2) | 61 (29.5) | 8 (16.7) | 38 (19.8) | 23 (28.4) | 135 (21.6) |
| | Goes into the sewage | 2 (2.1) | 4 (1.9) | - | 2 (1.0) | - | 8 (1.3) |
| | Other | 11 (11.5) | 12 (5.8) | - | 7 (3.6) | 3 (3.7) | 33 (5.3) |
| Did not answer | - | 20 (9.7) | 3 (6.3) | 6 (3.1) | 5 (6.2) | 34 (5.4) |
| Did not answer | - | 20 (9.7) | 3 (6.3) | 6 (3.1) | 5 (6.2) | 34 (5.4) |
| **Survival of the parasite for a long period inside the human body** | Survives | 75 (78.1) | 149 (72.0) | 36 (75.0) | 144 (75.0) | 58 (71.6) | 462 (74.0) |
| | Dies | 7 (7.3) | 13 (6.3) | 3 (6.3) | 14 (7.3) | 8 (9.9) | 45 (7.2) |
| | Did not answer | - | 8 (3.9) | 2 (4.2) | 1 (0.5) | 2 (2.5) | 13 (2.1) |
| Did not answer | - | 8 (3.9) | 2 (4.2) | 1 (0.5) | 2 (2.5) | 13 (2.1) |
### Table 4 - Frequency of responses related to the intestinal parasitic infections knowledge, attitudes and practices questionnaire (KAPQ) applied to male residents in the Complexo de Favelas de Manguinhos communities, Rio de Janeiro city, RJ State, Brazil, February 2018 to December 2019. (cont.)

| Evaluated parameter | Answers | MA 1 | MA 2 | MA 3 | MA 4 | MA 5 | Total |
|---------------------|---------|------|------|------|------|------|-------|
|                     |         | (n=96) | (n=207) | (n=48) | (n=192) | (n=81) |       |
| **Attitudes towards the disease** |           |       |       |       |       |       |       |
| Seeks help/treatment | 68 (70.8) | 112 (54.1) | 30 (62.5) | 124 (64.6) | 46 (56.8) | 380 (60.9) |       |
| Takes medicine      | 27 (28.1) | 95 (45.9) | 12 (25.0) | 55 (28.6) | 29 (35.8) | 218 (34.9) |       |
| Other               | 2 (2.1) | 6 (2.9) | 4 (8.3) | 11 (5.7) | 4 (4.9) | 27 (4.3) |       |
| Did not answer      | - | 6 (2.9) | 1 (2.1) | 2 (1.0) | - | 9 (1.4) |       |
| Did not know        | 4 (4.2) | - | 1 (2.1) | - | - | 5 (0.8) |       |
| **Means of prevention** |           |       |       |       |       |       |       |
| Avoid hands in the mouth | 3 (3.1) | 2 (1.0) | - | 2 (1.0) | 1 (1.2) | 8 (1.3) |       |
| Filter water        | 10 (10.4) | 17 (8.2) | 1 (2.1) | 11 (5.7) | 13 (16.0) | 52 (8.3) |       |
| Hygiene/hand washing | 49 (51.0) | 118 (57.0) | 20 (41.7) | 103 (53.6) | 51 (63.0) | 341 (54.6) |       |
| Do not walk barefoot | 3 (3.1) | 12 (5.8) | 6 (12.5) | 7 (3.6) | 3 (3.7) | 31 (5.0) |       |
| Do not eat sweets   | 4 (4.2) | 9 (4.3) | 1 (2.1) | 5 (2.6) | 7 (8.6) | 26 (4.2) |       |
| Other               | 58 (60.4) | 105 (50.7) | 33 (68.8) | 82 (42.7) | 40 (49.4) | 318 (51.0) |       |
| Did not answer      | - | 10 (4.8) | 2 (4.2) | 8 (4.2) | 1 (1.2) | 21 (3.4) |       |
| Did not know        | 5 (5.2) | 0 (0.0) | 1 (2.1) | 16 (8.3) | 2 (2.5) | 24 (3.8) |       |

### Table 5 - Association between socioeconomic variables and positivity of intestinal parasitic infections in male residents of the Complexo de Favelas de Manguinhos communities, Rio de Janeiro city, RJ State, Brazil, February 2018 to December 2019. Final logistic regression model.

| Independent variables | IPis n (%) | OR (95% CI) | p-value | AOR (95% CI) | p-value |
|-----------------------|------------|-------------|---------|--------------|---------|
| **Major Areas** (n=180) |            |             |         |              |         |
| MA1 †                 | 33 (30.6)  | -           | -       | -            | -       |
| MA2                   | 22 (20.4)  | 0.25 (0.13 - 0.47) | 0.0*    | 0.25 (0.13 - 0.47) | 0.00*   |
| MA3                   | 9 (8.3)    | 0.75 (0.30 - 1.88) | 0.55    | 0.75 (0.30 - 1.88) | 0.55    |
| MA4                   | 30 (27.7)  | 0.46 (0.25 - 0.85) | 0.0*    | 0.46 (0.25 - 0.85) | 0.01*   |
| MA5                   | 14 (13.0)  | 0.44 (0.21 - 0.92) | 0.03*   | 0.44 (0.21 - 0.92) | 0.03*   |
| **Education** (n=108) |            |             |         |              |         |
| Illiterate            | 5 (4.6)    | 2.12 (1.10 - 4.08) | 0.02*   | -            | -       |
| Elementary school †   | 50 (46.3)  | -           | -       | -            | NI      |
| High school           | 42 (38.9)  | 1.20 (0.73 - 2.00) | 0.46    | -            | -       |
| Higher education      | 11 (10.2)  | 2.53 (1.09 - 5.84) | 0.03*   | -            | -       |
| **Monthly family income** (n=108) | | | | | |
| < 1 minimum wage      | 7 (6.5)    | 1.47 (0.55 - 3.91) | 0.43    | -            | -       |
| 1 minimum wage        | 33 (30.6)  | 0.96 (0.56 - 1.64) | 0.89    | -            | -       |
| 1-2 minimum wages     | 13 (12.0)  | 0.45 (0.23 - 0.90) | 0.02*   | NI           | -       |
| 2-4 minimum wages †   | 40 (37.0)  | -           | -       | -            | -       |
| > 4 minimum wages     | 12 (11.1)  | 1.68 (0.76 - 3.73) | 0.19    | -            | -       |
| Did not know / Did not answer | 3 (2.8) | 1.10 (0.28 - 4.37) | 0.89    | -            | -       |
| **Occupation** (n=108) |            |             |         |              |         |
| Unemployed †          | 11 (10.2)  | -           | -       | -            | -       |
| Employed              | 91 (84.3)  | 0.83 (0.40 - 1.73) | 0.63    | NI           | -       |
| Beneficiary           | 5 (4.6)    | 1.04 (0.30 - 3.63) | 0.94    | -            | -       |
| Did not know/Did not answer | 1 (0.9) | 0.45 (0.04 - 4.21) | 0.48    | -            | -       |
DISCUSSION

This study provides knowledge related to men’s health in socio-environmental vulnerable areas, such as CFM in Rio de Janeiro city, RJ, Brazil. The prevalence of IPIs was assessed and related to knowledge, attitudes and practices about these diseases for a group that neglects health care. In Ethiopia and Iran, males were found to be at a high risk of developing protozoal IPIs due to socioeconomic factors and poor sanitation. Another study conducted with children of both genders found male individuals to have a

| Table 5 - Association between socioeconomic variables and positivity of intestinal parasitic infections in male residents of the Complexo de Favelas de Manguinhos communities, Rio de Janeiro city, RJ State, Brazil, February 2018 to December 2019. Final logistic regression model. (cont.) |
|---|---|---|---|---|---|
| Independent variables | IPIs n (%) | OR (95% CI) | p-value | AOR (95% CI) | p-value |
| **Has a water filter** (n=108) | | | | | |
| Yes † | 76 (70.4) | - | - | NI |
| No | 32 (29.6) | 0.91 (0.57-1.46) | 0.71 |
| **Water Supply** (n=108) | | | | | |
| Water tank † | 72 (66.7) | - | - | - |
| Cistern | 2 (1.9) | 3.00 (0.41 -21.68) | 0.27 |
| Water tank and cistern | 2 (1.9) | 3.00 (0.41 -21.68) | 0.27 | NI |
| Other (bucket/vessel) | - | - | - | - |
| Did not know | 30 (27.8) | 0.72 (0.44 -1.16) | 0.18 |
| Did not answer | 2 (1.9) | 6.00 (0.53 -67.15) | 0.14 |
| **Potable water standard** (n=85) | | | | | |
| Satisfactory † | 62 (72.9) | - | - | NI |
| Unsuitable for consumption | 23 (27.1) | 0.59 (0.34 –1.01) | 0.06 |

OR = odds ratio calculated by univariate logistic regression; AOR = adjusted odds ratio calculated by multivariate logistic regression; NI = variable not included in the final model; *Statistically significant association for $\alpha = 0.05$; † = reference category for the logistic regression.

95% CI: 1.02-3.07; p=0.04) and 55% (OR=1.55; 95% CI: 1.02-2.35; p=0.03) more likely to have water unsuitable for consumption in their households, respectively (Table 6).

| Table 6 - Association between responses to the intestinal parasitic infections knowledge, attitudes and practices questionnaire (KAPQ), positivity for intestinal parasitic infections and quality of water for consumption in households of male residents of the Complexo de Favelas de Manguinhos communities, Rio de Janeiro city, RJ State, Brazil, February 2018 to December 2019. |
|---|---|---|---|---|---|
| KAPQ responses | IPIs (n=108) | Water unsuitable for consumption (n=141) |
| | n (%) | OR (95% CI) | p-value | n (%) | OR (95% CI) | p-value |
| **How does one get worms?** | | | | | | |
| Walks barefoot | 13 (12.0) | 0.81 (0.42 - 1.55) | 0.52 | 29 (20.6) | 1.77 (1.02 - 3.07) | 0.04* |
| Contaminated/dirty food | 36 (33.3) | 0.99 (0.62 --1.56) | 0.97 | 42 (29.8) | 0.78 (0.50 - 1.22) | 0.28 |
| Dirt/lack of hygiene | 56 (51.8) | 0.79 (0.51 - 1.22) | 0.30 | 80 (56.7) | 1.09 (0.72-1.65) | 0.68 |
| Water | 21 (19.4) | 1.02 (0.60 - 1.75) | 0.92 | 27 (19.1) | 0.90 (0.54 - 1.52) | 0.71 |
| Other | 22 (20.3) | 1.02 (0.60 - 1.75) | 0.92 | 21 (14.9) | 0.59 (0.34 - 1.03) | 0.06 |
| Did not know | 13 (12.0) | 2.23 (1.07 - 4.65) | 0.03* | 8 (5.7) | 1.01 (0.41- 2.49) | 0.96 |
| Did not answer | 5 (4.6) | 0.59 (0.22 -1.59) | 0.30 | 15 (10.6) | 2.01 (0.94 - 4.30) | 0.06 |
| **After the worms enter the human body where do they stay?** | | | | | | |
| Intestine | 43 (39.8) | 1.47 (0.94 -2.31) | 0.08 | 39 (27.7) | 0.72 (0.45 -1.13) | 0.15 |
| Stomach | 22 (20.4) | 0.81 (0.47 - 1.37) | 0.43 | 39 (27.7) | 1.57 (0.97 -2.55) | 0.06 |
| Belly | 16 (14.8) | 0.72 (0.40 - 1.31) | 0.28 | 31 (22.0) | 1.25 (0.75 - 2.09) | 0.38 |
| Blood | 4 (3.7) | 0.54 (0.18 - 1.59) | 0.35* | 10 (7.1) | 1.29 (0.55 - 2.99) | 0.54 |
| Other | 24 (22.2) | 1.21 (0.71 - 2.05) | 0.47 | 25 (17.7) | 0.76 (0.45 - 1.29) | 0.32 |
| Did not know | 11 (10.2) | 1.52 (0.72 - 3.21) | 0.26 | 5 (3.5) | 0.33 (0.12 - 0.88) | 0.02* |
| Did not answer | 6 (5.5) | 0.64 (0.26 - 1.59) | 0.33 | 12 (8.5) | 1.20 (0.56 - 2.57) | 0.63 |
Table 6 - Association between responses to the intestinal parasitic infections knowledge, attitudes and practices questionnaire (KAPQ), positivity for intestinal parasitic infections and quality of water for consumption in households of male residents of the Complexo de Favelas de Manguinhos communities, Rio de Janeiro city, RJ State, Brazil, February 2018 to December 2019. (cont.)

| KAPQ responses                        | IPIs (n=108) | Water unsuitable for consumption (n=141) |
|---------------------------------------|--------------|----------------------------------------|
|                                       | n (%)        | OR (95% CI) | p-value | n (%) | OR (95% CI) | p-value |
| Where do the worms go when they come out of people? |               |            |         |       |            |         |
| Feces                                 | 31 (28.7)    | 1.50 (0.92 - 2.45) | 0.10 | 24 (17.0) | 0.63 (0.37 - 1.08) | 0.09 |
| Environment                           | 11 (10.2)    | 1.67 (0.78 - 3.56) | 0.18 | 14 (9.9)  | 1.51 (0.72 - 3.17) | 0.26 |
| Goes into the sewage                  | 45 (41.7)    | 0.68 (0.44 - 1.05) | 0.08 | 79 (56.0) | 1.55 (1.02 - 2.35) | 0.03* |
| Other                                 | 12 (11.1)    | 1.60 (0.77 - 3.31) | 0.19 | 7 (5.0)   | 0.51 (0.21 - 1.23) | 0.13 |
| Do not know                           | 8 (7.4)      | 0.64 (0.29 - 1.43) | 0.28 | 6 (4.3)   | 0.32 (0.13 - 0.80) | 0.01* |
| Did not answer                        | 7 (6.5)      | 0.89 (0.37 - 2.11) | 0.79 | 17 (12.1) | 1.88 (0.93 - 3.82) | 0.07 |
| Do worms live a long time in people?  |               |            |         |       |            |         |
| Yes                                   | 81 (75.0)    | 0.94 (0.57 - 1.56) | 0.83 | 106 (75.2) | 0.97 (0.60 - 1.56) | 0.90 |
| No                                    | 7 (6.5)      | 1.07 (0.44 - 2.59) | 0.87 | 10 (7.1)  | 1.52 (0.64 - 3.61) | 0.34 |
| Did not know                          | 19 (17.6)    | 1.13 (0.63 - 2.00) | 0.67 | 24 (17.0) | 1.05 (0.60 - 1.82) | 0.86 |
| Did not answer                        | 1 (0.9)      | 0.45 (0.05 - 3.72) | 0.68* | 1 (0.7)   | 0.21 (0.02 - 1.75) | 0.16* |
| What do people feel when they have worms? |            |              |         |       |            |         |
| Pain/discomfort in the belly          | 18 (16.7)    | 1.67 (0.90 - 3.07) | 0.09 | 15 (10.6) | 0.84 (0.43 - 1.62) | 0.61 |
| Stomach pain                          | 11 (10.2)    | 2.68 (1.18 - 6.11) | 0.01* | 7 (5.0)   | 0.95 (0.37 - 2.45) | 0.92 |
| Diarrhea                              | 21 (19.4)    | 0.88 (0.51 - 1.52) | 0.66 | 29 (20.6) | 1.06 (0.63 - 1.78) | 0.80 |
| Itching                               | 10 (9.3)     | 0.47 (0.23 - 0.96) | 0.03* | 23 (16.3) | 0.94 (0.54 - 1.64) | 0.83 |
| Nausea/vomit                          | 22 (20.4)    | 1.21 (0.70 - 2.10) | 0.47 | 28 (19.9) | 1.26 (0.74 - 2.16) | 0.37 |
| Other                                 | 55 (50.9)    | 1.50 (0.97 - 2.32) | 0.06 | 54 (38.3) | 0.80 (0.53 - 1.23) | 0.32 |
| Did not know                          | 9 (8.3)      | 0.83 (0.38 - 1.79) | 0.64 | 17 (12.1) | 1.13 (0.59 - 2.16) | 0.69 |
| Did not answer                        | 8 (7.4)      | 0.57 (0.06 - 1.27) | 0.17 | 18 (12.8) | 1.52 (0.78 - 2.94) | 0.20 |
| What happens to the worm outside the body? |            |              |         |       |            |         |
| Contaminates another person           | 6 (5.5)      | 0.95 (0.37 - 2.45) | 0.93 | 7 (5.0)   | 0.95 (0.37 - 2.45) | 0.92 |
| Goes to the sewage                   | 1 (0.9)      | 0.53 (0.06 - 4.44) | 1.00* | 1 (0.7)   | 0.35 (0.04 - 3.03) | 0.42* |
| Dies                                  | 44 (40.7)    | 0.83 (0.54 - 1.29) | 0.42 | 65 (46.1) | 1.01 (0.66 -1.53) | 0.95 |
| Stays alive                           | 21 (19.4)    | 0.84 (0.49 - 1.44) | 0.53 | 35 (24.8) | 1.32 (0.81 - 2.17) | 0.25 |
| Other                                 | 5 (4.6)      | 0.62 (0.23 - 1.67) | 0.34 | 12 (8.5)  | 1.70 (0.75 - 3.84) | 0.19 |
| Did not know                          | 26 (24.1)    | 1.67 (0.99 - 2.84) | 0.05 | 13 (9.2)  | 0.38 (0.20 -0.74) | 0.00* |
| Did not answer                        | 7 (6.5)      | 1.34 (0.54 -3.32)  | 0.52 | 10 (7.1)  | 1.66 (0.68 -4.02) | 0.25 |
| What should you do if you have worms? |            |              |         |       |            |         |
| Seek help/treatment                   | 64 (59.3)    | 0.94 (0.60 -1.46)  | 0.79 | 83 (58.9) | 0.96 (0.63 -1.46) | 0.86 |
| Take medicine                         | 39 (36.1)    | 1.02 (0.65 - 1.60) | 0.91 | 51 (36.2) | 0.93 (0.60 -1.42) | 0.74 |
| Other                                 | 5 (4.6)      | 0.93 (0.33 - 2.60) | 0.90 | 3 (2.1)   | 0.88 (0.32 - 2.41) | 0.81 |
| Did not know                          | 3 (2.8)      | 9.85 (1.01 - 95.76) | 0.04**| 2 (1.4)   | 3.59 (0.32 - 40.02) | 0.29* |
| Did not answer                        | 1 (0.9)      | 0.53 (0.06 - 4.44) | 1.00* | 2 (1.4)   | 3.59 (0.32 - 40.02) | 1.00* |

p-value referring to the Chi-square test or the Fisher's test; a = Fisher's test; OR = odds ratio; *Statistically significant association.

higher prevalence of IPIs. This finding can be explained by masculinity issues involved in the health-disease process. Reinforcing males’ lack of priority for preventive and self-care, a negligence that can be discouraged from childhood. The low level of education of most participants may contribute to the lack of basic knowledge about self-care and prevention of IPIs, thus favoring the maintenance of the transmission of these diseases in the territory, even though
most CFM residents are outside the poverty range\textsuperscript{32}, due to governmental inclusion programs.

Despite most respondents having “ceramic floor,” “masonry wall with finishing,” “toilet with tank” and “water tank”, and reporting filtering water prior to consumption in their households, it was possible to identify a high prevalence of IPIs in men residing in CFM.

Although most residents claimed to have “piped water or water supplied by the public system” in their households, this does not ensure that the water is free of environmental contamination\textsuperscript{19}. Our results corroborated the study conducted in the city of Jimma, Ethiopia\textsuperscript{3}, which identified an association between IPIs prevalence and the source of water for consumption.

The differences between MAs with respect to the best and worst water quality are due to (i) terrain elevation, (ii) exposed water pipes in some places of the communities, and/or (iii) distance from the rivers Faria Timbo, Jacare and Canal do Cunha. These rivers are contaminated due to sewage from households and industries\textsuperscript{39} and/or overflow because of frequent heavy rains.

Regarding the physicochemical and microbiological analyses of water for human consumption, Handan \textit{et al.}\textsuperscript{19} pointed out that acidic water can cause skin and eye irritation upon contact, in addition to gastric problems such as gastritis, ulcers and even cancer for those who consume it for prolonged periods. These authors also corroborated that the presence of fecal coliforms in water indicates the possible presence of other pathogenic microorganisms, supporting the identification of \textit{E. coli} and Salmonella \textit{sp.} in some of the MAs studied here, demonstrating that the water in the CFM requires a better care for human consumption.

Overall IPIs prevalence in CFM was 23.8%, surpassing the prevalence found by other studies carried out in Brazil according to the systematic review of Celestino \textit{et al.}\textsuperscript{34}, such as: in the Midwest region (20.2%), in Rio Grande do Sul State (12.0%), in Rondonia State (18.2%), in Sao Paulo State (21.3% and 11.5%), and in Minas Gerais State (22.7% and 18.1%).

Our results identified \textit{E. nana} (14.3%) as the protozoan with the highest prevalence in the studied population, and hookworm (1.7%) as well as \textit{A. lumbricoides} (1.5%) as the most prevalent helminths; these findings are in line with those of a previous study carried out in CFM\textsuperscript{8}, which presented the prevalence of 16.0%, 1.2% and 1.8%, respectively.

These findings differ from those of Mergulhão \textit{et al.}\textsuperscript{9} and Oishi \textit{et al.}\textsuperscript{10}, who identified \textit{G. intestinalis} (28.5%) and \textit{A. lumbricoides} (14.6%), \textit{Blastocystis hominis} (8.9%) and \textit{A. lumbricoides} (2.4%) to be the most abundant, respectively.

In this sense, the correct planning of ascariasis control strategies in CFM must consider the zoonotic potential of the transmission of \textit{Ascaris} infection between pigs and humans\textsuperscript{35} since stray pigs have been observed in some communities.

The frequency of polyparasitism in the CFM was 6.2%. Studies conducted in Mecha, Ethiopia\textsuperscript{36}, Mahajanga, Madagascar\textsuperscript{37}, Pilar (Alagoas) and Curitiba (Parana), Brazil\textsuperscript{9,10} have shown that polyparasitism (18.8%, 7.5%, 69.2%, and 33.8%, respectively) is common in areas with subnormal urban densification and poor access to environmental sanitation, the latter being responsible for an 82% decrease in IPIs in adulthood\textsuperscript{36}, due to the blocking of the parasite transmission cycle.

The high frequency of some protozoa may be associated with poor sanitary conditions\textsuperscript{32} in the MA where the participants live, suggesting environmental contamination by feces\textsuperscript{10}, since the variable “Major Area” was statistically significant when associated with infection by intestinal parasites. Although the Federal Government’s “Growth Acceleration Program” was implemented at CFM (started in 2007 and ended in 2010), it could not eliminate the floods that frequently occur due to the overflow of rivers caused by the vital flow of summer rains nor with the clandestine connections of water and sewage, which make the residents even more vulnerable to IPIs.

The low frequency of helminths in CFM may be due to some factors, including (i) the lack, in almost the entire area of CFM, of favorable conditions for the development of parasite cycles in the soil; (ii) self-medication practices due to easy access to anthelmintics in local pharmacies; or (iii) the prescription of anthelmintics during health care provided by Family Health Strategy professionals\textsuperscript{2}, since campaigns for mass administration of anthelmintics do not include the age group studied\textsuperscript{8}.

Although most participants reported having “ceramic floors” in their homes, the prevalence of hookworms and \textit{Strogyloides stercoralis} were high, and this finding may be due to: (i) many men do not know that “do not walk barefoot” is a preventive measure for IPIs; (ii) the participants did not have an appointment with a health professional for a long time; and/or (iii) the participants did not have a coproparasitological examination requested for a lengthy period.

This study identified an elevated frequency of \textit{B. hominis}, a parasite not identified in a previous study conducted at CFM in 2015 and 2016\textsuperscript{6}. This finding may be associated with increased environmental contamination by feces, intense fecal-oral transmission, lack of sanitation, and poorer water quality, corroborating studies conducted in Madagascar\textsuperscript{27} and in a periurban area of Curitiba, Brazil\textsuperscript{10}.
The evaluation of polyparasitism found that 94.1% of men had at least one commensal protozoa, reinforcing the existence of a high fecal-oral transmission of parasites in CFM, with greater emphasis on MA 1, which had already been identified in a previous study at CFM as the MA with the highest prevalence of parasitic diseases and environmental contamination due to disorderly human occupation. In response to the KAPQ, the most cited source of infection in all MAs was “dirt/lack of hygiene.” This finding corroborates a previous study carried out in the same area, which identified that the general population already had this understanding, as also evidenced when exclusively studying males.

Studies conducted in areas of Ethiopia highlighted the importance of personal hygiene, especially handwashing with soap and water after defecation and before meals, as a prophylactic measure for IPIs transmission. These measures, however, should be combined with water treatment, environmental sanitation, and medically supervised treatment of parasitized individuals.

When asked about the habitat of the parasites in the human body and their destination when they leave this host, most participants answered “intestine” and “sewage,” respectively. These results confirm the results of Ignacio et al., since men recognize the possibility of the presence of the parasite in feces and, consequently, in the sewage system, allowing the carriage of eggs and cysts and the maintenance of IPIs transmission. This is the case in areas where human occupation occurred in a disorderly manner with a lack of housing planning and with poor environmental sanitation.

It is noteworthy that about 45% of the respondents said that the parasite “dies” when eliminated from the human body. The lack of knowledge about the life cycle of the parasite outside the human host was statistically significant when associated with the quality of water unsuitable for human consumption, indicating the need of integrated practices of health education to improve the quality of care of water for human consumption and the management of self-care of IPIs.

Although most respondents reported symptoms that are not related to IPIs, “diarrhea” was the most cited. This result differs from those described by Ignacio et al., for which the most frequent symptom was “abdominal pain,” but reinforces the result of Kassaw et al. This can be explained by the fact that most intestinal parasitic infections are asymptomatic or present variable clinical manifestations common to other diseases, which may vary according to the etiologic agent, parasite load, and factors related to the host.

As for “attitude towards the disease,” most participants stated, “to seek help/treatment.” However, about 35% stated that they were self-medicated, showing that residents were unaware that the ingestion of antiparasitic drugs without prior coproparasitological diagnosis and medical follow-up could lead to parasite resistance and changes in their microbiota. These actions make it difficult to properly treat IPIs, contributing to the maintenance and transmission of these diseases and masking the lack of environmental sanitation in the territory. This practice may be associated with male resistance to seek care at health services, easy access to medication and negligence on the part of the public health services.

As for preventive measures, “have hygiene/handwashing” was the most cited strategy. According to Feleke et al., personal hygiene and washing hands regularly with soap and water reduce the chances of IPIs by 96% and 60%, respectively, thus making them crucial strategies for the prevention of IPIs and themes for health education practices in the population of CFM.

Limitations of the study

Individuals who refused to collaborate with the study after registration or who were not at home during visits by the research team were limitations to the study that should be considered when interpreting the results. Of the participants, 27.2% did not provide stool samples and 37.2% did not provide samples of household water for human consumption.

CONCLUSION

IPIs remain a severe public health problem in urban slums in Rio de Janeiro city, RJ, Brazil, and are neglected by Brazilian health authorities. This scenario reinforces the need to develop public policies focusing on environmental sanitation in slums, as well as greater funding and professional training in the areas of health and education for the control of these diseases with vulnerable populations. It also calls for greater funding so that there will be sufficient and quality public services with the guarantee of free access for the population’s health.

Our results indicated that the household can be considered strategic for primary health care activities of male residents in urban slums. This is because the household is a place where it is possible to develop integrated education and health practices that qualify the care of water for human consumption and the control of IPIs with participants, families, and the community. Therefore, KAP about IPIs, social determinants of health and local culture must be
considered to reduce gender inequalities in offered health practice, along with increasing men’s access to public services at this level of health care.

This study showed the need for a review of the Brazilian Policy for Integral Attention to Men’s Health by Brazilian health authorities. The policy should include social health determinants and the appreciation of popular knowledge and local culture and propose the household as a strategy for practices aimed at men’s health care.

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AUTHORS’ CONTRIBUTIONS

JCPB: conceptualization, formal analysis, investigation, methodology, project administration, validation; Visualization, writing; ETP: formal analysis, methodology, writing; MECS: formal analysis, methodology; MFLA: investigation, methodology, project administration, supervision, validation, writing; KNFG: formal analysis, methodology; ASM: funding acquisition, methodology, resources, validation, visualization; writing; JAAS: formal analysis, investigation, methodology, writing; MNB: conceptualization, formal analysis, investigation, methodology, project administration, supervision, validation, visualization, writing; AHAMN: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources; supervision, validation, visualization, writing.

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