REVISTA DO INSTITUTO DE MEDICINA TROPICAL DE SÃO PAULO

JOURNAL OF THE SÃO PAULO INSTITUTE OF TROPICAL MEDICINE

ORIGINAL ARTICLE

http://doi.org/10.1590/S1678-9946202264041

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

Julio Cesar Pegado Bordignon [1,2], Érica Tex Paulino [1,2,3], Milena Enderson Chagas da Silva [1], Maria de Fatima Leal Alencar [1], Keyla Nunes Farias Gomes [3], Adriana Sotero-Martins [4], José Augusto Albuquerque dos Santos [3], Marcio Neves Boia [5,6], Antonio Henrique Almeida de Moraes Neto [1]

[1]Fundação Oswaldo Cruz, Instituto Oswaldo Cruz, Laboratório de Inovações em Terapias, Ensino e Bioprodutos, Rio de Janeiro, Rio de Janeiro, Brazil

[2]Fundação Oswaldo Cruz, Instituto Oswaldo Cruz, Programa de Pós-Graduação em Medicina Tropical, Rio de Janeiro, Rio de Janeiro, Brazil

[3]Fundação Oswaldo Cruz, Instituto Oswaldo Cruz, Laboratório de Avaliação e Promoção da Saúde Ambiental, Rio de Janeiro, Rio de Janeiro, Brazil

[4]Fundação Oswaldo Cruz, Escola Nacional de Saúde Pública Sérgio Arouca, Departamento de Saneamento e Saúde Ambiental, Rio de Janeiro, Rio de Janeiro, Brazil

[5]Fundação Oswaldo Cruz, Instituto Oswaldo Cruz, Laboratório de Biologia e Parasitologia de Mamíferos Silvestres Reservatórios, Rio de Janeiro, Rio de Janeiro, Brazil

[6]Universidade do Estado do Rio de Janeiro, Faculdade de Ciências Médicas, Rio de Janeiro, Rio de Janeiro, Brazil

Correspondence to: Antonio Henrique Almeida de Moraes Neto
Fundação Oswaldo Cruz, Instituto Oswaldo Cruz, Laboratório de Inovações em Terapias, Ensino e Bioprodutos, Avenida Brasil, 4365, Pavilhão Lauro Travassos, Salas 16 e 18, CEP 21040-900, Rio de Janeiro, RJ, Brazil
Tel: +55 21 2562-1054
Fax: +55 21 2562-1604

E-mail: ahmn@ioc.fiocruz.br, antoniomoraesnetofiocruz@gmail.com

Received: 27 January 2022

Accepted: 4 May 2022

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 incapacitation for work and productivity, which oppose the Sustainable Development Goals of the United Nations[1].

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[2]. They can also reduce adult productivity[2] and cause high morbidity and mortality in vulnerable areas[3], resulting in a global loss of 39 million disability-adjusted life years (DALYs) per year[4].

Although infections by *Giardia intestinalis*, *Entamoeba histolytica/dispar* and *Cryptosporidium* spp. are common worldwide[3], the World Health Organization (WHO) recommends periodic administration of anthelmintics in populations at risk[5] as a prevention and control strategy, without taking into account IPIs caused by protozoa.

Routine coproparasitological screening is limited in Brazil[6] 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[7]. Despite public policies[8] and WHO recommendations[5], Brazilian studies[9,10] 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/Parana were found to have an overall prevalence of IPIs of 87.6% and 24.8%, respectively[9,10]. A recent study reported that the overall prevalence of IPIs in Rio de Janeiro State (RJ) ranges from 18.3% to 66%[11].

Studies conducted in Brazil have reported a higher prevalence of IPIs in men than in women. Oishi *et al.*[10] found a prevalence of 25.1% in men and 24.5% in women, while Faria *et al.*[11] found a 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%)[6].

However, few studies published in the last ten years have dealt with IPIs in more detail in populations living in urban slums in Brazil[6,12]. 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[13].

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[14], participant-observation[15] and action research[16] with a convenience sample. It was developed with male individuals aged 20 to 59 years[17] 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)[18]. 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[6], 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[19]. In 2017, there were about 17,000 households and 42,000 inhabitants, of which 14,137 were male and aged 20 to 59 year saccording 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[15] 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)[20].

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[21], and the KAPQ, with open and closed questions about IPIs[22].

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)[23].

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[24], with three slides read per sample[25], centrifugal flotation in sucrose medium[26], positive thermo-hydrotropism[27] and quali-quantitative method for geohelminths[28], 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.[23].

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[29], as described by Ignacio *et al.*[22].

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	Major Areas n (%)					
	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)

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. (cont.)

Characteristics	Major Areas n (%)					
	MA1 (n=96)	MA2 (n=207)	MA3 (n=48)	MA4 (n=192)	MA5 (n=81)	Total (n=624)
Walls						
Unfinished masonry	7 (7.29)	3 (1.5)	4 (8.3)	5 (2.6)	3 (3.7)	22 (3.5)
Masonry with finishing	89 (92.7)	202 (97.6)	44 (91.7)	186 (96.9)	77 (95.1)	598 (95.8)
Wood	-	1 (0.5)	-	-	-	1 (0.2)
Did not answer	-	1 (0.5)	-	1 (0.5)	1 (1.2)	3 (0.5)
Water Supply						
Some water reservoir	80 (83.3)	139 (67.1)	23 (47.9)	79 (41.1)	75 (92.6)	396 (63,4)
Water tanks	78 (81.3)	134 (64.7)	23 (47.9)	74 (38.5)	70 (86.4)	379 (60.7)
Water tanks and cisterns	1 (1.0)	-	-	1 (0.5)	3 (3.7)	5 (0.8)
Cistern	1 (1.0)	2 (0.9)	-	-	2 (2.5)	5 (0.8)
Other (bucket/vessel)	-	3 (1.5)	-	4 (2.1)	-	7 (1.1)
Did not answer	16 (16.7)	67 (32.4)	25 (52.1)	114 (59.3)	6 (7.4)	228 (36.5)
Did not know	-	1 (0.5)	-	-	-	1 (0.2)
Toilet						
With tank	93 (96.9)	202 (97.6)	47 (97.2)	190 (98.9)	81 (100.0)	613 (98.2)
Without tank	3 (3.1)	5 (2.4)	-	1 (0.5)	-	9 (1.4)
Did not have	-	-	1 (2.1)	1 (0.5)	-	2 (0.3)
Garbage collection						
Public System	96 (100.0)	199 (96.1)	48 (100.0)	185 (96.4)	79 (97.5)	607 (97.3)
Other	-	3 (1.5)	-	3 (1.6)	-	6 (0.9)
Did not answer	-	1 (0.5)	-	3 (1.6)	2 (2.5)	6 (0.9)
Did not know	-	4 (1.9)	-	1 (0.5)	-	5 (0.8)

Minimum wage = US$ 294.44.

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

Table 2 - Care and analysis of water for human consumption in households of male residents in the Complexo de Favelas de Manguinhos communities, Rio de Janeiro city, RJ State, Brazil, February 2018 to December 2019.

Evaluated parameter	Answers	Major Areas n (%)					Total
		MA1	MA2	MA3	MA4	MA5	n (%)
Water tank cleaning time (n=384)	Less than 6 months	21 (26.6)	58 (43.3)	12 (52.2)	27 (36.0)	22 (30.1)	140 (36.4)
	6 months to 1 year	23 (29.1)	24 (17.9)	2 (8.7)	21 (28.0)	11 (15.1)	81 (21.1)
	1 year	1 (1.2)	-	-	-	-	1 (0.3)
	> 1 year	13 (16.5)	20 (14.9)	2 (8.7)	12 (16.0)	17 (23.3)	64 (16.7)
	Do not wash	6 (7.6)	11 (8.2)	-	-	6 (8.2)	23 (6.0)
	Did not answer	6 (7.6)	3 (2.3)	2 (8.7)	3 (4.0)	-	14 (3.6)
	Did not know	9 (11.4)	18 (13.4)	5 (21.7)	12 (16.0)	17 (23.3)	61 (15.9)
Access (n=624)	Purchase	6 (6.3)	7 (3.4)	5 (10.4)	1 (0.5)	2 (2.5)	21 (3.3)
	Public system	90 (93.7)	200 (96.6)	42 (87.5)	191 (99.5)	79 (97.5)	602 (96.5)
	Did not know	-	-	1 (2.1)	-	-	1 (0.2)
Treats water (n=624)	Yes	67 (69.8)	146 (70.5)	30 (62.5)	188 (97.9)	64 (79.0)	495 (79.3)
	No	22 (22.9)	61 (29.5)	18 (37.5)	4 (2.1)	17 (21.0)	122 (19.6)
	Did not answer	7 (7.3)	-	-	-	-	7 (1.1)
Water treatment strategy (n=624)	Strain	-	2 (1.0)	-	1 (0.5)	-	3 (0.5)
	Boil	-	2 (1.0)	-	1 (0.5)	-	3 (0.5)
	Filtering	66 (68.8)	128 (61.8)	29 (60.4)	134 (69.8)	56 (69.1)	413 (66.2)
	Other	1 (1.0)	14 (6.8)	-	2 (1.0)	8 (9.9)	25 (4.0)
	Did not answer	29 (30.2)	61 (29.4)	19 (39.6)	54 (28.2)	17 (21.0)	180 (28.8)
Water potability standard (n=392)	Unsuitable for consumption	12 (17.1)	64 (48.5)	3 (25.0)	41 (35.3)	21 (33.9)	141 (36.0)
	Satisfactory	58 (82.9)	68 (51.5)	9 (75.0)	75 (64.7)	41 (66.1)	251 (64.0)
Water quality parameters (n=392)	Total hardness (mg/L $CaCO_3$)	165.0 ± 51.1	18.2 ± 7.6	155.6 ± 44.7	118.2 ± 134.8	28.8 ± 45.2	80.4 ± 99.3
	pH	5.5 ± 0.4	5.6 ± 0.5	5.5 ± 0.3	5.4 ± 0.5	5.4 ± 0.5	5.5 ± 0.5
	Conductivity (µS/cm)	94.5 ± 13.6	86.7 ± 60.3	52.6 ± 19.5	109.8 ± 72.0	121.2 ± 63.5	99.2 ± 60.4
	Total dissolved solids	49.1 ± 8.1	38.8 ± 26.8	31.5 ± 15.9	55.0 ± 33.7	57.6 ± 29.4	48.1 ± 28.2
	Chlorides (mg/L Cl^-)	12.6 ± 4.8	10.3 ± 4.1	13.9 ± 7.4	20.0 ± 21.8	15.2 ± 12.5	14.5 ± 13.8
	Total alkalinity (mg/L $CaCO_3$)	28.6 ± 9.1	24.8 ± 7.2	27.6 ± 9	29.3 ± 11.0	25.2 ± 8.4	27.0 ± 9.2
	N-ammonia (mg/L)	0.2 ± 0.3	0.1 ± 0.1	0.0 ± 0.1	0.0 ± 0.1	0.1 ± 0.1	0.1 ± 0.2
	N-nitrite (mg/L)	0.1 ± 0.1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.1
	Sulfates (mg/L SO_4=)	11.4 ± 7.3	5.2 ± 3.5	5.6 ± 7.3	12.8 ± 6.2	10.8 ± 7.3	9.5 ± 6.7
	Turbidity (NTU)	0.5 ± 1.2	3.5 ± 10.2	0.8 ± 0.9	1.2 ± 1.7	1.5 ± 1.2	1.9 ± 6.2
	Total coliforms (CFU/mL)	0.4 ± 2.7	4.8 ± 19.9	4.8 ± 11.8	1.3 ± 7.1	3.3 ± 13.7	2.8 ± 13.7
	Escherichia coli (CFU/mL)	0.0 ± 0.0	0.0 ± 0.4	0.0 ± 0.0	0.0 ± 0.0	0.1 ± 0.3	0.0 ± 0.3
	Salmonella sp (CFU/mL)	0.0 ± 0.0	0.4 ± 2.3	0.0 ± 0.0	0.3 ± 2.9	0.0 ± 0.0	0.2 ± 2.1

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
	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)	108 (100)
Monoparasitism	17 (20.5)	17 (11.0)	8 (29.6)	26 (20.5)	12 (19.4)	80 (17.6)
Protozoan Infections	13 (15.6)	14 (9.0)	6 (22.2)	22 (17.3)	11 (17.7)	66 (14.5)
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	4 (4.8)	3 (1.9)	2 (7.4)	4 (3.1)	1 (1.6)	14 (3.0)
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)
Trichuris 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						
Protozoan Infections	10 (12.0)	2 (1.2)	1 (3.7)	3 (2.4)	1 (1.6)	17 (3.7)
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 butschlli*	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						
Protozoan Infections						
Blastocystis hominis + *Endolimax nana* + *Iodamoeba butschlli*	1 (1.2)	-	-	-	-	1 (0.2)
Entamoeba coli + *Entamoeba histolytica/dispar* + *Iodamoeba butschlii*	-	1 (0.6)	-	-	-	1 (0.2)
Entamoeba coli + *Entamoeba histolytica/dispar* + *Endolimax nana*	-	1 (0.6)	-	-	-	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 (0.6)	-	-	-	1 (0.2)
Strongyloides stercoralis + *Endolimax nana* + *Entamoeba histolytica/díspar*	1 (1.2)	-	-	-	-	1 (0.2)
Four parasites detected						
Protozoan Infections						
Blastocystis hominis + *Endolimax nana* + *Entamoeba coli* + *Entamoeba histolytica/dispar*	1 (1.2)	-	-	-	-	1 (0.2)

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.

Evaluated parameter	Answers	Major Areas n (%)					Total
		MA 1	MA 2	MA 3	MA 4	MA 5	
		(n=96)	(n=207)	(n=48)	(n=192)	(n=81)	
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 know	12 (12.5)	-	11 (22.9)	28 (14.6)	1 (1.2)	52 (8.3)
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 know	18 (18.8)	-	5 (10.4)	20 (10.4)	-	43 (6.9)
Parasite destination site	Environment	3 (3.1)	20 (9.7)	-	14 (7.3)	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 know	25 (26.0)	-	14 (29.2)	27 (14.1)	1 (1.2)	67 (10.7)
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 know	23 (24.0)	1 (0.5)	6 (12.5)	25 (13.0)	-	55 (8.8)
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 know	35 (36.5)	2 (1.0)	15 (31.3)	60 (31.3)	-	112 (17.9)
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 know	14 (14.6)	37 (17.9)	7 (14.6)	33 (17.2)	13 (16.0)	104 (16.7)

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	Major Areas n (%)					Total
		MA 1	MA 2	MA 3	MA 4	MA 5	
		(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 - 173)	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		

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).

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[13,17].

In Ethiopia[30] and Iran[31], 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[10] found male individuals to have a

Table 6 - Association between responses to the intestinal parasitic infections knowledge, attitudesand 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[a]	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
Doid 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, attitudesand 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)	0.327 (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[a]	1 (0.7)	0.21 (0.02 - 1.75)	0.16[a]
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 (0.26 - 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[a]	1 (0.7)	0.35 (0.04 - 3.03)	0.42[a]
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[a]*	2 (1.4)	3.59 (0.32 - 40.02)	0.29[a]
Did not answer	1 (0.9)	0.53 (0.06 - 4.44)	1.00[a]	2 (1.4)	3.59 (0.32 - 40.02)	1.00[a]
What do you do to prevent having worms?						
Hygiene/hand washing	69 (63.9)	1.32 (0.84 - 2.06)	0.21	83 (58.9)	1.19 (0.78 - 1.80)	0.41
Do not walk barefoot	5 (4.6)	0.88 (0.32 - 2.44)	0.81	8 (5.7)	1.01 (0.41 - 2.49)	0.96
Avoid hands in the mouth	3 (2.8)	3.26 (0.65 - 16.42)	0.14[a]	1 (0.7)	0.29 (0.03 - 2.44)	0.42[a]
Filter water	11 (10.2)	1.19 (0.57 - 2.47)	0.63	14 (9.9)	1.20 (0.59 - 2.45)	0.60
Do not eat sweets	2 (1.8)	0.38 (0.08 - 1.72)	0.26[a]	6 (4.7)	0.97 (0.35 - 2.68)	0.95
Other	54 (50.0)	0.95 (0.6 - 1.47)	0.83	68 (48.2)	0.85 (0.56 - 1.28)	0.45
Did not know	5 (4.6)	1.81 (0.59 - 5.54)	0.28	2 (1.4)	0.34 (0.07 -1.60)	0.22[a]
Did not answer	2 (1.8)	0.79 (0.16 - 3.81)	0.77[a]	2 (1.4)	0.38 (0.08 -1.81)	0.34[a]

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[13], 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[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[19]. Our results corroborated the study conducted in the city of Jimma, Ethiopia[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[33] and overflow because of frequent heavy rains.

Regarding the physicochemical and microbiological analyses of water for human consumption, Handan *et al.*[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 *E. coli* and *Salmonella* 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 *et al.*[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 *E. nana* (14.3%) as the protozoan with the highest prevalence in the studied population, and hookworm (1.7%) as well as *A. lumbricoides* (1.5%) as the most prevalent helminths; these findings are in line with those of a previous study carried out in CFM[6], which presented the prevalence of 16.0%, 1.2% and 1.8%, respectively.

These findings differ from those of Mergulhão *et al.*[9] and Oishi *et al.*[10], who identified *G. intestinalis* (28.5%) and *A. lumbricoides* (14.6%), *Blastocystis hominis* (8.9%) and *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 *Ascaris* infection between pigs and humans[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[36], Mahajanga, Madagascar[37], Pilar (Alagoas) and Curitiba (Parana), Brazil[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[36], due to the blocking of the parasite transmission cycle.

The high frequency of some protozoa may be associated with poor sanitary conditions[37] in the MA where the participants live, suggesting environmental contamination by feces[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[7], since campaigns for mass administration of anthelmintics do not include the age group studied[8].

Although most participants reported having "ceramic floors" in their homes, the prevalence of hookworms and *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 *B. hominis*, a parasite not identified in a previous study conducted at CFM in 2015 and 2016[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[37] and in a periurban area of Curitiba, Brazil[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[6].

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[22], which identified that the general population already had this understanding, as also evidenced when exclusively studying males.

Studies conducted in areas of Ethiopia[30,36] 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.*[22], 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[10].

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 qualify of care of water for human consumption and the management of self-care of IPIs[4,10].

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.*[22], for which the most frequent symptom was “abdominal pain,” but reinforces the result of Kassaw *et al.*[38]. 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[39,40]. 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[13], easy access to medication and negligence oon the part of the public health services[7].

As for preventive measures, “have hygiene/handwashing” was the most cited strategy. According to Feleke *et al.*[36], 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.

ACKNOWLEDGMENTS

We would like to thank the residents of Complexo de Favelas de Manguinhos; the professionals of *Centro de Saúde Escola Germano Sinval Faria* da *Escola Nacional de Saúde Pública*, Fiocruz e da *Clínica da Família Victor Valla*; the staff *of Laboratorio de Biologia e Parasitologia de Mamíferos Silvestres Reservatórios*, Instituto Oswaldo Cruz, Fiocruz, for logistical support and infrastructure to perform coproparasitological diagnoses; and the students of *Escola Técnica Estadual Juscelino Kubitschek*, participants of *Programa Jovens Talentos para a Ciência* da *Fundação Carlos Chagas Filho de Amparo* à *Pesquisa do Estado do Rio de Janeiro*, for technical assistance.

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.

FUNDING

This study was conducted with the support of the *Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* (CAPES) - funding code 001; TEIAS Escola – Manguinhos, *Escola Nacional de Saúde Pública*, Fiocruz; POM of the *Laboratório de Inovações em Terapias, Ensino e Bioprodutos*, Instituto Oswaldo Cruz, Fiocruz; *Fundação Carlos Chagas Filho de Amparo* à *Pesquisa do Estado do Rio de Janeiro* (FAPERJ); Financiadora de Estudos e Projetos (FINEP) [FINEP/FIOCRUZ Agreement 01.11.0025.04, Rede Morar.Ts]; and the *Vice-Presidência de Ambiente, Atenção e Promoção da Saúde*, Fiocruz.

REFERENCES

1. Organização das Nações Unidas. Agenda 2030 para o desenvolvimento sustentável. [cited 2022 May 4]. Available from: https://brasil.un.org/pt-br/91863-agenda-2030-para-o-desenvolvimento-sustentavel
2. Poague KI, Mingoti SA, Heller L. Association between water and sanitation and soil-transmitted helminthiases: analysis of Brazilian National Survey of Prevalence (2011-2015). Arch Public Health. 2021;79:83.
3. Belete YA, Kassa TY, Baye MF. Prevalence of intestinal parasite infections and associated risk factors among patients of Jimma health center request for stool examination, Jimma, Ethiopia. PLoS One. 2021;16:e0247063.
4. Eyayu T, Kiros T, Workineh L, Sema M, Damtie S, Hailemichael W, et al. Prevalence of intestinal parasitic infections and associated factors among patients attending at Sanja Primary Hospital, Northwest Ethiopia: an institutional-based cross-sectional study. PLoS One. 2021;16: e0247075.
5. World Health Organization. References and related helminths. [cited 2022 May 4]. Available from: https://www.who.int/teams/immunization-vaccines-and-biologicals/essential-programme-on-immunization/integration/linking-with-other-health-interventions/references-and-related-helminths
6. Ignacio CF, Silva ME, Handam NB, Alencar MF, Sotero-Martins A, Barata MM, et al. Socioenvironmental conditions and intestinal parasitic infections in Brazilian urban slums: a cross-sectional study. Rev Inst Med Trop Sao Paulo. 2017;59:e56.
7. Teixeira PA, Fantinatti M, Gonçalves MP, Silva JS. Parasitoses intestinais e saneamento básico no Brasil: estudo de revisão integrativa. Braz J Dev. 2020;6:22867-90.
8. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Departamento de Vigilância das Doenças Transmissíveis. Guia prático para o controle das geo-helmintíases. Brasília: Ministério da Saúde; 2018. [cited 2022 May 4]. Available from: https://bvsms.saude.gov.br/bvs/publicacoes/guia_pratico_controle_geohelmintiases.pdf
9. Mergulhão NL, Santos AC, Santos SS, Silva EM, Lima Júnior MC, Couto JL. Ocorrência de enteroparasitoses em moradores de um povoado na zona periurbana do município de Pilar (Alagoas, Brasil). Braz J Dev. 2020;6:96255-66.
10. Oishi CY, Klisiowicz DR, Seguí R, Köster PC, Carmena D, Toledo R, et al. Reduced prevalence of soil-transmitted helminths and high frequency of protozoan infections in the surrounding

urban area of Curitiba, Paraná, Brazil. Parasite Epidemiol Control. 2019;7:e00115.
11. Faria CP, Zanini GM, Dias GS, Silva S, Freitas MB, Almendra R, et al. Geospatial distribution of intestinal parasitic infections in Rio de Janeiro (Brazil) and its association with social determinants. PLoS Negl Trop Dis. 2017;11:e0005445.
12. Gil FF, Busatti HG, Cruz VL, Santos JF, Gomes MA. High prevalence of enteroparasitosis in urban slums of Belo Horizonte-Brazil: presence of enteroparasites as a risk factor in the family group. Pathog Glob Health. 2013;107:320-4.
13. Cesaro BC, Santos HB, Silva FN. Masculinidades inerentes à política brasileira de saúde do homem. Rev Panam Salud Publica. 2018;42:e119.
14. Polit DF, Beck CT. Fundamentos da pesquisa em enfermagem: avaliação de evidências para a prática da enfermagem. 7ª ed. Porto Alegre: Artmed; 2011.
15. Queiroz DT, Vall J, Souza AM, Vieira NF. Observação participante na pesquisa qualitativa: conceitos e aplicações na área da saúde. Rev Enferm UERJ. 2007;15:276-83.
16. Thiollent M. Pesquisa-ação nas organizações. 2ª ed. São Paulo: Atlas; 2009.
17. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Ações Programáticas Estratégicas. Política Nacional de Atenção Integral à Saúde do Homem: princípios e diretrizes. Brasília: Ministério da Saúde; 2009. [cited 2022 May 4]. Available from: http://www.unfpa.org.br/Arquivos/saude_do_homem.pdf
18. Google Earth. Manguinhos. [cited 2022 May 4]. Available from: https://earth.google.com/web/@-22.87993893,-43.24916595,6.53450765a,5174.3030091d,35y,36.58237419h,45.00017262t,0r
19. Handam NB, Santos JA, Moraes Neto AH, Alencar MF, Ignacio CF, Sotero-Martins A. Drinking water quality in Brasilian urban slums. Rev Ambient Agua. 2020;15:e2532.
20. Médecins du Monde. The KAP survey model (knowledge, attitude & practices). [cited 2022 May 4]. Available from: https://www.spring-nutrition.org/publications/tool-summaries/kap-survey-model-knowledge-attitudes-and-practices
21. Instituto Brasileiro de Geografia e Estatística. Censo demográfico 2010: características da população e dos domicílios: resultado do universo. Rio de Janeiro: IBGE; 2011. [cited 2022 May 4]. Available from: https://biblioteca.ibge.gov.br/visualizacao/periodicos/93/cd_2010_caracteristicas_populacao_domicilios.pdf
22. Ignacio CF, Barata MM, Moraes Neto AH. The Brazilian Family Health Strategy and the management of intestinal parasitic infections. Prim Health Care Res Dev. 2018;19:333-43.
23. Brasil. Ministério da Saúde. Gabinete do Ministro. Portaria de Consolidação Nº 5, de 28 de setembro de 2017. Consolidação das normas sobre as ações e os serviços de saúde do Sistema Único de Saúde. Diário Oficial da União, Brasília, 28 set. 2017.
24. Lutz A. O Schistosomum mansoni e a Schistosomatose segundo observações, feitas no Brasil. Mem Inst Oswaldo Cruz. 1919;11:121-55.
25. Tibiriçá SH, Abramo C, Simões AS, Pinheiro IO, Ribeiro LC, Coimbra ES. Validação do número de lâminas para realização do método de sedimentação espontânea das fezes. HU Rev. 2009;35:105-10.
26. Sheather AL. The detection of intestinal protozoa and mange parasites by a flotation technique. J Comp Pathol Ther. 1923;36:266-75.
27. Moraes RG. Contribuição para o estudo do Strongyloides stercoralis e da estrongiloidíase no Brasil. Rev Serv Saude Publica. 1948;1:507-624.
28. Katz N, Chavez A, Pellegrino J. A simple device for quantitative stool thick-smear technique in schistosomiasis mansoni. Rev Inst Med Trop Sao Paulo. 1972;14:397-400.
29. Rey L. Base da parasitologia médica. 3ª ed. Rio de Janeiro: Guanabara Koogan; 2010.
30. Berhe B, Bugssa G, Bayisa S, Alemu M. Foodborne intestinal protozoan infection and associated factors among patients with watery diarrhea in Northern Ethiopia; a cross-sectional study. J Health Popul Nutr. 2018; 37:5.
31. Kazemi E, Rostamkhani P, Hooshyar H. A survey on prevalence of intestinal parasites infections in patients referred to the Public Hospital in Khoy, West Azarbaijan Province, Iran, 2014-2016. Avicenna J Clin Microbiol Infect. 2017;4:56114.
32. Instituto Brasileiro de Geografia e Estatística. Diretoria de Pesquisas. Coordenação de População e Indicadores Sociais. Síntese de indicadores sociais: uma análise das condições de vida da população brasileira: 2020. Rio de Janeiro: IBGE; 2020. [cited 2022 May 4]. Avalable from: https://biblioteca.ibge.gov.br/visualizacao/livros/liv101760.pdf
33. Handam NB, Santos JA, Moraes Neto AH, Duarte AN, Alves EB, Salles MJ, et al. Sanitary quality of the rivers in the Communities of Manguinhos' Territory, Rio de Janeiro, RJ. Rev Ambient Agua. 2018;13:e2125.
34. Celestino AO, Vieira SC, Lima PA, Rodrigues LM, Lopes IR, França CM, et al. Prevalence of intestinal parasitic infections in Brazil: a systematic review. Rev Soc Bras Med Trop. 2021;54:e0033-2021.
35. Monteiro KJ, Calegar DA, Santos JP, Bacelar PA, Coronato-Nunes B, Reis ER, et al. Genetic diversity of Ascaris spp infecting humans and pigs in distinct Brazilian regions, as revealed by mitochondrial DNA. PLoS One. 2019;14:e0218867.
36. Feleke BE, Beyene MB, Feleke TE, Jember TH, Abera B. Intestinal parasitic infection among household contacts of primary cases, a comparative cross-sectional study. PLoS One. 2019;14:e0221190.
37. Greigert V, Abou-Bacar A, Brunet J, Nourisson C, Pfaff AW, Benarbia L, et al. Human intestinal parasites in Mahajanga, Madagascar: the kingdom of the protozoa. PLoS One. 2018;13:e0204576.

38. Kassaw MW, Abebe AM, Abate BB, Zemariam AB, Kassie AM. Knowledge, attitude and practice of mothers on prevention and control of intestinal parasitic infestations in Sekota Town, Waghimra Zone, Ethiopia. Pediatric Health Med Ther. 2020;11:161-9.
39. Müller J, Hemphill A, Müller N. Physiological aspects of nitro drug resistance in Giardia lamblia. Int J Parasitol Drugs Drug Resist. 2018;8:271-7.
40. Palmeirim MS, Hurlimann E, Knopp S, Speich B, Belizario Junior V, Joseph SA, et al. Efficacy and safety of co-administered ivermectin plus albendazole for treating soil-transmitted helminths: a systematic review, meta-analysis and individual patient data analysis. PLoS Negl Trop Dis. 2018;12:e0006458.