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RESEARCH ARTICLE

PREVALENCE OF ENTAMOEBA HISTOLYTICA AND GIARDIA LAMBLIA AMONG PATIENTS ATTENDING SOME HOSPITALS IN AL-MANSSORA DIRECTORATE, ADEN – YEMEN

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Abstract

This study was conducted from October 2019 to October 2020.To determine the prevalence of *Entamoeba histolytica* and *Giardia lamblia* among patients attending some hospitals (22 May Hospital, Cuban Hospital, Al-Naqeeb Hospital, Al Salam Hospital) in Al-manssora Directorate, Aden - Yemen. This study included 603 patients. Stool samples were obtained from all participants and laboratory conducted using a direct mount preparation with physiological normal saline (0.9%) and iodine stain. The results of the current study showed that the overall prevalence rate was 384/603 (63.68%). The prevalence of *E. histolytica* and *G. lamblia* was higher among males (33.34%) than that in female (30.34%). The prevalence rate of these parasites was higher in the age group between 20-67 years old (36.31%), followed by the age group (10-19) years. The study concluded that the prevalence of *Entamoeba histolytica* and *Giardia lamblia* among diarrheal patients in Al-manssora Directorate, Aden – Yemen was high

Keywords: *Entamoeba histolytica*, *Giardia lamblia*, Intestinal protozoa.

Introduction

Protozoa classified into four classes, Amoeba, Flagellates, Ciliophora, and Coccidian [1]. Several epidemiological studies have been carried out in Yemen to investigate the prevalence of intestinal parasitic infections [2-12]. Protozoan infections were amongst the leading causes of morbidity and mortality throughout the world [13]. With more than 58 million diarrheal cases detected each year [14]. However, it was difficult to determine the actual burden of protozoan infections due to under reporting. Intestinal protozoan infections contribute to malnutrition, protein and iron deficiencies, and an increment on health costs, as well as a long-term deleterious effects [15].

Protozoa are unicellular organisms inhabiting the intestinal tract of humans [16]. Infections usually occur through ingestion contaminating food or drinking water with cysts [17]. There were a number of intestinal protozoa that cause diarrhea but *E. histolytica* and *G. lamblia* were the most important causes of diarrhea [14].

Intestinal protozoan diseases in Yemen were a significant health problem with prevalence rate ranging from 18% to 27% [2]. In addition, Yemen is one of the poorest countries in the world, with more than 50% of the total population (26 million people) living under the national poverty line [18]. Yemen located at the southern part of the Arabian Peninsula, the country depends totally on ground water and rain water as a source of water. The country has fallen into a deep-water crisis characterized by very rapid mining of groundwater extreme water supply shortages in the major cities, and limited access of the population to safe drinking water [19]. Only 25% of the population have access to primary healthcare services, sanitation, and safe drinking water [20]. The current civil war that started in March 2015 has worsened the situation; over 2 million people have been internally displaced, and the prevalence of infectious diseases has increased [21].

The Amoebiasis and Giardiasis caused by public health problems in most developing countries as well as some developed countries. *G. lamblia and E. histolytica* were considered to be one of the leading diarrhea in both children and adults [22]. Adequate knowledge of the

geographical distribution of protozoa and the demographic variables that influence their prevalence of importance for effective control of infection in at-risk populations [23]. The current status of *G. lamblia* and *E. histolytica* agents still needs to be evaluated, thus this study was conducted to determine the prevalence and some associated risk factors of *E. histolytica* and *G. lamblia* infections among patients attending some hospitals in Al-manssora Directorate, Aden – Yemen.

Materials and Methods

Study Design

The study was cross-sectional conducted to detect *E. histolytica* and *G. lamblia infections* in the patients.

Study population

The study included patients who attended to some different and private hospitals in Al-manssora Directorate, Aden – Yemen.

Study area

Aden governorate is located along the southern coast of Republic of Yemen. It lies at (12^{O} - 47'N) latitude and (44^{O} - 58'E) longitude it is a semi island. [24] Aden is about 363 kilometers far from the capital Sana'a. It occupied about 750 km^2 and divided into eight districts. The population of Aden governorate is 684,322 [25].

Inclusion criteria

Patients who have diarrhea not depended on age, gender, social status, and living area.

Exclusion criteria

Patients who have diarrhea but not agreed to take sample from him.

Specimen size

A total of 603 specimens were collected from patients with diarrhea.

Ethical considerations

This is study was approved from Faculty of Education, of Graduate Studies and Scientific Research, and Department of Biology, Faculty of Science in Aden, Some of the patients were informed verbally using simple language about the aim and benefits of the study.

Questionnaire

The subjects from whom stool and blood samples were taken were questioned by asking them to answer questions related to factors social and behavioral such as: name, gender, area of residence, family size, family occupation, availability of latrine, source of water ,hand washing habits, latrine usage habit , habit of swimming.

Stool Samples Collection

Clean plastic cups were used for stool samples collection avoiding presence of urine or any other substances that may lead to false examination.

Macroscopically Examination

It was performed by observing grossly the consistency of stool samples, blood, mucus and the colour of stool.

Microscopically Examination

Wet preparation technique

About 2 mg of faces were mixed with one or two drops of physiological saline (0.9 gm/dl) on a slide and covered with a cover-glass and examined microscopically using low power objective lens (10X), followed by high objective lenses (40X), at least three smears were examined for each sample [26].

Each specimen was examined microscopically by preparing saline, 2% iodine solution, methylene blue wet mounts, [26].

Direct method of the concentration technique by simple centrifugation.

About 1 gram of faces was added to 14 ml of normal saline (0.9 g/dl) in a conical tube and the faces was broken by glass rod and mixed with normal saline. Then the conical tube, was centrifuged at 1500 in a centrifuge. The supernatant was discarded (about 3 times) till it was clear. The sediment was then mixed and mounted to a slide and covered with a cover-glass and examined under microscope firstly with 10x and then with 40x [27].

Formalin – Ether sedimentation technique:

All specimens were kept in refrigerator set at 4 ºC for not more than 24 hour before examination. These specimens were used for formalin-ether sedimentation. Approximately 2 g of stool were emulsified in a wax-paper cupusing applicator sticks in 20 ml of distilled water. Half of this suspension was then filtered through two layers of gauze into each of two 15 ml-conical tubes and centrifuged at 1,500 r.p.m. for 2 min [28]. The supernatant was then discarded. The 10 ml of 10% formalin was added to each tube, and the sediment was thoroughly mixed and allowed to fix for at least 10 min. The 1 ml of diethyl ether was then added to tube, tubes were then closed with a stopper, inverted, shaken vigorously for 30 s and the mixture was re-centrifuged at 1,500 r.p.m. for 2 min.

After loosening the debris plug, the top three layers were discarded. The sediment was mixed using a wooden stick and transferred onto a clean glass slide for microscopic examination. The slides were examined under light microscope at the magnifications of 400x, respectively [28].

Divide patients into age groups:

- The first age group of (1-9) years
- The second age group of (10-19) years
- The third age group of (20-67) years

Statistical analysis

Statistical analysis of the data was performed using T-test, Analysis of variance (ANOVA) and LSD were applied to find the significant difference between the data by using the Statistical Package for the Social Sciences (SPSS) (version 21).

Results

Intestinal protozoan (*E. histolytica* and *G. lamblia*) was found in 384/603 (63.68%) samples against 219/603 (36.32%) other parasites intestinal (*Entamoeba coli, Strongyloides* spp., *Ascaris lumbricoides, Hymenolepis nana, Enterobius vermicularis*).This study record that the number and percentage of parasite as follows: *E. histolytica* 162(26.87%), *G. lamblia* 60(9.95%), CO-infection 120 (19.90%), Multi infection 42 (6.96%) (Fig 1)

Table (1) shows the percentage of intestinal protozoan infection in both males and females, as the infection in males was higher than that of females, as its rate in males reached 201/603 (33.34%) and in females 183/603 (30.34%).With statistical differences that did not reach a significant degree. (t = 1.042, P = 0.298) in both sexes.

The infection with *E. histolytica* was the highest, with its rate in males 84/603 (13.93%) and in females 78/603 (12.94%), followed by co-infection (*E. histolytica + G. lamblia*,) which was in males 54/603 (8.96%) and 66/603 (10.94%) in females. Followed by *G. lamblia*, which was 39/603(6.47%) in males and in females 21/603 (3.48%), while the rate of multi infection was *E. histolytica +G. lamblia +E. Coli* in males 9/603 (1.49%) and females 7/603 (1.16%), *E. histolytica +G. lamblia + E. vermicularis* in males 6/603 (1.00%) and females 4/603 (0.66%), *E. histolytica +G. lamblia + Strongyloides* in males 4/603 (0.66%) and females 2/603 (0.33%), *E. histolytica +G. lamblia +A. lumbricoides* in males 3/603(0.50%) and females 2/603 (0.33%), *E. histolytica +G. lamblia +H .nana* in males 2/603(0.33%) and females 3/603 (0.50%) .Statistically and by using the chi-square test (x^2), which showed significant differences in parasite infection *Giardia lamblia* .(x^2= 5.400, *P*= 0.020).

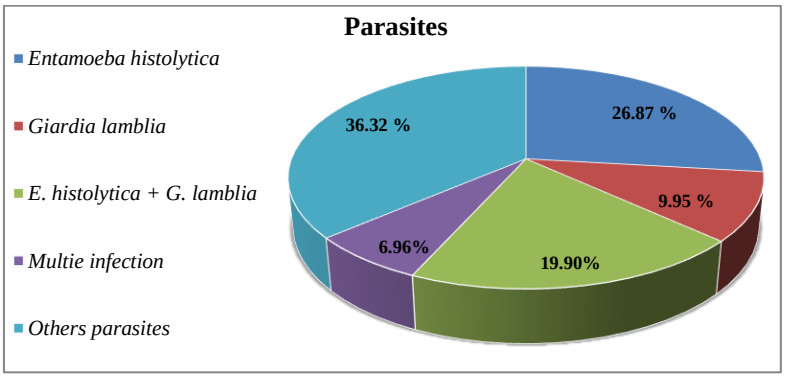

Fig (1): Intestinal protozoa infections and the other parasites among patients in some Al-manssora Directorate hospitals Aden, Yemen.

Table (1): Prevalence of intestinal protozoa infections by Sex.

Parasites	Gender			X2	P-value
	Male (n =330) NO (%)	Female (n= 273) NO (%)	Total (n=603) NO (%)		
Entamoeba histolytica	84 (13.93)	78 (12.94)	162 (26.87)	0.222	0.637
Giardia lamblia	39(6.47)	21 (3.48)	60 (9.95)	5.400	0.020
E. histolytica + G. lamblia	54 (8.96)	66(10.94)	120 (19.90)	1.200	0.273
E. histolytica + G. lamblia + E. coli	9 (1.49)	7 (1.16)	16 (2.65)	0.250	0.617
E. histolytica + G. lamblia + Strongyloides	4 (0.66)	2 (0.33)	6 (0.99)	0.667	0.414
E. histolytica + G. lamblia + A. lumbricoides	3 (0.50)	2 (0.33)	5(0.83)	0.200	0.655
E. histolytica + G. lamblia + H. nana	2 (0.33)	3 (0.50)	5 (0.83)	0.200	0.655
E. histolytica + G. lamblia + E. vermicularis	6 (1.00)	4 (0.66)	10 (1.66)	0.400	0.527
Total	**201(33.34)**	**183(30.34)**	**384(63.68)**	**0.00**	

NO = Number. X^2 =Chi-Square, t=1.042, P= 0.298. Significant at *P*-value < *0.05*

Table (2) shows the percentage of intestinal protozoan infection between different age groups. Using the ANOVA test, it was found that there are significant differences between the rate of infection with intestinal protozoan and age groups at the level of significance (*P* = 0.000).

Where the highest infection rate was recorded in the age group (20-67) years and the injury rate was 219/603 (36.31%), followed by the age group (10-19) 99/603 (16.42%) years, and the lowest infection rate was recorded in the age group (1-9) years. Its percentage was 66/603 (10.95%).To find out the trend of differences between age groups, LSD statistical analysis was used to test the least significant difference at a significance level less than (P =0.05) that showed significant differences between the infection rate the age group (20-67) years and the age group (1-9) years at the level of significance (*P* = 0.000).

Significant differences were also found between the incidence of infection in the age group (10-19) years and the age group (1-9) years at the level of significance (p = 0.001), and between the age group (1-9) years and the age group (10-19) year and the age group (20-67) year at the level of significance (P = 0.000).

In the age group (1-9) years, the highest rate of infection was *E. histolytica* 30/603 (4.98%)followed by co-infection (*E. histolytica and G. lamblia*) 21/603 (3.48%) then infection with a parasite *G. lamblia* 9 (1.49%) and the lowest rate was multiple infections, where the rate of infection was for each of *E. histolytica +G. lamblia + E. vermicularis* 4 (0.66%), *E. histolytica + G. lamblia +E. Coli* 2 (0.33%).

As for the age group (10-19) years, the highest rate of infection was *E.histolytica* 39/603 (6.46%), followed by co-infection (*E. histolytica and G. lamblia*) 27 (4.48%), then infection with the parasite *G. lamblia* 18 (2.99%) as was the rate of multiple infection for each of *E. histolytica+ G.lamblia + E. Coli* 5 (0.83%) , *E. histolytica +G. lamblia +A. lumbricoides* 3 (0.50%), *E. histolytica +G. lamblia +E. vermicularis* 3 (0.50%), *E. histolytica + G. lamblia + Strongyloides* 2 (0.33%), *E. histolytica + G. lamblia + H .nana* 2 (0.33%).

For the age group (20-67) year the highest rate of infection was *E. histolytica* 93 (15.42%), followed by co-infection *(E. histolytica + G. lamblia)*, 72 (11.94%). then infection with the parasite *G. lamblia* 33 (5.47%) as was the rate of multiple infection for each of *E. histolytica + G. lamblia + E.Coli*9(1.49%), *E. histolytica + G. lamblia* + Strongyloides 4(0.66%)*E. histolytica + G. lamblia + H.nana* 3 (0.50%), *E. histolytica + G. lamblia+ E.vermicularis* 3 (0.50%), *E. histolytica + G. lamblia +A. lumbricoides* 2 (0.33%).Statistically and by using the chi-square test (x^2), which showed significant differences in parasite infection *E. histolytica* (x^2=43.000, *P*=0.000), *G. lamblia* (x^2=14.700, *P*=0.001) and co-infection (*E. histolytica + G. lamblia*) (x^2=38.850,*P*=0.000).

Table (2): Prevalence of intestinal protozoa infections by Ages group.

Parasites	Age Group			Total (n=603)	X2	P-value
	1-9 (n=66) NO (%)	10-19 (n=156) NO (%)	20-67 (n=381) NO (%)			
E. histolytica	30 (4.98)	39(6.46)	93(15.42)	162(26.87)	43.00	0.000
Giardia lamblia	9 (1.49)	18(2.99)	33(5.47)	60(9.95)	14.700	0.001
E. histolytica + G. lamblia	21 (3.48)	27(4.48)	72(11.94)	120(19.90)	38.850	0.000
E. histolytica + G. lamblia + E. Coli	2(0.33)	5(0.83)	9(1.49)	16(2.65)	4.625	0.099
E. histolytica + G. lamblia + Strongyloides	0	2(0.33)	4(0.66)	6(0.99)	0.667	0.414
E. histolytica + G. lamblia + A. lumbricoides	0	3(0.50)	2(0.33)	5(0.83)	0.200	0.655
E. histolytica + G. lamblia + H. nana	0	2(0.33)	3(0.50)	5(0.83)	0.200	0.655
E. histolytica + G. lamblia + E. vermicularis	4(0.66)	3(0.50)	3(0.50)	10(1.66)	0.200	0.905
Total	**66(10.95)**	**99(16.42)**	**219(36.31)**	**384(63.68)**	**0.00**	

NO = Number. X^2 =Chi-Square. Significant at *P*-value <0.05

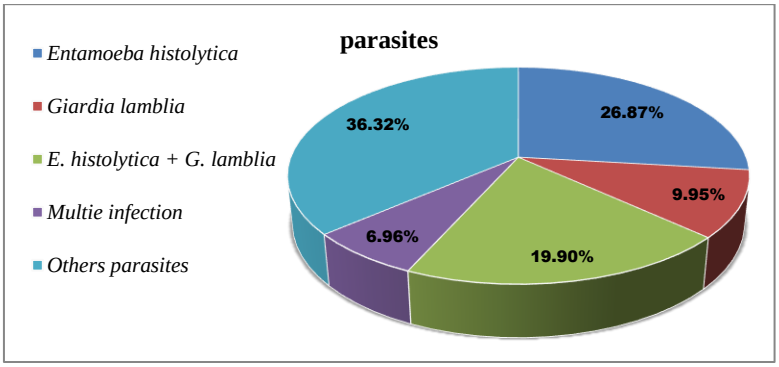

Fig. 2: Multiplicity of intestinal protozoan infections.

Figure (2) shows the prevalence rate of infection for each parasite, as *E. histolytica* and *G. lamblia* were found as single infections in 222/603 samples (36.82%) of stool samples positive for intestinal parasitism and co-infection in 120/603 samples (19.90%) and in multi infection in 42/603 samples (6.96%). The study also revealed the presence of other parasites in 219 samples (36.32%). That the highest rate of infection was *E. histolytica*, which was found in 324/603 samples (53.73%), of which 162/603 samples (26.87%) were single infection, and 120/603 samples (19.90%) in co-infection, and it was found multi infection in 42/603 samples (6.96%). Followed by *Giardia lamblia*, which was found in 222/603 samples (36.82%), of which 60/603 samples (9.95%) were single, 120/603 samples (19.90%) in co-infection, and 42/603 samples (6.96%) in mixed form. Statistically, no significant differences were recorded between the presence of *E. histolytica*, *G. lamblia*, as co-infection and mixed.(*P* =0.872). However, the differences were significant between the single infection (*P* = 0.000).

Table (3) shows the nationality areas from infected and the number of people infected with intestinal protozoa and other parasites for both sexes in Al-Mansoura district, Aden governorate, statistically, and using the ANOVA test, it was found that there was a significant difference between the infection rate and the area of residence at the level of significance (*P* = 0.000).Altaqnih and Kaputa areas recorded the highest prevalence of intestinal protozoan infection, followed by Aleiadat, Hashed, Khalifah, Wadie Hadad, and Aldrin area , where the infection rate in the Altaqnih area 135 samples (22.39%) of the total studied samples 78 samples (12.94%) males and 57 samples, (9.45%) females.In the Kaputa area, the infection rate was 106 samples (17.58%) of the total studied samples 56 samples (9.29%) from males and 50 samples (8.29%) from females. As for Aleiadat area, the infection rate was 87 samples (14.43%) of the total studied samples, 48 samples (7.96%) of males and 39 samples (6.47%) of females. In the Hashed area, the infection rate was 76 samples (12.60%) of the total studied samples, 45 samples (7.46%) were males and 31 samples (5.14%) were females. As for the Khalifah area and Wadie Hadad area the infection rate Per region was 75 (12.44%) of the total studied samples In the area of Khalifah 39 samples (6.47%) from males and 36 samples (5.97%) from females and in the area of Wadie Hadad, of the total studied samples 42 samples (6.97%) from males and 33 samples (5.74%) from females. For Aldrin area, the infection rate was 49 samples (8.12%) from the total number of samples studied, 22 samples (3.64%) from males and 27 samples (4.48%) from females, which is the lowest percentage. In order to find out the direction of the differences between residential areas, LSD statistical analysis was used to test the lowest significant difference at a level of significance less than (*P* = 0.05) and it was found that significant differences between ALtaqnih area and area Aleiadat and Hashed, and Khalifah and, Wadie Hadad, and Aldrin area at Significance level (P = 0.000). Also significant differences were found between Kaputa areas and Aleiadat, Hashed, Khalifah, Wadie Hadad, and Aldrin area at significance level (*P* = 0.000). The lowest prevalence of intestinal protozoa was also recorded in Aldrin area (8.12%), with significant differences with all areas. (*P* = 0.001).

Table (3): Prevalence of intestinal protozoan infections and the other parasites by nationality areas.

Infected	Areas		
	Male n (339) No %	Female n (285) No %	Total (n= 624) NO %
Altaqnih	78(12.94%)	57(9.45%)	22.39(135)
Kaputa	56(9.29%)	50(8.29%)	106 (17.58)
Khalifah	39(6.47%)	36(5.97%)	75(12.44)
Hashed	45(7.46)	31(5.14%)	76 (12.60)
Aleiadat	48(7.96%)	39(6.47%)	87 (14.43)
Wadie Hadad	42(6.97%)	33(5.74%)	75 (12.44)
Aldrin	22(3.64%)	27(4.48%)	49 (8.12)
Total	**330(54.73%)**	**273(45.27%)**	**603 (%100)**

Table (4) shows the social factors and their impact on the spread of intestinal protozoa and other parasites. As the rate of infection among males (97.35%) reached 330 out of 339 infected males and in females (95.79%) 273 out

of 285 infected females statistically, no significant differences were recorded between infection with parasites and sex (X^2 = 1.152, *P* = 0.283).The family occupation, were the infection rate among families who do not work in agriculture was (96.79%) higher than the infection rate among families who work in agriculture (95.24%). Parasites were found in 543 samples out of 561 samples taken from families that do not work in agriculture and in 60 samples. Out of 63 samples of families working in agriculture statistically, no significant differences were recorded between parasite infection and family function (X^2 = 0.420, *P* = 0.517).

Table (4): Sociological risk factors associated with parasites intestinal infection.

Risk factor	parasites intestinal infection.			x2	p-value
	No. %	Positive N (%)	Negative N (%)		
Sex					
Male	339 (54.33)	330 (97.35)	9 (2.65)	1.152	0.283
Female	285 (45.67)	273 (95.79)	12 (4.21)		
Family occupation					
Agriculture	63(10.1)	60(95.24)	3(4.76)	0.420	0.517
Non agriculture	561(89.90)	543(96.79)	18(3.21)		
Availability of latrine					
Present	602(96.47)	582(96.68)	20(3.32)	0.098	0.755
Absent	22(3.53)	21(95.45)	1(4.55)		
Source of Water					
piped water	215(34.45)	207(96.28)	8(3.72)	13.557	0.001
Water well /tanks	297(47.60)	294(98.99)	3(1.01)		
bottled water	112(17.95)	102(91.07)	10(8.93)		
Family size					
≥5	506(81.09)	499 (98.62)	7(1.38)	26.566	0.000
≤ 5	118(18.91)	104(88.14)	14(11.86)		

NO = Number. Significant at *P*-value ≤ 0.05. X^2 =Chi-Square. % =percent.

Rate of infection with intestinal protozoa and other parasites among people with availability of latrine (96.68%), it is higher than the infection rate among people who do not have latrines(%95.45) as parasites were found in 582 samples out of 602 samples in people with availability of latrines and in 21 samples. Out of 22 samples in people who do not have latrines statistically, no significant differences were recorded for parasites infection and availability of toilets (X^2 = 0.098, *P* = 0.755). The highest incidence of intestinal protozoa and other parasites among people who use water well / tanks was (98.99%) as parasites were found in 294/297 samples that were studied. Followed by the rate of infection among people who use piped water (96.28%), where parasites were found in 207/215 samples were studied. The lowest percentage of infection was recorded for people who use bottled water as a source for drinking (91.07%). Parasites were found in 102/112 samples that were studied. Statistically, a significant correlation was found between drinking water sources and infection with parasites (X^2 = 13.557, *P* = 0. 001). As for the family size, the highest rate of infection with intestinal protozoa and other parasites was recorded in families whose number exceeds 5 people (98.62%). Parasites were found in 499/506 samples studied, followed by the rate of infection in families with less than 5 people (88.14%), where Parasites were found in 104/118 samples studied. Statistically, a significant correlation was found between parasite infection and family size (X^2 = 26.566, *P* = 0. 000).

Table (5) showed the behavioral factors and their effect on the spread of intestinal protozoa and other parasites. The rate of infection was among people who wash their hands sometimes/not at all (99.18%), higher than the percentage of people who wash their hands always (95.01%). Parasites were found in 241/243 samples taken from people who wash their hands sometimes/not at all. 362/381 samples were taken from people who wash their hands always, statistically, a significant correlation was found between protozoa infection and hand washing habits (X^2 = 7.910, *P* = 0.005).

Regarding latrine usage habit the infection rate of people who have used to use latrine was (96.75%), as parasites were found in 565/584 samples studied, and this percentage is higher than the infection rate among people who not used to use latrine which reached (95%). Parasites were found in 38 of the 40 samples studied. Statistically, no significant differences were recorded between parasites infection and toilet usage habits (X^2 = 0.082, *P* = 0.774). The rate of infection with intestinal protozoa and other protozoa among people who did not swim was (97.97%), as parasites were found in 530/541 samples studied, and this percentage is higher than the rate of infection among people who swim (87.95%), as parasites were found in 73/83 samples were studied. Statistically, no significant differences were recorded between parasite infection and swimming habits (X^2 = 5.821, *P* = 0.61). Reached the percentage of infection among people those who have dirt under the fingernails (99.14%), which is higher than the rate of infection among people who do not have dirt under the fingernails (95.15%). Parasites were found in 230 samples out of 232 samples were taken from people who had dirt under the fingernails and In 373 samples out of 392 samples from people who did not have dirt under the fingernails. Statistically, a significant correlation was found between infection with parasites and the presence of dirt under in the hand fingernails (X^2 = 7.116, *P* = 0.008).

Table (5): Behavioral risk factors associated with intestinal parasites infection.

Risk factor	parasites intestinal infection.			x2	p-value
	No. %	Positive N (%)	Negative N (%)		
Hand washing habits					
Always	381(61.06)	362(95.01)	19 (4.99)	7.910	0.005
Sometimes/not at all	243(38.94)	241(99.18)	2(0.82)		
Latrine usage habit					
Present	584(93.59)	565(96.75)	19(3.25)	0.082	0.774
Absent	40(6.41)	38(95)	2(5)		
Habit of Swimming					
Present	83(13.30)	73(87.95)	10(12.05)	5.821	0.61
Absent	541(86.70)	530(97.97)	11(2.03)		
Dirty materials in the hand fingernails					
Present	232(37.18)	230(99.14)	2(0.86)	7.116	0.008
Absent	392(62.82)	373(95.15)	19(4.85)		

NO = Number. Significant at *P*-value ≤ 0.05. X^2 =Chi-Square. % =percent.

Discussion

The results of the current study showed that the percentage of intestinal protozoa infection was (63.68%), this percentage higher than the rate recorded from previous studies in Yemen such as [2] in Sana'a where the percentage was 30.9% and [6] recorded in Ibb 57.3%. In some Arab countries such as Qatar [22] 24.8%, [23] 5.39%, Saudi Arabia [26] 42%, Egypt [27] 53.5%, Sudan [28] 20%, and Iraq [29] 40.98%.In other parts of the world such as Tajikistan [30] 47.1%, Ghana [31] 42.9%, India [32] 16.25%, Uganda [33] 36.5%, and Ethiopia [15] 45.3%. It is possible that this increase in the rate of intestinal protozoa in this study is due to the lack of healthy water for drinking and the large numbers of the family and the lack of attention to personal and public hygiene.On the other hand, this rate is lower than stated in other studies conducted in Yemen and the other countries such as Aden governorate [3] 70%, and Ibb governorate [11], 85.64% UAE [34] 92.2%, Lebanon [35] 95%, Nigeria [36] 97%, Iran [37] 95% and Burkina Faso [38] 84.7% . These results were similar to previous studies conducted in Yemen Lahaj governorate [9] 64.45% and in Ethiopia [15] 59.3%.

This wide variation in intestinal protozoa levels from one region to another and from one country to another can be attributed to the differences in the economic, social and health levels of the residents of the regions and the countries where the studies were conducted, as well as the weak cultural awareness and the differences in human behaviours towards intestinal protozoa. The difference methods of examination and the duration of time covered by each study as well as the size of the studied sample play in the variation in the infection of intestinal protozoa [9].

Entamoeba histolytica and *G. lamblia* are the most common intestinal protozoa in the directorate of Al-Mansoura, Aden governorate.These parasites have the potential for direct oral transmission and this explains their wide global spread compared to other intestinal parasites [39]. Both Amoebiasis, Giardiasis among the most common intestinal parasitic infections worldwide and were closely related to socioeconomic status, poor sanitation, inadequate medical care and absence of safe drinking water supplies [40].

In this study, *E. histolytica* was more prevalent than *G. lamblia* among residents Al-Mansoura directorate, where it reached 324/603 (53.73%), followed by *G. lamblia* 222 (36.82%).This result is similar with many other studies conducted in Yemen, such as Lahaj Governorate [41] 36.57%, [4] 64%, and Sanaa [5] 21.5%, and Taiz [7] 33.7%. and in the Arab world such as Egypt [42] 60%, and Iraq [43] 23.37%, and Jordan [44] 41%.The results of this study differ from many results from previous studies that found that the *G. lamblia* parasite was more prevalent than *E. histolytica* as in Hadramawt, Yemen [45] 19.17%, and Aden [3] 43%, Lahaj [9] 57.66%, and in the Arab world such as Sudan [46] 67.2%, Egypt [27] 14.5%, and in Western Uganda [33] 16%.

The widespread prevalence of *E. histolytica* was due to the presence of parasite-resistant cysts in the study area [47]. That poor health awareness and contamination of food and water with these parasitic stages was a cause of high parasitic infection, it was found that the infectious, cyst phase was characterized by its resistance to chemical sterilizers, including chlorine, and severe environmental conditions, such as dehydration and broad ranges of pH. Also, the high level of *E. histolytica* may be due to the presence of *Entamoeba dispar*, which was difficult to distinguish between it and *E. histolytica* [48].

In our study, the infection of one type of parasite was the most frequent, with a percentage for *E. histolytica* and *G. lamblia* (36.82%) followed by co-infection (19.90%) and the lowest prevalence was the Multiinfection (6.96%), these result was similar with several previous studies, as in the study [9]conducted in Radfan district, Lahaj governorate, where the rates of single infection and co-infection and Multiinfection were (80.78%), (18.39%), (0.48%), respectively, and the study conducted by [49] in Iran where the results of his study showed that the proportion of single infection was the most prevalent, followed by co-infection and then Multiinfection, where it reached (35.9%) (5.9%) (0.5%), respectively, and the

study conducted by [50] in Ethiopia, where of rates single infection , co-infection and Multiinfection were 49.9%, 10.7% and 1.83%, respectively and the study conducted by [51] in India where the results showed that infection with one parasite was more common and the reason for that may be due to the availability of appropriate conditions for the growth and development of some parasites such as parasite *E. histolytica* more than jealousy.

The results of our study showed a high incidence of intestinal protozoa among males (33.34%) compared to the incidence among females (30.34%) with statistically significant differences that did not reach the moral level (t = 1.042, P = 0.298). This result was consistent with the results obtained from many previous studies such as in Yemen [8]where the percentage of males (61.42%) and females (38.55%), and in Iraq [52] males (61.42%), females (38.55%), Ethiopia [40] males (50.98%), females (49.02%), and Iran [49], males (42.5%), females 41.3%.The results of our study differ from those of the studies whose results showed that the prevalence of intestinal protozoa was higher among females than among males such as Yemen. [3] females (65.7%), males (60.8%), Egypt [42], females (54%), males (46%), and Iraq [53]females (19.0%), males (16.0%), Sudan [28], females (58%), males (42%), and Palestine [54], females (48%), and males (42%).The absence of significant differences in the prevalence of protozoa infection in both sexes can be attributed to the fact that the chances of infection with pathogens intestinal protozoa in both sexes are equal [55]. The absence of a significant difference in infection between males and females were due to the fact that both sexes live under one circumstance, and that their cultural and mental levels are close enough to practice the same behaviour, which exposes them to injury in equal proportions [56]. Another study conducted by [57] in which he indicated that there were no significant differences in the rate of the incidence of parasites between male and female patients was attributed to the fact that both sexes were equal in the external and internal activities that lead to the transmission of the parasite in both sexes.

The results of the study showed that the age group (20-67) years was the most infected to the intestinal protozoa its rate was (36.31%), while the age group (1-9 years) was the lowest percentage, reaching (10.95%). This result is consistent with what was reached in previous studies such as [58], in Libya, was the age group 21-50 years the most infected where it reached to (51.38%), and Saudi Arabia [59] 25- 34 years (29%). Iran [60] 20-29 years (31.8%). This was due to the fact that this category is the most active category in Craft professions and general professions and was mixed with people and exposed to eating food outside their homes, and from restaurants that may not be subject to conditions [58].

The results related to the housing area showed that the highest prevalence of intestinal protozoa and other parasites was in the AL-taqnih region, where the prevalence rate (22.39%), followed by Kaputa with a percentage (17.58%) and the lowest incidence was in Aldrin (8.12%). The results of the statistical analysis showed the presence of significant differences in the percentage of injury and the area of residence at the level of significance (*P*= 0.000).

We concludes that the higher incidence of infection in these two regions more than others is due to poor sanitation and personal hygiene behaviours in addition to the use of reservoir water and there are many reports that indicate the burden of parasitic diseases in Yemen. However there are many fields including the current study area which lacks previous studies. Therefore, this study is considered the first in the Mansoura area which focused on studying the prevalence of intestinal protozoa (*Entamoeba histolytica* and *Giardia lamblia*) and its effect on blood.

The results of the study showed that the social factors as well as the behaviours performed by the person play a large role in the prevalence of infection with intestinal protozoa and other parasites. The results of the current study showed that there was a significant correlation between drinking water sources and infection percentage (X^2 = 13.557, P = 0,001), as there was a significant prevalence of intestinal protozoa and other parasites infection among people using unsafe drinking water such as water well / tanks at a rate (98.99%). People who use piped water (96.28%) compared to those who drink bottled water, where the infection rate is (91.07%), which is the lowest percentage. This study is consistent with the results of many previous studies. Such as Yemen [7] where the infection rate reached (67.5%), [8] (34.2%), Egypt [61] (59.7%), Malaysia [62] (86.8%).Those who found that the prevalence of intestinal protozoa infection was high among people using unsafe drinking water. This prevalence could be attributed to contaminated hands or contaminated utensils and containers used to store drinking water [8].Our study also agreed with the findings of [63], who found that the prevalence of infection was high among people drinking piped water, where the infection rate was 15.9%. Other authors showed the children who drink piped water are infected with *E. histolytica* and *G. lamblia* more than those who drink from other sources where the infection rate reached for each of them was 70.9% 61.54% [6, 64], this high prevalence may be due to contamination of the piped water was occurring after the treatment process has taken place, and could be attributed to the usage of containers and utensils that may have been previously soiled with Giardia cysts when handling and storing drinking water [61] Our study differs from the findings of [31], which did not find significant differences between sources of drinking water and infection of intestinal protozoa.

The results of the current study also showed that the size of the family plays a large role in the prevalence of infection with intestinal protozoa and other parasites. The study showed that people who live in families of more than five people were more susceptible to infection by a rate of (98.62%), compared to the incidence rate among people who they live in families with fewer than five persons (88.14%). The results of the statistical analysis confirmed that there was a significant correlation between the number of family members and the percentage of intestinal protozoa infection (X^2 = 26.566, P = 0,000), this indicates that the prevalence of intestinal protozoa increases with increasing number of individuals family. This study was consistent with many studies, such as in Yemen [9], the infection rate was 83.12%, [7] (52.4%), [3] (64.2%) and in other countries such as Ghana [65] (62.7%), Malaysia [63] (14.8%).

Our study differs with the findings of [5], where it was found that people who lived in homes with more than seven members of the family had a lower prevalence rate compared to those from families with fewer than seven individuals (24.3% versus 32.3%).

The prevalence of intestinal protozoa and other parasites was closely related to personal hygiene, as it was found that the people who wash their hands always were less affected by intestinal protozoa and other parasites with a rate of (95.01%), compared to the incidence rate among the persons who wash their hands sometimes / not at all (99.18%). With a significant difference (X^2 = 7.910, *P* = 0.005), these results indicate that personal and general hygiene is one of the most important factors affecting the incidence of infection. This result is consistent with the results of previous studies conducted in Yemen in both governorates Sana'a [2], Taiz [7], and in other countries such Libya [66], Egypt [67], Ethiopia [68], India [69], and Nepal [70]. This is because infectious cysts remain in the environment for a very long period of time, which can be easily captured during contact with the environment and mixing freely with family members, so, not washing hands facilitates the spread of infection [63].The incidence of intestinal protozoa and other parasites among people who have dirt under the nails (99.14%), compared with people without dirt under the nails (95.15%), with significant differences (X^2 = 7.116, *P* = 0.008), this result is consistent with the results of previous studies conducted Ethiopia [15, 71], and India [72].

No statistically significant differences were detected between the prevalence intestinal protozoa and other parasites factors such as gender (X^2 = 1.152, *P* = 0.283), Family occupation (X^2 = 0.420, *P* = 0.517), presence of toilets, (X^2 = 0.098, *P* = 0.755), toilet use habits (X^2 = 0.082, P = 0.774), and swimming habits (X^2 =5.821, *P* = 0.61).

Conclusion:

The results of the study showed that the rate of prevalence of intestinal protozoa were (63.68%). Followed by *G. lamblia*. Single infections was more common than co-infection and Multi infection.There was an increase in the rate of infection among males (33.34%) compared to the rate of among females (30.34%).Statistical differences that did not reach a significant degree. (t = 1.042, P = 0.298) in both sexes. There was the difference in the prevalence of infection with intestinal protozoa between different age groups, where the highest prevalence was recorded in the age group (20-67) years (36.31%).

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مقالة بحثية

انتشار المتحولة الحالة للنسيج و الجاردية اللمبلية بين المرضى في بعض مستشفيات مديرية المنصورة، عدن، اليمن

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المُلخّص

أجريت هذه الدراسة في الفترة من أكتوبر 2019 إلى أكتوبر 2020. لتحديد مدى انتشار عدوى الطفيليات المعوية *المتحولة الحالة للنسيج والجاردية اللمبلية* بين المرضى المراجعين لبعض المستشفيات (مستشفى 22 مايو، المستشفى الكوبي، مستشفى النقيب، مستشفى السلام) في مديرية المنصورة عدن -اليمن. شملت هذه الدراسة 603 مرضى. من الجنسين ومن مختلف الأعمار. تم أخذ عينات البراز من هؤلاء المرضى وأجريت عليهم الفحوصات المخبرية بواسطة مسحة مباشرة باستخدام محلول فسيولوجي بتركيز 0.9% ومحلول اليود المائي وتقنية ترسيب الفورمالين إيثر وتقنية التركيز بالطرد المركزي البسيط. أظهرت نتائج الدراسة الحالية أن معدل الإصابة الكلي لكلا النوعين المتحولة الحالة للنسج والجياردیا اللمبلية كان 603/384 (63.68%). كما أوضحت نتائج الدراسة أن انتشار هذه الطفيليات بين الذكور كان أعلى من الإناث، حيث بلغ معدل انتشارها بين الذكور 33.34% والإناث 30.34%. كما أظهرت النتائج أن نسبة انتشار هذه الطفيليات في الفئة العمرية (20-67) سنة والتي بلغت 36.31% أكثر من الفئة العمرية (10-19) سنة و (1-9) سنوات والبالغة 16.42. %، 10.95%. خلصت الدراسة إلى أن انتشار المتحولة الحالة للنسيج والجاردية اللمبلية بين مرضى الإسهال في مديرية المنصورة، عدن -اليمن كان مرتفعاً.

الكلمات المفتاحية: المتحولة الحالة للنسيج، الجاردية اللمبلية، الأوليات المعوية.

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