Prevalence and risk factors of intestinal parasite infections in Mazandaran province, North of Iran

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ABSTRACT

Background: Intestinal parasitic infections (IPIs) are confirmed as major public health problems, worldwide. Northern Iran is highly endemic area for such infections. This research aimed to study on the prevalence of IPIs among people referred to the health care centers in Mazandaran Province, Northern Iran.

Methods: In this descriptive cross-sectional survey, 984 stool samples were collected during 2015–2016. Fresh stool samples were collected from all individuals and examined by direct slide smear, formalin-ether concentration, trichrome and modified Ziehl-Neelsen staining techniques. The results were analyzed using SPSS version 16 and Chi-square test.

Results: Out of 984 participants, the overall prevalence of IPIs was 12.1% (95 CI, 11.4–12.7; 119/984). The prevalence of protozoa and helminthes infections were 7.9% (95 CI, 7.4–8.3; 109/984) and 5.3% (95 CI, 4.9%–5.5%; 69/984), respectively. The most prevalent protozoan IPIs were include *Giardia lamblia* (3.3%), *Entamoeba coli* (2%), *Blastocystis hominis* (1.3%), *Entamoeba histolytica/dispar* (1.1%), *Entamoeba hartmanni* (1.1%) and *Cryptosporidium* spp. (0.6%). Also major helminthic infections were include *Trichostrongylus* spp. (2.6%), Hookworms (1.7%), *Strongyloides stercoralis* (1.1%), *Hymenolepis nana* (0.6%) and *Dicrocoelium dendriticum* (0.6%). The results of the univariate analysis revealed that residence (rural being [P = 0.017]) and occupation (farmers [0.033]) were statistically significant risk factor for IPIs.

Conclusion: In conclusion, we have found, despite persistent improvement in sanitary conditions over the recent years in northern part of Iran, IPIs are still among the main public health problems in this area. Moreover, helminths infection in our study were considerable. Thus, effective control programs are essential to reduce the incidence of IPIs.

1. Introduction

Intestinal parasitic infection (IPIs) are among the main public health concerns worldwide with high morbidity and mortality. According to the World Health Organization, it is estimated that more than 24% of people worldwide are infected with IPIs, with high prevalence in developing countries.¹ These infections are related with several complications including iron deficiency anemia, growth retardation, poor educational performance, weight loss, vitamin A deficiency, abdominal pain, dyspepsia, and other physical and mental health problems in infected people, especially among children, elderly people and immunocompromised patients.^{2–4}

Soil-transmitted helminths (STHs) (i.e. *Trichuris trichiura*, *Ascaris*

lumbricoides, hookworm, *Strongyloides stercoralis* and some of the *Taenia* spp.) and enteric protozoan pathogens (i.e. *Giardia duodenalis*, *Entamoeba histolytica*, *Cryptosporidium* spp., *Dientamoeba fragilis* and *Balantidium coli*) are among the most important intestinal parasites.^{5,6} STH infections primarily occur in rural and deprived urban areas among poorest communities in tropical and sub-tropical countries. Inappropriate hygiene practices, lack of access to clean water, poor sanitation and health facilities, alcoholism and male gender are the main risk factors associated to the persistence of these infections.^{7,8}

Geographically, Iran is situated in the Middle East and borders the Caspian Sea, Persian Gulf, and Oman Sea. Iran has favorable conditions for the activity of various parasites because of the geographical location, climate, and biological and cultural characteristics. Previous

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studies indicated a decreasing trend for intestinal helminthes infections, while intestinal protozoa have still high prevalence in different parts of Iran.^{9,10} Moreover, these studies showed high prevalence for *B. hominis* and *G. lamblia* and also high clinical importance for *Cryptosporidium* spp. and *E. histolytica/dispar* in different groups.^{7,11–13} Northern part of Iran is endemic area for several intestinal parasites and previous reports showed high prevalence of IPIs in this area.^{14,15} The main aim of this study was to assess the prevalence and risk factors of IPIs in Babol city, one of the biggest cities in Mazandaran province, north of Iran.

2. Material and methods

This cross sectional study was performed from September 2015 to June 2016 at Babol County in Mazandaran province, northern Iran. The Babol County (36° 33'N 52° 40'E) has a hot-summer Mediterranean climate with a mean annual temperature of 17 °C and about 1000 mm of rainfall annually. According to Statistical Centre of Iran (SCI), the number of total population of the Babol County was approximately 532,000 people. Stool samples were collected according to comments of statistical consultant for 10 months. To estimate the sample size we used a prevalence reference of 18%,¹⁶ at a confidence level of 95% and a marginal error of 0.025. The formula ($n = \frac{Z_{1-\frac{\alpha}{2}}^2 P(1-P)}{d^2}$) of the sample size for the cross-sectional studies was used. The result of the calculation was 907 subjects, and 984 participants were sampled for more accuracy. At first, written consent was obtained from both the health center administrators and participants, and then participants were asked to complete a questionnaire containing personal information (sex, age, residence), socio-demographic data (education, occupation), health status (consumption of vegetables, contact with domestic animal). We included participants if they don't used any anti-parasitic drugs in the month prior to the study, and also we excluded people who did not provide sufficient fecal material for all procedures or did not complete the questionnaire. All procedures for this study were approved by the Ethics Committee of the Shahid Beheshti University of Medical Science (SBMU), Tehran, Iran.

Study population were all individuals referred to different medical laboratories in the Babol County. All the participants were given a clean and dry plastic collector, pre-labeled with their name and an ID number, and were asked to submit a stool sample up to one or two next days. Fresh samples of feces (daily) were collected from each participant and all specimens were immediately sent to the Research Center of the Azad University of Babol to parasitological examination. The diarrheal fecal specimens were sent immediately to the laboratory for parasitological examination, while formed stool samples were preserved in 10% formalin for further analysis. Stool samples were examined using standard methods such as direct wet smear with saline and lugol's iodine solution, formalin-ether concentration and trichrome and modified Ziehl-Neelsen staining techniques, all based on the protocol of World Health Organization.¹⁷ All procedures in this study were performed by well-trained parasitologists.

Statistical Package for the Social Sciences software version₁₆ (SPSS, Chicago, IL, USA) was used for data analysis. Frequencies and percentages were used to present of the descriptive data such as the prevalence of IPIs according to the residence, education, occupation, age and gender. Overall, 95% confidence intervals (CI) were calculated using binomial distribution. To identify the potential risk factors, the Pearson's Chi-square and logistic regression analyses. A *P* value < 0.05 was considered statistically significant.

3. Results

In total, 984 samples include 518 (52.6%) male and 466 (47.4%) female were collected. The participants were aged between 6-days and 83 years old, with a mean age of 29.9 ± 23.4. Three hundred and

Table 1

Prevalence of intestinal parasitic infections among Individuals Referred to the Medical Centers of Babol city, Mazandaran Province, Iran, 2015–2016.

Type of parasites	Total (n = 984)	
	n positive	% (95 CI%)
Protozoa		
<i>Giardia lamblia</i>	32	3.3 (3.1–3.4)
<i>Entamoeba coli</i>	20	2 (1.8–2.1)
<i>Blastocystis hominis</i>	13	1.3 (1.2–1.4)
<i>Cryptosporidium</i> spp.	6	0.6 (0.5–0.6)
<i>Entamoeba histolytica/E. dispar</i>	11	1.1 (1–1.5%)
<i>Endolimax nana</i>	10	1 (0.8–1.3)
<i>Iodamoeba bucheli</i>	2	0.2 (0.1–0.3)
<i>Entamoeba hartmanni</i>	11	1.1 (1–1.5)
<i>Trichomonas hominis</i>	1	0.1 (0.0–0.2)
<i>Chilomastix mesnili</i>	3	0.3 (0.2–0.3)
Total protozoa	109	7.9 (7.4–8.3)
Helminthes		
<i>Trichostrongylus</i>	26	2.6 (2.4–2.7)
Hookworm	17	1.7 (1.6–1.77)
<i>Strongyloides stercoralis</i>	11	1.1 (1–1.2)
<i>Hymenolepis nana</i>	6	0.6 (0.56–0.63)
<i>Dicrocoelium dendriticum</i>	6	0.6 (0.56–0.63)
<i>Enterobius vermicularis</i>	1	0.1 (0.09–0.10)
<i>Taenia</i> spp	1	0.1 (0.09–0.10)
<i>Trichuris Trichura</i>	1	0.1 (0.09–0.1)
Total helminthes	69	5.3 (4.9–5.5)

thirty-one individuals (33.6%) lived in urban areas and 653 individuals (66.4%) lived in rural areas. Of the 984 samples, 119 people (12.1%; 95 CI, 11.4–12.7) were infected with at least one intestinal parasites. Multi-parasitism was found in 40 (4%; 95 CI, 3.7%–4.2%) participants. Thirty people (3.4%) were infected with two IPIs, and six, three and one peoples were infected with three, four and five parasites, respectively.

Eighteen species of intestinal parasites were found in the study population. Prevalence of intestinal protozoa was 7.9% (95 CI, 7.4–8.3; 109/984) and helminthes parasites were found in 5.3% (95 CI, 4.9%–5.5%; 69/984) of participants. The most common protozoan parasite was *Giardia lamblia* (32 participants, 3.2%), followed by *Blastocystis hominis* (13 participants, 1.3%) and *Entamoeba histolytica/dispar* (11 participants, 1.1%). The most prevalent helminth parasite was *Trichostrongylus* spp. (26 participants, 2.6%), Hookworm (17 participants, 1.7%) and *Strongyloides stercoralis* (11 participants, 1.1%). The prevalence of other IPIs is presented in Table 1. There was also only one positive microscopic examination of *Tenia* spp., *Trichuris trichiura* and *Enterobius vermicularis*.

Infection rate in females (12.7%, 59/466) was slightly higher than males (11.6%, 60/18), although, there was no statistically significant differences regarding two sex in both univariate (*P* = 0.67) and logistic regression analyses (*P* = 0.51). The results of the univariate analysis revealed that age (higher prevalence with increasing in age [*P* = 0.011]), residence (rural being [*P* = 0.017]) and occupation (farmers [0.033]) were statistically significant risk factor for IPIs. Although none of evaluated variables were statistically significant in logistic regression analysis (Table 2).

4. Discussion

Parasitic diseases are still a major public health problem in both developing and developed countries. Several factors such as overcrowding, weather conditions, lack or absence of health facilities, poverty and in some cases special political situations and regional conflicts are factors affecting the spread of parasitic diseases in different regions of the world. In some cases, developed countries are not safe from the destructive impacts of parasites and many outbreaks have been reported.^{18,19} In Mazandaran province Factors such as weather conditions, population density, high water level, high humidity and

Table 2

Univariate analysis of risk factors associated with intestinal parasitic infection among those referring to Babol medical centers, Northern Iran (n = 984).

Variables	Positive n (%)	Negative n (%)	OR	CI 95%		p-value
				Lower	Upper	
Gender						0.964
Male	60 (11.6)	458 (88.4)	0.991	0.668	1.470	
Female	59 (12.7)	407 (87.3)	Reference			
Age (Year)						0.007
0–5	6 (3.1)	190 (96.9)	0.158	0.052	0.479	0.001
6–10	4 (10.8)	33 (89.2)	0.601	0.166	2.171	0.437
11–15	5 (29.4)	12 (70.6)	1.908	0.527	6.913	0.325
16–30	33 (14.7)	192 (85.3)	0.813	0.355	1.862	0.624
31–45	39 (13.3)	255 (86.7)	0.724	0.321	1.636	0.438
46–60	23 (13.7)	145 (86.3)	0.728	0.309	1.714	0.467
> 60	9 (19.1)	38 (80.9)	Reference			
Educational Status						0.679
Illiterate	9 (15/3)	50 (84/7)	0.622	0.120	3.232	0.572
Primary school	6 (13/3)	39 (86/7)	0.730	0.162	3.282	0.681
Guidance	12 (14/5)	71 (85/5)	1.232	0.401	3.789	0.716
Secondary school	20 (20/8)	76 (79/2)	1.804	0.652	4.988	0.256
Diploma	36 (13/8)	224 (86/2)	1.370	0.549	3.417	0.500
Associate	19 (14/7)	110 (85/3)	1.597	0.638	4.000	0.317
License or higher	8 (9/1)	80 (90/9)	Reference			
Residence						0.324
Rural	91 (13/9)	562 (86/1)	1.307	0.768	2.223	
urban	28 (8/5)	303 (91/5)	Reference			
Occupation (> 17 years old)						.474
Gov't employer	7 (9/2)	69 (90/8)	0.282	.663	1.481	.261
Farmer	17 (27/4)	45 (72/6)	1.862	.316	3.349	.072
Student	10 (12/3)	71 (87/7)	0.818	0.198	1.685	.619
House wife	29 (13/2)	190 (86/8)	0.066	.403	1.818	.898
Other	40 (13/9)	247 (86/1)	Reference			
Contact with domestic animal						0.054
Exposure	25 (19.2)	105 (80/8)	1.733	.990	3.036	
No exposure	94 (11)	760 (89)	Reference			
Vegetables						.070
Daily	14 (12/3)	100 (87/7)	1.106	.516	2.371	.796
Weekly	72 (16/5)	365 (83/5)	1.749	1.037	2.950	.036
Monthly	33 (7/6)	400 (92/4)	Reference			

rainfall, extensive agricultural activity, the large number of tourists and the existence of animals in various human environments provided a suitable condition to distribution of intestinal parasites.^{3,15} It should be noted that previous studies in Babol city were conducted on a specific group of people. We decided to have more comprehensive research and sampling from the total number of people referring to Babol medical centers. According to the results observed in the present study, the total contamination rate was 12.1%, and the prevalence of intestinal protozoan was 6.9%, intestinal helminthes was 4.3%. Although still low, but rate of IPIs in the current study increased in comparison with the other studies conducted in the region or in other regions of the country with relatively similar conditions.^{20–25}

In Iran, results of previous studies indicated that *G. lamblia* and *Blastocystis* spp. are the most common intestinal protozoan infection among the population.^{13,16,24,26–28} Similarly, in our study the most prevalent intestinal parasite was *G. lamblia* (3.3%). The results of this study indicated that IPIs are still a significant public health problem in Iran and also in developed countries. Prevalence rate of IPIs in our study (12.1%) was higher than previous reports from Tehran (10%) and Karaj (4%) and lower than reports from Boyer-Ahmad (37.5%), Zahedan (27%) and Nahavand (32.2%).^{9,26,29,30} Diverse climate condition, human development index (HDI), and agriculture and animal husbandry activities can explain different prevalence rate of IPIs in different parts of Iran. In comparison with other countries, our result was approximately similar to prevalence rate reported by Shobha et al.³¹ in western India (15.1%) and lower than reports from central Asia (38%) and Malaysia (68%).^{32,33}

Our results indicated high prevalence of helminthic infections (5.3%), which was slightly lower protozoan infections (7.9%). This

results is in contract with recent studies in Iran that had shown a substantial decrease in the incidence of intestinal helminth infections in different parts of country.^{7,9,10} This difference could be explained by this fact that Mazandaran province, due to wet climatic condition and suitable ecosystem, is highly endemic area intestinal helminthic infection, and had higher prevalence rate of helminthes infection compared to other parts of country. Furthermore, more rural population and also agricultural and husbandry activities of people living in Mazandaran province could be another explanation for high prevalence of parasitic infection in this area.^{34,35} Also our results showed most prevalent helminthes infection was *Trichostrongylus* spp., and it is in agreement with recent studies in north of Iran.^{36,37}

Globally, earlier investigations demonstrated several risk factors for the high prevalence and incidence of IPIs including poor sanitation, low family income, poor personal hygiene, untreated water supply, low level of self and parental education, eating unwashed vegetables, contact with animals and contaminated soils.^{9,38,39} In our study, univariate analysis showed that increasing in age, rural and farmer being are potential risk factor to acquisition of IPIs in north of Iran. However, none of the variables were statistically significant in logistic regression analysis. More outdoor activities and higher exposure to sources of infectious are possible explanations to more prevalence of IPIs in older people or rural and farmers. Although it should be noted that increasing prevalence with increasing age in our study may be biased due to uneven sampling of across age groups.

The strengths for this study are large sample size and coverage the majority of health care centers of Babol County. Although there are some limitation in this study. Firstly, it is ideal that fecal samples be gathered in three consecutive days and this sampling strategy increased

sensitivity of microscopic methods, although in our study one stool sampling was performed and this is an important limitation. Another limitation was this that due to facilities and financial constraints, we have not applied all the laboratory techniques for detection of worm's eggs and larvae (e.g. Baerman technique, Kato-Katz and adhesive tapes) or protozoa cysts and trophozoites (e.g. cultural methods).

In conclusion, we have found, despite persistent improvement in sanitary conditions over the recent years in northern part of Iran, IPIs are still among the main public health problems in this area. Moreover, helminths infection in our study were considerable. Thus, effective control programs are essential to reduce the incidence of IPIs.

5. Conflicts of interest

The authors do not have any conflict of interest.

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