JIDC | THE JOURNAL OF INFECTION IN DEVELOPING COUNTRIES

Original Article

A cross-sectional analysis of intestinal parasitic infections among the general population in north of Iran

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Abstract

Introduction: Intestinal parasitic infection (IPIs) is one of the most important health problems in the developing countries. Study on the prevalence of IPIs in various communities is a prerequisite for the development of appropriate control strategies. The aim of this study was to evaluate the prevalence of intestinal parasites among the general population in Mazandaran province, northern Iran.

Methodology: This study was conducted on 4,788 specimens collected from 17 urban areas (2,515 samples) and 34 rural areas (2,273 samples) within January-December 2016. Fecal specimens were examined by direct wet mounting, formalin-ether concentration, modified Ziehl–Neelsen, and trichrome staining methods.

Results: The overall infection rate of intestinal parasite was 14.2% (680/ 4,788). *Blastocystis hominis* and *Giardia lamblia* were identified as the most frequent parasites. Protozoa, helminths, and polyparasitism (co-infections with two or more parasite species) were observed in 12.3%, 1.03%, and 0.85% of the specimens, respectively. Furthermore, IPIs showed a significant association with household income, place of residence, washing of vegetables, exposure to soil and season ($p < 0.05$).

Conclusions: Based on the findings, parasitic infections are still a major public health concern in the north of Iran that requires special attention. Therefore, the major key to success in the prevention of IPIs is the execution of some interventions, including patient screening and treatment, public education, and improvement of sanitary conditions.

Key words: intestinal parasitic infection; general population; Iran; protozoa; helminths.

J Infect Dev Ctries 2018; 12(2):120-126. doi:10.3855/jidc.9512

(Received 13 June 2017 – Accepted 01 August 2018)

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Introduction

One of the most important health indicators in each society is the prevalence status of parasitic diseases among its population [1, 2]. Intestinal parasitic infections (IPIs) are among the most common causes of infections worldwide. The World Health Organization has estimated that about 3.5 billion people are affected by intestinal parasites that 450 million of them are ill due to these infections [3].

The IPIs can cause mortality and morbidity, and is associated with symptoms such as gastrointestinal disorders, malabsorption syndromes, psychosocial problems, growth retardation in children and iron deficiency anemia [4-6]. Individuals are susceptible to parasitic infections in all ages; however, children are more commonly inflicted with the effect of these pathogens [7].

The prevalence of parasitic infection in a region may be attributed to poor sanitation, low socio-economic status, lack of clean and safe water, high population density and improper waste disposal. In addition, the lack of sufficient research investigating the status of parasitic diseases in some parts of the world or unavailability of follow-up treatments are other barriers to the reduction of parasitic infection rate [7,8].

The prevalence of IPIs has been reported to range within 2-61% by several studies conducted in different parts of Iran [9,10]. Given the diversity of climatic

conditions, economic status, local traditions, and social factors in the different regions of Iran, the implementation of epidemiological surveys in various locations can provide a useful basis for planning and controlling the parasitic infections. The previous studies performed in the north of Iran were focused on the prevalence of IPIs in specific community groups, such as school children, food handlers, intellectual disability children, and rural communities [11-13].

To the best of our knowledge, there is no adequate information concerning the prevalence of intestinal parasites in the general population in this region. Regarding this point, the present study was conducted with the aim of investigating the prevalence and risk factors of intestinal parasites among the general population of Mazandaran province in the north of Iran, as the first comprehensive research in this area.

Methodology

Research population and study area

This cross-sectional study was conducted on 4,788 specimens collected from 17 urban (2,515) and 34 rural areas (2,273) from January to December 2016. Sampling was performed using a stratified random sampling method. The size of the samples was calculated in proportion to the population of each area. Mazandaran province is located in the north of Iran at the geographical coordinates of $35^{0}47^{/}36^{//}$N $50^{o}34^{/}$E. This province has a population of 3,073,943 individuals and 23841.64 km^2 of area. This region has a subtropical climate characterized by warm humid summers and mild, wet winters. The air temperature is maximum in August and minimum in January. The mean of annual relative humidity is 83%, with rainfall occurring in all seasons of the year [12].

Ethical considerations

The study protocol was peer reviewed and cleared by the Medical Research Ethics Committee of Mazandaran University of Medical Sciences, Sari, Iran. Furthermore, informed consent was obtained from all the participants.

Sample collection and examination

A questionnaire was prepared on the basis of socio-demographic data and possible factors associated with IPIs including gender, age, educational level, exposure to soil, washing of fruits and vegetables, household income, number of family members, occupation, and site of residence (urban/rural). Stool specimen was collected from each individual into a clean plastic container.

The containers were labeled with the identification number and transferred to the parasitology laboratory in Mazandaran University of Medical Sciences. A piece of stool samples used for performing wet mounting, Lugol's iodine staining, and formalin ether sedimentation techniques. The remaining of the specimens were divided in containers with polyvinyl alcohol (P.V.A) and 10% formaline preservative for trichrome staining and modified Ziehl-Neelsen, respectively.

Statistical analysis

Quantitative variables were reported as mean ± standard deviation and qualitative variables were also

Table 1. Prevalence of IPIs according to parasite species and number of infections in Mazandaran province, northern Iran.

	Parasites species	Positive cases number	Prevalence (%)
Monoparasitism	*Blastocystis hominis*	250	5.22
	Giardia lamblia	222	4.64
	Entamoeba coli	70	1.46
	Entamoeba histolytica	16	0.33
	Endolimax nana	6	0.13
	Chilomastix mesnili	4	0.08
	Iodamoeba butschlii	7	0.15
	Cryptosporidium parvum	15	0.31
	Hymenolepis nana	10	0.21
	Taenia saginata	7	0.15
	Strongyloides stercoralis	18	0.38
	Trichostrongylus spp	14	0.29
Polyparasitism	*Giardia lamblia* + *Blastocystis hominis*	23	0.48
	Giardia lamblia + *Entamoeba coli*	6	0.13
	Blastocystis hominis + *Entamoeba coli*	4	0.08
	Giardia lamblia + *Trichostrongylus* spp.	5	0.1
	Entamoeba coli+ *Hymenolepis nana*	3	0.06

reported as frequency (%). To test the association between qualitative variables such IPIs and associated risk factors, Chi-Squared and Fisher's exact test were used. All statistical analysis was performed using SPSS (Statistics Package for Social Sciences) version 18 at the significant level of 0.05. Furthermore, Arc GIS 9.3 software was applied to draw mapping based on the distribution of intestinal parasites.

Results

Out of 4,788 participants in the current study, 2579 (53.9%) were males and 2209 (46.1%) females; with mean age of 32.39 ± 17.75 years (range, median (quartile range): 1–77, 35(30) years, respectively). Based on the laboratory findings, the overall prevalence of IPIs was 14.2% (680/4788). A total of 12 different intestinal parasite species were diagnosed. Out of the 680 infected samples, 590 (86.8%) and 49 (7.2%) cases were found to be infected with intestinal protozoa and helminths, respectively. In addition, 41 (6%) subjects had polyparasitism.

The prevalence of infection with intestinal protozoa and helminths are summarized in Table 1. Among the intestinal protozoa, *Blastocystis hominis* (5.2%) was the most predominant protozoan identified in the stool samples of the studied participants, followed by *Giardia lamblia* (4.6%) and *Entamoeba coli* (1.4%). In addition, the most frequent intestinal helminth was *Strongyloides stercoralis* (0.37%), followed by *Trichostrongylus* (0.29%) and *Hymenolepis nana* (0.2%).

The prevalence rates of infection in the females and males were 55.9% and 44.1%, respectively. The results revealed no significant association between gender and infection rates (Chi-Square = 1.29, df = 1, p = 0.25). The age group of 1-9 years had the highest infection prevalence rate (16.5%). Nonetheless, there was no significant association between age and prevalence of infection (Chi-Square = 4.02, df = 1, p = 0.13) (Table 2).

Figure 1. Distribution of intestinal parasitic infections in Mazandaran province, northern Iran.

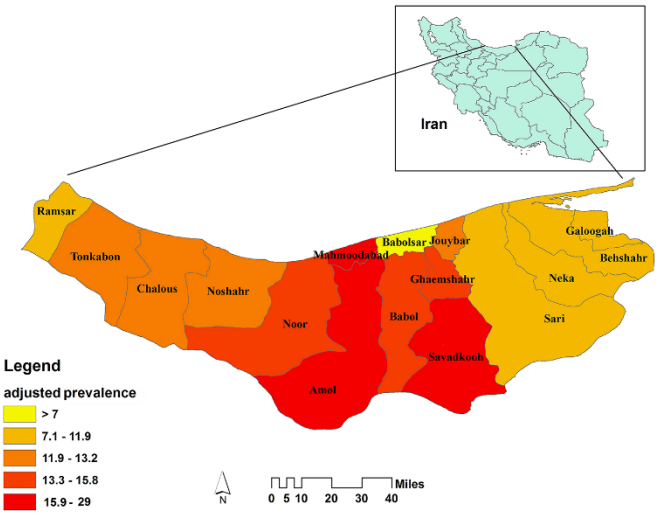
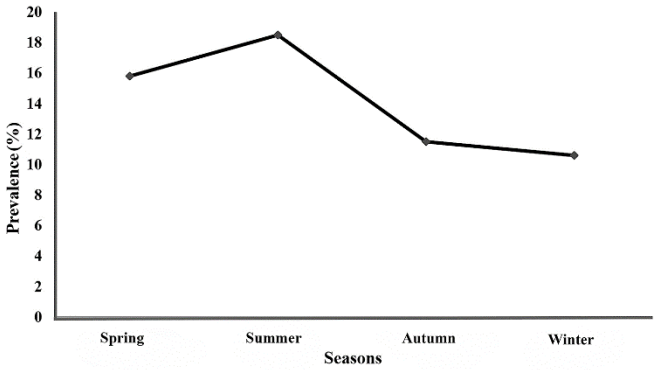


Figure 2. Prevalence of IPIs according to season in Mazandaran province, northern Iran.



The frequency of IPIs was higher in the rural areas (64.1%) than that in the urban regions (35.9%). Furthermore, there was a significant relationship between the infection rate and place of residence (Chi-Square = 88.28, df = 1, p = 0.001). Among the cities of Mazandaran province, Amol and Savadkooh had the highest rates of IPIs, while Babolsar had the lowest rate. The prevalence rates of intestinal parasites in the regions are shown in Figure 1. Our results were

Table 2. Prevalence of IPIs according to sex and age group in Mazandaran province, northern Iran.

Variable		Number of specimens (%)	Positive cases number (%)	p-value
Age group	<9	736 (15.4)	122 (16.5)	0.13
	10-19	803 (16.8)	114 (14.1)	
	20-29	462 (9.6)	74 (16.1)	
	30-39	791 (16.5)	100 (12.6)	
	40-49	1092 (22.8)	149 (13.6)	
	>50	904 (18.9)	121 (13.4)	
Sex	Male	2579 (53.9)	380 (14.7)	0.25
	Female	2209 (46.1)	300 (13.5)	

Table 3. The relationship between the prevalence of IPIs and risk factors in Mazandaran province, northern Iran.

Risk factor		Number of specimens	Positive cases number (%)	p-value
Educational level	Illiterate	943	138 (14.6)	0.67
	Primary school	1477	217 (14.7)	
	High school	1646	236 (14.3)	
	Academic degree	722	89 (12.3)	
Occupation	Student	1587	213 (13.4)	0.27
	Housewife	1139	141 (12.3)	
	Government employee	348	38 (10.9)	
	Farmers	629	127 (20.2)	
	Other business	1085	161 (14.8)	
Household income level	≤ 300 US$	3242	503 (15.5)	0.001
	> 300 US$	1546	177 (11.4)	
Number of people per household	≤ 4 individuals	3176	441 (13.9)	0.37
	> 4 individuals	1612	239 (14.8)	
Contact with soil	Yes	2427	427 (17.6)	0.001
	No	2361	253 (10.7)	
Washing of vegetables	Water	3431	576 (16.8)	0.001
	Chlorine	86	6 (7)	
	Detergent	1271	98 (7.7)	

indicative of the higher prevalence of parasitic infections in the summer (18.4%), compared to those in the spring, autumn, and winter (15.8%, 11.5%, and 10.6 %, respectively) (Figure 2). In this regard, a significant association was observed between season and infection rate ($p = 0.001$). In this study, parasitic infections demonstrated a significant correlation with exposure to soil, household income level, season, and washing of vegetables. On the other hand, these infections had no association with educational level, number of people per household, and occupation ($p > 0.05$). Table 3 presents the associations among various risk factors and IPIs.

Discussion

This study was the first attempt demonstrating the prevalence of IPIs in the population of northern Iran. The overall prevalence of parasites infection was 14.2% in the current study. In the previous studies conducted on specific community groups in Mazandaran province, the prevalence rates of IPIs were reported to be 15.5%, 26.2%, 33.3%, and 12% in the food handlers, mentally challenged children, school children, and rural inhabitants, respectively [11-14].

The prevalence of intestinal parasites varies in different regions of Iran. Accordingly, these rates are 35.1%, 28.8%, 59%, 56.6%, and 66% in Hamadan, Golestan, Kermanshah, Qazvin, and Shahriar, respectively [15-19]. A national epidemiological study of the Iranian population reported the prevalence rate of 19.3% for IPIs in Iran [10]. The differences between our results and those of the previous studies conducted in Iran in terms of the overall prevalence of IPIs may be due to the differences in study populations, sanitary conditions, access to health facilities, and modern agricultural development in the investigated areas.

In the present study, the most common intestinal parasites were *B. hominis* and *G lamblia,*, which is similar to the results reported by Kia et al (2008) and Daryani et al (2012) in Mazandaran province [12,14]. *B. hominis* is the microscopic parasitic organism found throughout the world [20]. The pathogenicity of *B. hominis* is still controversial; nonetheless, the findings of some studies have supported the role of this parasite as a causative agent by observing the clinical symptoms in the infected people [21,22].

In our study, giardiasis was found in all ages; however, it was more prevalent in children. This infection can present a broad range of clinical signs, such as asymptomatic acute or chronic diarrhea associated with abdominal pain, malabsorption, weight loss, nausea and impotence. The distribution of this parasitic infection varies within 2-7% and 20-30% in the developed and developing countries, respectively [23,24]. The prevalence of giardiasis seems to increase in the areas where sanitation and personal hygiene is inadequately observed [25].

An important finding in this study was the identification of 15 cases with *Cryptosporidium*, while other studies carried out in the north of Iran, rarely detected this parasite among different populations [12-14]. This finding might be due to the diagnostic methods used in this study (e.g., Ziehl Neelsen stain technique) [26]. Cryptosporidiosis is usually observed

in patients with diarrhea, which mostly occurs in children and immunocompromised individuals and causes long-term diarrhea and weight loss [27].

Based on the laboratory results, intestinal protozoa were more prevalent than helminthes. Several studies carried out in the different parts of Iran indicate that intestinal helminths had a downward trend in the recent years as compared to previous decades [28,29]. This can be due to the easier transmission of protozoa, compared to the eggs or larvae of worms, implementation of routine drug therapy with Mebendazole in the health centers of the northern Iran and use of chemical fertilizer on the farms in this region [30].

In the current study, about 6% of the study participants were concurrently infected with multiple parasites. The most common co-infection (0.4%) was observed between *B. hominis* and *G.lamblia*. The prevalence of mixed infection differs in various populations globally [31]. This may be probably due to the same mode of transmission in many species of protozoa.

We also demonstrated that the prevalence of IPIs in different regions of Mazandaran province varied within 6.1-29%. In this regard, the individuals living in the rural area had a higher prevalence of IPIs, compared to those in the urban areas. The majority of the residents in the rural areas are involved in agricultural and ranching activities. Therefore, they are more exposed to contaminant carriers, such as soil and animals, and accordingly have higher prevalence of IPIs [10,32].

The present results showed that neither age nor gender was associated with parasitic infection. However, the prevalence of IPIs was slightly higher in males than that in females. Some studies reported that gender and age were not associated with the risk of parasitic infection and reported the effect of environmental conditions on the transmission of parasites [21,33,34].

Our data showed that the prevalence of parasitic infection was significantly associated with washing of vegetables. Raw vegetables can act as a potential source for the spread of human parasitic infections. The use of wastewater as well as human and animal excreta as fertilizers for the production of vegetables is a potential factor for their contamination [35].

Our findings demonstrated that intestinal parasites were significantly associated with environmental conditions, such as contamination with soil. Parasite eggs, oocysts, and cysts in the soil can be transferred to vegetables, then to the hands, and thence directly into the mouth [36]. In the present study, the prevalence of IPIs in the summer was higher, compared to that in the other seasons. This can be due to the implementation of more outdoor activities in the summer, which enhances the frequency of parasite transmission.

In addition, in this study, there was a significant correlation between infection rate and household income level. There are studies supporting the notion that economic conditions play a vital role in the occurrence of intestinal parasites [7,12]. Hygienic conditions, precarious sanitary and other factors associated with low income facilitate the transmission of many infectious diseases.

Conclusions

The recent effort targeted toward the improvement of sanitation, hygiene, and overall health of people in Mazandaran province has had a positive impact on reducing the burden of intestinal parasites [11-14]. Based on the findings, it could be concluded that helminthic infections well controlled among people; however, protozoan infections are on rise. Since most of the protozoa are directly transmitted, the execution of some interventions, including patient follow-up and treatment and health education, may be a desirable course of action for the prevention of this infection. The findings of this study can be used to develop public health strategies and preventive programs for IPIs.

Acknowledgements

This study was supported by the Office of the Vice-Chancellor for Research of Mazandaran University of Medical Sciences (project No. 1031). The authors would like to thank the staff of health centers in Mazandaran and participants for their kind cooperation and assistance during the study.

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Conflict of interests: No conflict of interests is declared.