Spatial Distribution of Common Pathogenic Human Intestinal Protozoa in Iran: A Systematic Review

Mehdi MOHEBALI 1,2, Hossein KESHAVARZ 1,2, Mohammad Javad ABBASZADEH AFSHAR 2, Ahmad Ali HANAFI-BOJD 3, *Gholamreza HASSANPOUR 1,2

1. Center for Research of Endemic Parasites of Iran (CREPI), Tehran University of Medical Sciences, Tehran, Iran
2. Department of Medical Parasitology and Mycology, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran
3. Department of Medical Entomology and Vector Control, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran

*Corresponding Author: Email: hassanpour@tums.ac.ir
(Received 10 Mar 2020; accepted 21 May 2020)

Abstract
Background: Pathogenic intestinal protozoa are considered as a serious public health problem in developing countries. This study aimed to elucidate the overall prevalence and spatial distribution of three common human pathogenic intestinal protozoan infections in Iran.
Methods: Six English and Persian databases were explored for published papers on the prevalence of Entamoeba histolytica/dispar, Giardia lamblia, and Cryptosporidium spp. in the general population of Iran from 2000 to 2015. All eligible data were collected using a pre-designed data extraction form, and the overall prevalence was estimated using a random-effects meta-analysis model. We used ArcMap for mapping the prevalence of the studied protozoa and clustering analysis.
Results: Altogether, 118 eligible papers from 24 provinces of Iran were included and analyzed. The weighted prevalence of E. histolytica/dispar, G. lamblia, and Cryptosporidium spp. infection among Iranian general population were calculated 1.3% (95% CI 1.1-1.5%), 10.6% (95% CI 9.6-11.5%) and 2% (95% CI 1.5-2.5%), respectively.
Conclusion: Our findings indicated human intestinal protozoan infections caused by E. histolytica/dispar, G. lamblia, and Cryptosporidium spp. have still public health importance in some parts of Iran.

Keywords: Pathogenic intestinal protozoa; Prevalence; Modeling; Human; Iran

Introduction
Pathogenic intestinal protozoa are a serious public health problem in developing countries. Despite the low mortality rate, the morbidity rate of these parasites is significant, particularly in developing countries (1). Entamoeba histolytica, the causative agent of amebiasis, has been reported to kill between 40,000 and 100,000 cases annually; thus, it is one of the most important parasitic diseases worldwide (2). The prevalence of Giardia lamblia has been estimated at 2–3% in developed and 20–30% in developing countries (3). Cryptosporidium spp. is another causal agent of diarrhea, primarily affecting immunocompromised patients such as HIV+ individuals (4). Despite the advancement in sanitation infrastructure, hygiene status, increased knowledge, attitude and, practice (KAP) during recent years (5), it...
seems that the prevalence of intestinal parasites was reducing among Iranian people (6), although the results of some studies have been shown that the rate of these infections is still significant (7, 8).

During two recent decades, many studies have been carried out on the prevalence of human intestinal protozoan infections in different geographic areas of Iran using various diagnostic methods (9-15). Although many studies were performed on prevalence and risk factors of these infections in Iran, studies on the spatial distribution of intestinal protozoan infections are very limited.

Geographical information system (GIS) can prepare a geographical pattern of disease distribution and helps to develop early warning systems for early detection of infectious diseases (16). We aimed to determine the spatial distribution of the most common human intestinal parasites infections in Iran using data available from 2000 to 2015.

**Methods**

**Search strategy**

To evaluate the epidemiological aspects of the pathogenic intestinal protozoa, i.e. *E. histolytica/dispar*, *G. lamblia*, and *Cryptosporidium* spp. among Iranian healthy population (people without gastrointestinal disorders and any underlying diseases), we planned a systematic review and meta-analysis according to the online literature screening of English (PubMed, Scopus, Web of Science and Embase) and Persian (SID and Magiran) databases for published papers from Jan 2000 to Nov 2015. We applied the medical subject heading (MeSH) terms and keywords as follows: “*Entamoeba histolytica*”, “*Entamoeba dispar*”, “Amoebiasis”, “*Giardia lamblia*”, “*Cryptosporidium* spp.”, “Intestinal parasite infection”, “Iran”, “Epidemiology” and “Prevalence” alone or combined using “OR” and/or “AND”. The reference list of selected full-text papers was also meticulously checked manually to find articles not retrieved by the database searching.

**Study selection and data extraction**

Pertinent to inclusion criteria, the cross-sectional studies based on parasitological methods that estimated the prevalence of *E. histolytica*, *G. lamblia*, and *Cryptosporidium* spp. infections among Iranian healthy population were included. Investigations that are written in a language other than English or Persian and without available full text, and hospital-based studies, as well as congress abstracts that were not published in valuable journals were excluded. Two reviewers assessed the eligibility of all explored papers. The discrepancies among studies were obviated by discussion and consensus. Afterward, data of interest were gathered using a pre-designed data extraction form based on the province, sample size, positive cases, method of examination, and year of publication. The current review was performed based on PRISMA (preferred reporting items for systematic review and meta-analysis) guideline (17).

**Meta-analysis and Heterogeneity assessment**

The prevalence and its standard error were calculated for each study. The random-effects model was used to the report of pooled prevalence with a 95% confidence interval (CI). STATA 14.1 (Stata Corp, College Station, TX, USA) was used for data analysis. In addition, the statistical heterogeneity was explored using the chi-squared test at 10% significant level. The I² statistic was used to quantify the amount of heterogeneity between the results of the included studies (18, 19).

**Mapping and modeling**

All data extracted from the reviewed papers were imported to ArcMap for mapping the prevalence of the studied protozoa. Clustering analysis was conducted using Anselin Local Moran’s I statistic to identify statistically significant hot spots, cold spots, and spatial outliers. The local Moran’s I statistic of spatial association

\[
I_i = \frac{x_i - \bar{X}}{S^2_i} \sum_{j=1, j \neq i}^{n} w_{ij}(x_j - \bar{X})
\]

is given as:
Where $x_i$ is an attribute for future I, $X$ is the mean of the corresponding attribute, $w_{ij}$ is the spatial weight between future i and j, and:

$$S_i^2 = \frac{\sum_{j=1, j \neq i}^{n} (x_j - \bar{X})^2}{n - 1}$$

With n equating to the total number of features (http://pro.arcgis.com/en/pro-app/tool-reference/spatial-statistics/h-how-cluster-and-outlier-analysis-anselin-local-m.htm).

**Results**

Of the 2124 publications that were gathered for this systematic review, 118 records were qualified (Fig. 1). The results of qualified literature and details of each study are embedded in Excel sheet (As supplement but stored in the journal office) (10-13, 20-127). The random-effects model revealed that the weighted overall prevalence of *E. histolytica/dispar*, *G. lamblia* and, *Cryptosporidium* spp. infection among Iranian healthy population was 1.3 % (95% CI 1.1-1.5%), 10.6% (95% CI 9.6-11.5%) and 2% (95% CI 1.5-2.5%), respectively.

**Mapping**

The infection rate of the studied parasites in the general population of several provinces of Iran is shown in Figs. 2-4.

![PRISMA flow diagram](http://ijph.tums.ac.ir)
Fig. 2: Pooled prevalence of *Entamoeba histolytica/dispar* infection in the Iranian general population at the provincial scale, 2000-2015

Fig. 3: Pooled prevalence of *Giardia lamblia* infection in the Iranian general population at the provincial scale, 2000-2015

Available at:  [http://ijph.tums.ac.ir](http://ijph.tums.ac.ir)
Fig. 4: Pooled prevalence of Cryptosporidium spp. infection in the Iranian general population at the provincial scale, 2000-2015

**Modeling**

Figs 5-7 show the spatial association observed in the data. The areas shaded in red had positive spatial autocorrelation while those shaded in blue had negative spatial autocorrelation of giardiasis rates. A high-low cluster was occurred in East Azerbaijan Province regarding *E. histolytica/dispar* parasite (Fig. 5), while for *G. lamblia* there was no significant cluster in different provinces of Iran (Fig. 6). Finally, for *Cryptosporidium* spp., there was a high-high cluster in the Ilam province, and two high-low clusters in Razavi Khorasan and East Azerbaijan provinces (Fig. 7).

Fig. 5: Moran scatterplot of *Entamoeba histolytica/dispar*, represents the distribution of local Moran's I values, at the provincial scale, Iran, 2000-2015
Discussion

There are many published articles on the prevalence of human intestinal protozoa using various laboratory methods in different parts of Iran. This was the first comprehensive systematic review that presented a new epidemiological concept of the most three important pathogenic intestinal protozoan infections, including *E. histolytica/dispar*, *G. lamblia*, and *Cryptosporidium spp.* in Iran. This review showed the four types of spatial association using the pooled prevalence of men-

Fig. 6: Moran scatterplot of *Giardia lamblia*, represents the distribution of local Moran's I values, at the provincial scale, Iran, 2000-2015

Fig. 7: Moran scatterplot of *Cryptosporidium* spp., represents the distribution of local Moran's I values, at the provincial scale, Iran, 2000-2015
tioned protozoan infections and their hot spots in provinces of Iran.

One of the most important pathogenic intestinal parasites is *E. histolytica*, which is estimated to infect about 50 million people worldwide and kills more than 55 individuals each year. Referring to recent study, almost 90% of intestinal amoebic infections were caused by *E. dispar* (128). *E. dispar* is a new species of Entamoeba that is similar to *E. histolytica* and morphologically differentiation of them is impossible. Improved methods such as molecular and biochemical assays need to differentiate both species (129). Hence, in this study, the agent of amoebiasis infection reported as *E. histolytica/dispar*.

The prevalence rate of intestinal infection caused by *E. histolytica/dispar* was reported from 1-40% associated with various geographical areas of the world. Referring to a systematic review and meta-analysis study that was carried out on 71 eligible articles in 25 provinces of Iran, the pooled prevalence of *E. histolytica/dispar* infection was calculated by about 1% (28). In our study, *E. histolylica/dispar* infection among healthy population was calculated 1.3% (95% CI 1.1-1.5%) which is similar to the results of Karambaigi et al (130). The reason for these differences may be associated with the hot and dry climate in most parts of Iran and poor sanitary conditions and no integration and implementation of amoebic detection in primary health care (PHC) network of Iran. Fig. 2 showed that the highest prevalence of *E. histolytica/dispar* infection in the Iranian healthy population is from south Khorasan Province in northeastern Iran, where the climate is hot and dry, and the sanitation measures are limited.

Cryptosporidiosis is an important cause of human morbidity and mortality worldwide (131). Kalantari et al estimated the pooled prevalence of *Cryptosporidium* infections among children and immunocompromised patients in Iran through a systematic review and meta-analysis (132). The estimated prevalences of *Cryptosporidium* infections obtained in the mentioned study were 3.8% and 8% among children and immunosuppressed patients, respectively. In this study, the estimated prevalence of *Cryptosporidium* spp. infection among Iranian healthy population was obtained 2% (95% CI 1.5-2.5%) that is lower than prevalence rate 6% in Iranian children and immunosuppressive patients reported by Kalantari et al. Children and immunocompromised patients consider as the high-risk groups for *Cryptosporidium* infection in the world. East Azerbaijan province in northwestern Iran showed the highest level of the *Cryptosporidium* spp. prevalence (Fig. 4).

*G. lamblia* is a human pathogen protozoan with a worldwide distribution. The prevalence of *Giardia* infection is higher in countries with limited sanitation, and this disease was listed as the ‘WHO Neglected Diseases Initiative’ in 2004. *Giardia* infection has been the most widespread intestinal parasites of humans in Iran, particularly in children under the ages of primary school and food handlers (133). Several studies were carried out on *Giardia* infection in different parts of Iran, during the last decades, which documented various infections rates between 1.4-39.5% (134). Referring to a systematic review, altogether, 4788 people who referred to health centers in the Mazandaran province of northern Iran during 2015, the overall prevalence of *Giardia* infection was estimated at 4.6% that was significantly higher among 5-9 yr ages compared to other older groups (134).

In this study, the pooled prevalence of *G. lamblia* infection among the healthy population lived in different parts of Iran was estimated at 10.6% (95% CI 9.6-11.5%). It appears that differences between the prevalence of the infection should be caused by many factors such as the target population under study, sampling methods, seasonal variation, source of drinking water, processing of stool specimens, and different diagnostic tests. Fig. 3 showed the highest prevalence of *Giardia* infection in the Iranian healthy population was reported from Razavi Khorasan and East Azerbaijan provinces in the northeastern and northwestern Iran, respectively. It should be noted that these two important provinces of Iran attract a great number of pilgrims, tourists, immigrants, and foreign refugees annually. Travelers’ diarrhea is a more prevalent event among tour-
ists, and *G. lamblia* is one of the principal causative agents of diarrhea.

The strengths of this study was a large number of eligible studies, covering large populations and different provinces with geographical characteristics, presentation of pooled prevalence of simultaneous three prevalent intestinal protozoan infections, utilization of distribution models of the infection rates and identification of their hot spots in Iran. Moreover, this study has some limitations such as significant heterogeneity of studies and an underestimation of the true prevalence due to lacking data for some provinces.

**Conclusion**

This review provided a comprehensive view of the pooled prevalence as well as specific spatial and temporal patterns of the most important pathogenic intestinal protozoan infections in various geographical zones of Iran. These pieces of evidence can be considered and implemented for the control of the diseases by decision-makers. We suggested additional investigations to further clarify other epidemiological aspects of the three pathogenic intestinal protozoan infections in Iran using molecular methods to prepare an appropriate guideline for the more appropriate control strategies of the infections.

**Ethical considerations**

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

**Acknowledgements**

This research was financially supported by Tehran University of Medical Sciences, Tehran, Iran (Project No: 95-04-160-33908).

**Conflicts of interest**

The authors declare that there is no conflict of interest.

**References**

1. World Health Organization (1997). Amoebiasis. Sudan University of Science and Technology Questionnair. *Weekly Epidemiol Res*, 7:297-100.
2. Stanley SL, Jr. (2003). Amoebiasis. *Lanvet*, 361(9362):1025-34.
3. Escobedo AA, Cimerman S (2007). Giardiasis: a pharmacotherapy review. *Expert Opin Pharmacother*, 8(12):1885-902.
4. Agarwal A, Ninghouja S, Sharma D, et al (1998). Cryptosporidium and HIV. *J Indian Med Assoc*, 96(9):276-7.
5. Hadian M, Raeeis P, Shali M, et al (2019). Investigating the effects of human health resource changes on the basic health indicators in Iran: An econometric study. *J Educ Health Promot*, 8:207.
6. Daryani A, Hosseini-Teshnizi S, et al (2017). Intestinal parasitic infections in Iranian preschool and school children: A systematic review and meta-analysis. *Acta Trop*, 169:69-83.
7. Abbasszadeh Afshar MJ, Barkhori Mehni M, Rezaeian M, et al (2020). Prevalence and associated risk factors of human intestinal parasitic infections: a population-based study in the southeast of Kerman province, southeastern Iran. *BMC Infect Dis*, 20(1):12.
8. Hemmati N, Razmjou E, Hashemi-Hafshejani S, et al (2017). Prevalence and risk factors of human intestinal parasites in Roudehen, Tehran province, Iran. *Iran J Parasitol*, 12(3):364-373.
9. Zali MR, Mehr AJ, Rezaian M, et al (2004). Prevalence of intestinal parasitic pathogens among HIV-positive individuals in Iran. *Jpn J Infect Dis*, 57(6):268-70.
10. Pestehchian N, Nazari M, Haghighi A, et al (2015). Prevalence of intestinal parasitic infection among inhabitants and tribes of Chelgerd, Iran, 2008-2009. *J Clin Diagn Res*, 9(5):L001-4.
11. Nematian J, Nematian E, Gholamrezanezhad A, Asgari AA (2004). Prevalence of intestinal
parasitic infections and their relation with socio-economic factors and hygienic habits in Tehran primary school students. *Acta Trop*, 92(3):179-86.

12. Kuzehkamani AB, Rezaei S, Babaei Z, et al (2011). Enteric protozoan parasites in rural areas of Bandar-abbas, southern Iran: comparison of past and present situation. *Iran J Public Health*, 40(1):80-85.

13. Kia E, Hosseini M, Nilforoushan M, et al (2008). Study of intestinal protozoan parasites in rural inhabitants of Mazandaran province, northern Iran. *Iran J Parasitol*, 3(1):21-9.

14. Barkhori Mahni M, Rezaeian M, Kia EB, et al (2016). Prevalence of intestinal parasitic infections in Jiroft, Kerman province, Iran. *Iran J Parasitol*, 11(2):232-238.

15. Abbaszadeh Afshar MJ, Zahabiun F, Heydarian P, et al (2020). A systematic review and meta-analysis of *Toxocara*is in Iran: Is it time to take it seriously? *Acta Parasitol*, 65(3):569-584.

16. Moore DA, Carpenter TE (1999). Spatial analytical methods and geographic information systems: use in health research and epidemiology. *Epidemiol Rev*, 21(2):143-61.

17. Liberati A, Altman DG, Tetzlaff J, et al (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Med*, 6(7):e1000100.

18. Higgins JP, Thompson SG, Deeks JJ, Altman DG (2003). Measuring inconsistency in meta-analyses. *BMJ*, 327(7414):557-60.

19. Higgins JP, Thomas J, Chandler J, et al. *Cochrane handbook for systematic reviews of interventions*. John Wiley & Sons; 2019.

20. Sharif M, Daryani A, Kia E, et al (2015). Prevalence of intestinal parasites among food handlers of Sari, northern Iran. *Rev Inst Med Trop Sao Paulo*, 57(2):139-44.

21. Shakkal M, Kamali Z (2015). Occurrence of *Giardia*is and serum albumin concentration among the food staff in Bandarababs. *J Food Hygiene*, 5(2):93-97.

22. Sedighi I, Asadi M, Olfat M, Maghsoud AH (2015). Prevalence and risk factors of *Giardia lamblia* and *Blastocystis hominis* infections in children under ten years old, Hamadan, Iran. *Avicenna J Clin Microbiol Infect*, 2(2):22713.

23. Rahimi H, Dehghani M, Norouzi P, Fazli M (2015). Frequency of *Giardia lamblia* and *Entrobovus vermicularis* Infections in Shahroud kindergartens, 2013. *J of Ardabil Uni of Med sci*, 15(1):7-14.

24. Motazedian MH, Najjari M, Ebrahimpour M, et al (2015). Prevalence of intestinal parasites among food-handlers in Shiraz, Iran. *Iran J Parasitol*, 10(4):652-67.

25. Mohtashamipour M, Ghaffari Hoseini SG, Pestehchian N, et al (2015). Intestinal parasitic infections in patients with diabetes mellitus: A case-control study. *J Anal Res Clin Med*, 3(3):157-163.

26. Khoshnood S, Saki J, Rafiei A, Alizadeh K (2015). Prevalence of intestinal prasitic infections among people in Baghmalek during 2013-2014. *Jentashapir J Cell Mol Biol*, 6(2):e24792.

27. Jafari R, Maghsoud AH, Safari M, et al (2015). Comparison of fecal antigen detection using enzyme linked immunosorbant assay with the auramine phenol staining method for diagnosis of human cryptosporidiosis. *Jundishapur J Microbiol*, 8(2):e16470.

28. Haghighi A, Riahi SM, Taghipour A, et al (2018). *Amoebiasis in Iran: a systematic review and meta-analysis*. *Epidemiol Infect*, 146(15):1880-1890.

29. Ashrafi K, Saadat F, O'Neill S, et al (2015). The endermicity of human fascioliasis in Guilan province, northern Iran: The baseline for implementation of control strategies. *Iran J Public Health*, 44(4):501-11.

30. Asadi M, Maghsoud AH (2015). The study of frequency of intestinal protozoa and related demographic factors among mothers visiting health care centers of Hamadan city, during 2013-2014. *Avicenna J Clinic Med*, 22(3):187-94.

31. Arbabi M, Esmaili N, Parastouei K, et al (2015). Levels of zinc, copper, magnesium elements, and vitamin B12, in sera of schoolchildren with giardiasis and entrobirosis in Kashan, Iran. *Zabedan J Res Med Sci*, 17(1):e3659.

32. Anvari Tafti M, Fattahi Baighi A, Jafari A, Ghafoorzadeh M (2015). Prevalence of intestinal parasites among mentally disabled in welfare boarding center of Taft city. *Toloo-e-Behbod*, 14(1):54-62.

33. Zarezadeh M, Malakotian M (2014). Prevalence of bacteria (Salmonella, Shigella) and intestinal

Available at:  [http://ijph.tums.ac.ir](http://ijph.tums.ac.ir)
parasites among food handlers in Kerman, Iran, in 1390. *Pajohande*, 19(1):55-59.

34. Shahbazi AE, Rezaeian M, Eshraghian MR, et al (2014). The prevalence of human intestinal parasites in rural areas of Saveh, Markazi province, Iran. *J Fasa Univ Med Sci*, 4(2):177-184.

35. Rafiei A, Rashno Z, Sambarbaftadeh A, Khademvatan S (2014). Molecular characterization of *Cryptosporidium* spp. isolated from immunocompromised patients and children. *Jundishapur J Microbiol*, 7(4):e9183.

36. Khieirandish F, Tarahi MJ, Ezatpour B (2014). Prevalence of intestinal parasites among food handlers in western Iran. *Rev Inst Med Troop Sao Paulo*, 56(2):111-4.

37. Jafari R, Fallah M, Yousofi Darani H, et al (2014). Prevalence of intestinal parasitic infections among rural inhabitants of Hamadan city, Iran, 2012. *Avicenna J Clin Microbiol Infect*, 1(2):21445.

38. Izadi M, Jonaodi-Jafari N, Saburi A, et al (2014). Cryptosporidiosis in Iranian farm workers and their household members: A hypothesis about possible zoonotic transmission. *J Trp Med*, 2014:405875.

39. Hamzavi Y, Amir M, Jalalvandi S (2014). Cryptosporidiosis in children with and without diarrhea in Kermanshah from 2011-12. *Journal of Clinical Res Paramed Sci*, 3(1):40-46.

40. Haji Aliani F, Enipour S, Abadi A, Tahvikdar Birooni F (2014). Prevalence of intestinal parasites in kindergartens in Karaj in 2012. *Alborz Univ Med Sci*, 3(4):239-252.

41. Garedaghi Y, Firouzivand Y (2014). Protozoal infections of restaurant workers in Tabriz, Iran. *Crescent J of Med and Bio Sci*, 1(2):46-48.

42. Fouladvand M, Barazesh A, Tahmasebi R (2014). Prevalence of intestinal parasites among workers involved in collection, transportation and recycling of wastes in the Pars Special Economic Energy Zone, Bushehr. *Iran South Med J*, 16(6):508-518.

43. Balarak D, Jaffari M, Ansaripour H (2014). Prevalence of intestinal parasites among the food handlers in the city of Qom, 2014. *Community Health Journal*, 8(4):20-8.

44. Badparva E, Khieirandish F, Ebrahimzade F (2014). Prevalence of intestinal parasites in Lorestan province, west of Iran. *Asian Pacific J of Trop Dis*, 4(2):S728-S32.

45. Asmar M, Ashrafi K, Amintahmasbi H, et al (2014). Prevalence of intestinal parasitic infections in the urban areas of Bandar Anzali, northern Iran. *J Guilan Uni Med Sci*, 22(88):18-25.

46. Asadi M, Sedighi I, Fallah M, et al (2014). A survey study of *Cryptosporidium* infection in children under 10 years old referred to the health care centers of Hamadan district in 2013. *Avicenna J Clinic Med*, 21(3):211-217.

47. Abdi J, Farhadi M, Aghaei S (2014). Prevalence of intestinal parasites among children attending the daycare centers of Ilam, western Iran. *J Med Sci*, 14:143-146.

48. Salari S, Safizadeh H (2012). Prevalence of intestinal parasite infestation in the food suppliers of Kerman city, Iran, in 2010. *J Health and Development*, 1(4):315-322.

49. Niazi S, Mazlomi S, Shirzad MR, et al (2013). Survey the outbreak of giardiasis among food supply and distributions of South Pars Economic Zone Petrochemicals. *J Environ Health Sci Engineer*, 1(1):37-43.

50. Momen Heravi M, Rasti S, Vakili Z, et al (2013). Prevalence of intestinal parasites infections among Afghan children of primary and junior high schools residing Kashan city, Iran, 2009-2010. *Iran J Med Microbiol*, 7(1):46-52.

51. Khalili B, Imani R, Boostani S (2013). Intestinal parasitic infections in chronic psychiatric patients in Sina hospital Shahre-Kord, Iran. *Jundishapur J Microbiol*, 6:252-255.

52. Amiri M, Nazemi S, Raci M, et al (2013). A comparison of direct technique and formalin-ether method in determining parasitic infection among health-card applicants in Shahroud City. *Med Lab J*, 7(3):69-74.

53. Abedi M, Dabirzadeh M, Zohor A, Banirvanl I, Vatanparast A (2013). Prevalence study of intestinal parasitic infections among health card applicants Zabol city in 2012. *J zabol Uni Med Sci*, 5(2):53-59.

54. Shahbazi A, Sh G, Mirshamsi N, et al (2012). Detection of *Cyclospora, Microsporidia* and *Cryptosporidium* by direct microscopy and PCR in stools specimens in northwest, Iran. *Res Opin Anim Vet Sci*, 2(5):352-9.

55. Sazmand A, Rasooli A, Noori M, et al (2012). Prevalence of *Cryptosporidium* spp. in camels.
and involved people in Yazd province, Iran. *Iran J Parasitol*, 7(1):80-84.

56. Saki J, Khademwatan S, Masoumi K, Chagfhan M (2012). Prevalence of intestinal parasitic infections among food handlers in Khuzestan, southwest of Iran: A 10-year retrospective study. *AfJ Microbiol Res*, 6(10):2475-2480.

57. Rostami M, Tohidi F, Sharbatkhori M, et al (2012). The prevalence of intestinal parasitic infections in primary school students in Gorgan, Iran. *Med Lab J*, 6(2):42-6.

58. Kooohsae F, Amini A, Ayatollahi A A, et al (2012). The prevalence of intestinal parasitic infections in food handlers in Gorgan, Iran. *Med Lab J*, 6(1):27-34.

59. Jafari R, Maghsood AH, Fallah M (2012). Prevalence of *Cryptosporidium* infection among livestock and humans in contact with livestock in Hamadan district, Iran, 2012. *J Res Health Sci*, 13(1):86-9.

60. Heidarnegadi S, Mohebali M, Maraghi S, et al (2012). *Cryptosporidium* spp. infection in human and domestic animals. *Iran J Parasitol*, 7(1):53-58.

61. Heidari H, Gharkan J (2012). Study of *Cryptosporidium* infection in the livestock (cattle, sheep, dogs, fowls) and humans, in Hamadan city and its suburbs during 2006-2011. *Avicenna J Clinic Med*, 19(3):67-74.

62. Daryani A, Sharif M, Nasrolahi M, et al (2012). Epidemiological survey of the prevalence of intestinal parasites among schoolchildren in Sari, northern Iran. *Trans R Soc Trop Med Hyg*, 106(8):455-9.

63. Azizi M, Hooshyar H, Mosavi G, et al (2012). Investigation the relationship between chemotherapy and intestinal parasitic infections in cancer patients undergoing chemotherapy. *J of Med Couns Iran*, 30(1):42-48.

64. Hazrati Tappe K, Mohammadzadeh H, Khashaveh S, et al (2011). Prevalence of intestinal parasitic infections among primary school attending students in Barandooz-Chay rural region of Urmia, west Azerbaijan province, Iran in 2008. *African J Microbiol Res*, 5(7):788-791.

65. Taheri F, Namakin K, Zarban A, Sharifzadeh G (2011). Intestinal parasitic infection among school children in south Khorasan province, Iran. *J Res Health Sci*, 11(1):45-50.

66. Kousha A, Hakimi S, Fallah E, et al (2011). Prevalence of intestinal parasites among symptomless primary school children attending urban health centers, Tabriz. *Med J Tabriz Uni Med Sci*, 33(3):58-62.

67. Kheirandish F, Tarahi M, Haghighi A, et al (2011). Prevalence of intestinal parasites in bakery workers in Khorramabad, Lorestan Iran. *Iran J Parasitol*, 6(4):78-83.

68. Garelaghi Y, Mashaei S (2011). Parasitic infections among restaurant workers in Tabriz (East-Azerbaijan province) Iran. *Res J of Med Sci*, 5:116-118.

69. Fallah M, Sadeghian S, Taherkhani H, et al (2011). Study of parasitic and bacterial infections in the food-handling personnel, Hamadan, Iran. *J Res Health Sci*, 4(1):3-10.

70. Fallah M (2011). Rapid reinfection by *Giardia lamblia* after treatment in a hyperendemic community, during one year follow up. *J Res Health Sci*, 3(2):29-32.

71. Berenji F, Sarvghad M, Fata A, et al (2010). A study of the prevalence of intestinal parasitic infection in HIV positive individuals in Mashhad, Northeast Iran. *Jundishapur J Microbiology*, 3(2):61-65.

72. Azami M, Sharifi M, Hejazi SH, Tazhibi M (2010). Intestinal parasitic infections in renal transplant recipients. *Braz J Infect Dis*, 14(1):15-8.

73. Nasiri V, Esmaeilia K, Karim G, Nasiri M, Akhavan O (2009). Intestinal parasitic infections among inhabitants of Kanaj City, Tehran province, Iran in 2006-2008. *Korean J Parasitol*, 47(3):265-8.

74. Daryani A, Sharif M, Meigouni M, et al (2009). Prevalence of intestinal parasites and profile of CD4+ counts in HIV+/AIDS people in north of Iran, 2007-2008. *Pak J Biol Sci*, 12(18):1277-81.

75. Badparva E, Fallahi S, Birjandi M, et al (2009). Prevalence of intestinal parasitic infections in the rural regions of Kouhlasht, Lorestan province, Iran, 2008. *Asian J of Biol Sci*, 2:105-111.

76. Nematian J, Gholamrezaneshad A, Nematian E (2008). Giardiasis and other intestinal parasitic infections in relation to anthropometric indicators of malnutrition: a large, population-
Based survey of schoolchildren in Tehran. Ann Trop Med Parasitol, 102(3):209-14.
77. Mowlavi G, MirAhmadi H, Rezaeian M, et al (2012). Prevalence of intestinal parasites in tribal parts of Khuzestan province during 2005-07. Gavavesh, 12(4):10.
78. Monajemzadeh SM, Monajemzadeh M (2008). Comparison of iron and hematological indices in Giardia lamblia infection before and after treatment in 102 children in Ahwaz, Iran. Med Sci Monit, 14(1):CR19-23.
79. Hedayati A, Sadraei J, Ghofranipour F (2008). Prevalence of giardiasis in daycare children at Rafsanjan. J Rafsanjan Uni Med Sci, 6(3):193-200.
80. Hassanpour A (2008). Prevalence of cryptosporidiosis in calves and humans to be in contact them in Tabriz area in Iran. Int J Infect Dis, 12:e126.
81. Fallahi s, Ghorvi mj, Qara-gozelou b, et al (2008). A comparative evaluation of giardiasis Prevalence by Rutine Parasitical Assays and antigen detection in elementary school children in Delfan town, Iran. Yafteh, 9(4):45-49.
82. Davami MH, Roohi R, Sadeghi AR (2008). The prevalence of intestinal parasitic infections among 7-15 year old children in Jahrom, Iran during 2006-7. Pers J of Med Sci, 6(1):49-55.
83. Azami M, Dorostkar Moghadam D (2008). Prevalence of cryptosporidium in children under 5 years of age, immunocompromised patients and high risk persons in Isfahan province. Iran South Med J, 11(1):47-54.
84. Alavi S, Sefidgaran G (2008). Frequency of anti Toxocara antibodies in school children with chronic cough and eosinophilia in Ahwaz, Iran. Pak J Med Sci, 24(3):360-363.
85. Rostami M, Keshavarz H, Eskandari E, Kia E, Rezaeian M (2007). Intestinal parasitic infections in renal transplant recipients. Iran J Parasitol, 2(3):16-23.
86. Partovi F, Khaliili G, Kariminia A, Mahmoudzadeh-Niknam H (2007). Effect of Giardia lamblia infection on the cognitive function of school children. Iran J Public Health, 36(1):73-78.
87. Mojarad E, Haghighi A, Azimirad M, et al (2007). Prevalence of Entamoeba histolytica and Entamoeba dispar in Gonbad city, 2006, Iran. Iran J Parasitol, 2(2):48-52.
88. Molavi G, Masoud J, Moubedi I, Hassanpour G (2007). Prevalence of intestinal parasites in Esfahan municipal workers. J of School Public Health, 5(3):43-50.
89. Mohsenimoqadam F, Jafarpour P, Shahidi Zandi B (2007). Prevalence of giardiasis in daycare children at Rafsanjan. J Rafsanjan Uni Med Sci, 6(3):193-200.
90. Mirzaei M (2007). Prevalence of Cryptosporidium sp. infection in diarrheic and non-diarrheic humans in Iran. Korean J Parasitol, 45(2):133-7.
91. Meamar A, Rezaian M, Mohraz M, et al (2007). A comparative analysis of intestinal parasitic infections between HIV+/AIDS patients and non-HIV infected individuals. Iran J Parasitol, 2(1):1-6.
92. Ghorbani R, Sadat-Hashemi SM, Pazooki R (2007). Protozoa infection and its associated factors among urban babies 6 to 24 months age, in Semnnan, Iran. Saudi Med J, 28(2):299-301.
93. Barazesh A, Hazrati Tappeh K, Mohammadzadeh H, Khashave S (2007). The study of prevalence of intestinal parasitic infections in the personnel of private and governmental rehabilitation centers of Urmia. Nurs Midwifery J, 5(3):101-106.
94. Aminzadeh Z, Tarami M, Gachkar I (2007). Prevalence of intestinal parasites and related factors in primary school children in Varamin. J Compr Ped, 1(2):55-8.
95. Shaddel M, Pouya Nazari M, Abadi AR (2006). Comparative sensitivity of formol-detergent technique with formalin-ether and direct technique for detection of intestinal parasite. Annal Military and Health Sci Res, 4(3):895-899.
96. Seyrafi S, Pestehchian N, Kerdegari M, et al (2006). Prevalence rate of Cryptosporidium infection in hemodialysis patients in Iran. Hemodial Int, 10(4):375-9.
97. Rezaian M, Hooshyar H (2006). Differential diagnosis of Entamoeba histolytica from Entamoeba dispar and a study on the intestinal parasites in rural areas of Ahwaz and Hamidieh. J School Public Health, 4(4):33-38.
98. Neghab M, S M, Moemenbullah-Fard M (2006). Prevalence of intestinal parasitic infections among catering staff of students’ canteens at

Available at: http://ijph.tums.ac.ir
99. Mosaviani Z (2006). Contamination with Oxyure and Giardia in children of kindergartens and welfare centers in Tehran. *Avicenna J Nurs Midwifery Care*, 14(1):40-50.

100. Hazrati Tappeh K, Mostaghim M, Khalkhali H, Aghayar Malkouei A (2006). The prevalence of intestinal parasitic infection in the students of primary schools in Nazloo region in Urmia during 2004-2005. *J Urmia Uni Med Sci*, 16(4):212-217.

101. Esfahani A A, Ghorbani GH A, Asari SH (2006). Prevalence of intestinal parasites infestation in navy forces of Sepah-e Pasdaran in 1385. *J Military Med*, 8(3):197-203.

102. Davami Mh, khazaei Mr, Rafiei M, Milani M (2006). An investigation on the prevalence of intestinal Parasitic infections in food handlers in Arak. *Jahrom Uni Med Sci*, 3(3):8-15.

103. Atashnafas E, Ghorbani R, Peyvandi S, Imani S (2006). Prevalence of intestinal parasitic infections and related factors among school children in Semnan province (2005). *Koomesh*, 8(1):75-84.

104. Akhlagli I, Gharegozlou M, Ourmazdi H, et al (2006). Relationship between giardiasis and allergy in children referred to the allergy clinic of Tehran Children’s Medical Center, 2003-2004. *Razi J Med Sci*, 13(51):33-38.

105. Ranjab-Bahadori Sh, Dastorian AR, Heidari B (2005). Prevalence of intestinal parasites in Ghaemshahr in 2004. *Med Sci*, 15(3):151-155.

106. Ghomami S, Sharif M, Mobdi E, et al (2005). Intestinal protozoan infections in cattle breeders in rural regions of Mazandaran province in 2003. *J Mazandaran Uni Med Sci*, 14(45):51-60.

107. Saffar MJ, Qaffari J, Khalilian AR, Kosarian M (2005). Rapid reinfection by *Giardia lamblia* after treatment in a hyperendemic area: the case against treatment. *East Mediterr Health J*, 11(1-2):73-8.

108. Sadjjadi S, Tanideh N (2005). Nutritional status of preschool children infected with *Giardia Intestinalis*. *Iran J Public Health*, 34(4):51-57.

109. Koohsar F, Ghaemi EA, Behnampour N, et al (2004). Prevalence of enteric parasites in primary school students in Aliabad City in 2002. *Sci J Kurdistan Uni Med Sci*, 9(1):48-54.

110. Davoudi S, Zangiabadi M, Salehi M, Javadzadeh M (2004). Intestinal parasitic infections in Zahedan day-care units. *Zabedan J Res Med Sci*, 6(2):95019.

111. Azad AAS, Nourjah N, Shahbazi F (2004). Relationship of intestinal parasitic infections to malnutrition among schoolchildren near Tehran, Iran. *Southeast Asian J Trop Med Public Health*, 35(Suppl 1):116-9.

112. Arbabi M, Talari S (2004). Intestinal parasites in student of Kashan University of Medical Sciences. *J Ilam Uni Med Sci*, 1(2):44-5.

113. Razavyoon T, Massoud J (2003). Intestinal parasitic infection in Feraydooon Kenar, Mazandaran, *J School Public Health*, 1(1):39-49.

114. Maleki F, Sadegh Hasani S (2003). Prevalence of cryptosporidiosis in students of elementary schools in the west Tehran-Iran from 1999-2001. *Razi J Med Sci*, 10(33):105-109.

115. Karimi Zarchi A A, Mahmoodzadeh A, Vatani H, Shirbazo S. (2003). An epidemiologic study of intestinal amoebiasis in borders villages of Sarakhs. *J Military Med*, 5(1):27-31.

116. Hooshyar H, Rezaian M, Kazemi B (2003). Distribution and differential diagnosis of *Entamoeba histolytica* from *Entamoeba dispar* by the PCR-RFLP method in central Iran. *Ann Saudi Med*, 23(6):363-6.

117. Heidari A, Rokni MB (2003). Prevalence of intestinal parasites among children in day-care centers in Damghan - Iran. *Iran J Public Health*, 32(1):31-34.

118. Asgari G, Nateghpour M, Rezaian M (2003). Prevalence of intestinal parasites in the inhabitants of Islam-Shah district. *J School Public Health*, 1(3):67-74.

119. Sharifi Sarasiabi K, Madani A, Zare S (2002). Prevalence of intestinal parasites in primary school publish of Bandar Abbas. *J Hormozgan Uni Med Sci*, 4(5):25-30.

120. Mokhber M, Mesghi B (2002). Epidemiological study of cryptosporidial infestation of man and animals. *J Vete Res*, 57(1):87-92.

121. Davarni M, Kazaii M, Eslamirad Z, et al (2002). An investigation on intestinal parasitic infections and the effective demographic factors in children (1-13 years) in Shahراك-e-Valiisr Arak during 1999. *Arak Med Uni J*, 5(2):5-10.

122. Shekarabi M, Oormazdi H, Ghamchili A, Razavi M (2001). A Comparative study on the two
methods of direct fluorescent antibody and Kynion acid-fast staining techniques on the laboratory diagnosis of cryptosporidiosis. Razij Med Saí, 8(25):300-307.

123. Sadjjadi SM, Alborzi AW, Mostovfi H (2001). Comparative clinical trial of mebendazole and metronidazole in giardiasis of children. J Trop Pediatr, 47(3):176-8.

124. Rohani S, Kiyani H, Athari H (2001). Prevalence of intestinal parasites in villages of Sari (1998-99). J Zanjan Uni Med Sai, 9(34):33-40.

125. Ghahramanlou M, Hassanjani R, Haji A (2001). Prevalence of intestinal parasites in primary school children (Eastern Bandpay, Babol, 1999). J Babol Uni Med Sai, 3(2):47-51.

126. Sobati H, Lotfi H, Mobedi A (2000). Prevalence of intestinal parasites schools children in Abomosa. Iran Trop Med Public Health, 27:73-7.

127. Athari A, Sadafi H, Tokeh G (2000). Intestinal parasites in immunocompromised patients in Tehran in 1998. J Advance in Med and Biomed Sai, 8(30):61-68.

128. Shirley D-AT, Farr L, Watanabe K, Moonah S (2018). A review of the global burden, new diagnostics, and current therapeutics for amebiasis. Open Forum Infect Dis, 5(7):ofy161.

129. Al-Areeqi MA, Sady H, Al-Mekhlafi HM, et al (2017). First molecular epidemiology of Entamoeba histolytica, E. dispers and E. moshkovskii infections in Yemen: different species-specific associated risk factors. Trop Med Int Health, 22(4):493-504.

130. Abdi J, Sayehmiri K (2012). Prevalence of Entamoeba histolytica in Iran during 1988 to 2009: Systematic review and meta-analyses. African J Microb Res, 6:3944-3947.

131. Checkley W, White AC, Jaganath D, et al (2015). A review of the global burden, novel diagnostics, therapeutics, and vaccine targets for cryptosporidium. Lancet Infect Dis, 15(1):85-94.

132. Kalantari N, Ghaffari S, Bayani M (2018). Cryptosporidium spp. infection in Iranian children and immunosuppressive patients: A systematic review and meta-analysis. Caspian J Intern Med, 9(2):106-115.

133. Torgerson PR, Devleesschauwer B, Praet N, et al (2015). World Health Organization estimates of the global and regional disease burden of 11 Foodborne Parasitic Diseases, 2010: A Data Synthesis. PLoS Med, 12(12):e1001920.

134. Siyadatpanah A, Sharif M, Daryani A, et al (2018). Spatial distribution of Giardia lamblia infection among general population in Mazandaran province, north of Iran. J Parasit Dis, 42(2):171-176.