

## Prevalence and risk factors of intestinal protozoan infections in children (2–15 yr old) from Lorestan Province, western Iran

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**Abstract.** Intestinal parasitic infections are considered as one of the main socioeconomic and health problems around the world, mostly in tropical and sub-tropical regions. The present study aimed to evaluate the prevalence of intestinal protozoan parasites in 366 children (2–15 yr old) admitted to health centers of Lorestan Province, Iran. Microscopic examination was performed on 366 stools using the direct smear and formol-ether techniques as well as trichrome and modified Zeihl-Neelsen staining methods. The results showed that 48 children (13.1%) were infected with at least one or more intestinal parasites, of whom 4 (7.1%) had more than one type of parasite. The most prevalent parasites were *Giardia lamblia* (5.5%), *Blastocystis hominis* (3.1%), and *Entamoeba coli* (1.6%), respectively. The study showed that some risk factors such as gender, living in rural areas and consuming unwashed vegetables and fruits ( $p < 0.001$ ) were significantly related to intestinal protozoan infections. These results can be a catalyst for health providers to pay special attention to intestinal protozoan parasites among children in Lorestan Province, Iran. Moreover, intervention curriculums and teaching of children and environmental hygiene must be taken into consideration to prevent and control intestinal protozoan infections in this area.

### INTRODUCTION

Intestinal parasitic infections are considered as one of the main socioeconomic and health problems around the world, mostly in tropical and sub-tropical regions (Hotez *et al.*, 2009). Based on the world health organization (WHO) reports, approximately two-thirds of the world population are infected with a wide range of parasitic worms and protozoa, and yearly, 450 million people demonstrate clinical manifestations (WHO 2014). These reports also showed that, nearly 16 million of the total deaths occurring in developing countries are related to parasitic infections (Stephenson *et al.*, 2000; WHO 2007). According to earlier studies, children from

developing countries, especially school age children, have the maximum rate of morbidity to intestinal parasites in comparison with other ages (Stephenson *et al.*, 2000; WHO 2007).

In children, infections may lead to some serious complications including malabsorption, malnutrition, growth and development disturbance, anaemia, and physical and mental problems (Mehraj *et al.*, 2008; Banke *et al.*, 2006; Gutierrez-Jimenez *et al.*, 2013; Stoltzfus *et al.*, 2008). Therefore, studies on the prevalence of different species of intestinal parasitic infections in various geographic regions are a requirement for developing suitable control strategies.

Human intestinal protozoan parasites are divided into nonpathogenic and pathogenic parasites (WHO 2014). Although pathogenic protozoa can lead to some clinical manifestations in infected people, nonpathogenic protozoa are important because their presence indicates fecal-oral transmission in infected individuals (Gutierrez-Jimenez *et al.*, 2013). Contamination with nonpathogenic protozoa is an indicator of hygienic and health situation of people under study (Mehraj *et al.*, 2008; Stephenson *et al.*, 2000; WHO 2007). Currently, several studies on intestinal parasites among children from different parts of the world, showed different results which depended on the geographical and health conditions of the people (Faria *et al.*, 2017). Studies have shown statistics on the prevalence of intestinal parasitic infections in different regions of Iran. This indicates parasitic infections as one of the most important health problems in some parts of the country (Rokni, 2008; Daryani *et al.*, 2017). However, these variations in the prevalence rate of intestinal parasites can be related to some factors including climatic situation and geographical site, as well as a variety of cultural, economic, and social variables (Nematian *et al.*, 2004, 2008). The present study aimed to evaluate the prevalence of intestinal parasites in children (2–15 yr old) admitted to health centers of Lorestan Province, Iran.

## MATERIAL AND METHODS

### *Study design*

This cross-sectional study was performed from October 2016 to March 2017 on 366 children (aged 2-15 years) admitted to health centers of Lorestan Province that is located between valleys of Zagros Mountain in the west of Iran, bordering with the provinces of Markazi, Hamedan, Kermanshah, Khuzestan, Ilam, and Isfahan. Lorestan covers an area of 28,294 km<sup>2</sup> with a population of approximately 2 million people (Mahmoudvand *et al.*, 2017).

### *Ethics*

This study was approved by the Ethics Committee of Lorestan University of Medical Sciences, Khorramabad, Iran (No. 2017/235). The parents/guardians provided informed written consent on behalf of all the child participants.

### *Sample collection and stool examination*

A total of 366 stool samples were collected from the children (aged 2-15 years) admitted to health centers of Lorestan Province, Iran. The selection of the sample size was based on the study population and the prevalence rate of intestinal parasites in this province. Furthermore, children who took antiparasitic medications at the time of the survey or 14 days before the investigation were excluded. Stool samples (one stool sample from each participant) were collected in mouthed screw-capped containers. A container was given to each participant. In the following morning, the containers were collected and transferred to Department of Parasitology at Razi Herbal Medicines Research Center, Lorestan University of Medical Sciences, Khorramabad, Iran. In this study, applied questionnaire was designed to obtain information about the children demographics data and other variables related to parasitic infections such as age, sex, animal contacts, and residence. Stool samples such as color, shape, stool consistency (watery, soft, formed), mucus, pus, smell and presence of blood were examined macroscopically. The microscopic examination was performed using the direct smear technique (wet mount and Lugol's iodine) and formol-ether concentration techniques. Moreover, slide smear was prepared in fresh stool and stained with trichrome permanent stain to accurately differentiate intestinal protozoa (*Entamoeba*, *Giardia*, *Blastocystis* sp. and etc). For detecting coccidian parasites (*Cryptosporidium* spp.), modified Zeihl-Neelsen staining after the concentration technique was proposed (Stoll *et al.*, 1983; Idris *et al.*, 2001; Hsieh *et al.*, 2010).

### Statistical analysis

The analytical and descriptive statistics were carried out using SPSS 24.0 software (SPSS Inc., Chicago, IL, USA). Descriptive statistics were showed in terms of percent (for categorical) and mean (SD) (for continuous) variables. The Chi-square test was applied to evaluate the univariate association between independent variables and outcome. All the variables in univariate analysis (Chi-square test) that had a *p* value less than 0.25 were entered into multivariate analysis (Logistic regression). Multifactorial logistic regression models were used to evaluate association between protozoan infections and the potential risk factors. Here, *P*<0.05 was considered to be statistically significant.

## RESULTS

### Participants

A total of 366 children (2–15 year-old) admitted to the health centers located in Lorestan province, Iran, were included in this study. The mean age of the participants was 7.3±2.1 years and most participants were male (*n*=197, 53.8%). A total of 266 participants (72.6%) were living in urban regions and the others (27.4%) were in rural areas. Among the participants, 96 (26.2%) children were in contact with animals; however, 270 (73.8%) children had no contact

with animals. It was found that only 47 subjects (12.8%) consumed or eat raw vegetables and unwashed fruits and the rest (87.2%) did not consume raw or unwashed vegetables and fruits.

### Stool examination

Results showed that 48 children (13.1%) were infected with at least one or more intestinal protozoan parasites, of whom 4 children (7.1%) suffered from more than one type of parasite. Table 1 shows the frequency of intestinal protozoan parasites among the participating children in Lorestan province, Iran. The most prevalent parasites were *Giardia lamblia* (5.5%), *Blastocystis hominis* (3.1%), and *Entamoeba coli* (1.6%), respectively.

Table 2 presents the demographic characteristics and risk factors related to the prevalence of intestinal parasites among the children aged 2–15 years. The prevalence of intestinal parasites was significantly (*p*=0.046) higher among the male children. Thirty-four boys (17.25%) were infected with at least one or more intestinal parasites; however, only 14 girls (8.3%) had the same experience. Chi-square test showed that the prevalence of intestinal parasites did not differ among the children with regard to their age (*p*=0.56). Out of 266 children living in urban regions, 29 children (10.9%) were infected with at least one or more intestinal parasites; whereas, 19

Table 1. Prevalence of intestinal protozoan parasites among children (aged 2–15 years) from Lorestan province, western Iran

Parasite	No. of positive participants	(%). of positive participants
<i>Giardia lamblia</i>	20	5.5
<i>Blastocystis hominis</i>	11	3.1
<i>Entamoeba coli</i>	6	1.63
<i>Iodamoeba butschlii</i>	3	0.82
<i>Endolimax nana</i>	3	0.82
<i>Trichomonas hominis</i>	2	0.55
<i>Entamoeba histolytica/dispar</i>	2	0.55
<i>Cryptosporidium</i> spp.	1	0.28
Total	48	13.1

Table 2. Demographic characteristics and risk factors the prevalence of intestinal parasites among children (aged 2–15 years) from Lorestan province, western Iran

Variables	No. (%)	Positive No. (%)	<i>P</i> value
Gender			
Male	197 (53.8)	34 (17.25)	0.046*
Female	169 (46.2)	14 (8.3)	
Age groups			
<7yrs	140 (38.2)	19 (13.6)	0.56
≥7yrs	226 (61.8)	29 (12.8)	0.47
Residential place			
Urban	266 (72.6)	29 (10.9)	–
Rural	100 (27.4)	19 (19.0)	<0.001*
Being in contact with animal			
No	270 (73.8)	33 (12.2)	0.056
Yes	96 (26.2)	15 (15.6)	
Unwashed vegetables / fruit consumption			
No	319 (87.2)	31 (9.7)	<0.001*
Yes	47 (12.8)	17 (36.1)	–

\* $P < 0.05$ , difference is statistically significant.

participants (19.0%), out of 100 participants living in rural areas, were infected with at least one or more intestinal parasites. There was a significant difference in the prevalence of intestinal protozoan parasites among children who were living in urban and rural areas ( $p < 0.001$ ).

Out of 96 children who had contact with animals, 15 subjects (15.6%) were infected with at least one or more intestinal parasites; however, 33 children (12.2%), out of 270 children who had no contact with animals, were infected with at least one or more intestinal parasites. There was no significant difference in the prevalence of intestinal protozoan parasites among the children who had contact with animal and those had no contact with animal ( $p = 0.056$ ).

Out of the 47 children who consumed raw or unwashed vegetables and fruits, 17 children (36.1%) were infected with at least one or more intestinal parasites. On the

other hand, 31 children (9.7%), out of 319 children who did not eat raw or unwashed vegetables and fruits, were infected with at least one or more intestinal parasites. There was a significant ( $p < 0.001$ ) difference regarding the prevalence of intestinal protozoan parasites among the children who consumed raw or unwashed vegetables and fruits and those who did not.

Table 3 indicates the association found between risk factors and prevalence intestinal protozoan parasites using multivariate logistic regression analysis. Some risk factors which were significantly related to the prevalence of intestinal protozoan parasites included gender ( $p = 0.012$ ), living in rural regions ( $p < 0.001$ ) and consuming raw or unwashed vegetables and fruits ( $p < 0.001$ ). Other demographic and risk factors, however, did not demonstrate any association with the prevalence of intestinal protozoan parasites.

Table 3. Logistic regression analysis of the potential factors associated with the prevalence intestinal protozoan parasites among children (aged 2–15 years), referring to health centers of Lorestan province, Iran

Variables	OR (95% CI)	P value
Gender		
Male	3.1 (1.27–7.1)	0.012
Female	1	–
Residential place		
Urban	1	–
Rural	4.7 (2.13–10.34)	<0.001*
Unwashed vegetables / fruit consumption		
No	1	–
Yes	30.8 (12.9–73.3)	<0.001*

\*P<0.05, difference is statistically significant.

## DISCUSSION

Nowadays, intestinal parasitic infections are one of the major public health concerns around the world, especially in developing countries (WHO 2014). Previous reports demonstrated that intestinal parasitic infections affect more than 3 billion persons worldwide and cause clinical manifestations in nearly 450 million people (WHO 2007; Hotez *et al.*, 2009). Reviews have reported that protozoan infections including amoebiasis, giardiasis and cryptosporidiosis as well as helminthic infections such as ascariasis, enterobiasis, hookworms and trichuriasis constitute the largest part of intestinal parasitic infection around the world (Kiani *et al.*, 2016). Due to their high hand-mouth activities, uncontrolled fecal activities and immature immune systems, children are the most susceptible persons among all age groups (WHO 2007; Mehraj *et al.*, 2008).

The current investigation aimed to assess the prevalence of intestinal parasites in 2–15-year-old children from Lorestan province, Iran. The findings indicated that 48 children (13.1%), out of 366 participants, were infected with at least one or more intestinal parasites and that of whom, 4 children (7.1%) had more than one type of parasite. The

results also suggested that the most prevalent parasites were *G. lamblia* (5.5%), *B. hominis* (3.0%), and *E. coli* (2.7%), respectively. All children suffering from at least one or more intestinal parasites received adequate orientations and medical treatment.

Daryani *et al.* (2017) recently reported that the prevalence rate of intestinal parasitic infections was 38% in Iran; even though, the prevalence rates of intestinal protozoa, intestinal helminthic infections and non-pathogenic parasites were 16.9%, 9.48% and 18.5%, respectively.

In comparison with other developing countries, the findings of the current study indicated that the prevalence rate of intestinal parasitic infections in children from western regions of Iran was lower than the equivalent rate reported in various regions around the world such as Angola (80%), Turkey (48%), Palestine (22.2%), Pakistan (52.8%) and Caribbean Islands of Saint Lucia (61.6%) (Tomlinson *et al.*, 2010; Yentur Doni *et al.*, 2015; Hussein 2011; Mehraj *et al.*, 2008; Kurup *et al.*, 2010). As compared to other regions of Iran, the prevalence rate of intestinal parasitic infections in children from Lorestan province was higher than that reported in Tehran (10.8%), Hormozgan (10.3%) and Yazd (10%)

provinces (Anvari-Tafti *et al.*, 2014; Davami *et al.*, 2008; Khademi and Arman 2010; Haghi-Ashtiani *et al.*, 2011); however, the rate was lower than the rate reported for Fars (15.4%), Golestan (33.6%), Bushehr (25.1%), Isfahan (33.9%), South Khorasan (47.1%) and Nahavand (21.8%) (Kiani *et al.*, 2016; Tohidi & Qorbani, 2009; Barazesh *et al.*, 2017; Momenharavi *et al.*, 2012; Taheri *et al.*, 2011). The variations observed in the prevalence rate of intestinal parasitic infections in various parts in the world, including Iran, may be the result of differences in personal, social and cultural habits, climatic conditions, environmental hygiene, economic and educational status and previous control efforts (Nematian 2004, 2008; Daryani *et al.*, 2017).

Here, we found that the most common intestinal parasite was *G. lamblia* with 20 cases (5.5%) being infected. In line with these results, Daryani *et al.* (2017) reported that *G. lamblia* was the most common parasite (16%) among the protozoan infections in Iran.

Consistent with several other studies, no association was found between some demographic properties such as age and the prevalence of intestinal parasitic infections (Daryani *et al.*, 2017). However, the study results indicated that some risk factors significantly affecting intestinal parasitic infections included gender, living in rural regions and consuming unwashed vegetables and fruit (Daryani *et al.*, 2017).

## CONCLUSION

Regarding the remarkable frequency of intestinal protozoan parasitic infection among the children (2–15 yr old) from Lorestan province, western Iran; these results can be alarm for health centers to pay special attention to intestinal protozoan parasites between children. Moreover, intervention curriculums and teaching on personal and environmental hygiene must be engaged to prevent and control of intestinal protozoan infections in this area.

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## Conflict of interest

The authors declare that there is no conflict of interests.

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