

## Prevalence and associated risk factors of intestinal helminthic infections in children from Lorestan province, Western Iran

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### ABSTRACT

**Background:** Intestinal helminthic infections are among the most important global socio-economic and health problems. This study aimed to estimate the frequency of intestinal parasites in 366 children aged 2 to 15 years referred to the main pediatric health center of Lorestan Province, Iran.

**Methods:** Microscopic analysis was performed on 366 stool samples. We applied direct smear, scotch tape, and formol-ether methods. Moreover, a questionnaire was filled in by parents or guardians of the children.

**Results:** The results showed that 36 children (9.8%) were infected with at least one or more intestinal parasites. The most prevalent parasites were *Enterobius vermicularis* (6.8%), *Hymenolepis nana* (1.9%), and *Ascaris lumbricoides* (0.55%), in the order of their appearance. Statistical analysis showed that several risk factors were significantly associated with the prevalence intestinal helminthic parasites, including male sex (OR = 2.9; 95% CI: 1.2–6.2;  $p < 0.05$ ), residing in rural regions (OR = 4.2; 95% CI: 2.1–10.6;  $p < 0.001$ ), no handwashing habit before eating (OR = 5.2; 95% CI: 2.2–12.5;  $p < 0.001$ ), and consuming raw or unwashed vegetables and fruits (OR = 4.8; 95% CI: 2.3–11.2;  $p < 0.001$ ).

**Conclusion:** The present study showed a high overall frequency of intestinal helminthic infections among the children in Lorestan province, Iran. The results of the risk factor analysis suggest that improving environmental hygiene and health education would be important for effective control of intestinal parasitic infections.

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## 1. Introduction

Intestinal helminthic infections are one of the most important socioeconomic and health problems worldwide (Hotez et al., 2009). These infections can be observed globally, especially in tropical and subtropical regions that are deprived of healthy water and sanitation facilities. According to the World Health Organization (WHO) data, many people in the world are infected with a broad spectrum of parasitic helminth and protozoa (Hotez et al., 2009). Moreover, previous reports have verified that intestinal parasitic infections affect over three billion people globally, creating clinical manifestations in many other people (Hotez et al., 2009; Stephenson et al., 2000). These reports also confirmed that these infections are responsible for >15 million of the overall deaths occurring in developing countries (Stephenson et al., 2000; World Health Organization, 2007, 2014).

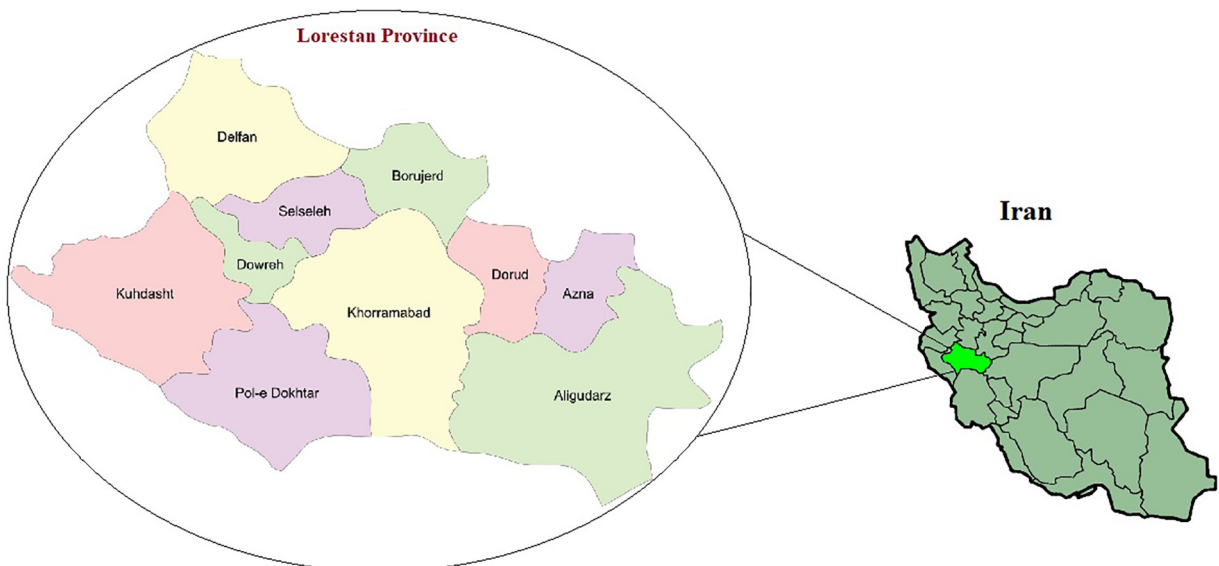
A high prevalence of intestinal parasites has been reported in children in comparison with people of other ages (World Health Organization, 2007; Mehraj et al., 2008). Intestinal helminthic infections in children can lead to severe complications such as malabsorption, malnutrition, growth and development disorder, anemia, and physical and mental consequences (Banke et al., 2006; Gutierrez-Jimenez et al., 2013; Stoltzfus et al., 2008). As a result, studies on the frequency of intestinal helminthic infections in various geographic areas are needed for developing proper control policies. So far, several studies have focused on the prevalence of intestinal parasites in children in various countries, demonstrating various results based on the geographical and health status of the study area (Faria et al., 2017; Forson et al., 2017; Dessie et al., 2019; Guan and Han, 2019; Daryani et al., 2017). Reviews have presented a range of statistics on the frequency of intestinal helminthic infections in different provinces of Iran, revealing helminthic infections as one of the most important health problems in some parts of the country (Daryani et al., 2017; Rokni, 2008). However, differences in the prevalence rate of helminthic parasites can be associated with various factors such as climatic situation, geographical site, and a variety of cultural, economic, and social characteristics (Nematian et al., 2008).

In Iran, reviews have shown that prevalence of intestinal protozoan and helminthic infections is 16.9% and 9.48%, respectively, and *Giardia lamblia* (15.1%) and *Enterobius vermicularis* (16.5%) were the most prevalent among protozoa and helminthic infections, respectively (Daryani et al., 2017). While there is no national control program for these infections in Iran, some measures such as epidemiological studies and the identification of endemic areas of these infections, along with the use of preventive programs such as health education, can be effective in controlling this infection (Daryani et al., 2017). A recent survey reported that the prevalence of intestinal parasites in adults of Lorestan was 16.4% (Badparva et al., 2014). The goal of the present epidemiological study was to estimate the prevalence of intestinal helminthic infections and identify associated risk factors in children (aged 2 to 15 years) referred to health centers of Lorestan province, Iran.

## 2. Material and methods

### 2.1. Study area

Lorestan Province, situated among the valleys of Zagros Mountain, Western Iran, has varied climatic conditions including cold mountainous climate, Mediterranean climate, and warm climate. The population of this province was estimated at 1,716,527



**Fig. 1.** Geographical location of Lorestan province (Western Iran); where this cross-sectional survey carried out on 366 children referring to the main pediatric health center of the province.

people. The main cities are Khorramabad, Borujerd, Aligudarz, Dorud, Kuhdasht, Azna, Aleshtar, Nurabad, and Pol-e Dokhtar. The sampling was performed in main children medical centers of Lorestan province (Fig. 1).

## 2.2. Study design

The present cross-sectional survey was carried out from July 2016 to April 2017 on 366 children (ranging from 2 to 15 years old), who were referred to the main pediatric health center of Lorestan province, Iran.

## 2.3. Questionnaire

In this study applied questionnaire (answered by parents/guardians of children) was designed to gain information about the children's socio-demographics data and other variables related to helminthic infections, such as age, sex, residence, hand washing habit, and consumption of raw or unwashed vegetables and fruits.

## 2.4. Ethical considerations

The current investigation was approved by Ethics Committee of Lorestan University of Medical Sciences, Khorramabad, Iran (LUMS.REC.2017/233). In addition, parents/guardians provided a written informed consent on behalf of all children.

## 2.5. Sample collection and stool examinations

A total of 366 stool specimens and scotch tape samples were collected; the sample size was based on study population and prevalence of intestinal parasites in this province. Furthermore, children whose parents said that they received antihelminthic medications at the time of the survey or 14 days before the investigation were excluded. To obtain stool samples, the day before stool sampling, a sterile containers accompanied by comprehensive information along with Scotch tapes was given to the parents/guardians of each child. A sample from all the selected children was received. All specimens were tested macroscopically for the presence of helminthes visible to the naked eye or using of a hand lens. Microscopic examination was accomplished using the direct smear technique (wet mount) and formol-ether concentration technique (Eyamo et al., 2019; Dahal et al., 2019). The children who were diagnosed positive were referred to a pediatrician to receive the suitable orientations and medical treatments as well as follow up.

## 2.6. Statistical analysis

The sample size was arrived at via a formula  $n = \frac{Z^2 \times P(1-P)}{d^2}$ . The estimation of the sample size was based on population and previous study on prevalence intestinal helminthic infections in Iran (Daryani et al., 2017). Where P = prevalence of intestinal parasites from previous study (10%), d = margin of error (0.015) and Z = standard score corresponds to 1.96. This gave a sample size of 336. To reduce errors rising from the probability of non-compliance, 10% of the sample size was added giving a final sample size of 366.

We used the SPSS 24.0 software (SPSS Inc., Chicago, IL, USA) to data analysis. Numerical statistics were displayed as mean  $\pm$  SD. Variables that were significantly related with helminthic infections were analyzed as possible risk factors by means of univariate logistic regression. P < 0.05 was measured to be statistically significant.

## 3. Results

### 3.1. Socio-demographic characteristics of the participants

The mean age of the children was  $7.3 \pm 2.1$  years, and most of them were boys (53.8%). Moreover, a total of 266 (72.6%) children lived in urban regions, 303 (82.8%) children reportedly did not wash their hands before eating, and 47 (12.8%) reportedly consumed raw vegetables and fruits.

**Table 1**

Prevalence of intestinal helminthic parasites among 366 children (aged 2–15 years) from Lorestan province, western Iran.

Parasite	Number of positive children from 366 children	(%) of positive	95% CI
<i>Enterobius vermicularis</i>	25	6.8	4.3–9.3
<i>Hymenolepis nana</i>	7	1.9	0.8–2.7
<i>Ascaris lumbricoides</i>	2	0.55	0.5–1.3
<i>Trichuris trichiura</i>	1	0.28	0.08–0.78
<i>Taenia</i> spp.	1	0.28	0.08–0.78
Total	36	9.8	6.3–12.6

### 3.2. Stool examination

The findings demonstrated that 36 children (9.8%; 95% CI: 6.8–12.8) were infected with one type of intestinal helminths and one child (0.27%; 95% CI: 0.1–0.77) had more than one type of intestinal helminths (*E. vermicularis* + *Hymenolepis nana*). Table 1 presents the prevalence of intestinal helminthic parasites among the children in Lorestan with respect to the type of parasite. The most prevalent parasites were *E. vermicularis* (6.8%; 95% CI: 4.3–9.3), *H. nana* (1.9%; 95% CI: 0.5–3.3), and *A. lumbricoides* (0.55%; 95% CI: 0–1.3), in the order of their appearance.

### 3.3. Risk factors of intestinal helminthic infections

Demographic characteristics and risk factors associated with parasitic infection among the children are reported in Table 2. Boys had higher odds to be infected than girls (OR = 2.9; 95% CI = 1.2–6.2;  $p = 0.02$ ). Twenty-four (12.2%) boys and 12 girls (7.1%) were infected with one or more species of intestinal helminths. By age, statistical analysis demonstrated that the prevalence of intestinal helminthic infections did not differ in terms of age between the participants ( $p = 0.7$ ).

In terms of the residence, of 266 children living in urban regions, 21 (7.8%) were infected with one or more species of intestinal helminths. In comparison, from 100 children residing in rural regions, 15 (15.0%) were infected with one or more species of intestinal helminths. So, it can be stated that children who live in rural regions had higher odds to be infected than those living in urban regions (OR = 4.2; 95% CI = 2.1–10.6;  $p < 0.001$ ).

In terms of handwashing habit, of the 63 children who reportedly did not wash their hands before eating, 13 (20.6%) were infected with one or more species of intestinal helminths, while of 303 children who reportedly did wash their hands before eating, 23 (11.3%) were infected with one or more species of intestinal helminths. These findings indicate that children who did not wash their hands before eating had higher odds to be infected than those who reportedly washed their hands before eating (OR = 5.2; 95% CI = 2.2–12.5;  $p < 0.001$ ).

Out of 47 children who reportedly consumed raw or unwashed vegetables and fruits, 8 (17.0%) were infected with at least one or more intestinal parasites. In comparison, of 319 children who did not eat raw or unwashed vegetables and fruits, 28 (8.8%) were infected with one or more species of intestinal helminths. This result indicated that children who consumed raw or unwashed vegetables and fruits had higher odds to be infected than those who did not consume them (OR = 4.8; 95% CI = 2.3–11.2;  $p < 0.001$ ) (Table 2).

## 4. Discussion

Currently, there is no national control program in Iran for intestinal helminthic infections. Efforts such as epidemiological studies and subsequently the identification of endemic areas of these infections along with using preventive programs such as health education can be effective in controlling these infections. In the present study, we evaluated the prevalence of intestinal helminthic infections and associated risk factors in children referred to the main pediatric health center of Lorestan province, Iran.

Based on the obtained results, of 366 children, 36 were infected with at least one or more intestinal parasites. Recently, the prevalence of intestinal parasitic infections was estimated to be 38% in Iran (Daryani et al., 2017), where the prevalence of intestinal protozoa, intestinal helminthic infections, and non-pathogenic parasites was 16.9%, 9.48%, and 18.5%, respectively. Compared to other regions of Iran, the prevalence of intestinal helminthic infections in children from Lorestan appeared lower than that reported in Hamedan (52.6%), Sistan and Baluchestan (24.8%), Kerman (23.5%), and Isfahan (12.5%) Provinces, and higher than that reported in Alborz (2.3%), Bushehr (1.4%), Ghazvin (1.5%), Tehran (1.3%), and Zanjan (4.2%) (Daryani et al., 2017; Kiani et al., 2016).

**Table 2**

Logistic regression analysis of the significant predictors associated with the prevalence intestinal helminthic parasites among 366 children (aged 2–15 years), referring to the main pediatric health center of Lorestan province, Iran.

Variables	Negative no. (%)	Positive no. (%)	OR (95% CI)	P value
Gender				
Male	173 (87.8)	24 (12.2)	2.9 (1.2–6.2)	0.02*
Female	157 (92.9)	12 (7.1)	1	
Age groups				
<7 yrs	124 (88.6)	16 (11.4)	1.3 (0.7–2.2)	0.7
≥7 yrs	206 (91.2)	20 (8.8)	1	–
Residential place				
Urban	245 (92.2)	21 (7.8)	1	–
Rural	85 (85.0)	15 (15.0)	4.2 (2.1–10.6)	<0.001*
Hand washing habit before eating				
No	50 (79.4)	13 (20.6)	5.2 (2.2–12.5)	<0.001*
Yes	280 (92.4)	23 (7.6)	1	–
Unwashed vegetables/fruit consumption				
No	291 (91.2)	28 (8.8)	1	<0.001*
Yes	39 (83.0)	8 (17.0)	4.8 (2.3–11.2)	–

\*  $P < .05$ , difference considered statistically significant.

Research shows that the prevalence of helminthic infections differs significantly across areas, districts, and countries. The variations in the prevalence of intestinal helminthic infections in various parts in the world including Iran may be the consequence of the differences in personal, social, and cultural habits; climatic conditions; economic and educational status; and previous control efforts (Daryani et al., 2017; Nematian et al., 2004, 2008). Moreover, further factors regarding the time of study and experimental methods provide differences in the prevalence and dissemination of intestinal helminths.

Our results revealed that the most prevalent parasites in the study area were *E. vermicularis*, *H. nana*, and *A. lumbricoides*. In line with these results, in Ardabil Province, Iran, it has been reported that among helminthic infections, *E. vermicularis* (18.2%) followed by *H. nana* (0.4%) and *A. lumbricoides* (0.1%) were the most common among primary school students (Daryani et al., 2017). Previous studies have concluded that *E. vermicularis* (15.8%) followed by *H. nana* (3.1%) and *A. lumbricoides* (0.3%) were the most frequent parasites among primary school students in Golestan Province (Tohidi and Qorbani, 2009; Kohsar et al., 2004). Also, *E. vermicularis* (15.8%) followed by *H. nana* (3.1%) and *A. lumbricoides* (0.3%) were found to be the most prevalent helminthic parasites among primary school students in Kerman Province (Ahmadrajabi et al., 2003; Molazade and Rahimi, 2005).

Badparva et al. (2009) reported that of 598 primary school students of Kouhdasht rural regions, Lorestan Province, *E. vermicularis* was found in 202 children (33.7%). Reviews also revealed that in Tehran Province, the prevalence of *E. vermicularis*, *H. nana*, and *A. lumbricoides* was 5.1, 0.3, and 0.1%, respectively (Daryani et al., 2017).

Previous studies have shown that some risk factors such as residence, lack of handwashing before eating, and consumption of unwashed fruit/vegetables are associated with the prevalence of intestinal helminthic infections in Iran (Daryani et al., 2017). Therefore, we evaluated the associations between these risk factors and the prevalence of intestinal helminthic infections in Lorestan province, Iran. Consistent with our results, some studies reported associations between these risk factors and with the prevalence of intestinal parasitic infections (Daryani et al., 2017; Mahmoudvand et al., 2018a,b; Ragunathan et al., 2010). Our findings revealed that the handwashing habit before eating and no consumption of washed vegetables and fruits were protective factors regarding the prevalence of intestinal helminthic infections in the setting of our study.

## 5. Conclusion

The present study demonstrated the frequency of intestinal helminthic infections among children in Lorestan province, Iran. According to the obtained results, sex of males, residing in rural regions, hand washing habits, and consuming raw or unwashed vegetables and fruits are associated with the prevalence of intestinal helminthic parasites. The results suggest that improving hygiene and health education would be important for the effective control of intestinal parasitic infections.

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## Declaration of competing interest

The authors declare that there is no conflict of interest.

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