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Prevalence and Associated Risk Factors of Soil-Transmitted Helminthic Parasites in Iranian Children with Hypereosinophilia

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ABSTRACT

Background: This survey was aimed to study the prevalence of the intestinal helminthic parasites among children with hypereosinophilia and healthy children from Lorestan province, western Iran. **Methods**: This case-control study was carried out from July 2017 to August 2018 on 224 children (ranging from 2 to 15 years old) including 112 children with peripheral blood eosinophils greater than 1000 per microliter who referring to health centers of Lorestan province, Iran (case group) and 112 healthy children with normal peripheral blood eosinophils. The microscopic examination was performed on the stool samples from each child by means of the direct smear and formol-ether methods. An applied questionnaire was considered to reach information about the children's demographics data and other variables related to helminthic infections. **Results**: Out of 112 children with eosinophilia (case group), the helminthic infection was found in 23 (20.5%) children; whereas from 112 healthy children in the control group, the helminthic infection was found in 12 (10.7%) children, indicating the significant difference (p<0.001) in the prevalence of helminthic infection among the children in the case and control groups. The results demonstrated that many risk factors were considerably related to the prevalence of intestinal helminthic parasites including gender (p=0.013) and consumption of raw or unwashed vegetables and fruits (p<0.001). **Conclusion**: The obtained findings revealed the considerable prevalence of intestinal helminthic parasites among children with hypereosinophilia in Lorestan province, Western Iran. The results of the present study also suggest that physicians should pay more attention to worm infections as an important factor for eosinophilia.

Keywords: *Intestinal parasites, hypereosinophilia, formalin-ether, Iran, Protozoa, Children.*

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INTRODUCTION

Eosinophilia is a health condition, which happens when the number of peripheral blood eosinophils is greater than 450 per microliter, or when the eosinophils account for more than 7% of the white blood cells [1]. Eosinophilia can be caused by both infectious and non-infectious processes, many of which may be clinically indistinguishable [1]. Eosinophilia may have different causes, from infectious to non-infectious agents including parasitic and fungal infections, Allergies, drug hypersensitivity, autoimmune disorders, toxins, etc. [2].

Among the parasitic infections, eosinophilia is caused due to some protozoan (*Cryptosporidium*

parvum, Cystoisospora belli, Giardia lamblia, Entamoeba histolytica, etc) and helminthic (*Ascaris lumbricoides, Hymenolepis spp, Trichostrongylus spp, Strongyloides stercoralis*, hookworms) parasites in human [2-5].

Parasitic diseases in terms of distribution, mortality, and morbidity are among the most important tropical infectious diseases around the world. The prevalence and distribution of different types of intestinal parasites vary from region to region and from country to country, due to differences in the environment and geographical as well as social factors [6, 7]. Therefore, epidemiological studies on the prevalence of intestinal parasitic in different regions and countries is an essential objective for determining the communities and groups at risk and formulating precautionary measures [8, 9].

Children are considered as the most vulnerable people with parasitic diseases. Parasites can reduce or stop the growth rate, physical weakness, malnutrition, micronutrient deficiencies (vitamin B12 and iron), loss of learning, and in the event of a lack of attention and treatment, they eventually cause death [8, 10]. Children in the first decade of their life due to higher contact with soil and contaminating materials and also lack of primary health standards are more likely to infect with parasites [10]. The present investigation was designed to evaluate the prevalence of the intestinal helminthic parasites among children with hypereosinophilia and healthy children from Lorestan province, western, Iran.

MATERIALS AND METHODS

Ethics

The protocol of the present study was allowed by the Ethics Committee of Lorestan University of Medical Sciences, Khorramabad, Iran (LUMS.REC.1398.016). In addition, parents/guardians were responsible for informed consent on behalf of all children**.**

Study design and patients

This case-control study was carried out from July 2017 to August 2018 on 224 children (ranging from 2 to 15 years old) including 112 children with peripheral blood eosinophils greater than 1000 per microliter who referring to health centers of Lorestan province, Iran (case group) and 112 healthy children with normal peripheral blood eosinophils, referring the health centers during the above period for routine examination were included in the control group. The exclusion criteria were: subjects who did not agree to sign an informed consent, patients who had taken systemic antibiotics in the last three months, and also immunocompromised individuals.

Questionnaire

An applied questionnaire was considered to reach information about the children's demographics data and other variables related to helminthic infections, such as age, sex, residence, handwashing habit before eating, and consumption of raw or unwashed vegetables and fruits.

Sample collection

The samples were collected in such a way that the day before stool sampling, a sterile container along with and applied questionnaire was given to each child. All the selected children returned the next day to deliver the stool sample. Stool samples (one sample from each child) were examined macroscopically for color, shape, stool consistency (watery, soft, formed), mucus, pus, smell, and presence of blood. All specimens were tested macroscopically for the attendance of some helminths for example *Ascaris*, *Enterobius*, proglottids of *Taenia*, and adult hookworm by the naked eye or using a hand lens. Finally, the direct smear technique (wet mount) and formol-ether concentration technique and consequently microscopic examination were carried out [11, 12]. It should be mentioned, the children who were diagnosed positive referred to the pediatrician to receive suitable orientations and medical treatments.

Statistical analysis

The statistical analysis of the results was done by SPSS 24.0 software (SPSS Inc., Chicago, IL, USA). Numerical statistics were displayed as mean ± SD. Variables that were significantly related to parasites prevalence were analyzed as possible risk factors by means of univariate logistic regression. $P < 0.05$ was measured to be statistically significant.

RESULTS

Participants

In this cross-control survey, a total of 224 children including 112 children with hypereosinophilia and 112 healthy children referred to the health centers of Lorestan province, Iran was studied to evaluate the prevalence of helminthic parasites and also the associated risk factors among them. The mean age of children in the case and control groups was 7.8 ± 2.12 and 7.1 ± 2.4 years, respectively. Most of the children were male in the case (68, 60.7%) and control (65, 58%) groups. By residence, in the case and control groups, 73 (65.2%) and 78 (69.6%) children lived in urban areas, respectively; whereas the rest living in rural regions. Among the children in the case and control groups, 99 (88.4%) and 91 (81.25%) had hand washing before eating, respectively; while the rest of them did not do it. In terms of consumed unwashed fruits and vegetables, in the case and control groups, 41 (36.6%) and 37 (33.0%) children had consumed unwashed fruits and vegetables, respectively; while other children did not consume unwashed fruits and vegetables (Table 1).

Prevalence of Helminthic infections

Out of 112 children with eosinophilia (case group), the helminthic infection was found in 23 (20.5%) children; whereas from 112 healthy children in the control group helminthic infection was found in 12 (10.7%) children, indicating the significant difference (p<0.001) in the prevalence of helminthic infection among children in the case and control groups (Table 2). The most common helminths were *Enterobiusver micularis* (8%), *Hymenolepis nana* (4.0%), and *Trichostrongylus sp.* (2.2%), respectively (Table 3).

No significant association was observed in the prevalence of helminthic infections in children with age-related groups (p=0.325) among the case and control groups. The findings revealed that a significant association was found between gender with the prevalence of helminthic infections (p<0.01); considering residence, the statistical analysis showed no significant correlation (p=0.31) between residence and the prevalence of helminthic infections; so that helminthic infections were found in 19.2 and 23.1% in children who live in urban and rural areas, respectively. In the case of handwashing, the obtained results demonstrated no significant association between hand washing or not and the prevalence of helminthic infections (p=0.16); whereas 20 (20.2%) and 3 (23.1%) children with the handwashing or not were found positive for helminthic, respectively. Based on the statistical analysis, there is a significant relationship between the consumption of unwashed fruits/vegetables or not and the prevalence of helminthic infections (p<0.001); so that, among children who consumed unwashed fruits/vegetables or not 29.3% and 15.5% were found positive for helminthic infections, respectively (Table 4).

DISCUSSION

Despite the vast scientific advances that have led to a reduction in the incidence and mortality of parasitic diseases in recent decades, parasitic infections are still one of the major health and social problems in most developing countries [13]. In the world, more than 2 billion people are infected with soil-transmitted helminth infections, of which nearly 450 million are diagnosed with a clinical and symptomatic condition [13, 14]. Of the 51 million deaths in the world, 39 million deaths are attributable to developing countries, and according to the statistics of 16 million deaths that occur annually in developing countries associated with infectious and parasitic diseases [13-17].

During the onset of many diseases such as allergies, asthma, rheumatic diseases, malignancies, immunodeficiency, or either gastrointestinal or parasitic infection, including soil-transmitted infection, the level of peripheral blood eosinophils may increase significantly [1, 3]. The present investigation was designed to evaluate the prevalence of the intestinal helminthic parasites among children with hypereosinophilia and healthy children from Lorestan province, western, Iran.

The obtained findings revealed that out of 112 children with eosinophilia in the case group, helminthic infections were found in 23 (20.5%) children; whereas from 112 healthy children in the control group, helminthic infections were found in 12 (10.7%) children; indicating the significant difference (p<0.001) in the

prevalence of helminthic infection among children in the case and control groups. The most common helminths are *Enterobiusvermicularis* (8%), *Hymenolepis nana* (4.0%), and *Trichostrongylus sp.* (2.2%), respectively. On the other hand, we found *Strongyloides stercoralis, Trichuris trichiura,* and *Ascaris lumbricoides* in the case group; however, none of these parasites were seen in the control group.

In line with our findings, reviews have demonstrated that eosinophilia is associated with many soil-transmitted helminthic infections such as ascariasis, strongyloidiasis, enterobiasis, Trichostrongyliasis, etc [3]. Previously Harris et al. demonstrated that among returned travelers with eosinophilia, the prevalence rate of helminthic infection was 39%; whereas the most frequent infections were loiasis, hookworm, trichuriasis or strongyloidiasis [18]. In a study conducted by Nutman et al., more than 80% of patients with an absolute eosinophil count >500/ml had at least one helminthic parasites [19]. In Iran, in a study conducted by Ashrafi et al. (2010), among 150 patients with eosinophilia, *S. stercoralis (42%), Fasciola* sp. (6%), and *Ttrichostrongylus* sp (0.7%) were found the most prevalent helminth parasites, respectively [20]. Recently, Darlan et al. (2017) demonstrated that the prevalence of soil-transmitted helminthic infections among primary school children in Medan with eosinophilia was 7.6%; whereas the most frequent parasites were 3.8% with *T. trichiura* (3.8) and *A. lumbricoides* (3%), respectively [21].

Our findings also revealed that although there was no significant association between the prevalence of helminthic infection and some demographic and risk factors such as age, residence, and hand washing before eating; however a significant correlation was found between gender of male (p=0.013) and consumption of unwashed fruits and vegetables and the prevalence of soil-transmitted helminthic parasites (p<0.001). Following our results, in a study conducted by Mahmoudvand et al. on 366 children in Lorestan province (Western Iran), there was a significant relationship between the prevalence of intestinal parasites and gender as well as the consumption of raw or unwashed fruit/vegetables [22]. Reviews also in line with our findings revealed no correlation between many demographic characteristics such as age and the frequency of soil-transmitted helminthic infections [23]. Considering the limitations of the present study, we can mention factors such as the methods used, sample size, and socio-cultural items.

CONCLUSION

The obtained findings revealed the considerable prevalence of intestinal helminthics parasites among children with hypereosinophilia in Lorestan province, Western Iran. The results of the present study also suggest that physicians should pay more attention to worm infections as an important factor for eosinophilia.

Conflict of Interest: The authors declare no conflict of interest in this study.

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Table 1. Demographic characterization of participants in case and control groups.

Variable	Group		P-value
	Case (children with eosinophilia) No. (%)	**Control (healthy children) No. (%)**	
Age			
<7 yrs	43 (38.4)	51 (45.5)	0.162
≥7 yrs	69 (61.6)	61 (54.5)	-
Gender			
Male	68 (60.7)	65 (58.0)	0.681
Female	44 (39.3)	47 (42.0)	-
Residence			
Urban	73 (65.2)	78 (69.6)	0.365
Rural	39 (34.8)	34 (30.4)	-
Hand washing before eating			
Yes	99 (88.4)	91 (81.2)	0.548
No	13 (11.6)	21 (18.8)	
Consumed unwashed fruits/vegetables			
Yes	41 (36.6)	37 (33.0)	-
No	71 (63.4)	75 (67.0)	0.845

Table 2. Comparison of the prevalence of helminthic parasites in the case and control groups.

Group	Microscopic test			P-value
	Positive No. (%)	Negative No. (%)	Total No. (%)	
Case (Children with eosinophilia)	23 (20.5)	89 (76.5)	112 (100)	<0.001 *
Control (Healthy children)	12 (10.7)	100 (89.3)	112 (100)	-

Table 3. Prevalence of intestinal helminthic parasites among case and control groups.

Parasite	No. (%) of positive children from 112 children with eosinophilia	No. (%) of positive children from 112 healthy children	Total
Ascaris lumbricoides	1 (0.9)	-	1(0.45)
Enterobius vermicularis	11 (9.8)	7 (6.25)	18 (8.0)
Hymenolepis nana	5 (5.4)	4 (2.7)	9 (4.0)
Strongyloides stercoralis	1 (0.9)	-	1 (0.45)
Trichostrongylus sp.	4 (3.6)	1 (0.9)	5 (2.2)
Trichuris trichiura	1 (0.9)	-	2 (0.9)
Total	23 (20.5)	12 (10.7)	35 (15.6)

Table 4. Frequency of helminthic infections in patients with hypereosinophilia based on the demographic characteristics and associated risk factors.

Variable	Microscopic test		P-value
	No. (%) of positive	**No. (%) of negative**	
Age			
<7 yrs	8 (18.6)	35 (81.4)	0.76
≥7 yrs	15 (21.7)	54 (78.3)	-
Gender			
Male	18 (26.5)	50 (73.5)	0.013*
Female	5 (11.3)	39 (88.7)	
Residence			
Urban	14 (19.2)	59 (80.8)	0.365
Rural	9 (23.1)	30 (76.9)	
Hand washing before eating			
Yes	20 (20.2)	77 (77.8)	0.548
No	3 (23.1)	10 (76.9)	
Consumed unwashed fruits/vegetables			
Yes	12 (29.3)	29 (70.7)	-
No	11 (15.5)	60 (84.5)	<0.001