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RESEARCH ARTICLE

PREVALENCE OF INTESTINAL HELMINTHIASIS AND THEIR ASSOCIATION WITH EOSINOPHILIA AMONG SCHOOLCHILDREN IN WADIDHAHAR DISTRICT AT SANA'A GOVERNORATE, YEMEN

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Abstract

Objectives: Allergy and parasitic infections are common causes of blood eosinophilia. Intestinal helminthiasis remains a major health problem in many developing countries. Eosinophils are an effector immune cell against parasites.The objective of this study was to determine the prevalence of intestinal helminthiasis and eosinophilia among primary schoolchildren in Wadi Dhahr district, Sana'a governorate, Yemen.
Subjects and methods: Four hundred and fourteen pupils were enrolled in this study. Blood and stool samples were collected from each pupil. Stool samples were examined using Hoffman's sedimentation method for the presence of worms' ova. Blood smears were stained with Giemsa stain and used for counting the eosinophils' percentages.
Results: Out of 414 specimens, the prevalence of intestinal helminths infections was 79(19%) among schoolchildren; (52 (18%) males and 27 (21%) females). Eosinophilia was 134 (32%) observed in the participated pupils; 86 (30%) males and 48 (37%) females. The age group 5-10 years had the highest frequent rate of eosinophilia with a statistically significant difference (χ^2=10.4, p=0.002) and 60% of infected students with intestinal worms had eosinophilia (χ^2=32.8, p<0.001). Females had a higher rate of eosinophilia than males. The most common helminthiasis infections were hymenolepiasis (10.6%) followed by ascariasis (4.1%), enterobiasis (2.7%), and taeniasis (2.4%). The high rate of eosinophilia was recorded among students infected with *Ascaris lumbricoides* (82%) followed by *Enterobius vermicularis* (73%), *Trichuris trichiura*(67%), *Hymenolepis nana* (59%), and *Taeniasaginata* (30%).
Conclusions: Intestinal helminthiasis still a common health problem among schoolchildrenin WadiDhahar district at Sana'a governorate, Yemen, and was found to be associated with high blood eosinophils. Eosinophilia was statistically significant among students infected with ascariasis, hymenolepiasis, and enterobiasis but not with taeniasis and trichuriasis.
Keywords: Intestinal helminthiasis, eosinophilia, schoolchildren, WadiDhar, Yemen.

INTRODUCTION

Typically, eosinophils' count in the blood is often less than 6% of the total blood leukocyte count. An increase in the eosinophil number, more than 6%, is called eosinophilia. Varied disorders and etiologies may increase blood eosinophils which mainly include worm infections and allergic diseases. Parasitic infections are the most common cause of persistent eosinophilia in developing countries while atopic diseases such as eczema and asthma are the most common causes in developed countries[1,2]. In some parasitic infections, increase in the eosinophil number may be the only symptom[3].

Eosinophilia may vary depending on the parasite development stage, parasite location in the body, parasite load, and co-infections with more than one parasite. Helminths which migrate into the tissues as part of their growth life cycle such as ascariasis induce persistent eosinophilia in both blood and tissues[4,5]. Globally 1.5 billion individuals were infected with intestinal helminths; of which more than 267 million pre-school children and above 568 million school-children are considered at risk of morbidity,

particularly in developing countries[6]. In 2010, anestimated 819 million individuals were infected with *Ascarislum bricoides*, 464 million with *Trichuris trichura*, and 438 million with *Ancylostoma* worms in the world[7]. In children, worm infections can cause significant malnutrition, delayed physical development, cognitive impairment while in adults; worms can reduce their productivity[8,9,10]. Helminth infections have been associated with poor personal hygiene, environmental sanitation, and limited access to potable water[11] particularly in Yemen where most of people live under poverty line that lacks the effective programs for parasitic infection control and prevention[12,13,14]. It was reported that the prevalence rate of intestinal parasitic infection was 62.7% recorded among schoolchildren in Ibb city[13]. Also, a study performed by Al-Mekhlafi *et al.*,[14] reported that the overall prevalence of intestinal parasitic infections was 17.2% among schoolchildren. In Yemen, there are several investigations that focused on the prevalence of intestinal parasitic infection among children school and associated with environmental factors. To date, data on the prevalence of intestinal helminthiasis associated with eosinophilia levels among schoolchildren are not available for Sana'a governorate, Yemen. Therefore, this study aimed to determine the prevalence of intestinal helminthiasis and its association with eosinophilia among schoolchildren at WadiDhahr district in Sana'a governorate, Yemen.

MATERIALS AND METHODS

Study design and area

A cross-sectional survey was conducted between January 2016 to June 2018 at two primary schools (AL-Wahda and AL-Mutanabi) situated in WadiDhahr locating about 15 Km north of Sana'a, the capital of Yemen.

Study population

A total of 414 pupils, aged between 5-15 years, were enrolled in this study. Samples were chosen by using a simple random method from each school. One hundred and ninety-six samples were collected from students presented at AL-Wahda school while two hundred and eighteen samples were collected from AL-Mutanabi school.

Exclusion criteria

Students who were taking medications that may affect eosinophilia (e.g. penicillins and cephalosporins) or who had received anti-helminthic drugs within three months from the beginning of the study. Also, students known to have a food allergy or asthma were excluded from the study.

Ethical considerations

This study was approved by the Faculty of Medicine and Health Sciences, Sana'a University. Also, permission to conduct this study was approved by the office of educational authorities and school heads. Prior samples and data collection, the study objective was clarified to the parents, school teachers, and students. Oral consent was obtained from pupils' parents to participate in this study.

Sample collection

Two samples were obtained from each participant: blood and stool specimens. One gram of stool sample was emulsified in 7 ml of 10% formalin for fixation[15].Blood samples were collected by finger prick using disposable lancets. Blood smears were made from capillary blood on a glass slide, left to air dry, and then fixed with absolute methanol[16].

Examination of stool specimens

Stool samples were examined using Hoffman's sedimentation method[15]. Helminthic ova are concentrated by passing the fecal suspension through a gauze followed by centrifugation for two minutes at 1000 rpm. The upper liquid phase was discarded using a pipette. Two slides per fecal sample were prepared and read by two investigators[15].

Examination of blood films

Differential blood count*:*

Fixed blood films were stained by Giemsa method. Blood films were washed and left to dry in air. Dried films were then examined microscopically using 40X and 100X objectives. One hundred white blood cells (WBC) were counted to determine the eosinophil percentages in the peripheral blood of each student. Eosinophil count greater than 6% was considered to be eosinophilia[16].

Statistical analysis

The obtained results were analyzed using SPSS (Version 20). The statistical analysis was performed by using an odds ratio (OR), 95% confidence interval (CI), Chi-square test (χ^2), and probability (p) value <0.05 (significant) were used to determine the association between eosinophilia and helminths infection.

RESULTS

The present results showed that out of 414 participated schoolchildren; 285(69%) were males and 129(31%) were females. Also, 67(16%) and 347(84%) of student participants were aged, respectively, between-group of 5-15 years and 11-15 years. The frequency rate of infection with intestinal helminths was 79(19%) recorded among both males and females, while 335(81%) of participated were negative for an intestinal infection. The eosinophilia was 134(32%) reported among the schoolchildren (Table 1). The current findings found that the age group 5-10 years had the highest frequent rate of eosinophilia compared to the age group 11-15 years with a statistically significant difference (χ^2 =10.4, p =0.002). In addition, it was observed that the higher rate of eosinophilia (60%) was recorded among students infected with intestinal parasites whereas 26% of non-infected students had eosinophilia (χ^2=32.8, p<0.001). The frequency of eosinophilia was higher among the females (37%) compared to the males (30%) with no statistical difference as listed in Table 2. The present results revealed that the hymenolepiasis was the most common intestinal worms among schoolchildren (44; 10.6%), followed by ascariasis (17; 4.1%), enterobiasis (11; 2.7%) and taeniasis (10; 2.4%).

Table 1: Characteristics of schoolchildren participate in the study.

Characteristics	Males (n =285)		Females (n =129)		Total	
	No.	%	No.	%	No.	%
Age groups						
5-10 years	45	16	22	17	67	16
11-15 years	240	84	107	82	347	84
Mean age±SD*	12±1.7		12±1.7			
Intestinal helminths						
Infected	52	18	27	21	79	19
Non-infected	233	82	102	79	335	81
Eosinophilia						
Yes	86	30	48	37	134	32
No	199	70	81	63	280	68
Total					414	100

Table 2: Eosinophilia among students according to their gender, age groups and Intestinal helminthiasis.

	Eosinophilia		Normal		OR	*C.I*	χ^2	*p* value
	No.	%	No.	%				
Age groups								
5-10	33	49	34	51	2.4	1.39-4.02	10.4	0.002*
11-15	101	29	246	71				
Intestinal helminths								
Infected	47	60	32	40	4.2	2.5-6.98	32.8	<0.001*
Non-infected	87	26	248	74				
Gender								
Males	86	30	199	70	1.4	0.89-2.12	2	0.17
Females	48	37	81	63				

**p* value is significant (≤ 0.05)

Also, 10(2.4%) of students were infected with more than on intestinal helminths (Table 3). Table 4 shows that the most frequent of eosinophilia rate was recorded among infected students with *A. lumbricoides* (82%) followed by *E.vermicularis* (73%), *T. trichiura* (67%), *H. nana* (59%), and *T. saginata* (30%). Moreover, the eosinophilia was found in all pupils who were infected with more than one intestinal helminth.

Table 3: Types of worm infections among schoolchildren.

Infection type	No.	%
Hymenolepiasis	44	10.6
Ascariasis	17	4.1
Enterobiasis	11	2.7
Taeniasis	10	2.4
Trichuriasis	6	1.4
Schistosomiasis	2	0.5
Mixed infection	10	2.4

There was a statistical significance among students infected with *A. lumbricoides*, *H. nana* ($p<0.001$), and *E. vermicularis* ($p<0.007$). Nevertheless, no significant difference ($p>0.05$) between infected participants with *T. saginata* and *T. trichiura*.

DISCUSSION

Intestinal parasitic infections are still major public health problems in developing countries and affect the poorest and most deprived communities. Soil-transmitted helminths impair the nutritional status and affect the general intelligence of the people they infect. Malnutrition has a significant impact on the growth and physical development of the infected children[6,17]. Current study confirms intestinal helminthiasis to remain a medical health problem in children from the two elementary schools at WadiDhahr district with a prevalence rate of 19%. Intestinal helminths in current study are almost similar to those reported from Nepal (20.4%) and Egypt (21%)[18,19].The prevalence rate of intestinal helminthiasis among schoolchildren in the present study was lower than that reported from Nigeria 20(59%), India (50%), and Ethiopia (48%)[20,21,22]. The high prevalence of intestinal helminthiasis may reflect poor adhesion to preventive measures which helps re-infection to occur after dewormed programs performed by WHO. Hymenolepiasis was the most frequent intestinal helminthiasis among schoolchildren followed by ascariasis and enterobiasis. Current finding is consistent with studies conducted in Saudi Arabia and Egypt which reported *H. nana* to be the most common intestinal worm among schoolchildren[23,24]. However, current study disagrees with studies performed in Nigeria which found *A. lumbricoides* to be the most frequent intestinal helminth among Nigerian schoolchildren, and also from a study conducted in Nepal which reported *T. trichiura* to be the most common intestinal worm among schoolchildren[20,25]. The pattern of intestinal helminthiasis is found to vary geographically within the country (rural versus urban) and from country to country. This variation might be due to changes in the climate and other environmental factors that may support the survival of the infective stage in the soil for a long time[26,27]. Eosinophilia was

common among school children infected with intestinal worms. Current finding is in agreement with those reported by Jiero *et al*., and Darlan *et al*., who found a significant association between soil-transmitted worms and high blood eosinophil count[28,29]. This could be explained by fact that worm infections induce immune responses via T helper cell type 2 subset (Th2 cells). Th2 cells produce interleukin-4 (IL-4), IL-5, IL-10, and IL-13 which stimulate more production of eosinophils from bone marrow resulting in peripheral blood eosinophilia[17,30-33]. The presence of blood eosinophilia without intestinal helminthiasis could be attributed to that students may have allergies, other worm infections such as urinary schistosomiasis, or a light number of parasites in the students' gastrointestinal tracts.

Table 4: Association of eosinophilia with different types of intestinal worms.

Species of worms	Eosinophilia		Normal		χ^2	*C.I*	*p* value
	No.	%	No.	%			
Ascarislumbricoides	14	82	3	18	20.2	0.026-0.329	<0.001*
Hymenolepis nana	26	59	18	41	16.1	0.150-0.542	<0.001*
Enterobiusvermicularis	8	73	3	27	8.4	0.045-0.654	0.007*
Trichuris trichiura	4	67	2	33	3.3	0.042-1.293	0.089
Taeniasaginata	3	30	7	70	0.03	0.285-4.399	0.59

* *p* value is significant (≤ 0.05)

Eosinophilia was significantly more frequent among children infected with *A. lumbricoides*, *Evermicularis*, and *H. nana*. Similar observations were reported by other studies[28, 34-37]. This could be explained by presence of tissue-invading larvae that migrate from the small intestine into blood circulation to reach lungs and elicit pulmonary inflammation[4, 38-40]. Nevertheless, eosinophilia was non-significant among schoolchildren infected with *T. trichiura* and *Taenia saginata*. This may be interpreted by worms that do not invade host tissues and thus do not come in contact with host immune system[41]. Limitations for this study was neither availability of nearby laboratory to perform complete blood count in order to calculate absolute eosinophil counts nor refrigerator for sample storage until they were being investigated.

CONCLUSION

Current study indicates that eosinophil percentages for schoolchildren who were infected with intestinal helminthiasis were significantly higher than in schoolchildren who were not infected.

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AUTHORS' CONTRIBUTIONS

Othman AM: writing original draft, clinical work. **Al-Mekhalfi AM:** methodology, formal analysis, conceptualization. All authors revised the article and approved the final version.

DATA AVAILABILITY

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

CONFLICT OF INTEREST

None to declare.

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