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ORIGINAL ARTICLE

Prevalence of *Enterobius vermicularis* amongst kindergartens and preschool children in Mazandaran Province, North of Iran

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Abstract Enterobiasis (oxyuriasis) is probably the most common helminth, which infects humans. Amongst different age groups, prevalence of *Enterobius vermicularis* in children is high compared to adults. Oxyuriasis is one of the most significant parasitic diseases of children. This nematode in children can result in loss of appetite, insomnia, grinding of the teeth, restlessness, endometritis, abdominal cramps, diarrhea and etc. Due to important complications of this parasite, the objective of the current study was to determine the prevalence of enterobiasis in kindergarten and preschool children of Amol, Mazandaran Province, North of Iran. A total number of 462 children from 32 kindergartens of Amol were examined for the prevalence of *E. vermicularis* infection, 2013. Adhesive cello-tape anal swab method was trained to parents for sampling. In addition, a questionnaire was designed and filled out to collect demographic information for each individual. Data were analyzed using Chi square test and multivariate logistic regression for each risk factor. The overall prevalence of *E. vermicularis* infection was 7.1 % (33). Although infection with *E. vermicularis* in girls 7.9 % was higher compared to boys 6.3 %, there was no significant difference between gender and age ($p > 0.05$) whereas binary logistic regression showed significant difference between enterobiasis and age ($p < 0.05$). The findings indicated that the prevalence of *E. vermicularis* in kindergarten and preschool children is relatively high and still is an important health problem and should not be underestimated due to being highly contagious infection. Therefore, educational programs and mass treatment should be carried out in order to reduce infection incidence in this area and regular parasitological test and attention to personal hygiene in kindergarten and preschool is of great importance.

Keywords *Enterobius vermicularis* · Oxyuris · Prevalence · Children · Intestinal infection · Primary schools

Introduction

Enterobiasis is certainly one of the most common human helminth infections in the throughout the world, particularly in temperate climates, with an estimate of 1000 million cases worldwide (Cook 1994). Historically *Enterobius* eggs have been found in 10,000-year-old coprolites from caves in Tennessee and Utah, in the United States of America (USA), and Chile, therefore, it is considered as a well-established human parasite. The adults dwell in the lumen of the caecum and appendix also occasionally attached to the mucosa by their anterior end (Muller 2002). The embryonated eggs can survive for 6–8 weeks under cool, moist, conditions while dry climate destroy eggs in a few days. Human usually acquires

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infection by ingestion of eggs. Direct contamination from anus to fingers that normally happens in children is a common mode of infection. Besides, inhalation of eggs is considered another route of infection (Park et al. 2005).

Enterobiasis is known as a group infection and most common take place in large families and in institutions including orphanages, boarding schools, mental homes and hospitals. Eggs are immediately contaminative and transmission usually occurs indoors (Ng et al. 2011).

Even though, the majority of cases are symptomless, children in heavy pinworm infection often suffer from irritability and loss of appetite, nausea, insomnia, bed-wetting, nightmares, grinding of the teeth, diarrhea, pruritus ani, catarrhal inflammation, pruritus vulvae, recurrent cellulitis and endometritis. Rarely, pinworms penetrate into submucosa that can be fatal (Roberts and Janovy 2000). Prevalence of *E. vermicularis* in developed countries is about 10 % (Hwang et al. 2002). In addition, prevalence of this nematode in Iran was reported 25–29 % (Nourozian and Youssefi 2012). Considering all the above-mentioned symptoms and signs, it seems to be necessary to monitor, up-date and re-evaluate data about *E. vermicularis* status in communities. Hence, the objective of the current study was to determine the prevalence of *E. vermicularis* infection among kindergarten and preschool children of Amol, Mazandaran Province, North of Iran, 2013.

Materials and methods

Study area

Amol (36°28′11″N 52°21′03″E) is a county that is located on the Haraz river bank in Mazandaran Province at the northern part of Iran and on the southern coast of the Caspian Sea. It covers an area of 4374 km^2 and its population is composed by 343,747 inhabitants. This area has a particular geographical condition with moderate and subtropical climate with 70–100 % relative humidity, 11–20 °C average temperature and 829 mm annual rainfall. It has diverse ecosystems including many plains, prairies and forests (Youssefi et al. 2014) (Fig. 1).

Fig. 1 Map of Iran, orange area shows position of Amol County in Mazandaran Province. (Color figure online)

Sampling and parasitological procedure

A total number of 462 (223 boys and 239 girls) children from 32 kindergartens from Amol, Mazandaran Province was examined for the prevalence of *E. vermicularis* infection using Scotch-tape technique which is considered as the gold standard for the diagnosis of parasite eggs (Shoup 2001). Sampling method was simple systematic. Samples selected equal proportion of all kindergartens. A piece of clear adhesive tape was used to collect a specimen from the perianal surface of children in the morning before defecation. The sample was mounted (adhesive side down) on a glass slide and screened under a light microscope using 10× and 40× magnifications by expert parasitologists in the Department of Paramedical, Mazandaran University of Medical Sciences, Amol, Iran. Furthermore, a questionnaire was designed and filled out for each individual to collect demographic and clinical information which seem to be related with enterobiasis. Finally, the results were presented to kindergartens and prevention and control methods were educated.

Statistical analysis

The data were analyzed using SPSS 16 and EpiInfo 6 programs. Odds ratios for risk factors analysis were calculated by multivariate logistic regression model. p value less than 0.05 was considered as significant.

Results

The overall prevalence of enterobiasis among examined individuals was determined 7.1 % (33). Although girls17.2 % (34) showed more infection rate compared to boys21.7 % (27), no statistically significant difference was seen between infection rate and genders ($p > 0.05$). Infection with age of 5 and 6 years old (9 %) was more than 2–4 years old children (2.5 %) and binary logistic regression showed significant difference between enterobiasis and age ($p < 0.05$). Furthermore, enterobiasis infection in larger families (10 %) was more than small ones (6.8 %). Besides, infection with *E. vermicularis* in rural and urban areas was 14.3 and 6.4 %, respectively. Table 1 indicates demographic and clinical factors of examined individuals. In addition, there was no significant association between enterobiasis and the listed demographic and clinical factors presented in Table 1. Figure 2 shows the collected *E. vermicularis* eggs from patient.

Discussion

The current study showed a relatively high prevalence of *E. vermicularis* infection amongst kindergarten and preschool children. This finding is in accordance with reports which have been conducted in different areas of Iran including Semnan (8.1 %), Sari and Babol (7.3 %). These results were more than prevalence of enterobiasis in Urmia (4.6 %), Isfahan (2.38 %) and Alborz (0.028 %) (Hazratitape et al. 2007; Atash Nafas et al. 2007; Abedi et al. 2004; Sharif and Ziaie Hezar Garibi 2000; Nasiri et al. 2009). Whereas some studies reported a higher prevalence rate including: Kermanshah (14.7 %), Ardebil (18.3 %), Zahedan (31.8 %), Babol (33.3 %), Ahwaz (34.6 %) and Tehran (40 %) (Nourozian and Youssefi 2013; Sharif and Ziaie Hezar Garibi 2000; Sha-Mohammadi et al. 2014; Maghrebi 1994; Daryani and Ettehad 2003).

Enterobius vermicularis infection among children on western and southern coastal islands of the Republic of Korea was reported 18.5 % (Park et al. 2005). In Argentina, the prevalence of *E. vermicularis* in preschool children was shown 43.4 % (Guignard and Freye 2000). Also among children in Lower Northern Thailand was 25 % (Bunchu et al. 2011). An epidemiological survey on intestinal nematode infections in Romania reported 42.8 % of examined cases were infected with *E. vermicularis* (Neghina et al. 2011). A retrospective evaluation of the prevalence of intestinal parasites in Istanbul, Turkey, revealed 9 % using cellophane tape.

In this study, there was no significant difference between prevalence of enterobiasis and gender of examined children that is in agreement with some studies (Nourozian and Youssefi 2013; Haghi et al. 2013). There was a association between prevalence of *E. vermicularis* infection and age that is in accordance with Nithikathkul et al. (2001) and Bunchu et al. (2011). This point is noteworthy to mention that north of Iran has favorable conditions for survival of *E. vermicularis* eggs and this point make it difficult to control and prevent *E. vermicularis* infection in these areas.

Generally pinworm infection is the predominant disease in areas and communities where environmental conditions and socio-economic, and hygiene practice levels, are low. Disease is easily transmitted among family members via contaminated hands, inhalation and fomites (Haswell-Elkins et al. 1987; Noor Hayati and Rajeswari 1991). As a result, rapid spread and high re-infection are common among children in the same class, or among family members. Usually, children are considered as the main targets, because of this fact that children's behaviors contribute more to the development of *E. vermicularis* infection compared to adults.

Table 1 Univariate and multiple logistic regression analysis on different risk factor for enterobiasis

Risk factor	Frequency		Enterobiasis		*p* value	Multivariate meta regression analysis		
	No.	%	Yes %	No %		*p* value	CI	OR
Sex								
Boy	223	48.3	14(6.3)	220(92.1)	0.304	–	–	–
Girl	239	51.7	19(7.9)	117(97.5)		0.370	0.7–3.04	1.4
Age (year)								
2–4	120	26	3(2.5)	136(88.9)	0.023	–	–	–
5	153	33.1	17(11.1)	176(93.1)		0.006	1.7–22.2	6.1
6	189	40.9	13(6.9)	393(93.6)		0.071	0.9–12.5	3.3
Area								
Urban	420	90.9	27(6.4)	36(85.7)	0.067	–	–	–
Rural	42	9.1	6(14.3)	251(92.6)		0.029	1.1–8.5	3.1
Family members								
3	271	58.7	20(7.4)	151(93.8)	0.740	–	–	–
4	161	34.8	10(6.2)	27(90)		0.429	0.3–1.6	0.7
5	30	6.5	3(10)	123(94.6)		0.546	0.4–5.9	1.5
Anal itching								
Yes	130	28.1	7(5.4)	306(92.2)	0.241	0.311	0.2–1.6	0.6
No	332	71.9	26(7.8)	130(95.6)		–	–	–
Teeth grinding								
Yes	136	29.4	6(4.4)	299(91.7)	0.098	0.113	0.2–1.2	0.5
No	326	70.6	27(8.3)	63(91.3)		–	–	–
Finger sucking								
Yes	69	14.9	6(8.7)	366(93.1)	0.368	0.296	0.6–4.6	1.7
No	393	85.1	27(6.9)	107(95.5)		–	–	–
Restlessness								
Yes	112	24.2	5(4.5)	322(92)	0.145	0.222	0.2–1.5	0.5
No	350	75.8	28(8)	41(95.3)		–	–	–
Insomnia								
Yes	43	9.3	2(4.7)	388(92.6)	0.388	0.724	0.2–3.5	0.7
No	419	90.7	31(7.4)	382(92.9)		–	–	–
High level of parental care								
Yes	411	89	29(7.1)	47(92.2)	0.506	0.593	0.2–2.3	0.7
No	51	11	4(7.8)	26(96.3)		–	–	–
Infection of family with entrobious								
Yes	27	5.8	1(3.7)	403(92.6)	0.409	0.508	0.05–4.1	0.5
No	435	94.2	32(7.4)	64(90.1)		–	–	–
Infection with other parasites								
Yes	71	15.4	7(9.9)	365(93.4)	0.320	0.263	0.7–4.3	1.7
No	391	84.6	26(6.6)	–		–	–	–
Total	462	100	–		–	–	–	–

Self declare of mothers at response to some of questions was of the limitation of present study.

In conclusion, based on our findings the prevalence rate of *E. vermicularis* in kindergarten and preschool children is relatively high and should not be underestimated due to being highly contagious infection. Thus, effective educational programs and mass treatment should be carried out in order to reduce and control infection in this area. In addition, regular parasitological test and attention to personal hygiene in kindergarten and preschool is of great importance.

Fig. 2 A large number of *E. vermicularis* eggs under light microscopy using Scotch-tape technique from examined individual (×40)

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