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Prevalence and time-trend analysis of intestinal parasitic infections in north-central Iran, 2012-2016

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Abstract. Intestinal parasitic infections are still considered as health challenges, predominately in the areas with low sanitation and socioeconomic conditions. Owing to the socioeconomic impact, these infections are considered as important Neglected Tropical Diseases in developing countries, including Iran. This study aimed to evaluate the prevalence and time-trend of intestinal parasitic infections in Nazarabad, Alborz Province north-central Iran. In a cross-sectional study, medical records of 4427 suspected cases of intestinal parasites, referred to the Nazarabad health network, from 2012 to 2016 were reviewed. Bio-data, as well as laboratory data, were extracted after obtaining ethics approval. The descriptive and time-trend analyses were applied to the data. Linear regression analysis was used for the time-trend analysis. The results indicated that 18.0% of the cases to have at least one parasite in their intestine. A total of 4.5% (36/798) of positive cases has mixed infection. The median age was 31 with a range from 4 to 84 years. There are 12 different parasites detected. *Blastocystis* (9.2%) and *Giardia (*7.4%) were more prevalent parasites in the cases. Time-trend analysis showed a decreasing trend of the infection from 2012 to 2016. The most prevalent infection was found in the spring months. These infections are still among the health challenges in north-central Iran. More investigations are needed to determinate the main sources of these parasites in this area. More effective control programs are needed to combat these infections, especially in the spring and summer months.

INTRODUCTION

Intestinal parasitic infections (IPIs) are still considered as health challenges, predominately in the areas with low sanitation and socioeconomic conditions (Abu-Madi *et al.*, 2016; Archer *et al.*, 2017; Alanazi, 2017; Dib *et al.*, 2015). According to the World Health Organization, these parasites infect about 3.5 billion people globally, of which 450 million cases have clinical manifestations (Rokni, 2008; Bdir & Adwan, 2010). Owing to the socio-economic impact, IPIs are considered as important neglected tropical diseases in developing countries, including Iran (Sayyari *et al.*, 2005).

Due to some progress in the control of parasitic diseases, distinct decreases have been achieved in Iran. This is obvious, especially in helminthic infections (Motazedian *et al.*, 2015; Sadeghi *et al.*,

2015). However, the high prevalence rate of IPIs, especially protozoans, remains as a nationwide dilemma for the health system in the country (Sarkari *et al.*, 2016; Bdir & Adwan, 2010; Campbell *et al.*, 2016; Sabzikarian *et al.*, 2016).

Transmission of most intestinal organisms is through the oral-faecal route (Efstratiou *et al.*, 2017; Tulu *et al.*, 2016). Contaminated food and water with human and animal faeces are the most important sources for human societies (Lim & Nissapatorn, 2017; Dubey, 2015; Rokni, 2008). Among IPIs, infections with *Ascaris lumbricoides*, *Trichuris trichiura*, hook worms, *Taenia saginata*, and *Strongyloides stercoralis* show clear decreases in Iran (Afrakhteh *et al.*, 2016). *Hymenolepis nana* and *Enterobious vermicularis* are two other more common helminthic parasites in the country (Amiri *et al.*, 2016; Daryani *et al.*, 2017; Turki *et al.*, 2016). Enterobiosis is reported more in the preschool and school children, especially in the rural areas (Barkhori Mahni *et al.*, 2016; Turki *et al.*, 2016; Wang *et al.*, 2017).

Giardia and *Blastocystis*, as pathogenic and *Entamoeba coli* as nonpathogenic protozoans are more prevalent in human infections and reported throughout the country (Barkhori Mahni *et al.*, 2016; Jafari *et al.*, 2016; Kia *et al.*, 2008; Nasiri *et al.*, 2009; Abera *et al.*, 2016; MacKenzie *et al.*, 1995). The high frequency of nonpathogenic parasites could be considered as an index for the measure of the level of sanitation and health in each region (MacKenzie *et al.*, 1995). Prevalence of IPIs is more in the rural areas, and are strongly dependent on the low level of hygiene and environmental conditions (Campbell *et al.*, 2016; Kia *et al.*, 2008; Kuzehkanani *et al.*, 2011; Sinniah *et al.*, 2014).

For evidence-based management of each disease, different aspects of epidemiology should be investigated in the endemic regions (Huffman *et al.*, 1997). Determination of transmission patterns and timelines of IPIs are very important for the control of these diseases (Huffman *et al.*, 1997; Jaran, 2017; Martins-Melo *et al.*, 2016). Many IPIs are reported in spring and summer months when the high temperature and moisture is suitable for transmission of these parasites. More focus on the control programs in these periods could be more effective in the management of IPIs (Huffman *et al.*, 1997; Jaran, 2017).

Time-trend analysis of IPIs has less consideration in Iran. The transmission rate of these parasites in the different seasons of the year is not exactly known in the country. This study's aim was to evaluate the prevalence and time-trend of IPIs in north-central Iran.

MATERIALS AND METHODS

Patients and study site

In a cross-sectional study, medical records of 4427 suspected cases of infections with intestinal parasites, referred to the Nazarabad health network, from 2012 to 2016 were reviewed. Bio-data (sex and age), as well as laboratory reports of the cases, were extracted and inserted in a prepared form. The prevalence of intestinal parasites was calculated as a number of infected cases divided by a total number of subjects in each year or in each month. Nazarabad, located in north-central Iran has a temperate weather with 301 mm annual precipitation (I.R. of Iran Meteorological Organization). Water distribution network is well developed in this area; however, more attention is needed especially in the rural areas.

Statistical analyses

Descriptive analyses were used to calculate frequencies, percentages, means, and standard deviation (SD). To compare the variables according to the health status of the subjects, chi-square, t-test, and analysis of variance were conducted, as appropriate. Linear regression analysis was used for the time-trend analysis. Statistical analysis was performed at a significance level of 0.05 using STATA version 12. The figures were plotted by Sigmaplot software version 12.

RESULTS

Between 2012 and 2016, a total of 4427 cases were referred to the Nazarabad Health network. Overall, the prevalence of intestinal infections was 18.0% and most of them (98.0%) were due to protozoans. More than half of these cases were males (58.6%) and the mean age was 31.8 (SD 12.5). The most number of infected cases were in 21-50 year age groups with 67.5% of positive cases (Table 1). *Blastocystis* and *Giardia* were the most prevalent parasites with 9.2% and 7.4% infections, respectively. Mixed infections were observed in 4.5% (n=36/798) of positive cases.

Table 2 shows the overall prevalence of protozoan and helminthic parasites by different seasonal and age groups.

Figure 1 depicts a declining trend in the prevalence of IPIs with a regression coefficient of -0.071 (P=0.075) and the higher prevalence was recorded in April 2013. During this time, the prevalence of IPIs declined from 22.4% in 2012 to 16.3% in 2016 (Fig. 1). The trend of the monthly prevalence of IPIs showed the most in April 2012 (38.03%) and March 2012 (26.83%), whereas the lowest prevalence was in December 2016 (7.41%) (Fig. 1). In addition, the time-trend analysis indicated declining in the prevalence of IPIs from 2012 (22.4%) to 2016 (16.3%).

A significant downward trend was found according to the seasons with a more prevalent trend in spring (Fig. 2). Fig. 2 shows the comparison of prevalence of IPIs by seasons. A significant difference was found in the prevalence rate between summer, fall and winter with spring.

There was no significant difference in the total prevalence of IPIs between male (19.89±8.3) and female (17.37±6.4) (P=0.064). However, time-trend analysis of the prevalence by sex indicated a declining trend in males and females with a significant trend in males (P=0.007) (Fig. 3).

Analysis of monthly trend prevalence in the different age groups revealed a declining trend in 0-20 (P=0.244) and 21-50 (P=0.007) groups. The upward trend in the age group 51 and over was observed but was non-significant (regression coefficient=0.02, P=0.846) (Fig. 4).

DISCUSSION

In spite of massive progress in the global control of IPIs, these infections still remain as a health challenge, especially in the low socioeconomic areas (Emile *et al.*, 2013). As with developing countries, IPIs caused by anthroponotic and zoonotic parasites, impose a health threat in Iran (Sayyari *et al.*, 2005; Bahmani *et al.*, 2017; Balarak *et al.*, 2016; Ramos *et al.*, 2014).

As with previous studies, in the current study, a high prevalence (18.0%) of IPIs was indicated in Iran. Other studies in Iran have reported the prevalence to range from 4.7-56% throughout the country (Bahmani *et al.*, 2017; Balarak *et al.*, 2016; Barkhori Mahni *et al.*, 2016; Kuzehkanani *et al.*, 2011; Masoumeh *et al.*, 2012; Nasiri *et al.*, 2009;

Table 1. Characteristics of the cases referred to Nazarabad Health network by healthy status

Variable	Subgroup	Intestinal infection No. (%)	Healthy No. (%)	P-value
Sex	Female	446 (55.9)	2147 (59.2)	0.089
	Male	352 (44.1)	1482 (40.8)	
Age groups	0-20	211 (26.4)	474 (13.1)	<0.001
	21-50	539 (67.5)	2847 (78.4)	
	51 and over	48 (6.1)	308 (8.5)	
Season	Spring	257 (32.2)	856 (23.6)	<0.001
	Summer	187 (23.4)	904 (24.9)	
	Fall	182 (22.8)	967 (26.6)	
	Winter	172 (21.6)	902 (24.9)	

Table 2. Overall prevalence of protozoan and helminthic parasites in the cases referred to Nazarabad Health network by different seasonal and age groups

Type of parasite	Protozoan parasite No. (%)							Helminthic parasites No. (%)					Total No. (%)
	Giardia	*Blastocystis*	*E. nana*	*I. butschlii*	*E. histolytica/ dispar*	*E. coli*	*T. hominis*	*T. saginata*	*H. nana*	*T. trichura*	*Oxyur*	*S. stercoralis*	
Age groups (in years)													
<20	133 (19.4)	62 (9.1)	2 (0.3)	2 (0.3)	1 (0.2)	3 (0.4)	1 (0.2)	0 (0.0)	0 (0.0)	0 (0.0)	7 (1.0)	0 (0.0)	685 (30.8)
21-50	178 (5.3)	314 (9.3)	9 (0.3)	6 (0.2)	9 (0.3)	12 (0.4)	2 (0.1)	3 (0.1)	3 (0.1)	2 (0.1)	0 (0.0)	1 (0.03)	3386 (15.9)
>51	16 (4.5)	31 (8.7)	0 (0.0)	1 (0.3)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	356 (13.5)
Season													
Spring	140 (12.6)	107 (9.6)	4 (0.4)	1 (0.1)	2 (0.2)	1 (0.1)	0 (0.0)	0 (0.0)	1 (0.1)	0 (0.0)	1 (0.1)	0 (0.0)	1113 (23.1)
Summer	80 (7.3)	94 (8.6)	5 (0.5)	0 (0.0)	2 (0.2)	3 (0.3)	0 (0.0)	1 (0.1)	1 (0.1)	0 (0.0)	0 (0.0)	1 (0.1)	1091 (17.1)
Fall	65 (5.7)	100 (8.7)	1 (0.1)	5 (0.4)	2 (0.2)	3 (0.3)	1 (0.1)	1 (0.1)	1 (0.1)	1 (0.1)	2 (0.2)	0 (0.0)	1149 (15.8)
Winter	42 (3.9)	106 (9.9)	1 (0.1)	3 (0.3)	4 (0.4)	8 (0.7)	2 (0.2)	1 (0.1)	0 (0.0)	1 (0.1)	4 (0.4)	0 (0.0)	1074 (16.0)

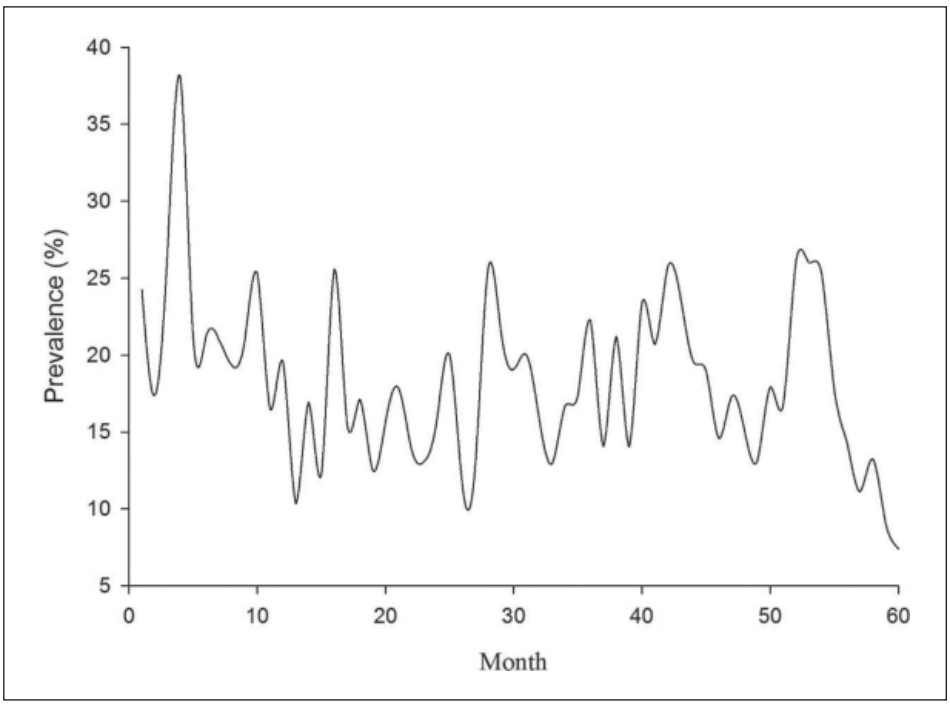

Figure 1. Trend of monthly prevalence of IPIs in the cases referred to Nazarabad Health network.

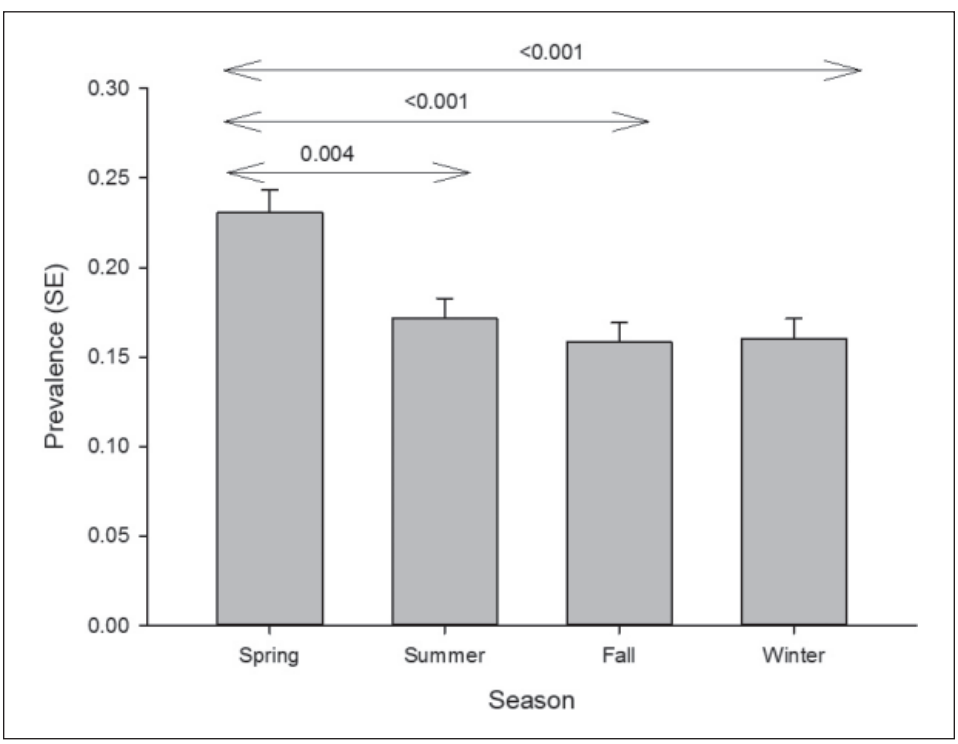

Figure 2. Prevalence of intestinal parasitic infections by season in the cases referred to Nazarabad Health network, figures shows the P-value of comparison.

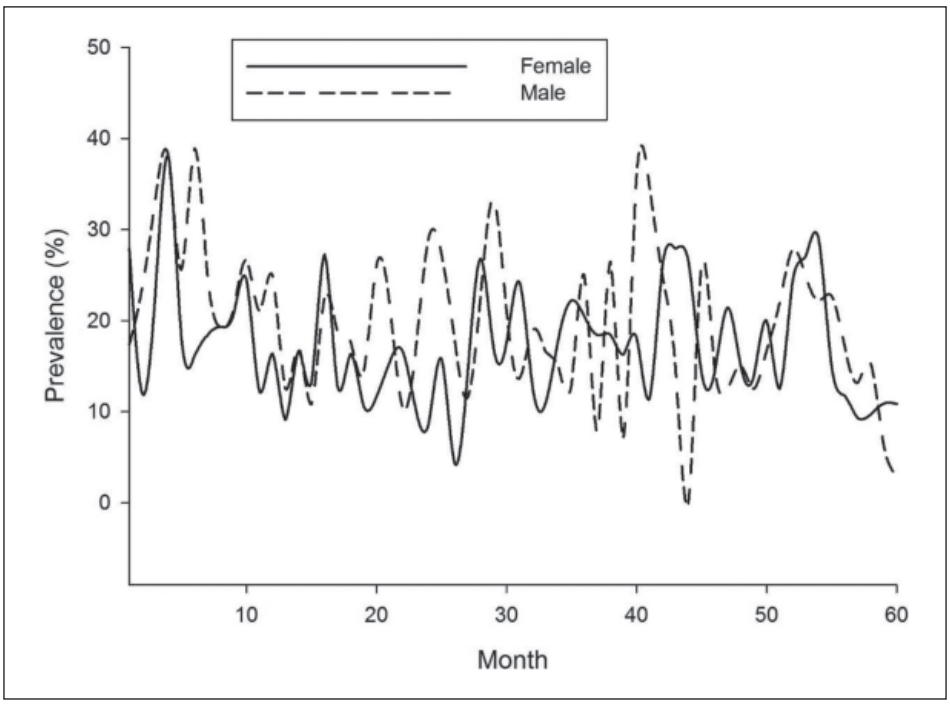

Figure 3. Trend of monthly prevalence of IPIs by sex in the cases referred to Nazarabad Health network.

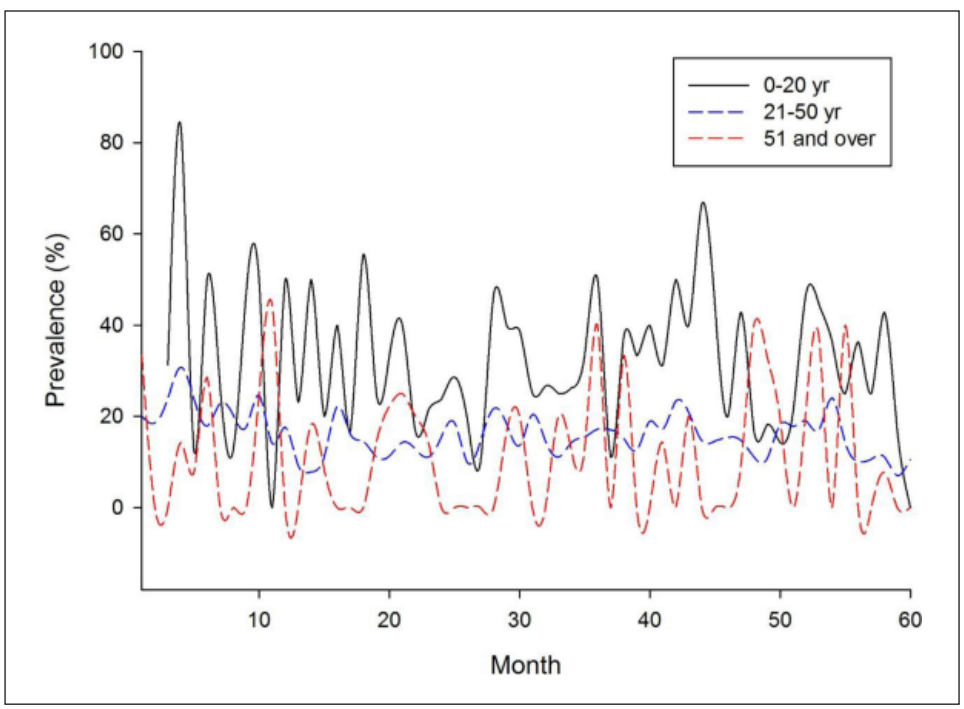

Figure 4. Trend of monthly prevalence of IPIs by age groups in the cases referred to Nazarabad Health network.

Pestehchian *et al.*, 2015; Daryani *et al.*, 2017; Sarkari *et al.*, 2016; Rasti *et al.*, 2017). One study in Boyer-Ahmad District, South-western Iran, showed that more than 30% of rural areas have individuals with at least one parasite in their intestine (Sarkari *et al.*, 2016). All previous studies in Iran indicated a noticeable decrease in the prevalence of human helminthic parasites, whereas infections with intestinal protozoans remain quite high especially in the rural regions (Arani *et al.*, 2008; Kia *et al.*, 2008; Rasti *et al.*, 2017).

In this study, infection with intestinal parasite was more in males (58.6%) and it concurs with previous studies in Iran and other countries (Kuzehkanani *et al.*, 2011; Rasti *et al.*, 2017; Alanazi, 2017). However, some studies showed more infections in females (Barkhori Mahni *et al.*, 2016; Motazedian *et al.*, 2015; Pestehchian *et al.*, 2015). One study in Shiraz, Iran, indicated more infections in females with a significant statistical difference that showed the presence of women like men in the distribution of foods amongst societies as food-handlers (Motazedian *et al.*, 2015).

As with previous studies, in the recent study, IPIs caused by *Blastocystis* and *Giardia* parasites was more prevalent throughout the world (Arani *et al.*, 2008; Jafari *et al.*, 2016; Masoumeh *et al.*, 2012; MacKenzie *et al.*, 1995; Soriano *et al.*, 2011). While not medically threatening, it is important to evaluate these non-pathogenic parasites, as well as the pathogenic ones due to the similar transmission route of these parasites. High prevalence of non-pathogenic parasites like *E. coli* act as indicators that reveal the contamination of water supplies and low level of sanitation indices (Bopda *et al.*, 2016; MacKenzie *et al.*, 1995; Sianturi *et al.*, 2016; Dib *et al.*, 2015).

Due to the transmission patterns of IPIs, it could occur in the different age and sex groups (Bopda *et al.*, 2016). However, infections in children and immuno-compromised patients must be given more consideration. These infections cause mal-nutrition, mental and behavioural disorders in children and could be even fatal in the patients with immune diseases (Dhital *et al.*, 2016; Ashtiani *et al.*, 2011; Kiani *et al.*, 2016; Kyambikwa Bisangamo *et al.*, 2017; Mukhiya *et al.*, 2012; Nanthavong *et al.*, 2017; Najjari *et al.*, 2016). Food-handlers being the most important guild in preparing and distributing foods amongst societies were emphasised in several studies to be the source of infection as studies have shown high prevalence of IPIs amongst them (Abu-Madi *et al.*, 2008; Balarak *et al.*, 2016; Kheirandish *et al.*, 2014; Zaglool *et al.*, 2011; Sharif *et al.*, 2015; Heydari-Hengami *et al.*, 2018).

Previous researchers have tended to focus more on the prevalence of IPIs only, which led to ignoring the other important patterns of IPIs epidemiology. Time-trend analysis of IPIs helps health authorities to implement the control programs at the proper time with the best outcome in combating these infections (Huffman *et al.*, 1997; Jaran, 2017; Ahmad *et al.*, 2014).

In the current study, a significant association was found between IPIs and time. Transmission of intestinal parasites was significantly ($P<0.001$) more in the spring months. Owing to warmer and higher humidity in the spring and summer months, the weather is suitable for reproduction and transmission of intestinal parasites. Contamination of water supplies and foods with cyst and eggs of these parasites could result in parasitic infections in each area (Efstratiou *et al.*, 2017).

Although Nazarabad County has access to urban water supply, sanitation and other services are much needed, especially in the rural areas. Evaluation of contaminated foods and water supply, the two important sources for IPIs, should be done more in this area.

CONCLUSION

Despite some progress in the control of IPIs, a high prevalence of IPIs is observed in Nazarabad County in north-central Iran. More investigation is needed to determinate the main sources of these parasites in the mentioned area. More effective control and

management programs are needed to combat these infections, especially in the spring and summer months when the prevalence of infection is high.

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Conflict of Interest

The authors declare that they do not have conflicts of interest.

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