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The infection with Toxocariasis in Kirkuk city, Iraq

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ABSTRACT

The present study carried out through the period from July till October 2019 to determine the seroprevalence of Toxocariasis in Kirkuk city population and report its relationship with some epidemiological factors. Questionnaire form is performed to record information about individuals under study. A blood samples of 200 cases are collected from individuals either playing football on a dirt field, people live in rural areas or in countrysides, in addition to students in schools and colleges; of both genders (male and female). Anti-*Toxocara* immunoglobulin G (IgG) is detected in serum of individuals included the study using an enzyme-linked immunosorbent assay (ELISA) technique. The total seroprevalence of Toxocariasis reported in the study is (8%). The infection is more prevalent in males (7%) than females (1%) with peak seroprevalence (28.1%) determined within the age group 5-12 years. In primary school the highest seroprevalence (11.66%) is determined. Toxocariasis is more prevalent in rural areas (10.22%) than in urban areas (6.25%).

Introduction

Toxocariasis is an important neglected tropical disease caused by the roundworms *Toxocara canis* and *Toxocara cati*. The adult worms of *Toxocara* species are live in the small intestines of different definitive hosts. For instance, *T. canis* infects the canine hosts, including domestic (as dogs) and wild (as foxes, wolves) species; whereas the animal of Felidae family act as final hosts for *T. cati*. Eggs containing infective third-stage larvae of *Toxocara* spp. are accidentally ingested by human to cause Toxocariasis [1,2].

In the definitive hosts, the parasite lives as adult worm within the lumen of the small intestine, and the infection transmitted to human when the eggs which found in canine or feline feces, respectively, are ingested by humans [3]. Human act as aberrant host with respect to the completion of the life cycle; a human can be infected by direct contact with infective (embryonated) eggs in contaminated soil (gardens, sandpits and play-grounds), by unwashed hands or raw vegetables [4,5].

In human, infective larvae hatch after ingestion of eggs, penetrate the intestine then travel through the circulatory system to various organs throughout the body to infect the tissues, the juvenile stages fail to develop to mature adult worms, instead, they wander

throughout the body for months or up to several years, causing damage to whatever tissue they happen to enter [6]. *Toxocara* spp. does not multiply within the human host, but exist in host tissues in a state of arrested development. The larvae die in human tissue therefore the inflammatory reaction produced by the body causes the symptoms of Toxocariasis [7].

Clinical signs and symptoms of this infection are non-specific, depend on number and migration site of *Toxocara* larvae [8], which classified into four groups: visceral larvae migration, ocular larvae, neural larvae and covert form [9]. Most cases of visceral larvae migration are asymptomatic in adults, most important signs are fever, weakness and intestinal pain. While the signs of severe infection in children are asthma, loss of vision, eosinophilia, encephalitis, abdominal pain and hepatomegaly. Some patients suffering from nausea, vomiting, limb pain, muscular pain, cough, pneumonia, wheezing, lethargy, lymphadenitis and neurological disturbance [10].

Direct examination for visceral larvae migrants in biopsy is very difficult, so in directional serum tests are the best. Enzyme-linked immunosorbent assay (ELISA) test depend on using secretory antigens from

second stage larvae, in ahead of these tests, the highly specific and sensitive results [11].

Studies of Toxocariasis in human in Iraq had a very little attention from the researchers. A small number of studies are done about Toxocariasis; as the study of Al-Dabbagh *et al.* [12] in Mosul, Hammad [13] in Biji- Salah Al-Din province, Hadi [14] in Baghdad. There is no study about Toxocariasis in Kirkuk governorate. According to the above data, the present study is focusing to determination the prevalence of infection with Toxocariasis by ELISA-IgG in population of Kirkuk governorate, and study the relationship between the infection with some epidemiological parameters (age, gender, level of education and living area).

Materials and methods

The study conducted in Kirkuk city through the period from July till October 2019. The study included 200 individuals aged from 5 to 44 years old, of both sexes (male and female).

Questionnaire form is performed to record information about individuals under study (name, sex, age, level of education, living area), individuals playing football on a dirt field, people live in rural areas or in countrysides, in addition to students in schools and colleges.

Anti *Toxocara* IgG is detected in serum of individuals included the study. The qualitative immunoenzymatic determination of specific antibodies is based on the ELISA technique (Biotek, America). Microplates are coated with specific antigens to bind corresponding antibodies of the sample. Using Anti-*Toxocara* IgG ELISA kit manufactured by Demeditec company, German.

Results

The total seroprevalence of Toxocariasis according to the determination of IgG antibodies reported in the study is 8% with 16 positive cases. The infection is more prevalent in males (7% with 14 positive cases), more than females (1% with 2 positive cases) as in Table (1).

Table 1: Prevalence of infection with Toxocariasis in Kirkuk city, using ELISA test.

No. of examined cases	IgG –ELISA test	
	No. of positive cases (Patient)	Prevalence of infection(%)
Male (135)	14	7.00
Female (65)	2	1.00
Total (200)	16	8.00

In the present study results is noticed that IgG antibodies titer varies in different age groups of individuals included the study. Toxocariasis highest seroprevalence (28.1%) within age group 5-12 year, followed by seroprevalence 26.4% in age group 13-20 year, then 18.2% in age group 21-28 and age group 29-36 (16.3%). Toxocariasis lowest seroprevalence (14.6%) within age group 37-44 year. Non- significant differences are reported when comparing between age group 5-12 year and age group 13-20 year or when comparing between age groups 21-28, 29-36, 37-44 year (Table 2).

Table 2: The value of IgG titer (using IgG- ELISA test) according to its absorbance in patients infected with Toxocariasis in Kirkuk city.

Group	Absorbance mean (no. of cases)	Titer of IgG
Negative control	0.13 (2)	2.71 d
Cut-off	0.37 (2)	10.4 c
Positive control	0.93 (2)	12.5 c
According to age group (year)		
5-12	1.94 (6)	28.1 a
13-20	1.76 (3)	26.4 a
21-28	1.63 (4)	18.2 b
29-36	1.47 (2)	16.3 b
37-44	1.21 (1)	14.6 b
Total	8.00 (16)	122.3

- The different small letters refer to significant differences in the value of the column ($p \leq 0.01$).

- cut-off: the titer of immunoglobulin.

In general, the higher seroprevalence is 11.66% within primary school individuals, with 10% in males and 1.66% in females. Followed by 8.82% which completed higher education individuals (5.88% in males and 2.94% in females). The other seroprevalence (6.06%, 4.34% and 3.70%) are determined within secondary school individuals, median school individuals and higher education individuals, respectively, which recorded in males only (Table 3).

Table 3: Prevalence of infection with Toxocariasis (using IgG- ELISA test) according to the gender and its level of education.

Gender Level of study	No. of examined cases	Male		Female		Total	
		No. of infected cases	Prevalence of infection (%)	No. of infected cases	Prevalence of infection (%)	No. of infected cases	Prevalence of infection (%)
Primary School	60	6	10.00	1	1.66	7	11.66
Median School	46	2	4.34	0	0	2	4.34
Secondary School	33	2	6.06	0	0	2	6.06
Higher Education	27	1	3.7	0	0	1	3.70
Complete higher education	34	2	5.88	1	2.94	3	8.82
Total	200	13	29.98	2	4.60	15	34.58

Toxocariasis is more prevalent in rural areas (10.22%) compared with urban areas (6.25%). The infection in rural areas individuals is more prevalent in males (7.95%) than in females (2.27%). In urban

areas individuals, the infection are reported only in males (6.25%), with no infected cases for females (Table 4).

Table 4: Prevalence of infection with Toxocariasis (using IgG- ELISA test) in Kirkuk city according to the gender and its type of living area.

Gender Living area	No. of examined cases	Male	Female	Total	Prevalence of infection (%)	No. of infected cases	Prevalence of infection (%)
		No. of infected cases	Prevalence of infection (%)	No. of infected cases			
Urban	112	7	6.25	0	0	7	6.25
Rural	88	7	7.95	2	2.27	9	10.22

Discussion

This study is the first attempt to determine the seroprevalence of human Toxocariasis in Kirkuk city, Iraq. The diagnosis of human Toxocariasis is typically based on serological tests such as IgG-ELISA antibodies as having good sensitivity 78% and specificity 92% as in Noordin *et al.* [15]. Toxocariasis as a zoonotic infection is a highly widespread parasitic disease in the tropical and subtropical regions around the world. It is usually a pediatric disease and generally asymptomatic [16, 17].

The seroprevalence of Toxocariasis in this study according to Toxocara IgG-ELISA antibodies is (8%). This seroprevalence is lower than those determined by other studies [12] in Iraq reported 30.8% cases in their study carried out in Mosul city. Another study conducted at Baghdad city reported 40.5% cases [14]. While, our results are higher than study of [13] who recorded seroprevalence is 6.81% cases in Biji city, Salah Al-Din province. The comparison of present results of Toxocariasis seroprevalence with other studies over the world, revealed some differences for example the study in a Dutch population [18] determined seroprevalence (8.0 %) in their study which are similar to our results. Whereas, the seroprevalence of Toxocariasis reported in the current study is higher than two studies conducted in Iran, 4.4% in health centers of Lorestan province, Iran by Mahmoudvand *et al.* [17] and 1.70% reported by Shahraki [19] in Sistan and Baluchestan

in Iran. Yet, the seroprevalence of Toxocariasis reported in the present study is lower than that reported in other studies over the world, for example in Serbia 13% cases determined [20]. and 15.5% cases determined by Cassenote *et al.* [21] study carried out in Northeast Brazil.

Toxocariasis has been described as the most common human parasitic worm infection in developed countries. Toxocariasis has a worldwide distribution, as well as, tend to be more prevalent in tropical regions, including industrialized countries and they are considered to be the cause of the more frequent form of helminthiasis [21].

The seroprevalence of Toxocariasis depends on the environmental and the hygienic conditions [22]. These variations in the Toxocariasis seroprevalence among different studies in several countries may be explained by geographical region where the study is made and even to different populations inhabiting the same region [12]. For geographical conditions, the difference in the environmental conditions of the studied region, where low humidity and high temperature may reduce the viability of infective larvae, in addition, the type and size of population evaluated, as well as the specificity and sensitivity of the detection methods used [11,23]. Also, the literature reported that lifestyle of the population evaluated and behaviors like a lack of parental supervision and poor personal hygiene, close contact with young dogs, ingestion of raw meat, as well as,

age, gender and socioeconomic status may affect the frequency of Toxocariasis [24].

Toxocariasis appear to be associated with sociodemographic factors such as age, sex, ethnicity, poverty and geographical region [25]. The present study showed that the seroprevalence of Toxocariasis is higher in males (7%) than females (1%). Similar results are described in some previous studies [13, 14, 26, 27, 28, 29]. Whereas, some other studies [23, 30, 31] reported that females more prevalent than males.

The highest seroprevalence of Toxocariasis in males than females may be explained by the traditionally oriented behaviors and activities of males, including the occupational work such as farming [32]. Berrett *et al.* [25] mention that, males nearly twice as likely to be seropositive for *Toxocara* than females, seropositivity tended to increase with age, both education and socioeconomic status are inversely associated with seroprevalence. Male sex, socioeconomic status and race-ethnicity associated with seroprevalence of Toxocariasis. Santos *et al.* [33] referred to the role of hormones (testosterone) may impair the host immune response according to a study on rodent males.

There are different results described by authors on the relation of the frequency of Toxocariasis and age. Some of them reported no significant relation with age, while others claimed that Toxocariasis is more frequent in childhood. In the present study the peak seroprevalence of Toxocariasis is (28.1%) determined in the age groups 5 to 12 year, followed by the age group 13-20 year (26.4%), 21-28 year (18.2%) and 29-36 (16.3%), while Toxocariasis lowest seroprevalence is (14.6%) determined within the age group 37-44 year. Convergent results agreed with our study are reported in several previous studies [12, 13, 14, 31, 34, 35].

It is known that *Toxocara* spp. transmitted to human being orally by taking the infective eggs that are found in soil contaminated with feces of infected dogs and cats. Thus, individuals at a high risk of contact with soil contaminated with dog and cat feces [36]. Seroprevalence of Toxocariasis increased in childhood, because children are likely to play in contaminated environments, poor hygiene, put their fingers and hands in their mouths either incidentally or intentionally, immaturity of their immune system also repeated infection, leading to the persistence of antibodies [35, 36]. Karadam *et al.* [37] mentioned that infection with Toxocariasis increased in children may be due to contamination of playfields with infected cat and dog feces. Gürel *et al.* [38] supported this hypothesis, they detected (18.9%) *Toxocara* spp. eggs in playfields. Infected adult may probably have a past in a rural region, so they may have a contact with contaminated soil which is a risk factor for Toxocariasis. So, it is thought that the results in the elderly reflect past infections [37]. Yet, it is difficult to determine whether seroprevalence in older age groups is a reflection of previous infections with

persistent antibodies or newly acquired light infections. A few reports suggest that *Toxocara* antibodies can persist for years, even after anthelmintic treatment, but most of these reports are based on relatively small sample sizes [39].

Toxocariasis seroprevalence differs across ethnic groups, suggesting that cultural and genetic factors might affect the seroprevalence [25]. The present study is determined a high seroprevalence of Toxocariasis in primary school education (11.66%) individuals, followed by complete higher education (8.82%) individuals. Whereas, in median school education and secondary school education (4.34%, 6.06%) respectively. The lowest seroprevalence reported in higher school education (3.7%). Our results agreed with study of Hadi [14], while Hammad [13] determined 11.1% cases in non-educated individuals and (3.3%) cases in secondary school individuals. Mughini-Gras *et al.* [18] reported in their serosurveys study in 1995/1996, Toxocariasis seroprevalence in non-educated individuals 10.8%, low education 13.9%, intermediate education 8.0%, high education 6.0%, very high education 5.7% and unknown education 17.2%. While, in 2006/2007 [18] reported Toxocariasis seroprevalence in non-educated individuals 11.7%, low education 11.2%, intermediate education 7.2%, high education 7.1%, very high education 3.1%, unknown education 16.0%.

A more recent publication focused on VLM typically occurs in preschool-aged children with a history of eating dirt, emphasizing the importance of this habit in seroprevalence of Toxocariasis [12]. Berrett *et al.* [25] mention that Toxocariasis more prevalent in people with a less educational level and lower income. The association between higher education and decreased anti-*Toxocara* antibody levels may essentially mirror the effect of the knowledge and hygiene measures in addition to the occupation [18]. Yet, another study [36] reported that there is no statistical difference in contamination by *Toxocara* spp. of sand and grass between schools and public squares. It seems that sand suffers more influence of climate and that can contribute to contamination. Gheorghe [40] mentioned that, poor personal hygiene, even if the children are part of families with a high income and good living standard, the tendency to contact with the animals, especially with puppies without parental supervision, leads to an increased risk of receiving Toxocariasis.

The current study determined the seroprevalence of Toxocariasis is more prevalent in rural areas (10.22%) than urban areas (6.25%). Our study result agreed with previous studies, Doğan *et al.* [41] study reported (16.97%) cases in rural areas and (0.71%) cases in urban areas. Also, Nourian *et al.* [29] agreed with our study determined 4.4% cases in rural areas and 1.6% cases in urban areas. Similar results also reported in another study [42] which reported 11.9% cases in rural areas and 2.1% cases in urban areas.

Rural areas are naturally considered as higher risk areas than urban [43]. High prevalence of infection in rural areas is probably due to large, untreated unconstrained dog population; combined with generally low standards of education and hygiene and

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الاصابة بداء السهميات Toxocariasis في محافظة كركوك، العراق

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الملخص

انجزت الدراسة الحالية خلال المدة من شهر تموز ولغاية شهر تشرين الأول 2019، للتحري عن الانتشار المصلي لداء السهميات Toxocariasis في سكان مدينة كركوك وتحديد العلاقة بين داء السهميات وبعض المعايير الوبائية. صممت استمارة استبيان لتسجيل المعلومات حول الافراد (ولكل من الجنسين الذكور والاناث) قيد الدراسة. تم جمع 200 عينة دم من الافراد الذين يلعبون كرة القدم في الحقول الترابية، ومن سكان القرى والأرياف، فضلا عن طلاب المدارس والكليات. تم الكشف عن الازداد المناعية المتولدة ضد طفيلي التوكسوكارا anti immunoglobulin G (IgG) في مصل الافراد الذي شملتهم الدراسة باستخدام تقنية الأليزا ELISA. بينت نتائج فحص الأليزا أن نسبة الانتشار المصلي لداء السهميات (8%). سجلت نسبة الإصابة بداء السهميات في الذكور (7%) اعلى من الاناث (1%)، حيث تم تسجيل اعلى نسبة اصابة (28.1%) ضمن الفئة العمرية 5 الى 12 سنة. كما سجلت اعلى نسبة اصابة (11.6%) في طلاب المدارس الابتدائية. سجلت نسبة الإصابة بداء السهميات في المناطق الريفية (10.22%) اعلى منها في المناطق الحضرية (6.25%).