



Prevalence of *Toxocara* spp. eggs in soil of public areas in Iran: A systematic review and meta-analysis



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ABSTRACT

Toxocariasis is a zoonotic and widespread infection which manifest as a spectrum of syndromes in humans such as visceral, neural, ocular, covert and asymptomatic. Herein we aimed to design a systematic review and meta-analysis to determine the prevalence of *Toxocara* spp. eggs in soil depositories in Iran. English (PubMed, Scopus, Google Scholar, Web of Science, Science Direct, EBSCO, and Ovid) and Persian (Scientific Information Database and Magiran) databases were explored. This review resulted in a total of 14 publications meeting the inclusion criteria during January 2000–November 2016. Altogether, 3031 soil samples were examined among which 470 were positive in terms of *Toxocara* spp. The weighted overall prevalence of *Toxocara* spp. in soil samples was 16% (95% CI = 11–21%), and Tehran and Qazvin provinces had the highest and lowest prevalence rates, respectively. Meta-regression analysis showed that the correlation between prevalence of *Toxocara* eggs in soil with sample size ($P = 0.45$) and year of study ($P = 0.42$) were not statistically significant. Further studies are highly recommended to enlighten different aspects of toxocariasis in Iran.

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1. Introduction

The enigmatic ascarid roundworms, *Toxocara canis* (*T. canis*) and *Toxocara cati* (*T. cati*), are envisaged as one of the striking neglected tropical diseases, being able to ignite serious complications such as visceral larva migrans (VLM) syndrome and toxocariasis.^{1,2} Feline and canine feces act as the significant depot of unembryonated eggs, and become larvated in optimum soil and environmental conditions.^{3,4} Humans are considered as the paratentic hosts and infection would occur via ingestion of undercooked meat of infected paratentic hosts (chickens, pigs and ruminants), polluted water, contaminated soil (playgrounds, parks, gardens, lake beaches and sandpits) and close contact with pet animals.^{4–10} Ingested eggs penetrate the intestinal mucosa, disseminate in human body through blood stream and encyst in several tissues.⁵ Four major manifestations of toxocariasis are as follows: (1) VLM, frequently taking place in young children, is evinced by *Toxocara* larva wandering in body organs enclosing liver, lungs and brain, provoking symptoms such as hepatitis, pneumonitis, meningo-encephalitis, headache, abdominal cramps, eosinophilia, behavioral and cognitive perturbations; (2) the so-called ocular larva migrans (OLM) is permanent loss of sight due to retinal damage and detachment which is typical in older children; (3) long time subjection to infection in children may increase a hidden, hardly diagnosed form called covert toxocariasis which emerges as asthma-like symptoms or eosinophilia with sleep and intellectual disorders; and (4) common toxocariasis usually in adults with rash, pruritus, dyspnea and abdominal pain.¹ One of the most noted outcomes of infection is dysfunction of cognitive practices in youngsters, where infected individuals show decreased ability in reading, math operations and block design.¹¹ On the other hand, toxocariasis is believed to

be a possible reason of blindness, a potential cause of asthma and has been linked to seizures and epilepsy. Furthermore, a rare but likely life-threatening disorder caused by toxocariasis is cardiac involvement that evokes inflammation of heart tissues, tamponade and heart failure.^{12–15}

Infection with *Toxocara* species has global distribution and is taken into account as one of the most frequent helminthiases in humans, according to seroprevalence reports.^{1,8} Histopathological examinations as well as several medical imaging techniques, e.g. computed tomography (CT), ultrasound and magnetic resonance imaging (MRI) have been employed to discern injuries of creeping parasites in human body.^{16–19} Although serological tests such as enzyme-linked immunosorbent assay (ELISA) with *Toxocara* excretory-secretory antigens and western blotting are the regular methods of diagnosis for toxocariasis, it is not very specific as the cross reactions may occur.^{20–22} As far as we know, there is lack of a systematic and quantitative analysis of obtained data in terms of prevalence of *Toxocara* species in soil depots in Iran. So, herein we designed a systematic review and meta-analysis study in order to shed light on the prevalence of these common ascarids in Iran.

2. Methods

2.1. Search strategy

To unravel part of the prevalence of *Toxocara* spp. eggs in soil in Iran, we planned a systematic review and meta-analysis according to online literature screening of English (Pubmed, Scopus, Google Scholar, Web of Science, Science Direct, EBSCO, and Ovid) and Persian (Scientific Information Database and Magiran) databases for published papers from January 2000 – November 2016. We applied

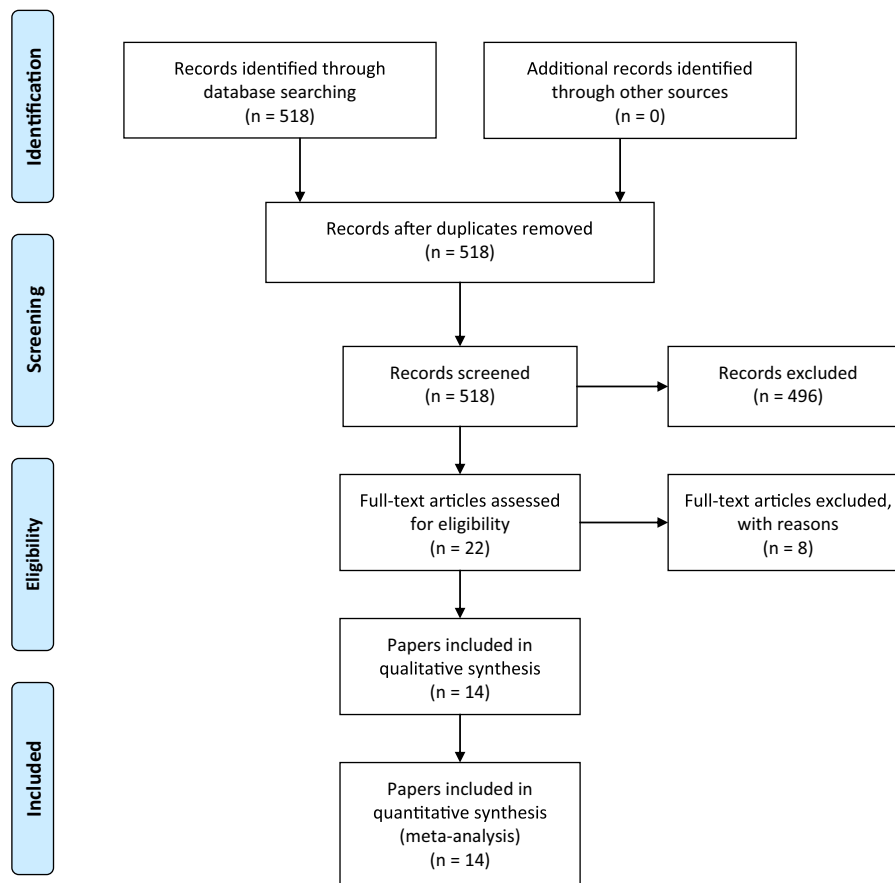


Fig. 1. PRISMA flow diagram.

medical subject heading (MeSH) terms as follows: “*Toxocara* spp.”, “Iran”, “Epidemiology” and “Prevalence” alone or combined together using “OR” and/or “AND”. The reference list of selected full-text papers were also meticulously checked manually to find articles not retrieved by the database searching.

2.2. Study selection and data extraction

Pertinent to inclusion criteria, the cross-sectional studies based on parasitological and molecular techniques that estimated the prevalence of *Toxocara* spp. eggs in soil samples were included. Eligibility of all explored papers were assessed by three reviewers (MF, MG, and BM). The discrepancies among studies were obviated by discussion and consensus. Afterwards, data of interest were gathered using a pre-designed data extraction form on the basis of province, sample size, positive cases, method of examination, main findings and year of publication. Current review was performed based on PRISMA guideline (preferred reporting items for systematic review and meta-analysis).²³

2.3. Meta-analysis

Meta-analysis procedure was performed as formerly described.^{24–29}

3. Results

Amid 518 reviewed studies from online literatures, 14 papers were eligible for this systematic review and meta-analysis, based on inclusion criteria, as depicted in Fig 1. The results of qualified literature and details of each study are embedded in Table 1. Egger's regression test was exerted to discover publication bias, indicating that publication bias was very statistically significant ($P = 0.001$) (Fig. 2). Totally, 3031 soil samples were examined for *Toxocara* from January 2000– November 2016. The random-effects model revealed that the weighted overall prevalence of *Toxocara* spp. in soil samples was 16% (95% CI = 11–21%). Comply with meta-regression results, the correlation between prevalence of *Toxocara* spp. eggs in soil with sample size ($P = 0.45$) and year of study ($P = 0.42$) were not statistically significant (Table 2). The diagram of forest plot is illustrated in Fig. 3.

4. Discussion

Despite of health and hygiene promotion in today societies, still there exist risk of transmission and incidence of parasitic infections. Toxocarosis is a soil-transmitted helminthiasis that could

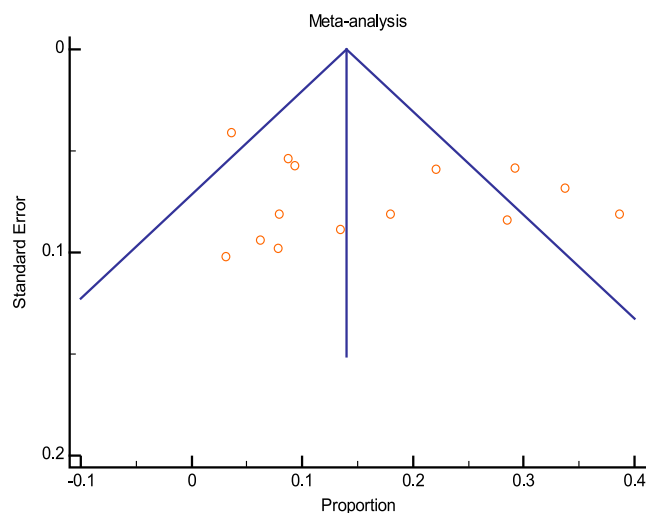


Fig. 2. Funnel plot to detect publication bias.

Table 2

Result of metaregression, the affect of sample size and year on prevalence of *Toxocara* spp.

p	Coef.	Err.	t	P>t	[95% Conf. Interval]
Year	0.0099	0.0119	0.84	0.42	−0.016 0.036
Sample	−0.0002	0.0003	−0.78	0.45	−0.001 0.0004
_cons	−19.8988	23.941	−0.83	0.424	−72.591 32.79

lead to serious sequelae.^{1,2} Ahead meta-analysis aims to estimate the prevalence of *Toxocara* spp. in soil samples in Iran. Upon accurate literature review and based on inclusion criteria, 14 papers were finally elected, indicating that the weighted overall prevalence of *Toxocara* spp. in soil samples was 16% (95% CI = 11–21%). Some investigations in North and South America have approximated the prevalence of *Toxocara* ova in soil samples, ranging 0.3–39% and 0.3–79.4%, respectively.^{30–32} Furthermore, the prevalence rate in Europe and Asia are confined to 3.2–64% and 5.7–95%, respectively.^{33–36}

The toxocarosis is probably mainly associated with *T. canis* and to a lesser extent by *T. cati*.³⁷ Several biological factors implicate in the constant prevalence of this helminthiasis in the final hosts, such as taking advantage of vertical transmission, recruiting a diverse multiple-host system as well as high resistant of eggs in various environments.³⁸ It has been demonstrated that embryonation of *T. canis* eggs would frequently occur during warm seasons,

Table 1

Baseline characteristics of included studies.

No.	Province	Year of publication	Sample size (n)	Positive n (%)	Method	Ref
1.	Fars	2006	112	7 (6.3)	Flotation (Zinc sulfate)	48
2.	West Azarbaijan	2008	102	8 (7.8)	Flotation (Saturated salt)	49
3.	Lorestan	2010	285	63 (22.2)	Flotation (Saturated sucrose)	50
4.	East Azarbaijan	2012	300	28 (9.3)	Flotation (Saturated salt)	51
5.	Tehran	2012	150	58 (38.7)	Flotation (Sodium nitrate)	52
6.	Qazvin	2012	95	3 (3.15)	Flotation (Saturated sucrose)	53
7.	West Azarbaijan	2014	150	12 (8)	Flotation (Zinc sulfate)	54
8.	Khuzestan	2014	291	85 (29.2)	Flotation (Saturated sucrose)	55
9.	Khuzestan	2014	210	71 (33.8)	PCR	10
10.	Khorasan Razavi	2015	340	30 (8.82)	Flotation (Saturated sucrose)	56
11.	Isfahan	2015	140	40 (28.6)	Flotation (Saturated sucrose)	57
12.	Kermanshah	2016	126	17 (13.5)	Flotation (Sodium nitrate)	58
13.	Mazandaran	2016	580	21 (3.73)	Flotation (Saturated sucrose)	59
14.	Kermanshah	2016	150	27 (18)	Flotation (Sodium nitrate)	60

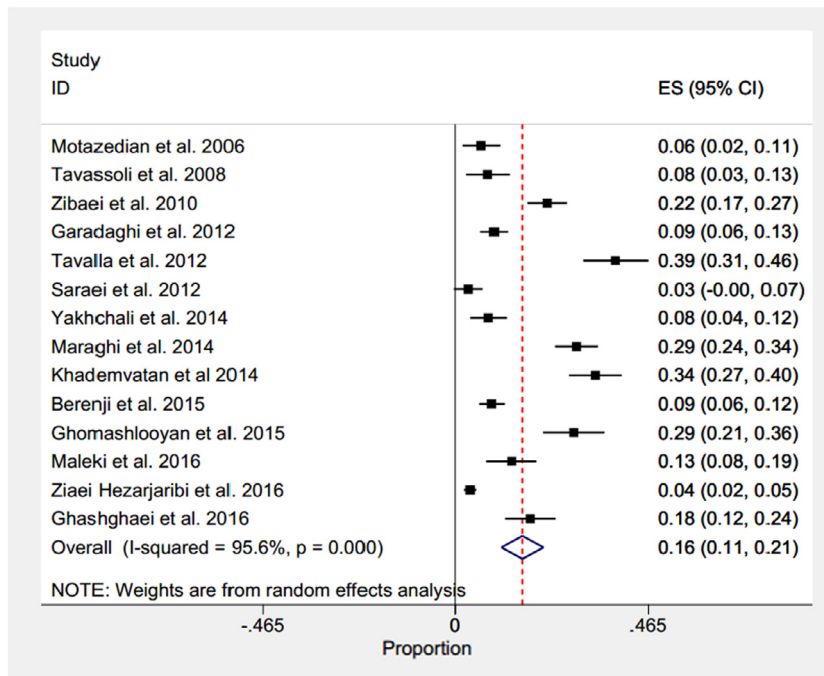


Fig. 3. Forest plot diagram of the present systematic review and meta-analysis.

whereas in tropical countries it may take place throughout the year. Additionally, type of soil, pH and vegetation density can play a major role in survival of *Toxocara ova*.^{39–41} Beside, some human risk factors such as geophagia and/or pica, mostly in low-income countries, highlight the importance of soil as a main source of infection in propagation of toxocariasis. Children are usually more prone to accidentally ingest *Toxocara* spp. eggs due to putting different objects in mouth, their proximity and emotional feeling to dogs, the likelihood of geophagia and eating earthworms, etc.^{38,42–45}

Toxocariasis is considered as a public health issue. Based on epidemiologic data, *T. canis* is found in many habitats, from tropical regions to sub-Arctic lands.^{46,47} In comparison to developed countries, the prevalence status of toxocariasis is more elevated in underdeveloped, tropical-located nations such as Swaziland, Nigeria, Nepal, Indonesia, Brazil and Peru.³⁸ Regarding to presence of *Toxocara* species, their permanent persistence in dogs and cats and their potentially pathogenic nature in humans, it is recommended to examine pet feces regularly and apply anti-helminthic medication program. Furthermore, enclosing playgrounds and other terrestrial lands with a fence in municipal parts in order to avert the entry of definitive hosts and avoiding children playing with soil in public places or using processed, sanitary soil supplies for children would decrease the possibility of infection transmission. Also, a huge attention must be paid to public, particularly pet owners where they should familiarize with origin of infection, transmission pathways, disease symptoms and control measures. On the other hand, general physicians and medical experts should take into account toxocariasis as a probable differential diagnosis. Raising public awareness is a helpful modality to reach early detection and stay away from subsequent outcomes.

Current review met some limitations, including: (1) most studies on soil samples have not mentioned detailed soil characteristics and accurate climatic parameters in sampling area; (2) there is a gap in terms of molecular techniques to determine *Toxocara* species in soil, since most studies have performed parasitological examination; and (3) there is lack of literature in many parts of

the country. These limitations might have a significant role on the epidemiologic perspectives of toxocariasis in Iran.

Authors' contribution

BM, MG, and MF conceived the study; BM and MF designed the study protocol; BM, MG, and MF searched the literature and extracted the data; AK analyzed and interpreted the data; HM wrote the manuscript; HM, AK, AM, BM and MF critically revised the manuscript. All authors read and approved the final manuscript.

Compliance with ethical standards

Conflicts of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Ethical approval

As this review did not involve any human or animal subjects, ethical approval was not required.

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