



ORIGINAL ARTICLE

Toxocariasis: seroprevalence in abandoned-institutionalized children and infants

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KEYWORDS

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Abstract

Toxocariasis is an infection that has worldwide distribution. *Toxocara canis* is the most relevant agent due to its frequent occurrence in humans. Soil contamination with embryonated eggs is the primary source of *T. canis*. This study aimed to determine the seroprevalence of toxocariasis in 10-month to 3 year-old abandoned infants, considered to be at high risk because of their orphanhood status and early age. Blood samples were collected from 120 children institutionalized in an orphanage in the city of La Plata. In this study, we observed 38.33% of seropositive cases for *T. canis* by ELISA and 45% by Western blot techniques; significant differences among groups A (<1 year), B (1-2 years) and C (>2 years) were also found. In research group A, children presented a seropositivity rate of 23.91%, in group B of 42.85% and in group C of 56%, which indicates an increase in frequency as age advances, probably because of greater chances of contact with infective forms of the parasite since canines and soil are frequently infected with *T. canis* eggs. Abandoned children come from poor households, under highly unsanitary conditions resulting from inadequate or lack of water supply and sewer networks, and frequent promiscuity with canines, which promotes the occurrence of parasitic diseases. These children are highly vulnerable due to their orphanhood status and age.

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PALABRAS CLAVE

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Niños abandonados;
Niños
institucionalizados

Toxocariosis: seroprevalencia en infantes expósitos, abandonados e institucionalizados**Resumen**

La toxocariosis es una enfermedad presente en todo el mundo. Como causa primaria de infección se cita la contaminación de los suelos con huevos embrionados de *Toxocara canis*. Nuestro objetivo fue determinar la seroprevalencia de toxocariosis en niños expósitos (abandonados) de 10 meses hasta 3 años, los que se consideran de alto riesgo por su condición de orfandad y escasa edad. Las muestras de sangre fueron recolectadas de 120 niños institucionalizados en un orfanato de la ciudad de La Plata. En este estudio, se observó un porcentaje de seropositivos para *T. canis* de 38,33 % por la técnica de ELISA y de 45 % por la técnica de Western blot, con diferencias significativas entre los grupos etarios estudiados (A: < 1 año, B: 1-2 años, C: > 2 años). Los niños del grupo A presentaron una frecuencia de seropositividad de 23,91 %; los del grupo B, de 42,85 % y en los niños del grupo C fue del 56 %. Esto indica un incremento de la frecuencia de presentación a medida que aumentó la edad, debido probablemente a las mayores posibilidades de contactar con estados infectantes del parásito, ya que los caninos y el suelo se hallan frecuentemente infectados por huevos de *T. canis*. Los niños abandonados provienen de hogares carenciados, donde a las malas condiciones de higiene resultantes de la ausencia de red de agua y cloacal se le agrega la frecuente promiscuidad con caninos, lo cual propicia la presencia de parasitosis. Sumado a la condición de desamparo, esto produce un estado de máxima vulnerabilidad.

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Introduction

Toxocariosis, visceral larva migrans or parasitic granulosis is a disease distributed worldwide with high prevalence in tropical and temperate regions. The agents involved are: *Toxocara canis* (dog roundworms) and *Toxocara cati* (cat roundworms), the former being the most significant due to its frequency in humans¹⁸. The soil is the natural reservoir and source of infection where the eggs develop into infective stages (stage J2-J3)¹², being able to remain viable for extended periods of one to three years³². In humans, the infection is transmitted via the oral route, by accidental ingestion of infective eggs from the fur of animals, consumption of poorly sanitized fruits or vegetables, soil-contaminated hands, geophagy or early stages of nematodes present in tissues of paratenic or transport hosts^{3,5,16,26,29,32}.

Four clinical presentations are known: visceral larva migrans (VLM), with abscess formation in the organs^{23,34}, allergic asthma and eczema⁶ among other manifestations; ocular larva migrans (OLM)¹² without the characteristic eosinophilia; neurological toxocariosis³⁰ with diverse manifestations such as dementia, meningo-encephalitis, myelitis, cerebral vasculitis, epilepsy, or optic neuritis^{15,19,30} and covert toxocariosis which occurs when the larva is found in striated muscles, with no or few, general and non-specific symptoms³. Several studies have determined the seroprevalence of toxocariosis in different clusters of people and geographical areas: children of low socioeconomic status, middle class, rural areas, indigenous people, developed countries with different pathologies, school age, kindergarten and 12 year-old children^{7,4,7-9,14,20-22,25,30,33}. However, investigations on the prevalence of toxocariosis in children younger than 3 years of age are scarce³⁸ and

there are no publications on abandoned-institutionalized children or infant foundlings^{10,17,24,28,38}. The terms abandoned-institutionalized children or infant foundlings refer to those children whose parents have moved away from them, leaving them on any site or to the care of an institution, due to economic, social or moral reasons. The *de facto* abandonment may be transient or permanent. This is how "the family, a social unit, is replaced by a foundling asylum"^{27,36}.

The state of helplessness in the strict etymological sense is synonymous with neglect, with the subsequent waiver of all rights and duties of the child. This extreme situation that involves judicial action is at the same time a health concern due to the consequences associated with the growth and development of the child when separated from his family environment¹¹.

The aim of this work was to determine the seroprevalence of toxocariosis in infant foundlings (abandoned or institutionalized) up to 3 years of age since they are considered to be at high risk for several diseases due to their orphanhood status that leaves them in a situation of maximum vulnerability.

Materials and methods

Study samples: Samples were obtained from 10-month to 3 year-old abandoned and institutionalized children. After the routine hematological testing performed on admission, the remaining serum was used in this study upon approval of the Instituto de Investigaciones Biomedicas / IRB Barcelona. A total of 120 samples were analyzed by ELISA. They were divided into three groups: A (<1 year old), B (1-2 years

old) and C (>2 years old); 60 of them were randomly selected and analyzed by Western blot.

The ELISA test was performed using a commercial kit (Bordier Affinity products, Crissier 1013, Lausanne, Switzerland) in compliance with the manufacturer's instructions. The presence of parasite specific serum antibodies was detected with anti-human IgG-alkaline phosphatase conjugate on sensitized plates with *T. canis* excretory-secretory antigen.

Interpretation: Samples with an absorbance lower than that of the weak positive control serum were considered negative, while those with a higher absorbance were considered positive.

The Western blot assay was performed according to the technique used in the Department of Parasitology, National Institute of Infectious Diseases ANLIS "Dr. Carlos G. Malbrán"⁵⁵.

Interpretation: It is considered positive when observing bands of 120, 70, 55, 30, 32 kDa and/or bands of 70 and 55 kDa.

For statistical analyses, Epidat 3.1¹³ and W in Episcope 2.0³⁹ were used.

Results

The ELISA technique was used to analyze 120 serum samples, detecting a total of 46 seropositive children for *T. canis* IgG (38.33%) (Table 1).

After applying the test (chi-square = 7.77, $p < 0.05$), there was a significant association between age and seroprevalence; the linear trend was also significant.

Only 60 of the 120 original samples were processed by Western blot, of which 27 (45%) showed the characteristic positive bands for *T. canis* (Table 2).

The differences observed between the two techniques are, since Western blot technique presents 100% specificity, predictive value positive 93.3% and predictive value negative 100%. The kappa index (0.762) reported a strong correlation between the two techniques.

Discussion

Toxocariasis is a cosmopolitan parasitic infection observed primarily in childhood, with little recognition as a public health problem. Different authors used the ELISA test for serological diagnosis of toxocariasis. In Resistencia, a subtropical region of Argentina, a seropositivity of 37.9% in children aged 1-14 was observed². In the same area, a prevalence of 67% among individuals with similar age and high eosinophilia²⁵ was reported as well as a prevalence of 20% in children younger than 14 years old from a rural community of Argentina^{8,31}. Taranto et al.³⁷ reported a positivity of 22.1% in an indigenous population of the northern province of Salta. In the province of Buenos Aires, a positivity of 17% and 36% was observed in children up to 12 years old from an urban and suburban area respectively³². In two regions of Spain, a seroprevalence of 0% and 4.2% was found in children from Madrid and Tenerife respectively⁹. In the same country, a prevalence of 0% vs. 37% was reported in middle class infants, aged 2-5 years old, in contrast with others of

Table 1 Seroprevalence. Distribution by age

Group	Age	Positive	Negative	Total	%
A	< 1a	11	35	46	23.91
B	1 to 2a	21	28	49	42.85
C	>	24	11	25	56
Total		46	74	120	38.33

Table 2 Results of the 60 serum samples analyzed by both techniques

	WB (+)	WB (-)	Total
ELISA (+)	22	2	24
ELISA (-)	5	31	36
Total	27	33	60

the same age but socially disadvantaged in Iran⁹, using two kinds of ELISA assays, in which frequencies of 11 and 25% respectively were observed, in children ranging from one month to 30 months of age, without significant differences regarding age. However, this study found that 38.33% of children were positive for *T. canis* using the ELISA technique and 36.66% using Western blot. Significant differences among groups A, B and C were also observed. In this research, children in group A showed 23.91% of seropositivity, group B 42.85% and group C 56%, which indicates an increase in the frequency of occurrence as age advances, probably due to greater chances of contact with the parasite infective stages. As stated before, canines and soil are very often infected with *T. canis*^{16,28,40}.

Not all individuals are equally likely to get infected or die, but for some, this alternative is greater. Abandoned children also belong to deprived households where as previously mentioned^{16,28}, poor hygienic conditions resulting from lack of water and sewage networks and frequent promiscuity with canines, favor the presence of parasitic diseases. These, coupled with the condition of helplessness, cause a state of high vulnerability. This situation is reflected in the results obtained in this research in infants.

The bibliographic research conducted does not reveal any studies on seroprevalence of toxocariasis in the area of abandoned or institutionalized children. The results herein obtained showed that the determination of this disease should be included in routine hematology tests when admitted to an institution, especially in the case of abandoned children under the age of 3, considering that, as they are very young, the possibility of having contracted the disease might affect not only their physical and mental integrity but also their future growth, maturation and cognitive development or even lead to fatal consequences.

Ethical responsibilities

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this investigation.

Confidentiality of data. The authors declare that no patient data appears in this article.

Right to privacy and informed consent. The authors declare that no patient data appears in this article.

Conflicts of interest

The authors declare that they have no conflicts of interest.

References

- Agudelo C, Villareal E, Cáceres E, López C, Eljach J, Ramírez N. Human and dogs *Toxocara canis* infection in a poor neighborhood in Bogota. *Mem Inst Oswaldo Cruz*. 1990;85:75-8.
- Alonso JM, Bojanich MV, Chamorro M, Gorodner JO. *Toxocara* seroprevalence in children from a subtropical city in Argentina. *Rev Inst Med Trop Sao Paulo*. 2000;42:235-7.
- Archelli SM, Kozubsky L. *Toxocara* y *Toxocariosis*. *ABCL*. 2008;42:379-84.
- Arpino C, Gattinara GC, Bergili D, Curatolo P. *Toxocara* infection and epilepsy in children: a case-control study. *Epilepsia*. 1990;31:33-6.
- Aydenizoz-Ozkayhan M, Yagci BB, Erat S. The investigation of *Toxocara canis* eggs in coats of different dog breeds as a potential transmission route in human toxocariasis. *Vet Parasitol*. 2008;152:94-100.
- Buijs J, Borsboom G, Van Gemund JJ, Hazebroek A, Van Dongen PA, Van den Knapen F. *Toxocara* seroprevalence in 5-year-old elementary schoolchildren: relation with allergic asthma. *Am J Epidemiol*. 1994;140:839-47.
- Chan PW, Anuar AK, Fong MY, Debruyne JA, Ibrahim J. *Toxocara* seroprevalence and childhood asthma among Malaysian children. *Pediatr Int*. 2001;43:350-3.
- Chiodo P, Basualdo J, Ciarmela L, Rizzani B, Apezteguia M, Minvielle M. Related factors to human toxocariasis in a rural community of Argentina. *Mem Inst Oswaldo Cruz*. 2006;101:397-400.
- Cilla G, Perez-Trallero E, Gutierrez C, Part C, Gomariz M. Seroprevalence of *Toxocara* infection in middle-class and disadvantaged children in northern Spain (Gipuzkoa, Basque Country). *Eur J Epidemiol*. 1996;12:541-3.
- Colángelo M. Un abordaje al abandono infantil: El hospital zonal especializado "Dr. Noel H. Sbarra". La Plata: Ed Casa Cuna; 2001.
- Cusminsky M, Masson MA, Zorzoli MC. Asistencia del desnutrido: una experiencia Interdisciplinaria. *Med y Soc*. 1988;11:119-26.
- Despommier D. Toxocariasis: clinical aspects, epidemiology, medical ecology, and molecular aspects. *Clin Microbiol Rev*. 2003;16:265-72.
- Epidat 3.1 Programa de Uso Público. (Xunta de Galicia-OPS-OMS).
- Fenoy S, Cuellar C, Guillen JL. Seroprevalence of toxocariasis in children and adults in Madrid and Tenerife, Spain. *J Helminthol*. 1996;70:109-13.
- Finsterer J, Auer H. Neurotoxocarosis. *Rev Inst Med Trop Sao Paulo*. 2007;49:279-87.
- Fonrouge R, Guardis MV, Radman NE, Archelli SM. Soil contamination with *Toxocara* sp. eggs in squares and public places from the city of La Plata. Buenos Aires, Argentina. *Bol Chil Parasitol*. 2000;55:83-5.
- Gonzalez MT, Ibanez O, Balcarce N, Nanfeto G, Kozubsky L, Radman N. Toxocariasis with liver involvement. *Acta Gastroenterol Latinoam*. 2000;30:187-90.
- Havasiova-Reiterova K, Tomasovicova O, Dubinsky P. Effect of various doses of infective *Toxocara canis* and *Toxocara cati* eggs on the humoral response and distribution of larvae in mice. *Parasitol Res*. 1995;81:13-7.
- Hill IR, Denham DA, Scholtz CL. *Toxocara canis* larvae in the brain of a British child. *Trans R Soc Trop Med Hyg*. 1985;79:351-4.
- Holland CV, O'Lorcain P, Taylor MR, Kelly A. sero-epidemiology of toxocariasis in school children. *Parasitology*. 1995;110:535-45.
- Issa RM. Serodiagnosis of *Toxocara* antibodies among infants and pregnant women suspected of ocular or visceral toxocariasis using two types ELISA antigens. *Iran J Immunol*. 2006;3:176-80.
- Kaplan M, Kalkan A, Hosoglu S, Kulk S, Ozden M, Demirdag K. The frequency of *Toxocara* infection in mentally retarded children. *Mem Inst Oswaldo Cruz*. 2004;99:121-5.
- Kozubsky L, Pereyras S, Girard Bosch M, Sisliauskas M, Medina P, Bethencourt A. Toxocariosis: Epidemiología y parámetros de laboratorio. *ABCL*. 2004;4:38.
- Larroca N, Nahimias S, Jankilevich A. Historia de los establecimientos asistenciales de la República Argentina I, Período Hispano. Bs As: FECLIBA; 1988.
- Lopez M, Martin G, Chamorro M, Alonso M. Toxocariosis en niños de una región subtropical. *Medicina (Buenos Aires)*. 2005;65:226-30.
- Magnaval JF, Glickman LT, Dorchie P, Morassin B. Highlights of human toxocariasis. *Korean J Parasitol*. 2001;39:1-11.
- Mateos R. Metodología para la detección precoz del abandono infantil basada en el enfoque de riesgo. *Rev Quiron*. 1992;23:25-49.
- Muradian V, Gennari SM, Glickman LT, Pinheiro SR. Epidemiological aspects of Visceral Larva Migrans in children living at Sao Remo Community, Sao Paulo (SP), Brazil. *Vet Parasitol*. 2005;134:93-7.
- Petithory JC, Beddok A, Quedoc M. Ascaridiasis zoonoses: visceral larva migrans syndromes. *Bull Acad Natl Med*. 1994;178:635-45.
- Radman N, Guardis M, Schamun A, Testi A, Archelli S, Fonrouge R, Santillán G. Toxocarosis neurológica: descripción de un caso. *Rev Chil Neuro-Psiquiat*. 2000;38:196-200.
- Radman NE, Archelli SM, Fonrouge RD, del VGM, Linzitto OR. Human Toxocariasis. Its seroprevalence in the city of La Plata. *Mem Inst Oswaldo Cruz*. 2000;95:281-5.
- Radman NE, Fonrouge RD, Archelli SM, Burgos L, Linzitto OR. Toxocarosis. Estudio epidemiológico en dos áreas de distinto nivel socio-económico en la Ciudad de La Plata, Prov de Bs As Argentina. *Rev Vet Cuyana*. 2010;5:468.
- Radman NE, Santillan G, Archelli SM, Fonrouge RD, Burgos L, Linzitto OR, Guardis M del V. Toxocarosis. Seroprevalencia en una población pediátrica y comparación entre dos técnicas de diagnóstico (ELISA vs Western Blot). *REIE*. 2005;3:19-21.
- Rayes A, Teixeira D, Nobre V, Serufo JC, Goncalves R, Valadares L, et al. Visceral larva migrans syndrome complicated by liver abscess. *Scand J Infect Dis*. 1999;31:324-5.
- Santillan GI. Caracterización de proteínas específicas para el diagnóstico de *Toxocara canis*. (Tesis de la Maestría en Biología Molecular). 2000 UNSAM. <http://posgrado.unsam.edu.ar/R0202/santillan.htm>.
- Sbarra NH, Salas MA, Falabella E. La ayuda de crianza de la Casa Cuna de La Plata. *Rev Soc d Pediatr*. 1945;71:24-28.
- Taranto NJ, Cajal SP, De Marzi JC, Fernandez MM, Frank FM, Bru AM, Minvielle MC, Basualdo JA, Malchiodi EL. Clinical status and parasitic infection in a Wichi Aboriginal community in Salta, Argentina. *T Roy Soc Trop Med H*. 2003;97:554-8.
- Teixeira CR, Chieff PP, Lescano SA, de Melo Silva EO, Fux B, Cury MC. Frequency and risk factors for toxocariasis in children from a pediatric outpatient center in southeastern Brazil. *Rev Inst Med Trop Sao Paulo*. 2006; 48:251-5.
- Win Episcopo 2.0 Programa de uso público.
- Worley G, Green JA, Frothingham TE, Sturner RA, Walls KW, Pakalnis V A. *Toxocara canis* infection: clinical and epidemiological associations with seropositivity in kindergarten children. *J Infect Dis*. 1984;149:591-7.