Toxocariasis in Waste Pickers: A Case Control Seroprevalence Study

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Abstract

Background: The epidemiology of Toxocara infection in humans in Mexico has been poorly explored. There is a lack of information about Toxocara infection in waste pickers.

Aims: Determine the seroepidemiology of Toxocara infection in waste pickers.

Methods: Through a case control study design, the presence of anti-Toxocara IgG antibodies was determined in 90 waste pickers and 90 age- and gender-matched controls using an enzyme-linked immunoassay. Associations of Toxocara exposure with socio-demographic, work, clinical, and behavioral data of the waste pickers were also evaluated.

Results: The seroprevalence of anti-Toxocara IgG antibodies was significantly higher in waste pickers (12/90: 13%) than in control subjects (19/90: 21%) (OR = 14; 95% CI: 2–288). The seroprevalence was not influenced by socio-demographic or work characteristics. In contrast, increased seroprevalence was found in waste pickers suffering from gastritis, reflux and visual impairments. Multivariate analysis showed that Toxocara exposure was associated with a low frequency of eating out of home (OR = 26; 95% CI: 2–363) and negatively associated with consumption of chicken meat (OR = 0.03; 95% CI: 0.003–0.59). Other behavioral characteristics such as animal contacts or exposure to soil were not associated with Toxocara seropositivity.

Conclusions: 1) Waste pickers are a risk group for Toxocara infection. 2) Toxocara is impacting the health of waste pickers. This is the first report of Toxocara exposure in waste pickers and of associations of gastritis and reflux impairment with Toxocara seropositivity. Results warrant for further research.

Introduction

Infection with the parasite Toxocara is among the most common zoonotic infections worldwide [1,2]. The Toxocara eggs are present in dogs and cat feces and become infectious within weeks after they are deposited in the local environment [3,4]. When embryonated eggs are accidentally ingested by humans, larvae hatch in the small intestine, penetrate the intestinal wall and migrate, via the bloodstream, to anywhere in the body including liver, lungs, muscles, eye, and central nervous system [2,5]. Human infection may also occur by ingesting Toxocara larvae from undercooked giblets [6]. Most human infections with Toxocara are asymptomatic; however, Toxocara may lead to serious illness and death [1,2,7]. Ocular toxocariasis causes permanent vision loss in many patients [8]. There is poor understanding of the global impact and cost of human toxocariasis [9]. To my knowledge, there is not any report in the medical literature about the epidemiology of Toxocara infection in waste pickers. This group of population lives under disadvantaged socioeconomic conditions including poor housing, food, and sanitation, and has very low hygiene practices. In addition, waste pickers have not social security for covering health care services as diagnosis, treatment, and prevention of infectious diseases. This study was aimed to determine the seroprevalence of Toxocara infection in waste pickers in Durango, Mexico and to identify their characteristics associated with Toxocara seropositivity.

Methods

Through an age- and gender-matched case-control study using serum samples from recent Toxoplasma gondii serosurveys [10,11], 90 waste pickers and 90 control subjects were compared for the presence of anti-Toxocara IgG antibodies. Inclusion criteria for the waste pickers were: 1) waste pickers in the Municipal solid waste transfer station of Durango City, Mexico; 2) aged 14 years and older; 3) any gender; 4) waste picking for at least 3 months; and 5) who accepted to participate in the study. Waste pickers were 14–76 (mean = 36.0+/−17.1) years old, 34 were males and 56 were females. Control subjects were matched with waste pickers by age and gender and consisted of 34 males and 56 females with miscellaneous occupations other than waste picking including students of public schools, employees, factory workers, housewives, business, and others. The mean age in controls was 35.7±16.8
(range: 18–78) years and comparable with that in waste pickers (P = NS).

This study was approved by the Ethical Committee of the Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado in Durango City. The purpose and procedures of the study were explained to all participants. A written informed consent was obtained from all participants.

The characteristics of the participants were obtained by using a standardized questionnaire. Socio-demographic data including age, gender, birth place, residence, educational level, and socioeconomic level were obtained from all participants. Work characteristics included seniority in the activity, habitual use of safety practices (use of hand gloves and face masks), eating while working, drinking alcoholic while waste picking, washing hands before eating, eating from the garbage, and ever had suffered from injuries with sharp material of the garbage. Clinical data explored included the presence of underlying diseases, memory, reflex, hearing, and visual impairments, and history of blood transfusion or transplants. Behavioral data included animal contacts, traveling, meat consumption (pork, beef, goat, mutton, chicken, turkey, rabbit, venison, squirrel, horse, or other), consumption of raw or undercooked meat, unpasteurized milk, dried or cured meat (ham, sausages, salami or chorizo), consumption of unwashed raw vegetables, fruits, or untreated water, frequency of eating out of home (in restaurants or fast food outlets), contact with soil (gardening or agriculture), and types of floors at home from all participants were obtained.

Serum samples were obtained from all participants and kept frozen at −20°C until analyzed. Serum samples were analyzed for anti-Toxocara IgG antibodies with a commercially available enzyme immunoassay “Toxocara” kit (Diagnostic Automation, Inc. Calabasas, CA, U.S.A.). Absorbance reading equal to or greater than 0.3 OD units was considered positive. All tests were performed following the instructions of the manufacturer.

The statistical analysis was performed with the aid of the software Epi Info version 3.5.3 and SPSS version 15.0. The Pearson’s chi-square test and the Fisher exact test (when values were less than 5) were used for comparison of the frequencies among groups. Age in cases and controls was compared with the student t test. Bivariate and multivariate analyses were used to assess the association between the characteristics of the waste pickers and Toxocara seropositivity. Variables were included in the multivariate analysis if they had a P value equal to or less than 0.20 in the bivariate analysis. Odd ratio (OR) and 95% confidence interval (CI) were calculated by multivariate analysis using multiple, unconditional logistic regression. A P value less than 0.05 was considered statistically significant.

**Results**

The seroprevalence of anti-Toxocara IgG antibodies was significantly higher in waste pickers (12/90: 13%) than in control subjects (1/90: 1%) (OR = 14; 95% CI: 2–288; P<0.01). General socio-demographic characteristics of the waste pickers studied are shown in Table 1. Toxocara seroprevalence was not influenced by gender, age, residence, educational level, or socioeconomic status of waste pickers.

None of the work characteristics in waste pickers including seniority in the activity, habitual use of safety practices, eating while working, drinking alcohol while waste picking, washing hands before eating, eating from the garbage, and ever had suffered from injuries with sharp material of the garbage influenced the prevalence of Toxocara seropositivity.

| Characteristic                | No. Of subjects testeda | Prevalence | Odds ratio | 95% Confidence interval | P value |
|------------------------------|-------------------------|------------|------------|-------------------------|---------|
| Gender                       |                         |            |            |                         |         |
| Male                         | 34                      | 11.8       | 1.0        |                         |         |
| Female                       | 56                      | 14.3       | 1.3        | 0.30–5.47               | 0.49    |
| Age groups (years)           |                         |            |            |                         |         |
| 30 or less                   | 46                      | 15.2       | 1.0        |                         |         |
| 31–50                        | 22                      | 18.2       | 1.2        | 0.26–5.61               | 0.50    |
| >50                          | 21                      | 4.8        | 0.3        | 0.01–2.57               | 0.21    |
| Residence place              |                         |            |            |                         |         |
| Durango State                | 88                      | 13.6       | 1.0        |                         |         |
| Other Mexican State          | 2                       | 0.0        | 0.0        | 0.00–29.35              | 0.75    |
| Residence area               |                         |            |            |                         |         |
| Urban                        | 83                      | 12.0       | 1.0        |                         |         |
| Suburban or rural            | 6                       | 16.7       | 1.5        | 0.03–15.11              | 0.55    |
| Educational level            |                         |            |            |                         |         |
| No education                 | 28                      | 17.9       | 1.0        |                         |         |
| 1–6 years                    | 50                      | 10.0       | 0.5        | 0.11–2.32               | 0.25    |
| More than 6 years            | 12                      | 16.7       | 0.9        | 0.10–7.00               | 0.65    |
| Socioeconomic level          |                         |            |            |                         |         |
| Low                          | 67                      | 14.9       | 1.0        |                         |         |
| Medium                       | 17                      | 11.8       | 0.8        | 0.10–4.37               | 0.54    |

aParticipants with available data.
With respect to clinical data, the prevalence of *Toxocara* seropositivity was significantly higher in waste pickers suffering from gastritis and reflex impairment than those without such clinical features. Waste pickers with visual impairment had a higher (with borderline significance: \( P = 0.05 \)) prevalence of *Toxocara* seropositivity than those without this clinical characteristic. The frequencies of other clinical characteristics including memory and hearing impairments, blood transfusion and transplant history were similar among *Toxocara* positive and *Toxocara* negative waste pickers.

Concerning behavioral characteristics, the bivariate analysis showed 7 characteristics with a \( P \) value equal to or less than 0.20 including: cats in the neighborhood (\( P = 0.07 \)), traveling abroad (\( P = 0.09 \)), consumption of pork (\( P = 0.13 \)), beef (\( P = 0.12 \)), chicken meat (\( P = 0.19 \)), and raw goat milk (\( P = 0.04 \)), and low frequency (up to 10 times a year) of eating out of home (\( P = 0.01 \)). Other behavioral characteristics including raising dogs, soil contact, degree of meat cooking, or eating unwashed raw fruits and vegetables were not associated with *Toxocara* seropositivity in bivariate analysis. Multivariate analysis showed that a low frequency of eating out of home was positively associated with *Toxocara* exposure (OR = 26; 95% CI: 0.003–0.59; \( P < 0.05 \)). No further behavioral characteristics of waste pickers associated with *Toxocara* exposure were found.

**Table 2.** Seroprevalence (%) of toxocaral infection in waste pickers relative to bivariate analysis of clinical characteristics.

| Characteristic    | No. Of subjects tested\( ^{a} \) | Prevalence | Odds ratio | 95% Confidence interval | \( P \) value |
|------------------|----------------------------------|------------|------------|-------------------------|--------------|
| Health status    |                                  |            |            |                         |              |
| Healthy          | 78                               | 11.5       | 1.0        |                         |              |
| Ill              | 10                               | 30.0       | 3.3        | 0.55–18.34              | 0.13         |
| Gastritis        |                                  |            |            |                         |              |
| Yes              | 3                                | 66.7       | 15.0       | 0.93–464.17             | 0.04         |
| No               | 85                               | 11.8       | 1.0        |                         |              |
| Memory impairment|                                  |            |            |                         |              |
| Yes              | 20                               | 25.0       | 3.0        | 0.70–12.69              | 0.09         |
| No               | 70                               | 10.0       | 1.0        |                         |              |
| Reflex impairment|                                  |            |            |                         |              |
| Yes              | 10                               | 40.0       | 6.0        | 1.12–32.36              | 0.02         |
| No               | 80                               | 10.0       | 1.0        |                         |              |
| Hearing impairment|                                 |            |            |                         |              |
| Yes              | 7                                | 0.0        | -          | -                       | 0.34         |
| No               | 82                               | 14.6       | 1.0        |                         |              |
| Visual impairment|                                 |            |            |                         |              |
| Yes              | 18                               | 27.8       | 3.6        | 0.82–15.45              | 0.05         |
| No               | 72                               | 9.7        | 1.0        |                         |              |
| Blood transfusion|                                 |            |            |                         |              |
| Yes              | 9                                | 33.3       | 4.0        | 0.65–23.31              | 0.09         |
| No               | 81                               | 11.1       | 1.0        |                         |              |
| Transplantation  |                                 |            |            |                         |              |
| Yes              | 2                                | 0          | -          | -                       | 0.74         |
| No               | 88                               | 13.6       | 1.0        |                         |              |

*Participants with available data.

doi:10.1371/journal.pone.0054897.t002

With respect to clinical data, the prevalence of *Toxocara* seropositivity was significantly (\( P < 0.05 \)) higher in waste pickers suffering from gastritis and reflex impairment than those without such clinical features. Waste pickers with visual impairment had a higher (with borderline significance: \( P = 0.05 \)) prevalence of *Toxocara* seropositivity than those without this clinical characteristic. The frequencies of other clinical characteristics including memory and hearing impairments, blood transfusion and transplant history were similar among *Toxocara* positive and *Toxocara* negative waste pickers.

Concerning behavioral characteristics, the bivariate analysis showed 7 characteristics with a \( P \) value equal to or less than 0.20 including: cats in the neighborhood (\( P = 0.07 \)), traveling abroad (\( P = 0.09 \)), consumption of pork (\( P = 0.13 \)), beef (\( P = 0.12 \)), chicken meat (\( P = 0.19 \)), and raw goat milk (\( P = 0.04 \)), and low frequency (up to 10 times a year) of eating out of home (\( P = 0.01 \)). Other behavioral characteristics including raising dogs, soil contact, degree of meat cooking, or eating unwashed raw fruits and vegetables were not associated with *Toxocara* seropositivity in bivariate analysis. Multivariate analysis showed that a low frequency of eating out of home was positively associated with *Toxocara* exposure (OR = 26; 95% CI: 0.003–0.59; \( P < 0.05 \)). No further behavioral characteristics of waste pickers associated with *Toxocara* exposure were found.

### Discussion

In this study, a significantly higher seroprevalence of anti-*Toxocara* IgG antibodies in waste pickers than in age- and gender-matched controls was found. Results clearly indicate that waste pickers represent a risk group for *Toxocara* infection. The 13% seroprevalence found in the present study indicates that *Toxocara* exposure is common among waste pickers; however, the lack of *Toxocara* seroprevalence studies in waste pickers does not allow comparing the prevalence of *Toxocara* seropositivity found with those in other waste pickers. However, in an international context, the seroprevalence in waste pickers is lower than those reported in some South American countries. *Toxocara* seroprevalences ranging from 21% to 39% have been reported in rural and urban populations in Bolivia [12], Brazil [13], Argentina [14–16], and Peru [17,18]. In contrast, the seroprevalence in waste pickers is higher than the *Toxocara* seroprevalences less than 5% reported in Canada [19,20]. The seroprevalence in waste pickers is comparable with the 14% seroprevalence reported in the USA [21]. The seroprevalence in waste pickers is also higher than those (2%–6%) reported in populations in Denmark [22], Korea [23], Spain [24], and India [25], and lower to the high (81%) *Toxocara* seroprevalence reported in Nepalese people [26], and to the 30% seroprevalence found in adults in Nigeria [27].
Table 3. Seroprevalence (%) of toxocarial infection in waste pickers relative to bivariate analysis of food consumption, feeding habits and other behavioural characteristics.

| Characteristic                              | No. of subjects tested | Prevalence | Odds ratio | 95% Confidence interval | P value |
|---------------------------------------------|------------------------|------------|------------|--------------------------|---------|
| Cats at home                                |                         |            |            |                          |         |
| +                                           | 46                     | 17.4       | 2.1        | 0.51–9.17                | 0.24    |
| −                                           | 44                     | 9.1        | 1.0        |                          |         |
| Cats in the neighborhood                     |                         |            |            |                          |         |
| +                                           | 63                     | 17.5       | 5.5        | 0.67–120.06              | 0.07    |
| −                                           | 27                     | 3.7        | 1.0        |                          |         |
| Cleaning cat excrement                       |                         |            |            |                          |         |
| +                                           | 25                     | 12         | 0.8        | 0.16–3.84                | 0.55    |
| −                                           | 64                     | 14.1       | 1.0        |                          |         |
| Raising animalsb                            |                         |            |            |                          |         |
| +                                           | 36                     | 13.9       | 1.1        | 0.27–4.28                | 0.56    |
| −                                           | 54                     | 13         | 1.0        |                          |         |
| Dogs at home                                |                         |            |            |                          |         |
| +                                           | 15                     | 6.7        | 0.4        | 0.02–3.62                | 0.36    |
| −                                           | 75                     | 14.7       | 1.0        |                          |         |
| Traveled abroad                             |                         |            |            |                          |         |
| +                                           | 4                      | 50         | 8.4        | 0.73–100.32              | 0.07    |
| −                                           | 85                     | 10.6       | 1.0        |                          |         |
| National trips                              |                         |            |            |                          |         |
| +                                           | 27                     | 11.1       | 0.8        | 0.16–3.96                | 0.55    |
| −                                           | 62                     | 12.9       | 1.0        |                          |         |
| Consumption of:                             |                         |            |            |                          |         |
| Pork                                        |                         |            |            |                          |         |
| +                                           | 74                     | 10.8       | 0.4        | 0.08–1.72                | 0.13    |
| −                                           | 16                     | 25         | 1.0        |                          |         |
| Beef                                        |                         |            |            |                          |         |
| +                                           | 80                     | 11.3       | 0.3        | 0.05–1.76                | 0.12    |
| −                                           | 10                     | 30         | 1.0        |                          |         |
| Mutton                                      |                         |            |            |                          |         |
| +                                           | 34                     | 8.8        | 0.5        | 0.10–2.28                | 0.25    |
| −                                           | 56                     | 16.1       | 1.0        |                          |         |
| Chicken                                     |                         |            |            |                          |         |
| +                                           | 72                     | 11.1       | 0.4        | 0.10–2.03                | 0.19    |
| −                                           | 18                     | 22.2       | 1.0        |                          |         |
| Turkey                                      |                         |            |            |                          |         |
| +                                           | 48                     | 16.7       | 1.9        | 0.46–8.28                | 0.24    |
| −                                           | 42                     | 9.5        | 1.0        |                          |         |
| Raw cow milk                                |                         |            |            |                          |         |
| +                                           | 25                     | 12         | 0.9        | 0.16–3.91                | 0.56    |
| −                                           | 65                     | 13.8       | 1.0        |                          |         |
| Raw goat milk                               |                         |            |            |                          |         |
| +                                           | 3                      | 66.7       | 15.4       | 0.95–476.41              | 0.04    |
| −                                           | 87                     | 11.5       | 1.0        |                          |         |
| Chorizo                                     |                         |            |            |                          |         |
| +                                           | 73                     | 15.1       | 2.8        | 0.33–63.09               | 0.28    |
| −                                           | 17                     | 5.9        | 1.0        |                          |         |
Concerning demographic characteristics, the *Toxocara* seroprevalence found in the present study was not significantly associated with any of the socio-demographic characteristics of the waste pickers. It has been reported that the prevalence of toxocariasis decreases with age [16]; however, *Toxocara* seroprevalence in waste pickers was not significantly influenced by age. This finding might suggest frequent *Toxocara* exposure in waste pickers. Toxocariasis has been associated with low educational level [28]. The lack of association of toxocariasis and educational level in waste pickers must be interpreted with care, since the great majority of waste pickers had a low educational level and a comparison with waste pickers with much higher educational level was not possible.

With respect to work characteristics, no significant associations of *Toxocara* seropositivity and work characteristics were found. The lack of association of *Toxocara* seropositivity with the years of working suggests that *Toxocara* exposure might occur early during the waste picking activity.

### Table 3. Cont.

| Characteristic                  | No. of subjects tested<sup>a</sup> | Prevalence | Odds ratio | 95% Confidence interval | P value |
|-------------------------------|-----------------------------------|------------|------------|-------------------------|---------|
| Unwashed raw vegetables       |                                   |            |            |                         |         |
| +                             | 29                                | 18         | 0.7        | 0.13–3.03               | 0.41    |
| –                             | 61                                | 14.8       | 1.0        |                         |         |
| Unwashed raw fruits           |                                   |            |            |                         |         |
| +                             | 37                                | 10.8       | 0.7        | 0.16–2.80              | 0.39    |
| –                             | 53                                | 15.1       | 1.0        |                         |         |
| Untreated water               |                                   |            |            |                         |         |
| +                             | 64                                | 12.5       | 0.8        | 0.19–3.49              | 0.47    |
| –                             | 26                                | 15.4       | 1.0        |                         |         |
| Degree of meat cooking        |                                   |            |            |                         |         |
| Undercooked                   | 5                                 | 20         | 1.8        | 0.03–20.93             | 0.49    |
| Well done                     | 83                                | 12         | 1.0        |                         |         |
| Frequency of eating out of home|                                   |            |            |                         |         |
| Never                         | 9                                 | 22.2       | 4.1        | 0.42–34.94             | 0.16    |
| 1–10 times a year             | 20                                | 30         | 6.1        | 1.28–30.73             | 0.01    |
| >10 times a year              | 61                                | 6.6        | 1.0        |                         |         |
| Soil contact                  |                                   |            |            |                         |         |
| +                             | 36                                | 16.7       | 1.6        | 0.40–6.18              | 0.33    |
| –                             | 53                                | 11.3       | 1.0        |                         |         |
| Floor at home                 |                                   |            |            |                         |         |
| Ceramic or wood               | 3                                 | 0          | 0.0        | 0.00–16.80             | 0.62    |
| Concrete                      | 39                                | 15.4       | 1.0        |                         |         |
| Soil                          | 48                                | 12.5       | 0.8        | 0.20–3.09              | 0.69    |

<sup>a</sup>Subjects with available data.
<sup>b</sup>Raising of any kind of animals.
<sup>+</sup> = Yes; <sup>–</sup> = No.

### Table 4. Results of multivariate analysis.

| Variable                        | P value | Odds ratio | 95% Confidence interval |
|---------------------------------|---------|------------|-------------------------|
| Cats in the neighborhood        | 0.16    | 5.94       | 0.47–73.71              |
| Traveled abroad                 | 0.23    | 8.14       | 0.25–260.81             |
| Pork consumption                | 0.33    | 0.25       | 0.01–3.97              |
| Beef consumption                | 0.84    | 0.78       | 0.06–9.47              |
| Chicken consumption             | 0.02    | 0.03       | 0.003–0.59             |
| Raw goat milk consumption       | 0.05    | 46.54      | 1.00–2160.38           |
| Low frequency of eating out of home | 0.01 | 25.52       | 1.79–362.93            |

<sup>DOI</sup>:10.1371/journal.pone.0054897.t003
Of the clinical data, results indicate that *Toxocara* infection is impacting the health of waste pickers. Firstly, the prevalence of *Toxocara* seropositivity was significantly (*P* < 0.05) higher in waste pickers suffering from gastritis than those without such clinical feature. To my knowledge, there is not previous report of an association of *Toxocara* infection and gastritis. Further research on the role of *Toxocara* infection in gastritis is needed. Secondly, seroprevalence of *Toxocara* infection was higher (borderline significance: *P* = 0.05) in waste pickers with visual impairment than those without this clinical feature. *Toxocara* infection is a known cause of eye disease [8], and further research on ocular toxocariasis in waste pickers is needed. Thirdly, waste pickers with reflex impairment had a significantly higher prevalence of *Toxocara* seropositivity than those without such clinical feature. My knowledge there is not previous report of an association of *Toxocara* seropositivity than those without such clinical feature. To my knowledge, there is not previous report of an association of *Toxocara* seropositivity than those without such clinical feature.

Concerning behavioral characteristics, multivariate analysis showed that *Toxocara* seropositivity was associated with a low frequency of eating out of home. This result suggests that infection with *Toxocara* was not acquired in restaurants or fast food outlets. Instead, it is possible that *Toxocara* exposure in waste pickers might have occurred at the waste transfer unit or at home. In addition, multivariate analysis showed that *Toxocara* seropositivity was negatively associated with chicken meat consumption. This finding suggests that chicken meat did not play a major role in *Toxocara* exposure in waste pickers.

*Toxocara* seropositivity has been associated with dog ownership [21,28]. However, in the present study no association between *Toxocara* seropositivity and dog or cat ownership was found. This finding agrees with those found in other studies [27,30]. In the present study, an association of *Toxocara* exposure and dog contact cannot be excluded because there were plenty dogs in the waste transfer unit and, therefore, waste pickers had contact with dogs at work. Contact with soil has been also found associated with toxocariasis [31]. However, in the present study such association was not found.

The conclusions of the present study are: 1) Waste pickers represent a risk group of *Toxocara* infection; 2) *Toxocara* is impacting the health of waste pickers. This is the first report of *Toxocara* infection in waste pickers and of associations of gastritis and reflex impairment with *Toxocara* seropositivity. Results warrant for further research.

### Author Contributions

Conceived and designed the study protocol: CAE. Performed the laboratory tests: CAE. Read and approved the final version of the manuscript: CAE. Analyzed the data: CAE. Wrote the paper: CAE.

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