Introduction:
Toxocariasis is a parasitic infection that causes eosinophilia in humans. Infection in humans is created by swallowing parasite eggs through contaminated soil or hands. Then, the larvae exit from eggs in the small intestine and enter the bloodstream through the perforation of the intestine, and from there, they migrate to all various organs, leading to the creation of visceral larva migrans syndrome and ocular larva migrans syndrome.

Methods:
In this case study, a prospective study was performed on 100 patients who referred to these centers from February 2017 to January 2018 in different hospitals in Tabriz, in Iran. After the diagnosis of 50 hypereosinophilic patients (more than 10% eosinophilia) without a history of allergic disease as a case group and 50 patients without eosinophilia as a control group, we collected blood samples from these individuals and isolated their serum or plasma. Then, anti-Toxocara antibodies were measured by the enzyme-linked immunosorbent assay (ELISA) method in these patients. The data were analyzed by SPSS software.

Results:
The prevalence of anti-Toxocara antibodies was observed in 20% (10 patients) and 2% (1 patient) of hyperosinophils and controls, respectively. The mean age of the case and control groups was 22–75 years and 17–79 years, respectively, and 57% and 43% of the subjects were males and females.

Conclusion:
Seroepidemiological studies in Iran have shown a seroprevalence of the disease between 2% and 25.6%. Due to the fact that toxocariasis is caused by worm larvae, this disease can be diagnosed only by serological methods. Therefore, it is necessary to suspect toxocariasis in people with unspecified hypereosinophilia and perform an immunoserological test by the ELISA method. The findings demonstrated that this infection exists in the city of Tabriz.

Keywords: Human toxocariasis, Hypereosinophilic patients, ELISA, Tabriz, Iran
**Materials and Methods**

This was a case-control and prospective study that was performed on patients referred to medical centers in Tabriz from February 2017 to January 2018. Patients were divided into case and control groups.

Using the formula \( n = \frac{Z^2 \cdot P \cdot (1-P)}{d^2} \), the sample size for each of the two groups (control and case) was 50 people.

In this study, patients who referred to these centers, first, underwent a complete blood count or cell count test and then performed a cell count and differentiated peripheral blood eosinophils by performing a differentiation test.

If the patient’s blood eosinophils are more than 1000 per microliter of blood, the person is hypereosinophilic and is in the case group, and if the person is not hypereosinophilic, he/she is in the control group.

The exclusion criteria included having any allergic disease and taking medications that cause hypereosinophilia. Personal characteristics and information about the required variables, such as age, gender, and the like, were collected with the help of a questionnaire.

Hypereosinophils as a case group and non-hypereosinophils as a control group were tested for anti-\( \text{Toxocara} \) immunoglobulin G (IgG) serum by the ELISA method using a commercial kit in the laboratory. Statistical data were analyzed using SPSS software version 26.

**Results**

In this study, experiments were performed on serum samples of 50 patients in the case group (hypereosinophilic individuals) and 50 controls (non-hypereosinophilic individuals), and the mean age of those in the case and control groups was 22–75 years and 17–79 years, respectively.

It should be noted that after ELISA tests, the number of serum-positive people in terms of anti-\( \text{Toxocara} \) antibody response in the case and control groups was 10 (20%) and 1 (2%), respectively.

Therefore, there was a statistically significant relationship between hypereosinophilia and a positive response to anti-\( \text{Toxocara} \) antibodies \((P = 0.007)\).

The result of the chi-square test revealed that there was a significant relationship between contact with soil and vegetables and dogs and cats in hypereosinophils (case group) and a positive response to anti-\( \text{Toxocara} \) antibodies \((P = 0.004)\).

The frequency distribution of variables and age characteristics of the subjects are presented in Tables 1 and 2, respectively.

**Discussion**

In this study, anti-\( \text{Toxocara} \) antibodies were observed in 20% of hypereosinophilic individuals and 2% in non-eosinophilic individuals. Therefore, a significant relationship was found between hypereosinophilia and the positive response of anti-\( \text{Toxocara} \) antibodies. In other words, eosinophilia in individuals can be used as an indicator to guide physicians in the possible diagnosis of \( \text{Toxocariasis} \) and prove the need for serological and immunological tests in these individuals.

In a comparative study by Karadam et al, at Aydin University in Turkey on anti-\( \text{Toxocara} \) IgG antibody titers in two groups with eosinophilia and no eosinophilia, 32.6% in the hypereosinophilia group and 20.3% in the non-hypereosinophilia group were positive for the anti-\( \text{Toxocara} \) antibody response (9).

Kwon et al from the University of Seoul, Korea, performed a serological study of toxocarasis in patients with unknown eosinophilia from 2001 to 2005. Out of 103 patients with unknown eosinophilia, 83% were positive for anti-\( \text{Toxocara} \) antibody titers, of which 70 (68%) were diagnosed with toxocarasis (10).

Likewise, Park et al in Korea found that the prevalence of anti-\( \text{Toxocara} \)-specific IgG antibodies worldwide ranged from 5.1% to 76.6%, which was due to cultural, religious, and climatic differences in different parts of the world (11).

Alavi et al in Ahvaz attempted to determine the prevalence of \( \text{T. canis} \) in children aged 6–15 years and concluded that out of 203 students, 10.3% had eosinophilia, of which 2% were positive for \( \text{Toxocara} \) (12). In this study, as in other studies, including the
recent study, there was a significant relationship between hypereosinophilic individuals who tested positive for anti-Toxocara antibody titer, but there was no significant relationship between Toxocara antibody titer and gender and age.

In a study conducted by Dr. Nasiri et al among 270 patients with the symptoms of blurred vision and high eosinophilia who referred to the ophthalmology ward in a hospital in Tehran, 38% of patients reported being infected with Toxocariasis (13).

Another finding from recent research is that in hypereosinophilic individuals who tested positive for anti-Toxocara antibodies, there were those who had some contact with soil, vegetables, dogs, and cats (14,15). In other words, people’s jobs are effective at having high antibody titers; for example, housewives are more exposed to soil and vegetables than female employees, and farmers and ranchers are more exposed to soil, vegetables, dogs, and cats than employees.

In fact, there is a significant association between contact with soil, vegetables, dogs, and cats with high titers of effective anti-Toxocara antibodies (16,17).

Therefore, it is observed that the serum prevalence of toxocariasis in different geographical areas with different climatic conditions and among different countries can be due to the degree of contact with dogs and cats in different religions and breeds (e.g., among Muslims), close contact with dogs and objects that the dog has been in contact with is forbidden, which could be one of the reasons for the decrease in the prevalence of Toxocara in Muslim countries (18,19). In addition, the titles used to interpret the test results, as well as the sensitivity of the kit used in different studies, may have varied (20,21).

In any case, the overall serum prevalence of Toxocara obtained in this study was lower than in other studies, which can be due to the religious beliefs of people in different parts of Tabriz to avoid close contact with dogs and cats, as well as the cold and mountainous climate of the region, which provides unfavorable conditions for the parasite’s eggs to survive. For example, in a country like Turkey, which has a higher percentage of humidity than our country, the survival of parasite eggs, including Toxocara, is higher; thus, the serum prevalence of Toxocara is extremely higher among people than in our country, which has a dry climate. Therefore, it is suggested that more extensive epidemiological studies be conducted in the East Azerbaijan province of Iran to provide more complete information to infectious disease specialists and health professionals in the province to take steps to improve health and prevent toxocariasis infection.

### Conclusion

Based on the findings of this study, there was a significant relationship between hypereosinophilia and a positive Toxocara titer. Another conclusion drawn from this study is that in hypereosinophilics, a significant relationship was found between the positive response of anti-Toxocara antibodies and contact with soil, dogs, and cats. In other words, people with hypereosinophilia who were exposed to soil, dogs, and cats due to more occupational activity had a higher prevalence of Toxocara serum. It is also necessary that the ELISA test be performed on people with unspecified hypereosinophilia suspected of toxocariasis. Finally, people who have a positive anti-Toxocara antibody response should be screened for toxocariasis.

### Authors’ Contribution

Data curation: Yagoob Garedaghi.
Funding acquisition: Yagoob Garedaghi.
Project administration: Yagoob Garedaghi.
Supervision: Yagoob Garedaghi.
Validation: Ali Shabestari Asl.
Visualization: Yagoob Garedaghi.
Writing—original draft: Yagoob Garedaghi.
Writing—review & editing: Yagoob Garedaghi, Ali Shabestari Asl.

### Competing Interests

The authors declare that they have no conflict of interests.

### Ethical Approval

Ethical considerations have been fully observed in this research.

### References

2. Mohamad S, Azmi NC, Noordin R. Development and

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Table 1. Frequency Distribution of Variables in Case (Hypereosinophilia) and Control Groups in Patients Referred to Tabriz Hospitals in 2017

<table>
<thead>
<tr>
<th>Gender</th>
<th>Case</th>
<th>Control</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male (man)</td>
<td>30 (60%)</td>
<td>22 (44%)</td>
<td>0.004</td>
</tr>
<tr>
<td>Female (woman)</td>
<td>20 (40%)</td>
<td>28 (56%)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Contact with dogs, cats, and soil</th>
<th>Positive serum</th>
<th>Negative serum</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive serum</td>
<td>10 (50%)</td>
<td>1 (5%)</td>
<td>0.004</td>
</tr>
<tr>
<td>Negative serum</td>
<td>10 (50%)</td>
<td>20 (52%)</td>
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</table>

<table>
<thead>
<tr>
<th>Abundance of people in terms of response to antibodies anti-Toxocara</th>
<th>Positive</th>
<th>Negative</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>10 (20%)</td>
<td>1 (2%)</td>
<td>0.007</td>
</tr>
<tr>
<td>Negative</td>
<td>40 (80%)</td>
<td>49 (80%)</td>
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</table>

Table 2. The Average Age of the Case and Control Groups in Patients Referred to Tabriz Hospitals in 2017

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Group</th>
<th>Case</th>
<th>Control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (maximum)</td>
<td>75</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>Age (minimum)</td>
<td>22</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Mean or average</td>
<td>48/5</td>
<td>48</td>
<td></td>
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