Abstract
This study was done to determine the seroprevalence of *Toxocara* infection in children by using ELISA test.
Blood samples were collected from 120 hospitalized children with age ranging from [1-15] years, and [25] children (apparently healthy) served as controls.
Serum samples of 120 children [66 males and 54 females] and 25 healthy controls were examined for anti-*Toxocara* IgG antibody by a commercial ELISA test. The seropositivity rates were 30.8% and 12% in diseased and healthy children respectively. No statistical differences were observed with regard to age and sex. Diagnosis of sera from children with geophagia in urban and rural areas revealed that 55.2% were seropositive for *Toxocara* IgG antibody. Haematological parameters in children showed that the highest ESR rate and lowest Hb% was frequent in 1-2 and 3-5 years old respectively. Eosinophilia was statistically frequent in 3-5 year old group.

Conclusion
*Toxocara* seroprevalence suggest that toxocariasis is frequent in children in this community.

Serological Study of Toxocariasis in Children in Mosul Province
Wisam M. Al-Saeed       Nawfal Y. Al-Dabbagh       Hind J. Mahmood*
College of Medicine,University of Mosul.
*Mosul Technical Institute.

Introduction
Toxocariasis is an infectious disease caused by the accidental ingestion of infective egg of the dog roundworm *Toxocara canis* and less frequently cat roundworm *Toxocara cati* that usually live in the intestine of dogs and cats [1,2]. When they infect humans, the
illness is called toxocariasis, toxocarosis or visceral larva migrans VLM [3,4]. Toxocariasis usually affects children under the age of ten years [5]. The children at risk are those who like to put things in their mouths or those whose families own pet dogs or cats [6]. Young children (2-9 years) are most susceptible to infection with this organism, because they are more likely to ingest the eggs of the worm from contaminated soil or by direct contact with infected puppies [7].

There are three major clinical syndromes associated with human toxocariasis, visceral larva migrans (VLM), ocular larva migrans (OLM) and covert toxocariasis CT (2). The presentation of VLM includes eosinophilia (sometimes approaching 70%), leukocytosis, fever, hepatomegaly, anemia, cough, wheezing and bronchospasm resembling asthma [4,8]. The ELISA test has proved to be a sensitive and specific test in the diagnosis of VLM, Immunoglobulin mainly IgG, but to a lesser extent IgM and IgE are produced in response to the infection [9, 10, 11].

The present work is concerned with seroprevalence of human toxocariasis among children in Mosul area no previous work has ever been done in Mosul concerning this aspect of the disease.

Patients and Methods
Collection of Blood Samples:
Sera from 1-15 years old children were obtained from 120 blood samples submitted to Ibin- Al-Ather Hospital and Ibin Sina Teaching Hospital Pediatric Department. Collection started from January to May 2005. In patient children (1-15 years old), specially those with pica, anemia, Two to three ml. of blood was drawn by venipuncture from 120 hepatomegally, and general weakness, blood was also drawn from 25 control children (apparently healthy) of matched ages selected randomly from Mosul City [12].

Sera were collected and assayed for specific antibodies against T.canis and before that the sera were absorbed with extracts of Ascaris and Toxocara antigens and examined for C-reactive protein [13].

Calculation of Results
Samples were considered as positive if the absorbance value is higher than 10% over the cut-off value. Samples with an absorbance value of less than 10% above or below the cut-off should not be considered as clearly positive or negative (gray zone). Samples were considered as negative if the absorbance value is lower than 10% below the cut-off (NOVATEC IMMUNODIAGNOSTIC GMBH).

Statistical Analysis
Chi-square test, Anova test, and t-test were used for the analysis of data [14].

Results
Sera of children collected and analyzed by ELISA test showed that out of 120 sera collected from inpatients children aged (1-15) years old suffering from different pathological conditions with different signs and symptoms in addition to (25) sera collected from apparently healthy children of both sexes used as a control group, 37 (25.8%) of tested children and 3 (12.0%) of healthy controls were reactive for anti-Toxocara antibodies, including 20 (13.9%) of 66 and 17 (11.9%) of 54 sera of the male and female children respectively. Sera were also checked for C-reactive protein by using latex agglutination slide method (Biokit spanish comapny). The results showed negative reaction for the tested and control groups except two sera which gave positive reaction; one
serum was taken from child suffering from bronchitis and the other from child with arthritis.

Statistical analysis using t-test revealed no significant difference between the infection with toxocariasis in male and female groups (P= 0.508). Results also indicated no significant differences between different age groups (1-15 years), as indicated in (Table 1). The number and distribution of toxocariasis among different age groups (from 1-15 years old), and in different clinical signs and symptoms is presented in (Table 2).

Statistical analysis by using ANOVA-F-test showed that the positive number of infected children with toxocariasis is not significant by comparing the different age groups (P= 0.837).

Diagnosis of sera from children with geophagia (eating soil and dirt), in urban and rural regions and among male and female subjects revealed that 20 (54.1%) out of 37 with geophagia in males and 7 (56.7%) out of 30 females, were seropositive for IgG (Table 4). Gender analysis showed, no statistical significance between children with geophagia and non-geophagia.

The mean age and standard deviation of the groups of 120 patients children was 5.86 ± years. About half of this number originated from villages surrounding Mosul area, geophagia was most frequently recorded in the 1-2 years old group.

Distinct hematological values were most frequently observed in the 1-2 years age group (Table 12), while the most common clinical symptoms were abdominal pain, bronchitis, hepatosplenomegaly, lymphadenopathy often accompanied by anorexia, vomiting and anemia (Table 11). Table 11 shows that the highest erythrocyte sedimentation rate was frequent in the 1-2 years old group (30%), while the lowest hemoglobin rate (15%) was seen in 3-5 year old group, with the most common clinical symptoms being, abdominal pain, hepatosplenomegaly, lymphadenopathy and less frequently anemia. As in all patients with larval toxocariasis, eosinophilia was also most frequent in the (3-5) year old group of children (22.5%) (Table 12), which was the most interesting point. Leucocytosis were most frequently detected in (11-15) year old children (25%), which was an indicator of inflammation.
Table 1 Seropositivity of toxocariasis according to age and sex of children.

<table>
<thead>
<tr>
<th>Age (year)</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>Healthy control</th>
<th>Control</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Examined no.</td>
<td>Positive no.</td>
<td>%</td>
<td>Examined no.</td>
<td>Positive no.</td>
<td>%</td>
</tr>
<tr>
<td>1-2</td>
<td>11</td>
<td>5</td>
<td>3.4</td>
<td>9</td>
<td>3</td>
<td>2.1</td>
</tr>
<tr>
<td>3-4</td>
<td>12</td>
<td>4</td>
<td>2.8</td>
<td>10</td>
<td>4</td>
<td>2.8</td>
</tr>
<tr>
<td>5-6</td>
<td>10</td>
<td>3</td>
<td>2.1</td>
<td>8</td>
<td>3</td>
<td>2.1</td>
</tr>
<tr>
<td>7-8</td>
<td>8</td>
<td>3</td>
<td>2.1</td>
<td>9</td>
<td>2</td>
<td>1.4</td>
</tr>
<tr>
<td>9-10</td>
<td>9</td>
<td>2</td>
<td>1.4</td>
<td>7</td>
<td>2</td>
<td>1.4</td>
</tr>
<tr>
<td>11-12</td>
<td>9</td>
<td>2</td>
<td>1.4</td>
<td>6</td>
<td>2</td>
<td>1.4</td>
</tr>
<tr>
<td>13-14</td>
<td>7</td>
<td>1</td>
<td>0.7</td>
<td>5</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td>Total</td>
<td>66</td>
<td>20</td>
<td>30.30</td>
<td>54</td>
<td>17</td>
<td>31.48</td>
</tr>
</tbody>
</table>

Mean = 2.86
Standard deviation (st. D.) = 1.35
P.value = 0.508
### Table 2 Clinical symptoms of toxocariasis in hospitalized children

<table>
<thead>
<tr>
<th>Age in year</th>
<th>1-2</th>
<th>3-5</th>
<th>6-10</th>
<th>11-15</th>
<th>Healthy children (control)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms</td>
<td>N = 20</td>
<td>p.n.</td>
<td>%</td>
<td>n = 40</td>
<td>p.n.</td>
</tr>
<tr>
<td>Fever</td>
<td>5</td>
<td>1</td>
<td>20</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>Abdominal pain</td>
<td>4</td>
<td>2</td>
<td>50</td>
<td>14</td>
<td>3</td>
</tr>
<tr>
<td>Bronchitis</td>
<td>2</td>
<td>1</td>
<td>50</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Pharyngitis</td>
<td>1</td>
<td>0</td>
<td>-</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Hepatosplenomegaly</td>
<td>3</td>
<td>2</td>
<td>66.7</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Anaemia</td>
<td>3</td>
<td>1</td>
<td>33.3</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Arthritis</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lymphadenopathy</td>
<td>2</td>
<td>1</td>
<td>50</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Macular lesion</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Total = 20 | 8 | 40% | 40 | 11 | 27.5% | 33 | 10 | 30.30% | 27 | 8 | 29.62% | 3 | 25 |
Mean = 0.8889 1.222 1.111 0.8889 |
Standard deviation = 0.7817 1.302 0.928 0.0601 |
P.value = 0.837 |
Statistical analysis by (Avona table - F-test) |

n = number examined  
pn = positive number with ELISA test.
<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Variable</th>
<th>Increased ESR mm/h</th>
<th>Low Hemoglobin (gm/dl)</th>
<th>Leucocytes count X10³</th>
<th>Eosinophilia %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-2</td>
<td>No. examined positive no. increased suppressed *%</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>Mean value + S.D.</td>
<td>30.0</td>
<td>39.5 ± 8.76</td>
<td>8.86 ± 0.999</td>
<td>3.925 ± 0.929</td>
</tr>
<tr>
<td>3-5</td>
<td>No. examined positive no. increased, suppressed*%</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>Mean value + S.D.</td>
<td>17.5</td>
<td>37.14 ± 6.54</td>
<td>8.683 ± 1.426</td>
<td>12.6 ± 1.14</td>
</tr>
<tr>
<td>6-10</td>
<td>No. examined positive no. increased, suppressed*%</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Mean value + S.D.</td>
<td>9</td>
<td>34.22 ± 10.33</td>
<td>8.25 ± 1.018</td>
<td>4.071 ± 0.745</td>
</tr>
<tr>
<td>11-15</td>
<td>No. examined positive no. increased, suppressed*%</td>
<td>27</td>
<td>27</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Mean + S.D</td>
<td>6</td>
<td>29.6 ± 5.76</td>
<td>8.233 ± 0.898</td>
<td>3.671 ± 0.559</td>
</tr>
</tbody>
</table>

P = 0.05
(S) = significant
(N.S) = Not significant
Statistical analysis by (ANOVA – F – test)

- Suppressed
Table 4 Relationship between toxocariasis, seropositivity of children from urban and rural places and geophagia in Mosul Governorate

<table>
<thead>
<tr>
<th></th>
<th>Urban</th>
<th>Rural</th>
<th>No. with geophagia</th>
<th>No. with Toxocariasis</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>30</td>
<td>36</td>
<td>37</td>
<td>20</td>
<td>54.1</td>
</tr>
<tr>
<td>Female</td>
<td>25</td>
<td>29</td>
<td>30</td>
<td>17</td>
<td>56.66</td>
</tr>
<tr>
<td>Overall</td>
<td>55</td>
<td>65</td>
<td>67</td>
<td>37</td>
<td>55.2</td>
</tr>
</tbody>
</table>

\[(\chi^2) = 0.003\]
P-value = 0.956
N.S = not significant between geophagia and Toxocariasis
Discussion

Human toxocariasis is still a poorly diagnostic disease, especially in places with conditions, which favors its development and its being largely unknown either to health professionals or the general population [13]. This is true in a country like Iraq. In this study, the frequency of Toxocara seropositivity in hospitalized children was found to be 30.8%. This rate is statistically higher than the rate identified in the control group. Toxocara seroprevalence may vary according to geographical region where the study is made and even to different populations inhabiting the same region [10,14,15]. When compared with seroprevalence rates ranging between 2.7% and 73% reported by different studies [10,13,14,15,16,17]. The rate of 30.8% which was found for children group, may not be considered very high.

The observation of a high frequency of Toxocara seroprevalence in hospitalized children compared to the control group (12%) suggests that these cases in Mosul region may be considered under risk of Toxocara infection.

The present work reports for the first time serological proven human toxocariasis in Mosul area. The seropositivity reported in the present study shows that the disease is a zoonotic problem in the study area. Woodruff and colleagues (1981) reported that the prevalence of Toxocara antibodies (7.3%) in the sera of adult persons from Baghdad certainly indicates that the transmission of Toxocara is proceeding from dogs in Iraq.

The present result further suggests that toxocaral infection in the study area is acquired by the ingestion by soil containing infective Toxocara spp. eggs and confirms an earlier report by Woodruff and colleagues (1981) and Al-Dabbagh (1995) that there is a wide-spread contamination of the environment in Mosul with Toxocara spp. Eggs [18,19].

Toxocariasis is seen more frequently among children than among adults [2,4,20]. This may be due to such reasons as frequent contact with contaminated soil, poor hygiene, and consuming contaminated food [10,21, 22].

The rate of seropositivity found among children in the present study (30.8%) is consistent with reports conducted in children groups (26.6%) from Egypt (23), Nigeria 29.8% (24), Iran 25.6% (25), Spain 27.2% (15), Bolivia 24.8% (26), Turkey 25.9% (10) and Iran 25.6%. [17].

The seropositivity rates were higher among age groups between 1-2 and 7-8 year old children. This observation is in accordance with report by Caseiro (1996) who observed that 27.6% of prevalence rates ranging from 7-9 years old and 18.9% ranging 10-12 years old [27].

The high specificity and sensitivity of ELISA assay (92% and 78% ressectively), are quite useful for serodiagnosis of human toxocariasis using IgG ELISA commercial kits [28]. T. canis IgG ELISA has been used in the current study, with its diagnostic specificity of 98% and diagnostic sensitivity of 98% as stated by the manufacturer (Nova Tec-Germany).

All infected children with toxocarasis showed the predominance of non-specific symptoms and disorders, which may result in the narrowing of the spectrum in the differential diagnosis [29]. However, the present study showed various symptoms among seropositive children of different ages. These symptoms include fever, abdominal pain, bronchiitis, pharyngitis, hepatosplenomegaly, anemia, lymphadenopathy and macular lesion (Table 2).

Almost all cases of severe VLM are diagnosed in children up to 3 years of age [4]. The tendency of some children at this age to eat dirt places them at risk for ingesting many Toxocara spp. eggs. Children with geophagia pica (compulsion to eat dirt) a behavior disorder noted in 2-
10% of children at age 1-6 years are extremely vulnerable to infection if in a contaminated environment [3,4]. Despommier (2003) indicated that children with pica were at higher risk of ingesting embryonated eggs from soil than those not exhibiting this behavior[2]. A more recent publication stressed that VLM typically occurs in preschool-aged children with a history of eating dirt, emphasizing the importance of this habit in toxocariasis. In this regard, children should be discouraged from putting dirty fingers in their mouths and eating dirt, [20,30].

References: