Seroepidemiology of *Toxoplasma gondii* IgG and IgM among butchers in southwest of Iran

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**Objective:** To test for immunoglobulin G (IgG) and immunoglobulin M (IgM) antibodies in butchers in the province of Khuzestan in Iran and compare them with a control group from the general population.

**Methods:** Blood samples were taken from 110 butchers in five cities of Khuzestan, southwest of Iran, to test for the incidence of *Toxoplasma*. The participants were accepted and tested on the basis of age, work experience, engagement in animal husbandry, and positive or negative *Toxoplasma* IgM and IgG results.

**Results:** The results showed that the seroprevalence of *Toxoplasma* IgG was 41.8% (56 cases) among the group of butchers in Khuzestan and 28.8% in the control group. The seroprevalence of *Toxoplasma* IgM was 1 case (2.2%) among butchers, while none in the control group.

**Conclusions:** A comparison of results indicated that butchers in Khuzestan were at the risk of toxoplasmosis. The greatest frequency was 17.6% (20 cases) in the group with age ranging from 35 to 44 years. In terms of work experience, the greatest frequency was 16.5% (18 cases) among butchers having 9–17 years of work experience.
east (Behbahan), west (Dasht-e Azadegan) and center (Ahvaz) of
Khuzestan Province.

This was a case-control study on individuals working with raw
meat. The study population consisted of butchers who sold raw meat
in shops, while the control group was selected from the general
population and was matched for age, gender and place of residence
with the group of butchers. A total of 110 butchers and 110 individuals
matched for the defined characteristics were selected.

The study objectives and methodology were explained to all
participants. The characteristics of participants were obtained and
recorded by using a standardized questionnaire. The demographic data
included age, gender, place of birth, place of residence, and level of
education. Information related to work experience, the most common
types of animal slaughtered, and the regular use of safety practices at
work (use of gloves, masks, and goggles) were also evaluated.

2.2. Sampling collection and serology

A sample of 5 mL blood was taken from each person and
immediately transferred to the laboratory. After centrifugation, the
serum was stored individually in a freezer at -20°C until testing. After
the desired number of samples was collected, ELISA was carried out.
The serum sample was first removed from the freezer and allowed to
reach room temperature. The antibodies on the plates were counted
and subsequently separated into IgG and IgM groups according to the
guidelines provided in the A tobio Toxo ELISA kit.

2.3. Statistical analysis

SPSS software (version 16) was used for statistical analysis. The t-test
was used to compare mean age and work experience among
butchers with positive and negative IgG results. The Chi-square test
was applied to compare the prevalence of IgG among butchers.

3. Results

The incidence of Toxoplasma IgG and IgM antibodies among
butchers was given in Tables 1, 2 and 3. Table 1 shows that of 110
butchers, the prevalence of Toxoplasma IgG was 42.7%. By age, it
broke down to 4.5% for the 16–24 years, 10.0% for 25–34 years,
18.1% for 35–44 years, 5.54% for 45–54 years, and 4.5% for over
55 years. The 35–44 years group showed the greatest incidence of
positive IgG (20 cases). Out of 110 butchers, only one case (1.1%) of
work experience (11 of 22 cases). There was no significant difference
had 27–34 years, and 0.9% had 35–42 years. The greatest frequency
of work experience, 16.4% had 9–17 years, 10.0% had 18–26 years, 4.5%
had 27–34 years, and 0.9% had 35–42 years. The greatest frequency

Table 1
Prevalence of Toxoplasma IgG in butchers in K huzestan vs. age. n (%).

| Age range | Positive | Negative | Total |
|-----------|----------|----------|-------|
| 16–24 years | 5 (4.5)  | 11 (10.0) | 16 (14.5) |
| 25–34 years | 11 (10.0) | 25 (22.7) | 36 (32.7) |
| 35–44 years | 20 (18.1) | 7 (6.4) | 27 (24.5) |
| 45–54 years | 6 (5.5) | 14 (12.7) | 20 (18.2) |
| > 55 years | 5 (4.5) | 6 (5.5) | 11 (10.0) |
| Total | 47 (42.7) | 63 (57.3) | 110 (100.0) |

Table 2 shows that the prevalence of Toxoplasma IgG among
the butchers was 41.8%. Of these, 10.0% had 0–8 years of work
experience, 16.4% had 9–17 years, 10.0% had 18–26 years, 4.5%
had 27–34 years, and 0.9% had 35–42 years. The greatest frequency
of Toxoplasma antigens occurred in butchers having 18–26 years of
work experience (11 of 22 cases). There was no significant difference
in the work experience of those testing positive and negative for
Toxoplasma IgG at the 95% confidence level. Only one butcher
(0.9%) with 35–42 years of work experience tested positive for
Toxoplasma IgG.

Table 2
Prevalence of Toxoplasma IgG in butchers of K huzestan vs work
experience. n (%).

| Work experience | Positive | Negative | Total |
|-----------------|----------|----------|-------|
| 0–8 years | 11 (10.0) | 19 (17.2) | 30 (27.2) |
| 9–17 years | 16 (14.5) | 23 (20.9) | 41 (37.3) |
| 18–26 years | 11 (10.0) | 11 (10.0) | 22 (20.0) |
| 27–34 years | 5 (4.5) | 7 (6.4) | 12 (10.9) |
| 35–42 years | 1 (0.9) | 4 (3.7) | 5 (4.6) |
| Total | 46 (41.8) | 64 (58.2) | 110 (100.0) |

Table 3 shows that of the 110 butchers with Toxoplasma IgG, 16.4% lived
in Ahvaz, 9.0% in Behbahan, 4.5% in Dasht-e Azadegan, 10.0% in
Dezful, and 1.8% in Abadan. While, of 53 butchers testing negative
for Toxoplasma IgG, 20.9% lived in Ahvaz, 11.0% in Behbahan,
12.7% in Dasht-e Azadegan, 4.5% in Dezful, and 9.0% in Abadan.
As seen, the greatest incidence rate of Toxoplasma IgG occurred in
Dezful (11 of 16 cases). Only two (2.2%) butcher tested positive for
Toxoplasma IgM in Abadan.

Table 3
Prevalence of Toxoplasma IgG in butchers of K huzestan vs. city. n (%).

| City | Positive | Negative | Total |
|------|----------|----------|-------|
| Ahvaz | 18 (16.4) | 23 (20.9) | 41 (37.3) |
| Behbahan | 10 (9.0) | 12 (11.0) | 22 (20.0) |
| Dasht-e Azadegan | 5 (4.5) | 14 (12.7) | 19 (17.2) |
| Dezful | 11 (10.0) | 5 (4.5) | 16 (14.5) |
| Abadan | 2 (1.8) | 10 (9.2) | 12 (11.0) |
| Total | 56 (41.7) | 64 (58.3) | 110 (100.0) |

In the control group, the prevalence of Toxoplasma IgG was 28.8%
and for IgM was zero. There was no significant difference for age and
personal hygiene practices in this group. No significant association
was observed between incidence of the antibodies and the use of
gloves as well as the habit of washing hands before eating. The
increase in prevalence among butchers could result from their close
proximity to slaughtered animals and consumption of undercooked
meat. A secondary possible reason was the large number of cats in
these regions.

4. Discussion

The Sabin-Feldman dye test is the gold standard for detection
of human Toxoplasma antibodies; however, its high cost makes it
unfeasible for epidemiological studies. The difference in Toxoplasma
serum could result from differences in the characteristics for work
and social behavior in butchers of different countries. In reality,
most butchers do not regularly wear gloves. This increases the
probability of injury during work, which is another possible source of
infection.[11,17,18]

The results of this study showed that the occupational exposure
to raw meat in Khuzestan increased the prevalence of Toxoplasma
IgG antibodies. The seroprevalence of Toxoplasma IgG was 41.8%
among butchers in the current study, which was not consistent with
the results reported from Brazil, Saudi Arabia, Bangladesh, Japan,
Poland and Tanzania (33%–80%).[19] Of the 47 workers studied in a
sausage production plant in Londrina, Finland, a prevalence of 59.5%
and 25% was reported overall and among 159 butchers, respectively.
A study from Egypt reported 52.4% of 21 slaughterhouse workers
were infected.[20]

The risk of toxoplasmosis is high among people working in
slaughterhouses and kitchens, and among veterinarians and butchers,
In China, the consumption of pork is high, which accounts for the very high prevalence of toxoplasmosis. The prevalence varied by province from 16.9% to 53.4%[21,22]. The risk of prevalence has been reported to be high among butchers in Finland[20], Egypt and Brazil[22,23]. The prevalence in the USA was 2.7%, Germany was 4.1%, and Mexico was 12.7%.

In China, educational programs promoting a change in food habits, such as avoiding consumption of uncooked meat, testing of meat before distribution, and suitable health conditions in slaughterhouses have been suggested[22]. In the present study, the frequency indicated that the higher Toxoplasma IgG antibodies in humans was the result of the frequent consumption of cooked red meat, working as a butcher, and improper washing of hands before meals and working with meat. In the USA, a significant percentage of toxoplasmosis results from the consumption of contaminated raw or undercooked meat[21].

A study in slaughterhouses in Iraq shows a high prevalence of toxoplasmosis (42%) in workers in the meat industry because of their close proximity to animals, especially cats. A significant increase in the toxoplasmosis has also been reported to correlate with an increase in age in Iraq[24]. The rate of infection with toxoplasmosis was higher in the present study than what has been reported in neighboring countries of Saudi Arabia (32.7%) and the United Arabic Emirates (25%). The results of the present study in Iran are consistent with the similarity of weather conditions and customs are factors.

In Finland, the prevalence of toxoplasmosis was reported to be 59.9% (47 cases) among workers in the meat industry; in Egypt, it was reported to be 52.4% in slaughterhouse[25]. A survey conducted on workers in the meat industry in Kashan, Iran reported a prevalence of 50%. Some of the increase could result from weather conditions, adequacy of hygiene, and the consumption of raw or undercooked meat[26].

The results of this study showed that there was a significant difference between the prevalence of toxoplasmosis among butchers (41.8%) in Khuzestan and of individuals in the general population (28.8%). These differences in different areas could result from the diversity of locations, climatic conditions, type of nutrition, and different health practices among different countries.

Conflict of interest statement

We declare that we have no conflict of interest.

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