(Review Article)

Importance of toxoplasmosis for human and animal health, present condition, problems and solution proposals in Turkey and the World

Bilgili Ali 1, * and Hanedan Başak 2

1 University of Ankara, Faculty of Veterinary Medicine, Department of Pharmacology and Toxicology, Ankara, Turkey.
2 University of Ataturk, Faculty of Veterinary Medicine, Department of Internal Medicine, Erzurum, Turkey.

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Abstract

Noting the fact that a major part of emerging diseases in humans are caused by animals, food security and sustainable food security can only be performed in a condition that animal health and welfare are secured and sustainable livestock raising is established. Taking into account the fact that animal health directly affects human health and animal products are undisputedly necessary in human nutrition, it is deduced that human health depends on animal health. According to the World Health Organization, more than 60% of infectious agents affecting humans and newly described in the last decade are caused by animals or products of animal origin. Toxoplasmosis is one of the most common zoonotic diseases in the world. Toxoplasma gondii, intracellular protozoan, is a food and water-borne parasite that has recently infected about 1 billion people in the world. In this context, in both humans and animals toxoplasmosis threatening health and causing important economic losses is known as a most important protozoan-related zoonosis. In the context of this presentation with the specified reasons, concise knowledge was given on presenting of knowledge belonging to present condition, concerns, sharing of preventive medicine/public health approaches in the prevention and control of infection, actions to be taken, and solution proposals related to Toxoplasma gondii important but yet ignored in many regions in Turkey and the world.

Keywords: Toxoplasmosis; Animal and human health; Concerns; Solution proposals

1. Introduction

Toxoplasma gondii (T. gondii), which is intracellular protozoan, is a food and water-borne parasite infecting about 1 billion people in the world [1]. T. gondii is a zoonotic protozoan that can infect all warm blooded animals including birds, farm animals, marine mammals, and humans [2-4]. Cats are definitive host and shed oocysts via feces for 1 to 2 weeks after a new infection [5]. Oocysts are sporulated in environmental condition in 1-5 days. Sporulated oocysts can remain infective for 1 year or for a long period of time in humid environment [4].

2. Present condition

2.1. Transmission of T. gondii

Transmission can occur via soil, water, undercooked meat, shellfish contaminated with cat feces, congenital way, breastfeeding, transfusion of body fluids, transplantation of tissues or organs [6], and inhalation of oocysts in dust particles [7]. The contamination of soil and underground water with oocysts is common [8]. The infection of ruminants, birds, wild herbivores, and pigs is likely to develop via environmental exposure to T. gondii oocysts [9].
In Ordu city, in the drinking waters *T. gondii* DNA has not been detected but in the river waters *T. gondii* DNA has been detected by traditional PCR at 21.42%, and nested-PCR at %28.57 [10]. In Giresun city, *T. gondii* DNA has been detected in the environmental waters at 13.2% [11].

*T. gondii* oocysts can be ingested by intermediate hosts such as rodents, thus ingestion of the infected rodents is another transmission way [12]. Out of 68 snakes brains collected in Iran, 55 brains for *T. gondii* GRA6 gene have been positively detected by nested-PCR method. This study suggests that the prevalence of *T. gondii* is high among snakes [13].

Consuming unpasteurized milk is a risk factor for human toxoplasmosis. For example, in the Northeast region of Brazil, *T. gondii* DNA and its seroprevalence have been detected to be 6.05% (15/248) in milk and 22.58% (56/248) in sera in goats naturally infected with *T. gondii* [14]. In North-West Tunisia, *T. gondii* seroprevalence and *T. gondii* DNA in milk have been reported to be 31.2% in sera and 7.8% in milk in 77 goats, respectively. This suggests that the consumption of raw milk from goats naturally infected with *T. gondii* is a source for human infection [15].

Food and Agriculture Organization/World Health Organization estimates that *T. gondii* infections in humans are caused by meat at a rate of 22%. *T. gondii* prevalence has been reported to be higher in extensive farming system compared to intensive farming system in systematic meta-analysis of six farm animals in US [16]. It has been reported that humans are infected with *T. gondii* by ingesting undercooked horse meat comprising tissue cysts [17]. Dogs play a role as mechanical vector for humans by shedding oocysts via feces after eating infective oocysts [18].

### 2.2. Lifecycle of *T. gondii*

After humans and warm blooded animals ingest sporulated oocysts, parasite is transformed into the stage infecting intestine and moves to many tissues by blood vessels in the body [6,19]. Tachyzoites have a crescent shape. They occur in the active proliferation stage of *T. gondii* and in this phase they infect macrophages and monocytes. They are motile and are rapidly grown by endodyogeny. In the phase of chronic infection, there are bradyzoites in parasitophorous vacuole of cell. They slowly grow, are protected from host immune system and drugs, and remain in this form for months or years [20].

### 2.3. Epidemiology of *T. gondii*

The prevalence of *T. gondii* in humans and animals in Turkey and in the world is given in Tables 1-8.

| Province     | Animal Species          | Number of Samples | Prevalence (%) | Scientific Source |
|--------------|-------------------------|-------------------|----------------|-------------------|
| İzmir        | Stray cat               | 1121              | 34.2           | Can et al., 2014  [21] |
| Ankara and Kırıkkale | Cat           | 102               | 48.03          | Duru et al., 2017 [22] |
| Niğde        | Cat                     | 72                | 76.4           | Karatepe et al., 2008 [23] |
| Niğde        | Domestic pigeon         | 105               | 0.95           | Karatepe et al., 2011 [24] |
| Niğde        | Wild pigeon             | 111               | 0.90           | Karatepe et al., 2011 [24] |
| Niğde        | Squirrel                | 105               | 11.4           | Karatepe et al., 2004 [25] |
| Kocaeli      | Owned dog               | 116               | 69.8           | Şimşek et al., 2006 [26] |
| Şanlıurfa    | Shelter dog             | 80                | 97.5           | Babür et al., 2007 [27] |
| Eskişehir    | Stray dog               | 185               | 54.1           | Doğan et al., 2014 [28] |
| Kars         | Owned dog               | 179               | 96.1           | Gökç et al., 2010 [29] |
| Diyarbakır   | Ownerless dog           | 100               | 94             | İçen et al., 2010 [30] |
| Ankara       | Stray dog               | 116               | 62.06          | Aslantaş et al., 2005 [31] |
| Ankara       | Stray dog               | 107               | 54             | Şahal et al., 2009 [32] |
| İstanbul     | Stray dog               | 100               | 19             | Uysal et al., 2017 [33] |
| Sivas        | Dog                     | 120               | 95.8           | Altay et al., 2013 [34] |
Table 2 The prevalence of *T. gondii* in small animals in the world.

| Country                          | Animal Species | Number of Samples | Prevalence (%) | Scientific Source                                      |
|---------------------------------|----------------|-------------------|----------------|--------------------------------------------------------|
| Estonia                         | Cat            | 306 Pet           | 60.8           | Must et al., 2015 [35]                                  |
|                                 |                | 184 Shelter       |                |                                                        |
| Ethiopia                        | Cat            | 124               | 87.72          | Gebremedhin and Tadesse, 2015 [36]                     |
| Brazil                          | Cat            | 348 Pet           | 71.26          | Magalhaes et al., 2017 [37]                            |
|                                 |                | 247 Shelter       | 22.7           |                                                        |
| Southern Spain and Northern Africa | Dog            | 769               | 30.6           | Cano-Terriza et al., 2016 [38]                         |
| Czech Republic                  | Red Fox        | 80                | 100            | Bartova et al., 2016 [39]                              |
| Southern China                  | Dog            | 364               | 51.9           | Jiang et al., 2015 [40]                                |
| China                           | Raccoon Dog    | 1181              | 8.64           | Zheng et al., 2017 [41]                                |

In some regions of Turkey, prevalence of toxoplasmosis in shelter and ownerless dogs were very high. In the world, prevalence of toxoplasmosis in red foxes in Czech Republic and in cats in Ethiopia was rather high.

Table 3 The prevalence of *T. gondii* in livestock animals in Turkey.

| Province               | Animal Species | Number of Samples | Prevalence (%) | Scientific Source                                      |
|------------------------|----------------|-------------------|----------------|--------------------------------------------------------|
| Aydın                  | Cattle         | 487               | 45.2           | Karagenç et al., 2005 [42]                              |
| Kars                   | Cattle         | 216               | 93.5           | Akca and Mor, 2010 [43]                                |
| Samsun                 | Cattle         | 96                | 54.16          | Acici et al., 2008 [44]                                |
| Adana                  | Cattle         | 132               | 56.06          | Yücel et al., 2014 [45]                                |
| Afyon and Samsun       | Water buffalo  | 131               | 87.79          | Beyhan et al., 2014 [46]                               |
| Van-Sıirt              | Goat           | 275               | 72.7           | Ataseven et al., 2006 [47]                             |
| Afyon                  | Sheep          | 186               | 98.92          | Çiçek et al., 2011 [48]                                |
| Yalova                 | Sheep          | 63                | 66.66          | Öncel et al., 2005 [49]                                |
| Şanlıurfa              | Sheep          | 300               | 55.66          | Sevgili et al., 2005 [50]                              |
| Kilis                  | Goat           | 105               | 95.24          | Beyhan et al., 2013 [51]                               |
| Ankara                 | Horse          | 168               | 36.9           | Gazyağcı et al., 2011 [52]                             |
| Ankara                 | Goat           | 137               | 81.75          | Ural et al., 2009 [53]                                 |
| Van                    | Goat           | 98                | 80.61          | Karaca et al., 2007 [54]                               |
| Silopi                 | Sheep          | 100               | 97             | Leblebicier and Yildiz, 2014 [55]                       |
| Erzurum                | Donkey         | 92                | 92             | Balkaya et al., 2011 [56]                              |
### Table 4: Congenital toxoplasmosis in animal species in EU in 2012-2016 (EFSA, 2017) [57].

| Species      | Sampled unit number | 2012 | 2013  | 2014  | 2015  | 2016  |
|--------------|---------------------|------|-------|-------|-------|-------|
| Sheep and Goat |                    |      |       |       |       |       |
|               |                     | 5,291| 4,813 | 4,694 | 3,139 | 5,561 |
| Positive rate % |                   | 28   | 42.4  | 26.8  | 38.8  | 18.7  |
| The number of member countries reporting |          | 10   | 12    | 12    | 11    | 12    |
| Cattle        |                     |      |       |       |       |       |
|               |                     | 2012 | 2013  | 2014  | 2015  | 2016  |
| Sampled unit number |          | 1,348| 1,078 | 1,000 | 1,177 | 451   |
| Positive rate % |                   | 9.1  | 13.8  | 6.2   | 4.2   | 3.3   |
| The number of member countries reporting |          | 7    | 5     | 9     | 7     | 8     |

### Table 5: The prevalence of T. gondii in livestock animals in the world.

| Country      | Animal Species | Number of Samples | Prevalence (%) | Scientific Source |
|--------------|----------------|------------------|----------------|-------------------|
| Czech Republic | Cattle         | 546              | 9.7            | Bartova et al., 2015 [58] |
| Ghana        | Sheep          | 170              | 35.9           | Bentum et al., 2019 [59] |
|               | Goat           | 177              | 23.7           |                    |
| Nigeria      | Cattle         | 210              | 13.91          | Onyiche and Ademola, 2015 [60] |
| Brazil       | Pig            | 500              | 12.6           | dos Santos et al., 2015 [61] |
| Brazil       | Goat           | 248              | 22.58          | Bezerra et al., 2015 [14] |
|               | Goat milk      |                  | 6.05           |                    |
| India        | Sheep          | 177              | 1.69           | Kalambhe et al., 2017 [62] |
|               | Goat           | 223              | 1.34           |                    |
| Nigeria      | Pig            | 302              | 29.14          | Onyiche and Ademola, 2015 [60] |
| Tunisia      | Goat           | 77               | 31.2           | Amairia et al., 2016 [15] |
|               | Goat milk      |                  | 7.8            |                    |
| USA          | Deer           | 142              | 56.3           | Cox et al., 2017 [63] |
| China        | Chicken        | 1173             | 30.36          | Zhao et al., 2012 [64] |
| Portugal     | Free range     | 178              | 5.6            | Rodrigues et al., 2019 [65] |
|               | Broiler chicken | 170              | 0              |                    |
| China        | Goose          | 900              | 21.1           | Tan et al., 2016 [66] |
| China        | Horse          | 637              | 31.4           | Wang et al., 2015 [67] |
| Mexico       | Donkey         | 239              | 10.9           | Alvarado-Esquivel et al., 2015 [68] |
| Mongolia     | Goat           | 1078             | 32             | Pagmadulam et al., 2019 [69] |
|               | Sheep          | 882              | 34.8           |                    |
| Brazil       | Goat           | 580              | 40.5           | Rego et al., 2016 [70] |
|               | Sheep          | 374              | 48.7           |                    |

In Turkey, prevalence of toxoplasmosis in livestock animals was very high and reached 98.92% in sheep in Afyon. In EU, congenital toxoplasmosis prevalence was 42.4% in sheep in 2013 and 13.8% in cattle in 2013. In the world, prevalence of toxoplasmosis in livestock animals changed according to the regions. However, this rate was 48.7% in sheep in Brazil and 56.3% in deer in USA.
Table 6 The prevalence of *T. gondii* in humans in Turkey.

| Province              | Human                                      | Number of Samples | Prevalence (%) | Scientific Source               |
|-----------------------|--------------------------------------------|-------------------|----------------|--------------------------------|
| Afyon                 | Pregnant                                   | 1284              | 23.4           | Şimşek et al., 2016 [71]       |
| Ordu                  | Pregnant                                   | 2791              | 27.6           | Çalgın et al., 2017 [72]       |
| İstanbul              | Schizophrenia Anxiety and Depression patients, Healthy individuals | 300 150 150       | 60.7 36.7 45.3 | Yuksel et al., 2010 [73]       |
| Kayseri               | Pregnant                                   | 1676              | 33.9           | Kayman and Kayman, 2010 [74]   |
| Van                   | 0-18 years age                             | 1562              | 8.4            | Okur et al., 2012 [75]         |
| Van                   | Pregnant                                   | 9809              | 37.6           | Parlak et al., 2015 [76]       |
| Ankara                | Veterinary surgeons, Veterinary technician, Volunteer animal lovers, Healthy individuals | 88 25 14          | 28.4 16 50     | Çelebi et al., 2008 [77]       |
| Kocaeli               | Pregnant                                   | 1972              | 48.3           | Tamer et al., 2009 [78]        |
| Antalya, İskenderun   | Pregnant                                   | 1652              | 52.1           | Ocak et al., 2007 [79]         |
| Adıyaman              | Pregnant                                   | 455               | 48.4           | Kölgelier et al., 2009 [80]    |
| Ankara                | Pregnant                                   | 30.86             | 25.5           | Çelen et al., 2013 [81]        |
| Isparta               | Pregnant                                   | 3140              | 28.4           | Akpınar et al., 2017 [82]      |
| İstanbul, Bursa, Adana, Kayseri Kocaeli | Childbearing women | 17.751            | 24.61          | Akyar, 2011 [83]               |
| Kahramanmaraş         | Pregnant                                   | 11.324            | 47.15          | Bakacak et al., 2014 [84]      |
| Muğla                 | Human                                      | 1162              | 2.4            | Sankur et al., 2015 [85]       |
|                       |                                            |                   | 20.6           |                                |
| Uşak                  | Pregnant                                   | 1465              | 18.3           | Toklu, 2013 [86]               |
| İzmir                 | Pregnant                                   | 4651              | 39.9           | Uysal et al., 2013 [87]        |
| Amasya                | Pregnant                                   | 1838              | 23.39          | Kılınç et al., 2015 [88]       |
| İstanbul              | Pregnant                                   | 1737              | 24.2           | Sele et al., 2015 [89]         |
| Isparta               | Childbearing women                         | 794               | 24.4           | Ayhan et al., 2016 [90]        |
| Denizli               | Pregnant                                   | 1102              | 37             | Karabulut et al., 2011 [91]    |
| Manisa                | Human                                      | 2815              | 23.3           | Bölük et al., 2012 [92]        |
| Country          | 2012 Cases | Rate | 2013 Cases | Rate | 2014 Cases | Rate | 2015 Cases | Rate | 2016 Cases | Rate |
|------------------|------------|------|------------|------|------------|------|------------|------|------------|------|
| Austria          | -          | -    | -          | -    | -          | -    | -          | -    | -          | -    |
| Belgium          | -          | -    | -          | -    | -          | -    | -          | -    | -          | -    |
| Bulgaria         | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 |
| Croatia          | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 |
| Cyprus           | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 |
| Czech Republic   | 1          | 0.90 | 0          | 0.00 | 1          | 0.90 | 1          | 0.90 | 0          | 0.00 |
| Denmark          | -          | -    | -          | -    | -          | -    | -          | -    | -          | -    |
| Estonia          | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 1          | 1.80 |
| Finland          | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 1          | 1.80 |
| France           | 104        | 12.70| 179        | 22.00| 216        | 26.40| 246        | 30.76| -          | -    |
| Germany          | 20         | 3.00 | 10         | 1.50 | 6          | 0.80 | 15         | 2.03 | 10         | 1.36 |
| Greece           | -          | -    | -          | -    | -          | -    | -          | -    | -          | -    |
| Hungary          | 0          | 0.00 | 0          | 0.00 | 3          | 3.20 | 1          | 1.10 | 0          | 0.00 |
| Ireland          | 1          | 1.40 | 1          | 1.50 | 0          | 0.00 | 1          | 1.50 | 0          | 0.00 |
| Italy            | -          | -    | -          | -    | -          | -    | -          | -    | -          | -    |
| Latvia           | 1          | 5.03 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 |
| Lithuania        | 1          | 3.30 | 1          | 3.30 | 0          | 0.00 | 1          | 3.30 | 0          | 0.00 |
| Luxembourg       | 1          | 16.50| 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 |
| Malta            | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 |
| Netherlands      | -          | -    | -          | -    | -          | -    | -          | -    | -          | -    |
| Poland           | 10         | 2.60 | 18         | 4.90 | 20         | 5.30 | 15         | 4.00 | 20         | 5.42 |
| Portugal         | -          | -    | -          | -    | -          | -    | -          | -    | -          | -    |
| Romania          | 0          | 0.00 | 0          | 0.00 | 1          | 0.50 | 0          | 0.00 | 0          | 0.00 |
| Slovakia         | 0          | 0.00 | 2          | 3.60 | 0          | 0.00 | 0          | 0.00 | 2          | 3.60 |
| Slovenia         | 0          | 0.00 | 0          | 0.00 | 0          | 0.00 | 1          | 4.80 | 1          | 4.84 |
| Spain            | 0          | -    | 0          | -    | 0          | -    | 0          | -    | 5          | -    |
| Sweden           | -          | -    | -          | -    | -          | -    | -          | -    | -          | -    |
| United Kingdom   | 5          | 0.60 | 2          | 0.30 | 11         | 1.40 | 7          | 0.90 | 8          | 1.03 |
| EU Total         | 144        | 4.20 | 213        | 6.20 | 258        | 7.40 | 288        | 8.27 | 47         | 1.57 |
| Iceland          | -          | -    | 0          | -    | 0          | -    | 0          | -    | 0          | -    |
| Norway           | -          | -    | -          | -    | -          | -    | -          | -    | -          | -    |
| Switzerland      | -          | -    | -          | -    | -          | -    | -          | -    | -          | -    |
Figure 1 The number of toxoplasmosis cases in humans in Turkey among 2013-2017 (Ministry of Health, 2018) [93].

Table 8 The prevalence of *T. gondii* in humans in the world.

| Country | Human | Number of Samples | Prevalence (%) | Scientific Source |
|---------|-------|-------------------|----------------|-------------------|
| Scotland | Human | 1403              | 13.2           | Burrells et al., 2016 [94] |
| Iran    | Human | 360               | 27             | Khademi et al., 2019 [95] |
| Germany | Human | 6564              | 55             | Wilking et al., 2016 [96] |

Toxoplasmosis prevalence in pregnant women reached 48.3% in Kocaeli region in Turkey. In Turkey, toxoplasmosis prevalence showed apparent increase in 2017 than 2013-2016 years. In EU, human congenital toxoplasmosis was significant rate in 2015. In Germany, human toxoplasmosis was significant level as 55%.

2.4. Clinical signs of *T. gondii*

In humans, three important clonal lineages of *T. gondii* are responsible for a major part of infections [97]. Atypical strains have been described to cause congenital toxoplasmosis [98] and symptomatic reactivation in immunosuppressive individuals [99]. The disease usually do not develop symptom but is an important problem in pregnant women, fetus and immunocompromised subjects. In individuals with adequate immune response severe toxoplasmosis infection such as myocarditis, pneumonia, encephalitis, and hepatitis rarely occurs [100].

Congenital toxoplasmosis occurs via ingestion of the causative agents during pregnancy. Infections in the first trimester of pregnancy are more severe than infections in the second and third trimester of pregnancy [9]. Hydrocephalus, intracerebral calcification, chorioretinitis, and mental retardation develop [100]. Toxoplasmosis causes posterior uveitis via the causative agents carried by blood circulation [100]. The reason of schizophrenia, character changes, dementia, and suicidal tendencies in toxoplasmosis is expressed by tropism of *T. gondii* toward brain [101]. *T. gondii* may cause endometritis, ovarian and uterus atrophy, adrenal hypertrophy, vasculitis, cessation of estrus cycle [102]. Test for *T. gondii* infection is required in some European Countries [9].

2.5. Diagnosis of *T. gondii*

The diagnosis of *T. gondii* in humans and animals is performed by isolation of parasites from various tissues, detection of specific DNA by PCR, or serological methods [103].
2.6. Treatment of *T. gondii*

Drugs used in the treatment of *T. gondii* infection include spiramycin, azithromycin, pyrimethamine-sulfadiazine, trimethoprim-sulfamethoxazole, pyrimethamine-clindamycin and traditional Chinese treatments. In a study regarding meta-analysis of efficacy of anti-*T. gondii* medicines in humans, the treatment of toxoplasma encephalitis with pyrimethamine-sulfadiazine, trimethoprim-sulfamethoxazole, and pyrimethamine-clindamycin has been determined to decrease clinical signs at the rate of 49.8%, 59.9% and 47.6%, respectively [104].

3. Problems

- Toxoplasmosis is a protozoan infection that is not among notifiable diseases by Ministry of Agriculture and Forestry, and is not routinely followed. According to the directive of notification system of contagious diseases in Ministry of Health, toxoplasmosis is in a list of notifiable diseases of Group C.
- Uncontrolled animal transportation among regions or foreign countries.
- Paying no attention for house hygiene and cleaning while cat is kept in house, going outside of cats in house [35] and feeding uncooked meat to cats [55].
- Not giving enough information to humans or not enough understanding the importance of the toxoplasmosis.
- Direct contamination of infected cat feces to fruits and vegetables growing on the ground and eating them without washing well.
- While children play with soil or in sand box, the contamination of their hands with infected cat feces and then moving their hands to their mouths without washing their hands.
- The consumption of unpasteurized milk; during preparing meal contacting of hands to raw meat and then moving hands to mucous membranes such as mouth and eye, and not washing hands and kitchen tools well.
- The consumption of a piece of undercooked meat while meat is cooked [60,92].
- Insufficient treatments of both owned and stray cats.
- The contamination of meals, and mouth and nares of humans by flying in wind of oocysts in infected feces that become dust by drying.
- That serious eradication has not yet been implemented in our country, and that the number of cats is rather high.
- Toxoplasmosis continues to be concern due to the fact that animals for slaughter are not properly killed, and that our community is not educated on the disease.

4. Solution proposals

- Taking precaution for stray cats in combating the disease.
- Preventing cats to eat organs with cyst; and feeding cats with well-cooked food or canned food [105,106].
- Amending abattoirs and checking them regularly.
- Disposing of organs with toxoplasmosis during slaughter in abattoirs under the control of veterinarian and under suitable conditions.
- Water should be drunk after boiled for killing *T. gondii* oocysts [8].
- All kinds of material such as cutting board and knife etc. used for meat after each use should be washed with hot water and soap; vegetables and fruits should be washed before consumption [8].
- Unpasteurized milk and raw eggs should not be consumed; moving hands to mucous membranes such as mouth and eye while contacting with hands to raw meat during preparing meal should be avoided; It should be waited until meat is cooked and the consumption of a piece of undercooked meat should be avoided.
- Risk of infection is substantially decreased by keeping meat for several days in deep freezer before cooking.
- Wearing gloves is necessary during contact of human waste or animal manure and hands should be washed; vegetables after washed well should be eaten when they are irrigated with human waste and animal manure [8].
- Gloves should be worn while gardening [105, 106].
- Paying attention for house hygiene and cleaning while cat is kept in house; avoiding going outside of cats in house.
- Pregnant women should be educated and serologically tested.
- Pregnant women should not contact with soil, raw meat, cat because toxoplasma poses a risk on fetus [105,106].
- Litter box of cat should be daily cleaned and not be emptied into toilet [105,106].
- Technicians involving animal care should wear mask and protective clothing while cleaning boxes of cats [105,106].
Awareness should be created in the society by making public educations via related all foundations in order to combat toxoplasmosis (especially knowledge of disease should be given in schools in the manner that children can understand; children should be avoided playing with stray dogs) and preventive measures should be taken by society.

Necessary regulations should be prepared on combating toxoplasmosis disease and follow-up according to fourth article regarding food and fodder law of plant health of veterinary services, with the number of 5996.

One health approach is required including mutual scientific studies of physicians and veterinarians by looking into consumption of raw meat, vegetable and fruit, hand hygiene, habits of animal care according to socio-cultural structure of each country and region, in the reduction, control and prevention of zoonotic infections such as toxoplasmosis. Occupational groups of various specialization areas should be studied together in order that one health approach is succeed.

Contact of cats with animals should be prevented; cats should be neutered; and populations of cats and rodents should be controlled [107].

Feeds should be properly stored and cats entry to animal houses and feed storages should be prevented [107].

5. Conclusion
Toxoplasmosis is a common zoonotic parasitic disease in animals and humans in the world. This disease can be substantially decreased with knowing present problems and implementing the preventive measures.

Compliance with ethical standards

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Disclosure of conflict of interest
There is no any conflict to declare by authors in this study.

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