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Serological survey of human *Toxoplasma gondii* infection in northern and central regions of Iran

Khodadad Pirali-Kheirabadi
Associate Professor of Parasitology, Shahrekord University, Iran, pirali-k@vet.sku.ac.ir
Hossein Tahmasby*
DVM, University of Shahrekord, Iran, h.tahmasby@yahoo.com
Kurosh Manouchehri-Naeini
Associate Professor of Medical Parasitology, Shahrekord University of Medical Sciences, Iran, k_manouchehri@yahoo.com
Saeid Masoumi-Ghajari
DVM, University of Shahrekord, Shahrekord, Iran, saeedmasoomi65@gmail.com

Abstract

Introduction: *Toxoplasma gondii* is an important zoonotic protozoan parasite that can infect man and animals. The pathogen can infect the fetus by congenital transmission during pregnancy. The aim of this study was to investigate *T. gondii* infection in people referred to health care centers in northern and central regions of Iran.

Materials and methods: Serum samples from 712 individuals in Mazandaran, Isfahan and ChaharmahalvaBakhtiari provinces, Iran, were examined for the levels of anti-*T. Gondii* IgG by ELISA. Prevalence of *T. gondii* infection in respect of gender and age was analyzed.

Results: The overall anti-*T. gondii* IgG prevalence in the study population was 72.05%. In Mazandaran, Isfahan and ChaharmahalvaBakhtiari provinces,in male population respectively 87.6, 41.46 and 61.81% and in female population respectively 89.31, 47.61 and 64.44% were sero-positive with anti-*T. gondii* IgG. Sero-prevalance of anti-*T.gondii* IgG in the females was higher than in the males in the northern and central regions of Iran.

Discussion and conclusion: The present study demonstrates high prevalence of *Toxoplasma* infection in northern and central regions of Iran and a higher prevalence of *T. gondii* infection was observed in females. Significant difference in infection rate between individuals living in northern and central areas in Iran was found (p <0.05), which indicated that *T. gondii* infection is dependent on living places. Deeper investigations for the potential risk factors that threat the Iranian populations, especially female are recommended.

Key words:*Toxoplasma*, prevalence, risk factor, infection

*Corresponding Author

Introduction

Toxoplasma gondii is a protozoan parasite that is considered as the most prevalent parasitic zoonotic disease worldwide (1). The Pathogen can infect virtually all warm-blooded animals and humans. In healthy people, the parasite remains in their body in an inactive state, because their immune system usually keeps the parasite from causing illness. It can become reactivated if the person becomes immunosuppressed, such as patients with AIDS or organ transplantation (1- 3). Up to a third of the world's human population is approximated to carry a *T. gondii* infection (2- 5). Additionally, up to 14.8% of patients with Acquired Immunodeficiency Syndrome (AIDS) in Southeast Asia were infected with toxoplasmosis of central nervous system (6). Toxoplasmosis during pregnancy may result in congenital infection and manifest as mental illness and blindness in the infant (7, 8). Therefore investigation of *Toxoplasma* infection and the distribution of the oocysts in the human living environments are considered important about prevention of toxoplasmosis (9).

Sporulated oocysts remain viable and infectious in a warm, humid environment for a number of years, because they can largely resist threats such as heat and cold. In laboratory conditions, sporulated oocysts remained alive up to 54 months at 4°C and for 106 days of freezing at −10°C. It has been also demonstrated that sporulated oocysts survived at least 32 days at 35°C and 9 days at 40°C, while exposure at a temperature of 37°C during a period of 24 h had destructive effects for non-sporulated oocysts (10- 12).

Climatic conditions directly influence the risk of infection in cats. It is demonstrated that prevalence of antibodies against *T. gondii* is related to the interaction between temperature and rain (13). The infection risk increases when the weather is both warm and humid, or moderated and less humid. Humid conditions can increase oocyst survival during longer periods of heat (13; 14). In the USA, the lowest seroprevalence of *T. gondii* infection in cats were encountered in the most arid regions (15).

Origins of human *T. gondii* infection are cats which have intestinal infection and will be shedding oocysts in feces that may be ingested by humans by consumption of uncooked fruit, berries, or vegetables (16) or tissue cysts from infected meat animals (17- 19).

Although experimental results of many studies have indicated a positive correlation between Enzyme-Linked Immunosorbent Assay (ELISA) and Immuno-Fluorescent Antibody (IFA) test for detection of IgG antibodies to *T. gondii*, ELISA can be used as a qualitative test to screen more samples in a given time (20, 21).

The epidemiological studies in Iran like other countries have been done, but the prevalence of *T. gondii* in Mazandaran and ChaharmahalvaBakhtiari in recent years is not clear. Hence, in this study, we investigated the prevalence of anti-*T. gondii* IgG in the sera of more than 700 Iranian individuals referred to health care centers in the northern and central regions of Iran by ELISA method.

Materials and Methods

Study populations and Serum samples

712 serum samples were collected from health care centers in Mazandaran (north), Isfahan and ChaharmahalvaBakhtiari provinces (center) from May 2009 to October 2010 (Table 1). The age of the studied population spanned from 8 to 84 years of age. The study was carried out with permission from the Research Institute of Zoonotic Diseases of Shahrekord, Shahrekord University, Iran.

Serological assay

Sera were kept frozen at -20°C and sent to the Research Institute of Zoonotic Diseases (university of Shahrekord, Iran) to be tested for *Toxoplasma*-specific IgG using ELISA (Dia.pro; Milano, Italy). The procedure was performed according to the manufacturer's instructions.

Statistical Analysis

SPSS 16.0 software package was used to analyze the anti-*T. gondii* Ig Gseroprevalence in respect of gender, age and residence of the populations. Logistic regression analysis was used to assess the association with gender, age and residence of the subjects and *T. gondii* infection in populations. Adjusted odds ratio (OR) and 95% confidence interval (CI) were calculated by multivariate analysis using logistic regression.

Results

The overall prevalence of anti-*T.gondii* IgG in the studied population was 72.05% (Table 1). The general seroprevalence of individuals living in Mazandaran, Isfahan and ChaharmahalvaBakhtiari provinces were 88.73, 46.1, and 63.68% respectively.

Table 1- Number of serum samples from study regions, gender distribution and seroprevalence

Gender	Mazandaran	Isfahan	ChaharmahalvaBakhtiari	Total
Female	89.31 (209/234)	47.61 (60/126)	64.44 (87/135)	71.91 (356/495)
Male	87.6 (106/121)	41.46 (17/41)	61.81 (34/55)	72.35 (157/217)
Total	88.73 (315/355)	46.1 (77/167)	63.68 (121/190)	72.05 (513/712)

Sera which had anti-*T.gondii* antibodies were divided into 5 groups based on the age (<20, 20-29, 30-39, 40-49 and >50 years) of the individuals. The seroprevalence of the five age groups were 55, 66.17, 84.7, 79.62 and 70.76% respectively in the clinically healthy population (Fig. 1). Furthermore, the difference of *T. gondii* infection rate between male and female in less than 20 years old was more obvious, with 46.42% in male population and 58.33% in female population.

Discussion and Conclusion

During a national-wide survey carried out in previous years (22), the prevalence of *T. gondii* infection in general population of Iran was reported to be around 51.8%. In the current study, we investigated more than 700 individuals living in northern and central regions of Iran. The overall infection rate of *T. gondii* in the studied population was 72.05%, which was more than previous studies (22).

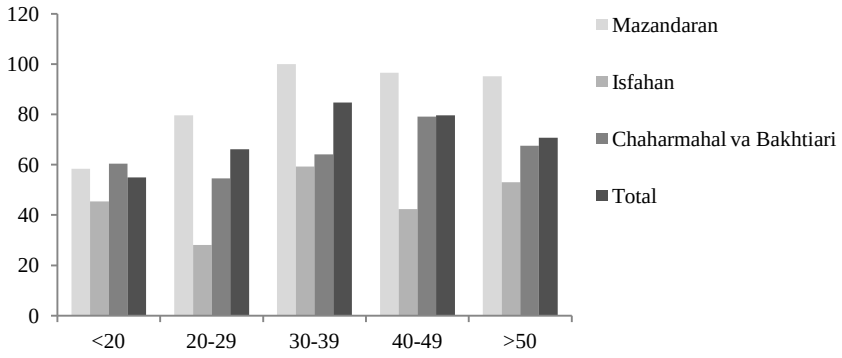

Fig1-Seroprevalence of *T. gondii* antibody in different age groups in Mazandaran, Isfahan and ChaharmahalvaBakhtiari provinces

Like findings in previous studies in Mazandaran province (north), 72.5% prevalence in schizophrenia patients referred to Psychiatric Hospital (23), 63.9% prevalence in matrimonial women (24), 77.4% prevalence in rehabilation centers **(**25) and 78.7% prevalence in butchers (26), our study proved high frequency of *T. gondii* infection in Mazandaran. But the results of the present study showed a higher prevalence of *Toxoplasma* infection (88.73%) in Mazandaran province.

The results which we obtained in our investigation showed that Isfahan province had a lower prevalence (46.1%) than both Mazandaran (88.73%) and ChaharmahalvaBakhtiari (63.68%) provinces. Mostafavi *et al* study result (2012) was somewhat similar to our study. Although they reported a 47.5% positive rate in women of childbearing age from Isfahan (27), Mahmodi *et al.,* reported 18.4% among high-school girls in Isfahan (28).

In comparison with previous studies, our study showed an increase in infection rate in the people of ChaharmahalvaBakhtiari province (63.68%). Manouchehri-Naeini *et al* reported 27.4% prevalence in rural pregnant woman from ChaharmahalvaBakhtiari (29) and 27.6% prevalence in pregnant woman from ChaharmahalvaBakhtiari (30).

Some studies indicated high prevalence of infection among intermediate and definitive hosts as potential sources of *Toxoplasma* infection in different parts of Iran (31, 32).

Our research suggests increasing prevalence of *T. gondii* infection rate in northern and central regions of Iran. The high prevalence in humans found here could be due to having pet animals and changes in consumption habits, consuming raw or undercooked meat in northern and central regions of Iran. So consumption of perfectly cooked meat, safe handling, and appropriate disposal of faecal material from pet cats are important to avoid *Toxoplasma* infection.

Environmental conditions are important for survival of the resistant stage of the parasite (oocysts). *T. gondii* is more prevalent in humid tropical areas and less prevalent in hot and dry areas. Additionally, prevalence of the *T. gondii* in arctic areas is low (1). Change of climate causes increasing temperatures, drier summers, and more humidity during the winter. Because mean winter temperature is rising, the parasite survival is likely to increase. This can have consequences for prevalence of *T. gondii* in intermediate and final hosts. The infection risk increases when the weather is both warm and humid, or moderated and less humid (33).

Significant difference ($p<0.05$) in infection rate between individuals living in northern and central areas in Iran was found (fig. 1), which indicated that *T. gondii* infection is dependent on living places. In Mazandaran province (north) environmental conditions are more humid than Isfahan and ChahamahalvaBakhtiari (center) provinces (34) and prevalence of *Toxoplasma* was higher in Mazandaran.

The finding that seroprevalance of anti-*T.gondii* IgG in the females is higher than in the males in the northern and central regions of Iranian population, indicates that females are at higher risk of contracting *T. gondii* infection. This may be due to many factors, such as spending more time to their pets including cats, having contact with raw or undercooked meat more often than men.

This study showed that infection rate of *T. gondii* in the studied population was higher than what was recorded by previous studies, and importantly, results suggest that women have a higher risk of being infected by *T. gondii* than men in northern and central regions of Iran. Since *T. gondii* reactivation may occur during gestation, it poses threat to the life of fetuses and

newborns. Thus knowledge of disease prevention is more important to females. These results emphasize for more attention in prevention of *T. gondii* infection in the female population and in particular pregnant women. Significant difference (p<0.05) in infection rate between individuals living in northern and central areas in Iran was found, which indicated that *T. gondii* infection is dependent on living places.

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بررسی سرولوژیک آلودگی به توکسوپلاسما گوندی انسانی در مناطق شمالی و مرکزی ایران

خداداد پیرعلی خیرآبادی: دانشیار انگل شناسی، دانشگاه شهرکرد، ایران، pirali-k@vet.sku.ac.ir
حسین طهماسبی: دکتری دامپزشکی، دانشگاه شهرکرد، ایران، h.tahmasby@yahoo.com *
کورش منوچهری نائینی: دانشیار انگل شناسی، دانشگاه علوم پزشکی شهرکرد، ایران، k_manouchehri@yahoo.com
سعید معصومی قاجاری: دکتری دامپزشکی، دانشگاه شهرکرد، ایران، saeedmasoomi65@gmail.com

چکیده

مقدمه: توکسوپلاسما گوندی یک انگل تک یاخته ای مهم مشترک انسان و حیوانات است که می‌تواند انسان و حیوانات را آلوده کند. این عامل بیماری زا در دوران بارداری می‌تواند جنین را از طریق انتقال مادرزادی آلوده کند. هدف از این مطالعه، بررسی آلودگی به توکسوپلاسما در افراد مراجعه کننده به مراکز بهداشتی درمانی در مناطق شمالی و مرکزی ایران است.

مواد و روش‌ها: نمونه های سرمی از ۷۱۲ نفر از استان های مازندران، اصفهان و استان چهارمحال و بختیاری برای سنجش IgG ضد توکسوپلاسما گوندی به روش الایزا بررسی شد. شیوع آلودگی به توکسوپلاسما گوندی بر حسب سن و جنس بررسی شد.

نتایج: شیوع IgG ضد توکسوپلاسما گوندی در افراد مورد مطالعه در کل ۷۲/۰۵ درصد بود. در استان های مازندران، اصفهان و چهارمحال و بختیاری، در جمعیت مردان به ترتیب ۸۷/۶، ۴۱/۴۶ و ۶۱/۸۱ درصد و در جمعیت زنان به ترتیب ۸۹/۳۱، ۴۷/۶۱ و ۶۴/۴۴ درصد از نظر IgG ضد توکسوپلاسما گوندی سرم مثبت بودند. شیوع سرمی IgG ضدتوکسوپلاسما گوندی در مناطق شمالی و مرکزی ایران، در زنان بالاتر از مردان بود.

بحث و نتیجه‌گیری: مطالعه حاضر شیوع بالای آلودگی به توکسوپلاسما در مناطق شمالی و مرکزی ایران را نشان می‌دهد و شیوع بیشتر آلودگی به توکسوپلاسما در زنان مشاهده شد. تفاوت معنی داری که در میزان آلودگی بین افراد ساکن در مناطق شمالی و مرکزی در ایران یافت شد ($p\ value< 0.05$)، نشان داد که آلودگی به توکسوپلاسما به مکان زندگی وابسته است. تحقیقات عمیق تر در مورد عوامل خطر بالقوه که جمعیت ایرانیان به ویژه زنان را تهدید می کنند، توصیه می شود.

واژه‌های کلیدی: توکسوپلاسما، شیوع، عوامل خطر، عفونت

* نویسنده مسؤول مکاتبات

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