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Seroprevalence of anti-*Toxoplasma* IgG and IgM among individuals who were referred to medical laboratories in Mazandaran province, northern Iran

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Summary *Toxoplasma gondii* (*T. gondii*) is a protozoan parasite that can cause toxoplasmosis in humans. However, there is no current data regarding *Toxoplasma* infection among individuals who were referred to medical laboratories in Mazandaran province (northern Iran). Therefore, we performed a population-based study of *Toxoplasma* seroprevalence in this region. A total of 1832 sera samples (from 654 men and 1178 women) were collected from people who were referred to medical laboratories in different cities throughout Mazandaran province between March and July 2012. The serum titers of anti-*T. gondii* IgG and IgM were measured using enzyme-linked immunosorbent assays. The seroprevalence of anti-*Toxoplasma* IgG was 55.5%; and 14.4% of the positive samples were seropositive for anti-*Toxoplasma* IgM. The highest seroprevalence was observed among people who were >50 years old (90.6%), and the lowest seroprevalence was observed among children who were 0—9 years old (9.4%; $P < 0.001$). There was no significant difference in the seroprevalences for each sex in the study population. However, a regional sex-specific

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difference in seroprevalence was observed between men (54.1%) and women (70.6%; $P = 0.003$) in the western cities of Mazandaran. As the seroprevalence of *T. gondii* in western and eastern Mazandaran was higher than that in the central cities, there is a need to evaluate the nature of the infection chain in these areas.

Introduction

Toxoplasma gondii (*T. gondii*) is an obligate intracellular protozoan parasite that can cause toxoplasmosis in a wide range of warm-blooded animals, including humans. The human immune system typically ensures that *T. gondii* infection is asymptomatic, subclinical, or mild in healthy humans, although this parasite is an extremely successful pathogen. Therefore, *T. gondii* can cause life-threatening disease in individuals with encephalitis, chorioretinitis, and lymphadenitis due to acquired infection, abortion, neonatal mortality, and fetal abnormalities (e.g., hydrocephalus). Infection is also severe in patients with microcephaly, intracranial calcification, mental retardation, seizures and blindness due to congenital infections, and severe encephalitis due to acute infection or reactivation of a latent infection in immunosuppressed individuals (e.g., patients with AIDS, immunosuppressive cancer, and transplant recipients) [1—7].

Humans acquire toxoplasmosis through various routes, including the ingestion or handling of undercooked or raw meats that contain cysts with viable bradyzoites and/or unwashed vegetables or water that is contaminated with oocysts that were shed by cats and other felids. Other routes of acquisition include blood transfusion, organ transplantation, and congenital acquisition via the transplacental transfer of tachyzoites, especially when the mother becomes infected for the first time while she is pregnant [8—11]. Nevertheless, toxoplasmosis is not a reportable disease and its reported prevalence is only based on regional studies. Thus, the prevalence of *T. gondii* infection varies widely, and is dependent on socioeconomic conditions, eating habits, geographic and climatic factors, and lifestyle [12—14]. Approximately one-third of the global population is estimated to be infected with *T. gondii* [8,15], although a 1978 study from northern Iran reported that approximately 55.7% of the population was seropositive for *T. gondii* [16]. Various seroprevalences have been reported among women who were referred to medical laboratories before marriage (74.6%) [17], women with a history of abortion (37.5%) [18], pregnant women (71%) [19], students (22%) [20], children with intellectual disabilities (77.4%) [21], individuals with HIV or AIDS (77.4%) [22], and patients with schizophrenia (72.5%) [23]. Furthermore, other authors have evaluated the seroprevalences among butchers (87.8%) [24], cats (40%) [25], and farm animals (30% in goats and 35% in sheep) [26].

This study was designed to provide recent data regarding *Toxoplasma* infection among individuals who were referred to medical laboratories in Mazandaran province, northern Iran. This study used a population-based design to evaluate the *Toxoplasma* seroprevalence (IgG and IgM) in this region, which is located near the Caspian Sea. Questionnaires were also used to investigate the epidemiological factors that were associated with *Toxoplasma* seropositivity.

Materials and methods

In this population-based cross-sectional study, we collected 1832 sera samples (from 654 men and 1178 women; 0—65 years old) from all individuals who were referred to medical laboratories in cities throughout Mazandaran province between March and July 2012. Mazandaran province is located on the south coast of the Caspian Sea, and the summer temperature is typically 20—35 °C; the winter temperature rarely drops below 0 °C. The annual rainfall is approximately 800—1200 mm and the relative humidity is typically 70—100%. This study was approved by the Research Ethical Committee of Mazandaran University of Medical Sciences, Iran. All participants were provided written informed consent after the study's purpose and procedures were explained.