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## Rolling up the pieces of a puzzle: A systematic review and meta-analysis of the prevalence of toxoplasmosis in Iran

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## ABSTRACT

Toxoplasmosis is a neglected parasitic disease with global distribution in warm-blooded vertebrates and high prevalence among different human societies. We contrived a systematic review and meta-analysis on the prevalence of toxoplasmosis in Iran. Following the general methodology recommended for systematic reviews and meta-analysis, four English and three Persian electronic databases were explored up to April 2016. Out of 105,139 examined samples of different hosts, the weighted overall prevalence was 37% (95% CI = 31–43). Due to the significant heterogeneity ( $I^2 = 81.9\%$ ) the random-effects model was used. The pool estimated prevalence of toxoplasmosis in human intermediate hosts, animal intermediate hosts, and definitive hosts was 43% (95% CI = 38–47), 26 (95% CI = 17–35) and, 34% (95% CI = 22–46), respectively. Our results represent that regular inspection in food industries, improved screening programs using standard diagnostic assay as well as distinguishing toxoplasmosis condition in other zoonotic hosts are extremely recommended for better disease management in Iran.

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## 1. Introduction

An obligate intracellular parasitic protozoan, *Toxoplasma gondii* (*T. gondii*), infects approximately one third of the world's population, and causes a potential zoonotic disease called toxoplasmosis.<sup>1–3</sup> This infection is appointed to be a neglected parasitic disease by CDC (Centers for Disease Control and Prevention), characterized by high prevalence and chronic nature as well, which principally occurs in regions with poor hygiene.<sup>4</sup> The majority of warm-blooded animals as intermediate hosts may be sources of tissue cysts, universal abundance of felines (Family: Felidae) as definitive hosts as well as multiple transmission routes have maintained parasite dissemination in the environment. *T. gondii* gains access to the host's body through several principal pathways, including: vertical transmission, oocyst-contaminated food and water, raw or undercooked meat containing viable tissues cysts, organ transplantation, and blood transfusion.<sup>1,3,5–8</sup> Human populations are dead-end host for toxoplasmosis with up to 80% suffering from chronic asymptomatic infection.<sup>9</sup> Pregnant women and immunocompromised individuals (cancer, transplant and AIDS patients) comprise the two important risk groups for toxoplasmosis.<sup>3,5,10,11</sup> Owing to the *Toxoplasma* predilection to the brain and eye, poor prognosis and complications such as glaucoma, chorioretinitis, retinal detachment, brain abscess and encephalitis can occur during acute or recrudescence infection.<sup>12,13</sup> Furthermore, serious complications such as brain focal lesions, hydrocephaly, microcephaly, deafness, and mental retardation may arise from congenital toxoplasmosis, according to the gestational age.<sup>3,6,10</sup> Additionally cerebral toxoplasmosis may have also a significant correlation to neurodegenerative disorders like schizophrenia, epilepsy, and bipolar disorder.<sup>14–17</sup> Moreover, chronic toxoplasmosis is strongly correlated to autoimmune diseases.<sup>18,19</sup> Routine diagnostic methods for toxoplasmosis generally pertain to serology-dependent experiments such as enzyme-linked immunosorbent assay (ELISA) and indirect immunofluorescence assay (IFA) in order to discern the *T. gondii*-specific antibodies, i.e. IgM or IgG.<sup>20</sup> In addition to the medical significance of toxoplasmosis, this protozoan is of veterinary importance in terms of abortion in sheep herds as

well as a relatively high prevalence in domestic animals in Iran such as cat, sheep, goat and cattle.<sup>21–23</sup>

We have designed a systematic review and meta-analysis in order to shed light on the status of *Toxoplasma* infection in both human and animal populations. We hope that the conception derived from this study help us to better understand the epidemiological surveillance of toxoplasmosis in Iran.

## 2. Materials and methods

### 2.1. Study area

Covering a wide area in the Middle East (1,648,195 km<sup>2</sup>) (Fig. 1), Iran with population of approximately 80 million in 2015, located between 25°3' and 39°47'N, and 44°5' and 63°18'E, and bordering Iraq and Turkey in the west, Afghanistan and Pakistan in the east, the Persian Gulf and Oman Sea in the south, as well as Azerbaijan, Armenia and Turkmenistan in the north. Except for a small region on the margin of the Caspian Sea coast with a considerable annual rainfall and covered by dense vegetation, the general climate of Iran is hot and dry, forming the Iranian plateau. It is one of the world's most mountainous countries, its landscape dominated by rugged mountain ranges that separate various basins or plateaux from each other. The populous western part is the most mountainous, with ranges such as the Caucasus, Zagros and Alborz Mountains. Lower temperatures, severe winters and heavy snowfalls exist in the Zagros basin, while in the central and eastern basins there is an arid climate because of high-altitude mountain ranges in the western and northern parts. These mountain ranges are so high that rain clouds cannot reach the central and eastern basins. Annual precipitation is 680 mm in the eastern part of the plain and more than 1700 mm (66.9 in.) in the western part.<sup>24</sup>

### 2.2. Search strategy

In this systematic review and meta-analysis we sought to determine the epidemiological aspects of toxoplasmosis in both human and animal population in Iran. The search strategy was performed



Fig. 1. Location of Iran country.

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