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Seroprevalence of *Toxoplasma gondii* infection among patients with non-schizophrenic neurodevelopmental disorders in Alexandria, Egypt

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ABSTRACT

Toxoplasma gondii is an opportunistic parasite with neurotropic characteristics that can mediate neurodevelopmental disorders, including mental, behavioral and personality aspects of their hosts. Therefore, the seroprevalence of anti-*Toxoplasma* antibodies has been studied in patients with different neurological disorders from different localities. On searching online databases, however, we could not find published studies on the seroprevalence of anti-*Toxoplasma* antibodies among patients with neurodevelopmental disorders in Egypt. Therefore, the present preliminary study was conducted to determine the serological profile of *T. gondii* infection among patients with non-schizophrenic neurodevelopmental disorders in Alexandria, Egypt. Data and blood samples were collected from 188 patients recruited for the study from four mental rehabilitation centers in the period from July 2014 to March 2015. The overall seropositivity rates of IgM and IgG among patients were 16.5% (31/188) and 50.0% (94/188), respectively. Of the studied patients' characteristics, only age was significantly associated with anti-*Toxoplasma* IgG seropositivity, with older patients being about twice more likely exposed to infection. However, no statistically significant association was found with IgM. In addition, seropositivity of anti-*Toxoplasma* IgG, but not IgM, was significantly associated with non-schizophrenic neurodevelopmental disorders; however, neither IgG nor IgM showed a significant association with cognitive impairment as indicated by the intelligence quotient scores.

1. Introduction

Toxoplasma gondii infection is one of the commonest zoonoses contracted by humans. Congenital infection with this neurotropic parasite has been associated with long-term neurodevelopmental disabilities, including mental, behavioral and personality disorders (Schendel, 2001; Schendel et al., 2002; Nelson, 2009; Fekadu et al., 2010; Hinze-Selch et al., 2010). Several studies have studied the serological profiles of anti-*Toxoplasma* immunoglobulins M and G (IgM and IgG) among patients with different neurodevelopmental disorders, including infantile cerebral palsy, attention-deficit hyperactivity disorder (ADHD) and autism (Saxon et al., 1973; Wilson et al., 1980; Flegr et al., 1996, 2003; Tay et al., 1997; Webster et al., 2006; Yolken et al., 2009; Hinze-Selch et al., 2010; Prandovszky et al., 2011; Brown, 2012; Carter, 2013; Abdoli and Dalimi, 2014; Rajkumar, 2014; Jeong et al., 2015). To the best of our knowledge, the serological profile of anti-*Toxoplasma* antibodies among patients with neurodevelopmental disorders has not been studied in Egypt. Therefore, the present study aimed to study the seroprevalence of anti-*Toxoplasma* IgM and IgG antibodies among patients with neurodevelopmental disorders in Alexandria, Egypt.

2. Subjects and methods

2.1. Study design, setting and population

The present hospital-based, cross-sectional study was conducted among patients with different neurodevelopmental disorders attending four mental rehabilitation centers in Alexandria, Egypt. Alexandria is the second largest Egyptian city situated on the Mediterranean Sea, about 183 km northwest of Cairo (Fig. 1).

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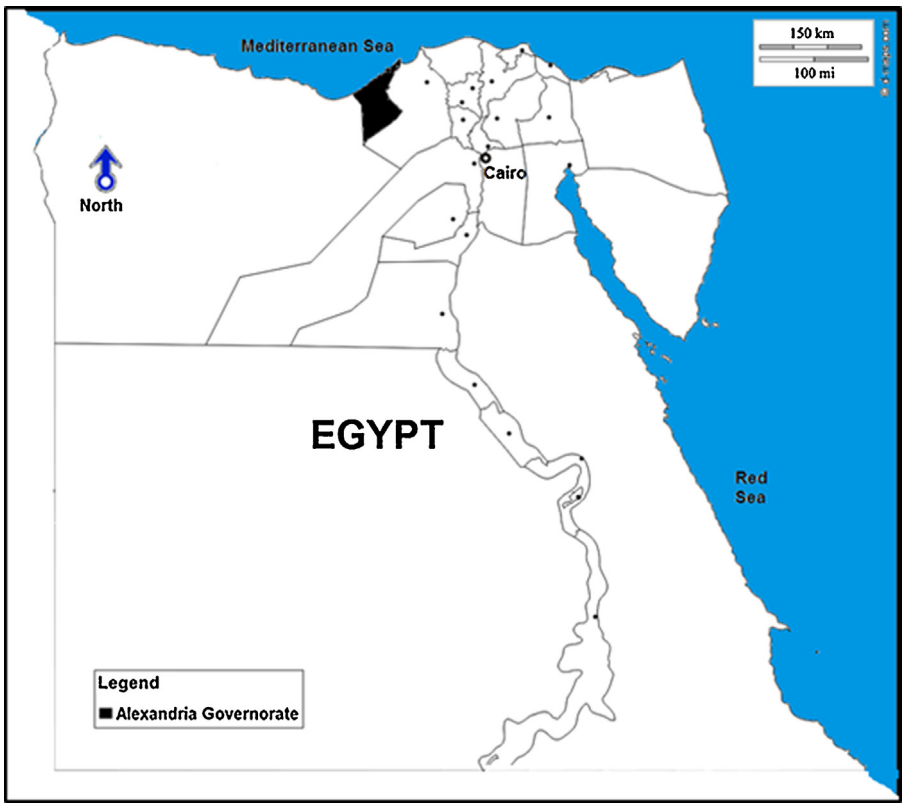

Fig. 1. Map of Egypt showing the location of the study area.

It is located at an altitude of about 18 m above sea level and has the geographical coordinates of 31°12′N 29°55′E (available at: http://www.worldatlas.com/webimage/countrys/africa/egypt/eglatlog.htm). All 188 patients admitted to the four centers in the study period from July 2014 to March 2015 and gave informed consent to participate were recruited in this study.

2.2. Data and sample collection

The study protocol was approved by the Research Ethics Committee of Pharos University, Alexandria-Egypt, and oral consent was obtained from all participants or their legal guardians. Data about the socioeconomic characteristics and the type of neurological disorder were collected using a pre-designed data collection sheet. Intelligence quotient (IQ) scores were obtained from the patients' records. The centers used the fourth edition of Stanford–Binet Intelligence Scale (Thorndike et al., 1986) to assess the intelligence and cognitive abilities of patients with neurodevelopmental disorders. Venous blood (3 ml) was collected by venipuncture into pre-labeled plain tubes and left to clot at room temperature. Sera were separated by centrifugation at 3000 rounds per min for 10 min and preserved at −20 °C until the performance of serological investigations.

2.3. Serological investigations

All sera were thawed to room temperature and tested for anti-*Toxoplasma* IgG and IgM using commercial enzyme-linked immunosorbent assay kits (BioCheck, Inc., CA, USA) according to the manufacturer's instructions. Positive and negative controls were included to ensure the integrity of reagents and technical procedures, and results were interpreted according to the instructions provided with the reagent kits.

2.4. Data analysis

Data entry, verification and analysis were performed using the Statistical Package for the Social Sciences for Windows, version 16.0 (SPSS Inc., Chicago, IL). Frequencies and percentages were used to present the descriptive data obtained from data collection sheets or laboratory investigations. The differences and associations between the categorical variables were calculated using Chi-square and considered statistically significant at P values <0.05.

3. Results

3.1. Characteristics and overall seropositivity status of the study population

Out of the 188 patients enrolled in the present study, 60.6% (114/188) of patients were males and 39.4% (74/188) were females, with a mean age of 16.84 ± 7.021 years old. The seropositivity rates of IgM and IgG among patients were 16.5% (31/188) and 50.0% (94/188), respectively.

3.2. Association between T. gondii seropositivity and characteristics of patients with neurodevelopmental disorders

Tables 1 and 2 show the association between IgM and IgG seropositivity and certain characteristics of patients with neurological disorders. No statistically significant difference was found between the seropositivity of anti-*Toxoplasma* IgM and IgG among patients with neurological disorders regarding the variables of sex, socioeconomic level and institutionalization. On the other hand, there was a statistically significant difference (P = 0.009) between IgG seropositivity regarding the age of the patients, where those of 20 years or older were twice more likely exposed to infection than those younger than 20 years old.