

SEROPREVALENCE OF TOXOPLASMA ANTIBODIES AMONG INDIVIDUALS TESTED AT HOSPITALS AND PRIVATE LABORATORIES IN BEIRUT

<http://www.lebanesemedicaljournal.org/articles/58-1/original2.pdf>Sarah F. BOUHAMDAN¹, Loubna K. BITAR¹, Hassan J. SAGHIR¹, Ali BAYAN², George F. ARAJ³

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ABSTRACT : Toxoplasmosis is a zoonotic disease of worldwide distribution. Infection with *Toxoplasma gondii* can result in debilitating disease especially in the immunocompromised host and pregnant women. Determination of its seroprevalence and risk factors have been studied in many countries as a mean to understand its epidemiology and implement control measures.

The scarcity of information on *T. gondii* infection in Lebanon warranted studying the toxoplasma antibody findings among individuals tested at different hospitals and private laboratories in Beirut in order to have an insight on its current seroprevalence in this country.

This is a retrospective study targeting information related to IgG and IgM anti-*T. gondii* antibodies among females tested at different hospitals and private laboratories in Beirut. Toxoplasma antibody determination in the sera was done using different formats of semi-automated enzyme immunoassay techniques. The age of each tested individual was also recorded.

The generated data was based on testing done at seven hospitals and seven private laboratories located in different areas of Beirut. The vast majority (around 96%) of the tested population were females with age ranging between 16 yrs and 40 yrs (i.e. mostly females at childbearing age). The seroprevalence of IgG anti-*T. gondii* antibodies determined on 1371 sera from hospital laboratories and 2145 sera from private laboratories were 55% and 67%, respectively. The IgM anti-*T. gondii* antibodies determined on 1352 sera from hospital laboratories and 2074 sera from private laboratories were 6.7% and 6.8%, respectively. Overall and among the 3516 and 3426 blood samples tested for toxoplasma IgG and IgM antibodies at all laboratories, the seropositivity was 62.2% and 6.8%, respectively. The toxoplasma IgG seropositivity showed significant ($p < 0.05$) increasing correlation with advanced age, for example, from 9% at ≤ 5 yrs to 78% at 46-50 yrs, and 94% at ≥ 51 yrs.

Based on this seroprevalence study, exposure to toxoplasma infection is considered high among the Lebanese population and it increases with advanced age. This current information reflects the endemicity of this disease and would help the medical and public health authorities to address policies for monitor and control aspects of the disease in Lebanon.

RÉSUMÉ : La toxoplasme est une maladie zoonotique existant partout dans le monde. L'infection à *Toxoplasme gondii* peut entraîner une maladie débilitante surtout chez les immunodéprimés ou les femmes enceintes. Sa séroprévalence ainsi que ses facteurs de risque ont été étudiés dans plusieurs pays en vue de connaître son épidémiologie et de prendre les mesures de contrôle adéquates.

Au Liban, il existe peu d'informations sur les infections à *T. gondii* ce qui a justifié cette étude sur les anticorps anti-toxoplasme d'individus testés dans différents laboratoires hospitaliers et privés à Beyrouth en vue d'évaluer sa séroprévalence dans ce pays.

Il s'agit d'une étude rétrospective ciblant les anticorps IgG et IgM anti-*T. gondii* chez des femmes testées dans différents laboratoires hospitaliers et privés à Beyrouth. La détermination d'anticorps anti-toxoplasme dans le sérum a été faite en utilisant différentes techniques d'immunoassay. L'âge de chaque personne testée a été enregistré. Les résultats obtenus ont été collectés à partir des tests effectués dans 7 laboratoires hospitaliers et 7 laboratoires privés situés dans différents quartiers de Beyrouth. La grande majorité de la population testée ($\approx 96\%$) était des femmes âgées de 16 à 40 ans (i.e. en âge de procréation). La séroprévalence des anticorps IgG anti-*T. gondii* effectuée sur 1371 sérums provenant de laboratoires hospitaliers et 2145 sérums provenant de laboratoires privés a été respectivement de 55% et 67%. La séroprévalence des anticorps IgM anti-*T. gondii* déterminés sur 1352 sérums provenant de laboratoires hospitaliers et 2074 sérums provenant de laboratoires privés a été respectivement de 6,7% et 6,8%. Au total, parmi les 3516 et 3426 échantillons de sang testés respectivement pour les anticorps IgG et IgM anti-toxoplasme dans tous les laboratoires, la séropositivité a été 62,2% et 6,8% respectivement. La séropositivité des IgG anti-toxoplasme augmente avec l'âge ; pour exemple, elle est de 9% au-dessous de 5 ans, 78% entre 46 et 50 ans et 94% au-delà de 51 ans.

Les résultats de cette étude montrent que l'exposition à l'infection par toxoplasme est considérée élevée chez les Libanais et augmente avec l'âge. Ceci témoigne de l'état endémique de cette maladie et devrait inciter le corps médical et les autorités de la santé publique à surveiller et à contrôler les effets de la toxoplasme au Liban.

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INTRODUCTION

Toxoplasmosis is a worldwide zoonosis caused by a protozoan parasite, *Toxoplasma gondii*, and estimated to infect around one third of the world's population. While it may manifest in several forms, infections in humans are usually clinically unapparent, and latent infection usually persists for life, which is not seen as a health threat except in case of pregnancy and immunocompromised individuals [1]. Its wide spectrum of infection ranges from asymptomatic, flue-like illness to serious morbidity in pregnant women and neonates, namely congenital toxoplasmosis [2-3].

Cats are the major reservoir of *T. gondii* and they shed the oocysts in their feces. Human infection is usually acquired through ingestion of contaminated items (e.g. food and water) with these oocysts, or by ingestion of undercooked meat (e.g. lamb and pork) or meat products containing viable tachyzoites or bradyzoites present in tissues [4].

The laboratory diagnosis of acute and latent toxoplasmosis mostly relies on the detection of *T. gondii* specific IgG and IgM antibodies [5-7], and the avidity test of *T. gondii* specific IgG antibodies has also been very helpful in diagnosis [8]. Generally, The toxoplasma IgG antibodies appear within one to two weeks of infection, peak in six to eight weeks, decline over the next two years, and remain detectable for life. The IgM antibodies may appear within the first week of infection, generally decline within a few months, and sometimes persist for years after the initial infection. Thus, the presence of IgM antibody should not be used to confirm a recent or acute infection without pursuing other tests and scrutinizing the clinical history [6].

In addition to diagnosis, these toxoplasma IgG antibodies are also used for seroprevalence determination of the disease, an important information for epidemiologic and control purposes. Studies have indicated that the toxoplasma seroprevalence varies among different countries and even within the same population [5]. The scarcity of such studies from Lebanon whereby only one study was done on a small numbers of individuals over 30 years ago [7], warranted this current study to shed light on the seroprevalence of IgG and IgM anti-*T. gondii* antibodies among females tested for this parasite in Beirut.

MATERIALS AND METHOD

The study was carried out in Beirut district of Lebanon, over a period of 12 months (January-December 2006). The hospitals and private laboratories that accepted to participate in sharing their data for this study were : Al Sahel Hospital, Al Zahraa Hospital, American University of Beirut Medical Center, Bahman Hospital, Beirut Governmental University Hospital, Rizk Hospital, Ebin Sina Laboratories, Ezz el Din Laboratories, Fontana Laboratories, Mar Elias Laboratories and San Mark Laboratories. To avoid bias in duplicate testing, only one result was

TABLE I
RATE OF POSITIVE IgG & IgM ANTI-*T. gondii* ANTIBODIES IN SERA OF FEMALES TESTED AT DIFFERENT HOSPITALS AND PRIVATE-BASED LABORATORIES IN BEIRUT

LABORATORIES*	Mean (Range)	
	% [‡] positive findings for anti- <i>T. gondii</i>	
	IgG	IgM
HOSPITAL	55 (44-65)	7 (4-12)
PRIVATE	67 (18-71)	7 (3-13)
ALL	62 (18-71)	7 (3-13)

*The number of tested sera for IgG and IgM anti-*T. gondii* antibodies at hospital and private laboratories were 1371 & 1352, and 2145 & 2074, respectively.

[‡]% rounded to closest decimal.

considered for each tested individual.

Toxoplasma antibodies determination on the sera was done using different formats of Enzyme Immunoassay Techniques : VIDAS Toxo IgG II and IgM (bioMerieux, Lyon, Marcy-l'Etoile, France) ; AXSYM Toxo IgG/IgM, (Abbott Laboratories, IL, USA) ; *Toxoplasma gondii* IgG/IgM – ELISA (Novatec Immundiagnostica GmbH Technologie and Waldpark) ; Immunlite/Immunlite1000-Toxo quantitative IgG/IgM (μ capture, laboratories diagnosis of infectious disease, New York).

RESULTS

Overall 3516 sera, one from each female, were tested for toxoplasma specific IgG antibodies. Among these, 3426 were also tested for IgM antibodies. The vast majority (around 96%) of the tested population were females. Their ages ranged between 2 months and 75 yrs, whereby 89% of these fell between ages 16 yrs-40 yrs (i.e. mostly females at childbearing age seeking prenatal care).

The number and % positive antitoxoplasma antibodies findings for the hospitals and private laboratories are presented in Table I.

The IgG toxoplasma seropositivity ranged between 44.4% and 65% among hospital laboratories and between 18.2% and 71.1% among private laboratories ; the overall IgG prevalence being 62.2%.

The IgM toxoplasma seropositivity ranged between 4 and 12.2% among hospital laboratories and between 3% and 13.4% among private laboratories ; the overall IgM prevalence being 6.8%.

The toxoplasma IgG seropositivity vs age distribution scattered at 5 years intervals from ≤ 5 to ≥ 51 years showed increasing prevalence with advanced age : 9% at ≤ 5 yrs, 25% at 5-10 yrs, 36% at 11-15 yrs, 43% at 16-20 yrs, 57% at 21-25 yrs, ranging between 64% and 69% between ages 26 and 45 yrs, 78% at 46-50 yrs, and 94% at ≥ 51 yrs. This increasing prevalence of toxoplasma IgG seropositivity is significantly correlated with increasing age ($p \leq 0.05$, based on Pearson bivariate correlation of 99.4%, as determined using SPSS version 16).

DISCUSSION

The value and relevance of this study is entailed in its relatively larger number of tested individuals (over three thousands five hundred) compared to the small number (less than 300 individuals) reported in the only other study from this country done earlier, over 30 years ago [7]. Such data dealing with toxoplasma seropositivity provides helpful information for epidemiologic and control aspects and would be useful for future monitoring of prevalence of this disease. Though the current study was limited to several hospitals and private laboratories in Beirut area, the data may reflect a close prevalence figure to the anticipated national one since these hospitals are among the major ones in the country and draw patients from all regions in Lebanon. Despite these positive values, the study still entails certain limitations in being non nationwide, liable to referral and selected testing bias to certain laboratories, a dire need for further studies is acknowledged and recognized to cover several disease aspects including characterizing epidemiology, analyzing risk factors and clinical outcome of patients, and covering wider sociodemographic regions in the country.

In order to make relevance, the current findings in this study will be discussed in context of those reported regionally and internationally, with an update on the pertinent aspects. Compared to the single earlier study reported in 1973 from Lebanon [7], the overall 62% rate of toxoplasma IgG seropositivity in the current study is over double the rate (30%) reported among 200 randomly selected Lebanese adults, and almost double the rate (35%) reported among 50 pregnant women tested at time of delivery, using the indirect fluorescent antibody test and considering a Toxo IgG positive result at arbitrarily dilution of $\geq 1:100$. Moreover, the 10% Toxo IgG seropositivity noted among 50 children 2-9 years old in the earlier study by Matossian [7], is lower than the 25% rate encountered among children 5-10 years old in the current study.

Compared to other countries, the overall 62% rate of toxoplasma IgG seropositivity in the current study is generally higher than most of those reported from different studies in the Arab world and our region. For example, the seroprevalence of toxoplasma IgG was reported to be 14.57% in a major Egyptian hospital (11.2% among random outpatients and 23% among suspected infected females) [9], 34.1% in Sudan [10], 25% among five areas of the East region in Saudi Arabia [11], 22.9% in the United Arab Emirates [12], 21.8% in Bahrain [13] and 30.1% in Turkey [14]. High prevalence ranging from 58.2% to 95.5% were reported from Kuwait [15-16].

Globally, reports of the epidemiological studies indicated that the prevalence of anti-IgG *T. gondii* antibodies in pregnant women or in the general population vary substantially among countries. In the earlier literature, for example, two major reviews of 62 and 32 studies reported seroprevalence rates of 0%-100% and 0%-72%, respectively [17-18]. The variable ranges were still being

reported in more recent studies, as shown for example in the 9%-67% seropositive range documented among European countries [19], the 6.1% and 47% reported between North and South Mexico [20], and the around 1%-30% range reported from different cities in the United States [6, 21]. A most recent global review searching electronic databases from 1975 to 2007 reported a toxoplasma seroprevalence rates among pregnant women ranging from 6.1% to 75.2% [22].

The seroprevalence also varies among different populations living within the same region but having different living habits. For example, a study on two rural populations, Israeli Jewish kibbutz vs Arab populations inhabiting the same region of Galilee, revealed differences in overall seroprevalence (22.2% vs 55.8%), differences among children in the first decade of life (0% vs 20.5%), and among increasing in age (42.6% at age ≥ 60 yrs vs 74% at age ≥ 40 yrs) [23]. The difference between the two groups probably stems from different eating habits, namely ingestion of raw meat and unpasteurized milk and milk products.

Concerning seroprevalence vs age, several reports indicated rise of seroprevalence in relation to advanced age. For example, a study of pregnant women from Jordan showed an IgG anti-*T. gondii* antibodies rate of 31.7% among age group 15-24 years, and 90% among age group 30-45 years [24]. In Panama, seroprevalence has been reported to be 13% by age 6 years and 90% by age 60 years [25]. In the United States, seroprevalence have been reported to be 5.2%, 23%, and 40% by ages 6-11, 40-49 and 60-69 years, respectively [26]. This increasing trend of toxoplasma IgG seropositivity with advanced age is also noted in our study being 9% at ≤ 5 yrs and reaching 78% at 46-50 yrs ($p \leq 0.05$), as reported under results section above.

Animals represent a major source of infection to humans, and in our region several studies documented the prevalence of toxoplasma infection in different animals. For example, in cats the seropositivity was 78.1% among the Lebanese ones [26]. In Jerusalem cats the seropositivity was 16% and 34% among the Jewish and Arab inhabited areas, respectively [27]. Among livestock, a study in Syria was done on Awassi sheep from nine provinces revealing an overall mean of toxoplasma seroprevalence of 44.5% (range 0%-100%) [28]. Also an Iranian study reported a seroprevalence rates of 30% in sheep, 15% in goats and 9% of cattle [29].

Several factors have been reported to explain the variation in the prevalence of human toxoplasma infection among different regions, countries and populations worldwide [22, 30]. These include : consumption of raw or undercooked meat (e.g. lamb & beef), having a pet cat at home or living in an area with stray cats living in close proximity, inadequate hand washing after handling contaminated garden soil or kitty litter, frequent consumption of raw vegetables outside the home, unsanitary feeding habits, climatic conditions (oocysts are killed by low temperature and sun exposure, while moderate climate and

high humidity favor their survival in soil), poor sanitation and hand hygiene, and increased age.

Control aspects is essentially based on knowledge of risk factors that can help to identify priorities for further epidemiological work. Elsheikha [22] defined effective preventive measures along five main themes of action : information and health education ; screening of pregnant women and infants ; limiting harm from risk behavior ; treatment of cases found to be at risk ; and vaccination. The impact of awareness and education on the decreasing seroprevalence rates of toxoplasma infection was exemplified in a study from Northern Greece which revealed a general population decreasing seroprevalence vs time of 37% in 1984, 29.9% in 1994 and 20% in 2004 [31].

In conclusion, this study revealed a high prevalence of IgG anti-*T. gondii* antibodies detected primarily in females of childbearing age tested at several hospitals and private based laboratories in Beirut region. Further studies on the sociodemographic, clinical, and behavioral data are needed to reveal the nationwide prevalence of toxoplasmosis infection, and identify population at risk in this country in order to establish solid foundation for control aspects.

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