DOI:10.34084/bshr.1361444 e-ISSN 2587-1641

Journal of Biotechnology and Strategic Health Research

Araştırma Makalesi /Research Article

http://dergipark.org.tr/tr/pub/bshr

Evaluation of Toxoplasma gondii, CMV, and Rubella Seropositivity and Avidity Tests in the First Trimester of Pregnancy: Why to Test?

Gebeliğin İlk Üç Ayında Toxoplasma gondii, CMV ve Rubella Seropozitifliği ve Avidite Testlerinin Değerlendirilmesi: Neden Test Etmeli?

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Geliş Tarihi / Received : 21-08-2023 **Kabul Tarihi / Accepted:** 12-09-2023 **Yayın Tarihi / Online Published:** 25-10-2023

Atıf Gösterimi/How to Cite: Uğur A.R., Esenkaya U., Günenc O. Evaluation of Toxoplasma gondii, CMV, and Rubella seropositivity and avidity tests in the first trimester of pregnancy: Why to test?, J Biotechnol and Strategic Health Res. 2023;7(3):174-182

Abstract

Aim The influence of intrauterine and perinatal infections on fetal and neonatal mortality rates and childhood morbidity is substantial. Toxoplasmosis gondii, CMV, and rubella are widely recognized as the major causative pathogens of in utero infections. The objective of this study is to investigate the seropositivity rates and avidity incidences of *T. gondii*, CMV, and rubella in pregnant women during the first trimester.

Material and Method The electrochemiluminescence immunoassay method (Elecsys, Roche, Germany) was used for the detection of the anti-toxo IgM, anti-toxo IgG, anti-CMV IgM, anti-CMV IgG, anti-rubella IgM, and anti-rubella IgG during the time period of January 1, 2021, to June 15, 2023, in pregnant women in their first trimester. The anti-toxo IgG, anti-CMV, and anti-rubella IgG avidity tests were performed with the enzyme-linked fluorescent assay method (VIDAS, bioMérieux, France). The data was retrospectively analyzed using the electronic archives.

Results Test results of a total of 15,356 pregnant women were evaluated. The seropositivity rates of *T. gondii* IgM and IgG were 2.1% and 22%, respectively. For *T. gondii*, a high avidity was observed in 75.8% of cases. We found the anti-CMV IgM and IgG seroprevalence as 1.6% and 96.9%, and the anti-rubella IgM and IgG seroprevalence as 0.8% and 98.7%, respectively. The IgG avidity rates with a high index for CMV and rubella were 99.4% and 99.1%, respectively.

Conclusion The present study revealed that the pregnant women exhibited an anti-toxo IgG seropositivity rate of 22% while demonstrating notably high IgG seropositivity rates for CMV and rubella. The seropositivity rates for *T. gondii*, CMV, and rubella IgM were found to be relatively low, but the rates of IgG avidity were shown to be high. A high IgG avidity index against these pathogens in first-trimester pregnant women with a positive IgM and IgG can rule out postconception infections. Treatment for *T. gondii* diagnosed during pregnancy, preventive behavioral measures for CMV and vaccination against rubella prior to pregnancy may help reduce congenital infections. Hence, it is imperative to prioritize the screening of pregnant women for *T. gondii*, CMV, and rubella, as it holds significant importance for the public health.

Keywords *Toxoplasma gondii*, CMV, rubella, serology, pregnancy, congenital infection

Özet

Amaç *İntrauterin ve perinatal enfeksiyonlar, fetal ve neonatal mortalite ve çocukluk çağı morbiditesi üzerinde oldukça büyük etkiye sahiptir. Toxoplasma gondii, sitomegalovirüs (CMV) ve rubella (kızamıkçık) fetüsün in utero enfeksiyonlarına neden olan başlıca patojen etkenlerdir. Bu çalışmanın amacı ilk trimesterdeki gebelerde T. gondii, CMV ve rubella seropozitiflik oranları ve avidite insidansını araştırmaktır.*

Gereç ve Yöntem *Hastanemize 1 Ocak 2021 - 15 Haziran 2023 tarihleri arasında ilk trimesterda başvuran gebelerde anti-toxo IgM, anti-toxo IgG, anti-CMV IgM, anti-CMV IgG, anti-rubella IgM ve anti-rubella IgG antikorlarının tespiti için elektrokemiluminesans immünolojik test yöntemi (Elecsys, Roche, Almanya) kullanıldı. Anti-toxo IgG, anti-CMV ve anti-rubella IgG avidite testleri, enzim bağlantılı floresan test yöntemi (VIDAS, bioMérieux, Fransa) ile gerçekleştirildi. Veriler elektronik arşiv üzerinden retrospektif olarak analiz edildi.*

Bulgular *Toplam 15,356 gebeye ait test sonuçları değerlendirildi. T. gondii IgM ve IgG seroprevalansı sırasıyla %2,1 ve %22 olarak belirlendi. T. gondii için %75,8'inde yüksek avidite gözlendi. Anti-CMV IgM ve IgG seroprevalansı sırasıyla %1,6 ve %96,9 tespit edildi. Anti-rubella IgM ve IgG seroprevalansı ise sırasıyla %0,8 ve %98,7 olarak belirlendi. CMV ve rubella için yüksek indeksli IgG avidite sonucu sırasıyla %99,4 ve %99,1 olarak bulundu.*

Sonuç *Bu çalışma, gebelerin %22 oranında bir anti-toxo IgG seropozitifliği sergilediğini, CMV ve rubella için ise oldukça yüksek IgG seropozitiflik oranları gösterdiğini ortaya koydu. T. gondii, CMV ve rubella için IgM seropozitiflik oranları nispeten düşük oranlarda bulunurken; IgG avidite oranlarının yüksek olduğu görüldü. IgM ve IgG pozitif ilk trimester gebelerinde bu etkenlere karşı belirlenen yüksek avidite test sonuçları gebelik sonrası enfeksiyonları dışlamak için kullanılabilir. Gebelik sırasında gelişen T. gondii tanı ve tedavisi, CMV bulaşını önleyici kişisel hijyen uygulamaları ve gebelik öncesi rubella aşılaması gibi önlemler konjenital enfeksiyonların azaltılmasına yardımcı olabilir. Bu nedenle, gebelerde T. gondii, CMV ve rubella taramasına öncelik verilmesi halk sağlığı açısından hayati önem taşımaktadır.*

Anahtar Kelimeler *Toxoplasma gondii, CMV, rubella, seroloji, gebelik, konjenital enfeksiyon*

INTRODUCTION

Intrauterine and perinatal infections exert a substantial impact on fetal and neonatal death rates and childhood morbidity.[1] The causative agents of in utero infection that are well-described include *Toxoplasmosis gondii*, CMV, and rubella.[1]

Toxoplasma gondii is an intracellular protozoan that is usually acquired early in life and whose definitive host is felines.[2] Humans are intermediate hosts. Transmission mostly occurs through raw or undercooked meat and meat products contaminated with parasitic bradyzoites; or by consuming raw vegetables and fruits contaminated with sporozoites.[3] In immunocompetent people, toxoplasma infection is typically asymptomatic or manifests as a mild illness with fever and malaise, lymphadenopathy being the main symptom. It causes significant morbidity and mortality in immunosuppressed patients.[4] Fetal infection occurs when there is transplacental transmission of tachyzoites prior to the production of maternal IgM antibodies during the primary maternal infection.[5] Although most newborns who are later found to have congenital toxoplasmosis do not present with any symptoms or obvious abnormalities at the time of delivery. The major clinical symptoms are chorioretinitis, hydrocephalus, and intracranial calcifications.[6] The risk of transmission is observed to be higher during later stages of gestation. However, it is important to note that the risk of severe complications such as neurologic and ocular abnormalities, is higher during first trimester infections.[6]

Cytomegalovirus (CMV) is classified as a member of the Herpesvirus family. It is the most common congenital viral infection and is widely prevalent among various age groups throughout the world, increasing with age.[7] Transmission occurs through direct contact with secretions such as saliva, urine or semen of infected patients or contaminated objects. The infection with CMV usually results in nonspecific symptoms such as headache, arthralgia, pharyngitis, rhinitis, myalgia, and fatigue with a mild fever. Immune-compromised individuals are susceptible to severe and disseminated illness.[8]

Primary maternal CMV infection during pregnancy is most commonly caused by close contact with young children.[9] The transplacental route is the major way through which mother-to-child transmission occurs.[10] The probability of vertical transmission rises as gestational age progresses.[10] The vast majority of infants infected by congenital CMV infection may be asymptomatic at delivery, yet are prone to late-onset neurologic impairments.[11] Isolated sensorineural hearing loss is the most common clinical presentation of congenital CMV infection.[11] In pregnants with a primary CMV infection, the risk of severe neonatal sequelae is 3%, and the risk of any adverse outcome is about 8%.[12] The observations made in symptomatic neonates encompass several clinical manifestations such as thrombocytopenia, jaundice, petechia, microcephaly, hepatosplenomegaly, ventriculomegaly, and chorioretinitis. Congenital CMV infection may have more severe sequela if primary maternal infection occurs before 20 weeks of gestation.[13] The congenital diseases can be caused by both primary and secondary infections.[13]

Rubella, often known as German measles, is an infectious and consequential human disease resulting from the rubella virus. Rubella is contracted through the inhalation of aerosols and direct contact with droplets containing nasopharyngeal secretions.[14] The manifestation of acquired rubella typically presents as a mild and self-limiting illness accompanied by a distinctive maculapapular rash called exanthem, occuring initially on the face.[14] Individuals who are affected may have prodromal symptoms characterized by a mild fever, malaise, conjunctivitis, sore throat, and headache.[15] Congenital infection is a result of the transmission of the virus crossing of the placenta hemotogenously.[14] Rubella induces cellular death, interferes with cellular division, and inflicts severe consequences on the growing fetus, resulting in spontaneous abortion, stillbirth, fetal infection, or intrauterine growth retardation.[14,15] The

incidence of congenital abnormalities following maternal infection is primarily confined to instances of maternal infection occurring within the initial 16 weeks of gestation.[16] Distinctive clinical presentation of congenital rubella syndrome include cardiac abnormalities such as patent ductus arteriosus, pulmonary stenosis, radiolucent bone lesions, and blueberry muffin skin lesions.[17,18]

The objective of this study is to investigate the seropositivity rates and avidity test results of *T. gondii*, CMV, and rubella in pregnant women who have undergone routine pregnancy visit during the first trimester.

MATERIALS and METHODS

The study was approved by the Ethics Board of the Faculty of Medicine of the University of Karatay (Decision no. 2023/024).

In the present study, a total of 15,847 pregnant women who consulted the Gynecology and Obstetrics outpatient clinic of Konya City Hospital from January 1, 2021, to June 15, 2023, for routine pregnancy monitoring were included in the study. Repeat tests within 3 days for 491 women were dismissed. The serum *T. gondii*, CMV, and rubella IgM and IgG antibodies, and IgG avidity tests were performed by the relevant techniques: The electrochemiluminescence immunoassay method (Elecsys, Roche, Germany) was employed for the detection of the anti-toxo IgM, anti-toxo IgG, anti-CMV IgM, anti-CMV IgG, anti-rubella IgM, and anti-rubella IgG. Anti-toxo IgM, anti-CMV IgM, and anti-rubella IgM tests with borderline results were tested twice. The anti-toxo IgG, anti-CMV, and anti-rubella IgG avidity tests were performed with the enzyme-linked fluorescent assay method (VIDAS, bioMérieux, France). The results were evaluated retrospectively by screening the electronic archive. Statistical analysis was conducted using the SPSS Statistics 22 software.

RESULTS

The serum *T. gondii* IgM positivity rate among 15,356 pregnant women was 2.1%; and *T. gondii* IgG positivity rate was determined as 22% in 8379 pregnant women. In the study, a total of 227 IgG avidity tests were conducted on patients who tested positive for both *T. gondii* IgM and IgG. For *T. gondii*, low avidity was observed in 13.6% (n = 31) of cases, while high avidity was detected in 75.8% (n = 172) of cases. Additionally, borderline avidity was found in 10.6% of the tests.

The anti-CMV IgM positivity rate among 3.500 pregnant women was 1.6%; and IgG positivity rate was determined as 96.9% in 2482. A total of 174 anti-CMV IgG avidity tests were conducted for patients who tested positive for both IgM and IgG against CMV. 99.4% (n = 173) of cases were detected as high avidity, while borderline avidity rate was 0.6% (n = 1). We did not detect low avidity for CMV infection.

The anti-rubella IgM positivity rate among 15.165 pregnant women was 0.8%; and IgG positivity rate was determined as 98.7% in 10.091 pregnant women. A total of 114 anti-rubella IgG avidity tests were conducted for patients who tested positive for both IgM and IgG against rubella. 99.1% (n = 113) of cases were detected as high avidity, while low avidity rate was 0.9% (n = 1) for rubella infection.

Table 1. presents the test numbers and the rates of seropositivity for IgM and IgG antibodies against *T. gondii*, CMV, and rubella in pregnant women, categorized by years. Table 2. shows the test numbers and the results of the avidity tests for *T. gondii*, CMV, and rubella according to years.

Table 1. IgG and IgM seropositivity rates against T. gondii, CMV, and Rubella by years.

		1 January-31 December 2021	1 January-31 December 2022	1 January-31 June 2023	Mean (Total n)
T. gondii	High avidity % (n)	%77.2 (71)	%80.5 (70)	%64.6 (31)	%75.8 (172)
	Borderline avidity % (n)	%9.8 (9)	%8 (7)	%16.7 (8)	%10.6 (24)
	Low avidity % (n)	%13 (12)	%11.5 (10)	% 18.5 (9)	%13.6 (31)
CMV	High avidity % (n)	99% (98)	100% (44)	100% (19)	99.4 (173)
	Borderline avidity % (n)	1% (1)	-	-	0.6% (1)
	Low avidity % (n)	-	-	-	-
Rubella	High avidity % (n)	97.8% (46)	100% (48)	100% (19)	99.1% (113)
	Borderline avidity % (n)	-	-	-	-
	Low avidity % (n)	2.2% (1)	-	-	0.9% (1)

Table 2. IgG Avidity indeces of T. gondii, CMV, and Rubella by years.

		1 January-31 December 2021	1 January-31 December 2022	1 January-31 June 2023	Mean (Total n)
T. gondii	IgG positive % (n)	23.2% (518)	21.7% (842)	21.2% (481)	22% (1841)
	IgG negative % (n)	76.8% (1710)	78.3% (3040)	78.8% (1788)	78% (6538)
	IgM positive % (n)	2% (129)	19.8% (122)	2.7% (77)	2.1% (328)
	IgM negative % (n)	97.3% (6149)	79.4% (6012)	95.9% (2735)	97% (14896)
	IgM borderline % (n)	0.7% (45)	0.8% (47)	1.4% (40)	0.9% (132)
CMV	IgG positive % (n)	100% (46)	99.6% (1470)	99.4% (954)	99.5% (2470)
	IgG negative % (n)	--	0.4% (6)	0.6% (6)	%0.5 (12)
	IgM positive % (n)	1.6% (13)	1.8% (32)	1.2% (12)	1.6% (57)
	IgM negative % (n)	96.5% (764)	96.6% (1687)	97.2% (937)	%96.9 (3388)
	IgM borderline % (n)	1.3% (11)	1.6% (29)	1.6% (15)	%1.5 (55)
Rubella	IgG positive % (n)	93.2% (3105)	92.5% (4205)	93.8% (2078)	93% (9388)
	IgG negative % (n)	6.8% (226)	7.5% (339)	6.2% (138)	7% (703)
	IgM positive % (n)	0.8% (52)	0.7% (43)	0.7% (20)	0.8% (115)
	IgM negative % (n)	98.7% (6084)	98.7% (6220)	98.7% (2663)	98.7% (14967)
	IgM borderline % (n)	0.5% (31)	0.6% (37)	0.6% (15)	0.5% (83)

DISCUSSION

According to the previous studies[19,20], it has been observed that timely treatment of maternal infection caused by *T. gondii* within the initial three weeks can effectively prevent fetal infection. The seroprevalence of toxoplasma in pregnant women exhibits significant variation, ranging from 45% to 80% in developing countries, while in Europe and the USA, it ranges from 7% to 34%.[21] Data on the incidence of acute toxoplasma infection during pregnancy are limited. The incidence of toxoplasma in the USA is estimated to be 0.2 per 1000 pregnant women.[22] It was reported that congenital toxoplasmosis infection was 1 in 10,000 live births in England between 1986 and 1992.[23]

The seroprevalence of anti-toxo IgG in Turkey ranges from 18% to 60%.[24-29] The variation in seropositivity across Turkey may be attributed to geographical variables and sociocultural differences. For example, in Şanlıurfa, a region known for its notably elevated seroprevalence of anti-toxo IgG antibodies, there exists a substantial consumption of raw meat as a result of its traditional culinary practices (çiğ köfte).[29] In multiple investigations conducted within Tur-

key, the seroprevalence of Anti-toxo IgM has been documented to range from 0.2% to 9%.[25,28,30] We found that the seroprevalence of anti-toxo IgG among pregnant women in their first trimester was 22%. Also, we found a 2.1% rate of anti-toxo IgM positivity, which aligns with existing literature on the subject within our region. In our study, a rate of 75.8% of high avidity, 10.6% of borderline avidity, and 13.6% of low avidity were detected in 227 patients with positive IgM and IgG antibodies against *T. gondii*. Several investigations conducted within Turkey have reported high avidity ranging from 70% to 96%. Additionally, a smaller percentage of individuals displayed borderline avidity levels, ranging from 3% to 24%, while a minority exhibited low avidity levels, ranging from 0% to 15%.[31-33]

In cases where a pregnant woman exhibits clinical suspicion, accompanied by fever and lymphadenopathy, and fetal ultrasound imaging revealing intracranial hyperechoic calcification areas or cerebral ventricular dilatation, it is recommended to conduct diagnostic tests for congenital toxoplasmosis.[22] It is not advisable to conduct routine pregnancy screening in countries with low toxoplasma prevalence and incidence, such as the United Kingdom, United States, and Canada.[34-36] In some European countries such as France, prenatal screening is performed at 1-2-3 month intervals.[37] It is conceivable that each country should decide on prenatal screening and its frequency by taking risk factors into consideration.[34] Hence, it is imperative to ascertain the immunological status of the mother prior to conception. There is no set policy for prenatal screening tests in Turkey, but pregnant women are routinely screened with serological tests in the first trimester.

Serological tests for the detection of IgM and IgG antibodies against toxoplasma are widely used routinely in diagnosing toxoplasma. The aforementioned tests are cost-effective, fast, and easy to perform. Conversely, the interpretation of positive toxoplasma diagnostic tests in asymptomatic pregnant women poses some challenges.[38] Firstly, it may not be possible to determine the timing of infection. Another disadvantage is that false positives are frequently encountered in these tests. When anti-toxo IgM is detected as positive or at the borderline level, it is necessary to confirm the result using a different method. Individuals who test positive for anti-toxo IgG and negative for IgM during the first trimester are considered immune and do not require more advanced testing.[39] If the pregnancy screening is conducted after the 20th week of gestation, further confirmatory tests may be necessary for pregnant women with positive IgG and negative IgM, who are clinically suspicious.[22]

The detection of serum anti-toxo IgM antibodies begins approximately two weeks after exposure to the parasite and can remain positive for several years. The anti-toxo IgG antibodies, on the other hand, become positive 6-8 weeks after infection and remain positive throughout the individual's lifetime.[38] The demonstration of IgM and IgG seroconversion is considered the most reliable diagnostic tests for acute toxoplasmosis. According to previous studies[38], a ≥ 2-fold increase in IgG titers obtained from blood samples taken three weeks apart and analyzed in the same laboratory simultaneously is indicative of an acute infection.

The likelihood of infection occurring after conception was shown to be low in pregnant women who tested positive for IgM and IgG antibodies for the first time towards the end of the first trimester.[38] A single positive IgM result in the first trimester is not sufficient for pregnancy termination or initiation of treatment.[25] In cases when both IgM and IgG are positive, avidity tests are necessary to differentiate between new and past infection or to exclude false positivity.[39] High avidity is an indication of an infection passed more than 4 months ago. On the other hand, low avidity is undiagnostic for new infection because it persists for years in some individuals.[40]

As in the case of *T. gondii*, age, geography, cultural and socioeconomic status affect CMV seroprevalence.[41] In de-

veloping countries, children are mostly infected by three years old, whereas in industrialized countries, infection occurs throughout childhood and adolescence.[42] Global seroprevalence of CMV in women of childbearing age is aproximately 83%.[7] During pregnancy, over 2% of seronegative pregnant women will acquire CMV infection.[7] Routine serologic maternal screening for CMV is discouraged due to various reasons such as, the lack of vaccine to prevent infection in individuals who lack antibodies against CMV, the challenge to differentiate between primary and non-primary infection, and the risk of fetal infection from reactivation or reinfection with a different viral strain as well as to establish the precise date of the infection.[35] However, the implementation of preventative behavioral interventions can help mitigate the transmission risk.[43]

Congenital CMV infection is the leading cause of sensorineural hearing loss.[7] Prenatal testing is indicated in pregnants with mononucleosis-like symptoms and abnormal USG examination consistent with congenital CMV infection, Demonstrating seroconversion is the gold standard for diagnosing primary CMV infection in pregnant women with clinical suspicion.[44] If the immune status of pregnant is unknown, positive results of both anti-CMV IgG and anti-CMV IgM can not discriminate initial infection, reactivation, reinfection, or latent illness. The detection of high avidity suggests that the infection is likely to have occurred at a minimum of six months prior, whereas low avidity implies a more recent onset of the infection.[44] In regions characterized by a high seroprevalence (80% - 100%), the incidence of neonatal CMV infection varies between 1% and 5%.[45] Conversely, in regions with a comparatively lower prevalence (40% - 70%), the incidence of congenital CMV infection ranges from 0.4% to 2%.[45] The prevalence of seroconversion during pregnancy is documented at 1% - 7%.[46] In fact, the seroprevalence of IgM of populations was found to be comparable between developing and industrialized countries. The seroprevalence of CMV IgM among adults in industrialized regions was estimated to range from 2.3% to 4.5%, while in source-limited countries, it ranged from 1.0% to 6.7%.[47] On the other hand, the seroprevalence of anti-CMV IgM among women of reproductive age exhibited slight variability across several regions, including Europe (1.0-4.6%), North America (2.3 - 4.5%), and Japan (0.8%)[48]. In a meta-analysis,[48] anti-CMV IgG seropositivity rates in pregnant women range from 84.10% to 100% in Turkey.[49] On the other hand, the seropositivity rates for anti-CMV IgM range from 0.12% to 3.2%.[48,49] In Turkey, a small number of studies[50-52] have reported CMV avidity between 0% and 7.1%. In our study, we found an anti-CMV seropositivity of 99.5%, an IgM incidence of 1.6% and a high avidity rate of 99,4%, which are consistent with existing data.

Rubella was widespread before the rubella vaccine, with the highest incidence among pre-school and schoolchildren. Epidemics have caused widespread illness and death.[53] An estimated 12.5 million individuals were infected during the 1964-1965 pandemic in US.[53] Over 20,000 cases of congenital rubella syndrome and 11,000 fetal deaths occurred during this outbreak.[52] Since the introduction of routine childhood rubella vaccination, the incidence of rubella has significantly decreased in Turkey and across the world.[53] On the other hand, rubella infections and resultant congenital rubella syndrome cases persist in areas with inadequate vaccination regimens.[53,54] WHO estimates that approximately 100,000 cases of congenital rubella syndrome occur annually worldwide.[15] Immigrants originating from war-torn nations have been identified as the primary carriers of rubella infection.[55] Periodic outbreaks of measles, particularly in the United States, are attributable to the growing resistance towards vaccination. There is a prediction that a comparable scenario could potentially arise in the context of rubella.[56]

The sole dependable indication of prior rubella infection is the detection of serum rubella IgG antibodies.[56] The most effective method for diagnosing acute rubella syndrome includes a fourfold rise in IgG titer when comparing serum specimens obtained during the acute phase and the

convalescent phase, and the detection of IgM antibodies against rubella.[57] If rubella IgM is detected in an asymtomatic pregnant woman without any prior history of contact, a rubella specific avidity assay may be useful to exclude a false positive result.[58] Rubella IgG antibodies in pregnant women in Turkey have been reported as 82% - 96.2% and anti-rubella IgM positivity as 0% - 1.9%.[49,52,59] The observed rates of low avidity for rubella among pregnant women in Turkey range from 0% to 82.9%, varying according to population characteristics and laboratory methods used.[60] A high seroprevalence of anti-Rubella IgG (93%), a low incidence of IgM positivity (0.8%), and a low detection rate for low avidity (0.9%) were observed in our study, suggesting the absence or very low incidence of rubella infection among pregnant women during the period of study and as an indication of high immunity against rubella among women of reproductive age. The seroprevalence data in our region have consistently exhibited similar levels over the course of several years.

The primary objective of our study was to make a scholarly contribution to the existing literature by providing insights into the seroprevalence rates, avidity results, and public health strategies of most well known causative agents of congenital infections. As a result, our findings were consistent with the data of our region, whose population is mainly engaged in agriculture and to some extent animal husbandry. Given the restricted availability of data on avidity tests for *T. gondii*, CMV, and rubella, it is anticipated that this article will provide a contribution to the existing body of national data. A limitation of our retrospective study is that an alternative confirmatory assay other than avidity test was not performed to exclude *T. gondii*, CMV and rubella IgM false positivity in pregnant women. In order to achieve this objective, it is important to conduct prospective research.

CONCLUSION

It is of utmost importance for public health to prioritize the screening of *T. gondii* in high-risk populations, particularly women of reproductive age and pregnant women, as well as to emphasize the significance of early detection and treatment of the infection. Timely diagnosis is crucial for promptly initiating appropriate therapy. On the other hand, the implementation of preventive behavioral treatments and good personel hygien can help reduce transmission of CMV in pregnant women. The main approach to mitigating the risk of rubella during pregnancy is administering vaccination before pregnancy. Consequently, being vigilant about congenital infections and screening pregnant women in the first trimester for *T. gondii*, CMV, and rubella can help reduce congenital infections.

Ethics Approval

The study was approved by the Ethics Board of the Faculty of Medicine of the KTO Karatay University (project no. 2023/024, date: 18.07.2023).

Peer-review

Externally and internally peer-reviewed.

Authorship Contributions

Concept: A.R.U., Ü.E., O.G. Design: A.R.U., Ü.E., O.G. Data Collection or Processing: A.R.U., Ü.E., O.G., Analysis or Interpretation: A.R.U., Ü.E., O.G. Literature Search: A.R.U., Ü.E., O.G. Writing: A.R.U., Ü.E., O.G.

Conflict of Interest

No conflict of interest was declared by the authors.

Funding

The authors declared that this study received no financial support.

Informed Consent

Informed consent was not obtained since it was a retrospective archive scan.

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