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Investigation of TORCH seroprevalence in a tertiary university hospital

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Abstract

This study aimed to investigate the seroprevalence of TORCH (Toxoplasma gondii, other agents, Rubella, Cytomegalovirus (CMV), and herpes simplex virus (HSV)) in pregnant women at a tertiary university hospital and determine the level of immunity in the community. This retrospective study included 1,556 pregnant women aged 18-50 years who visited the Department of Obstetrics and Gynecology between January 2022 and January 2024. Demographic data and TORCH antibody test results were collected from medical records. Seroprevalence rates were compared between the 18-35 and 35-50 age groups. Avidity test results were recorded for pregnant women with positive IgM antibodies against Toxoplasma, Rubella, and CMV. Seroprevalence rates were Toxoplasma IgM (0.3%), Toxoplasma IgG (76%), Rubella IgM (0.4%), Rubella IgG (96.7%), CMV IgM (0.2%), CMV IgG (97.2%), HSV IgG (97.8%), HBsAg (0.6%), Anti-HBs (18.1%), Anti-HCV (0.3%), and Anti-HIV (0.1%). The frequency of previous infections and proportion of vaccinated individuals increased in pregnant women aged 35-50 years. Avidity tests were performed on pregnant women with positive IgM antibodies against Toxoplasma, Rubella, and CMV to confirm the primary infection. The seroprevalence of TORCH infections in pregnant women at a tertiary university hospital was determined, with a higher proportion of previous infections and immunized individuals in the older age group. The results highlight the importance of prenatal screening for TORCH infections to prevent potential complications and guide health policies for infection control strategies.

Keywords: Cytomegalovirus, herpes simplex, rubella, seroprevalence, toxoplasma

Introduction

Toxoplasma gondii, other agents, Rubella, Cytomegalovirus (CMV), and Herpes simplex virus (HSV), collectively referred to as TORCH infections, represent a critical group of infectious diseases that can endanger both expectant mothers and their fetuses during pregnancy. These infections, especially those acquired during pregnancy, can infect the fetus through vertical transmission and lead to congenital anomalies, neurological damage, vision and hearing loss, low birth weight, and stillbirth. Therefore, early diagnosis and prevention of TORCH infections are of critical importance, both to protect maternal health and to support the healthy development of newborns [1].

The seroprevalence of TORCH infections varies between countries depending on hygiene, vaccination, health systems, and socioeconomic conditions. Toxoplasma seroprevalence in Türkiye is between 30-50% and is higher in rural areas [2]. It has been reported to be 15-50% in India [3], 9-11% in the USA and 50-80% in Brazil [4]. Rubella seropositivity is over 90% in Türkiye and the USA [2,4] and 70-80% in India, but seronegativity is a major problem in India [3]. CMV seropositivity is 80-90% in Türkiye [2], 90% in India [3], 50-60% in the USA and 90-95% in Brazil [4]. These findings suggest that hygiene and vaccination programs play decisive roles in the spread of infection.

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Seroprevalence studies provide critical data on the immune status and frequency of infection [5]. Tertiary university hospitals provide a suitable setting for such studies as centers where complex cases and high-risk groups are followed. Data obtained from these centers contribute to the development of infection control strategies by reflecting the level of immunity against infections in large populations and play an important role in reducing perinatal mortality and morbidity, particularly in pregnant women [3,5].

This study aimed to analyze the seroprevalence of TORCH infections in a tertiary care university hospital, providing up-to-date and regional data on the immune status of the community. While studies in the literature usually focus on the general population, this study stands out because it covers high-risk groups and complex cases. The findings will contribute to the development of infection control strategies, improving prenatal health services, and increasing the effectiveness of screening and prevention programs. This study provides valuable guidance for strengthening perinatal health policies.

Material and Methods

Patients and Data Collection

Between January 2022 and January 2024, 1556 pregnant women aged 18-50 years who presented to the Department of Obstetrics and Gynecology of a tertiary university hospital were included in the study.

Demographic data (age, gravida, parity, abortion, smoking, comorbidities, and medications used for existing comorbidity) were obtained retrospectively from medical records in the hospital automation system. Venous blood samples obtained from all pregnant women were analyzed for Toxoplasma IgG/IgM, Rubella IgG/IgM, CMV IgG/IgM, HSV IgG/IgM, HBs Ag, Anti-HBs, Anti-HCV, and Anti-HIV antibody test results using an Enzyme-Linked Immunosorbent Assay (ELISA) device. Since the age limit of 35 years is defined as "advanced age pregnancy" in the literature, and this group has a different risk profile, the antibody test results of the TORCH panel were compared by dividing the pregnant women into two groups as 18-35 years and 35-50 years.

Serum samples of 29 pregnant women who were reported to be positive for Toxoplasma IgM, Rubella IgM, CMV IgM, HBs Ag, Anti-HCV, and Anti-HIV antibodies based on the initial evaluation results were reanalyzed for confirmation and the possibility of false positivity. In pregnant women with positive Toxoplasma IgM, Rubella IgM, and CMV IgM antibodies, avidity tests were performed to confirm primary infection, and the results were recorded using an ELISA device.

Pregnant women admitted to the Department of Obstetrics and Gynecology between 2022 and 2024, but whose examination results could not be obtained in the first trimester, were excluded from the study.

Ethics Committee Approval

This study was approved by the Non-Interventional Clinical Research Ethics Committee of the Kafkas University Faculty of Medicine (01/10/2024, 80576354-050-99/ 534). This study complied with the recommendations of the Declaration of Helsinki for human biomedical research.

Statistical Analysis

The Windows SPSS program (version 24.0) was used for statistical analyses. The Kolmogorov-Smirnov test was used to evaluate whether the continuous variables (age, gravida, parity, abortion, and 1st and 5th minute APGAR scores) were normally distributed. Since the data showed an abnormal distribution as a result of the test, they were expressed as medians (minimum-maximum). Categorical variables are presented as numbers (n) and percentages (%). The chi-square test was used to compare antibody (18-35 years/35-50 years) and avidity (low/high) test results by age. Since it is a 2×2 table, Pearson chi-square test was used if the theoretical minimum frequency was >25, Yates chi-square test was used if it was between 5 and 25, and Fisher's exact test was used if it was <5, and the p result was written. Statistical significance was set at $p<0.05$. Prism software (version 8, GraphPad Software, San Diego, California, USA) was used for data analysis and graphs.

Results

Demographic Data of the Total Cohort

The median age of the 1556 pregnant women was 33 years (19-50). Median gravida was 1 (1-9), median parity was 0 (0-6) and median abortion was 0 (0-5). A total of 2.7% (n=42) of the pregnant women were smokers. A total of 117 pregnant women (7.5%) had comorbidities, with gestational diabetes mellitus being the most common (n=102, 6.6%). Hypothyroidism (n=41), gastroesophageal reflux (GER) (n=20), hypertension (n=11), thrombophilia (n=8), epilepsy (n=7), asthma (n=2), preeclampsia (n=2), rheumatoid arthritis (n=2), bipolar mood disorder (n=1), bronchiectasis (n=1), celiac disease (n=1), multicystic kidney disease (n=1), polycystic ovary syndrome (PCOS) (n=1), and ulcerative colitis (n=1). Of the pregnant women, 3.8 % (n=59) were taking medication.

Of the babies, 52.6% (n=818) were male, 47.4% (n=738) were female, 22% (n=343) were born in the preterm period, 77.8% (n=1211) in the term period, and 0.1% (n=2) in the post-term period. Birth weights were <2500 grams (n=101, 6.5%), 2500-4000 grams (n=1427, 91.7%), >4000 grams (n=28, 1.8%). The 1st minute APGAR score median was 7 (0-10) and the 5th minute APGAR score median was 9 (0-10). Detailed data are presented in Table 1.

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Table 1. Demographic data and TORCH antibody test results of the total cohort

	Total cohort (n=1556)
Age (years) (Median (Min-Max))	33 (19-50)
Smoking history (n, %)	42 (2.7)
Gravida (Median (Min-Max))	1 (1-9)
Parity (Median (Min-Max))	0 (0-6)
Abortion (Median (Min-Max))	0 (0-5)
Comorbidity (n, %)	117 (7.5)
Asthma	2 (0.1)
Bipolar disorder	1 (0.1)
Bronchiectasis	1 (0.1)
Celiac disease	1 (0.1)
Epilepsy	7 (0.4)
Gestational diabetes mellitus	102 (6.6)
Gastroesophageal reflux	20 (1.3)
Hypertension	11 (0.7)
Hypothyroidism	41 (2.6)
Multicystic kidney	1 (0.1)
Polycystic ovary syndrome	1 (0.1)
Preeclampsia	2 (0.1)
Rheumatoid arthritis	2 (0.1)
Thrombophilia	8 (0.5)
Ulcerative colitis	1 (0.1)
Medication (n, %)	59 (3.8)
Baby sex (n, %)	
Female	738 (47.4)
Male	818 (52.6)
Birth week (n, %)	
<37 weeks	343 (22)
37-42 weeks	1211 (77.8)
>42 weeks	2 (0.1)
Infant birth weight (n, %)	
<2500 gram	101 (6.5)
2500-4000 gram	1427 (91.7)
>4000 gram	28 (1.8)
1st minute APGAR score (Median (Min-Max))	7 (0-10)
5th minute APGAR score (Median (Min-Max))	9 (0-10)
TORCH (n, %)	
Toxoplasma IgM	4 (0.3)
Toxoplasma IgG	1182 (76)
Rubella IgM	7 (0.4)
Rubella IgG	1504 (96.7)
Cytomegalovirus IgM	3 (0.2)
Cytomegalovirus IgG	1513 (97.2)
Herpes Simplex Virus IgM	0 (0)
Herpes Simplex Virus IgG	1521 (97.8)
HBsAg	10 (0.6)
Anti-HBs	281 (18.1)
Anti-HCV	4 (0.3)
Anti-HIV	1 (0.1)

HBsAg: hepatitis B surface antigen, HCV: hepatitis C virus, HIV: human immunodeficiency virus

Evaluation of TORCH Antibody Test Results

TORCH test results of pregnant women; Toxoplasma IgM (n=4, 0.3%), Toxoplasma IgG (n=1182, 76%), Rubella IgM (n=7, 0.4%), Rubella IgG (n=1504, 96.7%), CMV IgM (n=3, 0.2%), CMV IgG (n=1513, 97.2%), HSV IgG (n=1521, 97.8%), HBsAg (n=10, 0.6%), Anti-HBs (n=281, 18.1%), Anti-HCV (n=4, 0.3%), Anti-HIV (n=1, 0.1%) (Figure 1A).

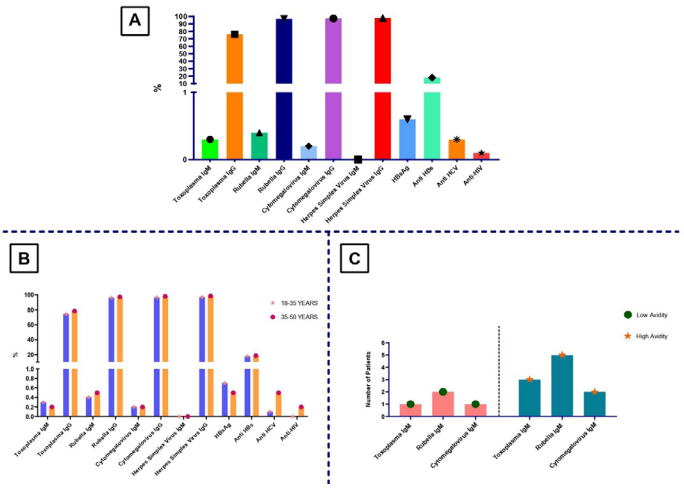

Figure 1 A. Toxoplasma IgG/IgM, Rubella IgG/IgM, CMV IgG/IgM, HSV IgG/IgM, HBs Ag, anti-HBs, anti-HCV and anti-HIV antibody test positivity in the total cohort; **B.** Toxoplasma IgG/IgM, Rubella IgG/IgM, CMV IgG/IgM, HSV IgG/ IgM, HBs Ag, anti-HBs, anti-HCV and anti-HIV antibody test positivity in patients aged 18-35 years and 35-50 years; **C.** Toxoplasma IgM, Rubella IgM and CMV IgM avidity test results

Comparison of TORCH Antibody Test Results by Age

There was no difference in seropositivity for toxoplasmosis, Rubella, CMV and HSV IgM between pregnant women aged 18-35 and 35-50 years (Figure 1B). However, the frequency of previous infections and the proportion of immunized individuals increased in pregnant women aged 35-50 years. Detailed data are presented in Table 2.

Table 2. Comparison of TORCH antibody test results by age

TORCH (n, %)	18-35 years (n=939)	35-50 years (n=617)	p
Toxoplasma IgM	3 (0.3)	1 (0.2)	1.0
Toxoplasma IgG	698 (74.3)	484 (78.4)	0.063
Rubella IgM	4 (0.4)	3 (0.5)	1.0
Rubella IgG	903 (96.2)	601 (97.4)	0.235
Cytomegalovirus IgM	2 (0.2)	1 (0.2)	1.0
Cytomegalovirus IgG	908 (96.7)	605 (98.1)	0.150
Herpes Simplex Virus IgM	0 (0)	0 (0)	*
Herpes Simplex Virus IgG	913 (97.2)	608 (98.5)	0.126
HBsAg	7 (0.7)	3 (0.5)	0.748
Anti-HBs	166 (17.7)	115 (18.6)	0.630
Anti-HCV	1 (0.1)	3 (0.5)	0.307
Anti-HIV	0 (0)	1 (0.2)	0.217

HBsAg: hepatitis B surface antigen, HCV: hepatitis C virus, HIV: human immunodeficiency virus

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Toxoplasma, Rubella and CMV Avidity Test Results

One of the four Toxoplasma IgM-positive pregnant women had low avidity and three had high avidity; two of the seven Rubella IgM-positive pregnant women had low avidity, five had high avidity, one of the three CMV IgM-positive pregnant women had low avidity, and two had high avidity (Figure 1C). Detailed data are presented in Table 3.

Table 3. Toxoplasma, Rubella and Cytomegalovirus avidity test results

	Low avidity (n=4)	High avidity (n=10)
Toxoplasma IgM (+) (n, %)	1 (25)	3 (75)
Rubella IgM (+) (n, %)	2 (28.5)	5 (71.5)
Cytomegalovirus IgM (+) (n, %)	1 (33.3)	2 (66.7)

Discussion

In this study, the seroprevalence of TORCH infection was investigated in a tertiary university hospital. Toxoplasma IgM positivity rate was 0.3% (n=4), Rubella IgM positivity rate was 0.4% (n=7), CMV IgM positivity rate was 0.2% (n=3), HBsAg positivity rate was 0.6% (n=10), anti-HCV positivity rate was 0.3% (n=4), and anti-HIV positivity rate was 0.06% (n=1) among 1556 pregnant women. In addition, IgG seropositivity rates for Toxoplasma, Rubella, and CMV were 76%, 96.7%, and 97.2%, respectively, and it was observed that the number of immunized individuals increased with age.

Toxoplasmosis is a widespread infection worldwide and in Türkiye, and is transmitted through the consumption of raw or undercooked meat, poorly washed vegetables and fruits, and materials contaminated with cat feces [6,7]. The seroprevalence of the disease varies depending on factors such as age, geographical region, hygiene conditions, lifestyle, and eating habits [8,9]. Toxoplasmosis in pregnancy can lead to severe fetal complications such as miscarriage, stillbirth, and severe malformations, especially in early pregnancy, but fetal effects are generally milder, although the risk of infection increases in the second and third trimesters [10,11]. However, the development of latent infection in the postnatal period can lead to complications such as vision loss, hearing loss, and neurological disorders in the late postnatal period. This situation emphasizes the critical importance of regular screening and early diagnosis, especially during pregnancy [8-11].

Recent studies have provided important data on the seroprevalence of Toxoplasma gondii in pregnant women. In Türkiye, the seroprevalence among 300 pregnant women was 12.7%, and living in a house with a garden was identified as a risk factor [12]. In an African meta-analysis, the seroprevalence among 29,383 pregnant women was 42.89%, with cat ownership and raw food consumption being the main risk factors [13]. In Morocco, the seroprevalence among 637 pregnant women was 43% and increased with age [14]. In a global meta-analysis, the IgG seroprevalence in pregnant women was 32.9%, highlighting regional differences [15]. In Egypt, the seroprevalence among 210 pregnant women was 36.7% [5]. In our study, Toxoplasma IgM seropositivity was 0.3%, whereas IgG seropositivity was 76% among pregnant women. These findings suggest that the number of pregnant women with previous infections and those who develop immunity increases with age.

Rubella infection can be transmitted transplacentally to the fetus during pregnancy, leading to serious congenital anomalies. The most common complications include congenital heart disease (especially patent ductus arteriosus), cataracts, sensorineural hearing loss, microcephaly, and developmental delay. Transmission of the virus to the fetus in the early stages of pregnancy increases the risk and severity of malformations [16]. Therefore, it is of great importance for individual and public health that women of childbearing age are seropositive for rubella [17]. In studies conducted in different countries, rubella seropositivity rates in women of childbearing age have been reported to vary between 70% and 99%. [18-20]. In studies conducted in Türkiye, Rubella IgM seropositivity rates were found to vary between 0% and 1.9%, while Rubella IgG seropositivity rates were found to vary between 82% and 93.5% [21]. It has been reported that rubella seropositivity rates increase with age owing to the effect of previous infections and the contribution of vaccination programs. The main objective of these vaccination programs is to control the development of congenital rubella syndrome by providing immunity to >90% of the pregnant women [7]. In our study, Rubella IgM seropositivity was 0.4% and IgG seropositivity was 96.7%. Our findings suggest that previous infections and the number of immunized pregnant women increase with age.

CMV is the most common congenital infection worldwide. Although most newborns are asymptomatic, 10-15% may develop serious complications, such as sensorineural hearing loss, visual disturbances, microcephaly, and neurological developmental delay. The rate of CMV seropositivity in pregnant women in the USA has been reported to be 50-60 [22]. In Nigeria, this rate has reached 96.5%, emphasizing the impact of socioeconomic conditions [23]. In Brazil, CMV seropositivity was reported to be over 90%, and hygiene conditions were reported as an important risk factor [24]. In our study, CMV IgM seropositivity was 0.2%, and IgG seropositivity was 97.2%, indicating that the number of immunized pregnant women increased with age.

HSV is widespread worldwide and rarely causes intrauterine infection in pregnancy, which can lead to serious complications such as hydrops fetalis, microcephaly, and intrauterine growth retardation [25]. Primary infection, especially in early pregnancy, increases the risk of permanent neurological damage to the fetus [26]. In the USA, the seroprevalence of HSV-2 was determined to be 22%, and the risk of transmission in the first trimester was reported as 30-50% [27]. In India, HSV-1 and HSV-2 seroprevalence was reported to be 70% and 40%, respectively, and in Africa, HSV-2 seropositivity was reported to be 52% [28]. In France, the rate of transmission to the fetus was 30% for primary

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infections and less than 1% for recurrent infections [26]. In our study, no HSV IgM seropositive pregnant women were found, while HSV IgG seropositivity was 97.8%, indicating that most pregnant women developed immunity due to previous infections.

HBV infection carries the risk of mother-to-baby transmission during pregnancy and is likely to be transmitted during delivery [29]. Early diagnosis makes it possible to administer hepatitis B immunoglobulin (HBIG) and vaccines to newborns, significantly reducing the risk of transmission and protecting infant health [30]. A study in Türkiye reported that administration of HBIG and vaccine to infants born to HBsAg-positive mothers prevented perinatal HBV transmission by 95% [31]. A study conducted in Taiwan showed that the combination of maternal antiviral therapy and neonatal vaccination reduced the risk of vertical transmission to less than 1% [32]. In our study, all ten HBsAg-positive pregnant women had cesarean delivery. This may be due to the preference for planned cesarean section to reduce the risk of vertical transmission.

HCV infection carries a risk of mother-to-baby transmission during pregnancy, and this risk is increased when the mother has a high viral load [33]. Although antiviral treatment is not recommended during pregnancy, it is important to closely monitor newborns of mothers with a high viral load for infection [34]. In a study conducted in Italy, it was reported that the rate of vertical transmission in infants of HCV RNA-positive mothers was 5-6%, but this rate increased up to 25% when the maternal viral load was above 10^6 copies/mL [34]. A study conducted in the USA has also shown that the risk of HCV transmission is significantly increased in infants of mothers with high viral loads [33]. In our study, all four HCV-positive pregnant women had cesarean deliveries. This may be due to the preference for planned cesarean section to reduce the risk of vertical transmission.

When left untreated, HIV can be transmitted from mother to baby at a high rate during pregnancy and can lead to serious complications [35]. However, antiretroviral treatment during pregnancy reduces this risk to 1-2%, protecting the health of both mother and baby. In a study conducted in France, it was reported that the rate of vertical transmission in infants of HIV-positive mothers who received antiretroviral therapy during pregnancy was less than 1% [36]. A study conducted in South Africa showed that the combination of maternal antiretroviral therapy and cesarean delivery reduced the risk of HIV transmission in newborns to less than 2% [35]. In our study, one HCV-positive pregnant woman had a cesarean delivery. This may be due to the preference for planned cesarean section to reduce the risk of vertical transmission.

As the study was conducted in a single university hospital, the generalizability of the findings is limited. It does not reflect the effects of different socioeconomic levels, geographical regions, or healthcare delivery standards. In addition, the retrospective design of the study may have increased the risk of potential data gaps or errors. Seroprevalence rates were not associated with important risk factors such as socioeconomic status, hygiene habits, or nutrition, limiting the opportunity for a more in-depth analysis of the causes of infection rates.

This study provided a strong statistical basis with a large sample size and included 1556 pregnant women, allowing for a reliable assessment of seroprevalence rates. It also provides a comprehensive perspective on public health by providing information on multiple types of infections critical to prenatal health. This study provides regional and up-to-date data, which is an important contribution to understanding the prevalence rates of TORCH infections, especially in Türkiye, and to develop relevant health policies. Comparison of seroprevalence rates by age group also provided guidance for more targeted public health interventions by highlighting age-related differences in infection and immunity levels.

Conclusion

This study revealed the seroprevalence of TORCH infections and age-related immune status in pregnant women followed up at a university hospital. These findings suggest that regular screening and assessment of immune status in the prenatal period are critical to protect maternal and fetal health. Previous infections and immunity were more prevalent, especially in older pregnancies. These results emphasize the need to strengthen vaccination programs and improve prenatal screening programs to increase population-based immunity levels. They also provide valuable contributions to the development of public health policies for TORCH infections and improvement of perinatal health services.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
This study was approved by the Non-Interventional Clinical Research Ethics Committee of the Kafkas University Faculty of Medicine (01/10/2024, 80576354-050-99/ 534).

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