BIBLIOGRAPHIC INFORMATION SYSTEM

Journal Full Title: Journal of Biomedical Research & Environmental Sciences

Journal NLM Abbreviation: J Biomed Res Environ Sci

Journal Website Link: <https://www.jelsciences.com>

Journal ISSN: 2766-2276

Category: Multidisciplinary

Subject Areas: Medicine Group, Biology Group, General, Environmental Sciences

Topics Summation: 128

Issue Regularity: Monthly

Review Process type: Double Blind

Time to Publication: 7-14 Days

Indexing catalog: [Visit here](#)

Publication fee catalog: [Visit here](#)

DOI: 10.37871 ([CrossRef](#))

Plagiarism detection software: [iThenticate](#)

Managing entity: USA

Language: English

Research work collecting capability: Worldwide

Organized by: [SciRes Literature LLC](#)

License: Open Access by Journal of Biomedical Research & Environmental Sciences is licensed under a Creative Commons Attribution 4.0 International License. Based on a work at SciRes Literature LLC.

Manuscript should be submitted in Word Document (.doc or .docx) through

Online Submission

form or can be mailed to support@jelsciences.com

Vision: Journal of Biomedical Research & Environmental Sciences main aim is to enhance the importance of science and technology to the scientific community and also to provide an equal opportunity to seek and share ideas to all our researchers and scientists without any barriers to develop their career and helping in their development of discovering the world.

ORIGINAL ARTICLE

Prevalence of Cytomegalovirus, Rubella and Toxoplasma gondii among Internally Displaced Women of District North Waziristan, Pakistan with Home Obstetric History

Saddam¹, Ghadir Ali², Abdul Rehman³ and Asim Shahzad^{1*}

¹Department of Microbiology and Biotechnology, Abasyn University, Peshawar 25000, Pakistan

²Department of Life Sciences, School of Science, University of Management and Technology (UMT), Lahore 54700, Pakistan

³Department of Microbiology, Kohat University of Science and Technology (KUST), Kohat 26000, Pakistan

ABSTRACT

The present study was conducted to estimate the prevalence rate and to identify risk factors of *Cytomegalovirus*, *Rubella* and *Toxoplasma gondii* among internally displaced women of District North Waziristan, Pakistan with home obstetric history. A total of 387 blood samples were collected from internally displaced infected women with the help of a comprehensive filled data form. To determine levels of *Cytomegalovirus*, *Rubella* and *Toxoplasma gondii* Infection, all blood samples were qualitative and quantitative analyzed using Immune chromatographic and Chemiluminescence Microparticle Immunoassay (CMIA) technique. Among 387 blood samples, the total numbers of reactive samples observed were 341 (88.11%) and non-reactive samples were 46 (11.88%). Of 341 (88.11%) reactive samples, the highest ratio 168 (49.26%) was reported for the co-infection of *Cytomegalovirus* and *Rubella*, followed by 76 (22.28%) for *Cytomegalovirus*, *Rubella* and *Toxoplasma gondii* combined. In reactive samples, the highest ratio of IgG was noted in order of CMV 22 (64.70%), *Rubella* 21 (67.74%) and *Toxoplasma gondii* 16 (72.72%), followed by IgG+IgM and IgM only. Regarding age-wise distribution, the highest ratio 144 (90.56%) of total reactive samples of *Cytomegalovirus*, *Rubella* and *Toxoplasma gondii* was reported in the 25-32 years old group of individuals. Similarly, the highest ratio 53 (48.18%) and 60 (41.66%) of co-infection among reactive samples for *Cytomegalovirus*, and *Rubella* was observed in 18-24 and 25-32 years old group. Further, the highest ratio of 100 (40.32%) of risk factors was observed in infected patients who were exposed to a poor hygienic environment and 57 (44.18%) of infected patients had complications of Severe UTI followed by others. Hence, it was revealed that *Cytomegalovirus*, *Rubella* and *Toxoplasma gondii* infection was most prevalent in internally displaced women of District North Waziristan, Pakistan. Therefore, an urgent base prophylactic approaches should need to be addressed to reduce the risk of the spread of disease in this locality.

*Corresponding author

Asim Shahzad, Department of Microbiology and Biotechnology, Abasyn University, Peshawar 25000, Pakistan

E-mail: asimshahzad87@yahoo.com

DOI: 10.37871/jbres1377

Submitted: 14 December 2021

Accepted: 22 December 2021

Published: 24 December 2021

Copyright: © 2021 Saddam, et al. Distributed under Creative Commons CC-BY 4.0

OPEN ACCESS

Keywords

- Prevalence
- *Cytomegalovirus*
- *Rubella*
- *Toxoplasma gondii*
- IDPs women
- Pakistan

INTRODUCTION

Now a day the congenital infections are one of the major causes of perinatal mortality and morbidity in developing countries [1]. Bad Obstetric History (BOH) involves earlier critical fetal outcome in conditions of two or more successive impulsive abortions, stillbirth, and history of intrauterine fetal fatality, early neonatal death, intrauterine growth retardation and congenital abnormalities [2]. The temporary immune suppression in pregnant women occurs during pregnancy due to which they become more vulnerable to different infection-causing organisms of TORCH family. The immune system of the fetus is weak and limited which cannot resist the dissemination of the infectious pathogen to

BIOLOGY GROUP

MICROBIOLOGY | VIROLOGY | BIOLOGY

VOLUME: 2 ISSUE: 12 - DECEMBER

How to cite this article: Saddam, Ali G, Rehman A, Shahzad A. Prevalence of *Cytomegalovirus*, *Rubella* and *Toxoplasma gondii* among Internally Displaced Women of District North Waziristan, Pakistan with Home Obstetric History. J Biomed Res Environ Sci. 2021 Dec 24; 2(12): 1231-1237. doi: 10.37871/jbres1377, Article ID: JBRES1377, Available at: <https://www.jelsciences.com/articles/jbres1377.pdf>

different organs [3]. Pathogens that belong to the TORCH family complex include *Cytomegalovirus* (CMV), *Rubella* virus and *Toxoplasma gondii* which are the main causative agents of BOH [4]. Such type of infection generally appears even before the woman realized that she is pregnant or requires medical awareness. The effect of the initial disease is more severe on the unborn fetus than the persistent disease [5]. Most frequently the pathogens CMV, *T. gondii* and *Rubella* infect traveler pregnant women and villagers living in areas of the weak resistant level, using not properly cooked meat, unclean vegetables, environment and deprived hygiene [6]. In the spread of CMV infection, contaminated body fluids like saliva, blood and urine are most commonly involved. Infection amongst expecting women develops over close contact with youngsters or due to sexual interaction with the male cohort [7]. In BOH the occurrence of toxoplasmosis is extremely to be concerned than those lacking it. These Infections throughout the prenatal period of gestation may be a clue to genetic deformity in 10–54 % of cases [8]. For the treatment of non-specific *Rubella*, different antiviral drugs are generally used, while for the treatment of congenital CMV infection, ganciclovir is recommended intravenously. Other orally antiviral drugs such as valganciclovir and ganciclovir have a great role in the treatment of infection. The acyclovir dose (20 mg/kg) is prescribed intravenously to the patient for 14–21 days and their blood cells count should be monitored during the treatment [9]. The present study aimed to evaluate and estimate the prevalence ratio of *Cytomegalovirus*, *Rubella* and *Toxoplasma gondii* infections among Internally Displaced Women (IDPs) of District North Waziristan, Pakistan with home obstetric history.

MATERIALS AND METHODS

Study area and duration

The present study was carried out at the Abasyn University Peshawar, Pakistan for a duration of 6 months from August 2017 to January 2018. A data form seeking demographics and clinical characteristics of CMV, *Rubella* and *Toxoplasma gondii* was filled from 387 individuals after taking the informed consents. Samples were collected from 387 infected women who were internally displaced from District North Waziristan region and admitted at the Hayat Abad Medical Complex (HMC) and North West General Hospital and Research Centre, Peshawar, Pakistan. Different age groups of individuals ranging from 18 to 45 years were included in the present study.

Sample collection, transportation and processing

A total of 387 blood samples were collected from infected women in a yellow top Gel and Clot activator tube from the infected patients. All samples were labeled properly with an Identification Number (PIN) and the complete history of each patient such as age, sex was specifically noted. To obtain serum from blood, samples were initially centrifuged

at 6000 rpm for 15 min on-site and stored at 21°C and then immediately transferred under the aseptic condition to the Microbiology Laboratory, Abasyn University, Peshawar, Pakistan for further processing.

Immuno chromatographic technique

Immune-Chromatographic Test (ICT) was performed for the detection of serum proteins (antigen). The process of ICT takes approximately 15 min to run. Before starting the test procedure the specimen and test component were brought to room temperature. The device was placed on a clean, flat surface after opening the pouch at the notch. The specimen ID number was labeled with the device 60–90 ml of the specimen or 2 drops of the sample were transferred with a plastic dropper into the well. The results for the qualitative determination of CMV, *Rubella* and *Toxoplasma gondii* antigen were noted after 15 min. If no line appears on T-line it shows a negative result, while if a line appears on T-line it shows a positive result.

Chemiluminescence Micro Particle Immunoassay (CMIA)

Chemiluminescence is a phenomenon in which light is emitted during a chemical reaction. In CMIA, a chemiluminescent molecule is used as an indicator label to detect or quantify immunological reactions. The centrifuged samples (human serum and plasma) were processed on CMIA for the quantitative determination of CMV, *Rubella* and *Toxoplasma gondii*. During processing on CMIA, a specific quantity of sample was sucked by the analyzer probe and was passed through the column where antigen reacted with its specific antibody which as a whole detected by the analyzer detector and were displayed on the screen and result was noted, correlated with the patients' proforma and was verified. All results were analyzed using GraphPad Prism software version (8.40).

RESULTS AND DISCUSSION

In the present study, a total of 387 blood samples were collected from internally displaced women of District North Waziristan, Pakistan with a home obstetric history. Samples were processed using the Immune-Chromatographic Test (ICT) and Chemiluminescence Micro-Particle Immunoassay (CMIA) technique to screen for reactive and non-reactive samples. Among 387 samples, 341 (88.11%) were found reactive while 46 (11.88%) were found non-reactive (Table 1). In a similar study, the same techniques such as ICT and CMIA were also used for the detection of CMV, *Rubella* and *Toxoplasma gondii* seroprevalence [10].

The reactive samples ($n = 341$) were further analyzed for the co-infection of CMV, *Rubella* and *Toxoplasma gondii*. Among them, 76 (22.28%) samples were determined for CMV, *Rubella* and *Toxoplasma gondii* combined, 168 (49.26%) for CMV and *Rubella*, 04 (1.17%) were for CMV and

Toxoplasma gondii, 06 (1.75%) for *Rubella* and *Toxoplasma gondii*, 34 (9.97%) were found for only CMV, followed by 31 (9%) for only *Rubella* and 22 (6.45) for only *Toxoplasma gondii* (Table 2). Although *Cytomegalovirus*, *Toxoplasma gondii* and *Rubella* infection is generally reported to be very common now a day, even in developed countries. A similar study was reported in Denizli province, Turkey, who stated that seroprevalence for *Rubella* was reported from 92.6%-97.3%, *Toxoplasma gondii* was from 30.7%-69.5% and for CMV was 93.5%-96.1% respectively [11].

For more analysis, the reactive samples of only *Cytomegalovirus*, *Rubella* and *Toxoplasma gondii* were further checked for the total number of antibodies such as IgG, IgM and IgG + IgM. Of the total 34 CMV samples, 08 (23.52%) were reactive for IgG+IgM, 22 (64.70%) for only IgG and 04 (11.76%) were reactive for only IgM. Similarly, of the total 31 *Rubella* samples, 07 (22.58%) were reactive for IgG+IgM, 21 (67.74%) for only IgG and 03 (9.67%) were reactive for only IgM. Furthermore, of the total of 22 *Toxoplasma gondii* reactive samples, 04 (18.18%) were reactive for IgG+IgM, 16 (72.72%) for only IgG and 02 (9%) were reactive for only IgM (Figure 1). In comparison, a study was conducted in Pokhara, Nepal, in which the IgG/IgM seropositivity for *Toxoplasma gondii* was 911.54%/1.92%, for *Rubella* (95.19%/0.0%), CMV (91.35%/0.96%) and HSV 1/2 (81.73%/ 1.92%) respectively [12]. Followed by another study in Peshawar, Pakistan, who reported (2.5%) prevalence for anti-*Toxoplasma* IgM antibodies, (1.5%) for *rubella*, (1.8%) for *cytomegalovirus* and (1.1%) *Herpes simplex virus* with a total prevalence of TORCH infection (6.99%) in 800 pregnant women [13].

Furthermore, samples from different age groups such as 18-24, 25-32, 33-39 and 40-44 were also checked for the reactivity of CMV, *Rubella*, and *Toxoplasma gondii*. Different reactive and non-reactive cases for CMV, *Rubella*

and *Toxoplasma gondii* were observed. From age 18-24, the number of reactive samples was 110 (90.16%) and non-reactive were 12 (9.83%) in a total of 122 samples. Followed by age 25-32, in which the number of reactive samples was 144 (90.56%) and non-reactive were 15 (9.43%) in a total of 159 samples. Similarly, from the 33-39 years group the numbers of reactive samples observed were 62 (86.30%) and non-reactive were 11 (15) in a total of 73 samples. The reactive samples observed in the age group of 40-44 years old were 25 (75.75%) and non-reactive were 08 (24.24%) in a total of 33 samples (Figure 2). A similar study was conducted from January to June 2009 to determine the seroprevalence of human *Cytomegalovirus* (HCMV) among 200 pregnant women admitted at Omdurman Maternity Hospital, Sudan. Of the 200 pregnant women, 195 (97.5%) were CMV IgG and 12 (6.0%) were CMV IgM positive. The average age of the tested women ranged from 18 to 43 years with significant history of miscarriage [14].

The reactive samples were also analyzed for the co-infection of CMV, *Rubella* and *Toxoplasma gondii* in different age groups. For CMV, *Rubella* and *Toxoplasma gondii* combined reactive samples the highest ratio 28 (19.44%) was found within the group of 25-32 years old individuals, while the lowest ratio 03 (12%) was in 40-44 years old group of individuals. Similarly, for CMV and *Rubella* combined samples, the highest ratio was 60 (41.66%) in the group of 25-32 years old individuals, while the lowest was 05 (20%) in the group of 40-44 years. Likewise, for CMV and *Toxoplasma gondii* combined samples, a 08 (5.55%) of highest ratio was observed in the age of 25-32 years old, while the lowest ratio 02 (8%) was observed among 40-44 years old individuals. Furthermore, the highest ratio 07(4.86%) for *Rubella* and *Toxoplasma gondii* combined samples was also found within the 25-32 years old group, while the lowest 02 (8%) was in the 40-44 years old group. Followed by, only CMV, for which the highest ratio 12 (10.90%) was observed within the group ranging from 18-24 years old individuals, while the least ratio 06 (24%) was found in 40-44 years old individuals. For only *Rubella*, the highest ratio was 15 (10.41%) in the group ranging from 25-32 years old, while the lowest ratio 03 (12%) was in the 40-44 age limits. Moreover, for *Toxoplasma gondii*, a 17 (11.80%) was observed the highest ratio within the group of 25-32 years old and the lowest 04 (16%) within 40-44 years old group of individuals as shown in (Table 3). Similarly, in another study, a high rate (77.8%) of co-infection was reported, in which (42.5%) of *Rubella* and CMV was observed with the control group (25%) and BOH (88.3%). Other agents with CMV and mixed infection were (77%) and *Rubella* with others was (66.7%) [15]. It has been stated that most of the infections related to CMV, *Rubella* and *Toxoplasma gondii* cause mild maternal morbidity, but have serious fetal consequences [16].

Furthermore, in reactive samples of different age groups CMV, *Rubella* and *Toxoplasma gondii* were screened for antibodies like IgG, IgM and IgG+IgM. From the age group

Table 1: Shows total, reactive and non-reactive samples in analyzed samples (n = 387).

Name of Sample	Total Number of Samples	Total %
Reactive	341	88.11
Non-Reactive	46	11.88
Total	387	100

Table 2: Shows the co-infection of CMV, *Rubella* and *Toxoplasma gondii* in total reactive samples (n = 341).

Name of co-infection	Total reactive Samples	Total %
CMV, <i>Rubella</i> & <i>Toxoplasma gondii</i>	76	22.28
CMV & <i>Rubella</i>	168	49.26
CMV & <i>Toxoplasma gondii</i>	04	1.17
<i>Rubella</i> & <i>Toxoplasma gondii</i>	06	1.75
CMV	34	9.97
<i>Rubella</i>	31	9
<i>Toxoplasma gondii</i>	22	6.45
Total	341	100

Figure 1 Shows the total number of IgG, IgM and IgG + IgM in CMV (a), Rubella (b) and Toxoplasma gondii (c) reactive samples.

Figure 2 Shows the age-wise distribution of total, reactive and non-reactive samples.

Table 3: Shows the co-infection of CMV, Rubella and Toxoplasma gondii in different age groups.

Reactive Samples	Age limit (year)			
	18-24 Count (%)	25-32 Count (%)	33-39 Count (%)	40-44 Count (%)
CMV, Rubella & Toxoplasma gondii	25 (22.72)	28 (19.44)	13 (20.96)	03 (12)
CMV & Rubella	53 (48.18)	60 (41.66)	19 (30.64)	05 (20)
CMV & Toxoplasma gondii	03 (2.72)	08 (5.55)	04 (6.45)	02 (8)
Rubella & Toxoplasma gondii	05 (4.54)	07(4.86)	05 (8)	02 (8)
CMV	12 (10.90)	10 (6.94)	08 (12.90)	06 (24)
Rubella	07 (6.36)	15 (10.41)	08 (12.90)	03 (12)
Toxoplasma gondii	05 (4.54)	17 (11.80)	05 (8)	04 (16)
Total	110 (100)	144 (100)	62 (100)	25 (100)

of 18-24, the total numbers of CMV reactive samples were 11. From age 25-32 these were 10, from age 33-39 these were 08 and from age 40-44 total number of CMV reactive sample were 06. Among total samples the highest ratio 08 (72.72%) of IgG was reported in the group of 18-24 years old individuals, the highest ratio 02 (25%) of IgM was observed in 33-39 years old group, while the highest ratio 02 (33.33%) of IgG+IgM was observed in the age group of 40-44 years old. Similarly, from age 18-24, the total no of *Rubella* reactive samples was 07. From age 25-32 these were 15. From age 33-39 these were 08 and from age 40-44 total no of *Rubella* reactive sample were 03. Among total samples, the highest ratio 10 (100%) of IgG and the highest ratio 03 (30%) of IgM was reported in the group of 25-32 years old individuals, while the highest ratio 02 (28.57%) of IgG+IgM observed in the age group of 18-24 years old. Likewise, from age 18-24 the total no of *Toxoplasma gondii* reactive samples was 05. From age 25-32 these were 17. From age 33-39 these were 05 from age 40-44 total no of *Toxoplasma gondii* reactive samples was 04. Among total samples, the highest ratio 04 (80%) of IgG was reported in the group of 33-39 years old individuals. The highest ratio 01 (25%) of IgM was reported in the 40-44 years old individuals, while the highest ratio 01 (20%) of IgG+IgM were observed in the age group of 18-24 years old. All the data is represented (Figure 3). In district Amritsar, India, the Seroprevalence of *Rubella* was determined in 580 women including 80 women of the medical community. The overall *Rubella* IgG seropositivity

was 68.8% while in women of the medical community it was 80%. The maximum numbers of women were seropositive (77.2%) in the age group of 26-35 years [17]. Followed by another study in southern Thailand, in which the overall seroprevalence of *toxoplasmosis* 181 (28.3%) was determined in a total of 640 pregnant women along with their associated risk factors. Of this, 138 (21.6%) were positive for only anti-*Toxoplasma* IgG antibody, 43 (6.7%) were positive for both IgG and IgM antibodies, and none were positive for IgM antibody [18].

The contributing risk factors to which reactive patients ($n = 248$) were linked and made them most vulnerable to the CMV, *Rubella* and *Toxoplasma gondii* infection were as 56 (22.58%) with Cattles, 100 (40.32%) with Environment, 39 (15.72%) with Diabetes, 23 (9.27%) patients with Obesity, 13 (5.24%) with HBV and 17 (6.85%) patients with HCV (Figure 4). It has been observed that contaminated environment and poor drainage system and unhygienic obstetric history was the main source of risk in causing *Cytomegalovirus*, *Toxoplasma gondii* and *Rubella* infection in the locality of North Waziristan, Pakistan. These observations are in similarity with other findings, they also stated that warm and humid environments [5], polluted water supplies [19], unhygienic cooking and practices [20], as well as high incidence ratio of HBV/HIV infection and weakened immune system [21] are the important factors that can increase or spread the chances of a disease.

Figure 3 Shows the age-wise distribution of CMV (a), *Rubella* (b) and *Toxoplasma gondii* (c) IgG, IgM and IgG+IgM antibodies.

In the present study, the complications noted due to CMV, Rubella and *Toxoplasma gondii* infection among reactive patients ($n = 248$) were as 39 (30.23%) patients had complete abortion stage, 13 (10%) patients were at risk of abortion, patients delivered their babies with malformation were 11 (8.5%), babies born with the evidence of diseases were 09 (6.97%) and patients had severe urinary tract infection were 57 (44.18%) (Figure 5). In relevancy, a study was reported in Saudi Arabia, in which high numbers of women (78.8%) were prone to primary infection with *T. gondii*. Among them, abortion was found in 29.1% (95) for the first or second time, while 9.5% (31) had abortions three times and more. It was observed that the *T. gondii* infection was the leading reason for the abortion [22]. Followed by another study, in which a total of 60 women (20–35 years) with BOH complications were studied. Among them, 47 (78%) had BOH and 36 (60%) had adverse outcomes occurred. In which 16 cases were reported in stillbirths, while the remaining 20 cases resulted in 7 abortions, 6 newborns with congenital malformations, 4 full-term stillbirths and 3 cases of Non-Immune Hydrops Fetalis (NIHF) [23].

Figure 4 Shows risk factors associated with CMV, Rubella and *Toxoplasma gondii* infection.

Figure 5 Shows complications related to CMV, Rubella and *Toxoplasma gondii* infection.

CONCLUSION

The present study reported a high prevalence of CMV, Rubella and *Toxoplasma gondii* 341 (88.11%) in an adult group of woman population among IDPs of District North Waziristan, Pakistan. Among them, a high prevalence ratio of co-infection was observed for CMV and Rubella 168 (49.26%), followed by CMV, Rubella and *Toxoplasma gondii* combined 76 (22.28%) and vice versa. The highest ratio of 144 (90.56%) of total reactive samples of CMV, Rubella and *Toxoplasma gondii* was reported in the 25–32 years old group of individuals. Further, the highest ratio 53 (48.18%) and 60 (41.66%) of co-infection among reactive samples for CMV and Rubella were observed in 18–24 and 25–32 years group members. Furthermore, in reactive samples, the highest ratio of IgG was noted in order of CMV 22 (64.70%), Rubella 21 (67.74%) and *Toxoplasma gondii* 16 (72.72%). The infected patients were mostly exposed to a poor hygienic environment and had a higher ratio of 100 (40.32%) among other contributing risk factors. Similarly, the highest ratio of complications caused in infected patients due to CMV, Rubella and *Toxoplasma gondii* infection was Severe UTI 57 (44.18%) followed by others.

RECOMMENDATIONS

It is recommended to aware community of the importance of CMV, Rubella and *Toxoplasma gondii* infection to avoid complications. A good and fresh environment, lifestyle modifications and a clean drainage system can help to prevent the CMV, Rubella and *Toxoplasma gondii* infection in a community. Clinical utility of sterilized supplementations and food fortification programs to avoid complications of these preventable diseases would be highly desirable. A suggested reasonable approach is the annual and serial monitoring of CMV, Rubella and *Toxoplasma gondii* concentration in the healthy adult women population for early detection and prevention and follow-up in deficient individuals after supplementation is strongly encouraged.

ACKNOWLEDGMENTS

We would like to thank the Department of Microbiology, Abasyn University, Peshawar, Pakistan for providing us technical support in samples collection and Lab facilities for conducting this research work.

References

- Shet A. Congenital and perinatal infections: throwing new light with an old TORCH. Indian J Pediatr. 2011 Jan;78(1):88-95. doi: 10.1007/s12098-010-0254-3. Epub 2010 Oct 16. PMID: 20953849.
- Lagrou K, Bodeus M, Van Ranst M, Goubau P. Evaluation of the new architect cytomegalovirus immunoglobulin M (IgM), IgG, and IgG avidity assays. J Clin Microbiol. 2009 Jun;47(6):1695-9. doi: 10.1128/JCM.02172-08. Epub 2009 Apr 1. PMID: 19339470; PMCID: PMC2691071.
- Guan Y, Sun D. TORCH infection in pregnant women: an analysis of 2862 cases. Chinese Journal of Nosocomiology. 2010;20(19):2956-7.
- Rajani M. Serological profile of TORCH infection among antenatal women at a tertiary care center in North India. J Pure Appl Microbiol. 2018 Dec 1;12(4):2305-2311. doi: 10.22207/JPAM.12.4.72

5. Ocak S, Zeteroglu S, Ozer C, Dolapcioglu K, Gungoren A. Seroprevalence of *Toxoplasma gondii*, rubella and cytomegalovirus among pregnant women in southern Turkey. *Scand J Infect Dis*. 2007;39(3):231-4. doi: 10.1080/00365540600978880. PMID: 17366053.
6. Yeung S, Davies EG. Infection in the fetus and neonate. *Medicine*. 2005 Apr 1;33(4):91-7.
7. Cannon MJ. Congenital cytomegalovirus (CMV) epidemiology and awareness. *J Clin Virol*. 2009 Dec;46 Suppl 4:S6-10. doi: 10.1016/j.jcv.2009.09.002. Epub 2009 Oct 2. PMID: 19800841.
8. Singh MP, Arora S, Das A, Mishra B, Ratho RK. Congenital rubella and cytomegalovirus infections in and around Chandigarh. *Indian J Pathol Microbiol*. 2009 Jan-Mar;52(1):46-8. doi: 10.4103/0377-4929.44962. PMID: 19136779.
9. Rawlinson WD, Boppana SB, Fowler KB, Kimberlin DW, Lazzarotto T, Alain S, Daly K, Doutré S, Gibson L, Giles ML, Greenlee J, Hamilton ST, Harrison GJ, Hui L, Jones CA, Palasanthiran P, Schleiss MR, Shand AW, van Zuylen WJ. Congenital cytomegalovirus infection in pregnancy and the neonate: Consensus recommendations for prevention, diagnosis, and therapy. *Lancet Infect Dis*. 2017 Jun;17(6):e177-e188. doi: 10.1016/S1473-3099(17)30143-3. Epub 2017 Mar 11. PMID: 28291720.
10. Mocanu AG, Gorun F, Ciohat I, Navolan D, Malita D, Vilibic-Cavlek T, Dahma G, Neamtu R, Popescu D, Cioca A, Craina M. Simultaneous Seroprevalence to *Toxoplasma gondii*, Cytomegalovirus and Rubella Virus in Childbearing Women from Western Romania. *Medicina (Kaunas)*. 2021 Sep 2;57(9):927. doi: 10.3390/medicina57090927. PMID: 34577850; PMCID: PMC8469601.
11. Karabulut A, Polat Y, Türk M, Balci YI. Evaluation of rubella, *Toxoplasma gondii*, and cytomegalovirus seroprevalences among pregnant women in Denizli province. *Turkish Journal of Medical Sciences*. 2011 Feb 14;41(1):159-64. doi:10.3906/sag-1001-568
12. Acharya MR. Study of *Toxoplasma gondii*, Rubella, CMV and HSV antibodies among pregnant women in pokhara, Nepal. *IOSR Journal of Dental and Medical Sciences*. 2020;19(1)42-47. <https://tinyurl.com/2p8rbdns>
13. Zeb MA, Jamal SF, Mir A, Khan AA, Ullah A. Frequency of torch infections during pregnancy in Peshawar. *Pakistan Advances in Applied Science Research*. 2018;9(1):22-26. <https://tinyurl.com/ytjmmb4d>
14. Khairi SI, Intisar KS, Enan KH, Ishag MY, Baraa AM, Ali YH. Seroprevalence of cytomegalovirus infection among pregnant women at Omdurman Maternity Hospital, Sudan. *Journal of Medical Laboratory and Diagnosis*. 2013 Oct 30;4(4):45-9. doi:10.5897/JMLD2013.0075
15. Alsamarai AM, Hassan HM, Alsalihi FG, Alobaidi AH, Aljumaili ZK. *Toxoplasma gondii*, Rubella and Cytomegalovirus co-infections as risk factors for abnormal pregnancy outcomes. *World Family Medicine Journal: Incorporating the Middle East Journal of Family Medicine*. 2014 Apr;99(1147):1-8.
16. Karacan M, Batukan M, Cebi Z, Berberoglugil M, Levent S, Kir M, Baksu A, Ozel E, Camlibel T. Screening cytomegalovirus, rubella and toxoplasma infections in pregnant women with unknown pre-pregnancy serological status. *Arch Gynecol Obstet*. 2014 Dec;290(6):1115-20. doi: 10.1007/s00404-014-3340-3. Epub 2014 Jul 16. PMID: 25027818.
17. Singla N, Jindal N, Aggarwal A. The seroepidemiology of Rubella in Amritsar (Punjab). *Indian J Med Microbiol*. 2004 Jan-Mar;22(1):61-3. PMID: 17642690.
18. Nissapattom V, Suwanrath C, Sawangjaroen N, Ling LY, Chandeying V. Toxoplasmosis-serological evidence and associated risk factors among pregnant women in southern Thailand. *Am J Trop Med Hyg*. 2011 Aug;85(2):243-7. doi: 10.4269/ajtmh.2011.10-0633. PMID: 21813842; PMCID: PMC3144820.
19. Shahzad A, Mian AH, Khan MA, Ali K, Hamid T. The emergence of different bacterial pathogens in hospital wastewater samples and their antibiotic resistance pattern. *Materials Circular Economy*. 2021 Dec;3(1):1-8. doi:10.1007/s42824-021-00046-y
20. Shahzad A, Ullah F, Irshad H, Ahmed S, Shakeela Q, Mian AH. Molecular detection of Shiga toxin-producing *Escherichia coli* (STEC) O157 in sheep, goats, cows and buffaloes. *Mol Biol Rep*. 2021 Aug;48(8):6113-6121. doi: 10.1007/s11033-021-06631-3. Epub 2021 Aug 10. PMID: 34374895.
21. Shahzad A, Anwar MF, Mian AH, Rehman A, Matiullah. Pharmacotherapy of different tuberculosis patients its analysis and outcomes: A retrospective cohort study. *J Biomed Res Environ Sci*. 2021 Nov 29;2(11):1154-1158. doi: 10.37871/jbres1363
22. Mohamed K, Bahathiq A, Degnah N, Basuni S, Al Malki A, Babalghith A. Detection of *Toxoplasma gondii* infection and associated risk factors among pregnant women in Makkah Al Mukarramah, Saudi Arabia. *Asian Pacific Journal of Tropical Disease*. 2016 Feb 1;6(2):113-9. doi: 10.1016/S2222-1808(15)60995-1
23. Kishore J, Misra R, Paisal A, Pradeep Y. Adverse reproductive outcome induced by Parvovirus B19 and TORCH infections in women with high-risk pregnancy. *J Infect Dev Ctries*. 2011 Dec 13;5(12):868-73. doi: 10.3855/jidc.1533. PMID: 22169786.

How to cite this article: Saddam, Ali G, Rehman A, Shahzad A. Prevalence of *Cytomegalovirus*, *Rubella* and *Toxoplasma gondii* among Internally Displaced Women of District North Waziristan, Pakistan with Home Obstetric History. *J Biomed Res Environ Sci*. 2021 Dec 24; 2(12): 1231-1237. doi: 10.37871/jbres1377, Article ID: JBRES1377, Available at: <https://www.jelsciences.com/articles/jbres1377.pdf>