

Serological Detection of measles virus in association with IL-10 and IL-17 levels in aborted women

Mohammed Jasim Mohammed Shallal¹, Hayder Raad Abbas¹, Nadia Saddam Fahad²

¹DEPARTMENT OF MICROBIOLOGY, COLLEGE OF MEDICINE, UNIVERSITY OF THI-QAR, THI-QAR, IRAQ,

²DEPARTMENT OF OBSTETRICS AND GYNECOLOGY, COLLEGE OF MEDICINE, UNIVERSITY OF THI-QAR, THI-QAR, IRAQ

ABSTRACT

Aim: To investigate immunological markers that may be associated with measles viral infections in aborted women, specifically cytokines IL-10 and IL-17.

Materials and Methods: From October 2024 to the end of December 2024, the study included 352 participants, comprising 176 females with a history of abortions and 176 females with normal pregnancies, who acted as a control group. Serum samples were analyzed for IL-10 and IL-17 using the enzyme-linked immunosorbent assay (ELISA) method.

Results: The serum level of IL-10 was significantly lower in women with abortion compared to the control group, with a median of 216.02 pg/ml versus 329.79 pg/ml, respectively ($p < 0.001$). Similarly, the serum level of IL-17 was significantly higher in women with abortion compared to the control group, with a median of 85.24 pg/ml versus 51.76 pg/ml, respectively ($p < 0.001$).

Conclusions: The main clinical features of a viral infection, such as measles, during pregnancy are fever. Correlation of IL-10 and IL-17 to measles infection in the control group: Measles IgM and IgG showed no significant correlation to IL-10 and IL-17 ($p > 0.05$). In the abortion group, measles IgM and IgG showed significant positive correlation to IL-10 and IL-17 $p < 0.001$, finally, family history is a significant risk factor for abortion.

KEY WORDS: measles virus, Interleukin-10, Interleukin-17, enzyme-linked immunosorbent assay, abortion

Wiad Lek. 2026;79(1):38-45. doi: 10.36740/WLek/216769 DOI

INTRODUCTION

Measles virus (MV) is a single-stranded, negative-sense RNA virus that belongs to the *Morbillivirus* genus and the *Paramyxoviridae* family. Its genome encodes at least six structural proteins, causing an acute, highly contagious infection primarily seen in children. Recovery is typically successful, but severe complications may occur [1]. It disseminates through the respiratory system via respiratory droplets, with humans being the only known reservoirs for MV [2]. MV infection during pregnancy is linked to a heightened risk of preterm labor, spontaneous abortion, and low birth weight in the neonate [3]. When measles appears late in pregnancy, it may lead to congenital infection, which can present in numerous ways and raise the risk of severe encephalitis in newly born infected mothers. Furthermore, pregnant individuals are at a higher risk of complications, such as pneumonia, compared to non-pregnant women [3-4]. Interleukin is a cytokine that facilitates communication between leukocytes and other cell types, exhibiting various stimulatory activities that regulate immune, inflammatory, and hematopoietic responses [5]. IL-10 is an important cytokine that

reduces inflammation. It is produced by immune cells like macrophages, natural killer (NK) cells, dendritic cells (DCs), CD8 T cells, B cells, and dermal keratinocytes [6]. It regulates cellular immunity by limiting cell-mediated responses and reducing proinflammatory cytokines during infections, thereby mitigating their negative effects. In particular, IL-10 suppresses responses by weakening APC antigen presentation [6-7]. The IL-17 cytokine family comprises IL-17A through IL-17F. Interleukin-17 is produced by CD4 and Th17 cells [8]. Interleukin-17 (IL-17) is known as an inflammatory cytokine that mainly affects myeloid and Mesenchymal cells. It does this by encouraging the production of certain chemokine that attract neutrophils to infection sites [6, 9]. Cytokines play an important role in reducing the detrimental effects of viral infections, as well as pro-inflammatory reactions [8, 10].

AIM

Aim of this study is to investigate immunological markers that may be associated with measles viral infections in aborted women, specifically cytokines IL-10 and IL-17.

MATERIALS AND METHODS

PARTICIPANTS AND STUDY DESIGN

From October 2024 to the end of December 2024, the research was conducted. Samples were collected from Al-Rumaitha General Hospital and the Gynecology and Pediatrics Teaching Hospital in the Al-Muthanna Governorate. A total of 352 participants were included in the study, comprising 176 women who had previously experienced abortions and 176 women in a control group with normal pregnancies without abortions. All participants were between the ages of 18 and 45.

SAMPLES COLLECTION

According to the aim of this study, which focused on detecting each rubella and measles virus, the most relevant women with miscarriage were collected in the first trimester, particularly before 12–16 weeks, and extended to the second trimester within 18–20 weeks of pregnancy. This is because of a high risk of getting infection with these viruses, especially rubella virus infection with serious consequences for fetuses.

Miscarriages occurred between the first and twentieth weeks as follows:

In the first trimester, there were 108 women (23 in weeks 1–6, 33 in weeks 7–9, and 52 in weeks 10–13).

In the second trimester, the number of women was 68 (from the 14th to the 15th week, there were 12 women, and from the 16th to the 20th week, there were 56 women).

All women in the patient group had experienced a spontaneous miscarriage, while the control group included pregnant women who had not experienced any type of miscarriage.

This study includes 4 ml of whole blood samples from both control and patient groups. The samples are centrifuged for 5 minutes at 4000 rpm. Serum samples are then analyzed to detect virus antibodies and cytokine markers such as IL-10 and IL-17. ELISA can identify measles through the presence of IgG and IgM antibodies.

INCLUDED CRITERIA

I grouped patients based on specific criteria. All patients participating in this study are using specific data pertaining to their needs. The following patients were enrolled in the study and had their information gathered, as detailed in the questionnaire: The family has a medical history. Date of birth, place of residence, clinical picture, and profession are all pieces of demographic data. Through the review of women with miscarriage in hospitals, all clinical signs were examined and record-

ed, and their general health condition was confirmed. Based on the comparison between the aborted and non-aborted cases regarding specific symptoms, such as rash, fever, and other general symptoms related to the general health of these individuals.

EXCLUDED CRITERIA

The study established specific inclusion criteria for patients based on age groups, and it excluded patients 46 years old or older. The study also excluded patients with autoimmune diseases or chronic diseases.

IL-10 AND IL-17 AND MEASLES VIRUS IGG AND IGM INVESTIGATION

A human interleukin ELISA kit was used for the test. IL-10, IL-17 (Bioassay Technology Laboratory), and measles virus IgG and IgM were measured and detected according to the ELISA kit instructions (SunLong Biotech Co., LTD).

STATISTICAL ANALYSIS

Microsoft Office Excel 2010 and the Statistical Package for the Social Sciences (SPSS) version 23 were used for data collection, summarization, analysis, and presentation. To express normally distributed numerical variables as mean (a measure of central tendency) and standard deviation, quantitative (numerical) variables were first assessed for normal distribution using the Kolmogorov-Smirnov test. Quantitative (numerical) variables were represented by means and standard deviations, while qualitative (categorical) variables were represented by numbers and percentages (a measure of dispersion). The following statistical tests were used in this investigation: The Fisher exact test was used in situations where the chi-square test proved unreliable. A significance threshold was considered reached when the P-value was 0.05 or below.

RESULTS

Clinical features contrasted between the abortion group and the control group are shown in Table (1). A rash was seen in a single case in the abortion group, and fever was reported in a substantial proportion of patients in the abortion group. The rash symptom showed no significant variation ($p = 1.000$); whereas, fever showed a significant association with abortion $p < 0.001$.

The risk association between current abortion and family history of abortion is shown in Table (2). It was observed that a positive family history of abortion was reported in 25.6%

Table 1. Clinical features contrasted between abortion group and control group

Characteristic	Abortion group n = 176	Control group n = 176	p
Rash			
Positive	1 (0.6%)	0 (0.0%)	1.000 F NS
Negative	175 (99.4%)	176 (100.0%)	
Fever			
Positive	45 (25.6%)	10 (5.7%)	<0.001 C ***
Negative	131 (74.4%)	166 (94.3%)	

n: number of cases; F: Fischer exact test; C: chi-square test; NS: not significant; ***: significant at $p \leq 0.001$

Source: compiled by the authors of this study

Table 2. Risk association between current abortion and family history of abortion

Characteristic	Abortion group n = 176	Control group n = 176	p	OR	95%CI
Family history of abortion					
Positive	45 (25.6%)	10 (5.7%)	<0.001 C ***	5.70	2.77 -11.74
Negative	131 (74.4%)	166 (94.3%)			

n: number of cases; OR: odds ratio; CI: confidence interval; C: chi-square test; ***: significant at $p \leq 0.001$

Source: compiled by the authors of this study

Table 3. Comparison of serum IL-10 and IL-17 levels between abortion and control groups

Characteristic	Abortion group n = 176	Control group n = 176	p
IL -10			
Median (IQR)	216.02 (65.55)	329.79 (323.88)	<0.001 M ***
Range	101.91 -504.65	18.54 -7858.60	
IL -17			
Median (IQR)	85.24 (52.37)	51.76 (19.45)	<0.001 M ***
Range	9.52 -1239.57	11.29 -950.62	

IQR: inter-quartile range; IL-10: interleukin-10; IL-17: interleukin-17; M: Mann Whitney U test; ***: significant at $p \leq 0.001$.

Source: compiled by the authors of this study

Table 4. Correlation of IL-10 and IL-17 to measles and Rubella infection

Infection	Statistic index	Control group		Abortion group	
		IL -10	IL -17	IL-10	IL-17
Measles IgM	r	-0.121	-0.036	0.292	0.382
	p	0.111	0.632	<0.001 ***	<0.001 ***
Measles IgG	r	-0.003	-0.004	0.496	0.376
	p	0.973	0.960	<0.001 ***	<0.001 ***

*: significant at $p \leq 0.05$; **: significant at $p \leq 0.01$; ***: significant at $p \leq 0.001$

Source: compiled by the authors of this study

of women in the abortion group and in only 5.7% of women in the control group. Thus, the proportion is significantly higher in women with abortions than in the control group $p < 0.001$. In terms of risk, the reported odds ratio was 5.7 (95% CI of 2.77-11.74); therefore, a woman with a positive family history of abortion is at approximately six times higher risk compared to women with a negative family history.

Comparison of serum IL-10 and IL-17 levels between the abortion and control groups is shown in Table (3) and Figures (1-2). The serum level of IL-10 was significantly lower in women

with abortions compared to the control group, with a median of 216.02 pg/ml versus 329.79 pg/ml, respectively ($p < 0.001$). The serum level of IL-17 was also significantly higher in women with abortions compared to the control group, with a median of 85.24 pg/ml versus 51.76 pg/ml, respectively; $p < 0.001$.

The correlation of IL-10 and IL-17 to measles infection is shown in Table (4). In the control group, measles IgM and IgG showed no significant correlation to IL-10 and IL-17 ($p > 0.05$). In the abortion group, measles IgM and IgG showed a significant positive correlation to IL-10 and IL-17 ($p < 0.001$).

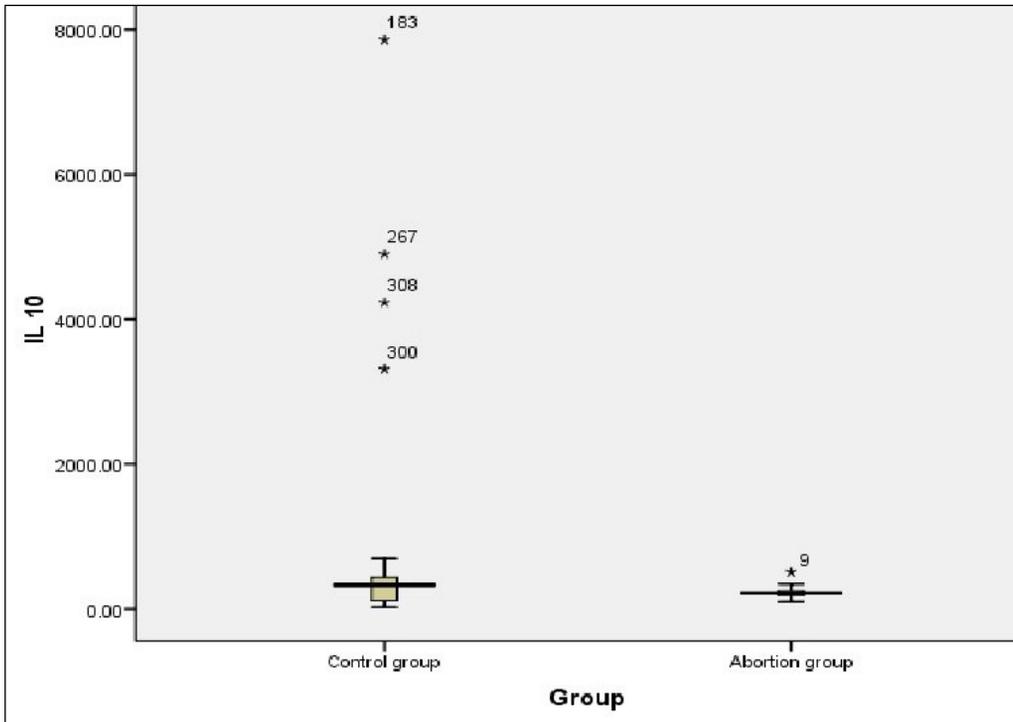


Fig. 1. Box plot showing comparison of serum IL-10 levels between abortion and control groups
 Source: compiled by the authors of this study

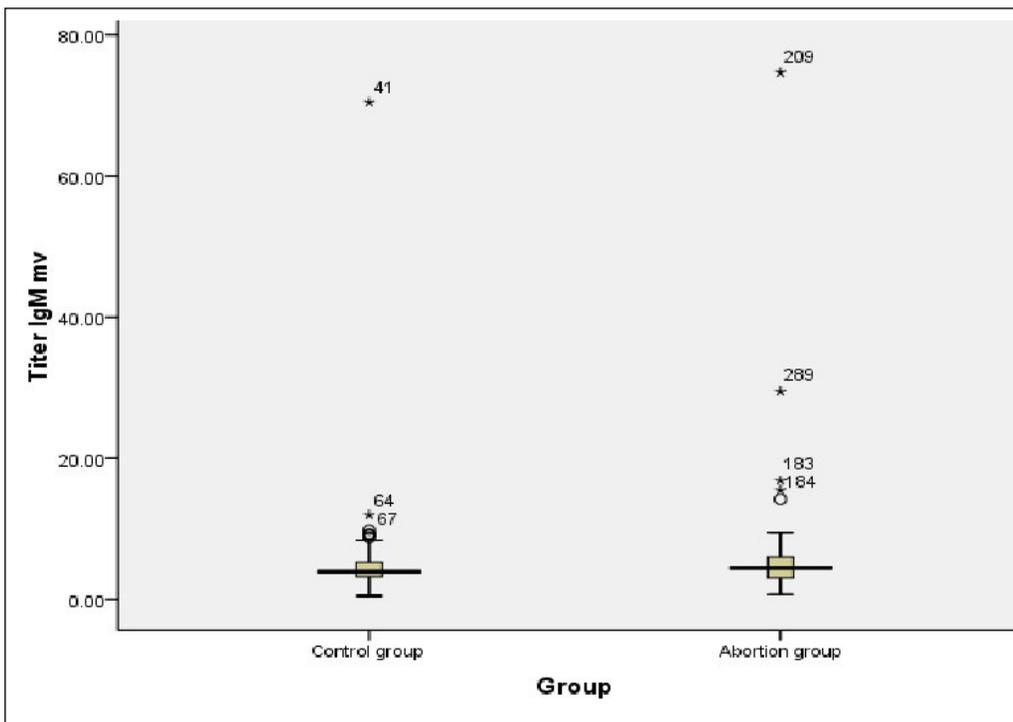


Fig. 2. Box plot showing comparison of serum IL-17 levels between abortion and control groups
 Source: compiled by the authors of this study

Comparison of titer levels of IgM and IgG for measles virus between the patient group and the control group is shown in Figures 3 and 4. Regarding measles, there was no significant difference in the levels of IgM and IgG between the abortion group and the control group ($p > 0.05$).

DISCUSSION

Regarding the association between fever and abortion in this study, the results align with previous reports [11-

13]. One study reported that a significant proportion of women with fever 8% experienced abortion early in pregnancy [13]. Fever during early pregnancy is often a clinical sign of maternal viral or bacterial infection [14]. Among well-known viral infections, measles and rubella viruses are implicated as risk factors for adverse pregnancy outcomes. In a study of 55 pregnant women with measles, this viral infection was identified as a significant contributor to miscarriage $p = 0.011$ [15]. Additionally, this study found that a positive family history

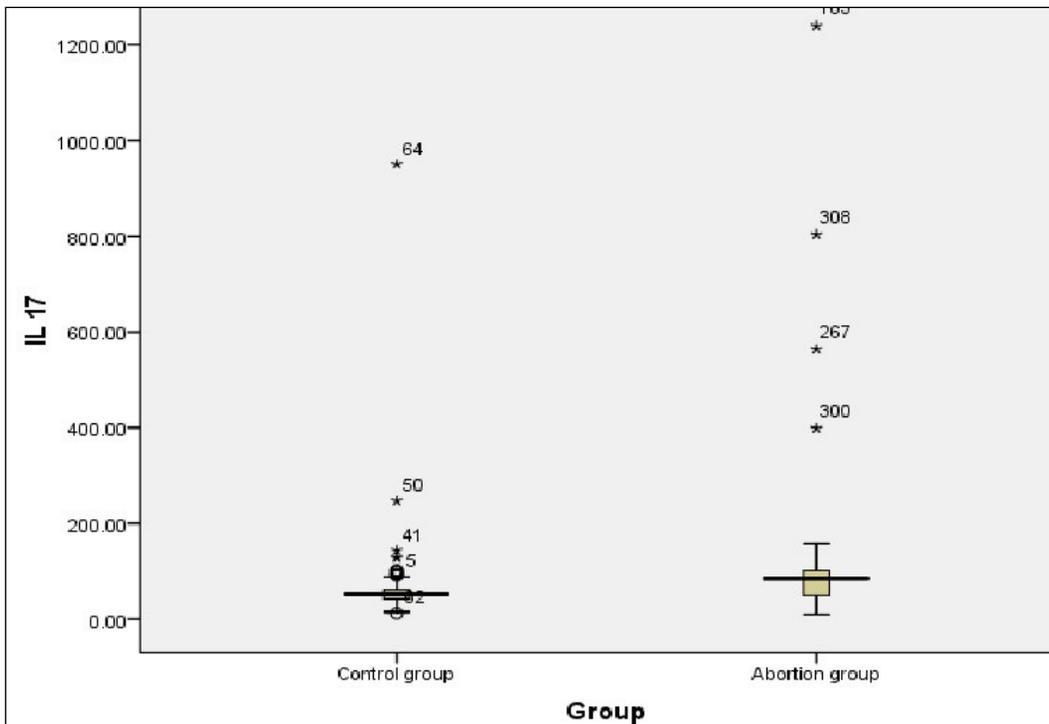


Fig. 3. Box plot showing comparison of IgM antibody titers for measles virus between abortion group and control group
Source: compiled by the authors of this study

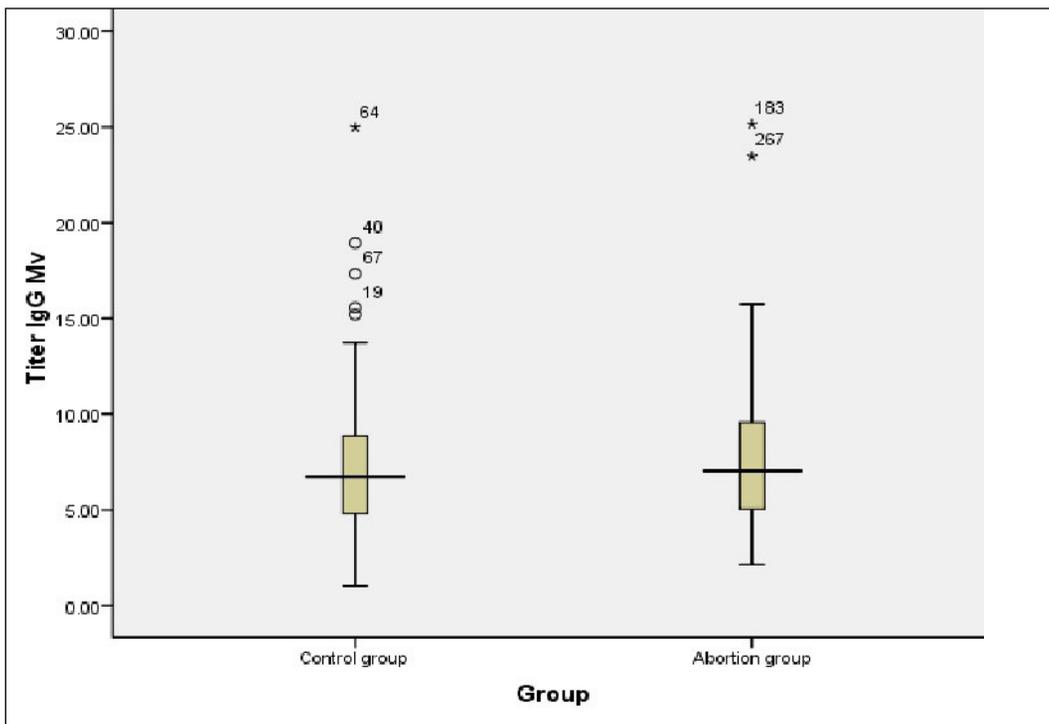


Fig. 4. Box plot showing comparison of IgG antibody titers of measles virus between abortion group and control group
Source: compiled by the authors of this study

of abortion is a significant risk factor. These findings are consistent with previous reports by several authors who examined the association between a positive family history and the current status of abortion [16-17]. Parental genetic polymorphisms related to immunological responses, coagulation processes, metabolic functions, and angiogenesis have been linked to idiopathic or recurrent miscarriage [18-19]. It is estimated that over 5% of couples experiencing recurrent miscarriage may carry chromosomal anomalies, which could increase the

risk of chromosomal irregularities in the fetus, leading to miscarriage or recurrent miscarriage [20]. If genetic determinants, such as specific gene polymorphisms or chromosomal rearrangements, play a role in miscarriage or recurrent miscarriage, it is plausible that this genetic susceptibility could be transmitted through familial lineages. Numerous environmental and lifestyle factors have also been implicated in miscarriage, including exposure to ionizing radiation, environmental heavy metals, chemical substances, tobacco use, caffeine con-

sumption, extremes of body mass index, and illicit drug use [17, 21]. Additionally, it is conceivable that these factors may be inherited across generations within the same family, potentially explaining the familial patterns of miscarriage observed among relatives [17]. According to [22], the level of IL-10 is reduced in cases of abortion. Human IL-10, which has a variable immunologic function that can be either stimulatory or counter-regulatory, is located on chromosome 1q32. IL-10 is referred to as a Th2 cytokine and has anti-inflammatory effects against the cytokines produced by the Th1 subset [22]. Reports have also linked reduced IL-10 levels to premature birth [23]. Based on the observation of [24], median levels of IL-10 are statistically significantly lower in pathological conditions compared to matching gestational ages of normal pregnancy. Successful pregnancy depends on the mother's immune system's ability to undergo immunoregulation to tolerate the fetus and to create and sustain a nurturing environment throughout all stages of pregnancy. Several reports indicate that interleukin 10 (IL-10) is vital for normal pregnancy, and low IL-10 levels are associated with pregnancy complications [24]. A study conducted by Sharief et al., (2014) showed that serum IL-10 levels are reduced in cases of abortion [25]. On the contrary, Bakir et al., [26] proved that IL-10 was higher in control group than in recurrent spontaneous [26]. IL-17 expression has been evaluated in various pregnancy-related situations, although the data from these studies are often controversial. For instance, one study reported higher IL-17 levels in patients with unexplained recurrent spontaneous abortion (URSA) compared to women with normal early pregnancies. Importantly, in this study, samples were obtained before artificial miscarriage [27]. Conversely, Hosseini et al., [28] found high IL-17 levels in the menstrual blood of healthy fertile women but not in URSA patients, suggesting that high IL-17 levels may

create an optimal environment for successful embryo implantation [28]. Additionally, the invasion of maternal tissues by the fetus can be compared to an allograft, and Th17 cells have been reported to play a significant role in allograft rejection [29]. The proposal of a Th1/Th2 balance to a favorable pregnancy outcome, in which a Th2- type cytokine response is predominant, was reinforced by a Th1 prevalence in various pregnancy complications. However, this dichotomy has been challenged by recent findings regarding the role of Th17 cytokines both in normal and pathological pregnancies [30]. Consistent with other research, this study has not found any evidence that measles causes abortions [31-32]. During viral infections, levels of interleukin-10 (IL-10) and interleukin-17 (IL-17) are significantly altered, reflecting both proinflammatory and anti-inflammatory immune responses. For instance, IL-10, which works as an anti-inflammatory cytokine, is commonly elevated in many viral diseases, including papillomavirus infection as cutaneous or mucosal warts, COVID-19, human immunodeficiency virus (HIV), hepatitis B virus (HBV), and hepatitis C virus (HCV). Its elevation is often associated with disease severity, immunosuppression, and poor clinical outcomes. For example, in both *Papillomaviral* infection and COVID-19, IL-10 levels are significantly higher in severe and critical cases, contributing to immune dysfunction and cytokine storms [33-35].

CONCLUSIONS

The main clinical features of a viral infection, such as measles, during pregnancy are fever. Correlation of IL-10 and IL-17 to measles infection in the control group: Measles IgM and IgG showed no significant correlation to IL-10 and IL-17 ($p > 0.05$). In the abortion group, measles IgM and IgG showed significant positive correlation to IL-10 and IL-17 ($p < 0.001$).

REFERENCES

- Misin A, Antonello RM, Di Bella S, Campisciano G, Zanotta N, Giacobbe DR, Comar M, Luzzati R. Measles: an overview of a re-emerging disease in children and immunocompromised patients. *Microorganisms*. 2020;8(2):276. doi: 10.3390/microorganisms8020276. DOI
- Gumar AS, Ali TH. Assessment of measles vaccine effectiveness and its correlation with IL-6 and INF- γ in vaccinated children of Thi-Qar Province, Iraq. *Microbes and Infectious Diseases*. 2025. doi: 10.21608/mid.2025.359152.2527 DOI
- Anselem O, Tsatsaris V, Lopez E, Krivine A, et al. Rougeole et grossesse. *Press Med*. 2011;40(11):1001-7. doi: 10.1016/j.lpm.2011.07.002. DOI
- Honarvar B, Moghadami M, Moattari A, Emami A, Odoomi N, Bagheri Lankarani K. Seroprevalence of Anti-Rubella and Anti-Measles IgG Antibodies in Pregnant Women in Shiraz, Southern Iran: Outcomes of a Nationwide Measles-Rubella Mass Vaccination Campaign. *PLoS One*. 2013;8(1):2-9. doi: 10.1371/journal.pone.0055043 DOI
- Ihim SA, Abubakar SD, Zian Z, Sasaki T, Saffarioun M, Maleknia S, Azizi G. Interleukin-18 cytokine in immunity, inflammation, and autoimmunity: Biological role in induction, regulation, and treatment. *Front Immunol*. 2022;13:919973. doi: 10.3389/fimmu.2022.919973. DOI
- Mahdi H, Shallal MJM, Naif AAH. Prevalence of non-genital warts generated by human papillomaviruses and role of interleukins IL10, IL17, and hematological parameters. *Ro Med J*. 2025;72(1):5-10. doi: 10.37897/RMJ.2025.1.1.

7. Kumar R, Ng S, Engwerda C. The role of IL-10 in malaria: a double edged sword. *Front Immunol.* 2019;10:229. doi: 10.3389/fimmu.2019.00229. [DOI](#)
8. Hassan RM, Degaim ZD. Effect of Ag nanoparticles on expression of fnbA gene in *S. aureus* and evaluation of IL-10 and IL-17 levels among burn patients. *Ro J Infect Dis.* 2024;27(2):112-7. doi:10.37897/RJID.2024.2.13. [DOI](#)
9. Kuen DS, Kim BS, Chung Y. IL-17-producing cells in tumor immunity: friends or foes?. *Immune Network.* 2020; 20(1): e6. doi: 10.4110/in.2020.20.e6 [DOI](#)
10. Conti PR, Ronconi G, Caraffa AL, Gallenga CE, Ross R, Frydas I, Kritas SK. Induction of pro-inflammatory cytokines (IL-1 and IL-6) and lung inflammation by Coronavirus-19 (COVI-19 or SARS-CoV-2): anti-inflammatory strategies. *J Biol Regul Homeost Agents.* 2020;34(2):327-31. doi: 10.23812/CONTI-E. [DOI](#)
11. Andersen AM, Vastrup P, Wohlfahrt J, Andersen PK, Olsen J, Melbye M. Fever in pregnancy and risk of fetal death: a cohort study. *Lancet.* 2002;360(9345):1552-6. doi: 10.1016/S0140-6736(02)11518-2. [DOI](#)
12. Edwards MJ. Hyperthermia and fever during pregnancy. *Birth defects research Part A: clinical and molecular teratology.* 2006;76(7):507-16. doi: 10.1002/bdra.20277. [DOI](#)
13. Eglolf C, Sibiude J, Couffignal C, Mandelbrot L, Picone O. Causes and consequences of fever during pregnancy: A retrospective study in a gynecological emergency department. *J Gynecol Obst Hum Reproduct.* 2020;49(9):101899. doi: 10.1016/j.jogoh.2020.101899. [DOI](#)
14. Giakoumelou S, Wheelhouse N, Cuschieri K, Entrican G, Howie SE, Horne AW. The role of infection in miscarriage. *Hum Reproduct Upd.* 2016; 22(1): 116-33. doi: 10.1093/humupd/dmv041. [DOI](#)
15. Ogbuanu IU, Zeko S, Chu SY, Muroua C, Gerber S, De Wee R, Kretsinger K, Wannemuehler K, Gerndt K, Allies M, Sandhu HS. Maternal, fetal, and neonatal outcomes associated with measles during pregnancy: Namibia, 2009-2010. *Clin Infect Dis.* 2014; 58(8): 1086-92. doi: 10.1093/cid/ciu037. [DOI](#)
16. Woolner AM, Raja EA, Bhattacharya S, Danielian P, Bhattacharya S. Inherited susceptibility to miscarriage: a nested case-control study of 31,565 women from an intergenerational cohort. *Am J Obst Gynecol.* 2020;222(2):168-e1. doi: 10.1016/j.ajog.2019.08.013. [DOI](#)
17. Woolner AMF, Nagdeve P, Raja EA, Bhattacharya S, Bhattacharya S. Family history and risk of miscarriage: A systematic review and meta-analysis of observational studies. *Acta Obst Gynecol Scand.* 2020 b;99(12):1584-1594. doi: 10.1111/aogs.13940. [DOI](#)
18. Perez N, Ostojić S, Kapović M, Peterlin B. Systematic review and meta-analysis of genetic association studies in idiopathic recurrent spontaneous abortion. *Fert Steril.* 2017;107(1):150-9. doi: 10.1016/j.fertnstert.2016.10.007. [DOI](#)
19. Shi X, Xie X, Jia Y, Li S. Maternal genetic polymorphisms and unexplained recurrent miscarriage: a systematic review and meta-analysis. *Clin Genet.* 2017;91(2):265-84. doi: 10.1111/cge.12910. [DOI](#)
20. Elkarhat Z, Kindil Z, Zarouf L, Razoki L, et al. Chromosomal abnormalities in couples with recurrent spontaneous miscarriage: a 21-year retrospective study, a report of a novel insertion, and a literature review *J Assist Reprod Genet.* 2019; 36: 499-507. doi: 10.1007/s10815-018-1373-4. [DOI](#)
21. Centers for Disease Control and Prevention. Radiation and pregnancy: a fact sheet for clinicians. May 2020; <http://www.bt.cdc.gov/radiation/prenatalphysician>
22. Thaker R, Oza H, Verma V, Gor M, Kumar S. The association of circulatory cytokines (IL-6 and IL-10) level with spontaneous abortion - A preliminary observation. *Reprod Sci.* 2021; 8(3): 857-64. doi: 10.1007/s43032-020-00292-6. [DOI](#)
23. Denny CH, Acero CS, Naimi TS, Kim SY. Consumption of Alcohol Beverages and Binge Drinking Among Pregnant Women Aged 18-44 Years - United States, 2015-2017. *MMWR.* 2019; 68(16): 365-368. doi: 10.15585/mmwr.mm6816a1. [DOI](#)
24. Azizieh FY, Raghupathy R. IL-10 and pregnancy complications. *Clin Exp Obstet Gynecol.* 2017;44(2):252-8. PMID: 29746033
25. Abdulkhaliq RJ, Mohammed S, Abbas AA. The Role of Some Cytokines in women with Recurrent Abortion in Iraqi Women. *PJMHS.* 2017; 11(2): 496
26. Bakir WA, Abdul-Gany ZS. The Role of IL-6, IL-10 and IFN- γ mRNA in Women with Recurrent Abortion. *Iraqi Journal of Cancer and Medical Genetics.* 2010; 3(1): 46-53. doi: 10.29409/ijcmg.v3i1.29.
27. Cai J, Li M, Huang Q, Fu X, Wu H. Differences in cytokine expression and STAT3 activation between healthy controls and patients of unexplained recurrent spontaneous abortion (URSA) during early pregnancy. *PLoS One.* 2016; 11(9): e0163252. doi: 10.1371/journal.pone.0163252. [DOI](#)
28. Hosseini S, Shokri F, Pour SA, Jeddi-Tehrani M, Nikoo S, Yousefi M, Zarnani AH. A shift in the balance of T17 and Treg cells in menstrual blood of women with unexplained recurrent spontaneous abortion. *J Reproduct Immunol.* 2016; 116: 13-22. doi: 10.1016/j.jri.2016.03.001 [DOI](#)
29. Heidt S, San D, Chadha R, Wood KJ. The impact of Th17 cells on transplant rejection and the induction of tolerance. *Curr Opin Organ Transplant.* 2010;15(4):456-61. doi: 10.1097/MOT.0b013e32833b9bfb. [DOI](#)
30. Kaminski VD, Ellwanger JH, Matte MC, Savaris RF, Vianna P, Chies JA. IL-17 blood levels increase in healthy pregnancy but not in spontaneous abortion. *Molec Biol Rep.* 2018;45(5): 1565-8. doi: 10.1007/s11033-018-4268-7. [DOI](#)
31. Congera P, Maraolo AE, Parente S, Moriello NS, Bianco V, Tosone G. Measles in pregnant women: a systematic review of clinical outcomes and a meta-analysis of antibodies Seroprevalence. *J Infect.* 2020;80(2):152-60. doi: 10.1016/j.jinf.2019.12.012. [DOI](#)

32. Ragusa R, Platania A, Cuccia M, Zappalà G, Giorgianni G, D'Agati P, et al. Measles and pregnancy: immunity and immunization—what can be learned from observing complications during an epidemic year. *J Pregn.* 2020; 2020(1):6532868. doi: 10.1155/2020/6532868 [DOI](#)
33. Mahdi, H., Mohammed Shallal, M. J., & Hasan Naif, A. A. (2025). Prevalence of non-genital warts generated by human papillomaviruses and role of interleukins IL10, IL17, and hematological parameters Romanian Medical Journal 72(1):5-10, doi: 10.37897/RMJ.2025.1.1. [DOI](#)
34. Huang C, Wang Y, Li X, Ren L, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020 Feb 15;395(10223):497-506. doi: 10.1016/S0140-6736(20)30183-5. [DOI](#)
35. Han H, Yang L, Liu R, Liu F, Wu KL, Li J, Liu XH, Zhu CL. Prominent changes in blood coagulation of patients with SARS-CoV-2 infection. *Clin Chem Lab Med.* 2020 Jun 25;58(7):1116-1120. doi: 10.1515/cclm-2020-0188. [DOI](#)

ETHICAL STATEMENT

The Research Committee of Al-Muthanna Health Directorate (No. 1627 on 27/10/2024) approved this study, and participants' consent was obtained verbally and in written form, printed for consent in hospitals.

ACKNOWLEDGMENTS

We would like to sincerely thank everyone who consented to take part in this research. We would also want to express our gratitude to the personnel of the Muthanna Governorate Hospitals (in Iraq), who helped with data collection and participant recruitment. The Research Ethics Committee's help in approving this study protocol (No. 1627 dated 27/10/2024) is also much appreciated. The specialized doctors who oversaw the patient sample collection and who gave their time, energy, and knowledge to ensure the success of this study are acknowledged for their invaluable efforts. Lastly, we would like to thank the faculty of the University of Thi-Qar College of Medicine's Postgraduate Studies Department for their excellent collaboration in overcoming challenges during the research time.

CONFLICT OF INTEREST

The Authors declare no conflict of interest

CORRESPONDING AUTHOR

Mohammed Jasim Mohammed Shallal

Department of Microbiology, College of Medicine,
University of Thi-Qar,
Thi-Qar Iraq
e-mail: mohammed-j@utq.edu.iq

ORCID AND CONTRIBUTIONSHIP

Mohammed Jasim Mohammed Shallal: 0000-0002-0429-5315 [B](#) [C](#) [E](#)

Hayder Raad Abbas: 0009-0000-9031-0245 [A](#) [E](#)

Nadia Saddam Fahad: 0009-0003-3043-095X [A](#) [F](#)

[A](#) – Work concept and design, [B](#) – Data collection and analysis, [C](#) – Responsibility for statistical analysis, [D](#) – Writing the article, [E](#) – Critical review, [F](#) – Final approval of the article

RECEIVED: 04.06.2025

ACCEPTED: 30.12.2025

