International Journal of Infectious Diseases and Therapy
2025, Vol. 10, No. 2, pp. 47-55
https://doi.org/10.11648/j.ijidt.20251002.13

Review Article

Fetomaternal Outcomes in Pregnancy in Women with Chikungunya - A Retrospective Observational Study in a Tertiary Care

Muntaha*, Shweta, Poonam

Department of Obstetrics and Gynaecology, Lady Harding Medical College, Delhi, India

Abstract

Objective: To evaluate the outcome of pregnancy in patients who developed chikungunya infection during the antenatal period and to evaluate the severity of chikungunya infection in pregnant women. Material and methodology - This retrospective, record-based, observational study recruited, a total of 47 antenatal women who were admitted to the Obst & gynae department in Lady Harding Medical College, hospital and tested chikungunya IgM Antibody positive during the chikungunya outbreak from September 2016 to September 2017 and an equal number of women with fever, but without chikungunya (IgM negative) who were admitted during the same period comparable in age and parity, were taken as a control group. The details of the admitted antenatal women were taken from the medical record section. ELISA IgM was taken as a positive case. The records included a detailed history, examination, investigations, delivery details, and maternal and perinatal outcomes. The pregnancy and neonatal outcomes were compared between pregnant women with fever, with Chikungunya IgM positive and negative. All the data was compiled in a Microsoft Excel sheet using the latest SPSS version. Result- In this study, 356 pregnant women with fever during the study period who were hospitalized were enrolled out of whom 47 had chikungunya IgM positive (13.2%). Out of 309 Chikungunya IgM-negative pregnant women (86.79%), 47 patients were randomly selected as a control group. Out of these 47 patients, one patient required intensive care unit (ICU) and later succumbed, whereas none were transferred to the ICU in the control group. One case of vertical transmission was reported amongst positive neonates. We found that overall chikungunya infection in pregnancy was not significantly associated with any adverse outcomes as compared to controls. However, admission to the Intensive Care Unit and neonatal ICU was greater in women with Chikungunya infection in comparison to women without infection. Conclusion- Although Chikungunya infection during pregnancy does not appear to increase Fetomaternal complications, careful monitoring is needed during the maternal viremia period.

Keywords

CHIKV (Chikungunya Virus), Intrauterine Death, Morbidity, ICU Admission, Pregnancy, Preterm Delivery

*Corresponding author: muntaha016@yahoo.co.in (Muntaha)

Received: 11 February 2025; **Accepted:** 24 March 2025; **Published:** 23 June 2025

1. Introduction

Chikungunya, a mosquito-borne viral illness, presents unique risks for pregnant women. While symptoms such as fever, joint pain, and rash are common, expectant mothers face heightened concerns due to potential complications. Chikungunya infection during pregnancy can increase the risk of adverse outcomes, including preterm birth and low birth weight. Additionally, there is a possibility of vertical transmission, where the virus passes from mother to fetus. To mitigate these risks, pregnant women in affected areas should prioritize measures to prevent mosquito bites, such as using repellents and wearing protective clothing. Prompt medical attention is crucial if symptoms arise, enabling healthcare providers to monitor the pregnancy closely and manage any complications effectively. Research and public health efforts continue to focus on understanding and addressing the specific challenges Chikungunya poses in pregnancy, aiming to safeguard maternal and fetal health. Still, literature is scarce on this in India. Henceforth, during the Chikungunya outbreak, this comparative study was done to increase the understanding of the impact of the virus on pregnancy.

2. Material and Methods

This study was a retrospective observational study. The objective of this study was to evaluate the outcome of pregnancy in patients who developed chikungunya infection during the antenatal period and to evaluate the severity of chikungunya virus infection (CHIKV) in pregnant women. In this study, we recruited a total of 356 pregnant women with fever, who were admitted to our department during the chikungunya outbreak from September 2016 to September 2017 in Lady Hardinge Medical College associated with Sucheta Kriplani Hospital, a tertiary-level hospital in Delhi. ELISA antibody assay was done in all fever cases. Out of those, 47 women were found chikungunya IgM Antibody positive, and amongst the rest of the 309 women, an equal number of women (47) with fever but without chikungunya comparable in age and parity, based on random selection were taken as a control group. That has been reflected in the flow chart Figure 1.

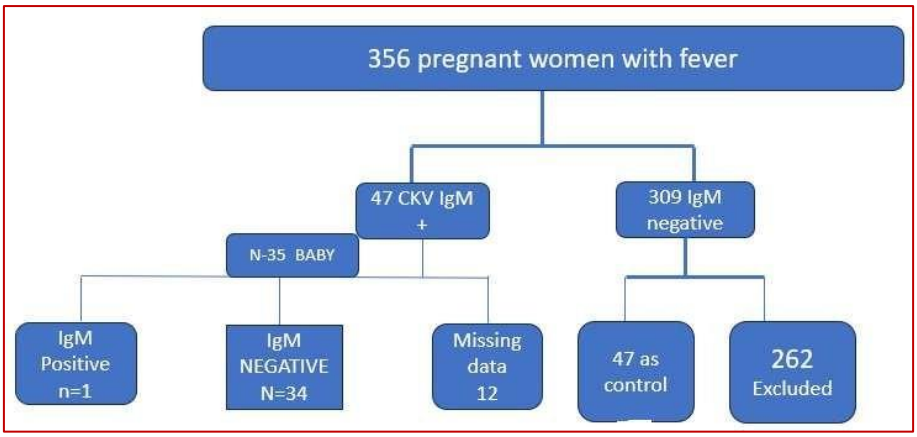

Figure 1. *Flow chart of case selection.*

The inclusion criteria of the study were pregnant women with confirmed chikungunya infection. (ELISA IgM positive) along with fever and exclusion criteria were pregnant women with fever etiology other than chikungunya infection and mixed infection. The details of the admitted antenatal women were taken from the medical record section. Confounding factors like dengue fever, Zika virus, and malaria were excluded from the study to prevent bias. Records included a detailed history, examination, investigations, delivery details, and maternal and perinatal outcomes. Composite pregnancy complication (abruption, vaginal bleeding, preterm labor), mode of delivery (cesarean delivery for fetal distress/abruption/ placental abnormality or operative vaginal delivery for fetal distress or normal vaginal delivery without any complication), and composite neonatal morbidity were taken as outcome variables.

All the data was compiled in a Microsoft Excel sheet using the latest SPSS version. The continuous variables were expressed as mean ± standard deviation and the categorical variables were expressed as frequency and percentage. The pregnancy and neonatal outcomes were compared between the pregnant women with fever with Chikungunya IgM positive and Chikungunya IgM negative.

3. Results

In our study, 356 pregnant women with fever during the study period who were hospitalized were enrolled out of which 47 had chikungunya IgM positive (13.2%) and the rest were negative. Out of 309 Chikungunya IgM-negative pregnant women (86.79%), randomly 47 patients were selected as a control group. The mean age in both groups was similar

(25.06 years vs 25.54 years). Both the case and control groups were compared to each other for Fetomaternal outcomes which were relevant to fever.

Patients who were Chikungunya IgM positive were mostly managed by high fluid intake, NSAIDS (nonsteroidal anti-inflammatory drugs), and paracetamol. The occurrence of adverse outcomes in pregnancy was non-significant between the two groups. Out of 47 patients from Chikungunya IgM-positive patients, 3 (6.4%) presented in the first trimester, 9 (19.1%) in the second trimester, and 35 (74.5%) in the third trimester. All these patients were followed till the delivery through records. The main symptoms reported by these patients were fever (single episode-19/47, multiple- 28/47), rashes (7/47), arthralgia (19/47), headache (29/47), retro-orbital pain (12/47) and vomiting (7/47). Multiple spikes of fever, rashes, arthralgia, headache, and retro-orbital pain were found to be significantly higher in the Chikungunya IgM-positive women in comparison to the control group (Table 4). Out of these 47 patients, one patient was transferred to the intensive care unit (ICU) and later expired whereas none of the patients was transferred to ICU in the control group. The mean gestational age at presentation was 35.4 ±1.4 and 35.0 ± 2.1 in the Chikungunya IgM positive and Chikungunya IgM negative group respectively. Women who had delivered spontaneously were significantly lower (p= 0.022) in the Chikungunya IgM positive group (10/47, 21.3%) versus the Chikungunya IgM negative group (20/47, 43.5%). Most of the patients had normal vaginal delivery in both groups (30/47, 63.8% Chikungunya IgM positive group versus 26/47, 56.5%; p= 0.101 in negative group) (Table 1). Thrombocytopenia was observed to be significantly higher in the Chikungunya IgM positive group (1.6±0.8 lakhs vs 2.3±1.4 lakhs; p= 0.009). Mean hemoglobin in the Chikungunya IgM positive group was 9.8±2.2 gm% which was similar to that of the Chikungunya IgM negative group i.e. 9.9±1.3 gm% (p=0.844). The mean Total lymphocyte count in the Chikungunya IgM positive group was 9297.8±4282.2 which was similar to that of the Chikungunya IgM negative group i.e. 8952.0±3001.9 (p=0.655) (Table 5). The occurrence of adverse outcomes of pregnancy like Oligohydramnios, preterm premature rupture of membranes, preterm labor pains, stillbirth, and cesarean section were not significantly different amongst the two groups.

Out of a total of 94 pregnancies, 44 newborns were males. The mean birthweight of the newborns in the Chikungunya IgM positive group was 2075.21± 873.52 gms which was significantly lower than that of the Chikungunya IgM negative group i.e. 2585.21±573.82 gms (p=0.001) (Table 3). None of the newborns in either group had any congenital anomalies. The adverse neonatal outcomes like 5-minute APGAR, NICU admission, and miscarriages were non-significant between the two groups. One case of vertical transmission was reported in which IgM antibodies were detected out of 35 positive neonates who were admitted to the NICU. (Table 2) Neonatal IgG antibodies that are transferred transplacentally from the mother can be detected in the neonate for the first few weeks to months of life. IgM antibodies cannot be transported across the placenta, so the presence of IgM antibodies in the newborn reflects either fetal or neonatal disease. [16].

Table 1. *Maternal outcomes in Chikungunya-positive and Negative pregnant women.*

Maternal parameters		CHIKUNGUNYA Positive N (%)	CHIKUNGUNYA Negative N (%)	Chi-square test P value
Anemia	Yes	21 (44.7%)	28 (59.5%)	0.176
	No	26 (55.3%)	19 (41.3%)	
Oligohydramnios	Yes	6 (12.8%)	3 (6.5%)	0.486*
	No	41 (87.2%)	44 (93.5%)	
PROM (Premature rupture of membrane)	Yes	4 (8.5%)	3 (6.5%)	1.000*
	No	43 (91.5%)	44 (93.5%)	
Gestational age at presentation	1st Trimester	3 (6.4%)	2 (4.3%)	0.294
	2nd trimester	9 (19.1%)	4 (8.7%)	
	3rd Trimester	35 (74.5%)	41 (87.23%)	
Labor	Spontaneous	10 (21.3%)	20 (43.5%)	0.022
	Induced	37 (78.7%)	27 (57.44%)	

Maternal parameters		CHIKUNGUNYA Positive N (%)	Negative N (%)	Chi-square test P value
Maternal Outcome	Stable	46 (97.9%)	47 (100.0%)	1.000
	Dead	1 (2.1%)	0 (0.0%)	
Mode of delivery	NVD	30 (63.8%)	26 (56.5%)	0.101
	LSCS	10 (21.3%)	19 (40.4%)	
	IUD	3 (6.4%)	0 (0.0%)	
	Fetus expulsion	4 (8.5%)	2 (4.3%)	

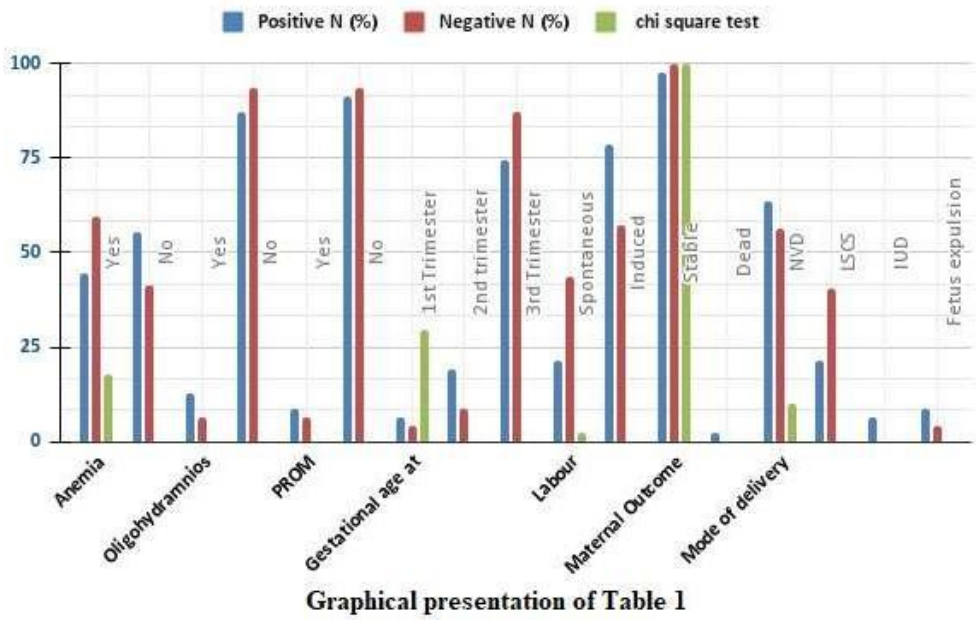

Figure 2. *Graphical representation of the maternal outcome of chikungunya-positive and negative patients.*

Table 2. *Comparison of Neonatal outcomes in chikungunya positive and negative patients.*

Fetal outcomes		CHIKUNGUNYA Positive N (%)	Negative N (%)	Chi-square test P value
Baby outcome	Live	38 (80.9%)	43 (93.5%)	0.163
	Abortion	4 (8.5%)	2 (4.3%)	
	IUD	5 (10.6%)	2 (4.3%)	
Liquor	MSL	6 (14.3%)	14 (29.7%)	0.112
	Clear	36 (85.7%)	33 (71.7%)	
NICU admission	Yes	35 (74.5%)	0 (0.0%)	<0.001
	No	12 (25.5%)	47 (100.0%)	
APGAR <7 at 5 minutes		5 (10.6%)	4 (8.5%)	0.154

Fetal outcomes		CHIKUNGUNYA		Chi-square test P value
		Positive N (%)	Negative N (%)	
Cord blood IgM Positive	35 neonates of the positive group, were admitted to NICU	1 (2.1%)	-	

IUD (Intrauterine death), MSL (Meconium-stained liquor, NICU (Neonatal ICU)

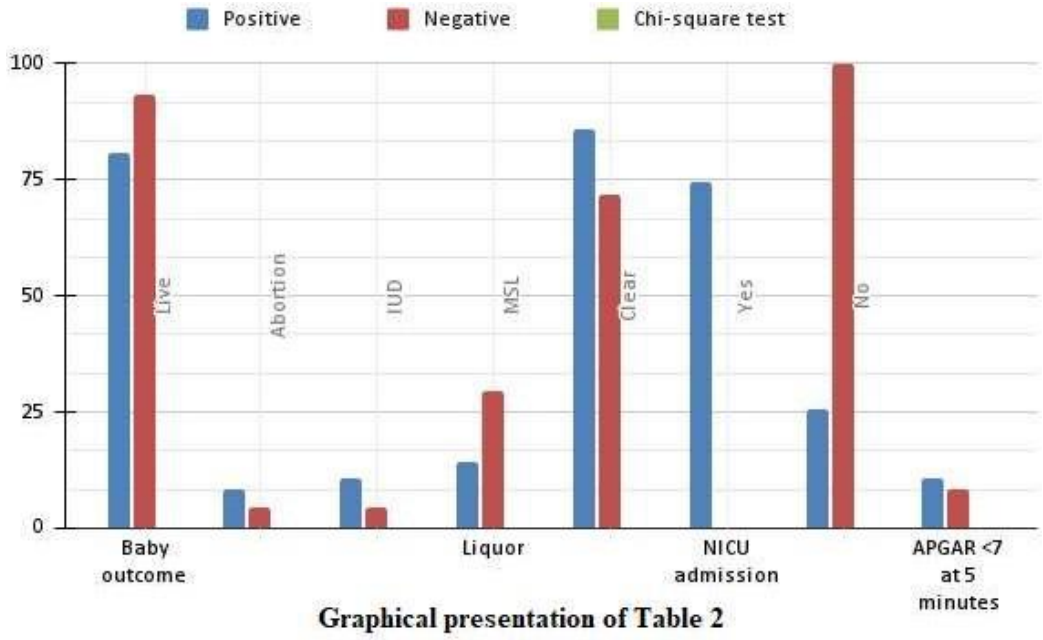

Figure 3. Graphical representation of neonatal outcome in Chikungunya positive and negative patient.

Table 3. Difference in mean baby birth weight in Chikungunya positive and negative patient.

CHIKUNGUNYA	N	Mean baby Birth weight (grams)	SD	Unpaired t test P value
Positive	47	2075.213	873.5221	0.001
Negative	47	2585.217	573.8244	

Table 4. Symptomatology in Pregnant Women.

Signs and symptoms associated with fever		CHIKUNGUNYA		
		Positive	Negative	Chi-square test P value
		N (%)	N (%)	
Fever spikes	Single	19 (40.4%)	29 (63.0%)	0.029
	Multiple	28 (59.6%)	18 (38.29%)	
Rashes	Yes	7 (14.9%)	0 (0.0%)	0.012*
	No	40 (85.1%)	47 (100.0%)	

Signs and symptoms associated with fever		CHIKUNGUNYA Positive N (%)	Negative N (%)	Chi-square test P value
Arthralgia	Yes	19 (40.4%)	4 (8.7%)	<0.001
	No	28 (59.6%)	43 (91.3%)	
Headache	Yes	29 (61.7%)	7 (15.2%)	<0.001
	No	18 (38.3%)	40 (85.10%)	
Retro-orbital pain	Yes	12 (25.5%)	3 (6.5%)	0.013
	No	35 (74.5%)	44 (93.5%)	
Vomiting	Yes	7 (14.9%)	3 (6.5%)	0.316*
	No	40 (85.1%)	44 (93.5%)	

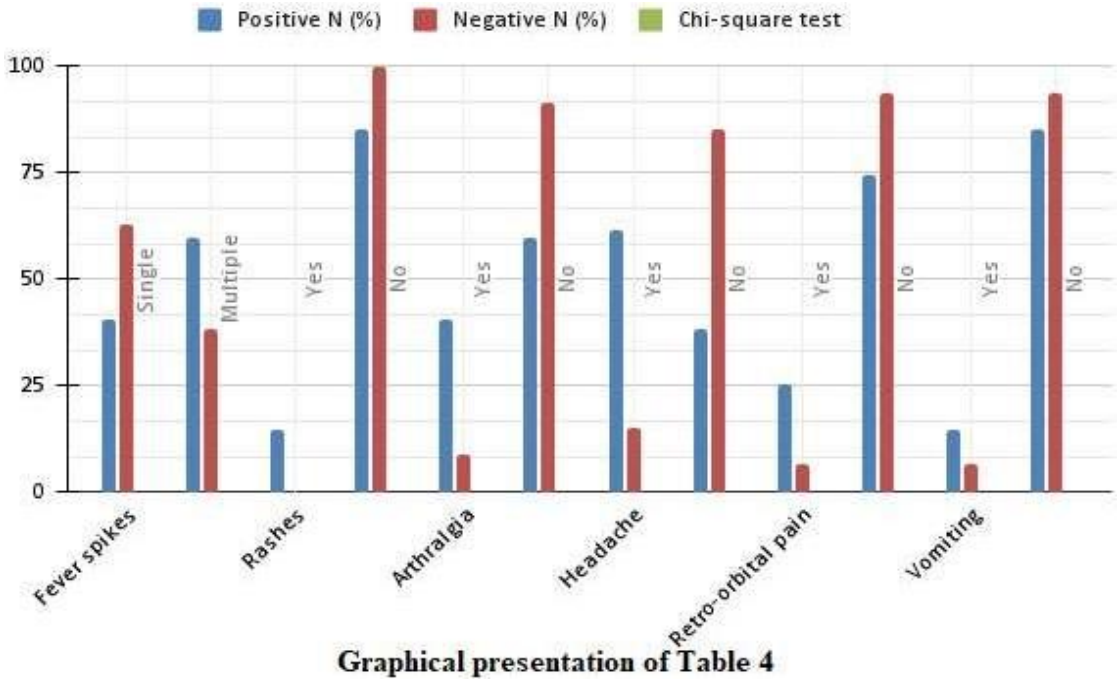

Figure 4. Symptomatology of Pregnant Women.

Table 5. Biochemical Status of women with fever.

Condition on delivery	CHIKUNGUNYA Positive Mean ± SD	Negative Mean ± SD	Unpaired t-test P value 873.5221
Hemoglobin	9.8 ±2.2	9.9 ±1.3	0.844
TLC	9297.8 ±4282.2	8952.0 ±3001.9	0.655
Platelet count	1.6 ±0.8	2.3 ±1.4	0.009

4. Review of Literature

Chikungunya is a re-emerging infection that has spread from East Africa to the Indian Ocean Islands. It is of particular concern for pregnant women. Fritel X et al, 2006, observed that the virus had no observable effect on pregnancy outcomes. [4] Basurko et al conducted a nested case-control study in French Guiana in 2022, intending to compare pregnancy and neonatal outcomes between pregnant women with CHIKV infection and pregnant women without CHIKV during the Chikungunya outbreak between June 2012 and June 2015. They concluded that the impact of CHIKV during pregnancy does not appear to increase the risk of maternal and fetal complications; vigilance is warranted when delivery occurs during the maternal viremia period. [1] Laoprasopwattana et al conducted a community-based epidemiological prospective study in Songkhla Province, Thailand, in the 2009–2010 CHIKV outbreak and found that complications during pregnancy, Newborn outcome, and congenital anomalies were not different in those who had recent, remote, or no CHIKV infections. [5] ME Foeller et al (2014-2015) concluded that CHIKV infection during pregnancy did not appear to pose a risk for pregnancy complications or neonatal health, but maternal infection just before delivery might increase the risk of mother-to-child transmission of CHIKV. [6] An observational study done by Suruchi et al from August 2016 to October 2016 reported an incidence of 20% adverse pregnancy outcomes as preterm delivery, premature rupture of membranes, decreased fetal movements, intrauterine death, oligohydramnios, and preterm labor pains in chikungunya-infected women [2]. They concluded that Chikungunya infection in pregnancy is associated with increased pregnancy morbidity and fetal mortality. A study by Kelly Aparecida et al in 2022 assessed the prevalence of immunity to Chikungunya virus (CHIKV) in pregnant women and newborns in the Western Brazilian Amazon and found that seropositivity for CHIKV was surprisingly frequent (10%) in both pregnant women and newborns, affecting mainly low-income women. [7] Laoprasopwattana, Kamolwish et al performed a comparative study in 2012 to differentiate CHIK from dengue and other acute febrile illnesses during a CHIK outbreak in a dengue-endemic area. They concluded that, along with clinical manifestation, specific antigen testing can help differentiate CHIK from Dengue viral illness. [8] Natal et al in 2021 reported four cases of spontaneous abortion in women who became infected with CHIKV between the 11th and 17th weeks of pregnancy, proven by RT-PCR, and gave evidence about early Feto-maternal transmission of CHIKV [9]. Elizabeth et al in 2021 statistically analyzed the link between cardiomyopathy and chikungunya infection and risk of death. [10] S Kumar et al in 2019 also conducted a retrospective study on maternal and perinatal infection of CHIKV, and a systematic review by Contopoulos-Ioannidis D, et al talked about vertical transmission of chikungunya and its harmful effects on the fetus. [12, 14] Bettis AA, L'Azou Jackson M et al presented a systematic literature review on the epidemiology of Chikungunya infection to develop a safe and effective vaccine [13]. Jain J, Nayak K et al, 2017 study emphasizes chikungunya disease progression and assesses clinical, virological, and serological parameters of chikungunya disease severity. [15]

Comparative findings from different studies on Chikungunya are summarized in Figure 5 below.

Studies	CKV positive	Type of study	Chikungunya symptoms Fever ,rashes, arthralgia	Maternal outcomes	Fetal outcomes	Vertical transmission (MTCT)
Sagey et al, 2024 Nigeria with USA	19	Cohort study	65% 3rd trim. 100% almost all symptoms	more preterm delivery, SB, Abortions& IUD	26.9% fetal complications	15.8% 3(19)
Celia et al, 2022 French Guiana,	73 + 173 -	Case control study	Fever100%,joint pain 83%, Rashes 8%	No ICU admission No obstetrics complication	Increased neonatal ICU admission	-
Foeller et al,2021 BJOJ	150	Retrospective observational study	Joint pain-100%,fever-75%,rash- 50%	No difference in both group(RR-0.76)	No diff., no risk of congenital anomaly	1.3%(2)
Despina C.I.et al @Stanford 2018;	1331	systemic review and meta analysis	50% all symptoms are present	Increased IUD(APFD) -0.3% Rest no abn findings	Neonatal infection-15.3% Neonatal death -0.6%	15.5%(206/1331)
Suruchi Gupta et al 2019	150	prospective, observational study	100%fever,95%rash, 98%arthalgia	20% Obst complication (PTVD7%,IUD2%, Oligo 2%),LSCS more	No GCA	-
Gerardin et al,2008 Island of La Reunion	678+61	Prospective study	100%all symptoms, Thrombocytopenia 89%	Increase rate of LSCS due to fetal distress	-	2.5%1(9/739)
Laoprasopwattana et al (2008-2009) Thailand	32	Prospective cohort study	70% fever,83% arthralgia and rash	nil	nil	-
Fritel X et al ,2006	658	Prospective multi center study	Fever 62%,Joint pain 93%,Rash 76%	No maternal complication	No fetal complication No increased ICU admission	-

Figure 5. *Comparative outcomes of different studies.*

5. Discussion

In this retrospective observational study, we examined the cases of Chikungunya virus (CHIKV) infection during pregnancy in our hospital in Delhi during the Chikungunya outbreak in India. With the data collected, we studied the short-term outcomes of pregnant females (abruption, vaginal bleeding, preterm labor), mode of delivery (cesarean delivery for fetal distress/abruption/ placental abnormality or operative vaginal delivery for fetal distress or normal vaginal delivery without any complication who were infected with chikungunya virus and also adverse neonatal outcomes like NICU admission, prematurity, Intrauterine death, stillbirth, neonatal mortality. We also compared the symptoms of CHIKV in pregnant women with those of pregnant women who had fever but were Chikungunya negative. To the best of our knowledge, there are only a few studies in India comparing Fetomaternal outcomes and also Chikungunya symptoms in Chikungunya-infected pregnant women.

Considering the antenatal phase, we found that overall Chikungunya infection in pregnancy was not significantly associated with any adverse outcomes as compared to controls. However, we noted that admission to the Intensive care unit (ICU) of women and neonatal ICU was greater in women with Chikungunya infection in comparison to women without infection. A similar finding was reported by Basurko et al in 2022. [1]. A study by Lenglet Y et al in 2010 reported similar results as our study i.e. (cesarean deliveries, obstetric hemorrhage, preterm births, stillbirths after 22 weeks, birthweight, congenital malformations, and newborn admissions) were similar in both Chikungunya infected and non-infected pregnant women [3].

Fritel X et al conducted a study of pregnant women in Réunion (France) in 2006 compared pregnancy outcomes for women not infected during pregnancy with those who were infected during pregnancy. They observed that pregnancy outcomes like cesarean deliveries, obstetric hemorrhage, preterm births, stillbirths after 22 weeks, birthweight, congenital malformations, and Newborn admissions were similar in both the groups and concluded that CHIKV had no observable effect on pregnancy outcomes, same as in our study [4]. Laoprasopwattana et al (2008-2009) observed that complications during pregnancy, newborn outcome, and congenital anomalies were not different in those who had recent, remote, or no CHIKV infections [5]. M E Foeller et al conducted a retrospective observational study in 2021 at Grenada to evaluate pregnancy and neonatal outcomes, disease severity, and mother-to-child transmission of CHIKV infection. They included women who gave birth between January 2014 to September 2015 and concluded that CHIKV infection during pregnancy did not appear to pose a risk for pregnancy complications or neonatal health, but maternal infection just before delivery might increase the risk of mother-to-child transmission of CHIKV [6], in our study also we found one case of vertical transmission in chikungunya positive patient. Because of the limitation of resources, the tests were not done in chikungunya-negative mothers. A study done by Sagay et al in 2024 found a 15.8% (3 out of 19) mothers-to-child transmission rate as compared to our study. [11] Several studies have been published related to Mother-to-child transmission of chikungunya infection, all indicated that transmission risk is higher if acute infection occurs near the term or delivery time. [4, 6]. So, our study strengthens the theory published in past articles that the Chikungunya virus as such doesn't cause any life-threatening side effects to mother and baby as compared to other viruses like Zika, Dengue, and Malaria. Long-term morbidity like severe joint pain in mothers that has been mentioned in a few studies, can last longer than a year. We couldn't comment on long-term sequelae because of the lack of follow-up data but symptoms of joint pain, fever, rashes, headache, and thrombocytopenia were more in the CHIKV group in our study.

The limitation of our study was its retrospective nature; a long-term follow-up of patients was not available. The sample size was small in comparison to other published studies. It was a single-center study. The tests to detect vertical transmission were done only in neonates who were admitted to NICU with chikungunya-positive mothers, it was not done in chikungunya-negative mothers because of the limitation of resources. Because of the incomplete submission of data, we cannot comment on the vertical transmission rate. However, consistent with other published literature, CHIKV infection in our cohort was not associated with any poor maternal and neonatal outcomes.

6. Conclusion

Although Chikungunya infection during pregnancy does not appear to increase Fetomaternal complications, careful monitoring is needed during the maternal viremia period. In our study, chikungunya infection did not appear to increase adverse pregnancy outcomes in women who were symptomatically infected with it than in women who were uninfected but had fever. However, further multicentric prospective studies with long-term follow-up are required to provide recommendations regarding the management of Chikungunya infection-positive pregnant women and their neonates.

Abbreviation

CKV	Chikungunya Virus
IgM	Immunoglobulin-M
N	Number

Author Contributions

Muntaha: Conceptualization, Data curation, Formal Analysis, Investigation, Methodology, Resources, Writing – original draft

Shweta: Formal Analysis, Validation, Visualization, Writing – review & editing

Funding

No funding was required in this study. Proper ethical clearance was taken.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Basurko, C.; Hcini, N.; Demar, M.; et al. Symptomatic Chikungunya Virus Infection and Pregnancy Outcomes: A Nested Case-Control Study in French Guiana. Viruses 2022, 14, 2705. https://doi.org/10.3390/v14122705

[2] Gupta S, Gupta N. Short-term pregnancy outcomes in patients' chikungunya infection: An observational study. J Family Med Prim Care 2019; 8: 985-7. https://doi.org/10.4103/jumps.jfmpc_274_18

[3] Lenglet Y, Barau G, Robillard PY et al. Infection à Chikungunya chez la femme enceinte et risque de transmission maternofetal [Chikungunya infection in pregnancy: Evidence for intrauterine infection in pregnant women and vertical transmission in the parturient. Survey of the Reunion Island outbreak]. J Gynecol Obstet Biol Reprod (Paris). 2006 Oct; 35(6): 578-83. French. https://doi.org/10.1016/s0368-2315(06)76447-x

[4] Fritel X, Rollot O, Gerardin P, Gauzere Ba et al. (2010) Chikungunya virus infection during pregnancy, Reunion, France, 2006. Emerg Infect Dis. 2010 Mar; 16(3): 418-25. https://doi.org/10.3201/eid1603.091403

[5] Laoprasopwattana K, Suntharasaj T, Petmanee P, et al. (2016) Chikungunya and dengue virus infections during pregnancy: seroprevalence, coincidence and maternal-fetal transmission, southern Thailand, 2009-2010. Epidemiol Infect. 2016 Jan; 144(2): 381-8. https://doi.org/10.1017/S0950268815001065

[6] Foeller ME, Nosrat C, Krystosik A, Noel T, et al. (2020) Chikungunya infection in pregnancy - reassuring maternal and perinatal outcomes: a retrospective observational study. BJOG. 2021 May; 128(6): 1077-1086. https://doi.org/10.1111/1471-0528.16562

[7] Kelly Aparecida Kanunfre Malta, Mussya Cisotto Rocha, Rodrigo Medeiros de Souza et al. (2022) Silent circulation of Chikungunya virus among pregnant women and newborns in the Western Brazilian Amazon before the first outbreak of chikungunya fever. 2022, March; Rev Inst Med Trop São Paulo. 2022; 64: e25 pg 1-8. https://doi.org/10.1590/S1678-9946202264025

[8] Laoprasopwattana, Kamolwish & Kaewjungwad, Lamy & Geater, Alan. (2012). Differential Diagnosis of Chikungunya, Dengue Viral Infection and Other Acute Febrile Illnesses in Children. The Pediatric Infectious Disease journal. 31(5): 459-63. https://doi.org/10.1097/INF.0b013e31824bb06d

[9] Natália Salomão, Michelle Brendolin, Kássila Rabelo, et al. (2021) Spontaneous Abortion and Chikungunya Infection: Pathological Findings. Viruses 2021, 13, 554. https://doi.org/10.3390/v13040554

[10] Elizabeth M. Traverse, Hannah K. Hopkins, Vedana Vaidhyanathan et al. Cardiomyopathy and Death Following Chikungunya Infection: An Increasingly Common Outcome. Trop. Med. Infect. Dis. 2021, 6, 108. https://doi.org/10.3390/tropicalmed6030108

[11] Atiene S. Sagay, Szu-Chia Hsieh, Yu-Ching Dai, et al. (2024) Chikungunya virus antepartum transmission and abnormal infant outcomes in a cohort of pregnant women in Nigeria; Int J Infect Dis. 2024 February; 139: 92–100. https://doi.org/10.1016/j.ijid.2023.11.036

[12] Kumar S, Agrawal G, Wazir S, Kumar A, Dubey S, Balde M, et al. (2019) Experience of perinatal and neonatal Chikungunya virus (CHIKV) infection in a tertiary care neonatal center during an outbreak in North India in 2016: a case series. J Trop Pediatr 2019; 65: 169–75. https://doi.org/10.1093/tropej/fmy032

[13] Bettis AA, L'Azou Jackson M, Yoon IK, Breugelmans JG, Goios A, Gubler DJ, et al. (2022) The global epidemiology of chikungunya from 1999 to 2020: a systematic literature review to inform the development and introduction of vaccines. PLoS Negl Trop Dis 2022; 16: e0010069. https://doi.org/10.1371/journal.pntd.0010069

[14] Contopoulos-Ioannidis D, Newman-Lindsay S, Chow C, LaBeaud AD. (2018) Mother-to-child transmission of Chikungunya virus: a systematic review and meta-analysis. PLoS Negl Trop Dis 2018; 12: e0006510. https://doi.org/10.1371/journal.Pntd.0006510

[15] Jain J, Nayak K, Tanwar N, Gaind R, Gupta B, Shastri JS, et al. (2017) Clinical, serological, and virological analysis of 572 chikungunya patients from 2010 to 2013 in India. Clin Infect Dis 2017; 65: 133–40. https://doi.org/10.1093/cid/cix283

[16] Malek A Role of IgG antibodies in association with placental function and immunologic diseases in human pregnancy. Expert Rev Clin Immunol 2013; 9: 235–49.