Journal of Holistic Nursing and Midwifery

July 2023, Volume 33, Number 3

Original Paper

Pregnancy Outcomes in Women Infected With COVID-19: A Retrospective Cohort Study

Maryam Nikpour[1], Mahdi Sepidarkish[2], Mahboobeh Darzipoor[3], Mahmoud Sadeghi Haddad Zavareh[4], Rahele Mehraeein[5], Zeinab Pahlavan[6], Fereshteh Behmanesh[7*]

1. Assistant Professor, Non-Communicable Pediatric Diseases Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran.
2. Assistant Professor, Department of Biostatistics and Epidemiology, School of Public Health, Babol University of Medical Sciences, Babol, Iran.
3. Health Education (MS), Clinical Research Development Center, Shahid Yahyanezhad Hospital, Babol University of Medical Sciences, Babol, Iran.
4. Associate Professor, Infectious Diseases and Tropical Medicine Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran.
5. Associated Professor, Department of Radiology, Rohani University Hospital, Health Research Institute, Babol University of Medical Sciences, Babol, Iran.
6. Fellowship of Perinatology, Department of Perinatology, Ayatollah Rouhani Hospital, Babol University of Medical Sciences, Babol, Iran.
7. PhD. of Reproductive Heath, Social Determinants of Health Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran.

Use your device to scan and read the article online

Citation Nikpour M, Sepidarkish M, Darzipoor M, Sadeghi Haddad Zavareh M, Mehraeein R, Pahlavan Z, et al. Pregnancy Outcomes in Women Infected With COVID-19: A Retrospective Cohort Study. J Holist Nurs Midwifery. 2023; 33(3):167-175. https://doi.org/10.32598/jhnm.33.3.2351

Running Title Pregnancy Outcomes in Women Infected With COVID-19

https://doi.org/10.32598/jhnm.33.3.2351

Article info:
Received: 08/11/2021
Accepted: 29/01/2023
Available Online: 01/07/2023

Keywords:
COVID-19, SARS-CoV-2, Cohort study, Pregnancy outcome

ABSTRACT

Introduction: Studies of the impact of the novel coronavirus 2019 (COVID-19) on pregnancy outcomes have yielded conflicting results.

Objective: This study examined pregnancy outcomes in COVID-19-infected and non-infected pregnant women.

Materials and Methods: In this retrospective cohort study, we included all pregnant women with (n=42) and without COVID-19 infection (n=185) admitted to a training and treatment center in Babol City, Iran, from March to November 2020. We abstracted the records of all pregnancies in women with COVID-19 (exposed cohort) and women without COVID-19 (non-exposed cohort). Patient information was taken from their medical records. The chi-square test and Student t-test were used for data analysis. Modified Poisson regression and mixed linear model were used to assess the adjusted risk ratio (aRR) and adjusted mean difference (aMD) between COVID-19 infection and pregnancy outcomes.

Results: A total of 227 pregnant women (42 in the exposure group, 185 in the non-exposed group) were included in the study. The mean age of mothers was 28.12±6.27 years, and also 48.5% of them had their first pregnancy. In comparison with non-infected women, women with COVID-19 faced the highest risk of cesarean section (aRR: 2.22, 95% CI, 1.35%-3.65%, P=0.002) and preterm birth (aRR: 1.22, 95% CI, 1.02%-1.48%, P=0.026). Also, pregnant women with COVID-19 had a significantly higher duration of hospital stay (aMD: 2.20, 95% CI, 1.32%-3.08%, P=0.001) compared to pregnant women without COVID-19. There was no significant difference between the two groups in terms of postpartum hemorrhage and premature rupture of membranes.

Conclusion: This study suggests that COVID-19 infection is associated with an increased risk of cesarean section, preterm birth, and increased duration of hospital stay but not with other outcomes. However, the current evidence does not support its causal effects, given the methodological limitations and small sample size.

*** Corresponding Author:**
Fereshteh Behmanesh, PhD.
Address: *Social Determinants of Health Research Center, Health Research Institute, Babol University of Medical Sciences, Babol, Iran.*
Tel: *+98 (912) 2135312*
E-mail: *f.behmanesh2015@gmail.com*

Highlights

- COVID-19 infection during pregnancy is associated with an increased risk of cesarean section and preterm birth.
- Pregnant women with COVID-19 had prolonged lengths of stay compared to non-infected women.
- Postpartum bleeding and premature rupture of membranes did not increase in pregnant women with COVID-19 compared to non-infected ones.

Plain Language Summary

The effect of COVID-19 infection on obstetric performance is less clear, and the findings are inconsistent. At the same time, some studies have found increased incidences of cesarean delivery, intrauterine distress, premature membrane rupture, abnormal amniotic fluid, umbilical cord, and abnormal placenta in these women. In contrast, others have reported no effect of COVID-19 on certain pregnancy complications. This study aims to evaluate the risk of pregnancy outcomes among women diagnosed with COVID-19 infection during pregnancy, compared to women not diagnosed with this infection. This study selected all pregnant women referred to a teaching hospital in Babol City, Iran, for vaginal delivery from March 2, 2020, to September 30, 2020. Of 227 pregnant women, 42 were infected with COVID-19 infection, and 185 were not. This study showed that COVID-19 infection during pregnancy is associated with an increased risk of cesarean section and preterm birth. However, there was no difference between the two groups of pregnant women regarding postpartum bleeding and premature rupture of membranes. Also, pregnant women with COVID-19 had prolonged stays compared to non-infected women.

Introduction

COVID-19 is the name of a newly diagnosed respiratory disease known as coronavirus or 2019-nCoV. Respiratory infections caused by coronavirus were first observed as an epidemic in Wuhan, China, in December 2019 and quickly became one of the most important health problems in the world [1-4]. The spread rate of coronavirus was such that the World Health Organization (WHO) identified it as a contagious pandemic disease [5, 6]. Coronaviruses can cause various illnesses, from cold to acute respiratory symptoms, and even death due to pneumonia and respiratory problems [7].

With the spread of coronavirus, the infection of pregnant women has also increased [8, 9]. Several viruses have produced maternal and fetal effects during pregnancy and may provide information on the potential impact and mechanism of COVID-19 in pregnancy [10]. Prevention and control of COVID-19 and similar diseases in pregnant women and the potential risk of vertical transmission are considered a concern [11].

In pregnant women, their tolerance to hypoxia decreases due to weakness of the immune system and physiological changes in the respiratory system (decreased diaphragm height, increased oxygen consumption, mucosal edema of the respiratory tract) [12-14]. Respiratory problems are expected to increase in pregnant women with COVID-19 [14]. Decreased leukocytes and lymphocytes, increased C-reactive protein, and increased blood transfusions in pregnant women with COVID-19 have been reported in laboratory studies [9, 13, 15].

In normal pregnancy, the coagulation agents increase with raised thrombin production and intravascular inflammation [16]. Higher levels of circulating coagulation and fibrinolytic factors, such as plasmin, may be involved in the pathogenesis of SARS-CoV-2 infection [17]. Therefore, pregnant women with COVID-19 may have an increased risk of thrombosis, resulting in miscarriage and placental abruption. Community-level surveillance and further research are needed to ascertain the possible increase in abortions with COVID-19 [10].

The effect of COVID-19 on obstetric performance is less clear, and the findings are inconsistent [11]. While some studies have found increased incidences of caesarian section (CS), intrauterine distress, premature rupture of membranes (PROM), abnormal amniotic fluid, umbilical cord, and abnormal placenta in these women, others have reported no COVID-19 effect on certain pregnancy complications [9, 18-21]. A new review reports that as of January 2020, several case and cohort studies have described the presentation and clinical course of COV-

ID-19 in pregnancy. Most studies have been reassuring, and the risk of severe COVID-19 in pregnancy appears to be no higher than in the general population [10].

Although various vaccines against the coronavirus have decreased the deaths caused by it, there is still a possibility of contracting weaker and deformed strains of this virus [22].

Increased knowledge about COVID-19 infection and its new strains may enhance awareness in the health policymakers' sector, generate life-saving interventions, and improve the treatment guideline for pregnant women. This retrospective cohort study aims to evaluate the risk of pregnancy outcomes among women diagnosed with COVID-19 infection during pregnancy, compared to women not diagnosed with this infection.

Materials and Methods

In this retrospective cohort study, all consecutive pregnant women hospitalized for vaginal delivery at a training and treatment center in Babol City, Iran, were enrolled from March to November 2020. Forty-two pregnant women had symptoms of COVID-19, and 185 had no symptoms (Figure 1). The eligibility criteria for the participants consisted of a singleton pregnancy, no history of CS, no contraindication for vaginal delivery, and no other infected disease. In this study, the data was collected from archive files.

The clinical data (signs and symptoms, underlying comorbidities, pharmacological and supportive treatments, and laboratory results) were extracted from hospital records and checked by two specialists: One specializes in Infectious Diseases and another in Health Sciences.

At admission, sputum and throat swab specimens were obtained from all pregnant women with suspected symptoms of COVID-19 and maintained in the viral-transport medium. The real-time polymerase chain reaction (RT-PCR) test for SARS-Cov-2 RNA was performed. This initial test was performed for all patients with suspected symptoms of COVID-19 who were referred to the hospital. Pregnant women were confirmed cases if the PCR test was positive for 2019-nCoV and were assigned to the exposed group. Then, women with COVID-19 infection (exposed group) underwent chest CT examinations according to infectious specialist advice for more assessment. The pregnant women were covered with a lead blanket before undergoing an abdominal and pelvic CT scan and were exposed to a low radiation dose (4.1±0.9 mGy). Pulmonary involvement was assessed by criteria such as consolidation, ground-glass opacity (GGO), and mixed GGO. Two experienced radiologists and an infectious diseases specialist evaluated all imaging features.

At admission, 5 mL of intravenous blood was taken from all pregnant women (exposed and non-exposed groups), and laboratory tests, including a complete blood count and serum biochemistry, were conducted. Routine tests were performed for both groups.

The consequences of delivery were compared in two groups of pregnant women with COVID-19 (exposed group) and non-infected pregnant women (non-exposed group). PROM is a rupture membrane before 37 weeks of pregnancy [15]. Preterm delivery (PB) is defined as babies born alive before 37 weeks of gestation [23]. Postpartum hemorrhage (PPH) is more bleeding than normal ≤500 mL in normal vaginal delivery or 1000 mL after the birth of a baby [9]. If the PPH medication prescription, such as misoprostol, methyl ergonovine, prostaglandin, and blood transmission, was recorded in the patient's hospital record, they were considered abnormal PPH [24]. Duration of hospital stay refers to the average number of days patients spend in hospital [25].

Continuous and categorical variables were described by Mean±SD and percentage, respectively. Prenatal outcomes of the women with and without COVID-19 were compared using the chi-square test for categorical variables and the student t-test for continuous variables. Using the modified Poisson regression model, we estimated the adjusted risk ratio (aRR) and 95% CI for the history of laboratory-confirmed infection and categorical adverse pregnancy outcomes. Also, A linear mixed-effect model was used to analyze changes in continuous prenatal outcomes. The results showed by adjusted mean difference (aMD) with 95% CIs. The models were adjusted for the following variables: Gestational age (GA), parity, maternal age, adverse outcomes in previous pregnancies, previous pregnancy problems, pre-existing medical problems, and mode of delivery. Statistical analyses were performed on Stata software, version 16 (Stata Corp, College Station, TX, USA). All statistical tests were two-tailed at a significance level of $P<0.05$.

Results

During the study, 574 pregnant women were referred to the hospital for childbirth, of whom 247 had not entered the study due to a lack of inclusion criteria. Finally, 227 pregnant women (42 in the exposed group and 185

in the non-exposed group) were included in the study. Most mothers (70%) had diploma educations, 87.2% were homemakers, and 55.5% lived in rural areas. The mean age of mothers was 28.12±6.27 years, and also 48.5% of them had their first pregnancy.

The most common symptoms in pregnant women were fever (69.04%) and increased blood C-reactive protein (69%). Also, the most common lung lesion in chest computed tomography was GGO (83.33%).

There was no significant statistical difference between the two groups in demographic variables. Regarding midwifery variables, half of the women experienced the first pregnancy. 42.85% of pregnant women with COVID-19 had almost the same frequency of comorbidities (thyroid disorders, preeclampsia, hypertension, premature rupture of membrane) compared to pregnant women without COVID-19 (44.32%). Pregnant women with COVID-19 had a significantly lower GA (MD: -2.01, 95% CI, -3.23% to -0.77%, P=0.002) than pregnant women without COVID-19 (Table 1).

Bivariate analysis showed that the risk of CS (RR: 2.07, 95% CI, 1.40%-3.06%, P=0.001) in women with COVID-19 was significantly higher than in non-exposed pregnant women. However, the risk of PB was identical between women with COVID-19 and controls (RR: 1.01, 95% CI, 0.77%-1.32%, P=0.948). After adjusting for potential confounders, the RR for CS remained significant (aRR: 2.11, 95% CI, 1.40%-3.18%, P=0.001). Also, the RR for PPH became significant (aRR: 1.23, 95% CI, 1.02%-1.48%, P=0.026). Pregnant women with COVID-19 had a significantly higher duration of hospital stay (MD: 3.58, 95% CI, 3.07%-4.10%; P=0.001) compared to pregnant women without COVID-19. The estimated mean difference (MD) changed slightly but remained significant when adjusting for maternal age, parity, delivery type, ICU admission, GA, comorbidities, and PROM (aMD: 3.63, 95% CI, 3.10%-4.16%, P=0.001). No significant association was found between COVID-19 infection and PROM. The estimate remained non-significant when adjusting for GA, parity, maternal age, previous pregnancy problems, and pre-existing medical problems. Also, there was no statistically significant difference between the two groups regarding postpartum hemorrhage. Adding the potential confounders to this model did not alter the estimated RR of experiencing a postpartum hemorrhage. The unadjusted and adjusted estimates for prenatal outcomes are presented in Table 2.

Discussion

Study results showed that after adjusting for potential confounders, the risk of CS and PB in women with COVID-19 was significantly higher than in non-exposed pregnant women. But there was no significant difference between the two groups in terms of PPH and PROM.

Table 1. Clinical characteristics of COVID-19 infected and non-infected mothers in the study groups

Vaiables		Mean±SD/No. (%)		P
		Non-infected Pregnant Women (n=185)	Infected Pregnant Women (n=42)	
Age (y)		28.74±6.46	27.51±6.08	0.255*
Gestational age (wk)		37.84±2.90	35.83±5.94	0.001*
Gravidity		1.81±1.01	1.97±1.13	0.321*
Parity		0.56±0.82	0.64±0.85	0.570*
Miscarriage		0.26±0.56	0.33±0.61	0.570*
Level of education	Diploma	129(69.3)	31(73.3)	0.60**
	University	56(30.3)	11(26.2)	
Residence place	Urban	104(56.2)	22(52.4)	0.65**
	Rural	81(43.8)	20(47.6)	
Occupation	Housewife	162(87.6)	34(81.0)	0.26**
	Worker	23(12.4)	8(19.0)	

*The independent t-test, **The chi-square test.

Table 2. Association between maternal infection and prenatal outcomes

Pregnancy Outcome	Crude				Adjusted			
	RR*	SE	95% CI Lower-Upper	P	RR	SE	95% CI Lower-Upper	P
Cesarean section	2.07	0.20	1.40-3.06	0.001	2.11	0.21	1.40-3.18	0.001
Premature rupture of membrane	0.92	0.76	0.21-4.05	0.912	0.83	1.03	0.11-6.20	0.863
Postpartum hemorrhage	2.77	0.71	0.69-11.17	0.151	3.57	0.82	0.72-17.74	0.120
Preterm birth	1.01	0.14	0.77-1.32	0.948	1.23	0.09	1.02-1.48	0.026

Pregnancy Outcome	Crude			Adjusted		
	MD**	95% CI Lower-Upper	p	MD	95% CI Lower-Upper	p
Duration of hospital stay	3.58	3.07-4.10	0.001	3.63	3.10-4.16	0.001

Abbreviations: CI: Confidence interval; Upper B; Upper bound; Lower B: lower bound; RR: Risk ratio; MD: Mean difference; SE: Standard error.

*Risk ratio estimated directly from Modified Poisson regression. The final multivariable models were adjusted for the following risk factors: gestational age, parity, maternal age, previous pregnancy problems, and pre-existing medical problems.

**Mean difference is estimated directly from a linear mixed-effects model. The final multivariable models were adjusted for the following risk factors: Gestational age, parity, maternal age, previous pregnancy, and pre-existing medical problems.

Zhang et al. reported no significant statistical difference between pregnant women with COVID-19 and non-infected women in terms of CS [26], and our finding was inconsistent with that study. The decision to have a CS or vaginal delivery in pregnant mothers with COVID-19 depends on the severity of the symptoms in the mother and its effect on the mother and fetus [27]. In Zhang et al. study [26], only one of the 16 patients had severe symptoms, and 15 had ordinary type. In the present study, fever and dyspnea were present at 100% and 60%, respectively, in the pregnant women; therefore, the treatment teams preferred CS and terminated the pregnancy as soon as possible. These findings were against other studies [4, 28, 29]. In our study, 18% of deliveries in the exposed group were performed by CS. In the studies of Chen et al. [4] and Yu et al. [9], 100% and 19% of deliveries in pregnant women with COVID-19 were performed, respectively, by CS prematurely. A possible explanation for CS in pregnant women with COVID-19 was the lack of possible vertical transfer of the mother to the fetus and the need to save the mother's life to start antiviral treatment. Timely termination of pregnancy in COVID-19-infected pregnant women will not increase the risk of PB and infant asphyxia [2]. Also, the stress and hypoxia-induced by pneumonia lead to placenta abruption and CS [28]. Lack of information about the possible complications of the natural delivery process and fear of legal claims were other reasons for the increase in the rate of CS during the first peak of the COVID-19.

Pregnancy may be associated with a higher respiratory problem [30]. Pregnant women experience physiological changes in their immunological and respiratory systems [31, 32]. These changes lead to respiratory complications during viral infections and increase fetal-maternal mortality. In addition, pregnant women are at higher risk in the third trimester than in the first and second trimesters because the delayed diagnosis of COVID-19 is associated with acute respiratory distress syndrome due to cytokine storm [32]. The right decision for the type of delivery and the time of termination of pregnancy for pregnant mothers with COVID-19 requires further study.

This study's findings demonstrated a significant difference between the two groups regarding preterm delivery after adjusting for the confounders. Yee et al. in a meta-analysis study of 9032 pregnant women with COVID-19 infection, showed that about 30% experienced preterm delivery [33]. Also, this result is consistent with other studies [9, 32, 34]. Other studies reported that

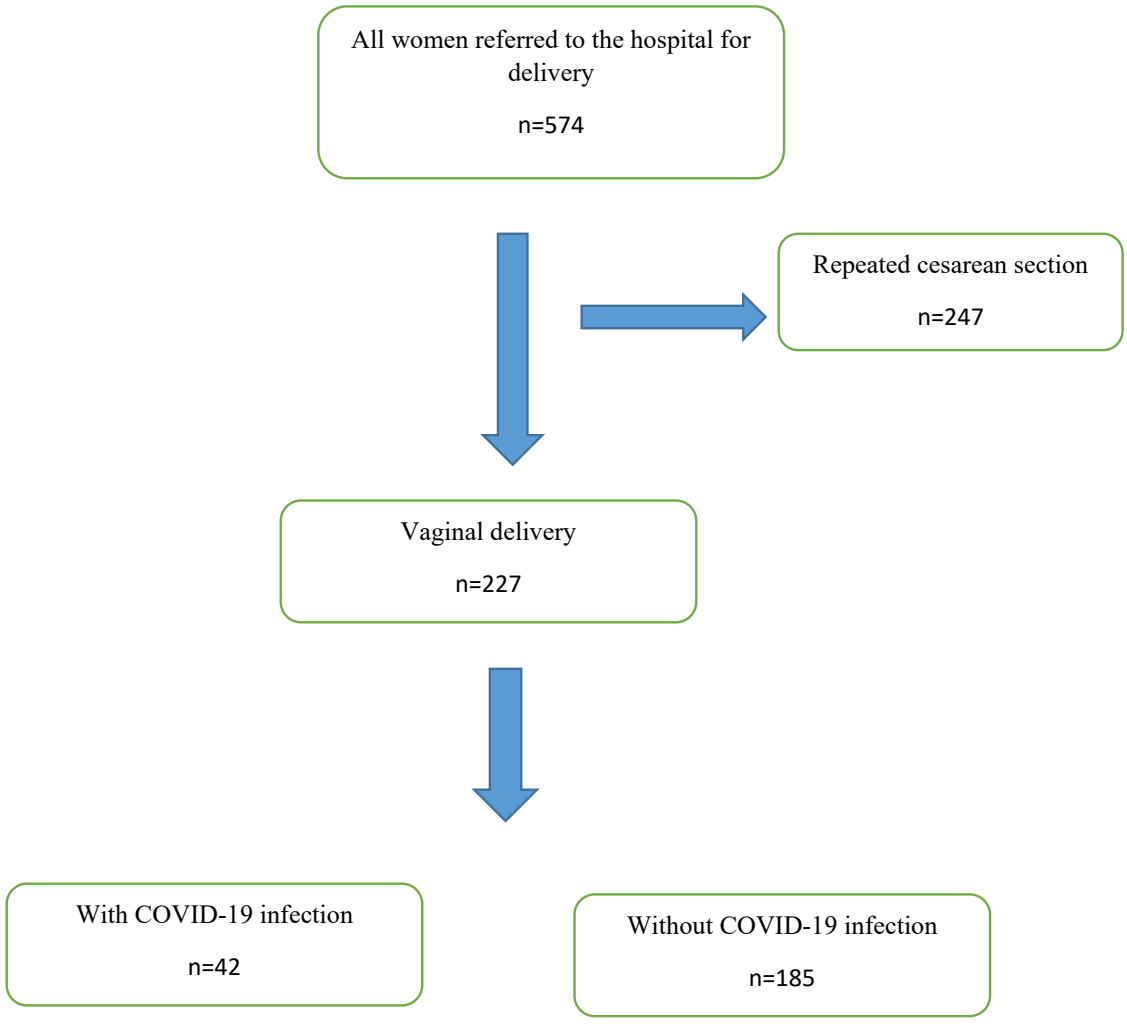

Figure 1. Flow diagrpam of sampling

pneumonia can increase the risk of preterm labor [28, 35-38]. For example, Tang et al. [35] reported that complicated pregnancies with pneumonia were associated with high maternal morbidity and mortality, such as preterm birth. Plasmin levels increase 50% during pregnancy compared to non-pregnancy time [39]. Plasmin and other proteases activate the surface protein of the SARS-CoV2 [32]. This protein activates the production of prostaglandins by binding and stimulating the cyclooxygenase enzyme. Therefore, high prostaglandins and other inflammatory mediators in COVID-19 with excessive immunological expression may be a potential cause of premature uterine contractions and preterm labor during COVID-19 pneumonia [40].

Study findings also showed that the hospital stay duration rate among the exposed group was significantly longer than the non-exposed group. A meta-analysis revealed that influenza infection in pregnant individuals resulted in a higher risk of hospital admission than in no pregnant individuals [41]. The increased duration of hospital stay in the exposed group was also due to the need for antibiotics, antiviral treatments, and oxygen support (nasal cannula) for patients. Pregnant women in the non-exposed group only receive postpartum care and discharge.

Study findings also showed no significant difference between the two groups in terms of postpartum hemorrhage after adjusting for the confounders. This finding is similar to Liu et al.'s study (15). The present study showed a 20% difference between the two study groups regarding postpartum hemorrhage in the exposed and 6% in the non-exposed groups. This difference may be significantly enhanced by increasing the sample size (in the exposed group). In the Zhang et al. study, using an analog of oxytocin (carbetocin) to treat uterine contraction fatigue in mothers with COVID-19 was significantly higher than in non-infected mothers. Zhang et al. recommend to reduce the incidence of postpartum hemorrhage during cesarean in a mother with COVID-19, it is best to use an analog of oxytocin prophylactic [26].

Our study found no significant difference between the two groups regarding PROM after adjusting for the confounders. A probable explanation for this outcome may be pregnant women with COVID-19 and GA<32 weeks were diagnosed and treated immediately. So, they were discharged in good condition after treatment. The pregnant women over 32 weeks had no difference from the control group regarding PROM. Morken et al. [42] reported that the link between maternal infection and preterm delivery may vary in different populations and healthcare settings.

The first limitation of this study was using a retrospective cohort design. Future studies are recommended to use cohort designs to provide more reliable data about the effect of COVID-19 on pregnancy outcomes. The sample size was limited. The low number of pregnant mothers in our study was related to the limited number of pregnant mothers with COVID-19 in the area (Babol in north of Iran).

This study suggests that COVID-19 infection is associated with an increased risk of CS, PB, and increased duration of hospital stay but not with other outcomes such as PROM and postpartum hemorrhage. However, given the methodological limitations and small sample size, the current evidence does not support its causal effects.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the Institutional Review Board of Babol University of Medical Sciences (Code: IR.MUBabol.HRI.REC.1399.074).

Funding

This study was funded by the Health Research Institute at Babol University of Medical Sciences (Grant No.: 724132942). The funder had a role in data collection and analysis but had no role in deciding to publish or prepare the manuscript.

Authors' contributions

Data collection: Mahboobeh Darzipoor; Draft the manuscript: Maryam Nikpour and Fereshteh Behmanesh; Review and editting: Mahdi SepidarKish, Mahmoud Sadeghi Haddad Zavareh, Rahele Mehraeein and Mahdi SepidarKish; Conceptualisation and final approval: All authors.

Conflict of interest

The authors declared no conflict of interest.

Acknowledgments

We want to thank Shabnam Mehdinia, Fatemeh Shafizadeh, Zinatossadat Sadat Bouzari, and Mahsa Adnani, the gynecologists of Rohani Hospital, Babol, Iran. We are also thankful to Health Center, Babol.

References

[1] Zhu H, Wang L, Fang C, Peng S, Zhang L, Chang G, et al. Clinical analysis of 10 neonates born to mothers with 2019-ncov pneumonia. Translational Pediatrics. 2020; 9(1):51-60. [DOI:10.21037/tp.2020.02.06] [PMID] [PMCID]

[2] Zhang J, Zhou L, Yang Y, Peng W, Wang W, Chen X. Therapeutic and triage strategies for 2019 novel coronavirus disease in fever clinics. The Lancet Respiratory Medicine. 2020; 8(3):e11-2. [DOI:10.1016/S2213-2600(20)30071-0] [PMID]

[3] Huang C, Wang Y, Li X, Ren L, Zhao J, Hu Y, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet. 2020; 395(10223):497-506. [DOI:10.1016/S0140-6736(20)30183-5] [PMID]

[4] Chen H, Guo J, Wang C, Luo F, Yu X, Zhang W, et al. Clinical characteristics and intrauterine vertical transmission potential of covid-19 infection in nine pregnant women: A retrospective review of medical records. Lancet. 2020; 395(10226):809-15. [DOI:10.1016/S0140-6736(20)30360-3] [PMID]

[5] World Health Organization (WHO). Coronavirus (covid-19) dashboard [Internet]. 2023 [Updated 2023 June 11]. Available from: [Link]

[6] Nikpour M, Behmanesh F, Darzipoor M. [Pregnancy outcomes and clinical manifestations of covid-19 in pregnant women: A narrative review (Persian)]. Journal of Military Medicine, 2022; 22(2):177-83. [DOI:10.30491/JMM.22.2.177]

[7] Mullins E, Evans D, Viner RM, O'Brien P, Morris E. Coronavirus in pregnancy and delivery: Rapid review. Ultrasound in Obstetrics & Gynecology. 2020; 55(5):586-92. [DOI:10.1002/uog.22014] [PMID]

[8] Dong L, Tian J, He S, Zhu C, Wang J, Liu C, et al. Possible vertical transmission of SARS-CoV-2 from an infected mother to her newborn. JAMA. 2020; 323(18):1846-8. [DOI:10.1001/jama.2020.4621] [PMID] [PMCID]

[9] Yu N, Li W, Kang Q, Xiong Z, Wang S, Lin X, et al. Clinical features and obstetric and neonatal outcomes of pregnant patients with covid-19 in Wuhan, China: A retrospective, single-centre, descriptive study. The Lancet Infectious Diseases. 2020; 20(5):559-64. [DOI:10.1016/S1473-3099(20)30176-6] [PMID]

[10] Wastnedge EAN, Reynolds RM, van Boeckel SR, Stock SJ, Denison FC, Maybin JA, et al. Pregnancy and covid-19. Physiological Reviews. 2021; 101(1):303-18. [DOI:10.1152/physrev.00024.2020] [PMID] [PMCID]

[11] Schwartz DA. An Analysis of 38 pregnant women with covid-19, their newborn infants, and maternal-fetal transmission of sars-cov-2: maternal coronavirus infections and pregnancy outcomes. Archives of Pathology & Laboratory Medicine. 2020; 144(7):799-805. [DOI:10.5858/arpa.2020-0901-SA] [PMID]

[12] Chua M, Lee J, Sulaiman S, Tan HK. From the frontline of covid-19 - how prepared are we as obstetricians? A commentary. BJOG. 2020; 127(7):786-8. [DOI:10.1111/1471-0528.16192] [PMID]

[13] Chen D, Yang H, Cao Y, Cheng W, Duan T, Fan C, et al. Expert consensus for managing pregnant women and neonates born to mothers with suspected or confirmed novel coronavirus (covid-19) infection. International Journal of Gynaecology and Obstetrics. 2020; 149(2):130-6. [DOI:10.1002/ijgo.13146] [PMID] [PMCID]

[14] Dashraath P, Wong JLJ, Lim MXK, Lim LM, Li S, Biswas A, et al. Coronavirus disease 2019 (covid-19) pandemic and pregnancy. American Journal of Obstetrics and Gynecology. 2020; 222(6):521-31. [DOI:10.1016/j.ajog.2020.03.021] [PMID] [PMCID]

[15] Liu W, Wang Q, Zhang Q, Chen L, Chen J, Zhang B, et al. Coronavirus disease 2019 (covid-19) during pregnancy: A case series. 2020; [Unpublished]. [Link]

[16] Di Renzo GC, Giardina I. Coronavirus disease 2019 in pregnancy: Consider thromboembolic disorders and thromboprophylaxis. American Journal of Obstetrics and Gynecology. 2020; 223(1):135. [DOI:10.1016/j.ajog.2020.04.017] [PMID] [PMCID]

[17] Ji HL, Zhao R, Matalon S, Matthay MA. Elevated plasmin(ogen) as a common risk factor for covid-19 susceptibility. Physiological Reviews. 2020; 100(3):1065-75. [DOI:10.1152/physrev.00013.2020] [PMID] [PMCID]

[18] Nayak MK, Panda SK, Panda SS, Rath S, Ghosh A, Mohakud NK. Neonatal outcomes of pregnant women with covid-19 in a developing country setup. Pediatrics and Neonatology. 2021; 62(5):499-505. [DOI:10.1016/j.pedneo.2021.05.004] [PMID] [PMCID]

[19] Soheili M, Moradi G, Baradaran HR, Soheili M, Mokhtari MM, Moradi Y. Clinical manifestation and maternal complications and neonatal outcomes in pregnant women with covid-19: A comprehensive evidence synthesis and meta-analysis. The Journal of Maternal-Fetal & Neonatal Medicine. 2021; 35(25):5672-85. [DOI:10.1080/14767058.2021.1888923]

[20] Yang R, Mei H, Zheng T, Fu Q, Zhang Y, Buka S, et al. Pregnant women with covid-19 and risk of adverse birth outcomes and maternal-fetal vertical transmission: A population-based cohort study in Wuhan, China. BMC Medicine. 2020; 18(1):330. [DOI:10.1186/s12916-020-01798-1] [PMID] [PMCID]

[21] Wang CL, Liu YY, Wu CH, Wang CY, Wang CH, Long CY. Impact of covid-19 on pregnancy. International Journal of Medical Sciences. 2021; 18(3):763-7. [DOI:10.7150/ijms.49923] [PMID] [PMCID]

[22] Yuda TK, Munir M. Social insecurity and varieties of family resilience strategies during the covid-19 pandemic. International Journal of Sociology and Social Policy. 2022; 43(7/8):756-76. [DOI:10.1108/IJSSP-08-2022-0201]

[23] Kim JI. Preterm labor and birth: Definition, assessment, and management. Korean Journal of Women Health Nursing. 2018; 24(3):231-2. [DOI:10.4069/kjwhn.2018.24.3.231]

[24] Cohain JS. Novel third stage protocol https://www.youtube.com/watch?v=AAJPW4p6rzU reduces postpartum hemorrhage at vaginal birth. European Journal of Obstetrics, Gynecology, and Reproductive Biology. 2022; 278:29-32. [DOI:10.1016/j.ejogrb.2022.08.016] [PMID]

[25] Baek H, Cho M, Kim S, Hwang H, Song M, Yoo S. Analysis of length of hospital stay using electronic health records: A statistical and data mining approach. Plos One. 2018; 13(4):e0195901. [DOI:10.1371/journal.pone.0195901] [PMID] [PMCID]

[26] Zhang J, Wu Y, Wang R, Lu K, Tu M, Guo H, et al. Bioinformatic analysis reveals that the reproductive system is potentially at risk from 2019-nCoV. Bioinformatic Analysis of Reproductive System. 2020; 1-15 [DOI:10.31219/osf.io/j2uyw]

[27] Cottler-Casanova S, Horowicz M, Gieszl S, Johnson-Agbakwu C, Abdulcadir J. Coding female genital mutilation/cutting and its complications using the International Classification of Diseases: A commentary. BJOG. 2020; 127(6):660-4. [DOI:10.1111/1471-0528.16086] [PMID]

[28] Romanyuk V, Raichel L, Sergienko R, Sheiner E. Pneumonia during pregnancy: Radiological characteristics, predisposing factors and pregnancy outcomes. The Journal of Maternal-Fetal & Neonatal Medicine. 2011; 24(1):113-7. [DOI:10.3109/14767051003678275] [PMID]

[29] Jin Y, Carriere KC, Marrie TJ, Predy G, Johnson DH. The effects of community-acquired pneumonia during pregnancy ending with a live birth. American Journal of Obstetrics and Gynecology. 2003; 188(3):800-6. [DOI:10.1067/mob.2003.175] [PMID]

[30] Dong Y, Mo X, Hu Y, Tong S., Epidemiological and transmission patterns of pregnant women with 2019 coronavirus disease in China. The Lancet. 2020; [Unpublished]. [DOI:10.2139/ssrn.3551330]

[31] Lam CM, Wong SF, Leung TN, Chow KM, Yu WC, Wong TY, et al. A case-controlled study comparing clinical course and outcomes of pregnant and non-pregnant women with severe acute respiratory syndrome. BJOG. 2004; 111(8):771-4. [DOI:10.1111/j.1471-0528.2004.00199.x] [PMID] [PMCID]

[32] Al-kuraishy H, Al-Maiahy T, Al-Gareeb AI, Musa RA, Ali ZH. covid-19 pneumonia in an Iraqi pregnant woman with preterm delivery. Asian Pacific Journal of Reproduction. 2020; 9(3):156-8. [DOI:10.4103/2305-0500.282984]

[33] Yee J, Kim W, Han JM, Yoon HY, Lee N, Lee KE, et al. Clinical manifestations and perinatal outcomes of pregnant women with covid-19: A systematic review and meta-analysis. Scientific Reports. 2020; 10(1):18126. [DOI:10.1038/s41598-020-75096-4] [PMID] [PMCID]

[34] Zhang L, Jiang Y, Wei M, Cheng BH, Zhou XC, Li J, et al. [Analysis of the pregnancy outcomes in pregnant women with covid-19 in Hubei Province (Chinese)]. Zhonghua Fu Chan Ke Za Zhi. 2020; 55(3):166-71. [DOI:10.3760/cma.j.cn112141-20200218-00111] [PMID]

[35] Tang P, Wang J, Song Y. Characteristics and pregnancy outcomes of patients with severe pneumonia complicating pregnancy: A retrospective study of 12 cases and a literature review. BMC Pregnancy Childbirth. 2018; 18(1):434. [DOI:10.1186/s12884-018-2070-0] [PMID] [PMCID]

[36] Brito V, Niederman MS. Pneumonia complicating pregnancy. Clinics in Chest Medicine. 2011; 32(1):121-32. [DOI:10.1016/j.ccm.2010.10.004] [PMID] [PMCID]

[37] Siston AM, Rasmussen SA, Honein MA, Fry AM, Seib K, Callaghan WM, et al. Pandemic 2009 influenza A(H1N1) virus illness among pregnant women in the United States. JAMA. 2010; 303(15):1517-25. [DOI:10.1001/jama.2010.479] [PMID] [PMCID]

[38] Chen YH, Keller J, Wang IT, Lin CC, Lin HC. Pneumonia and pregnancy outcomes: A nationwide population-based study. American Journal of Obstetrics and Gynecology. 2012; 207(4):288.e1-7. [DOI:10.1016/j.ajog.2012.08.023] [PMID] [PMCID]

[39] Lucena FC, Lage EM, Teixeira PG, Barbosa AS, Diniz R, Lwaleed B, et al. Longitudinal assessment of D-dimer and plasminogen activator inhibitor type-1 plasma levels in pregnant women with risk factors for preeclampsia. Hypertension in Pregnancy. 2019; 38(1):58-63. [DOI:10.1080/10641955.2019.1577435] [PMID]

[40] FitzGerald GA. Misguided drug advice for covid-19. Science. 2020; 367(6485):1434. [DOI:10.1126/science.abb8034] [PMID]

[41] Mertz D, Geraci J, Winkup J, Gessner BD, Ortiz JR, Loeb M. Pregnancy as a risk factor for severe outcomes from influenza virus infection: A systematic review and meta-analysis of observational studies. Vaccine. 2017; 35(4):521-8. [DOI:10.1016/j.vaccine.2016.12.012] [PMID] [PMCID]

[42] Morken NH, Gunnes N, Magnus P, Jacobsson B. Risk of spontaneous preterm delivery in a low-risk population: The impact of maternal febrile episodes, urinary tract infection, pneumonia and ear-nose-throat infections. European Journal of Obstetrics, Gynecology, and Reproductive Biology. 2011; 159(2):310-4. [DOI:10.1016/j.ejogrb.2011.08.006] [PMID]