



GESTATIONAL SARS-COV-2 AND THE MODE OF DELIVERY: MINI REVIEW

R. S. Jasem Al-Dahwi*, D. Kostadinova-Slavova, M. Angelova

Department of Obstetrics and Gynecology, Medical Faculty, Trakia University,
Stara Zagora, Bulgaria

ABSTRACT

Purpose: The emergence of the SARS-CoV-2 coronavirus has posed untold challenges to medical systems, as pregnant women are more susceptible to its harmful effects.

Material/Methods: Clinical studies are seeking to understand the intricacies of the virus's action during pregnancy, and to clarify the relationship between gestational infection with SARS-CoV-2 and mode of delivery. This literature review aims to explore and outline the existing knowledge related to different components of the topic, highlighting important subtopics such as: preterm birth, cesarean section, preeclampsia, preterm labor, and fetal distress. **Results:** Recent studies have shown a higher rate of preterm birth among pregnant women with SARS-CoV-2; and also that vaginal delivery is relatively safe with respect to SARS-CoV-2 infection in uncomplicated cases, but in complicated cases, cesarean section is a safe method. In addition to the complexity, gestational infection and SARS-CoV-2 infection can be followed by complications such as preeclampsia and premature rupture of membranes, additional factors determining the mode of delivery.

Conclusions: In this context, the aim of this literature review is to critically analyze the available information on the association between gestational infection with SARS-CoV-2 and the mode of delivery, shedding light on key issues related to clinical care and guiding future research efforts.

Keywords: SARS-CoV-2, pregnancy, delivery mode, infections

INTRODUCTION

The novel corona-virus disease (COVID-19) was discovered in December 2019, Wuhan, China, caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) [1, 2, 3].

The advent of the COVID-19 disease caused by the novel coronavirus, SARS-CoV-2, has brought up indescribable challenges to the medical systems all over the world, moreover, pregnant women turn out to be definitely more liable to its hurtful effects than the others. An important area of research, which clinicians and scientists are aiming at, in understanding the intricacies of a virus's action during pregnancy is to elucidate the relationship between

gestational SARS-CoV-2 infection and mode of delivery [2, 3].

The present literature review aims to scrutinize and delineate the existing knowledge related to various components of this monograph, highlighting prominent topics like preterm labour, cesarean section, preeclampsia, PROM, and fetal distress. Recent studies have shown a higher rate of receiving preterm labor among pregnant women with SARS-CoV-2 infection [4, 5]. Amongst others, Allotey et al. (2020) [4] substantiates that pregnant women infected with the SARS-CoV-2 virus are twice as likely to have preterm birth compared to those who are not carrying the virus. This, therefore, calls for systematic management of pregnant individuals with coronavirus as it will reduce complications during childbirth.

On the other hand, the delivery mode is another matter under constant deliberation regarding the

*Correspondence to: *Rafaah S. Jasem Al-Dahwi, Department of Obstetrics and Gynecology, Medical Faculty, Trakia University, 6000, Stara Zagora, Bulgaria*

gestational SARS-CoV-2 infection. While some researchers assume that vaginal delivery is rather safe in terms of SARS-CoV-2 infection among uncomplicated cases [6], others suggest that the risk of transmission through this channel is impossible to be eliminated and therefore, caesarean section is a safer method [2]. Adding to the complexity, gestational SARS-CoV-2 infection may be followed by various complications such as preeclampsia and premature rupture of membranes, an important factor contributing to the decision of the delivery mode [5, 7]. A multitude factors, including pregnancy complications and maternal morbidity, must be taken into account for clinical practice and the improvement of gestational SARS-CoV-2 infection outcomes in all cases.

With this background, the purpose of this literature review is to clearly analyse available information on the association between gestational SARS-CoV-2 infection and method of delivery, shining light on essential clinical care issues and guiding future research efforts. The review aims to give insights that can enhance evidence-based decision-making and improve outcomes for pregnant women and neonates who have been infected with SARS-CoV-2 during gestation.

METHODS

The database was searched from January 2020 to January 2024. Using specific keywords, we searched for SARS-CoV-2 infections, SARS-CoV-2 infections during pregnancy and mode

of delivery. Mini review was included examination of pregnant patients with SARS-CoV-2 infection at different modes of delivery. Non-pregnant patients were excluded.

Clinical Criteria and Epidemiological Criteria

- A clinically diagnosed case was defined as a suspected case with manifestations with catarrhal symptoms and moderate intoxication or pulmonary manifestations in pregnant women .
- A laboratory-confirmed case was defined as a positive result to SARS-CoV-2 and complete blood picture with elevated leucocytes, biochemical parameters like C-reactive protein and D-Dimer.
- A SARS-CoV-2 positive mothers with preeclampsia or PPRM (preterm premature ruptur of the membrane)

MATERNAL AND FETAL OUTCOMES OF GESTATIONAL SARS-COV-2: Implications for Preterm Labor

It is of great importance to grasp the delicate connection between gestational SARS-CoV-2 infection and its influence on obstetrical outcomes, particularly for preterm labour, due to the pandemic health condition. Studies on different groups of pregnant women uncover the more or less profound post-infection consequences related to different stages of pregnancy. The complexity of the relationship between the SARS-CoV-2 virus and a pregnant woman demands a complex approach to the interpretation of the obtained data (**Table 1**).

Table 1. Characteristics according to COVID-19 severity.

Study	Date of publication	Country	Study design	Gestational age	Maternal age	SARS-CoV-2 (±)
Khadijeh et al.,	2023	Iran-Isfahan	prospective cohort study	first trimester - third trimester	not reported	+
Piekos et al.	2022	USA	retrospective multicenter cohort study	different trimesters	not reported	+
McClymont et al.,	2022	Canada	exploratory surveillance study	28-37 gestational weeks	not reported	+

Khadijeh and co-workers [8], in a prospective cohort study, which was comprised of a considerable cohort of 430 known pregnant women who tested positive for COVID-19, and carefully followed the outcomes across

different trimesters. The data showed that the worst complications were perceived during the last two quarters when the need for mechanical ventilation and the prevalence of the protein disorder called pre-eclampsia were noticed

among infected ladies. In the meantime, fetal complications were commonly seen and included fetal growth restriction (FGR), oligohydramnios, and distress warning requiring cesarean section (C/S) in most cases involving prolonged pregnancies especially those in the end stage of gestation. The findings about this particular disorder prove not only the enhanced susceptibility to the disease but also the critical importance of the time of gestation. On the contrary study by Piekos et al. (2022) [9], scrutinizes the intricate temporal factors of SARS-CoV-2 infection in the course of pregnancy taking into account data from 18335 pregnant individuals during this period to ascertain its effect on all birth outcomes. The comparison of their observations raised a red flag, pointing to an elevated risk of early and still delivery due to mostly infections during the initial and middle period of gestation. Interestingly, they assumed that the chronic severity of acute COVID-19 did not correlate with gestational age at the time of coming into contact with the disease since there might be some underlying factor to blame, such as the time of infection while being pregnant. It underpins the necessity for taking into account the intricacy of the disease dynamics when establishing influential gestational outcomes.

Besides, the endless epidemiological survey by McClymont et al., 2022 [10] done across Canada, covering a wide cohort of 6012 pregnant women with the SARS-CoV-2 infection, shed light on the broader epidemiological landscape and associated outcomes. Their in-depth analysis proved the existence of greatly elevated odds of poor maternal outcomes, such as hospitalization or ICU admission which was incomparable to reproductive-age females in the general population with SARS-CoV-2 infection rate. The most notable increase was observed regarding the preterm birth rate in SARS-CoV-2-influenced pregnancies of even the most mild disease manifestations cases which did not require hospitalization. This trend raises a grave concern which is why careful monitoring and targeted measures are urgently required to combat the expanding risks of premature labor within the pandemic outbreak context. Finally, the combined evidence emphasizes the many facets of the relationship between preterm labour and gestational SARS-CoV-2 infection hence, crafting a picture with the overlapping time spans, the different severity levels of the maternal illness and the underlying risk factors

underneath. With the rapid scientific advancements uncovering the underlying mechanisms of maternal gestational SARS-CoV-2 infection, it is necessary to reinforce the obstetric care protocols and refine the prevention measures to do so it is essential to have a full understanding of the diverse aspects involved in gestational SARS-CoV-2 infection dynamics and its possible effects on mother-fetus health and wellbeing.

Delivery Mode in Gestational SARS-CoV-2: Comparing Vaginal Delivery and Cesarean Section

The subject of an optimal mode of delivery to pregnant individuals having gestational SARS-CoV-2 infection stays disputed, with various research findings offering reasonable doubts that should be analyzed critically to help develop evidence-based clinical practices. Certain studies are the help shedding light on different outcomes related vaginal delivery versus cesarean section in pregnancy and COVID-19 having a close look at the implications that are profound. Giuliani et al., 2022 [11] conducted a very detailed study to determine how the SARS-CoV-2 virus enters a newborn baby through either vaginal delivery or caesarian section and put forth conflicting details which do not easily simplify. Their findings, starting from the intercovid research, overthrew the traditional view by establishing a perplexing link between caesarean delivery and neonatal SARS-CoV-2 positivity (although a closer examination did not find any differences in maternal disease severity or the reasons for the cesarean section). Though compelling, such results challenge traditional viewpoints and evoke the requirement for additional research into underlying forces behind the infant infection pattern.

On the other side of the coin, Morán et al., 2021 [12] conducted a prospective observational study on more than 79 medical centres in order to shed light on the causes and the consequences of that trend for the people who are infected with SARS-CoV-2 and pregnant. The experts documented a compelling story in which cesarean section was positioned as a surgical need in cases of life-threatening maternal pneumonia and concurrent complications, thereby justifying a timely delivery. Even with the complicated post-surgical picture as demonstrated by the higher bleeding and ICU admissions rate, cesarean section still is considered a rescue procedure to reduce

maternal complications when a severe case of COVID-19 infection makes doing otherwise a very difficult task.

In addition, Cai et al., 2021 [13] published a comprehensive synthesising literature review, through which they were able to track the different effects of delivery mode on neonatal SARS-CoV-2 infection rates which in turn challenged the conventional approach. In particular, their meta-analysis which synthesized observational studies, showed no variability in neonatal infection rates between the group of infants born via vaginal delivery and those delivered by cesarean section. In spite of the expected dogma that cesarean section is a preventive measure against the vertical transmission of the virus, the equipoise of the low rate of neonatal infection serves as a basis for the complexity of choice-making in regards

to the appropriate mode of delivery as the SARS-CoV-2 infection in a pregnant woman is a possibility.

Along those lines, the research paper of Bisht et al., (2021) [14] which was done as a retrospective study for a year period, has sought to compare the results between LSCS and vaginal delivery under covid-19 infected pregnant women. While their findings appear to be contingent, they point towards the balance in method of delivery alternatives, with no type of delivery emerging as victorious in the sense of safety of mother and baby. Assuredly, personalized decision-making, especially for complications in pregnancy and labour indicators, is the cornerstone in overcoming the medical jungle caused by the pandemic (**Table 2**).

Table 2. Characteristics according to COVID-19 severity.

Study	Publication date	Country	Study design	Gestational age	Maternal age	SARS-CoV-2 (±)
Giuliani et al.,	2022	Italy	cohort study	34-39 gestational weeks	20-40	+
Morán et al.,	2021	Spain	Prospective observational study	34-39 gestational weeks	not reported	+
Cai et al.,	2021	China	Systemic review	30-39 gestational weeks	not reported	+
Bisht et al.,	2021	India	Retrospective study	irrespective to gestational age	not reported	+

In summary, the debate over gestational SARS-CoV-2 infection mode of delivery reveals the multi-aspects of the decision-making, because managing the maternal clinical complexities, neonatal infection dynamics and perinatal outcomes involves a comprehensive understanding. It is the complex scenario of conflicting evidence from various studies that collectively reaffirmed the fact that focused, case-based, evidence-informed decision-making for every particular pregnant woman in the COVID-19 period is best.

SARS-CoV-2 Infection during Pregnancy: Impact on Obstetric Complications like Preeclampsia and Preterm Premature Rupture of Membranes (PROM)

The intersection between SARS-CoV-2 infection and pregnancy unveils a complex

landscape fraught with challenges and uncertainties, particularly concerning the heightened risk of obstetric complications such as preeclampsia (PE) and preterm premature rupture of membranes (PPROM). A multitude of studies endeavor to unravel the intricate dynamics underpinning these associations, shedding light on the multifaceted interplay between viral pathophysiology and maternal-fetal physiology. Vanegas and Pérez (2023) [15] delve into the parallels between PE and SARS-CoV-2 infection, delineating a nexus characterized by heightened maternal morbidity and mortality, underscored by the ominous spectre of COVID-19-induced myocardial injury. Their study accentuates the dire consequences of SARS-CoV-2 infection during pregnancy, elucidating the mechanisms

underpinning the augmented risk of PE, ranging from direct viral effects on trophoblast function to exaggerated inflammatory responses and placental ischemia. By leveraging COVID-19 as a study model, this research underscores the imperative for heightened vigilance and tailored interventions to mitigate the ominous spectre of PE amidst the prevailing pandemic milieu.

Similarly, Celewicz et al. (2023) [16] undertake a comprehensive review to unravel the pathophysiological underpinnings linking SARS-CoV-2 infection to obstetric complications, with a particular focus on PE and PROM. Their synthesis underscores the intricate interplay between viral pathophysiology and physiological pregnancy, illuminating the convergence of endothelial injury, complement activation, and dysregulated immune responses in precipitating obstetric complications. Furthermore, their findings elucidate the aberrant subcellular changes engendered by SARS-CoV-2 infection, accentuating the imperative for targeted prophylaxis and therapeutic interventions to mitigate the heightened risk of obstetric complications amidst the pervasive threat of COVID-19.

Martinez-Perez et al. (2021) [17] present a multi-centred prospective study with remarkable conformation of connection between SARS-CoV-2 infections and pregnancy outcomes such as preterm delivery and preterm rupture of membranes via their

research. They revealed the potentially fatal effects of SARS-CoV-2 transmission as a result of increased chances of preterm birth and neonatal intensive care unit admissions. These findings stress the importance of close monitoring and custom approaches to combat the higher risk of obstetric complications in pregnant with Coronavirus patients. The situation shows the need for detailed risk stratification and proactive care management. Similarly, Akhtar et al., (2020) [18] conducted a systematic review to establish SARS-CoV-2 infection and poor pregnancy outcomes including but not limited to increased odds of preterm birth, PROM, and maternal mortality. Their all-embracing analysis heightens the dangers which are associated with the SARS-CoV-2 infection during pregnancy while pointing out the importance of routine monitoring and the need for preventive measures to minimize complications in obstetrics during the raging pandemic of COVID-19. Furthermore, Yi et al., (2024) [19] conducted a retrospective study to determine the correlation between the time period of the COVID-19 infection during pregnancy and perinatal outcomes, giving an insight on the intricate mechanisms which govern the adverse obstetric outcomes. Gestational age at COVID-19 infection was one of the critical factors identified in their study. Consequently, it will help to create a framework for risk stratification and proactive management strategies that are unique to each (**Table 3**) individual pregnant woman.

Table. 3 Characteristics according to COVID-19 severity.

Study	Publication Date, Country	Study design	Gestational age	Maternal age	SARS-CoV-2 (±)
Vanegas and Pérez	2023-Spain	provisional cohort study	not reported	not reported	+
Celewicz et al.,	2023-Poland	Retrospective study	not reported	not reported	+
Martinez-Perez et al.,	2021-Spain	Prospective study	not reported	not reported	+
Akhtar et al.,	2020-UK	Systemic review	not reported	not reported	+
Yi et al.,	2024-China	Retrospective study	14-40 gestational weeks	not reported	+

In summary, the connection between SARS-CoV-2 infection and pregnancy is a complex fabric in which dramatic obstetrical upshots such as PE and PROM stand out. These assorted

studies provide a clear picture of the pathophysiological processes and clinical ramifications of this linkage. However, what is required is integrative risk stratification and

tailored therapeutic strategies that can help in mitigating this high level of risk of obstetric complications in the context of the omnipresent threat posed by COVID-19. Through untangling the subtle process of perinathopathogenesis, these studies develop the basis of improved detection, proactive interventionization, and an optimal clinical outcome for mothers and their neonates in the current epidemic context.

Fetal Well-being and Delivery Decisions in Gestational SARS-CoV-2: Addressing Fetal Distress and Delivery Mode Considerations

The crossroads where antenatal SARS-CoV-2 infection and fetal health collide imply a complicated clinical case that needs a refined approach to birthing options in order to fulfill both the mom's and the newborn's health goals. In the course of the critical analysis of the available literature see a complex space where the lack of high-quality evidence is prevailing. The need for situational risk characterization as well as individualized management approaches is outlined addressing the dangerous and constant threat of COVID-19. David and Spencer (2022) [20] explicate the contemporary scenario that includes antenatal monitoring and safety evaluation in the context of clinical trials that require extreme precision of imaging modalities for the analysis of fetal growth and placental function. However, the likely advent of advanced techniques including the MRI and CTG provides hope to have advanced fetal assessment. Its practical application during prenatal SARS-CoV-2 infection has still to be clarified. Aside from that, MFAET (Maternal and Fetal Adverse Event Terminology), which is a standard safety monitoring framework, marks a major step towards the improvement of monitoring of safety during clinical trials. However, framework validity in the scope of COVID-19 is conditional on the presence of robust validation and tailored modification to address the peculiar problems of the pandemic. The paper titled „Pivotal Decision-Making Dilemma: Elective Delivery versus Expectant Management in Pregnant Individuals with COVID-19-related Acute Respiratory Distress Syndrome“ by Resende et al., (2022) [21] provided valuable insights on the significant decision-making considerations about elective delivery and expectant approach in pregnant women with COVID-19-The delivery recommendation developed by the obstetricians is based on the complex mix of factors such as gestational age, maternal respiratory distress

JASEM AL-DAHWI R.S., et al.

severity, and the probability of either intrauterine or maternal death that lead to delivery decisions. Nevertheless, the neonatal benefits of elective births are observed in particular high-risk cases such as gestational ages ≥ 30 weeks and pregnancy with risks, in which the superiority of expectant management remains debatable in the rest of clinical cases. Moreover, the implications of elective delivery on long-term maternal and neonatal morbidity warrant further investigation, necessitating a balanced approach grounded in evidence-based medicine and individualised risk assessment. Mullins et al., (2020) [22] cull out the clinical features and the related obstetric outcomes of the Mother and the infant with COVID-19 in the retrospective community where they conducted their research. The supposed lower case fatality rate and vertical transmission as compared with that observed in previous coronaviral outbreaks have been reported. However, the high incidence of preterm delivery is evidence of the importance of obstetric management as well as neonatal care. On the other hand, the present evidence is still very limited, so it is evident that strong epidemiological research is immediately needed to better understand the long-term impacts of gestational SARS-CoV-2 on the health of the mother and the baby.

Carvalho-Sauer et al. (2023) [23] has back the whole concept of how SARS-CoV-2 has affected maternal-fetal health through their study. The study found that pregnant individuals with COVID-19-related acute respiratory distress syndrome had a much higher risk of fetal death, which was four-fold higher. This study illuminates the necessity of a heightened sense of alertness and a good ventilation system in high-risk pregnancies with co-morbidities of respiratory illness and invasive ventilation. Nevertheless, despite the fact that the relationship between the gestational infection of SARS-CoV-2 and the adverse outcomes of the obstetrics is well-established, an optimal approach to fetal surveillance and delivery decisions stands with the individualized assessment of the risk and the nuanced grasp of the dynamic interplay between the maternal health status and the neonatal outcomes.

Ultimately, gestational SARS-CoV-2 infection and fetal being is confronting clinicians with a formidable challenge which requires an extensive assessment and individualistic therapies to enhance the well-being of mothers

and newborns. Although presently available literature provides valuable information on the pathophysiology of gestational SARS-CoV-2 infection and its clinical implication, it is still a fact that the sparsity of informative evidence on epidemiology and therapeutics indicates the call for large prospective clinical trials and epidemiological studies to boost the understanding of the optimal approach in prenatal monitoring and delivery decisions

under the ruse of through the accord of interdisciplinary partnerships and evidence-based policymaking, health providers can overcome the barriers of gestational SARS-CoV-2 infection with higher effectiveness and precision, so that they can develop outcomes that are favourable to both mothers and their unborn babies, in the context of the **(Table 4)** ongoing pandemic.

Table 4. Characteristics according to COVID-19 severity.

Study	Publication Date, Country	Study design	Gestational age	Maternal age	SARS-CoV-2 ($\pm$)
David and Spencer	2022- UK	systemic review	first trimester-midtrimester	not reported	-
Resende et al.,	2022Canada	systemic review	28-34 gestational weeks	not reported	+
Mullins et al.,	2020-UK	Rapid review	not reported	not reported	+
Carvalho-Sauer et al.,	2023-Barazil	Cohort study	not reported	not reported	+

Study Limitations

Our article has some limitations. Firstly, we didn't search for all the database. Secondly, we didn't perform analysis according to the severity of the COVID-19 infection of the mothers due to the missing information of the included studies. Pregnant women with more severe COVID-19 infection appear to prefer delivery by cesarean section rather than vaginal birth. What's more, all patients in the study who give birth were recruited in their second and third trimester, so we were unable to ascertain the possibility of intrauterine vertical transmission during the first trimester. For example, rubella infection in the first trimester can affect more than 50% of fetuses via intrauterine infection. In contrast, by the end of the second trimester, the incidence rate is reduced by half.

CONCLUSIONS

This mini-review emphasizes the complex effects of SARS-CoV-2 infection during pregnancy, which is linked to higher risks of preterm birth, caesarean delivery, preeclampsia, PROM, and fetal distress- especially when infection occurs in the second or third trimester. While caesarean sections were initially thought to reduce vertical transmission, current evidence shows no clear advantage over vaginal birth in this regard, suggesting delivery mode

should be based on clinical factors rather than COVID-19 status alone. The overlap between SARS-CoV-2-induced inflammation and pregnancy-related changes may worsen maternal vulnerability, requiring careful monitoring and interdisciplinary care. Decisions about timing and mode of delivery must balance maternal respiratory status and fetal health, though gaps remain in knowledge about long-term outcomes and early pregnancy infections. Ultimately, managing COVID-19 in pregnancy demands a tailored, evidence-based approach, improved prenatal care strategies, and further research to enhance maternal and neonatal outcomes.

Data Availability Statement

The original contributions presented in the study are included in the article/Supplementary Material, further inquiries can be directed to the corresponding authors.

Author Contributions

RJ had the idea contributed to the design of the article. DK and MA had roles in the assessment of the risk of bias in the included studies. All authors reviewed and approved the final version.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

ACKNOWLEDGMENTS

This study was funded by the PhD fellowship of Dr. Rafaah Jasem Al-Dahwi, and Scientific project 5/2023, Medical Faculty, Trakia University, Stara Zagora and Ministry of Education and Science BG-RRP-2.004-0006, Bulgaria.

REFERENCES

1. Alnasser A, Alburaih J, Abuzaid A, Al Thomali A, Alkhalazal M, Alraddadi A, et al. Effect of the severity of SARS-CoV-2 on pregnancy and delivery: A narrative review. *Microbes Infect Dis.* 2023;4(2):401–407. doi:10.21608/mid.2023.200981.1489
2. Di Toro F, Gjoka M, Di Lorenzo G, De Santo D, De Seta F, Maso G, et al. Impact of COVID-19 on maternal and neonatal outcomes: a systematic review and meta-analysis. *Clin Microbiol Infect.* 2021;27(1):36–46.
3. Bellos I, Pandita A, Panza R. Maternal and perinatal outcomes in pregnant women infected by SARS-CoV-2: A meta-analysis. *Eur J Obstet Gynecol Reprod Biol.* 2021;256:194–204.
4. Allotey J, et al. Clinical manifestations, risk factors, and maternal and perinatal outcomes of coronavirus disease 2019 in pregnancy: living systematic review and meta-analysis. *BMJ.* 2020.
5. Khalil A, et al. Change in the incidence of stillbirth and preterm delivery during the COVID-19 pandemic. *JAMA.* 2021.
6. Luo Y, Yin K. Management of pregnant women infected with COVID-19. *Lancet Infect Dis.* 2020.
7. Mendoza M, et al. Pre-eclampsia-like syndrome induced by severe COVID-19: A prospective observational study. *BJOG.* 2020.
8. Siahafshari KM, Movahedi M, Hajhashemi M, Khorvash F, Saeidi M, Allameh Z. Evaluation of maternal and fetal outcomes in pregnant women with COVID-19 based on different trimesters. *Adv Biomed Res.* 2023;12(1):165. doi:10.4103/abr.abr_173_22
9. Piekos SN, Roper RT, Hwang YM, Sorensen T, Price ND, Hood L, Hadlock JJ. The effect of maternal SARS-CoV-2 infection timing on birth outcomes: a retrospective

- JASEM AL-DAHWI R.S., et al.*
multicentre cohort study. *Lancet Digit Health.* 2022. doi:10.1016/S2589-7500(21)00250-8
10. McClymont E, Albert AY, Alton GD, Boucoiran I, Castillo E, Fell DB, et al. Association of SARS-CoV-2 Infection During Pregnancy with Maternal and Perinatal Outcomes. *JAMA.* 2022;327(20):1983–1991. doi:10.1001/jama.2022.5906
 11. Giuliani F, Deantoni S, Papageorgiou A.T. Vaginal vs cesarean delivery for COVID-19 in pregnancy. *Am J Obstet Gynecol.* 2022;228(3):358–359. doi:10.1016/j.ajog.2022.10.020
 12. Morán Antolín E, Broullón Molanes JR, de la Cruz Conty ML, Encinas Pardilla MB, Guadix Martín MDP, Sainz Bueno JA, et al. SARS-CoV-2 Infection and C-Section: A Prospective Observational Study. *Viruses.* 2021;13(11):2330. doi:10.3390/v13112330
 13. Cai J, Tang M, Gao Y, Zhang H, Yang Y, Zhang D, et al. Cesarean Section or Vaginal Delivery to Prevent Possible Vertical Transmission from a Pregnant Mother Confirmed with COVID-19 to a Neonate: A Systematic Review. *Front Med (Lausanne).* 2021;8:634949. doi:10.3389/fmed.2021.634949
 14. Bisht R, Kandalganekar VP, Shinde KK. Cesarean Section Rate among COVID-19 Mothers and Its Classification through Robson's Criteria. *J South Asian Fed Obstet Gynaecol.* 2021;13(5):342–346. doi:10.5005/jp-journals-10006-1921
 15. Vanegas OG, Pérez O. SARS-CoV-2 Infection and Preeclampsia—How an Infection Can Help Us to Know More about an Obstetric Condition. *Viruses.* 2023;15(7):1564. doi:10.3390/v15071564
 16. Celewicz A, Celewicz M, Michalczyk M, Woźniakowska-Gondek P, Krejczyk K, Misiek M, et al. SARS CoV-2 infection as a risk factor of preeclampsia and pre-term birth. *Ann Med.* 2023;55(1). doi:10.1080/07853890.2023.2197289
 17. Martinez-Perez O, Prats Rodriguez P, Muner Hernandez M, Encinas Pardilla MB, Perez Perez N, Vila Hernandez MR, et al. The association between SARS-CoV-2 infection and preterm delivery: a prospective study with a multivariable analysis. *BMC Pregnancy Childbirth.* 2021;21(1). doi:10.1186/s12884-021-03742-4
 18. Akhtar H, Patel C, Abuelgasim E, Harky A. COVID-19 (SARS-CoV-2) Infection in

- Pregnancy: A Systematic Review. *Gynecol Obstet Invest.* 2020. doi:10.1159/000509290
19. Yi J, Chen L, Meng X, Chen Y. The impact of gestational weeks of Coronavirus disease 2019 (COVID-19) infection on perinatal outcomes. *Reprod Health.* 2024;21(1). doi:10.1186/s12978-024-01762-9
 20. David AL, Spencer RN. Clinical Assessment of Fetal Well-Being and Fetal Safety Indicators. *J Clin Pharmacol.* 2022;62(S1). doi:10.1002/jcph.2126
 21. Resende MF, Yarnell C, D'souza R, Lapinsky S, Nam A, Shah V, et al. Clinical decision analysis of elective delivery vs expectant management for pregnant individuals with COVID-19-related acute respiratory distress syndrome. *Am J Obstet Gynecol MFM.* 2022;4(6):100697. doi:10.1016/j.ajogmf.2022.100697
 22. Mullins E, Evans D, Viner RM, O'Brien P, Morris E. Coronavirus in pregnancy and delivery: rapid review. *Ultrasound Obstet Gynecol.* 2020;55(5). doi:10.1002/uog.22014
 23. Carvalho-Sauer R, Flores J, Teixeira MG, Saavedra R, Niag M, Paixão ES. Fetal death as an outcome of acute respiratory distress in pregnancy, during the COVID-19 pandemic: a population-based cohort study in Bahia, Brazil. *BMC Pregnancy Childbirth.* 2023;23(1). doi:10.1186/s12884-023-05601-w