Pregnancy during the evolving pandemic Coronavirus Disease 2019 (COVID-19): A rapid scoping review of early evidence in the published literature

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Systematic Review

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Abstract

Background

Without any preventive or curative medication, the Coronavirus disease 2019 (COVID-19) poses a higher risk to pregnant women, due to their immunosuppression during pregnancy. This rapid scoping synthesized the earliest evidence from the published scientific literature on the clinical feature and management for pregnant women with COVID-19.

Method

Scientific literature (published in English between 1 January 2019 to 31 March 2020) were systematically extracted from PubMed, Embase, Scopus, Web of Science, and “Global research on coronavirus disease (COVID-19)”. Results from eligible studies were charted, synthesized, and presented in a narrative format.

Result

Our study identified 52 unique articles, and among them, 29 were included in this review. Pregnant women with COVID-19 were mostly in their third trimester and presented with fever, dry cough, myalgia, and dyspnea. Ground-glass opacity was the cardinal feature of COVID-19 in the computerized tomography scan of the chest. Except for two participants, severe pneumonia did not occur among pregnant women. Higher episodes of preterm birth and cesarean delivery were observed; however, it cannot be explicitly attributed to COVID-19. There is no published evidence on the vertical transmission. A collaborative team of healthcare professionals must manage pregnancy with COVID-19. Contact tracing, investigation of travel history, radiological assessment, and laboratory tests with regular fetal health monitoring must be done.

Conclusion

Evidence of higher perinatal complications puts pregnant women in a further vulnerable condition. Cautiousness is imperative during the clinical management of pregnant women with COVID-19, as there is no approved treatment regime available at this moment.

Background

Coronavirus disease 2019 (COVID-19) caused by a novel mutation of a previously known coronavirus (CoV) and has been labeled as Severe Acute Respiratory Syndrome CoV (SARS-CoV-2), mostly spreads through respiratory droplets. SARS-CoV-2 was first detected in Wuhan – the capital city of Hubei province in China – in December 2019, SARS-CoV-2 has been detected in every country of the world and established itself as the deadliest pandemic in last 100 years [1]. Although a large proportion of people infected with SARS-CoV-2 may suffer from asymptomatic infection to mild to moderate fever or respiratory illness and would recover without any special treatment, older people and people with

underlying medical conditions or immunosuppression (e.g., cardiovascular disease, diabetes, and other chronic diseases) may demonstrate a severe form of pneumonia, including deaths [2–4].

SARS-CoV-2 can also pose pregnant women at higher risk due to their immunosuppression during pregnancy [5]. Though evidence is emerging across the world on COVID-19, there is a dearth of studies reporting its impacts during pregnancy. Thus, a coherent summary of the earliest published evidence, including clinical features and management recommendations, may help to understand the impacts of SARS-CoV-2 on pregnancy. This rapid scoping review has synthesized the evidence from the earliest published scientific literature on the clinical feature of COVID-19 among pregnant women and recommendations around their clinical management.

Methods

This rapid scoping review was conducted following the recommended steps by Arksey and O'Malley [6], and Levac and colleagues [7]. Reporting of the result of this review was guided by the “Preferred Reporting Items for Systematic Reviews and Meta-Analyses” Extension for Scoping Reviews (PRISMA-ScR) [8]. The development and implementation of the search strategy were collaboratively done by MH and TA. Two investigators (MH and GMK) independently performed the study selection by title and abstract, and full-text screening. Due to the limitation of time, data extraction, and synthesis of the result was done collaboratively by MH and GMK. The schematic diagram of the study selection process based on the guidelines of Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) is presented in the supplementary material. Ethical approval was not required, as all data was obtained from publicly available literature databases.

Search strategy and selection criteria

As part of the review process, a systematic and replicable search strategy was developed considering two concepts: (a) pregnant women, and (b) COVID-19. Relevant keywords and index terms associated with these two concepts were identified from the MeSH terms listed in PubMed and from Google Scholar. To identify the earliest evidence of COVID-19 and pregnancy, the search strategy was implemented across four electronic databases: (a) PubMed (ncbi.nlm.nih.gov/pubmed/), (b) Embase ([embase.com](https://www.embase.com)), (c) Scopus ([scopus.org](https://www.scopus.org)), and (d) Web of Science ([webofknowledge.com](https://www.webofknowledge.com)). Also, a hand search was conducted in the electronic database “Global research on coronavirus disease (COVID-19)” managed by World Health Organization (WHO) (<https://www.who.int/emergencies/diseases/novel-coronavirus-2019/global-research-on-novel-coronavirus-2019-ncov>). The timeframe of the search was limited between 1 January 2019 to 31 March 2020.

An illustrative search strategy for PubMed is presented in Table 1, which generated 28 records. The detailed search strategy for the other databases is provided in the supplementary material. Search results from the five electronic databases resulted in 69 initially identified literature, which was imported into Covidence systematic review software ([covidence.org](https://www.covidence.org)) to implement the selection process. At this stage, 17 duplicates were removed. Next, titles and the abstracts of 52 uniquely identified studies were screened, and an additional 11 studies were found to be irrelevant based on the set of a priori inclusion and exclusion criteria (Please see the supplementary material).

Table 1: PubMed Search Strategy on pregnancy and Coronavirus Disease 2019 (COVID-19) implemented on 31 March 2020

Database	Concept	Key Words	Results
PubMed	Pregnant women	Line (Pregnant Woman[MESH] OR Pregnant*[tw] OR Gestation[tw] OR Gravid*[tw] OR natal*[tw] OR Antenatal[tw] OR Perinatal[tw] OR Postnatal[tw] OR partum*[tw] OR Antepartum*[tw] OR peripartum*[tw] OR postpartum*[tw] OR puerperium[tw]) AND	28
	Coronavirus disease-19	Line Wuhan coronavirus"[tw] OR "Wuhan seafood market pneumonia virus"[tw] OR "COVID19 virus"[tw] OR "COVID-19 virus"[tw] OR "coronavirus disease 2019 virus"[tw] OR "SARS-CoV-2"[tw] OR "SARS2"[tw] OR "2019-nCoV"[tw] OR "2019 novel coronavirus"[tw] OR "2019 novel coronavirus infection"[tw] OR "2019-nCoV infection"[tw] OR "COVID-19 pandemic"[tw] OR "coronavirus disease-19"[tw] OR "2019-nCoV disease" OR "COVID19"[tw] OR "2019 novel coronavirus disease"[tw] OR "coronavirus disease 2019"[tw]) AND	
	Time frame	Line ("2019/01/01"[PDat] : "2020/03/31"[PDat])	
		3	

For full-text screening, the same set of criteria was used by the investigators. Studies published in scientific journals and written in English were included. Due to the methodological plasticity of scoping review, a variety of published literature was included in the studies, which includes original research, case studies or reports, expert consensus, correspondence, reviews, etc. However, author's reply, research highlights, and news or media watches were excluded from the review.

Charting the data and analysis

We charted data on study characteristics (the type of study, location of the study), population characteristics (number of pregnant women, the clinical features of the women), and type of evidence presented in the study. The data were summarized in a narrative format with the help of tables across two thematic areas: (a) clinical feature of pregnant women with COVID-19, and (b) recommendations for clinical management of COVID-19 during pregnancy. Due to the sparsity of the early published articles, the quality of the literature was not assessed, considering the generalizability of the rapid scoping review [6,9,10]. No patients or populations were included in the conception and conduct of the scoping review.

Results

Out of the 69 extracted publications, 29 full-text publications were included for the scoping review [5,11-38] (Table 2). 16 studies presented clinical findings of COVID-19 among pregnant women, which includes six original articles [12,13,20-22,38], three case reports [15,32,33], two case-reviews [29,36], two research letters [18,37], and one correspondence [34], rapid review [24] and systematic review and meta-analysis [14] each. Out of these 16 studies, only 13 reported original data [12,13,15,18,20-22,24,32-34,37,38] and three study [14,29,31] reviewed data from existing studies (Table 3). Cumulatively clinical features of 229 pregnant women were reported in this review – ranging from a single [18,32-34,37] to 41 pregnant women [14,21]. It is possible that duplication of clinical cases presents between studies – however – we have actively tried to remove duplicate findings from the result. Most of the pregnant women suffering from COVID-19 cases were in their third

trimester. Liu et al. [20] presented a case of early pregnancy in its 12th week. Real-time reverse transcription-polymerase chain reaction (RT-PCR) test was used for COVID-19 confirmation for all studies, except for Liu et al. [21], where 25 participants (out of 41) were laboratory negative for SARS-CoV-2 but had clinical features of COVID-19. Seven studies reported both clinical findings and recommendations for the management of COVID-19 during pregnancy, which included four original articles [12,13,21,38], two case-reports [15,33], and one correspondence [34]. Twelve studies exclusively discussed management recommendations. Among these studies, three were correspondences [16,23,31], two were commentaries [26,27], two were opinion pieces [25,35], one of case review [36], expert consensus [11], expert review [28], review article [5], and special editorial [19] each (Table 4).

Table 2: Specifications of published studies (1 January 2019 to 31 March 2020) on pregnancy and Coronavirus Disease 2019 (COVID-19) between

Reference	Study Type	Country	Number of Pregnant Woman	Original Finding Reported	Recommendation Reported
Chen et al.[11]	Expert consensus	..	..	No	Yes
Chen et al. [12]	Original article	China	9	Yes	No
Chen et al. [13]	Original article	China	17	Yes	Yes
Di Mascio et al. [14]	Systematic review & meta-analysis	China	41 ^a	No	Yes
Fan et al. [15]	Case report	China	2	Yes	Yes
Favre et al. [16]	Correspondence	..	..	No	Yes
Jiao[17]	Commentary	..	..	No	Yes
Li et al. [18]	Research letter	China	1	Yes	Yes
Liang & Acharya [19]	Special editorial	..	..	No	Yes
Liu et al. [20]	Original article	China	15	Yes	No
Liu et al. [5]	Review article	..	..	No	Yes
Liu et al. [21]	Original article	China	41 ^b	Yes	No
Liu et al. [22]	Original article	China	13	Yes	No
Moro et al. [23]	Correspondence	..	..	No	Yes
Mullins et al. [24]	Rapid review	..	32	Yes	Yes
Poon et al. [25]	Opinion	..	..	No	Yes
Qiao [26]	Comment	..	..	No	Yes
Rasmussen & Jamieson [27]	Commentary	..	..	No	Yes
Rasmussen et al. [28]	Expert review	..	..	No	Yes
Schwartz [29]	Case review	China	38	No	No
Schwartz & Graham [30]	Correspondence	..	..	No	No
Wang et al. [31]	Correspondence	China	..	No	Yes
Wang et al. [32]	Case report	China	1	Yes	No
Wang et al. [33]	Case report	China	1	Yes	No
Wen et al. [34]	Correspondence	China	1	Yes	No
Yang et al. [35]	Opinion	..	..	No	Yes
Yu et al. [36]	Case review	China	7	No	Yes
Zambrano et al. [37]	Research letter	Honduras	1	Yes	No
Zhu et al. [38]	Original article	China	9	Yes	Yes

Note: a = Out of the 79 pregnancies affected by Corona Virus infections, 41 were affected by SARS-CoV-2
b = Out of 59 patients with COVID-19, 41 were pregnant

Table 3: Findings on pregnancy and Coronavirus Disease 2019 (COVID-19) reported in published literature (1 January 2019 to 31 March 2020)

Reference	Study Type	Patients Characteristics	Findings
Chen et al. [12]	Original article	All nine pregnant women were confirmed COVID-19 were in their third trimester	<ul style="list-style-type: none"> Seven women were presented with fever without chill Other symptoms included cough, myalgia, sore throat and malaise None of the women developed severe pneumonia Lymphopenia, elevated C-reactive protein, aminotransferase (ALT) and aspartate aminotransferase (AST) were observed among several patients Eight out of nine pregnant women presented patchy ground-glass opacity in the lung in CT scan All pregnant women underwent cesarean section All deliveries resulted in live births with no evidence of vertical transmission of SARS-CoV-2 The SARS-CoV-2 virus was not present in amniotic fluid, cord blood, neonatal throat swab, and breastmilk
Chen et al. [13]	Original article	All 17 pregnant women were tested positive by RT-PCR for SARS-CoV-2	<ul style="list-style-type: none"> Four women were presented with mild fever and chill Other symptoms included cough, fatigue, chest distress, overt dyspnea, and diarrhea Lymphopenia and elevated C-reactive protein were reported for some patients. However, all patients had a normal level of ALT, AST, creatinine and blood urea nitrogen All pregnant women presented patchy ground-glass opacity in the lung in CT scan All pregnant women underwent cesarean section 14 pregnant women received epidural anesthesia, and 12 of them experienced intraoperative hypotension Three patients received general anesthesia with tracheal intubation due to deteriorating clinical condition All deliveries resulted in live births, and none of the newborns were tested positive for SARS-CoV-2
Di Mascio et al. [14]	Systematic review and meta-analysis	All nine pregnant women were confirmed COVID-19 were in their third trimester	<ul style="list-style-type: none"> Most common symptoms of COVID-19 were fever, cough, and lymphopenia Radiological findings of pneumonia were presented in most of the cases No data were presented on miscarriage during the first trimester related to COVID-19 infection While the sample size is very limited, compared to MERS and SARS, COVID-19 infection resulted in higher rates of miscarriage, preeclampsia and preterm birth

Reference	Study Type	Patients Characteristics	Findings
			<ul style="list-style-type: none"> Preterm birth was reported most of the cases (41% before 37 weeks and 15% before 34 weeks) Preterm rupture of membranes reported for 19%, whereas only one pregnant woman suffered from Pre-eclampsia and no fetal growth restriction were reported No maternal death was reported Vertical transmission of SARS-CoV-2 was not reported for any newborns
Fan et al. [15]	Case report	Both pregnant women were physicians with confirmed COVID-19 were in their third trimester	<ul style="list-style-type: none"> Fever and nasal congestion were reported in both cases One of the patients presented a rash on her abdomen CT scan of the chest showed patchy consolidations indicating pneumonia Complete blood count was indicative of lymphopenia only in one of the cases Oseltamivir and Lianhua Qingwen capsules were prescribed for both cases. However, one of the pregnant women received Ceftazidime as antibiotic treatment - whereas - the other women received Azithromycin. One of the cases received methylprednisolone for pneumonia Both pregnant women underwent cesarean section Vertical transmission of SARS-CoV-2 was not reported, and the newborns or any products of conception was not tested positive for SARS-CoV-2
Li et al. [18]	Research Letter	The pregnant women were in 35th week of pregnancy with confirmed COVID-19	<ul style="list-style-type: none"> Clinical symptoms started with dry cough and fever Radiography of chest presented multiple patchy and scattered infiltrates in both lungs Antiviral drugs (Lopinavir and Ritonavir) and methylprednisolone were given to the patient. Emergency cesarean section was conducted on 36th week of the pregnancy, and the women delivered a live and healthy baby The newborn was not tested positive for SARS-CoV-2 in repeated testing during the postnatal period
Liu et al. [20]	Original article	All 15 pregnant women were confirmed for COVID-19 pneumonia with gestational age ranging from 12-38 weeks	<ul style="list-style-type: none"> Most prevalent clinical symptoms were fever and cough Fatigues, muscle ache, dyspnea, sore throat, and diarrhea were observed in fewer patients Lymphopenia and elevated C-reactive protein was observed among 12 and 10 patients accordingly, which were returned to normal

Reference	Study Type	Patients Characteristics	Findings
			<ul style="list-style-type: none"> · Early CT scan of the chest indicated ground-glass opacities in the lungs which developed into crazy paving pattern and consolidations · Among the 15 women, ten underwent cesarean section, and one delivered vaginally · The 11 women, who delivered, received antiviral treatment after delivery. The other four women did not receive antiviral treatment. All 15 women received antibiotic treatment · No neonatal complication was observed, and the newborns were not tested positive for SARS-CoV-2
Liu et al. [21]	Original article	Among 41 pregnant women, 16 were laboratory positive SARS-CoV-2, 25 were clinically-diagnosed COVID-19 cases. Their gestational age ranging from 22-40 weeks	<ul style="list-style-type: none"> · Initially, the pregnant women presented normal body temperature compared to the non-pregnant group · Leukocytosis and elevated neutrophil ratio were also presented among pregnant women · In the scan of the chest, a higher proportion of pregnant women presented mixed and complete consolidation compared to the non-pregnant group. However, pure ground-glass opacity was more common among the non-pregnant group · Six laboratory-positive and 8 CT-confirmed pregnant women receive Antiviral therapy. · Vertical transmission of SARS-CoV-2 was not reported for any newborns
Liu et al. [22]	Original article	Among 13 pregnant women with SARS-CoV-2 positive, two women were less than 28 weeks of gestation, and 11 were in their third trimester	<ul style="list-style-type: none"> · Most of the patients reported fever and fatigue. Other less prevalent feature included dyspnea · After treatment, three pregnant women were discharged. · Ten pregnant women went through the cesarean section. Among them, five underwent emergency cesarean section due to complications (such as fetal distress [three], premature rupture of the membrane [10] and stillbirth [one]) · Six pregnant women experienced preterm birth · One pregnant woman developed severe pneumonia with multiple organ failure, acute respiratory distress syndrome, acute hepatic failure, acute renal failure, and septic shock. Her respiration was supported by extracorporeal membrane oxygenation (ECMO) in the intensive care unit (ICU) · No vertical transmission of SARS-CoV-2 was reported among the live births
Mullins et al. [24]	Rapid review	32 pregnant women with confirmed SARS-CoV-2 infection	<ul style="list-style-type: none"> · fetal growth was not affected, and no information is available related to placental pathology

Reference	Study Type	Patients Characteristics	Findings
			<ul style="list-style-type: none"> Of the 32 pregnancies, 30 babies were delivered. Seven women were asymptomatic, and two were admitted to the intensive care unit. However, no maternal death was reported 47% (15 out of 32) pregnant women delivered prematurely. And most of the delivery was conducted by cesarean section No vertical transmission of SARS-CoV-2 was reported among the live births
Rasmussen et al. [28]	Expert review	--	<ul style="list-style-type: none"> Currently, there is no evidence suggesting pregnant women are more susceptible to COVID-19 Most common symptoms of COVID-19 are fever and cough, while lymphopenia was also common in several cases Premature birth and cesarean section were reported in several studies Any abnormality of fetal heart rate may indicate an early sign of the mothers' respiratory deterioration. There is limited information on perinatal or postnatal modes of transmission
Schwartz [29]	Case review	All 38 pregnant women were in their third trimester in pregnancy, and 37 had confirmed SARS-CoV-2 infection	<ul style="list-style-type: none"> Clinical features included fever, cough, myalgia, sore throat, malaise, gastrointestinal symptoms and shortness of breath Laboratory features were indicative of lymphopenia and elevated C-reactive protein, ALT, and AST. Patchy ground-glass opacity and pulmonary consolidation is observed in lung CT scan Premature rupture of membranes was observed most of the cases, which lead to premature birth by cesarean section was reported in most of the cases No vertical transmission of SARS-CoV-2 was reported One study from the review reported several newborns presented gastrointestinal (gastric bleeding, refusal to feed, bloating and food intolerance) and respiratory symptoms (abnormalities in chest radiography, respiratory distress syndrome, and pneumothorax). Two children developed thrombocytopenia. One premature newborn died on the 9th day due to multiple organ failure, refractory shock, and disseminated intravascular coagulation
Wang et al. [32]	Case report	The pregnant women were in her 40th week of pregnancy with COVID-19	<ul style="list-style-type: none"> The pregnant women developed low-grade fever two hours after having small vaginal bleeding and lower abdominal pain Chest CT scan indicated ground-glass opacities in the lung (left upper and lower lobes)

Reference	Study Type	Patients Characteristics	Findings
			<ul style="list-style-type: none"> · Laboratory diagnostic presented lymphopenia, neutrophilia, elevated C-reactive protein · Though there was no fetal distress, emergency cesarean delivery was performed, and meconium-stained liquor reported during the operative process · Immediate after delivery, the mother was asymptomatic, but later developed a fever. She received antiviral (Interferon α1b and Ganciclovir) and antibiotic (Abipenem and Moxifloxacin) and methylprednisolone. · The newborn was separated from the mother after the delivery. The infant appeared to be healthy but presented lymphopenia, elevated AST, total bilirubin, indirect bilirubin, and creatine kinase · The pharyngeal swab of the newborn was tested positive for SARS-CoV-2 at 36 hours after birth. However, the cord blood, placental specimens, and breast milk samples were tested negative for SARS-CoV-2. · The CT scan of the infant's chest presented high-density nodular shadow which evolved into scattered with small pieces of patchy shadow in the upper lobe of the right lung
Wang et al. [33]	Case report	A 30-week pregnant woman with COVID-19	<ul style="list-style-type: none"> · The pregnant women presented with fever for one week. · Laboratory findings presented a low level of lymphocytes and albumin · Chest CT scan of lung indicated ground-glass opacities (right side) and subpleural patchy consolidation (left side), which evolved into bilateral ground-glass opacities · To prepare for emergency cesarean delivery, the mother was provided with antivirals (Arbidol, Lopinavir, and Ritonavir), antibiotic (Cefoperazone Sodium and Sulbactam Sodium), Human Serum Albumin, dexamethasone and magnesium sulfate · Vertical transmission of SARS-CoV-2 was not reported, and the newborns or any products of conception was not tested positive for SARS-CoV-2
Wen et al. [34]	Correspondence	A 30-week pregnant woman with COVID-19	<ul style="list-style-type: none"> · During the initial presentation, the pregnant women were presented with mild diarrhea; however, she was afebrile, breathing normally and without any cough or chest pain

Reference	Study Type	Patients Characteristics	Findings
			<ul style="list-style-type: none"> · The chest CT scan of lung indicated ground-glass opacities and patchy consolidation in multiple regions. The lesions were “distributed along with the bronchial bundles or within the subpleural lung regions.” A small collection of fluid found in the left pleural cavity · The patient received interferon, antiviral (Lopinavir and Ritonavir) · The pregnant women were discharged after her nasopharyngeal swabs were negative for SARS-CoV-2 and clinical condition was improved
Yu et al. [36]	Original article	Seven pregnant women with COVID-19 between 37 weeks to 41 weeks of the gestational period	<ul style="list-style-type: none"> · The reported incubation period ranged from two to nine days. · Major clinical feature of six out of seven patients was fever, with few patients reporting cough, shortness of breath and diarrhea · Laboratory report indicated normal leukocyte count and elevated D-dimer for all patients. Five of the women had Neutrophilia, five had Lymphocytopenia, two had thrombocytopenia, and two had elevated ALT and AST. · Chest CT scan of the lung of all seven women was indicative of pneumonia · Antiviral medication (oseltamivir, ganciclovir, interferon, and Arbidol) and antibiotic (cephalosporins, quinolones, and macrolides) were given to the patients, along with traditional Chinese medications. Five women were treated with methylprednisolone at the postpartum stage · All patients underwent cesarean section with combined spinal and epidural anesthesia (six patients) or general anesthesia (one patient) · Among the seven neonates four were not tested for SARS-CoV-2, three were tested for SARS-CoV-2, and one neonate was tested positive for SARS-CoV-2 after 36 hours of birth
Zambrano et al. [37]	Research letter	Pregnant women with 31 weeks of gestation with COVID-19	<ul style="list-style-type: none"> · The initial presentation of the pregnant woman was fever, dry cough, myalgia, and headache. The patient also presented bilateral conjunctival hyperemia. · There was no other clinical feature reported which was related to COVID-19
Zhu et al. [38]	Original article	Nine pregnant women were confirmed with COVID-19 (gestational age 31-39 weeks)	<ul style="list-style-type: none"> · In most of the cases, fever and cough were the onsets of symptoms, with only one patient having diarrhea. · CT scan of the chest indicated viral pneumonia with bilateral ground-glass opacities with patchy lung consolidation and blurred borders of the lungs. After treatment, the lesions resolved significantly.

Reference	Study Type	Patients Characteristics	Findings
			<ul style="list-style-type: none"> · Several prenatal complications were reported which includes intrauterine distress (six women), premature rupture of membranes (three women), abnormality of amniotic fluid (two women) and umbilical cord (two women), and placenta previa (one woman) · Five women received antiviral therapy (oseltamivir) after delivery. Among them, one received oseltamivir and interferon combination · Seven women underwent cesarean sections, and two had vaginal deliveries. · Vertical transmission of SARS-CoV-2 was not reported for any newborns · Several newborns presented gastrointestinal (gastric bleeding, refusal to feed, bloating and food intolerance) and respiratory symptoms (abnormalities in chest radiography, respiratory distress syndrome, and pneumothorax). Two children developed thrombocytopenia. One premature newborn died on the 9th day due to multiple organ failure, refractory shock, and disseminated intravascular coagulation

Table 4: Recommendation related to pregnancy and Coronavirus Disease 2019 (COVID-19) reported in the published literature (1 January 2019 to 31 March 2020)

Recommendation	Caution	References
<u>Prevention</u>		
· It is recommended to maintain social distancing, refrain from unnecessary travel and crowds		[19,28]
· Maintain personal and social hygiene		[19,25,27]
· Provide pregnant women with necessary psychological support to prevent stress and anxiety		[19]
<u>Isolation and screening</u>		
· The screening process should begin before the pregnant woman arrives in the facility. If possible, detailed of clinical features and respiratory signs and symptoms should be discussed and noted over the telephone or using any online portal		[28,31]
· Immediate isolation of the suspected pregnant women in a single room for screening		[11,19,25–28,31,38]
· Travel history, contact history, and patient's location in a known clustering occurrence need to be investigated during the initial assessment		[11,25,28,31,38]
· Movement of the suspected pregnant women should be restricted throughout the facility		[11,27,28]
<u>Diagnostic procedures</u>		
· Even if asymptomatic, a pregnant woman with a travel history within the previous 14 days or reported contact with a confirmed SARS-CoV-2 patient should be tested for SARS-CoV-2 as soon as possible using real-time polymerase chain reaction (RT-PCR) test	· For diagnostic confirmation repeated testing may be required	[11,16,19,20,25,28,31]
· X-ray and computed tomography (CT) with abdominal shielding can be performed.	· May cause radiation exposure to the fetus	[5,11,19,24,25,31]
· Imaging is particularly important as a pregnant woman with imaging characteristics of COVID-19 should be considered as a clinically diagnosed case even if laboratory confirmation of SARS-CoV-2 is negative		[31]
· One study recommended application of lung ultrasound to identify pathological lesion indicative of COVID-19		[23]
· The blood sample should be collected for microbial cultures to investigate any secondary bacterial infection for pneumonia and sepsis,		[19,25,28]
<u>Management of suspected cases</u>		
· Supportive care (e.g., adequate rest, sleep and caloric intake; maintain electrolyte and fluid balance; and provide symptomatic medications such as antipyretic, antidiarrheal)		[25,28]
· Monitor oxygen saturation and vital signs		[25]
· Perform arterial blood gas analysis		[25]
· Perform chest imaging for monitoring		[25]
· Monitor fetal health using ultrasound or doppler assessment		[25]
<u>Management of confirmed cases</u>		
		[25]

Recommendation	Caution	References
<ul style="list-style-type: none"> · Treatment should be performed in a negative pressure room or isolation ward · Pregnant women with the critical illness must be transferred to the intensive care unit with negative pressure · A multidisciplinary team must do the management of pregnant women · Pregnant women need to be classified as <u>Mild</u>: Symptomatic but vital signs are stable <u>Severe</u>: Respiration rate is $\geq 30/\text{min}$, resting oxygen saturation is $\leq 93\%$, arterial blood oxygen partial pressure/oxygen concentration $\leq 300 \text{ mmHg}$ <u>Critical</u>: Respiratory failure with the need for mechanical ventilation, shock with organ failure or refractory hypoxemia · Supportive care (e.g., adequate rest, sleep and caloric intake; respiratory support by oxygen supplement; maintain electrolyte and fluid balance) · Suggest lateral-decubitus position for better oxygenation of the fetus · Broad-spectrum antibiotic (Ceftriaxone) was suggested to prevent community-acquired pneumonia. · Antiretroviral agents (e.g., Alpha-interferon, Lopinavir/ritonavir) were recommended in some studies. Traditional Chinese medicines were prescribed in some studies from china · Clinical trials are currently ongoing for Remdesivir (nucleotide analog) and chloroquine (an antimalarial drug). However, there is no conclusive evidence on their effectiveness at this moment 	<ul style="list-style-type: none"> · Bacterial culture and sensitivity results need to be performed · It is necessary to understand the teratogenic effect, impact on fetal growth and development before prescribing any specific drug. No safety data was available for the traditional Chinese medicines 	<ul style="list-style-type: none"> [11,19,25,28,38] [11,16,19,25] [25,28,31,36] [19] [11,19,25,27,28] [11,25] [11,19,25] [11,19,20,24,25,31] [19,24]
<ul style="list-style-type: none"> · Short term methylprednisolone may be used to reduce dyspnea and hypoxemia during pneumonia; however, the evidence is not conclusive · Hemodialysis for sepsis-induced severe acute renal failure · in case of reparatory failure, beyond mechanical ventilation, extracorporeal membrane oxygenation (ECMO) was suggested by some literature 	<ul style="list-style-type: none"> · Use of long-term corticosteroids treatment is not recommended 	<ul style="list-style-type: none"> [19] [11] [22,28]

Recommendation	Caution	References
<ul style="list-style-type: none"> “If the temperature reverts to normal for more than three days, the respiratory symptoms improve significantly, the lung imaging shows obvious absorption of inflammation, and the nucleic acid test for respiratory pathogens shows negative for two consecutive times (sampling interval at least one day), the patient could discharge from the hospital or be transferred to the appropriate department for treatment according to other illnesses.” 		[31]
<u>Clinical monitoring of confirmed cases</u>		
<ul style="list-style-type: none"> Monitor oxygen saturation and vital signs 		[11,19]
<ul style="list-style-type: none"> Perform arterial blood gas analysis 		[11]
<ul style="list-style-type: none"> Perform chest imaging for monitoring 		[11]
<ul style="list-style-type: none"> Monitor organ functions using complete blood count, metabolic panel, C-reactive protein, lactate, renal function, liver function, and cardiac enzymes, etc. 		[11,19]
<ul style="list-style-type: none"> Monitor fetal health using ultrasound or Doppler assessment 		[11,25]
<ul style="list-style-type: none"> Amniocentesis is not recommended 		[11]
<u>Management during the antenatal stage</u>		
<ul style="list-style-type: none"> Due to the evolving pandemic, very little is known about the effect of COVID-19 on during first and second trimester of the pregnancy. Regular monitoring and further research are needed. 		[17,5]
<ul style="list-style-type: none"> Asymptomatic pregnant woman with laboratory-confirmed SARS-CoV-2 infection must self-monitor herself at home for 14 days 		[16,25,28]
<ul style="list-style-type: none"> Routine antenatal care should be provided in a negative pressure room by healthcare providers using proper personal protection equipment 		[11,25-27,31]
<ul style="list-style-type: none"> Regular ultrasounds and doppler assessment were recommended to monitor fetal growth 		[16,19,25,31]
<u>Management during the delivery stage</u>		
<ul style="list-style-type: none"> COVID-19 is not an indication of pregnancy termination 	<ul style="list-style-type: none"> For Severe and critical cases or obstetric indications needs to be evaluated by physicians and care, management team 	[11,31]
<ul style="list-style-type: none"> COVID-19 alone should not be an indication of early delivery. Mother’s clinical status, gestational age and fetal well-being needs to be prioritized 	<ul style="list-style-type: none"> Deteriorating fetal condition may warrant early delivery 	[11,14,16,19,25,28,36]
<ul style="list-style-type: none"> The mode of delivery should be based on obstetric indications. While there is no indication of cesarean section, complications (such as acute organ failure, septic shock or fetal distress) may prompt for emergency cesarean section 		[11,16,19,25,35]

Recommendation	Caution	References
<ul style="list-style-type: none"> The anesthesiology team should indicate the mode of analgesia. Though during cesarean delivery epidural or general anesthesia can be safely used, neuraxial anesthesia may reduce pulmonary complications due to intubation Endotracheal intubation may be used for poor maternal status Use of steroids (dexamethasone or betamethasone) for lung maturation of the fetus needs to be evaluated by physicians Tocolysis is not recommended to delay spontaneous preterm labor for administering antenatal steroids Pregnancy-related by-product needs to be treated as biohazardous waste and disposal of them needs to abide by the proper biosafety regulation of the country Delivery should be performed in a negative pressure room with proper biosafety precautions for medical staff 	<ul style="list-style-type: none"> Hypotension needs to be managed during epidural anesthesia Use of antenatal steroid can worsen the disease condition 	<ul style="list-style-type: none"> [11,13,25] [11] [25] [25] [11,25] [11,13,18,19,25,35]
<u>Management during the postnatal stage</u>		
<ul style="list-style-type: none"> Delayed cord clamping is not recommended. However, recommendation varies across studies Newborns should be isolated from suspected or diagnosed COVID-19 mothers for 14 days Any recommendation for breastfeeding is not conclusive. However, to prevent human-to-human transmission (via direct contact, fomites, or potential aerosol), direct breastfeeding is discouraged. Provide the mother with necessary psychological support to prevent stress and anxiety 	<ul style="list-style-type: none"> Pumping breast milk can be an alternative option considering proper hygiene is maintained. Breastfeeding is not recommended when the mother is taking antiviral drugs (Lopinavir/ritonavir) 	<ul style="list-style-type: none"> [11,19,24,25] [11,19,25,26,28,35,38] [11,15,24–26,28,31] [25]

Clinical presentation and diagnostics of COVID-19 among pregnant women

The most common and earliest clinical presentation of COVID-19 is fever, accompanied by dry cough, myalgia, and malaise. Sore throat is the most common initial respiratory symptom; however, dyspnea and chest distress were also reported by pregnant women. Four studies reported gastrointestinal symptoms (diarrhea) [13,20,34,36]. Abdominal rash [15], and bilateral conjunctival hyperemia [37] were reported as atypical findings.

Apart from RT-PCR, computerized tomography (CT) scan of the chest was the primary mode of investigation to diagnose COVID-19 infection. Patchy ground-glass opacity (GGO) with or without consolidation was the most common feature of COVID-19 pneumonia, which resolved with time. Liu et al. [20] further elaborated on the progression of the lesion into paving patterns and consolidations. Other than lung parenchymal change, pleural

effusion was identified as an atypical finding in a 30-week pregnant woman who presented with [20].

Common laboratory finding includes lymphopenia and elevated C-reactive protein [12-15,20,28,29,32,33,36]. Impaired liver function was also observed, which is reflected by increased alanine aminotransferase (ALT) and aspartate aminotransferase (AST) [12,18,29,32,36]. Three studies reported neutrophilia [21,32,36]; one reported leukocytosis [21]; one reported lower albumin level [33]; one reported elevated D-dimer and thrombocytopenia [36] among the pregnant women.

Medication prescribed to the COVID-19 cases

Antiviral drugs were most commonly used to treat pregnant women with COVID-19, and the most frequently used antiviral drugs were - atomized inhalation of interferon-ALPHA [32,34,36,38], Oseltamivir [15,34,38], Lopinavir [18,34,34], and Ritonavir [18,33,34]. Ganciclovir [32] and Arbidol [33,36] were reported to be used for treatment. Secondary bacterial pneumonia was treated with a wide range of antibiotics, which included - Beta-lactam [32,33] (Abipenem and Sulbactam Sodium), Cephalosporins [15,33,36] (Cefoperazone Sodium and Ceftazidime), Macrolides [15,35] (Azithromycin), and Quinolones [32,35] (Moxifloxacin). Supportive treatment with methylprednisolone was also provided for pneumonia [15,18,32,36].

Two studies [15,36] reported the use of traditional Chinese medications along with antiviral and antibiotic treatment. Wang et al. [33] reported a 30-week pregnant woman with COVID-19 was given Human Serum Albumin, dexamethasone, and magnesium sulfate to prepare her for an emergency cesarean delivery. The clinical condition of all the pregnant women - except two [22,24] - improved after the treatment. However, none of the studies commented on the efficacy or effectiveness of the medication given to pregnant women for the management of COVID-19.

Maternal Outcomes

Rasmussen and colleagues [28] reported that there is no evidence suggesting higher susceptibility of COVID-19 among pregnant women, and no maternal death was reported in any study included in this scoping review. The incubation period among pregnant women ranges from two to nine days [36]. The development of severe pneumonia was not reported by the majority of the studies. Two studies - Liu et al. [22] and Mullins et al. [24] - reported that two pregnant women developed severe pneumonia, which required mechanical ventilation support in the intensive care unit (ICU).

It is essential to mention that, except for one pregnant woman - in her 12 weeks of gestation [20] - most confirmed COVID-19 cases were in their third trimester of pregnancy. Therefore, little is known about COVID-19 in the earlier stages of pregnancy. In their systematic review, Di Mascio et al. [14] reported no evidence was obtained of miscarriage in the first trimester, which was related to COVID-19 infection. However, with a limited number of cases and without proper controls, we cannot assume the association between miscarriages and SARS-CoV-2 infection.

Eight studies [12,15,18,24,29,33,36,38] specifically mentioned the duration of onset of symptoms to delivery, which ranged from one [12,29,38] to 13 days [24]. The duration of hospitalization was inconsistently mentioned. Preterm births was the most common feature among pregnant COVID-19 cases. Seven studies - including original articles [22,38], case review [29], research letter [18], and reviews [14,24] - reported preterm births. Preterm births were also accompanied by other pregnancy-related complications - such as preterm rupture of membranes [14,29,38], abnormality of amniotic fluid [32,38], pre-eclampsia

[14], intrauterine distress [38], abnormality of the umbilical cord [38], and placenta previa [38].

While these complications can be the indications for cesarean section, the majority of the pregnancies underwent cesarean section [12,13,15,18,20,22,24,29,32,33,36,38], yet specific indication for cesarean section was not always reported. Two of the articles specified that type of anesthetic agent (either epidural or general) used in the cesarean sections, and Chen et al. [13] reported 12 out of 14 pregnant women who received epidural anesthesia experience intraoperative hypotension. Only three vaginal deliveries were reported [20,38], and no peripartum or postpartum complications were mentioned for them.

Except for one stillbirth [22] – from a 34 weeks pregnant woman with fever and sore throat – all pregnancies resulted in live births. The study conducted by Zhu et al. [38] – this finding was also reported by Schwartz [29] – reported several newborns presented gastrointestinal (gastric bleeding, refusal to feed, bloating and food intolerance) and respiratory symptoms (abnormalities in chest radiography, respiratory distress syndrome and pneumothorax). Two children developed thrombocytopenia [38]. One premature newborn died on the 9th day due to multiple organ failure, refractory shock, and disseminated intravascular coagulation, which was the only postnatal death of newborns reported in the studies [29,38].

Vertical transmission of SARS-CoV-2 was not reported by any studies [12–15,18,20–22,24,28,29,33,36,38], as the newborns or any products of conception were not tested positive for SARS-CoV-2. Yu et al. [36] reported that one neonate was tested positive for SARS-CoV-2 after 36 hours of birth. However, the placenta and cord blood of the mother of the child tested negative for SARS-CoV-2 after delivery. Thus, it is not clear if this is a case of intrauterine vertical transmission.

Management recommendations for COVID-19 during Pregnancy

We have reported the findings on management recommendation across the following thematic area: prevention, isolation and screening, diagnostic procedures, management of suspected cases, management of confirmed cases, clinical monitoring of confirmed cases, antenatal, delivery, and postnatal stage.

Prevention [19,25,27,28]

Maintaining personal and social hygiene is the primary recommendation for preventing COVID-19. Due to the long incubation period, an asymptomatic individual can infect an unaware pregnant woman. Thus, maintaining social distancing measures (limiting unnecessary travel, avoiding the crowd and public transport and wearing a face mask), frequently washing hands using soap, using hand sanitizer, and avoid touching face (the areas around the mouth, chins, nose, and eyes) are extremely necessary. Also, it is crucial to take care of the mental health of pregnant women by providing her necessary psychological support to prevent stress and anxiety.

Isolation and screening [11,19,25–28,31,38]

Innovative use of technology can significantly help the screening of suspected pregnant women with COVID-19 infection. Initial screening and triage of the probable cases using the telephone, mobile, or online portal can reduce the spread of the infection. Within a healthcare facility, it is critical to immediately isolate any suspected pregnant women in a single room – if possible, with negative pressure – for screening, contact tracing, and history taking.

Diagnostic procedures [5,11,16,19,23-25,28,31]

Though asymptomatic, a pregnant woman with a travel history within the previous 14 days or reported contact with a confirmed SARS-CoV-2 patient should be tested for SARS-CoV-2 as soon as possible using an RT-PCR test. CT scans can also provide diagnostic support for COVID-19 cases. A pregnant woman with positive radiological findings should be considered as a clinically diagnosed case even if laboratory confirmation of SARS-CoV-2 is negative.

However, precautions need to be taken while using the CT scan with radiation exposure at its lowest achievable limit. It is also essential to assess the risk-benefit for each CT examination, and informed consent must be acquired before the procedure [39]. The blood sample should be collected and analyzed for microbial cultures to investigate any secondary bacterial infection for post-viral infection pneumonia and sepsis. One study recommended the application of lung ultrasound to identify pathological lesion indicative of COVID-19 [23]. While the RT-PCR test is yet not available everywhere, available ultrasound tests can significantly improve the accessibility of the diagnostic and treatment of COVID-19.

Management of suspected cases [25,28]

Management of probable cases of COVID-19 among pregnant women mostly includes supportive treatment and monitoring of the health status while keeping her in isolation. Supportive treatment must ensure adequate rest, sleep, and caloric intake; maintain electrolyte and fluid balance, and provide symptomatic medications such as antipyretic and antidiarrheal. In addition, oxygen saturation and vital signs need to be assessed, and arterial blood gas analysis, chest imaging, and fetal ultrasound or doppler assessment need to be performed as monitoring purposes.

Management of confirmed cases [5,11,16,19,22,24,25,28,31,36,38]

Treatment of pregnant women with COVID-19 needs to be performed in a negative pressure room – if possible – or in the isolation ward. Worsening cases of COVID-19 pneumonia must be transferred to the intensive care unit with mechanical ventilation support. A multidisciplinary team consisting of an obstetrician, intensive care medicine specialist, microbiologist, pathologist, anesthetist, and neonatologist must provide the care for pregnant women with COVID-19 infection. When prescribing antiviral or antibiotic therapy to a pregnant woman, it is necessary to understand the teratogenic effect of the drugs, which may impact on fetal growth and development.

Clinical monitoring of confirmed cases [19,25,28,40]

Preterm delivery and associated obstetric complications were observed among pregnant women with COVID-19 infection. Furthermore, existing comorbidities can lead to life-threatening conditions [40]. Thus, clinical monitoring of the patient during pregnancy is critical. Monitoring fetal health using ultrasound or Doppler assessment may also provide warning for the maternal condition. Any abnormality of fetal heart rate may indicate an early sign of the mother's respiratory deterioration [28]. Amniocentesis is not recommended at this stage as it can lead to intrauterine transmission of the infection.

Management during antenatal stage [5,11,16,17,19,25-28,31]

Very little is reported about the effect of COVID-19 during the first and second trimester of the pregnancy. Thus, asymptomatic pregnant women with laboratory-confirmed SARS-CoV-2 infection are recommended to self-monitor their health by isolating themselves at home

for 14 days. One should not stop receiving routine antenatal care due to COVID-19. Moreover, special attention must be given to monitoring fetal health and growth.

Management during delivery stage [11,13,14,16,18,19,25,28,31,35,36]

COVID-19 is not an indication of pregnancy termination or conducting an emergency cesarean section. The mother's clinical status, gestational age, and fetal well-being need to be prioritized, and the mode of delivery should be based on obstetric indications. Delivery should be performed in a negative pressure room –whenever possible – with proper biosafety precautions for medical staff. While COVID-19 alone is not an indication of cesarean section, new and emerging obstetric or health complications (such as acute organ failure, septic shock, or fetal distress) may prompt for emergency cesarean section. The anesthesiology team should indicate the mode of analgesia. Evidence suggests, either epidural or general anesthesia can be safely used during cesarean delivery. The use of neuraxial anesthesia may reduce pulmonary complications due to intubation.

As preterm births appear to be more prevalent among COVID-19 patients, the use of steroids (dexamethasone or betamethasone) for lung maturation of the fetus needs to be evaluated by physicians as it can worsen the maternal disease condition. Tocolysis is not recommended to delay spontaneous preterm labor for administering antenatal steroids. No study included in this scoping review indicated vertical transmission of the SARS-CoV-2. All pregnancy-related by-product needs to be treated as biohazardous waste, and disposal of them needs to abide by the proper biosafety regulation.

Management during postnatal stage [11,15,19,25,26,28,31,35,38]

Though recommendation varies across studies, some studies did not recommend delayed cord-clamping to prevent potential vertical transmission of SARS-CoV-2. Newborns should be isolated from suspected or diagnosed COVID-19 positive mother for 14 days. Recommendation on breastfeeding is not conclusive. However, to prevent human-to-human transmission (via direct contact, fomites, or potential aerosol), direct breastfeeding is discouraged. Pumping breast milk can be an alternative option considering proper hygiene is maintained. Mother receiving antiviral drugs should not breastfeed the child. Last but not least, it is imperative to provide psychological support for the mother to prevent stress and anxiety.

Conclusion

Pregnant women with COVID-19 infection present similar clinical features as others. The majority of the cases develop pneumonia, which is overtly diagnosed with radiological findings. Pregnant women with COVID-19 were treated with a wide range of antiviral drugs; however, to date, there are no approved drugs for the treatment of COVID-19 from the World Health Organization [4] or Center for Disease Control [41]. Pregnant women with COVID-19 presented higher episodes of preterm birth and cesarean delivery, though, it cannot be explicitly attributed to the SARS-CoV-2. There is no published evidence on the vertical transmission of SARS-CoV-2.

Pregnancy – being an immunocompromised physiological state – with COVID-19 infection needs to be treated as a priority case and needed to be treated in a higher-level healthcare facility. A collaborative team of intensive care medicine specialists, obstetricians, anesthetists, neonatologist, microbiologist, and pathologist is necessary to manage critical COVID-19 patients. Healthcare professionals should protect

themselves using proper personal protection equipment. Detail history taking (especially for contact tracing and travel history), radiological assessment, and laboratory testing with regular monitoring of fetal health need to be done at every stage of the pregnancy during COVID-19. Though reported only once [23], the effectiveness of lung ultrasound should be evaluated as a more accessible and cost-effective measure of investigation. While vertical transmission of SARS-CoV-2 was not reported, every effort should be made to prevent mother to child transmission or iatrogenic infection, during and after the delivery.

There are several limitations of this scoping review. As a part of this scoping review, we have included a wide range of published literature. However, due to the observational nature of the studies, the quality of the evidence considered is considerably variable. Due to the methodological design of the scoping review, a quality appraisal of the evidence was not conducted as a part of the review. As we only explored the early published literature, the findings of this review are mostly based on hospital-based studies and the late stage of the pregnancy. Except for one study from Honduras [37], all studies were based in China. Therefore, the outcomes of pregnancy may be different in other settings. This review is limited to pregnant women, and we did not extend the scope to include neonatal clinical presentation and management recommendations. We felt an over encompassing review of maternal, neonatal, and infantile findings would not be feasible at this stage.

We recommend further research and systematic synthesis of the data the emerging data across the world. Moreover, it is essential to acknowledge the contribution of the physicians and researchers who went above and beyond their capacity to produce these initial sets of evidence to highlight critical findings for pregnant women with COVID-19 cases. “Standing on the shoulders of giants” – our rapid scoping review is an effort to collate and report the existing evidence on clinical findings and management recommendations of the early published scientific literature.

Declarations

ADDITIONAL EDUCATIONAL RESOURCES

- Kasraeian M, Zare M, Vafaei H, et al. COVID-19 pneumonia and pregnancy; a systematic review and meta-analysis. *The Journal of Maternal-Fetal & Neonatal Medicine* 2020;0:1–8. doi:10.1080/14767058.2020.1763952
- Rajewska A, Mikołajek-Bedner W, Lebdowicz-Knul J, et al. COVID-19 and pregnancy – where are we now? A review. *Journal of Perinatal Medicine* 2020;48:428–34. doi:10.1515/jpm-2020-0132
- Trocado V, Silvestre-Machado J, Azevedo L, et al. Pregnancy and COVID-19: a systematic review of maternal, obstetric and neonatal outcomes. *The Journal of Maternal-Fetal & Neonatal Medicine* 2020;0:1–13. doi:10.1080/14767058.2020.1781809

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COMPETING INTERESTS

All authors declare no competing interests.

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None.

PATIENT AND PUBLIC INVOLVEMENT

No patients or public were consulted or involved in the development and execution of the scoping review

AUTHORS' CONTRIBUTIONS

MH conceptualized the research question and led to the development of the methodology. The development of the literature search strategy and implementation of the literature search was performed by MH and TA. MH and GMK independently performed the study selection by title and abstract and full-text screening. MH and GMK equally contributed to the analysis and interpretation of the data. MH took the lead to develop the first draft. Both MH and GMK finalized the manuscript and the abstract. All authors contributed to the manuscript revision and read and approved the submitted version of the manuscript.

ETHICAL APPROVAL AND PATIENT CONSENT FOR PUBLICATION

No ethical approval or patient consent is required for the study.

AVAILABILITY OF DATA AND MATERIALS

All data are publicly available, and no datasets were generated during the current study.

PROTOCOL AND REGISTRATION

10.17605/OSF.IO/NPF6M

Abbreviations

COVID-19 = Coronavirus disease 2019; CoV = Coronavirus; SARS-CoV-2 = Severe Acute Respiratory Syndrome CoV; PRISMA = Preferred Reporting Items for Systematic reviews and Meta-Analyses; RT-PCR = real-time reverse transcription-polymerase chain reaction; CT = computerized tomography; GGO = ground-glass opacity, ALT = Alanine aminotransferase; AST = Aspartate aminotransferase; ICU = Intensive care unit;

References

- 1 Johns Hopkins University. Coronavirus COVID-19 Global Cases. Johns Hopkins Coronavirus Resource Center. 2020.<https://coronavirus.jhu.edu/map.html> (accessed 14 Apr 2020).
- 2 Wang D, Hu B, Hu C, *et al*. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus-Infected Pneumonia in Wuhan, China. *JAMA* Published Online First: 7 February 2020. doi:10.1001/jama.2020.1585
- 3 Huang C, Wang Y, Li X, *et al*. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *The Lancet* 2020;**395**:497–506. doi:10.1016/S0140-6736(20)30183-5
- 4 World Health Organization. Clinical management of COVID-19: Interim guidance. Geneva, Switzerland: : World Health Organization 2020. <https://www.who.int/publications/i/item/clinical-management-of-covid-19> (accessed 14 Aug 2020).
- 5 Liu H, Wang L-L, Zhao S-J, *et al*. Why are pregnant women susceptible to viral infection: an immunological viewpoint? *Journal of Reproductive Immunology* 2020;:103122. doi:10.1016/j.jri.2020.103122
- 6 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology* 2005;**8**:19–32. doi:10.1080/1364557032000119616
- 7 Levac D, Colquhoun H, O'Brien KK. Scoping studies: advancing the methodology. *Implementation Science* 2010;**5**:69. doi:10.1186/1748-5908-5-69
- 8 Micah DJ Peters, Christina Godfrey, Patricia McInerney, *et al*. Chapter 11: Scoping reviews. In: Aromataris E, Munn Z, eds. *Joanna Briggs Institute Reviewer's Manual*. JBI 2020. <https://reviewersmanual.joannabriggs.org/>
- 9 Peters MDJ, Godfrey CM, Khalil H, *et al*. Guidance for conducting systematic scoping reviews. *International Journal of Evidence-Based Healthcare* 2015;**13**:141–6. doi:10.1097/XEB.0000000000000050
- 10 The Joanna Briggs Institute. Joanna Briggs Institute Reviewers' Manual: 2015 edition/supplement Methodology for JBI Scoping Reviews. Australia: 2015. <https://nursing.lsuhsu.edu/JBI/docs/ReviewersManuals/Scoping-.pdf> (accessed 25 Dec 2019).
- 11 Chen D, Yang H, Cao Y, *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 Gynecology & Obstetrics* 2020;**n/a**. doi:10.1002/ijgo.13146
- 12 Chen H, Guo J, Wang C, *et al*. Clinical characteristics and intrauterine vertical transmission potential of COVID-19 infection in nine pregnant women: a retrospective review of medical records. *The*

Lancet 2020;**395**:809–15. doi:10.1016/S0140-6736(20)30360-3

- 13 Chen R, Zhang Y, Huang L, *et al.* Safety and efficacy of different anesthetic regimens for parturients with COVID-19 undergoing Cesarean delivery: a case series of 17 patients. *Canadian journal of anaesthesia = Journal canadien d'anesthesie* Published Online First: 2020. doi:10.1007/s12630-020-01630-7
- 14 Di Mascio D, Khalil A, Saccone G, *et al.* Outcome of Coronavirus spectrum infections (SARS, MERS, COVID 1 -19) during pregnancy: a systematic review and meta-analysis. *American Journal of Obstetrics & Gynecology MFM* 2020;:100107. doi:10.1016/j.ajogmf.2020.100107
- 15 Fan C., Lei D., Fang C., *et al.* Perinatal Transmission of COVID-19 Associated SARS-CoV-2: Should We Worry? *Clinical infectious diseases: an official publication of the Infectious Diseases Society of America* Published Online First: 2020. doi:10.1093/cid/ciaa226
- 16 Favre G, Pomar L, Qi X, *et al.* Guidelines for pregnant women with suspected SARS-CoV-2 infection. *The Lancet Infectious Diseases* 2020;**0**. doi:10.1016/S1473-3099(20)30157-2
- 17 Jiao J. Under the epidemic situation of COVID-19, should special attention to pregnant women be given? *Journal of Medical Virology* 2020;**n/a**. doi:10.1002/jmv.25771
- 18 Li Y, Zhao R., Zheng S., *et al.* Lack of Vertical Transmission of Severe Acute Respiratory Syndrome Coronavirus 2, China. *Emerging infectious diseases* 2020;**26**. doi:10.3201/eid2606.200287
- 19 Liang H, Acharya G. Novel corona virus disease (COVID-19) in pregnancy: What clinical recommendations to follow? *Acta Obstetricia et Gynecologica Scandinavica* 2020;**99**:439–42. doi:10.1111/aogs.13836
- 20 Liu D, Li L, Wu X, *et al.* Pregnancy and Perinatal Outcomes of Women With Coronavirus Disease (COVID-19) Pneumonia: A Preliminary Analysis. *American Journal of Roentgenology* 2020;:1–6. doi:10.2214/AJR.20.23072
- 21 Liu H, Liu F, Li J, *et al.* Clinical and CT imaging features of the COVID-19 pneumonia: Focus on pregnant women and children. *Journal of Infection* 2020;**0**. doi:10.1016/j.jinf.2020.03.007
- 22 Liu Y, Chen H, Tang K, *et al.* Clinical manifestations and outcome of SARS-CoV-2 infection during pregnancy. *Journal of Infection* 2020;**0**. doi:10.1016/j.jinf.2020.02.028
- 23 Moro F, Buonsenso D, Moruzzi MC, *et al.* How to perform lung ultrasound in pregnant women with suspected COVID-19 infection. *Ultrasound in Obstetrics & Gynecology* 2020;**n/a**. doi:10.1002/uog.22028
- 24 Mullins E, Evans D, Viner RM, *et al.* Coronavirus in pregnancy and delivery: rapid review. *Ultrasound in Obstetrics & Gynecology* 2020;**n/a**. doi:10.1002/uog.22014

- 25 Poon LC, Yang H, Lee JCS, *et al.* ISUOG Interim Guidance on 2019 novel coronavirus infection during pregnancy and puerperium: information for healthcare professionals. *Ultrasound in Obstetrics & Gynecology* 2020;**n/a**. doi:10.1002/uog.22013
- 26 Qiao J. What are the risks of COVID-19 infection in pregnant women? *The Lancet* 2020;**395**:760–2. doi:10.1016/S0140-6736(20)30365-2
- 27 Rasmussen SA, Jamieson DJ. Coronavirus Disease 2019 (COVID-19) and Pregnancy: Responding to a Rapidly Evolving Situation. *Obstetrics & Gynecology* 2020;**Publish Ahead of Print**. doi:10.1097/AOG.0000000000003873
- 28 Rasmussen SA, Smulian JC, Lednický JA, *et al.* Coronavirus Disease 2019 (COVID-19) and Pregnancy: What obstetricians need to know. *American Journal of Obstetrics & Gynecology* 2020;**0**. doi:10.1016/j.ajog.2020.02.017
- 29 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* Published Online First: 17 March 2020. doi:10.5858/arpa.2020-0901-SA
- 30 Schwartz DA, Graham AL. Potential Maternal and Infant Outcomes from Coronavirus 2019-nCoV (SARS-CoV-2) Infecting Pregnant Women: Lessons from SARS, MERS, and Other Human Coronavirus Infections. *Viruses* 2020;**12**:194. doi:10.3390/v12020194
- 31 Wang S, Zhou X, Lin X, *et al.* Experience of Clinical Management for Pregnant Women and Newborns with Novel Coronavirus Pneumonia in Tongji Hospital, China. *CURR MED SCI* Published Online First: 26 March 2020. doi:10.1007/s11596-020-2174-4
- 32 Wang S, Guo L, Chen L, *et al.* A Case Report of Neonatal 2019 Coronavirus Disease in China. *Clinical Infectious Diseases* 2020;:ciaa225. doi:10.1093/cid/ciaa225
- 33 Wang X, Zhou Z, Zhang J, *et al.* A case of 2019 Novel Coronavirus in a pregnant woman with preterm delivery. *Clin Infect Dis* Published Online First: 2020. doi:10.1093/cid/ciaa200
- 34 Wen R, Sun Y, Xing Q-S. A patient with SARS-CoV-2 infection during pregnancy in Qingdao, China. *Journal of Microbiology, Immunology and Infection* Published Online First: 10 March 2020. doi:10.1016/j.jmii.2020.03.004
- 35 Yang H, Wang C, Poon LC. Novel coronavirus infection and pregnancy. *Ultrasound in Obstetrics & Gynecology* 2020;**n/a**. doi:10.1002/uog.22006
- 36 Yu N, Li W, Kang Q, *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;**0**. doi:10.1016/S1473-3099(20)30176-6

37 Zambrano LI, Fuentes-Barahona IC, Bejarano-Torres DA, *et al.* A pregnant woman with COVID-19 in Central America. *Travel Medicine and Infectious Disease* 2020;:101639. doi:10.1016/j.tmaid.2020.101639

38 Zhu H, Wang L, Fang C, *et al.* Clinical analysis of 10 neonates born to mothers with 2019-nCoV pneumonia. *Transl Pediatr* 2020;**9**:51–60. doi:10.21037/tp.2020.02.06

39 Tomà P, Bartoloni A, Salerno S, *et al.* Protecting sensitive patient groups from imaging using ionizing radiation: effects during pregnancy, in fetal life and childhood. *Radiol med* 2019;**124**:736–44. doi:10.1007/s11547-019-01034-8

40 Yang J, Zheng Y, Gou X, *et al.* Prevalence of comorbidities in the novel Wuhan coronavirus (COVID-19) infection: a systematic review and meta-analysis. *International Journal of Infectious Diseases* 2020;:S1201971220301363. doi:10.1016/j.ijid.2020.03.017

41 CDC. Interim Clinical Guidance for Management of Patients with Confirmed Coronavirus Disease (COVID-19). Centers for Disease Control and Prevention. 2020.<https://www.cdc.gov/coronavirus/2019-ncov/hcp/clinical-guidance-management-patients.html> (accessed 14 Aug 2020).

Figures

Figure 1

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