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ORIGINAL ARTICLE

COVID-19 and obstetric outcomes: a single-center retrospective experience in a predominantly Black population

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ABSTRACT

Objective: This retrospective, single-center case series was designed to characterize the effects of perinatal COVID-19 diagnosis on obstetric and neonatal outcomes in a predominantly high-risk, urban Black population.

Study Design: Data were collected *via* retrospective chart review on all COVID-19-positive obstetric patients and their neonates who presented to the University of Chicago Medical Center between March 2020 and November 2020, before the availability of the COVID-19 vaccine. Patient demographics, delivery outcomes, COVID-19 symptoms, treatment, and outcomes were analyzed.

Results: A total of 56 COVID-19-positive obstetric patients were included in the study, of which four were lost to follow-up before delivery. The median age of patients was 27 years (IQR 23, 32), with 73.2% publicly insured and 66.1% Black. Patients had a median body mass index (BMI) of 31.6 kg/m^2 (IQR 25.9, 35.5). 3.6% of patients had chronic hypertension, 12.5% had diabetes, and 16.1% had asthma. Perinatal complications were common. Twenty-six patients (50.0%) had a diagnosis of a hypertensive disorder of pregnancy (HDP). 28.8% had gestational hypertension, and 21.2% had preeclampsia (with and without severe features). The rate of maternal ICU admission was 3.6%. Furthermore, 23.5% of patients delivered preterm (<37 weeks gestation), and 50.9% of infants were admitted to the Neonatal Intensive Care Unit (NICU).

Conclusion: In our study of a predominantly Black, publicly-insured, unvaccinated group of COVID-19-positive pregnant patients, we found high rates of hypertensive disorders of pregnancy, preterm delivery, and NICU admission compared to rates reported in existing literature before widespread vaccine availability. Our findings suggest that SARS-CoV-2 infection during pregnancy, irrespective of maternal disease severity, may exacerbate existing obstetric health disparities by disproportionately impacting Black, publicly insured patients. Larger comparative studies are needed to better characterize possible racial and socioeconomic disparities in obstetric outcomes in the setting of SARS-CoV-2 infection during pregnancy. These studies should examine the pathophysiology of SARS-CoV-2 infection during pregnancy, as well as potential associations between adverse perinatal outcomes and disparities in access to care, COVID-19 vaccination, and other social determinants of health amongst more vulnerable populations infected with SARS-CoV-2 during pregnancy.

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COVID-19; pregnancy complications; perinatal outcomes; black women; racial disparities

Introduction

The scientific community has made great strides in understanding the physiologic effects of COVID-19 since the initial discovery of the novel coronavirus in early 2020. However, the impact of COVID-19 on pregnancy outcomes, as well as the impact of pregnancy on COVID-19 severity, remain incompletely understood. Furthermore, the extent to which the social determinants of health affect COVID-19-positive pregnant patients in marginalized communities in the US remains unclear. There appears to be an association between SARS-CoV-2 infection in pregnancy and increased severity of COVID-19 [1]. Nonetheless, there are conflicting data on the interaction between

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COVID-19 and obstetric and neonatal outcomes such as cesarean delivery, low birth weight, preterm birth, infant neonatal intensive care unit (NICU) admission, and hypertensive disorders of pregnancy (HDP) [2–8]. As a result of these inconsistencies, there has yet to be a consensus on the impact of COVID-19 on obstetric or neonatal outcomes. This may be partly due to the heterogeneity of pregnant populations in the United States (US). The American College of Obstetricians and Gynecologists (ACOG) and the Society for Maternal-Fetal Medicine (SMFM) state that adverse perinatal outcomes may be associated with severe-critical, but not mild-to-moderate, COVID-19 [9]. The National Institutes of Health (NIH) defines the severity of illness according to the degree of impact on pulmonary function. Those with mild-to-moderate illness have no evidence of decreased oxygen saturation and, thus, generally do not require supplemental oxygen support. Continued research is necessary to fully characterize the impacts of COVID-19 diagnosis on the heterogeneous pregnant populations of the US, particularly among patients who present with asymptomatic-moderate illness.

Publicly insured, Black obstetric patients may be at above-average risk for COVID-19-related morbidity and mortality compared to other pregnant patients. The reasons for this are complex but may involve structural inequities, systemic racism, and frequent comorbidities that predispose this population to adverse perinatal outcomes [10]. Previous studies have reported that nonwhite ethnicity is associated with severe COVID-19 [11,12]. Black pregnant women have amongst the lowest rates of COVID-19 vaccination, based on data collected in April-December 2021 in the National Immunization Survey (NIS) Adult COVID Module [13]. The combination of these factors results in Black obstetric patients facing higher pregnancy-related mortality rates than non-Hispanic White obstetric patients [14]. In Illinois between 2016–2017 (before the COVID-19 pandemic), Black pregnant patients had two- and three-fold higher rates of maternal mortality and severe maternal morbidity, respectively, when compared to White obstetric patients [15]. Similarly, as of 2018, the infant mortality rate for Black Illinois residents was two-to-three times that of all other racial-ethnic groups [16]. The impact of COVID-19 on racial disparities in maternal and neonatal outcomes has yet to be fully assessed.

In this retrospective, single-center case series, we sought to characterize the effects of perinatal COVID-19 diagnosis on obstetric and neonatal outcomes. Our study cohort is unique relative to those that have been previously described in that it is a predominantly publicly-insured Black cohort. In contrast, most US studies on COVID-19 in pregnancy have failed to include a high proportion of Black patients, ranging from 3.3% to 21.6% [17–20].

Methods

Study design

The University of Chicago is an academic tertiary care center on the South Side of Chicago, serving a predominantly Black, high-risk obstetric population. We conducted a retrospective chart review of all pregnant patients $\geq$18 years of age who presented to the University of Chicago Medical Center (UCMC) for obstetric care and had a documented positive RT-PCR SARS-CoV-2 test result between March 2020 and November 2020, before COVID-19 vaccine availability. Eligible participants were identified from a list in the electronic medical record (EMR) maintained by clinical obstetric staff. Two research team members manually reviewed and extracted demographic and clinical data from the EMR for each COVID-19-positive patient and their associated neonate. Key variables included race/ethnicity, insurance status, obstetric and medical history, presenting signs/symptoms of COVID-19, COVID-19 treatments received, delivery outcomes, anesthetic outcomes, and final obstetric diagnoses and complications. Data from obstetric patients' charts were collected beginning on the date of positive COVID-19 testing through the six-week postpartum visit. Pediatric outcomes for associated neonates were documented for the period of postnatal hospitalization. Of note, during the data collection period, no vaccinations against COVID-19 were available; therefore, no patients included in this analysis were vaccinated against COVID-19. The study was approved by the University of Chicago's International Review Board (Protocol 20-0643) with a waiver of written informed consent.

Statistical analysis

Given the descriptive nature of this study, data are presented in aggregate for the entire cohort. Continuous variables are reported as median (interquartile range [IQR]), given the skewed distributions. Normality was assessed with visual inspections of the data and confirmed using the Shapiro-Wilk test. Categorical data are presented as frequencies and proportions. No statistical inferences or formal hypotheses were evaluated. SAS 9.4 (SAS Institute

Inc., Cary, NC) was used to report the descriptive analyses.

Results

Baseline characteristics

A total of 56 (2.7%) COVID-positive patients were identified during the study period, out of approximately 2,080 patients who delivered at the University of Chicago Medical Center (UCMC) during the study period between March and November 2020 (Figure 1). The median age was 27 (IQR 23, 32) years. Two-thirds of the patients identified as Black/African American (66.1%) and majority were publicly insured (73.2%). Approximately one-third of the patients (33.9%) were nulliparous before the index birth. The vast majority were classified as overweight or obese, with a median body mass index of 31.6 kg/m^2 (IQR 25.9, 35.5). The most common chronic medical condition was asthma (16.1%), followed by diabetes (12.5%). Six patients (10.7%) had a history of preeclampsia in a prior pregnancy, two patients had chronic hypertension (3.6%), and two patients had a history of pulmonary disease besides asthma (3.6%). Additional baseline patient characteristics are presented in Table 1.

COVID-19 related outcomes

COVID-19 was identified in most patients (67.9%) based on universal, asymptomatic screening upon admission to labor and delivery. A total of 26 (46.4%) COVID-19-positive patients never developed symptoms of COVID-19. Among the 30 symptomatic patients, the most common symptoms were cough and shortness of breath. Most patients had asymptomatic, mild, or moderate illnesses requiring no treatment. Three patients (6.3%) had evidence of pneumonia on imaging, and six were admitted to the hospital due to COVID-19, two of which (3.6%) required ICU-level care. One patient (1.8%) required oxygen *via* nasal cannula due to severe COVID-19. Two of the 52 patients with available delivery records (3.8%) were delivered due to worsening maternal status secondary to COVID-19. One patient (1.8%) went into respiratory failure requiring intubation, prone ventilation, and eventually ECMO. She received remdesivir, vancomycin, cefepime, and metronidazole during her ICU admission. Besides this, no other patients received antiviral therapy or

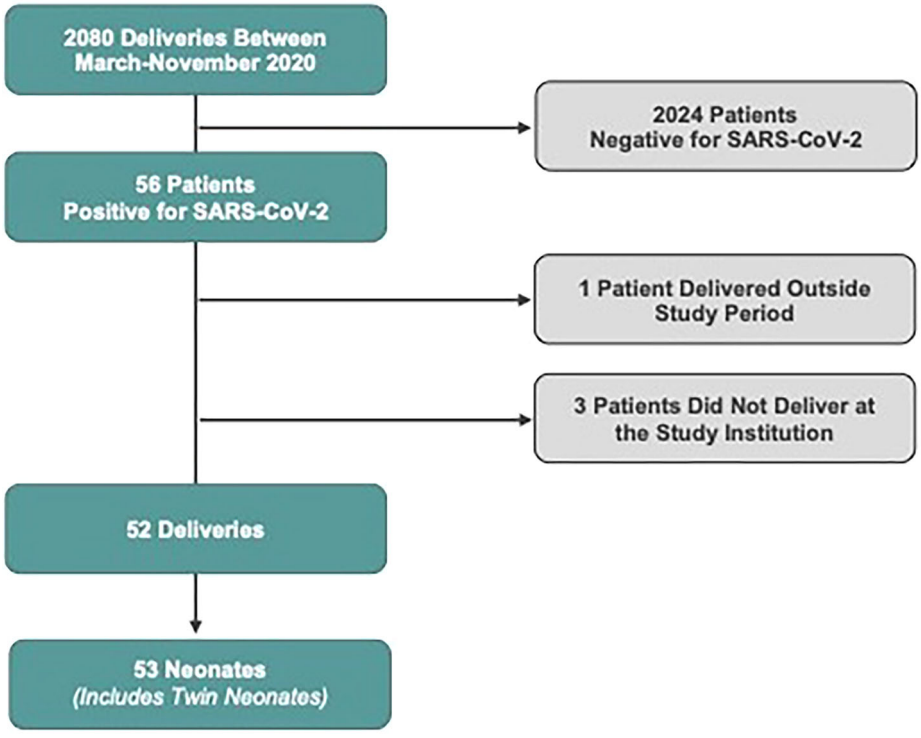

Figure 1. Study Cohort. Details of he study cohort are described below. A total of 2080 deliveries were screened including 56 patients who were positive for SARS-CoV-2. Of these, 52 delivered at the study hospital including two sets of twins, one of which resulted in a previable demise. A total of 52 deliveries and 53 neonates were thus ultimately included in the analysis.

Table 1. Maternal Baseline Characteristics.

	Patients Positive for SARS-CoV-2 *N = 56*
Age, *years*	27 (23, 32)
Insurance Status	
Public	41 (73.2)
Private	14 (25.0)
Unknown	1 (1.8)
Race	
Black / African American	37 (66.1)
White	12 (21.4)
American Indian or Alaskan Native	1 (1.8)
Unknown / Not Reported	6 (10.7)
Hispanic or LatinX	4 (7.1)
Gravidity	3 (1, 4)
Nulliparous	19 (33.9)
BMI (kg/m^2)	31.61 (25.90, 35.52)
Smoking Status	
Current Smoker/Vaper	1 (2.0)
Never Smoked	39 (76.5)
Quit Before Pregnancy	11 (21.6)
Substance Abuse	
Alcohol	1 (1.8)
Marijuana	3 (5.4)
Pre-pregnancy Medical History	
History of Preeclampsia	6 (10.7)
History of Chronic Hypertension	2 (3.6)
History of Diabetes	7 (12.5)
Type of Diabetes	
Type II	3 (42.9)
Gestational	4 (57.1)
History of Hypothyroidism	1 (1.8)
History of Pulmonary Disease	2 (3.6)
History of Asthma	9 (16.1)
Autoimmune Disease	2 (3.6)
Mental Health Disorder	3 (5.4)
Other Chronic Disease	7 (12.5)

Data is presented as median (quartile 1, quartile 3) or n (%) depending on variable type. Five patients had a missing smoking status. One patient's history of chronic hypertension was missing and one patient's height was missing so the body mass index could not be calculated.

any other novel COVID-19-specific therapy or clinical trial medications. Additional COVID-related data are presented in Table 2.

Labor and delivery outcomes

As four patients did not have delivery information (3 patients did not deliver at the study institution, and one patient delivered outside the study period), labor/delivery and neonatal outcomes are only described for 52 patient deliveries. Some delivery characteristics were missing for one additional patient, who was transferred to UCMC immediately postpartum. The median gestational age at delivery was 39.0 weeks (IQR 37.0, 39.7). Twelve patients (23.5%) delivered preterm (less than 37 weeks of completed gestation), one of which miscarried two non-viable fetuses at 18 weeks. Eighteen (34.6%) patients were induced. A total of 32 patients (61.5%) had a vaginal delivery, and 20 (38.5%) delivered by cesarean, of which five were repeat cesarean deliveries. The most common indication for cesarean delivery was non-reassuring fetal well-being (60.0%). Six of the twenty patients delivering by cesarean (30.0%) required general anesthesia. None of the 46 patients who received labor analgesia and/or anesthesia for cesarean delivery experienced anesthetic/analgesic complications.

Perinatal complications were common in this cohort (Table 3). Most notably, 50% of our sample patients had a hypertensive disorder of pregnancy diagnosis. Our institution follows the American College of Obstetricians and Gynecologists (ACOG) definition of preeclampsia [21]. This included 15 patients with gestational hypertension (28.8%) and 11 with preeclampsia, with and without severe features (21.2%). No patients developed HELLP (hemolysis- elevated liver enzymes- low platelet) syndrome. Furthermore, four patients (7.7%) had a placental abruption, and three patients (5.8%) had intrauterine growth restriction (IUGR). There was one intrauterine fetal death of twins and no neonatal deaths. Five patients developed chorioamnionitis (9.8%), and four required a blood transfusion for postpartum hemorrhage (7.7%). No patients developed disseminated intravascular coagulation (DIC). One patient had peripartum cardiomyopathy. Additionally, one patient developed a deep vein thrombosis in the setting of a prolonged intensive care unit (ICU) admission. Of the 52 patients with available delivery records, 31 (59.6%) received a 6-week course of Lovenox, per hospital clinical guidelines for COVID-19-positive obstetric patients during the study period. One patient died within a few days of being discharged; her cause of death is unknown.

Neonatal outcomes

Among the 52 consecutive deliveries to COVID-19-positive mothers at the study hospital, there were two sets of twins, one of which resulted in a pre-viable demise. All other deliveries were singleton. Therefore, a total of 53 neonates were ultimately included in the analysis. Of these, 36 neonates (67.9%) born to COVID-19-positive mothers were tested for SARS-CoV-2 infection. None of these infants tested positive for the virus. Two twin fetuses were miscarried at 18 weeks, and one infant was stillborn at 27 weeks in the setting of placental abruption. The median infant birth weight was 3165 grams (IQR 2650, 3448). Three infants were small for their gestational age (5.7%). Median APGAR scores were 8 (IQR 7, 9) and 9 (IQR 8, 9) at one and five minutes, respectively. Ten infants required continuous positive airway pressure (CPAP) in the delivery room (18.9%), and eight infants required intubation

Table 2. COVID Signs, Symptoms and Treatment.

	Patients Positive for SARS-CoV-2 *N = 56*
COVID-19 Testing Prompted By	
Symptoms	18 (32.1)
Universal Screening	38 (67.9)
Timing of Confirmation of COVID-19	
Prior to Admission	15 (26.8)
During Admission, Prior to Delivery	21 (37.5)
During Admission, Postpartum	5 (8.9)
Unknown	15 (26.8)
Asymptomatic	26 (46.43)
COVID-19 Symptoms	
Cough	15 (26.8)
Fever	8 (14.3)
Diarrhea	5 (8.9)
Shortness of Breath	10 (17.9)
Chest Pain	6 (10.7)
Headache	7 (12.5)
Myalgia	7 (12.5)
Malaise	6 (10.7)
Rigor	0 (0)
Absent sense of smell or taste	9 (16.1)
Gestational Age at First Positive Test, *weeks*	38.21 (30.93, 39.36)
Trimester at First Positive Test	
First	1 (1.8)
Second	4 (7.1)
Third	51 (91.1)
COVID was Reason for Testing Encounter	12 (21.4)
Level of Care Required for Management of COVID-19	
Outpatient	50 (89.3)
Inpatient (non-ICU)	4 (7.1)
ICU	2 (3.6)
Evidence of Pneumonia on Imaging	3 (6.25)
Highest Level of Oxygen Support due to COVID-19	
None	54 (96.4)
Nasal Cannula/Face mask	1 (1.8)
Extracorporeal membrane oxygenation (ECMO)	1 (1.8)
Prone Ventilation	1 (1.8)
Pharmacologic Therapy for COVID-19	
Antiviral Therapy	1 (1.8)
Antibiotic Therapy (Not for Chorioamnionitis, Endometritis, or Surgical Site Infection Prophylaxis)	7 (12.5)
Corticosteroids (Other than Betamethasone)	1 (1.8)

Data is presented as median (quartile 1, quartile 3) or n (%) depending on variable type. Imaging data to define pneumonia status was missing for eight patients.

(15.1%). Ultimately, 20 neonates had an oxygen requirement (38.5%). A total of 13 (25.0%) infants were diagnosed with respiratory distress syndrome, which was the most common neonatal complication. Other complications included sepsis, affecting two neonates (3.9%), and intraventricular hemorrhage, affecting one neonate (1.9%). Overall, 27 infants (50.9%) were admitted to the NICU, including four infants who were admitted to the NICU due to the birth parent's COVID-19 status per hospital infection control policy early in the study period. The median length of NICU stay was six days (IQR 4, 17). All neonatal outcomes are presented in Table 4.

Discussion

In this cohort of high-risk obstetric patients who delivered at the University of Chicago during the early phase of the pandemic with a diagnosis of COVID-19 during their pregnancy, we found that despite high baseline rates of obesity, diabetes, and asthma, only two patients in our sample developed severe COVID-19. Consistent with observational studies on COVID-19 in pregnancy, most of our patients had asymptomatic-moderate viral illness [9]. We did not observe appreciably higher rates of maternal ICU admission (3.6% vs. 4.0%) or cesarean delivery (38.5% vs. 36.2%) in our study compared to results described in the original version of the most extensive living systematic review on COVID-19 positive pregnant patients, published by Allotey et al. in September 2020, before COVID-19 vaccine availability [11]. Other, smaller systematic reviews have reported similar rates; however, Allotey et al. published the most extensive systematic review to date [22].

Severe SARS-CoV-2 infection has been associated with higher rates of preeclampsia, preterm birth, gestational diabetes, and low birth weight compared to a

Table 3. Labor and Delivery Characteristics.

	Delivered Patients Positive for SARS-CoV-2 *N = 52*
Gestational Age at Delivery, *weeks* *	39.00 (37.00, 39.71)
Preterm Delivery <37 Weeks *	12 (23.5)
Indication for Delivery	
Worsening Maternal Status Secondary to COVID-19	2 (3.8)
Term or Post Term Normal	16 (30.8)
Prior Cesarean Section	5 (9.6)
Spontaneous Labor	21 (40.4)
Preeclampsia	1 (1.9)
Severe Preeclampsia	4 (7.7)
Worsening Preeclampsia	2 (3.8)
Bleeding Abruption	3 (5.8)
Non-reassuring Fetal Status	9 (17.3)
Gestational Hypertension	6 (11.5)
Intrauterine Growth Restriction	2 (3.8)
Premature Rupture of Membranes (PROM)	6 (11.5)
Induced *	18 (34.6)
Mode of Delivery	
Vaginal	32 (61.5)
Instrumental	0 (0)
Cesarean Section	20 (38.5)
Indication for Cesarean Section	
Prior Cesarean Section	10 (50.0)
Breech Presentation	2 (10.0)
Non-Reassuring Fetal Well-Being	12 (60.0)
Failed Induction	1 (5.0)
Arrest of Descent	3 (15.0)
Arrest of Dilation	2 (10.0)
Other Maternal Indication	3 (15.0)
Anesthesia for Cesarean Delivery	
Spinal	1 (5.0)
De Novo Combined Spinal Epidural	6 (30.0)
Labor Neuraxial Catheter	7 (35.0)
General Anesthesia	6 (30.0)
Labor Analgesia *(if patient labored)*	*N = 45*
None	9 (20.0)
Opioids	1 (2.2)
Epidural†	35 (77.8)
Indication for General Anesthesia	*N = 6*
Emergency C-section	5 (83.3)
Patient Refusal of Neuraxial Anesthetic	1 (16.7)
Quantitative Blood Loss, *cc*	383 (141, 783)
Obstetrical Diagnosis and complications	
Normal	13 (25.5)
Hypertensive Disorders, Total	26 (50.0)
Chronic Hypertension	0 (0)
Gestational HTN	15 (28.8)
Preeclampsia, total	11 (21.2)
Preeclampsia without severe features	3 (5.8)
Preeclampsia with severe features	7 (13.5)
Chronic HTN with superimposed preeclampsia	1 (1.9)
Placental Abruption	4 (7.7)
IUGR	3 (5.8)
Other Obstetric Complications	
Blood Products Administered	4 (7.7)
Chorioamnionitis*	5 (9.8)
Cardiomyopathy	1 (1.9)
Thromboembolic Disease	1 (1.9)
Maternal Death	1 (1.9)
Thromboprophylaxis	31 (59.6)

*Data is presented as median (quartile 1, quartile 3) or n (%) depending on variable type. *Missing for one subject. †Includes epidurals, combined spinal epidurals and dural puncture epidurals.*

mild illness in prior studies [23,24]. Despite low rates of severe COVID-19, we did observe higher-than-expected rates of several adverse obstetric outcomes, namely preterm delivery, infant NICU admission, and hypertensive disorders of pregnancy. 23.5% of our patients delivered preterm, compared to 12.4% of COVID-19-positive pregnant patients in Allotey et al.'s 2020 systematic review [11]. Furthermore, 50.9% of infants in our cohort were admitted to the NICU, compared to 25.6% in Allotey's systematic review [11]. Of those neonates admitted to the NICU, only 4 neonates were admitted solely due to the COVID-19 separation

Table 4. Neonatal Outcomes.

	Neonates of Delivered Patients Positive for SARS-CoV-2 $N = 53^a$
Birth Weight	3165 (2650, 3448)
Birth Weight Percentile for Gestational Age, *grams*	40 (26, 69)
Small for Gestational Age (Below 10th Percentile)	3 (5.7)
APGAR (1 min)	8 (7, 9)
APGAR (5 min)	9 (8, 9)
Delivery Room Respiratory Support	
None	35 (66.0)
Continuous Positive Airway Pressure	10 (18.9)
Intubation	8 (15.1)
Initial Blood Sugar	67 (48, 88)
Neonatal Care	
No Escalation of Care	24 (46.2)
Care Escalated, No Increased Length of Stay	8 (15.4)
Prolonged Hospitalization	20 (38.5)
NICU Admission	27 (50.9)
NICU Length of Stay, *days*	6 (4, 17)
NICU Admission Solely Due to COVID-19 in Mother	4 (15.4)
Neonate was Tested for COVID-19	36 (67.9)
Neonate Positive COVID-19 Result	0 (0)
Complications	
Fetal Death or Stillbirth	1 (1.9)
Respiratory Distress Syndrome	13 (25.0)
Intraventricular Hemorrhage	1 (1.9)
Necrotizing Enterocolitis	0 (0)
Bronchopulmonary Dysplasia	1 (1.9)
Seizures	0 (0)
Sepsis	2 (3.9)
Oxygen Requirement	20 (38.5)

Data is presented as median (quartile 1, quartile 3) or n (%) depending on variable type. Neonatal care was unavailable for one subject.
[a]This table includes two twin neonates that are correspondent to a single delivery in previous tables. Birthweight and percentile were unavailable for one subject. Care escalation and complications (not including fetal death) were unavailable in one subject.

policy at our institution at the beginning of the study period. As of August 2020, the CDC no longer recommended separation of the neonate and NICU admission solely for maternal SARS-CoV-2 infection. Furthermore, preeclampsia was more prevalent among our patients compared to published reports on less diverse cohorts of pregnant COVID-19 patients; 21.2% of patients in our cohort were diagnosed with preeclampsia, compared to 3–8.1% reported in recent studies of preeclampsia and COVID-19 [4,5,25]. Although Black patients have higher rates of chronic hypertension at baseline, the rate of hypertensive disorders observed in our study surpasses that reported in the pre-pandemic literature on hypertensive disorders of pregnancy among Black patients. The rate of preeclampsia at the UCMC among Black obstetric patients prior to the pandemic between 2015-2019 was 7.6% [26]. Similar to our own pre-pandemic cohort, a pre-pandemic study conducted at a neighboring Chicago hospital reported a rate of maternal hypertensive disorders among low-income African American pregnant patients as 9.2% [27]. National rates of African American maternal hypertension have been reported at 9.8% [28]. In our study, we found that half of all patients and 65% of Black patients had a diagnosis of a hypertensive disorder of pregnancy. These findings may suggest that COVID-19 diagnosis in pregnancy amplifies existing racial disparities in maternal-infant health outcomes.

The mechanism responsible for the association between COVID-19 and higher rates of preeclampsia is not completely understood but may be related to endothelial dysfunction and placental dysfunction. In preeclampsia, abnormal placentation results in placental hypoxia and endothelial dysfunction, while SARS-CoV-2 infection results in direct viral-mediated damage to endothelial cells as well as hypoxic placental injury [29,30]. Additionally, SARS-CoV-2 infection has been associated with low placental weight, low birthweight/placental weight ratios, and altered metabolic scaling exponent ß, raising further concerns about placental dysfunction related to COVID-19 [31]. There is debate as to whether infection with SARS-COV2 causes a preeclampsia-like syndrome or infection with SARS-COV2 increases the risk for the development of preeclampsia. Both conditions are associated with a hyperinflammatory and hypercoagulable state [32].

As this is an observational study, it is not possible to draw conclusions about the causality of the observed high prevalence of preterm birth, NICU admission, and hypertensive disorders of pregnancy in our study population. It is possible that high rates of

obesity and diabetes, both independent risk factors for adverse pregnancy outcomes, may have influenced these associations. It is also plausible that SARS-CoV-2 infection, socioeconomic status, and structural racism, either independently or in combination, contributed to these results [33]. Beyond patient-level factors, our findings were likely influenced by the larger social and economic consequences of the pandemic, which strained nearly every sector of society, especially the healthcare system. There is evidence that the pandemic led to overall poorer obstetric outcomes for all patients, regardless of SARS-CoV-2 infection, including increased rates of maternal death and fetal demise, a decline in maternal mental health, and increased rates of ruptured ectopic pregnancies. This may, in part, represent delays in care [23]. Unfortunately, the many adverse effects of the pandemic have been disproportionately felt by communities of color, such as the patient population we serve at UCMC [34].

This study had several limitations, most notably the small sample size, some missing outcomes data, and the absence of a comparison group. Additionally, this was a single-center observational study of a predominantly high-risk cohort of COVID-19 positive pregnant patients prior to COVID-19 vaccine availability during a period when the Delta strain of SARS-CoV-2 predominated. Therefore, our findings are not easily generalizable to low-risk patients, vaccinated patients, or patients infected with Omicron subvariants or other strains of SARS-CoV-2. However, as one of the only US COVID-19 studies focused on a predominantly Black obstetric population, this report provides important insights for future research. A key strength of this study was that it included only unvaccinated patients, which allowed us to describe the natural history of COVID-19 in pregnancy. Additional strengths included manual extraction of data on each patient, comprehensive chart review for assessment of maternal and neonatal outcomes for all consecutive deliveries, and minimal incomplete data. Furthermore, all patients diagnosed with COVID-19 were included in the study and all data was collected on a standardized data form.

In conclusion, in our study of a predominantly Black, publicly-insured, unvaccinated group of COVID-19 positive pregnant patients, we found high rates of hypertensive disorders of pregnancy, preterm delivery, and infant NICU admission compared to rates reported in existing literature prior to widespread vaccine availability. The majority of patients in this study had mild to moderate illness. Despite the high-risk status of most patients in this study, they did not experience rates of severe-critical COVID-19 requiring ICU level care above those described in recent literature. Our findings suggest that SARS-CoV-2 infection during pregnancy, irrespective of maternal disease severity, may exacerbate existing obstetric health disparities due to a disproportionate negative impact on Black, publicly-insured patients. As Black obstetric patients continue to have below average rates of COVID-19 vaccination and contagious variants threaten to infect larger and larger portions of the population, it is important to further explore how COVID-19 interacts with other risk factors to impact the health of vulnerable Black obstetric patients during the global pandemic [13]. Larger comparative studies are needed to better characterize possible racial and socioeconomic disparities in obstetric outcomes in the setting of SARS-CoV-2 infection during pregnancy. These studies should examine the pathophysiology of SARS-CoV-2 infection during pregnancy, particularly in the setting of common comorbidities among high-risk patients, such as obesity and diabetes. Additionally, future studies should explore potential associations between adverse perinatal outcomes and disparities in access to care, COVID-19 vaccination, and other social determinants of health among diverse obstetric populations infected with SARS-CoV-2 during pregnancy.

Disclosure statement

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