Pregnancy outcomes in patients with COVID-19: A retrospective chart review and literature review

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ABSTRACT

Objective: *Pregnant women are at a higher risk for severe 2019 novel coronavirus (COVID-19) infection compared to non-pregnant women. Because of this, careful monitoring and studies of this population should be carried out. Here we identify the clinical characteristics, neonatal outcomes, and population demographics of COVID-positive pregnant women admitted to the University Medical Center in Lubbock, Texas.*

Methods: *This retrospective study reviewed a cohort of pregnant patients with confirmed COVID-19 admitted to Texas Tech University Health Sciences Center and its affiliated University Medical Center between April 12, 2020, and January 25, 2021.*

Results: *Thirty-six patients met inclusion criteria. The average patient age was 29 ± 4.8 years, and 61.1% of patients identified their ethnicity as Hispanic or Latino origin. The mean length of stay was 3.3 ± 3.6 days, and the remaining number of weeks of pregnancy at delivery was 37.8 ± 2.3 weeks. No deaths occurred in the mothers; three pregnancies did not result in a live birth. Notable findings included an increased rate of pre-term births (18.2%), an increased rate of NICU admissions (16.7%), and an increased rate of gestational diabetes (13.9%) compared to national averages in pregnant women.*

Conclusions: *Many of our findings confirmed the existing literature concerning pregnancy outcomes among COVID-19-positive pregnant women, including relatively high preterm birth and NICU admission rates. The number of women who identified their ethnicity as Hispanic or Latino was high, which may reflect the overall demographics in West Texas. Furthermore, our gestational diabetes rate was also higher than the national average, possibly reflecting the high obesity rates in this area. We recommend further research on the mechanisms of preterm birth in COVID-19 illness and on ways to improve the health and healthcare outcomes in West Texas residents.*

Keywords: COVID-19, pregnancy, pre-term birth, Hispanic, Latino

INTRODUCTION

Coronavirus disease 2019 (COVID-19), caused by severe acute respiratory distress syndrome coronavirus 2 (SARS-CoV-2), has stimulated significant research since the start of the global pandemic. Its effect on pregnancy and pregnancy outcomes has been frequently studied and but questions remain. Pregnancy is a medical condition that can increase the risk of severe COVID-19 illness; other important medical conditions include diabetes, chronic lung, kidney, or liver disease, smoking, cancer, cardiac disorders, human immunodeficiency virus (HIV) infections, certain neurological conditions, and an immunocompromised state. Therefore, pregnant patients represent a unique patient population

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of healthy individuals affected by the SARS-CoV-2 pandemic, and 26.5% of women between the ages of 15–49 who had a COVID-19-associated hospitalization between March 1 and August 22, 2020, were pregnant, based on a COVID-19-Associated Hospitalization Surveillance Network convenience sample.[1]

As pregnancy outcomes vary in existing studies, it is important to continue reporting findings associated with COVID-19 infection to achieve optimal outcomes for the mother and the neonate. Therefore, this study reports pregnancy outcomes in rural West Texas.

Methods

Study cohort and data collection

This study retrospectively reviewed outcomes in pregnant patients with confirmed COVID-19 infection admitted to Texas Tech University Health Sciences Center and its affiliated University Medical Center in Lubbock, Texas, between April 12, 2020, and January 25, 2021; the study included 36 patients admitted during this period. These patients initially presented to the emergency room, the UMC family birth center, and outpatient surgery for complications during their pregnancies or planned deliveries and were included in the study population only if followed for the complete duration of pregnancy. For COVID-19 testing, the POC COVID-19 Quidel Sofia® 2 SARS Antigen FIA was used, with specimens gathered using a nasopharyngeal swab upon their initial arrival or admission and confirmed using internal quality controls. Only patients with a positive result with this method were included. The electronic medical records of these patients during their initial intake and subsequent admission were reviewed and included pregnancy summaries, nursing notes, emergency medicine documents, and laboratory records. Data were summarized utilizing descriptive statistics, including mean and standard deviation, when appropriate. Percentages and counts were used for categorical values.

This study (L21–147) was approved by the Institutional Review Board at Texas Tech University Health Sciences Center in Lubbock, Texas.

Study definitions

The study factors examined were determined by the patients' self-reports during intake or their electronic medical record progress notes. These included race and ethnicity, Apgar score, type of delivery, and NICU admission. Documented prenatal care was determined by the patients' self-reports of prenatal care, previous visits to UMC or UMC-associated healthcare providers defined in the record as a visit for prenatal care, or a record of prenatal tests and labs reported in the patients' pregnancy summaries. The presence of prenatal vitamins was noted but was not defined as prenatal care if used alone. A patient was determined to be diabetic or have gestational diabetes based on a record of this diagnosis in the patient's record or an O'Sullivan one-hour glucose obstetric test over 135 mg/dL or 200 mg/dL. Patients without the diagnosis of diabetes/gestational diabetes or had blood glucose levels below 135 mg/dL were not defined as diabetic/gestational diabetic for this study. In this study, patients could respond to separate categories for Ethnicity (Hispanic or Latino or Spanish origin or Not Hispanic or Latino or Spanish Origin) and Race (Caucasian, Black/African American, Asian, Native Hawaiian/Pacific Islander, and No Reply).

Results

Demographics and clinical characteristics

All 36 patients in this study were adults, ranging from 20 to 36 years old (mean age 29.0 $\pm$ 4.8). The study population included 22 Hispanic or Latino women (61.1%), six Caucasian women (16.7%), two Asian women (5.6%), Native Hawaiian/Pacific Islander woman, and one Black/African American woman (both 2.8%). Four patients did not identify their race/ethnicity. Twenty-four patients (66.7%) had documented prenatal care before hospitalization. Gestational diabetes was present in five patients (13.8%). (See attached table for the results)

Clinical outcomes

No deaths occurred in the 36 patients in this study. The mean week of pregnancy in these patients when

Table. Demographics and pregnancy outcomes

Variable		
Age	Mean ± SD	29.0 ± 4.8
Ethnicity/Race	a) Hispanic/Latino b) Caucasian c) African American d) Asian e) Native Hawaiian/Pacific Islander f) Others/Refused to reveal	22 6 1 2 1 4
Length of stay	Mean ± SD	3.3 ± 3.6
Week of pregnancy during hospitalization	Mean ± SD	37.0 ± 4.9
Weeks at delivery	Mean ± SD	37.8 ± 2.3
Apgar Score (1 min)	Mean ± SD	7.5 ± 1.9
Apgar Score (5 min)	Mean ± SD	8.8 ± 0.5
Documented prenatal care	Yes No	24 12
Mother required invasive ventilation	Yes No	3 33
Caesarean delivery	Yes No	12 24
Diabetic- Gestational or other	Yes No	5 31
Weight of baby (gm)	Mean ± SD	3122.8 ± 579.0
NICU admission	Yes No	7 29

hospitalized was 37.0 ± 4.9 week. The average length of stay at the hospital was 3.39 ± 3.54 days. The average weeks of pregnancy at delivery was 37.8 ± 2.3 weeks. Six children (18.2%, n = 6/33) were born prematurely. Cesarean delivery occurred in 12 births (33.3%). Three mothers required invasive ventilation. Three patients had either miscarriage, incomplete abortion, or ectopic pregnancy. The other 33 patients reported successful and full-term pregnancies. Of the 33 live births, the average weight of infants born was 3122.8 ± 579.5 grams. The average Apgar score of infants at 1 minute was 7.52 ± 1.91, and the average Apgar score of infants at 5 minutes was 8.8 ± 0.5. Seven infants were admitted to the Neonatal Intensive Care Unit (NICU).

Discussion

The majority of pregnant patients in our study with COVID-19 infections were Hispanic/Latino, which is consistent with numerous reports in the literature that demonstrate the disproportionate impact that the COVID-19 pandemic has had on these ethnic groups.[2–4] For example, one study of 263 asymptomatic pregnant women at a New York City hospital found that Hispanic patients, including pregnant Hispanic women, were at a higher risk for COVID-19 infections ($p = 0.049$).[5] Another study of 17,446 women found that Hispanic women had a 2.6 times higher chance of being infected with COVID-19 than white women.[6] A study of 22,493 female patients with COVID-19 found that pregnant

women had higher rates of hospitalization compared to non-pregnant women (60.5% vs 17.0%, $p < 0.001$), but they did not have an increased risk for death or mechanical ventilation.[7] This higher risk may be due to socioeconomic factors, such as access to care, and later in the pandemic, mistrust in healthcare institutions.[8] The results observed here may also be impacted by the demographics of our region, which has a significant Hispanic population.

We observed a high prevalence of gestational diabetes (13.9%) in the pregnant COVID-19 patients in this study compared to the national average of 6.9% in 2019.[9] Studies have noted an increased risk for COVID-19 among women with gestational diabetes. For example, a multicentric prospective study of 1,490 women with COVID-19 observed that, while gestational diabetes was not associated with an adverse maternal outcome among patients overall (OR 1.50; 95% CI: 0.88–2.57), women who were obese or overweight and required insulin had an increased risk of severe COVID-19 (aOR 3.05; 95% CI: 1.38–6.73). Increased body mass index (≥25 kg/m^2) was also associated with worse fetal and neonatal outcomes (aOR 1.83; 95% CI: 1.05–3.18), including stillbirth, neonatal death <7 days after delivery, or transfer to the neonatal intensive care unit.[10] A case-control study of 224 patients with pre-existing diabetes and COVID-19 found an increased rate of gestational diabetes among COVID-19 patients compared to controls (36.4% vs 16.1%, $p = 0.002$).[11] Finally, meta-analyses of 438,548 pregnant patients found that severe COVID-19 infections were associated with gestational diabetes (OR 1.99; 95% CI: 1.09–3.64) at higher rates than patients with mild COIVD-19, but not compared to patients without COVID-19.[12] The pandemic may have also contributed to rates of gestational diabetes among pregnant women generally,[13,14] and increased rates during a lockdown period were also observed.[15] This latter observation may be due to indirect effects of the COVID-19 pandemic, including emotional distress, reduced physical activity,[15] reduced access to care, and reduced access to healthier nutrition, which may have contributed to increased rates of gestational diabetes.

Pre-term birth, defined as delivery before 37 weeks, is an important concern due to its impact on newborn mortality and its association with inflammatory states and infectious diseases.[16] In this study, the average number of modest scores against home weeks of pregnancy at delivery was 37.8 ± 2.3 weeks. In comparison, in a national, study just 27.3% of births in 2019 were at 37–38 weeks of pregnancy at delivery, relative to 62.5% of births after week 38.[17] Multiple studies have examined the relationship between COVID-19 and preterm birth. For example, a study of nearly 870,000 women observed that pregnant women with COVID-19 were likely to have preterm birth ($P < 0.01$).[18] Another study of approximately 240,000 women noted an increased risk of preterm (aRR 1.4; 95% CI: 1.3–1.4) and very pre-term birth (aRR 1.6; 95% CI:1.4–1.9) in women with COVID-19.[19] A meta-analysis of 42 studies with 438,548 pregnant women found that COVID-19 infection was associated with preterm birth (OR 1.82; 95% CI: 1.38–2.39), with a stronger association observed in severe COVID-19 patients compared to patients with mild COVID-19 (OR 4.29; 95% CI: 2.41–7.63).[12]

However, several studies have observed no change or a decrease in preterm birth rates.[20–22] There is also variation among studies examining rates of pre-term birth before and during the pandemic, with some noting overall increases and others noting no change[23,24] or even decreases in preterm birth rates.[25] This may be due in part to the number of centers included in the study,[26] types of subgroup analysis,[25] or the income of the country where the study occurred.[27] Reasons for decreased rates of pre-term birth may include increased physical demands during the lockdown,[28] reduced non-COVID-19 infections,[29] improved air quality,[29] and reduction in clinician-induced preterm birth (due to a disruption in obstetric care).[30] Conversely, increased rates may be due to less frequent use of healthcare resources, increased rates of depression,[31] increased unemployment,[32] and increased family conflicts.[32] The time of infection during gestation and the severity of COVID-19 infection may also help explain these differences. For example, a study of 14,264 women found that those with symptomatic COVID-19 before 20-week gestation had no increased risk of pre-term delivery, whereas those with severe COVID-19 after 20-week gestation had a higher risk compared to those with mild/moderate

COVID-19.[33] Risks have also been higher in patients with comorbidities.[19] Goldenberg and McClure suggest that reasons for the discrepancies among studies on COVID-19 and preterm birth during lockdown periods include negative publication bias, lack of reported methodology for determining gestational age, and different lengths of time for a case and historical control study population.[34]

Neonatal ICU admission rates (20.0%) were significantly higher than both the national average in 2018 (9.1%)[35] and in other studies that report maternal and neonatal outcomes from COVID-19 infection.[36,37] A systematic review and meta-analysis of 29 studies and 197,196 neonates noted that those born to COVID-19 positive women had a higher risk of NICU admission (OR 2.18; 95% CI:1.46–3.26).[38] Another study also noted that a majority of newborns from COVID-19-positive mothers were admitted to the NICU (86.4%), although this appeared to be mostly for isolation purposes, with four newborns testing positive for SARS-CoV-2.[39] However, several studies reporting NICU admissions found no change or a decrease in NICU admissions during the pandemic.[40,41] For example, a study of 43,963 newborns in New York did not report an increase in total NICU admissions in 2020; however, this was not statistically different from rates in 2012–2019 during the same time of year.[42] Of note, these studies typically examine total admissions (and not necessarily admissions from mothers who were COVID-19 positive during pregnancy). Other studies have found no difference between NICU admission between pregnant women with and without COVID-19.[43] The reasons for the differences are unclear, although the population studied and type of subgroup analysis (e.g., pregnant patients with severe COVID-19, comorbidities, or poor prenatal care) may contribute to these differences.

Another important observation involves the frequency of cesarean delivery, which occurred in 34.3% of reported births, which is higher though similar to the national rate of 31.7% in 2019.[44] Multiple studies have found no increase in Cesarean delivery rate during the pandemic.[45–47] A study of pregnancy outcomes across 463 hospitals noted a slight increase in Cesarean delivery (OR 1.02; 95% CI: 1.01–1.04).[48] The average weight of infants born was 3122.8 ± 579.5 grams, above the low birthweight cutoff of 2,500 grams.[49] In 2019, the percentage of total births that had low birthweights was 8.3%.[17] This differs from other studies that have found that maternal COVID-19 infection is associated with low birthweight. For example, one meta-analysis of 54 studies and 385 newborns found a high rate of low birthweight among neonates from COVID-19 positive mothers,[50] whereas a systematic analysis of the general population (40 studies and 168,295 pregnancies) found no such association.[27] Furthermore, in some of these studies, positive associations between maternal COVID-19 infection and low birthweights were observed in patients with severe or moderate-sever COVID-19 infection.[12,37] Finally, the average Apgar score of infants at 1 minute was 7.5 ± 1.9, and the average Apgar score of infants at 5 minutes was 8.8 ± 0.5 in this study. Apgar scores between 7–10, in line with the averages reported here, are considered reassuring.[51] Similar to studies reporting low birthweight, the association of low Apgar scores and COVID-19 infection appears to depend on whether maternal infection[50] or the general population examined.[27] A review of 246 articles and 663 neonates determined that Apgar scores were a poor predictor of neonatal COVID-19 infection;[52] there is limited evidence to support vertical transmission of this infection.[53,54]

In-depth analysis of the reasons for these observations on fetal outcomes is beyond the scope of this study. However, it is worth noting that several studies have found no evidence of vertical transmission of SARS-CoV-2. The reasons for poorer fetal and neonatal outcomes may be due to a variety of factors, including inflammatory responses and secondary causes, such as socioeconomic factors or other stressors created COVID-19 by the pandemic. Some studies suggest inflammatory and immunological responses to COVID-19 infection may harm fetal development.[55,56] Finally, the severity of the COVID-19 infection may dictate the presence and severity of poor neonatal outcomes. Studies that include populations of women with more severe COVID-19 infection may be more likely to observe negative outcomes.

This study is limited by the small number of patients included and the time period during the

pandemic in which both maternal and neonatal outcomes were studied. Vaccination status was not examined as these vaccines were not available until the end of the study period. This study is also limited to a single center which may limit its generalizability. Methods for determining the date of gestation were not specifically examined. As this was intended to be a descriptive, retrospective study, historical controls were not included. Changes to both the circulating strain of SARS-CoV-2, vaccination, and prior COVID-19 illness may make results from studies earlier in the pandemic less applicable or comparable to studies performed later. Nevertheless, this study provides additional information about COVID-19 infection and pregnancy in what has been and likely will be a continually evolving pandemic. It also highlights how different medical centers can have different experiences with COVID-19 patients, as some of our results differed from other institutional and national trends. Future studies should explore the long-term effects of children born to mothers who tested positive for COVID-19 during pregnancy, with particular attention to neurodevelopmental disorders secondary to the immunological changes precipitated by COVID-19 infection in pregnancy. Additional studies will be needed to reconcile discordant results regarding COVID-19 and pre-term birth.

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