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RESEARCH ARTICLE

Racial Disparities and Risk for COVID-19 Among Pregnant Patients: Results from a Large Regional Collaborative

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ABSTRACT

Objective: Though previous studies have assessed both COVID-19 outcomes in pregnancy and racial disparities among non-pregnant patients with COVID-19, few have specifically investigated racial disparities among pregnant patients with COVID-19. The objective of this study is to explore the potential association between race and disparate COVID-19 risk in pregnancy.

Study Design: A retrospective cohort analysis was performed using data collected as part of the COVID-19 in Pregnancy and The Newborn: State of Michigan Collaborative, an established database of pregnant patients admitted to 14 institutions in Southern Michigan. Cases were defined as patients with a positive SARS-CoV-2 test result. Controls, those who had no symptoms of COVID-19 prior to universal screening or a negative PCR test, were matched to cases on the same unit within 30 days of each case. For this analysis, the independent variable was race, with maternal age, body mass index (BMI), chronic hypertension, diabetes, asthma, substance use, and smoking included as a potential covariates- in a robust Poisson regression model, and COVID-19 status (COVID or non-COVID) used as the primary dependent variable. In addition, symptomatology (an aggregate of eighteen symptoms) and disease severity (mild/moderate/severe) were compared between non-Hispanic Black and non-Hispanic White patients using the same statistical method.

Results: Of 1,131 non-Hispanic gravidas, 42.9% (n=485) self-identified as Black. These patients were at two-fold greater risk for COVID-19 compared with their non-Hispanic White counterparts [35.9% vs. 18.3%, RR=1.96(1.6-2.4)]. After adjusting for the risk factors mentioned, only obesity and diabetes independently contributed, in addition to race (aRR 1.96[1.57-2.35]). There was no difference between non-Hispanic Black and White groups with COVID-19 in either symptomatology or severity of disease presentation.

Conclusions: There is disparity in the risk of COVID-19 during pregnancy between non-Hispanic Black and non-Hispanic white patients. This disparity is not explained by a range of covariate risk factors. Thus, other kinds of determinants, such as social determinants of health, will need to be examined to fully understand this disparity. In addition to increased susceptibility to infection, our analysis will further delve into examining disparities in treatment and outcome within our sample.

Introduction

The global pandemic caused by the acute respiratory syndrome coronavirus 2 (SARS-CoV-2), known as COVID-19, resulted in devastating consequences worldwide[1]. The cumulative global cases have reached a total of 776 million, with a staggering death toll exceeding seven million[2]. The spectrum of severity of symptoms ranges from asymptomatic cases to mild, moderate, or severe. Common symptoms include fever, cough, shortness of breath, new loss of taste or smell, sore throat, and other flu-like symptoms, as well as trouble breathing and new onset confusion in more severe cases[3].

The physiological changes of pregnancy make patients more at risk of severe disease from any infectious disease, including COVID-19. While numerous studies have repeatedly demonstrated the disproportionate effects of COVID-19 on vulnerable groups, such as racial minorities, limited research has focused on racial disparities in COVID-19 infection among pregnant individuals[4].

A study examining pregnant patients in Brazil revealed that maternal mortality in Black gravidas due to COVID-19 was nearly twice as high as their White counterparts[5]. Additionally, despite Black pregnant individuals being hospitalized in worse condition and having higher rates of ICU admissions, they did not significantly differ in the clinical risk factors commonly associated with worse prognosis. In another study at an academic medical center-based obstetrics practice in Boston, the authors looked at 44 pregnant or recently postpartum patients diagnosed with COVID-19 and found that the majority of these patients belonged to ethnic or racial minority groups[6]. Notably, eight of the nine individuals who required hospitalization and both patients who required ICU admission and mechanical ventilation were people of non-Hispanic Black and Hispanic backgrounds.

A study by Virk et al found that COVID-19 during pregnancy, specifically in the third trimester, was associated with increased risk of mechanical ventilation, acute kidney injury, renal replacement therapy, and complications such as preeclampsia, HELLP syndrome, and preterm birth [7]. They also demonstrated that COVID-19 was disproportionately more prevalent among low-income, Hispanic pregnant women. Another study also demonstrated disparities in rates of severe COVID-19 infection among pregnant Hispanic women vs. non-Hispanic white women[8].

While previous studies have concentrated on assessing pregnancy and neonatal outcomes in COVID-19 positive pregnancies compared to non-COVID-19 pregnancies, limited research has examined the disparities in risk, symptomatology, severity, and treatment of COVID-19 specifically between Black and White pregnant patients[5,6,14,16]. The Southern Michigan Regional COVID-19 in Pregnancy Collaborative was established to evaluate the impact of COVID-19 infection during pregnancy on perinatal outcomes [9,10,11]. The primary outcome of interest of the collaborative was preterm birth, and, as we have reported in another manuscript[10], COVID-19 was associated with higher rates of preterm birth mainly due to medically necessary deliveries caused by preeclampsia[10]. Furthermore, we demonstrated that COVID-19 infection raised the risk of preeclampsia, even in individuals without signs of infection[11]. Moreover, symptomatic patients were at an even higher risk of preeclampsia[11]. The current study is a secondary analysis that aims to evaluate the differences in the risk of developing COVID-19 in pregnancy between non-Hispanic White and non-Hispanic Black individuals, along with variability in severity, symptomatology, and treatment.

Materials and Methods

STUDY DESIGN

The Southern Michigan Regional COVID-19 Collaborative observational study was established in March 2020 as a response to the rising number of COVID-19 cases in Michigan[9]. The collaborative consists of 14 institutions primarily located in Southern Michigan, including four university-affiliated institutions along with community-based hospitals, that collectively care for over 50,000 deliveries annually, representing roughly half of the state's yearly births. IRB approvals from the respective institutions were obtained allowing for retrospective and prospective data collection from electronic medical records of the respective institutions. The Office of Women's Health at Wayne State University served as the data coordinating center of this collaborative. Comprehensive and detailed data collection on maternal, pregnancy, and newborn outcomes was conducted (Table 1).

Table 1: Redcap research database categories from Southern Michigan Regional COVID-19 in Pregnancy Collaborative1

Demographics
Hospital
Patient age
Race/ethnicity
Insurance status
Location of Residence
Highest educational level
Employment status
Marital status of patient and partner
Maternal height, weight, and BMI
Past history
Gravidity, parity, term births, preterm births, abortions, living children, prior preterm birth with gestational age
Pre-existing medical disorders
Smoking, history and present

Current obstetric history
Estimated due date Prenatal care? Ob disorders this pregnancy Number of fetuses
COVID-19 details
Date of admission and days since first Michigan case Contact with positive individual and social distancing? Symptomatic? Gestational age at symptom onset Trimester of COVID-19 infection Signs and symptoms (20+ other) Lab testing for virus and response Additional respiratory diagnosis
Lab findings (up to 14 entries for each of 26 lab assays potentially affected in COVID-19 infection with final interpretation of lab abnormality)
Imaging findings
Chest x-ray and CT scan
Brain MRI and EEG
CNS Abnormality
COVID-19 disease severity on admission and during hospitalization
Critical care admission? When?
ECMO? CPAP? Antibiotics
COVID-19 treatment with 13+ other drugs, including corticosteroids and anticoagulants
Same information for first admission and second through fifth admissions
Outcomes
Maternal outcome, or any of 14 other adverse outcomes Reason for maternal ICU admission Date and primary cause(s) of maternal death If discharged before delivery, gestational age Adverse pregnancy outcomes (9 + other) Significant persistent FHR abnormality Anesthesia Intrapartum complications Delivery type Induced and reason(s) Cesarean indication(s) Gestational age at delivery Length of delivery hospitalization Newborn gender, weight and length Premature birth status and newborn findings Major birth defects Newborn testing for COVID-19 with diagnosis Newborn complications including NICU admission and reason(s) Neonatal death with date and cause(s), including neurologic condition Neonatal serum IgM antibodies Neonatal secondary bacterial infection Placental analysis and histology Rooming in and breastfeeding with duration?

PATIENT POPULATION

This paper covers outcomes of pregnancies between March 10th and October 1st, 2020. Both cases and controls were included, whereby cases were pregnant patients with a confirmed SARS-CoV-2 PCR test during pregnancy and controls were pregnant patients who had a confirmed negative SARS-CoV-2 PCR test and no suspicion of the disease. Every case in the study was matched to 2 to 3 controls admitted in the same Labor and Delivery unit within 30 days from each case. During the initial outbreak of the pandemic, universal screening was not yet implemented across all labor and delivery units due to the shortage of testing kits, therefore, controls matched to the early cases were primarily asymptomatic patients with no clinical suspicion of COVID-19 disease. Overall, 29.3% of the total number of controls did not have a documented negative PCR test, and 70.7% did have a documented negative PCR test. For the purposes of this study, non-Hispanic White and non-Hispanic Black individuals were included in the analysis (Figure 1). Participants from other racial and ethnic groups were excluded from the sample as there was insufficient data (n = 328). Non-Hispanic White individuals were used as the reference group. Our primary outcome of interest was positive COVID-19 disease in pregnancy. We also compared disease presentation in terms of symptomatology (an aggregate of 18 symptoms) and severity. The secondary outcome was determining COVID-19 disease severity, categorized as follows: mild (no pneumonia), moderate (with pneumonia), severe

(respiratory/cardiovascular failure), and critical (shock/organ failure).

STATISTICAL ANALYSIS

Demographic characteristics and neonatal outcomes were compared between the two racial groups, non-Hispanic Black and non-Hispanic White individuals using Fisher exact tests. We used Poisson regression models to estimate relative risk (RR) for COVID-19 between White and Black gravidas. To ensure that racial disparity was not due to confounding factors, we adjusted the differences for the potential confounders. This adjustment involved incorporating covariates such as maternal age, BMI, insurance, marital status, history of smoking, and preexisting medical disorders (chronic hypertension and asthma) into the robust Poisson regression model. All analyses were conducted using R statistical language and environment. A p-value<0.05 was considered significant.

Results

A total of 1,131 non-Hispanic women were included in the study. Of these, 485 (42.9%) self-identified as Black and 646 (57.1%) self-identified as White (Table 2). The frequencies of COVID-19 among the Black and White groups were 35.9% and 18.5 % (p<0.001), respectively (Table 3). Chronic hypertension was more frequent in Black than in White patients (10.5% vs. 3.7%, p<0.05). We also observed a higher rate of previous preterm birth in Black patients (14.8% vs. 9.6%, p<0.05).

Table 2: Population characteristics by race

	Non-Hispanic White (n=646)	Non-Hispanic Black (n=485)	P value
Age(>28)	63.2	40.8	<0.001
BMI(>25)	86.7	91.3	0.017
Insurance (Private)	63.8	40.4	<0.001
Marital status (Single)	29.1	84.9	<0.001
Nulliparous	28.6	27.8	0.79
History of preterm birth	9.6	14.8	0.009
Chronic hypertension	3.7	10.5	<0.001
Diabetes	1.5	2.1	0.65
Asthma	10.1	15.1	0.013
History of smoking	18	14.6	0.146

Table 3: Racial disparity of Covid-19 among non-Hispanic patients

	Non-Hispanic White	Non-Hispanic Black	P-value	RR
COVID	18.3(118 / 646)	35.9(174 / 485)	<0.001	1.96(1.6-2.4)
COVID Asymptomatic	12(72 / 600)	25.2(105 / 416)	<0.001	2.1(1.6-2.76)
COVID Symptomatic	8(46 / 574)	18.2(69 / 380)	<0.001	2.27(1.6-3.21)

Black patients were at considerably greater risk of COVID-19 infection compared to White patients (RR=1.96 [1.6-2.4]). This risk remained higher for Black women even after adjusting for obesity (aRR=1.71 [1.11-2.63]) and diabetes mellitus (aRR=1.79 [1.12-2.87]) (Figure 2, Table 4).

There was evidence of racial disparity in the risk for COVID-19 seen in both asymptomatic and symptomatic cases, with a more pronounced disparity seen in those identified as symptomatic for COVID-19 (Table 2). Among patients with COVID-19, there was no racial disparity in symptomatology at presentation, disease severity at presentation, nor among treatment methods (Table 5).

Table 4: Adjusted Odds Ratio

	adjusted OR	P-value
Race	1.92(1.57-2.35)	0.0000
BMI>25	1.71(1.11-2.63)	0.0140
Diabetes Mellitus	1.79(1.12-2.87)	0.0150

Table 5: Covid-19 symptoms

	Non-Hispanic White	Non-Hispanic Black	P-value
Any symptoms	34.7(41 / 118)	34.5(60 / 174)	0.963
Fever	11(13 / 118)	16.7(29 / 174)	0.184
Nasal congestion	10.2(12 / 118)	6.3(11 / 174)	0.235
Cough	22.9(27 / 118)	21.3(37 / 174)	0.743
Myalgia/Arthralgia	5.9(7 / 118)	6.9(12 / 174)	0.744
Headache	7.6(9 / 118)	5.7(10 / 174)	0.524
Fatigue	4.2(5 / 118)	6.3(11 / 174)	0.447
Sore Throat	5.9(7 / 118)	5.7(10 / 174)	0.947
Shortness of breath	11.9(14 / 118)	17.8(31 / 174)	0.174
Nausea and vomiting	7.6(9 / 118)	8(14 / 174)	0.896
Reduced sense of smell	5.1(6 / 118)	5.7(10 / 174)	0.807
Reduced taste	5.9(7 / 118)	5.2(9 / 174)	0.78
Other symptoms noted	5.1(6 / 118)	10.3(18 / 174)	0.119

Discussion

WHAT THIS ADDS TO THE LITERATURE

When compared to the non-pregnant population, previous studies show that pregnant individuals exhibit higher rates of infection, worse outcomes, and potentially different presentations of COVID-19 disease[12]. Specifically, a study in Washington looking at COVID-19 infection rates in pregnancy concluded that the infection rate was 70% higher than that of a similarly aged general population, not completely explained by universal screening[13]. Another study published early in the pandemic suggested that pregnant patients are more likely to be hospitalized and admitted to the ICU than non-pregnant controls, but the mortality risk was similar[14]. In a living systematic review and meta-analysis, data suggested that pregnant and recently pregnant individuals with COVID-19 recently admitted to the hospital, are less likely to manifest typical symptoms. Instead, they are more likely to be admitted to the ICU and require invasive ventilation, leading to a higher chance of preterm delivery, and potentially, an increased risk of maternal death[15].

Studies have also shown that COVID-19 affects non-pregnant groups of color disproportionately[17]. Previous studies in large metropolitan areas of Houston, Los Angeles, Northern California, Georgia, and New York have demonstrated higher susceptibility and hospitalization among patients of non-Hispanic Black and Hispanic backgrounds, after controlling for sociodemographic and clinical factors[18,19,20,21,22]. Studies investigating these disparities revealed that Black patients are at higher risk of contracting COVID-19, even after controlling for factors like obesity, insurance, and pre-existing conditions[23]. Though we did not collect data on sociodemographic or income information, prior studies have suggested that many of these divergent risks and outcomes stem from practices that systemically disadvantaged minority populations, such as poorer access to timely healthcare, inadequate housing, and employment challenges[5,17,32]. Black patients often have higher rates of diabetes, asthma, heart disease, and obesity, which predispose to serious complications of COVID-19[24,25,26,27]. Additionally, individuals from marginalized groups are more likely to lack health insurance, limiting healthcare access and discouraging patients from seeking timely testing and treatment, thus delaying care and exacerbating outcomes[5,17].

Previous research has shown that factors such as chronic stress, obesity, asthma, belonging to a racial or ethnic minority group, and socioeconomic factors compound the risk of viral infections and exacerbate inflammation during pregnancy[15,28]. A 2022 study by Torres-Torres et al. looking at pregnant women affected by confirmed COVID-19 in Mexico, specifically confirmed that advanced maternal age, pre-existing diabetes, chronic hypertension, obesity, high social vulnerability, and low socioeconomic status were related to COVID-19 related maternal mortality[29]. When we adjusted for similar covariates, such as BMI $\geq$ 25, pre-existing medical conditions (e.g. diabetes and chronic hypertension), and lack of private insurance, Black women were still at higher risk for COVID-19 infection.

KEY FINDINGS OF THIS STUDY

In our study, Black pregnant patients were more likely to test positive for SARS-CoV-2 compared to White patients when hospitalized for delivery. Furthermore, this increased risk persisted after controlling for several covariates. Among women with risk factors such as higher BMI, lack of insurance, or preexisting medical conditions, Black women were still at higher risk of developing COVID-19 disease. Black women are also at higher risk of developing symptomatic COVID-19, though among symptomatic patients, there are no disparities in symptomatology.

STRENGTHS AND LIMITATIONS

Our study has several strengths. Primarily, it is a collaborative involving 14 institutions that serve a wide geographic area, with a diverse population, all adhering to similar medical and obstetric standards. Our study includes a large sample of pregnant women infected with COVID-19 and their time and institution matched, and hence, geographically and socioeconomically matched controls, who were SARS-CoV-2 negative. Nevertheless, our study is not without limitations. It was retrospective in nature and was originally designed to measure outcomes of pregnancy, thus powered for those outcomes. In addition, though this study included a significant amount of non-Hispanic Black and White individuals, the findings might have been more robust if the population consisted of a wider diversity of ethnicities and races.

Conclusion

Our findings suggest that among Black pregnant women, the conditions which predispose pregnant women to higher risk of COVID-19 and its severe complications do not explain the disparity in risk for COVID-19. In our study, this population continued to be at higher risk after controlling for these factors. Thus, other contributors, such as the impact of structural racism and social determinants of health, will need to be examined to understand this disparity. Though some previous studies have demonstrated no higher risk of adverse pregnancy and neonatal outcomes in pregnancies impacted by COVID-19, others have suggested a possibility of higher rates of hospitalization, ICU admission, and preterm birth in patients infected with COVID-19 during pregnancy[30,31]. This implies that patients who are at higher risk of developing COVID-19 during pregnancy are also at higher risk of these adverse outcomes. Given the importance of maternal and infant health, it is imperative for the healthcare system to mitigate factors contributing to this disparate risk. Our findings suggest that treating pre-existing medical conditions and obesity cannot be expected to fully decrease the risk of COVID-19 for Black pregnant patients. Therefore, additional research is warranted to investigate racial disparities in pregnancy and neonatal outcomes among pregnant people with COVID-19, focusing on factors that contribute to the disparity in COVID-19 risk among pregnant patients.

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