Maternal and Neonatal Outcomes Before and During the COVID-19 Pandemic

SARAH C. NIEHAUS; TERESA M. BROWN; MARGA E. KEMPNER, MD; JULIANNE E. SKARHA, PhD; NINA K. AYALA, MD

ABSTRACT

OBJECTIVE: The COVID-19 pandemic brought about many social, psychological, and economic changes. We sought to compare pregnancy and birth outcomes immediately preceding the COVID-19 lockdown to those 12 months later.

STUDY DESIGN: This was a retrospective cohort study of people giving birth at a large-volume tertiary medical center in Rhode Island. We compared those who gave birth in February 2020 to those in February 2021.

RESULTS: Fewer people delivered in 2021 than 2020 (562 vs. 655). There was a non-significant decrease in the number of primary cesarean deliveries from 2020 to 2021. Insurance status modified this effect as there was a significant decrease in the number of patients with private insurance undergoing primary cesarean (63.6 vs 36.4%, p=0.004). Neonatal complications significantly decreased (55.4% vs 47.4%, p=0.006).

CONCLUSION: There were differences in sociodemographic characteristics and outcomes of birthing people between 2020 and 2021. The socioeconomic and healthcare landscape caused by COVID-19 altered statewide birthing patterns.

KEYWORDS: Coronavirus, COVID-19, adverse perinatal outcomes, maternal, neonatal

INTRODUCTION

The ongoing global pandemic of coronavirus disease 2019 (COVID-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) brought about many social, psychological, and economic changes. The lockdown measures that were instituted across the United States in March of 2020 impacted employment rates, healthcare access, and social support structures.[1,2] In particular, there is concerning evidence that suggests that the social disturbances of the pandemic widened existing racial and socioeconomic disparities in pregnancy and birthing outcomes.[3–5] Studies have shown that women who are Black or Hispanic, living in neighborhoods with high deprivation, or experiencing job loss had a higher prevalence of COVID-19 infections; women living in neighborhoods with high unemployment rates were more than twice as likely to contract COVID-19 during the early pandemic.[3,4] These discrepancies in infection rates could translate to birth outcomes as COVID-19 infection during pregnancy is associated with increased rates of stillbirth, preterm birth, and preeclampsia. Pregnant women are also three times more likely to require ICU level care because of COVID-19 infection compared to non-pregnant women.[5]

During lockdown, women disproportionately experienced more job loss than men,[6] which put financial strain on many families and affected their family planning. In one study, 34% of participants reported delaying plans to have a child or reducing the number of children they were expected to have because of the pandemic and a 2020 report predicted 300,000 to 500,000 fewer births in the year following.[7,8] However, it is not known how these changes may have translated to local birthing characteristics and outcomes.

Additionally, the pandemic and the implementation of new public health measures also disrupted access to health care. One study reported that 33% of participants had to cancel or delay reproductive health appointments and barriers to receiving care were greater among Hispanic and Black patients compared to White patients.[8] The increased challenges in accessing health care also led to an estimated 12 million women who were unable to access family planning services.[9] These barriers will likely impact who is giving birth during the pandemic and change the risk profiles of pregnant patients.[10]

The pandemic also greatly altered the birthing experience in hospitals. In the early pandemic, many hospitals incorporated stringent visitor restrictions, in some cases not allowing any labor support.[11] Furthermore, in a prior study, half of birthing parents and newborns had a postpartum stay of just one night following vaginal delivery post-implementation of COVID-19 protocols as compared to only one-quarter of birthing parents and newborns in the pre-implementation group, which may have impacted their comfort in neonatal care after discharge.[11] With the added stress of the pandemic, there has also been a notable increase in peripartum anxiety and depression,[12,13] both of which are associated with preterm births and lower rates of breastfeeding.[14]

However, despite the many recognized impacts of the COVID-19 pandemic, much remains unknown. We aimed

to study differences in pregnancy and birth characteristics in Rhode Island between a pre-pandemic cohort and a cohort who gave birth 12 months after COVID-19 public health measures were implemented in the US. We hypothesized that the pandemic increased barriers and disparities in accessing reproductive services and obstetric care, resulting in changes in birth characteristics and birthing outcomes.

METHODS

This study was a retrospective cohort study involving all individuals who gave birth at ≥20 weeks gestation at Women & Infants Hospital in Providence, Rhode Island during the months of February 2020 and February 2021. Women & Infants Hospital is a tertiary medical center, performing over 8,000 deliveries per year, which represents over 85% of Rhode Island births. A detailed review of patient demographics, pregnancy and delivery characteristics, and neonatal outcomes were performed by trained research personnel, and 5% of charts were doubly abstracted to ensure quality control.

For this analysis, we compared those delivering immediately prior to the pandemic (February 2020) to those delivering approximately one year after the pandemic started (February 2021 with conception during lockdown in 2020). Our primary outcome of interest was mode of delivery (cesarean, spontaneous vaginal, or operative vaginal delivery). The secondary outcome was composite neonatal morbidity which included Neonatal Intensive Care Unit (NICU) admission, fetal or neonatal death (at delivery admission), APGAR score of <7 at 5 minutes of life, hypoglycemia (blood glucose of <40 mg/dL at any point), or hyperbilirubinemia (as documented on hospital discharge diagnoses).

STATISTICAL ANALYSES

We calculated descriptive statistics for our demographic variables by delivery year and estimated p-values using a 2-sample test for equality of proportions (z-test) with continuity correction for count values and the Welch 2-sample t-test for mean values. We similarly calculated descriptive statistics by delivery year for our outcomes of interest. We used bivariate logistic regression to report odds ratios for our main findings as determined by the descriptive statistics.

RESULTS

There was a total of 655 births in February 2020 and 562 in February 2021. Overall, demographic characteristics were similar between those delivering in 2020 compared with 2021, except that the proportion of people with private insurance decreased from 2020 to 2021 (56.5 vs 50.4%, p-value=0.04) (**Table 1**). There were no significant differences in mean maternal age, race and ethnicity, and number of primary English speakers between those giving birth in 2020 versus 2021.

Table 1. Demographic characteristics among birthing parents who delivered in February 2020 and February 2021

Demographics	2020	2021	P-value
Total	655	562	
Maternal age, years (mean, SD)	30.49 (5.8)	30.87 (5.9)	0.26
Advanced Maternal Age	189 (28.9)	165 (29.4)	0.90
Nulliparous	198 (30.2)	164 (29.2)	0.77
Race			
American Indian/Alaska Native	26 (4.0)	15 (2.7)	0.27
Asian	31 (4.7)	24 (4.3)	0.80
Black/African American	69 (10.5)	70 (12.5)	0.34
Native Hawaiian/Pacific Islander	8 (1.2)	2 (0.4)	N/A
White	417 (63.7)	348 (61.9)	0.57
Other	37 (5.7)	42 (7.5)	0.24
Unknown	67 (10.2)	61 (10.9)	N/A
Ethnicity			
Hispanic	192 (29.3)	157 (27.9)	0.64
Non-Hispanic	450 (68.7)	403 (71.7)	0.28
Unknown	13 (2.0)	2 (0.004)	N/A
Primary Language English	568 (86.7)	487 (86.7)	0.52
Insurance status			
Private	370 (56.5)	283 (50.4)	0.04
Public	279 (42.6)	275 (48.9)	0.04
Other	6 (0.9)	4 (0.7)	N/A

Columns are N (%) unless otherwise noted

For mode of delivery, the number of primary cesarean deliveries decreased non-significantly from 2020 to 2021 (20.2 vs 16.0%, p-value=0.08) (**Table 2**). This effect was modified by insurance status: the odds of primary cesarean among those with public insurance was unchanged (odds ratio [OR] 1.10, 95% confidence interval [CI] 0.71–1.69), whereas the odds of primary cesarean among those with private insurance was lower in 2021 compared with 2020 (OR 0.54, 95% CI 0.36–0.82) (**Table 3**). Other pregnancy and delivery characteristics were similar across the two periods, including rates of gestational diabetes, hypertensive disorders of pregnancy, postpartum hemorrhage, patients undergoing Trial of Labor After Cesarean (TOLAC), and multifetal gestation.

In terms of neonatal outcomes, there was a significantly higher number of neonatal complications in 2020 compared with 2021 (55.4 vs 47.4%, p=0.006). This difference was primarily driven by a decreased incidence of hyperbilirubinemia in 2021 (35.6 vs 24.0%, p<0.001) (**Table 4**). There was no statistically significant change in the rates of hypoglycemia and other complications between the two years. Additionally, the rates of NICU admissions, low birth weight (<2500g),

Table 2. Pregnancy and delivery characteristics among birthing parents who delivered in February 2020 and February 2021.

Characteristic	2020	2021	P-value
Total	655	562	
Labor Onset			
Spontaneous	313 (47.8)	262 (46.6)	0.78
Induction of labor	241 (36.8)	208 (37.0)	1.00
Scheduled cesarean	100 (15.3)	92 (16.4)	0.64
Mode of Delivery			
Spontaneous vaginal delivery (SVD)	398 (60.8)	359 (63.9)	0.31
Vacuum-assisted vaginal delivery (VAVD)	26 (4.0)	14 (2.5)	0.20
Forceps-assisted vaginal delivery (FAVD)	10 (1.5)	13 (2.3)	0.42
Primary cesarean	132 (20.2)	90 (16.0)	0.08
Repeat cesarean	89 (13.6)	86 (15.3)	0.43
Trial of Labor After Cesarean (TOLAC)†	26 (24.1)	36 (32.1)	0.24
Gestational diabetes	55 (8.4)	59 (10.5)	0.24
Hypertensive disorder of pregnancy*	84 (12.8)	71 (12.6)	1.00
Postpartum hemorrhage	27 (4.1)	32 (5.7)	0.25
Multifetal Gestation			
Twins	15 (2.3)	9 (1.6)	0.51
Triplets	1 (0.2)	0	N/A

Columns are N (%) unless otherwise noted
*Hypertensive disorders of pregnancy included gestational hypertension, pre-eclampsia, eclampsia
†Calculated only among patients who had a cesarean

Table 3. Odds ratio of primary cesarean delivery among nulliparous birthing parents delivering in February 2021 vs 2020 with private insurance and public insurance.

Odds Ratios	OR (95% CI)
Among people with private insurance, primary cesarean birth	0.54 (0.36, 0.82)
Among people with public insurance, primary cesarean birth	1.10 (0.71, 1.69)

Table 4. Neonatal characteristics among birthing parents who delivered in February 2020 and February 2021.

Neonatal Outcomes	2020	2021	P-value
Total	663	566	
Sex			
Male	333 (50.2)	286 (50.5)	0.96
Female	330 (49.8)	280 (49.5)	0.96
Preterm birth <37 weeks	68 (10.3)	66 (11.7)	0.49
Low birth weight <2500g	59 (8.9)	58 (10.3)	0.48
5 min APGAR (mean, SD)	8.76 (0.8)	8.78 (0.8)	0.69
Neonatal Complications, total	367 (55.4)	268 (47.4)	0.006
Hyperbilirubinemia	236 (35.6)	136 (24.0)	<0.001
Hypoglycemia	30 (4.5)	23 (4.1)	0.80
Other	101 (15.2)	109 (19.3)	N/A
NICU Admission	101 (15.2)	79 (14.0)	0.58
Readmission within 30 days	16 (2.4)	11 (1.9)	0.72

Columns are N (%) unless otherwise noted

congenital anomalies, neonatal readmission, APGAR scores, and preterm birth were comparable between 2020 and 2021.

DISCUSSION

In this study comparing maternal, neonatal, and birth characteristics before versus during the COVID-19 pandemic, we found an overall decrease in the number of births between 2020 and 2021, which was largely driven by a reduction in patients with private insurance giving birth. Privately insured patients also underwent fewer cesarean deliveries and there was an overall decrease in the rate of neonatal complications in 2021.

This is consistent with previous predictions that the birth rate would drop during the first year of the COVID-19 pandemic.[7,10] This decrease is likely multifactorial; the potential impact of close confinement during lockdown on increasing birth rate appeared to be outweighed by the stress and uncertainty caused by social and financial insecurities and the unknown progression of the pandemic.[15] The drop in patients with private insurance giving birth in 2021 with a similar number of patients with public insurance giving birth between the two years may be reflective of patients with lower socioeconomic status experiencing greater barriers to accessing birth control and family planning services during the pandemic, which has been found in other studies.[8,16] However, we did not detect differences by race and ethnicity that have been previously described. Additionally, with higher unemployment rates after the start of the pandemic, there may have been a shift from employer-sponsored health insurance to public coverage.[2]

We observed a non-significant decrease in the rate of primary cesarean births between the two time periods, that appears to be driven by a decreased rate of patients with private insurance undergoing primary cesarean delivery. This is consistent with a study of nulliparous patients delivering at full term in Rhode Island that reported a decrease in elective cesareans during the beginning of the pandemic in April 2020.[17] However, it is in contrast with other studies that found increased rates of cesarean births during the

pandemic.[18,19] These changes in cesarean delivery rates may signify differences in who is getting pregnant and pre-pregnancy risk profiles, with higher-risk patients being more likely to postpone birth given the social uncertainty associated with the pandemic. While we did not detect differences in pre-gestational complication profiles, including pre-gestational diabetes and hypertension, there may have been other medical comorbidities or characteristics we were unable to capture.

Our data also show a significant reduction in neonatal complications from 2020 to 2021, which was primarily driven by a decrease in hyperbilirubinemia. Contrary to other studies, we did not observe a significant difference in preterm births or rates of labor induction between 2020 and 2021, which might have otherwise explained this difference.[5,20–22] Similar to the findings above, this could represent that a population with fewer medical comorbidities achieved pregnancy during the pandemic, although we were not able to detect those differences.

STRENGTHS AND LIMITATIONS

This study has a number of important strengths and weaknesses. This study was completed at a large, diverse, tertiary medical center where >85% of the state births occur, generating a state-representative sample. We completed a comprehensive chart review for all patients birthing during the months included with stringent internal auditing protocols to increase validity of abstracted results. However, this analysis was not without limitations. We only collected data from two timepoints before/during the pandemic. It may have been more informative to have collected additional timepoints to establish longer-term patterns in care and outcomes. We also only collected data from a single site, so the results may be locally but not more widely representative of the experiences and outcomes in other locations. While our medical center experienced a decrease in total births, we cannot know if this was a result of a decreased birth rate or fewer people deciding to come to this site to give birth. We also did not have detailed data available on receipt of reproductive infertility treatments, which likely had an impact on the profile of birthing people across the two time periods and was a service that was not consistently accessible during the early pandemic.

CONCLUSIONS

Our data show that in the state of Rhode Island, there were fewer births among people with private insurance in 2021 compared to 2020 while patients with public insurance had a similar birth rate before and during the pandemic. We also found a significant reduction in neonatal complications in 2021, with no change in preterm birth rates, induction of labor rates, or medical comorbidity profiles. These shifts suggest that the societal and economic changes brought on by the COVID-19 pandemic altered birthing demographics by possibly affecting access to family planning services, health care, and private insurance. Further research is needed to explore the long-term impact of the COVID-19 pandemic on access to comprehensive reproductive health care and birthing outcomes.

References

1. *Unemployment Rate Rises to Record High 14.7 Percent in April 2020*. U.S. Bureau of Labor Statistics; 2020. Accessed June 4, 2022. https://www.bls.gov/opub/ted/2020/unemployment-rate-rises-to-record-high-14-point-7-percent-in-april-2020.htm (visited June 04, 2022).
2. Bundorf MK, Gupta S, Kim C. Trends in US Health Insurance Coverage During the COVID-19 Pandemic. *JAMA Health Forum*. 2021;2(9):e212487. doi:10.1001/jamahealthforum.2021.2487
3. Ames JL, Ferrara A, Avalos LA, et al. COVID-19 prevalence, symptoms, and sociodemographic disparities in infection among insured pregnant women in Northern California. Camacho-Rivera M, ed. *PLOS ONE*. 2021;16(9):e0256891. doi:10.1371/journal.pone.0256891
4. Emeruwa UN, Ona S, Shaman JL, et al. Associations Between Built Environment, Neighborhood Socioeconomic Status, and SARS-CoV-2 Infection Among Pregnant Women in New York City. *JAMA*. 2020;324(4):390-392. doi:10.1001/jama.2020.11370
5. Jamieson DJ, Rasmussen SA. An update on COVID-19 and pregnancy. *Am J Obstet Gynecol*. 2022;226(2):177-186. doi:10.1016/j.ajog.2021.08.054
6. Fry R. Some gender disparities widened in the U.S. workforce during the pandemic. Pew Research Center. Accessed May 10, 2022. https://www.pewresearch.org/fact-tank/2022/01/14/some-gender-disparities-widened-in-the-u-s-workforce-during-the-pandemic/
7. Kearney and Levine. Half a million fewer children? The coming COVID baby bust.
8. Lindberg LD, VandeVusse A, Mueller J, Kirstein M. Early Impacts of the COVID-19 Pandemic: Findings from the 2020 Guttmacher Survey of Reproductive Health Experiences. Published online June 24, 2020. doi:10.1363/2020.31482
9. UNFPA. Impact of COVID-19 on Family Planning: What We Know One Year Into the Pandemic. *UNFPA*. Published online March 11, 2021. https://www.unfpa.org/sites/default/files/resource-pdf/COVID_Impact_FP_V5.pdf
10. Flynn AC, Kavanagh K, Smith AD, Poston L, White SL. The Impact of the COVID-19 Pandemic on Pregnancy Planning Behaviors. *Womens Health Rep*. 2021;2(1):71-77. doi:10.1089/whr.2021.0005
11. Greene NH, Kilpatrick SJ, Wong MS, Ozimek JA, Naqvi M. Impact of labor and delivery unit policy modifications on maternal and neonatal outcomes during the coronavirus disease 2019 pandemic. *Am J Obstet Gynecol MFM*. 2020;2(4):100234. doi:10.1016/j.ajogmf.2020.100234
12. Lebel C, MacKinnon A, Bagshawe M, Tomfohr-Madsen L, Giesbrecht G. Elevated depression and anxiety symptoms among pregnant individuals during the COVID-19 pandemic. *J Affect Disord*. 2020;277:5-13. doi:10.1016/j.jad.2020.07.126
13. Werchan DM, Hendrix CL, Ablow JC, et al. Behavioral coping phenotypes and associated psychosocial outcomes of pregnant and postpartum women during the COVID-19 pandemic. *Sci Rep*. 2022;12(1):1209. doi:10.1038/s41598-022-05299-4
14. Grigoriadis S, VonderPorten EH, Mamisashvili L, et al. The Impact of Maternal Depression During Pregnancy on Perinatal Outcomes: A Systematic Review and Meta-Analysis. *J Clin Psychiatry*. 2013;74(04):e321-e341. doi:10.4088/JCP.12r07968
15. Luppi F, Arpino B, Rosina A. *The Impact of COVID-19 on Fertility Plans in Italy, Germany, France, Spain and UK*. SocArXiv; 2020. doi:10.31235/osf.io/wr9jb

16. Stanton T, Bateson D. Effects of the COVID-19 pandemic on family planning services. *Curr Opin Obstet Gynecol*. 2021;33(5):425-430. doi:10.1097/GCO.0000000000000746
17. Boehler-Tatman M, Howard E, Russo ML. Examining Outcomes for Nulliparous, at Term, Singleton and Vertex Deliveries During the First Wave of the COVID-19 Pandemic in Rhode Island. *R I Med J 2013*. 2022;105(1):37-41.
18. Di Toro F, Gjoka M, Di Lorenzo G, et al. Impact of COVID-19 on maternal and neonatal outcomes: a systematic review and meta-analysis. *Clin Microbiol Infect Off Publ Eur Soc Clin Microbiol Infect Dis*. 2021;27(1):36-46. doi:10.1016/j.cmi.2020.10.007
19. Villar J, Ariff S, Gunier RB, et al. Maternal and Neonatal Morbidity and Mortality Among Pregnant Women With and Without COVID-19 Infection: The INTERCOVID Multinational Cohort Study. *JAMA Pediatr*. 2021;175(8):817. doi:10.1001/jamapediatrics.2021.1050
20. Harvey EM, McNeer E, McDonald MF, et al. Association of Preterm Birth Rate With COVID-19 Statewide Stay-at-Home Orders in Tennessee. *JAMA Pediatr*. 2021;175(6):635. doi:10.1001/jamapediatrics.2020.6512
21. Philip RK, Purtill H, Reidy E, et al. Unprecedented reduction in births of very low birthweight (VLBW) and extremely low birthweight (ELBW) infants during the COVID-19 lockdown in Ireland: a 'natural experiment' allowing analysis of data from the prior two decades. *BMJ Glob Health*. 2020;5(9):e003075. doi:10.1136/bmjgh-2020-003075
22. Been JV, Burgos Ochoa L, Bertens LCM, Schoenmakers S, Steegers EAP, Reiss IKM. Impact of COVID-19 mitigation measures on the incidence of preterm birth: a national quasi-experimental study. *Lancet Public Health*. 2020;5(11):e604-e611. doi:10.1016/S2468-2667(20)30223-1

Authors

Sarah C. Niehaus, Alpert Medical School of Brown University, Providence, RI.

Teresa M. Brown, Alpert Medical School of Brown University, Providence, RI.

Marga E. Kempner, MD, University of Vermont Medical Center, Burlington, VT.

Julianne E. Skarha, PhD, Vermont Department of Health, Burlington, VT.

Nina K. Ayala, MD, Division of Maternal Fetal Medicine, Women & Infants Hospital of Rhode Island; Alpert Medical School of Brown University, Providence, RI.

Disclosures

Conflict of interest: The authors report no conflicts of interest
Disclosure of financial support for the study: none

Corresponding Author

Sarah Niehaus
Box # G-0182
Warren Alpert Medical School at Brown University
70 Ship Street
Providence, RI 02903
sarah_niehaus@brown.edu