Delivery Outcomes During the COVID-19 Pandemic as Reported in a Pregnancy Mobile Application: A Retrospective Cohort Study

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Abstract

Background: The COVID-19 pandemic has presented obstacles for providers and patients in the maternal healthcare setting, causing changes to many pregnant women's birth plans, as well as abrupt changes in hospital labor and delivery policies and procedures. Few data exist on the effects of the COVID-19 pandemic on the maternal healthcare landscape.

Objective: To assess the incidence of key obstetrics outcomes (preterm delivery, Cesarean sections, home births, and length of hospital stay) during the COVID-19 pandemic.

Methods: We conducted a retrospective cohort study of women in the US who delivered between October 1, 2019 and September 30, 2020, had singleton deliveries, and completed a birth report in the Ovia Health pregnancy mobile application. Women were assigned to the before-pandemic cohort if they delivered between October and March, and the during-pandemic cohort if they delivered between April and September. Gestational age at delivery, delivery method, delivery facility type, and length of hospital stay were compared.

Results: A total of 415,125 birth reports were collected with 213,541 (51%) in the before-pandemic cohort and 201,584 (49%) in the during-pandemic cohort. Compared to the before-pandemic cohort, principal findings indicate a 5% decrease in preterm deliveries in the during-pandemic cohort (P<.001; OR = 0.95, 95% CI 0.93-0.97), a 28% increase in home birth rates (P<.001; OR = 1.29, 95% CI 1.22-1.35), and a 7.6% decrease in the average hospital length of stay post-delivery (mean 2.53 (SD 1.4)).

Conclusions: Results suggest a need for continuous monitoring of maternal health trends as the COVID-19 pandemic progresses, and the important role of digital data collection, particularly during the pandemic.

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Short Paper

Delivery Outcomes During the COVID-19 Pandemic as Reported in a Pregnancy Mobile Application: A Retrospective Cohort Study

Introduction

The first confirmed case of Coronavirus disease (COVID-19) in a pregnant woman in the United States was during the week of January 19, 2020. By March 8, there were over 100 confirmed cases in pregnant women per day, increasing to over 2,000 cases per day by the first peak in early July [1]. By mid-to-late March 2020, the WHO had declared COVID-19 a pandemic, and shortly thereafter states initiated stay-at-home orders, the Centers for Medicaid and Medicare Services (CMS) expanded its coverage to include telehealth services, international travel was restricted, clinical trials were stalled, and the healthcare landscape was changed indefinitely[2]. During the following 16 months, and at the time of this writing, the COVID-19 pandemic has presented novel obstacles for patients and providers in the maternal healthcare setting. For pregnant women, the risk of infection has been a source of fear and anxiety, causing many to rethink birth plans[3]. For hospitals, the virus has forced changes to labor and delivery policies and procedures, including increased restrictions on the number of allowed support persons and visitors, reduced intermediary locations for admitted patients, and expedited postpartum discharges[4].

Several studies have explored the effects of COVID-19 infection in pregnant women and their birth outcomes, but there remains a lack of data (particularly at the national level) describing the effects of the pandemic itself, which could include infections, as well as policy and lifestyle adjustments, on birth outcomes. Early studies on potential pandemic effects show decreases in preterm deliveries[5, 6], as well as labor and delivery units with reductions in hospital length-of-stay (LOS)[7]. The free Ovia Pregnancy mobile application, developed to help support women throughout their pregnancies, is uniquely positioned to address this gap by tracking real-time pregnancy and birth outcomes data on a national scale. Annually, the application serves approximately 3 million women and families across 50 states, with 60% of users logging in on iOS devices and 40% on Android.

Using user-reported data from the Ovia Pregnancy mobile app, we assessed key obstetrics outcomes throughout the COVID-19 pandemic and compared them to outcomes in the six months prior to the pandemic. This short paper focuses on the incidence of preterm delivery, Cesarean sections, home births, and the length of hospital stays post-delivery during the first six months of the pandemic and the preceding six months.

Methods

Study Design

We conducted a retrospective cohort study of women ages 18-44 residing in the United States who had singleton deliveries between October 1, 2019 and September 30, 2020 and completed a birth report in a pregnancy mobile application. The birth report collected delivery date, delivery method, delivery facility type, and hospital admission and discharge dates. We assigned women to the pre-pandemic cohort if they delivered between October 1, 2019 and March 30, 2020, and to the during-pandemic cohort if they delivered between April 1, 2020 and September 30, 2020. We compared gestational age at delivery, delivery method, delivery facility type, and hospital LOS. Preterm delivery was defined as a baby born before 37 weeks of pregnancy. Delivery method options were vaginal, planned and unplanned Cesarean sections, and vaginal birth after Cesarean (VBAC). Delivery facility type options included hospital, birthing center, home birth, or other. Hospital LOS was equal to the difference in days between hospital admission date and discharge date and was limited to those who reported stays equal to or less than 14 days. Demographic data were collected via Ovia Pregnancy app questions delivered to users as part of their app experience. With the exception of age, all demographic questions were optional.

Statistical Analysis

All analyses were conducted in R Studio Version 1.3.959. Descriptive statistics were calculated using the *describeBy* function and unadjusted odds ratios for categorical variables were computed using the *odds.ratio* function. Proportions tests were conducted using the *prop.test* function. Means were compared using two-sample t-tests. Relative change from pre-pandemic to during-pandemic was also calculated for all outcomes. This study was granted exemption by an independent review board, Advarra.

Data Privacy

All of the data used in the study were collected from US-resident users. All of the personal information collected by Ovia is processed in accordance with Ovia's Privacy Policy[8] and applicable law.

Results

Sample Cohorts and Demographics

A total of 304,023 pregnant women in the US between the ages of 18 and 44 completed a birth report via the Ovia Pregnancy app and were thus eligible for the study. Among those, 152,832 (50.26%) women delivered between October 2019 and March 2020 and were assigned to the pre-pandemic cohort and 151,191 (49.73%) delivered between April 2020 and September 2020 and were assigned to the during-pandemic cohort. Women who reported their births represented 30.37% (pre-pandemic) and 31.10% (during-pandemic) of all women who used the app and also were expected to deliver during the respective time periods based on their logged last menstrual period (LMP) date. The sample used in this study represents approximately 8.11% of annual births in the United States[9].

Among all users in the sample, 45,530 (14.9%) completed questions about their race, 65,957 (21.7%) completed questions about their income, 61,886 (20.4%) completed questions about their education, and 177,359 (58.3%) completed questions about their education status. The majority (71.33%) identified as white, college-educated (37.30%), employed (74.09%), and had annual household incomes over $100,000 (24.25%). The average age at delivery was 28.31 years, and users in the during-pandemic cohort were, on average, slightly older. Demographic stratifications by cohort are shown in Table 1. Age at delivery and race and ethnicity stratifications accounting for potential effect modification are shown in Tables 3-6.

Table 1: Sample demographics pre-pandemic and during-pandemic

Variables	Pre-Pandemic (Oct 2019 – Mar 2020) (n = 152,832)	During-Pandemic (Apr 2020 – Sep 2020) (n = 151,191)
Age at Delivery (years), mean (SD)	28.2 (5.28)	28.5 (5.23)
Age at Delivery, n (%)		
<20	5,775 (3.78)	4,848 (3.21)
20-24	36,323 (23.77)	33,658 (22.26)
25-29	48,026 (31.42)	47,258 (31.26)
30-34	43,682 (28.58)	45, 687 (30.22)
35-39	15,474 (10.78)	17,152 (11.34)
40-44	2,552 (1.67)	2,588 (1.71)
Race, n (%)		
white (non-Hispanic)	16,571 (71.04)	15,906 (71.63)
Black (non-Hispanic)	1,584 (6.79)	1,467 (6.61)
Asian American/Pacific Islander	415 (1.78)	372 (1.68)
Hispanic/Latinx	1,782 (7.64)	1,704 (7.67)

Multi-racial	2,973 (12.75)	2,756 (12.41)
Annual Household Income, n (%)		
<$25,000	5,370 (15.87)	4,655 (14.49)
$25,000 - $50,000	8,047 (23.78)	7,436 (23.15)
$50,000 - $75,000	6,311 (18.65)	6,181 (19.24)
$75,000 - $100,000	6,034 (17.83)	5,926 (18.45)
>$100,000	8,072 (23.86)	7,925 (24.67)
Completed Education Level, n (%)		
Some High School	917 (2.91)	900 (2.96)
High School Degree/Equivalent	4,123 (13.10)	3,689 (12.13)
Some College	7,711 (24.50)	7,331 (24.10)
College Degree	11,670 (37.08)	11,415 (37.53)
Some Post-Graduate Studies	1,446 (4.59)	1,463 (4.81)
Post-Graduate Degree	5,604 (17.81)	5,617 (18.47)
Employment Status, n (%)		
Employed	65,619 (73.53)	65,801 (74.67)
Not employed	23,619 (26.47)	22,320 (25.33)

Preterm Delivery

A total of 272,686 (89.69%) users in the sample had valid gestational ages at delivery based on LMP. Overall preterm delivery rates had a relative decrease of 5.67%, from 8.46% in the pre-pandemic cohort to 7.98% in the during-pandemic cohort (P<.001; OR = 0.94, 95% CI 0.91-0.96) (Table 2). When compared to the reference period of October 2019, the overall greatest relative decrease in preterm deliveries was in September 2020 (Figure 1). Those aged 25-29 had the greatest relative decrease in preterm delivery rates at 9.70%, from 8.36% in the pre-pandemic cohort to 7.55% in the during-pandemic cohort (P<.001; OR = 0.90, 95% CI 0.85-0.94), followed by those aged 30-34, who had a 7.24% relative decrease, from 8.10% to 7.52% (P=.002; OR = 0.92, 95% CI 0.87-0.97) (Table 3). Compared to other races and ethnicities, white non-Hispanic users had the greatest relative decrease in preterm deliveries at 6.28%, from 7.74% pre-pandemic to 7.25% during-pandemic (P<.001; OR = 0.85, 95% CI 0.78-0.94) (Table 5).

Cesarean Sections

Among the total sample, 303,882 (99.9%) users completed the delivery method field of the app birth report form. Overall Cesarean section rates did not significantly change in the during-pandemic cohort compared to the pre-pandemic cohort (Table 2), however, there was a 11.68% relative increase in Cesareans in users under 20, from 19.13% pre-pandemic to 21.37% during-pandemic (P=.004; OR = 1.15, 95% CI 1.04 – 1.26). Conversely, those aged 30-34 had a 2.11% relative decrease, from 33.39% pre-pandemic to 32.68% during-pandemic (P=.025; OR = 0.96, 95% CI 0.94 – 0.99) (Table 3). Compared to other races and ethnicities, Black non-Hispanic users had the greatest difference in Cesarean rates with a 10.22% relative increase, from 36.48% (pre-pandemic) to 40.21% (during-pandemic) (P=.03; OR = 1.17, 95% CI 1.01 – 1.35) (Table 5).

Out-of-Hospital Births

Among the sample, 295,791 (97.29%) users provided their birth facility type in the app. Total out-of-hospital birth rates increased by 9.47%, from 4.12% pre-pandemic to 4.51% during-pandemic (P<.001; OR=1.1, 95% CI 1.06-1.14). When assessing home birth rates alone, there was a 30.00% relative increase in rates during-pandemic compared to pre-pandemic (P<.001; OR = 1.3, 95% CI 1.23-1.40) (Table 2). The overall relative increase in home birth rates peaked in May 2020 and remained consistently high through the end of the study period (Figure 1). Users aged 35-39 had the greatest change in home birth rates at 37.18%, increasing to 1.60% during-pandemic from 1.17% pre-pandemic

(Table 3). There were no statistically significant differences when stratifying by race and ethnicity (Table 5).

Hospital Length of Stay (LOS)

A total of 122,613 (40.33%) users who delivered in a hospital provided their admittance and discharge dates in the app. Average hospital LOS decreased by 7.81% in the during-pandemic cohort (mean 2.48 days (SD 1.35)) as compared to the pre-pandemic cohort (mean 2.69 (SD 1.39)) (Table 2). The largest overall decrease in hospital LOS was in April, compared to the reference period of October 2019 (Figure 1). Results were similar when stratified by birth method; for C-sections, mean hospital LOS decreased by 8.38% (mean 3.17 days (SD 1.59)), and for vaginal deliveries, mean LOS decreased by 7.44% (mean 2.24 days (SD 1.16))(Table 2). Users aged 40-44 had the greatest decrease in mean hospital LOS, both overall and for Cesarean deliveries, at 10.06% (mean 2.77 (SD 1.65)) and 14.84% (mean 3.27 (SD1.78)) respectively. Among vaginal deliveries, women aged 30-34 had the greatest decrease in LOS at 7.92% (mean 2.21 SD(1.13)) (Table 4). Hospital LOS decreases persisted across race and ethnicity groups. For all deliveries, multi-racial users had the greatest decrease in LOS at 11.41%, (mean 2.33 days (SD 1.24)). For Cesarean sections, Asian American/Pacific Islander users had a 9.8% decrease in LOS (mean 3.13 days (SD 1.52)). For Vaginal and VBAC births, Hispanic and Latinx users had the greatest decrease in LOS at 7.92%, (mean 2.21 days (SD 1.13)) (Table 6).

Table 2: Comparison of birth outcomes pre-pandemic and during-pandemic

	Value		Relative Change	P	Odds Ratio (95% CI)
	Pre-Pandemic	During-Pandemic			
Reported Births, n (%)	152,832 (50.26)	151,191 (49.73)	-1.05%		
Gestational Age at Delivery, n (%)					
Fullterm Births	121,113 (91.54)	129,165 (92.01)	0.51%	<.001*	0.94 (0.91 – 0.96)
Preterm Births (<37 Weeks)	11,192 (8.46)	11,216 (7.98)	-5.67%	<.001*	0.94 (0.91 – 0.96)
Delivery Method, n (%)			-0.04%		
Vaginal	103,808 (67.98)	102,717 (67.95)	-0.16%	0.79	1 (0.98 – 1.01)
C-Section	46,923 (30.73)	46,381 (30.68)	5.38%	0.79	0.99 (0.98 – 1.01)
VBAC	1,981 (1.30)	2,072 (1.37)		0.29	0.96 (0.91 – 1.02)
Delivery Facility Type, n (%)					
Hospital	141,267 (91.76)	141,173 (90.97)	-0.86%	<.001*	0.90 (0.87 - 0.93)
Birthing Center	4,812 (3.13)	4,985 (3.21)	2.56%	0.11	1 (99.2 – 1.07)
Home	1,535 (1.00)	2,019 (1.30)	30.00%	<.001*	1.3 (1.23 – 1.4)
Total Out-of-Hospital (Birthing Center + Home)	6,347 (4.12)	7,004 (4.51)	9.47%	<.001*	1.1 (1.06 – 1.14)
Hospital Stay Length in Days, mean (SD)					

All Deliveries	2.69 (1.39)	2.48 (1.35)	-7.81%	<.001*	
Vaginal + VBAC	2.42 (1.19)	2.24 (1.16)	-7.44%	<.001*	
C-Section	3.46 (1.62)	3.17 (1.59)	-8.38%	<.001*	
* = 5% statistical significance cutoff					

Table 3: Comparison of birth outcomes pre-pandemic and during-pandemic, by age group at delivery

	Pre-Pandemic		**During-Pandemic**		**Relative Change**	**P**	**OR, 95% CI**
Age Group, n (%)	**Preterm**	**Fullterm**	**Preterm**	**Fullterm**	**Preterm**		
<20	474 (9.25)	4648 (90.75)	411 (9.27)	4022 (90.73)	0.19%	1	1 (0.87 - 1.15)
20-24	2587 (8.15)	29153 (91.85)	2572 (8.36)	28190 (91.64)	2.58%	.35	1.02 (0.97 - 1.08)
25-29	3422 (8.36)	37498 (91.64)	3286 (7.55)	40231 (92.45)	-9.70%	<.001*	0.90 (0.85 - 0.94)
30-34	3036 (8.10)	34427 (91.90)	3223 (7.52)	39653 (92.48)	-7.24%	.002*	0.92 (0.87 - 0.97)
35-39	1363 (9.29)	13307 (90.71)	1424 (8.74)	14873 (91.26)	-5.95%	.09	0.93 (0.86 - 1.01)
40-44	310 (12.97)	2080 (87.03)	300 (12.02)	2196 (87.98)	-7.34%	.34	0.91 (0.77 - 1.09)
Delivery Method							
Age Group, n (%)	**Cesarean section**	**Vaginal/VBAC**	**Cesarean section**	**Vaginal/VBAC**	**Cesarean section**		
<20	1105 (19.13)	4670 (80.87)	1036 (21.37)	3812 (78.63)	11.68%	.004*	1.15 (1.04 - 1.26)
20-24	9124 (25.13)	27187 (74.87)	8598 (25.55)	25059 (74.45)	1.67%	.20	1.02 (0.98 - 1.06)
25-29	14103 (29.38)	33903 (70.62)	13664 (28.92)	33589 (71.08)	-1.57%	.12	0.97 (0.95 - 1.00)
30-34	14563 (33.39)	29052 (66.61)	14930 (32.68)	30749 (67.32)	-2.11%	.025*	0.96 (0.94 - 0.99)
35-39	6774 (41.16)	9684 (58.84)	6899 (40.24)	10247 (59.76)	-2.24%	.08	0.96 (0.92 - 1.00)
40-44	1254 (49.23)	1293 (50.77)	1254 (48.47)	1333 (51.53)	-1.55%	.60	0.97 (0.86 - 1.08)
Delivery Location							
Age Group, n (%)	**Home Birth**	**Other**	**Home Birth**	**Other**	**Home Birth**		
<20	33 (0.58)	5621 (99.42)	31 (0.65)	4756 (99.35)	10.95%	.77	1.11 (0.67 -

							1.82)
20-24	291 (0.83)	34892 (99.17)	338 (1.02)	32653 (98.98)	23.87%	.007*	1.24 (1.06 - 1.45)
25-29	509 (1.10)	45885 (98.90)	669 (1.45)	45587 (98.55)	31.83%	<.001*	1.32 (1.18 - 1.49)
30-34	486 (1.16)	41508 (98.84)	672 (1.50)	44087 (98.50)	29.73%	<.001*	1.30 (1.16 - 1.46)
35-39	186 (1.17)	15731 (98.83)	270 (1.60)	16573 (98.40)	37.18%	<.001*	1.37 (1.14 - 1.66)
40-44	30 (1.21)	2442 (98.79)	39 (1.53)	2502 (98.47)	26.47%	.39	1.26 (0.78 - 2.06)
* = 5% statistical significance cutoff							

Table 4: Comparison of hospital length-of-stay in days after delivery pre-pandemic and during-pandemic, by age group at delivery

	Pre-Pandemic	During-Pandemic	Relative Change	P
Age Group, mean (SD)	**All Deliveries**			
<20	2.73 (1.32)	2.56 (1.24)	-6.23%	<.001*
20-24	2.65 (1.33)	2.48(1.33)	-6.42%	<.001*
25-29	2.66 (1.4)	2.66 (1.32)	0.38%	<.001*
30-34	2.7 (1.41)	2.48 (1.36)	-6.77%	<.001*
35-39	2.84 (1.51)	2.58 (1.43)	-9.15%	<.001*
40-44	3.08 (1.62)	2.77 (1.65)	-10.06%	<.001*
Age Group, mean (SD)	**Cesarean Sections**			
<20	3.47 (1.52)	3.3 (1.42)	-4.90%	.05
20-24	3.42 (1.57)	3.19 (1.62)	-6.73%	<.001*
25-29	3.47 (1.67)	3.13 (1.52)	-9.80%	<.001*
30-34	3.44 (1.59)	3.18 (1.63)	-7.56%	<.001*
35-39	3.52 (1.60)	3.19 (1.58)	-9.38%	<.001*
40-44	3.84 (1.83)	3.27 (1.78)	-14.84%	<.001*
Age Group, mean (SD)	**Vaginal and VBAC**			
<20	2.57 (1.22)	2.38 (1.13)	-7.39%	<.001*
20-24	2.44 (1.16)	2.28 (1.16)	-6.56%	<.001*
25-29	2.38 (1.18)	2.21 (1.15)	-7.14%	<.001*
30-34	2.40 (1.20)	2.21 (1.13)	-7.92%	<.001*
35-39	2.46 (1.32)	2.27 (1.23)	-7.72%	<.001*
40-44	2.50 (1.15)	2.41 (1.44)	-3.60%	0.26
* = 5% statistical significance cutoff				

Table 5: Comparison of birth outcomes pre-pandemic and during-pandemic, by race and ethnicity

Hospital Length of Stay

	Pre-Pandemic	During-Pandemic	Relative Change	p-value
Age Group, mean (SD)		**All Deliveries**		
White (non-Hispanic)	2.58 (1.36)	2.32 (1.24)	-10.47%	<.001*
Black (non-Hispanic)	2.84 (1.45)	2.57 (1.43)	-9.51%	<.001*
Asian American/Pacific Islander	2.74 (1.57)	2.46 (1.15)	-10.22%	<.001*
Hispanic/Latinx	2.44 (1.21)	2.33 (1.29)	-4.51%	0.07
Multi-racial	2.63 (1.41)	2.33 (1.24)	-11.41%	<.001*
Age Group, mean (SD)		**Cesarean Sections**		
White (non-Hispanic)	3.47 (1.52)	3.3 (1.42)	-4.90%	.05
Black (non-Hispanic)	3.42 (1.57)	3.19 (1.62)	-6.73%	<.001*
Asian American/Pacific Islander	3.47 (1.67)	3.13 (1.52)	-9.80%	<.001*
Hispanic/Latinx	3.44 (1.59)	3.18 (1.63)	-7.56%	<.001*
Multi-racial	3.52 (1.6)	3.19 (1.58)	-9.38%	<.001*
Age Group, mean (SD)		**Vaginal and VBAC**		
White (non-Hispanic)	2.57 (1.22)	2.38 (1.13)	-7.39%	<.001*
Black (non-Hispanic)	2.44 (1.16)	2.28 (1.16)	-6.56%	<.001*
Asian American/Pacific Islander	2.38 (1.18)	2.21 (1.15)	-7.14%	<.001*
Hispanic/Latinx	2.4 (1.2)	2.21 (1.13)	-7.92%	<.001*
Multi-racial	2.46 (1.32)	2.27 (1.23)	-7.72%	<.001*
* = 5% statistical significance cutoff				

Table 6: Comparison of hospital length-of-stay (in days) after delivery pre-pandemic and during-pandemic, by race and ethnicity

	Pre-Pandemic	During-Pandemic	Relative Change	P
Race/Ethnicity, mean (SD)		**All Deliveries**		
White (non-Hispanic)	2.58 (1.36)	2.32 (1.24)	-10.47%	<.001*
Black (non-Hispanic)	2.84 (1.45)	2.57 (1.43)	-9.51%	<.001*
Asian American/Pacific Islander	2.74 (1.57)	2.46 (1.15)	-10.22%	<.001*
Hispanic/Latinx	2.44 (1.21)	2.33 (1.29)	-4.51%	0.07
Multi-racial	2.63 (1.41)	2.33 (1.24)	-11.41%	<.001*
Race/Ethnicity, mean (SD)		**Cesarean Sections**		
White (non-Hispanic)	3.47 (1.52)	3.3 (1.42)	-4.90%	.05
Black (non-Hispanic)	3.42 (1.57)	3.19 (1.62)	-6.73%	<.001*
Asian American/Pacific Islander	3.47 (1.67)	3.13 (1.52)	-9.80%	<.001*
Hispanic/Latinx	3.44 (1.59)	3.18 (1.63)	-7.56%	<.001*
Multi-racial	3.52 (1.6)	3.19 (1.58)	-9.38%	<.001*
Race/Ethnicity, mean (SD)		**Vaginal and VBAC**		
White (non-Hispanic)	2.57 (1.22)	2.38 (1.13)	-7.39%	<.001*
Black (non-Hispanic)	2.44 (1.16)	2.28 (1.16)	-6.56%	<.001*

Asian American/Pacific Islander	2.38 (1.18)	2.21 (1.15)	-7.14%	<.001*
Hispanic/Latinx	2.4 (1.2)	2.21 (1.13)	-7.92%	<.001*
Multi-racial	2.46 (1.32)	2.27 (1.23)	-7.72%	<.001*
* = 5% statistical significance cutoff				

Discussion

Principal findings

This paper describes key birth outcomes during the COVID-19 pandemic. Our results indicate a decline in preterm births, a contrast to recent trends in the United States reflecting data from non-pandemic years[9, 10]. These results were most prominent among those aged 25-29 and 30-34, and among white users. The overall declines align with other reports indicating COVID-19-related decreases in preterm deliveries, many of which have suggested several plausible reasons for the decline, including less exposure to infection and other consequences of physical distancing, mask wearing, increased attention to health and exercise, and possible reduction in antenatal surveillance that might lead to medical interventions and early delivery[5,6]. As these studies also suggest, more in-depth research is needed to test the plausibility of any one hypothesis.

Overall results indicated no change in Cesarean section rates between the two cohorts, but age-specific results showed increases in Cesarean section rates among those under 20 and decreases in those aged 30-34. When comparing race and ethnicity, Black non-Hispanic users had a significant increase in Cesareans compared to all other race groups. Special attention and further research should be conducted to address age-specific differences, as well as social determinants of health that disproportionately affect Black pregnant women, particularly during the COVID-19 pandemic.

We also find a significant increase in home births in just six months, compared to national reports indicating no change in home birth rates between 2018 and 2019[9]. This change was especially apparent in users aged 35-39. It is important that providers be diligent in informing patients and providing appropriate resources about home birth risks, as planned home births are associated with poorer outcomes for most of the population, as compared to hospital births[11].

Our study also shows a decreased average length of stay after delivery among those who delivered in a hospital, particularly among those aged 40-44 and those who are multi-racial. Reduced hospital LOS has both positive and negative implications: decreased hospital stay length could lead to increased readmission rates and costs, and poorer postpartum and neonatal outcomes[12]. Conversely, early discharge may reduce SARS-CoV-2 exposure with limited adverse consequences in low-risk patients[7].

Limitations

Our study is limited in that those who choose to report the details of their deliveries in an app may differ from those who do not. We are also reliant on user-reported data, which we recognize can present additional biases. Relatedly, while we do present some demographic data in this paper, we are largely restrained by demographic data completeness for this population, as most demographic fields in the Ovia Pregnancy app are not required or collected in the sign-up process. As such, sample sizes were limited when performing stratified analyses, and in-app questions, such as household income, education level, and employment status may have been completed and unchanged outside of the study time period.

We also know that SARS-CoV-2 (COVID-19) infection may play a significant role in the birth outcomes described here[13], and we are limited in that the Ovia Pregnancy app does not collect specific COVID-19 infection data.

Conclusions

As the pandemic progresses, continuous monitoring of these trends and others is necessary to evaluate long-term effects on birth outcomes. The use of digital data collection is paramount to monitoring these trends in real time, particularly during a time when access to care has increased limitations.

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Conflicts of Interest

None declared.

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Supplementary Files

Figures

Relative change in reported birth outcomes by month, compared to reference period (October 2019).