SARS-CoV-2 infections among neonates born to pregnant people with SARS-CoV-2 infection: Maternal, pregnancy and birth characteristics

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Abstract
Background: Multiple reports have described neonatal SARS-CoV-2 infection, including likely in utero transmission and early postnatal infection, but published estimates of neonatal infection range by geography and design type.
INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection can lead to serious coronavirus disease 2019 (COVID-19) in pregnant people, is associated with preterm birth and poses a potential risk of transmission to the neonate.\textsuperscript{1-3} Reports have described perinatal infection, including likely in utero transmission and early postnatal infection.\textsuperscript{3,4} The American Academy of Pediatrics (AAP) and the Centers for Disease Control and Prevention (CDC) recommend all neonates born to pregnant people with suspected or confirmed COVID-19 be tested for SARS-CoV-2 by real-time reverse transcription polymerase chain reaction (RT-PCR).\textsuperscript{5,6} Factors associated with infection among exposed neonates are unclear. We describe maternal, pregnancy and neonatal characteristics among a surveillance cohort of neonates born to people with SARS-CoV-2 infection during pregnancy and assess characteristics by reported neonatal SARS-CoV-2 RT-PCR testing.

OBJECTIVES: To describe maternal, pregnancy and neonatal characteristics among neonates born to people with SARS-CoV-2 infection during pregnancy by neonatal SARS-CoV-2 testing results.

METHODS: Using aggregated data from the Surveillance for Emerging Threats to Mothers and Babies Network (SET-NET) describing infections from 20 January 2020 to 31 December 2020, we identified neonates who were (1) born to people who were SARS-CoV-2 positive by RT-PCR at any time during their pregnancy, and (2) tested for SARS-CoV-2 by RT-PCR during the birth hospitalisation.

RESULTS: Among 28,771 neonates born to people with SARS-CoV-2 infection during pregnancy, 3816 (13%) underwent PCR testing and 138 neonates (3.6%) were PCR positive. Ninety-four per cent of neonates testing positive were born to people with infection identified ≤14 days of delivery. Neonatal SARS-CoV-2 infection was more frequent among neonates born preterm (5.7%) compared to term (3.4%). Neonates testing positive were born to both symptomatic and asymptomatic pregnant people.

CONCLUSIONS: Jurisdictions reported SARS-CoV-2 RT-PCR results for only 13% of neonates known to be born to people with SARS-CoV-2 infection during pregnancy. These results provide evidence of neonatal infection identified through multi-state systematic surveillance data collection and describe characteristics of neonates with SARS-CoV-2 infection. While perinatal SARS-CoV-2 infection was uncommon among tested neonates born to people with SARS-CoV-2 infection during pregnancy, nearly all cases of tested neonatal infection occurred in pregnant people infected around the time of delivery and was more frequent among neonates born preterm. These findings support the recommendation for neonatal SARS-CoV-2 RT-PCR testing, especially for people with acute infection around the time of delivery.

KEYWORDS
pregnancy, COVID-19, SARS-CoV-2, perinatal infection

1 | METHODS

2.1 | Cohort selection

Pregnant people with laboratory-confirmed SARS-CoV-2 infection from 20 January to 31 December 2020 were retrospectively ascertained through reporting of pregnancy in COVID-19 surveillance and cross-matching COVID-19 surveillance data with local data systems to assess pregnancy status. The data are enhanced through supplemental data sources at the jurisdiction level such as vital statistics, administrative data sets, electronic laboratory reporting and maternal and neonatal medical record review and submitted to the Surveillance for Emerging Threats to Mothers and Babies Network (SET-NET).\textsuperscript{7} SET-NET data contain maternal characteristics including demographics, prenatal history and SARS-CoV-2 infection (e.g. timing of infection and severity) as well as neonatal characteristics (e.g. gestational age and SARS-CoV-2 testing). This activity was reviewed by CDC and conducted consistent with applicable federal law and policy.\textsuperscript{8}
2.2 | Exposure

Using aggregated SET-NET data compiled through 5 November 2021, we identified neonates who were (1) born to people who were SARS-CoV-2 RT-PCR positive in pregnancy, and (2) tested for SARS-CoV-2 by RT-PCR during the birth hospitalisation. For neonates with extended hospitalisation (>14 days) or whose date of discharge was unknown, only SARS-CoV-2 tests conducted ≤14 days following birth were included to focus on perinatal infections.

2.3 | Statistical analysis

We described neonates by SARS-CoV-2 testing result. We focused on SARS-CoV-2-positive neonates and described maternal characteristics including demographics, COVID-19 disease severity, and timing of prenatal infection relative to delivery (determined by date of first positive SARS-CoV-2 or symptom onset if testing date was missing), pregnancy complications (e.g. preeclampsia), gestational age and birthweight. We also described these characteristics among neonates who were tested by SARS-CoV-2 RT-PCR following birth but who tested negative. Because negative results are not reported consistently to all jurisdictions, the group of test-negative neonates may not represent all neonates testing negative. Therefore, we did not perform statistical comparisons between neonates testing positive and negative for SARS-CoV-2. We compared testing status by maternal, birth and neonatal characteristics, including prevalence ratios for neonatal testing adjusted for jurisdiction and days from positive to delivery (Table 2).

3 | RESULTS

Twenty jurisdictions with neonatal testing data available reported 28,771 live-born neonates born to 25,487 pregnant people with SARS-CoV-2 infection (Figure 1). Of neonates, 24,955 (86.7%) had no SARS-CoV-2 testing data available, 26 (0.1%) were tested but had indeterminate or unknown results reported and 3790 (13.2%) had positive or negative SARS-CoV-2 RT-PCR results reported. The proportion known to be tested increased with trimester of infection, with testing performed for 1.4%, 2.9% and 24.1% of neonates born to people with first, second and third trimester infection respectively. The median time from maternal infection to delivery was 75 days (IQR: 20-143) among neonates not known to be tested and 1 day (IQR: 0–9) among those tested.

Of the 3790 neonates with test results, 3226 had only negative RT-PCR results reported and 138 (3.6%) had at least one positive RT-PCR result, representing 0.5% [138/28,771] of live births. Of these 138 neonates, 91 (65.6%) had only positive results and 46 (33.3%) had both positive and negative results (Figure S1).

Synopsis

Study question

What are maternal, pregnancy and neonatal characteristics among neonates born to people with SARS-CoV-2 infection during pregnancy, by neonate SARS-CoV-2 testing results at birth?

What’s already known?

Multiple reports have described perinatal SARS-CoV-2 infection, including likely in utero transmission and early postnatal infection. Published estimates of perinatal positivity in neonates range from 0.9% to 2.2% depending on location and methodology.

What this study adds?

This study provides a description of SARS-CoV-2 testing patterns among neonates and evidence of neonatal infection identified through multi-state systematic surveillance. Thirteen per cent of the 28,771 live-born neonates of pregnant people with SARS-CoV-2 infection had reported PCR testing and results; 138 (3.6%) were PCR positive. Nearly all positive neonates were born to people with infection <14 days before delivery.

Maternal characteristics are summarised in Table 1. Of SARS-CoV-2 positive neonates with date of maternal infection reported (n = 136), 94.1% were born to people with initial positive testing or symptom onset occurring ≤14 days before delivery and eight neonates were born to people with initial positive SARS-CoV-2 testing >14 days before delivery. Four of these persons remained SARS-CoV-2 positive within 2 days prior to delivery. Per cent positivity among neonates tested for SARS-CoV-2 was 1.1%, 2.5%, 4.1% and 4.6% for those born to people with infection diagnosed >14, 7–14, 3–6 and 0–2 days before delivery respectively. Of neonates testing positive and whose maternal disease severity was known, 47.8% were born to people reported as asymptomatic at COVID-19 diagnosis. Compared to neonates with no testing data reported, tested neonates were more likely to be born to people who were of non-White non-Hispanic race/ethnicity, with third trimester infection, infection ≤14 days before delivery, asymptomatic COVID-19 disease and caesarean delivery (Table 2). Compared to those without testing data, tested neonates were more likely to be born preterm or low birthweight, or have a neonatal intensive care unit admission.

Among the 138 neonates testing positive for SARS-CoV-2, 52.6% were female, 5.3% were small for gestational age (<10th percentile by INTERGROWTH-21st) and 23.9% were born preterm (i.e. <37 weeks gestation), including 5.8% born moderate-to-extremely
preterm (<34 weeks). Among neonates known to be tested, SARS-CoV-2 per cent positivity was 3.4% among neonates born at ≥37 weeks and 5.7% among neonates born preterm. Timing of first positive RT-PCR testing was available for 137 of the neonates with SARS-CoV-2 infection: six neonates were first tested on the day of birth, 80 on the second day of life (DOL) and 36 on the third DOL (Table 1, Figure S1). Timing of testing was similar for neonates testing negative for SARS-CoV-2.

3.1 | Comment

3.1.1 | Principal findings

Jurisdictions reported SARS-CoV-2 RT-PCR results for only 13.3% of neonates known to be born to people with SARS-CoV-2 infection during pregnancy. Neonates born to people with infection closer to delivery, with third trimester infection and with preterm delivery were more likely to have reported testing. Although the data are descriptive, these results provide evidence of neonatal infection identified through multi-state systematic surveillance data collection. Among neonates born to people with COVID-19 during pregnancy and known to be tested for SARS-CoV-2, neonatal infection was uncommon, occurring in 3.6%. However, we suspect this overestimates true per cent positivity because negative results are less frequently reported to health departments; the true percentage likely lies between 3.6% and 0.5% (the total neonates testing PCR positive among all live births), which is consistent with other studies.\(^\text{10,11}\) Neonatal infection was more frequent among tested neonates born to people diagnosed with COVID-19 close to delivery (<7 days) and among preterm neonates. Neonatal positivity occurred regardless of maternal symptom status.

3.1.2 | Strengths of the study

SET-NET is a large, geographically diverse cohort of pregnant people with laboratory-confirmed SARS-CoV-2 infections. The linked longitudinal surveillance allows for ascertainment of infection during pregnancy and follow-up to the birth hospitalisation using existing data sources including laboratory reporting.
Table 1: Maternal demographics, maternal disease characteristics and neonatal characteristics among neonates with reported perinatal SARS-CoV-2 real-time polymerase chain reaction (RT-PCR) test results – SET-NET, 20 jurisdictions, 29 March 2020 – 31 December, 2020 and reported by 5 November 2021

TABLE 1 (Continued)

| Maternal demographics, maternal disease characteristics and neonatal characteristics | TABLE 1 (Continued) |
|--------------------------------------|---------------------|
| Neatonic RT-PCR test results (N = 3790) | Neonate RT-PCR test results (N = 3790) |
| **Maternal demographics** | **Per cent positivity** |
| Positive | Negative | Per cent positivity |
|-----------|----------|---------------------|
| n (%) | 138 (3.6%) | 3652 (96.4%) | 3.6% |
| Maternal characteristics | | | |
| Age in years | N = 133 | N = 3620 |
| Median (IQR) | 29.3 | 29.0 | (24.9–34.6) | (24.7–33.8) |
| <25 | 36 (27.1%) | 957 (26.4%) | 3.6% |
| 25–34 | 65 (48.9%) | 1971 (54.4%) | 3.2% |
| ≥35 | 32 (24.1%) | 692 (19.1%) | 4.4% |
| Not reported, n (%) | 5 (3.6%) | 32 (0.9%) |
| Race/ethnicity | N = 122 | N = 3497 |
| Hispanic | 64 (52.5%) | 1703 (48.7%) | 3.6% |
| Black, non-Hispanic | 18 (14.8%) | 566 (16.2%) | 3.1% |
| White, non-Hispanic | 34 (27.9%) | 944 (27.0%) | 3.5% |
| Multiple or other race, non-Hispanic | 6 (4.9%) | 284 (8.1%) | 2.1% |
| Not reported, n (%) | 16 (11.6%) | 155 (4.2%) | 9.4% |
| Underlying conditions | | | |
| Any underlying condition(s) | N = 124 | N = 3319 |
| One or more | 59 (47.6%) | 1554 (46.8%) | 3.7% |
| None reported | 65 (52.4%) | 1765 (53.2%) | 3.6% |
| Missing, n (%) | 14 (10.1%) | 333 (9.1%) | 4.0% |
| Hypertensive disorders of pregnancy | N = 96 | N = 2721 |
| Yes | 16 (16.7%) | 361 (13.3%) | 4.2% |
| No | 80 (83.3%) | 2360 (86.7%) | 3.3% |
| Not reported, n (%) | 38 (28.4%) | 605 (18.2%) | 5.9% |
| Trimester of infection | N = 137 | N = 3635 |
| First | 1 (0.7%) | 73 (2.0%) | – |
| Second | 2 (1.5%) | 236 (6.5%) | – |
| Third | 134 (97.8%) | 3326 (91.5%) | 3.9% |
| Not reported, n (%) | 1 (0.7%) | 17 (0.5%) | – |
| Timing of pregnant person’s first positive RT-PCR test (days prior to delivery) | N = 136 | N = 3620 |
| Median (IQR) | 1 (0–1) | 1 (0–10) |
| >14 | 8 (5.9%) | 751 (20.7%) | 1.1% |
| 7–14 | 9 (6.6%) | 344 (9.5%) | 2.5% |
| 3–6 | 19 (14.0%) | 441 (12.2%) | 4.1% |
| Maternal disease severity | | | |
| Asymptomatic | 43 (47.8%) | 882 (42.2%) | 4.6% |
| Mild | 29 (32.2%) | 788 (37.7%) | 3.5% |
| Moderate/severe | 10 (11.1%) | 307 (14.7%) | 3.2% |
| Critical | 8 (8.9%) | 114 (5.5%) | 6.6% |
| Not enough information, n (%) | 48 (34.8%) | 1561 (42.7%) | 3.0% |
| Delivery type | N = 134 | N = 3375 |
| Vaginal | 74 (55.2%) | 2141 (63.4%) | 3.3% |
| Caesarean | 60 (44.8%) | 1234 (36.6%) | 4.6% |
| Not reported, n (%) | 4 (2.9%) | 277 (7.6%) | – |
| Infant characteristics | | | |
| Gestational age at birth | N = 138 | N = 3537 |
| Median weeks (IQR) | 38.8 | 39.0 | (37.1–39.6) | (37.6–39.9) |
| Term (≥37 weeks) | 105 (76.1%) | 2995 (84.7%) | 3.4% |
| Preterm (<37 weeks) | 33 (23.9%) | 542 (15.3%) | 5.7% |
| Late preterm (34–36 weeks) | 24 (17.4%) | 386 (10.9%) | 5.9% |
| Moderate-to-extremely preterm (<34 weeks) | 9 (5.8%) | 156 (3.8%) | 5.5% |
| Neonate Sex | N = 137 | N = 3648 |
| Female | 72 (52.6%) | 1790 (49.1%) | 3.9% |
| Male | 65 (47.4%) | 1858 (50.9%) | 3.4% |
| Not reported, n (%) | 1 (0.7%) | 4 (0.1%) | – |
| Weight in grams at birth | N = 132 | N = 3183 |
| Low birthweight (<2500 g) | 18 (13.6%) | 357 (11.2%) | 4.8% |
| Normal birthweight (≥2500 g) | 114 (84%) | 2826 (88.8%) | 3.9% |
| Small for gestational age | N = 132 | N = 3164 |
| Yes | 7 (5.3%) | 205 (6.5%) | 3.3% |
| No | 125 (94.7%) | 2959 (93.5%) | 4.1% |
| Not reported, n (%) | 6 (4.3%) | 488 (13.4%) | 1.2% |
TABLE 1 (Continued)

| Neonate RT-PCR test results (N = 3790)† | Per cent positivity |
|----------------------------------------|---------------------|
| Positivec | Negativedi |
| Neonatal intensive care unit admission | N = 115 | N = 2867 |
| Admitted during birth hospitalisation | 42 (36.5%) | 662 (23.1%) | 6.0% |
| Not admitted to ICU | 73 (63.5%) | 2205 (76.9%) | 3.2% |
| Not reported, n (%) | 23 (16.7%) | 785 (21.5%) | 2.8% |
| Day of first RT-PCR test following birth†, in days of life | |
| 1 | 6 (4.4%) | 227 (6.3%) | 2.6% |
| 2 | 80 (58.4%) | 2644 (73.1%) | 2.9% |
| 3 | 36 (26.3%) | 551 (15.2%) | 6.1% |
| ≥4 | 15 (10.9%) | 194 (5.4%) | 7.2% |

†Including California [excluding Los Angeles County], Georgia, Houston, Kansas, Los Angeles County, Massachusetts, Maryland, Michigan, Minnesota, Missouri, Nebraska, Nevada, New Jersey, New York [excluding New York City], North Dakota, Pennsylvania [excluding Philadelphia], Puerto Rico, Tennessee, Vermont and Washington. Among 28,771 live-born neonates reported to SET-NET, 3790 (13.2%) had a reported SARS-CoV-2 RT-PCR positive or negative test during the birth hospitalisation and within 14 days of delivery. Neonates with at least one positive RT-PCR test during the birth hospitalisation, including neonates with positive and negative RT-PCR test results. Neonates with no positive RT-PCR test and at least one negative RT-PCR test reported. Other race comprises American Indian or Alaska Native, Native Hawaiian or Pacific Islander, and Asian, Non-Hispanic. These were combined because of small cell sizes that yielded unreliable estimates. Includes cardiovascular disease, chronic hypertension, chronic lung disease, diabetes mellitus (type 1 or type 2), immunosuppression and obesity (body mass index ≥30 kg/m²). Inclusive of preeclampsia, eclampsia or HELLP (haemolysis, elevated liver enzymes and low platelet) syndrome. Does not include chronic hypertension. Hypertensive disorders of pregnancy were only considered underlying conditions for women with third trimester infection. Categories of disease severity were based on modified National Institute of Health and World Health Organization criteria as described in Galang et al. Pregnant people were considered asymptomatic if reported as having an absence of symptoms using a symptom status variable rather than sole absence of individual symptoms reported. Criteria were applied to classify severity using submitted data including symptoms, intensive care unit admission, invasive ventilation, use of COVID-19 therapies, complications associated with COVID-19 and death. Defined as weight <10th percentile for sex (presumed female if missing) and gestational age using the INTERGROWTH-21st online percentile calculator http://intergrowth21.ndog.ox.ac.uk. Some gestational ages were reported in completed weeks only (rather than in weeks and days). For infants with a positive SARS-CoV-2 RT-PCR test result, the day of life of the first positive result.

3.1.3 Limitations of the data

Limitations of our analysis include the high per cent of neonates without testing results. Testing practices of pregnant people and neonates likely varied over time, by facility and by maternal or neonatal characteristics (e.g. symptoms and intensive care unit admission). Additionally, we were unable to assess route of transmission (e.g. in utero and peripartum), given lack of immunoglobulin-M serology and RT-PCR testing data on sterile specimens (e.g. blood). Lastly, we could not assess infection prevention and control (IPC) measures implemented.

3.1.4 Interpretation

Identification of perinatal SARS-CoV-2 infection is influenced by testing practices. Although these data do not represent all perinatal testing practices, they suggest RT-PCR SARS-CoV-2 testing of neonates primarily occurred for those born to people with third trimester infection, especially infection ≤14 days before delivery. These testing patterns are consistent with the idea that transmission via respiratory droplets most likely occurs during the individual’s infectious period. Reported testing was also higher among neonates born preterm and neonates with NICU admission. Epidemiologic analyses of neonatal SARS-CoV-2 that rely on laboratory testing results must consider the inherent biases.

Much remains unknown about the mechanisms, frequency and risk factors for transmission of SARS-CoV-2 from a pregnant person to their foetus or neonate. Generally, neonatal positivity was highest among neonates who were most likely to have reported perinatal testing. Nearly all tested neonates born to people with infection occurring >14 days before delivery tested negative. While acknowledging the described biases, our findings that neonates with positive SARS-CoV-2 testing were born to both symptomatic and asymptomatic people support the guidance for neonatal SARS-CoV-2 testing when born to pregnant people with SARS-CoV-2 infection, and counselling for persons who acquire COVID-19 during pregnancy about potential risk to their neonates. Future studies that compare neonates with SARS-CoV-2 infection to a representative sample of neonates without infection are needed to identify risk factors for SARS-CoV-2 infection and other adverse outcomes.

4 Conclusion

Neonatal SARS-CoV-2 testing data are incomplete and may be biased. Neonates born to pregnant people with COVID-19 should be tested for SARS-CoV-2, particularly those born to people with infection identified close to delivery and even if the pregnant individual had asymptomatic infection. Additionally, pregnant people should take measures to prevent infection, including COVID-19 vaccination, to protect themselves and their infants.
| SET-NET data | Fully imputed data | Proportion of neonates with test data reported (%) | Adjusted Prevalence Ratio (95% CI) |
|--------------|--------------------|--------------------------------------------------|-----------------------------------|
| N = 24,955   | N = 24,955         | N = 3816                                         |                                   |

### Maternal characteristics

#### Age in years

- <25: 5959 (24.4%), 995 (26.3%), 14.2, 1.00 (Reference)
- 25–34: 14,357 (58.7%), 2054 (54.4%), 12.4, 0.98 (0.91, 1.05)
- ≥35: 4167 (17.0%), 730 (19.3%), 14.8, 1.00 (0.92, 1.09)
- Not reported: 472 (13.3%), 37

#### Race/ethnicity

- Asian, non-Hispanic: 920 (3.9%), 153 (4.3%), 14.4, 1.30 (1.12, 1.51)
- Black, non-Hispanic: 4162 (17.2%), 585 (15.9%), 12.4, 1.20 (1.08, 1.32)
- Hispanic: 7867 (33.2%), 1784 (49.3%), 18.5, 1.41 (1.30, 1.52)
- White, non-Hispanic: 10,146 (42.1%), 984 (26.7%), 8.8, 1.00 (Reference)
- Multiple or other race, non-Hispanic: 886 (3.7%), 139 (3.8%), 13.6, 1.18 (0.99, 1.4)
- Not reported: 974 (13.3%), 171

#### Underlying conditions

- One or more underlying conditions: 11,580 (46.4%), 1812 (47.9%), 13.65, 1.04 (0.98, 1.10)
- No underlying conditions: 13,375 (53.7%), 2004 (52.1%), 12.92, 1.00 (Reference)

#### Hypertensive disorders of pregnancy

- Yes: 884 (13.3%), 644 (22.2%), 33.8, 1.08 (0.98, 1.20)
- No: 9307 (86.7%), 2459 (77.8%), 21.5, 1.00 (Reference)
- Not reported: 746 (744)

#### Trimester of infection

- First: 5157 (20.6%), 74 (1.8%), 1.3, 1.00 (Reference)
- Second: 8114 (33.5%), 242 (6.4%), 2.8, 2.12 (1.62, 2.76)
- Third: 10,940 (45.9%), 3482 (91.8%), 23.4, 16.61 (13.11, 21.05)
- Not reported: 744 (18)

#### Maternal symptom status

- Asymptomatic: 1674 (16.5%), 927 (34.8%), 24.4, 1.00 (Reference)
- Symptomatic: 11,968 (83.5%), 1625 (65.2%), 10.7, 0.72 (0.66, 0.78)
- Not reported: 11,313 (11,313)

#### Timing of pregnant individual's first positive RT-PCR test (days prior to delivery)

- >14 days: 19,094 (80.1%), 767 (20.3%), 3.7, 1.00 (Reference)
- ≤14 days: 4770 (19.9%), 3015 (79.7%), 37.9, 9.94 (9.19, 10.77)
- Not reported: 1091 (34)

#### Delivery type

- Vaginal: 15,711 (65.9%), 2232 (61.7%), 12.5, 1.00 (Reference)
- Caesarean: 7812 (34.1%), 1303 (38.3%), 14.7, 1.07 (1.00, 1.13)
- Not reported: 1432 (281)
| Infant characteristics | SET-NET data | Fully imputed data | Proportion of neonates with test data reported (%) | Adjusted Prevalence Ratio (95% CI) |
|------------------------|--------------|--------------------|-----------------------------------------------|----------------------------------|
|                        | Neonates with no testing data reported | Neonates with one or more perinatal test result reported | Neonates with no testing data reported (%) | Adjusted Prevalence Ratio (95% CI) |
|                        | N = 24,955  | N = 3816           | N = 24,955                                    | N = 3816 |
| Term (≥37 wks)         | 21,286      | 3126               | 89.5                                          | 12.6   | 1.00 (Reference) |
| Late Preterm (34–36 weeks) | 1744        | 410                | 8.0                                           | 11.4   | 17.9  | 1.15 (1.04, 1.27) |
| Moderately and Extremely preterm (<34 weeks) | 607         | 165                | 2.5                                           | 4.4    | 21.1  | 1.15 (0.94, 1.41) |
| Not reported           | 1318        | 115                |                                               |        |       |
| Neonate sex            |             |                    |                                               |        |       |
| Female                 | 12,236      | 1874               | 49.3                                          | 49.2   | 13.2  | 1.00 (Reference) |
| Male                   | 12,592      | 1937               | 50.7                                          | 50.8   | 13.3  | 0.99 (0.93, 1.05) |
| Not reported           | 127         | 5                  |                                               |        |       |
| Birthweight            |             |                    |                                               |        |       |
| Low birthweight (<2500 g) | 1718        | 375                | 7.7                                           | 11.6   | 18.8  | 1.14 (1.02, 1.27) |
| Normal birthweight     | 21,613      | 2966               | 92.3                                          | 88.4   | 12.8  | 1.00 (Reference) |
| Not reported           | 1624        | 475                |                                               |        |       |
| Small for gestational age | 1201        | 212                | 5.5                                           | 6.8    | 16.0  | 1.06 (0.93, 1.2) |
| Not small for gestational age | 21,701 | 3110               | 94.5                                          | 93.2   | 13.1  | 1.00 (Reference) |
| Not enough information | 2053        | 494                |                                               |        |       |
| Neonatal intensive care unit admission |             |                    |                                               |        |       |
| Admitted during birth hospitalisation | 2165        | 707                | 10.1                                          | 25.5   | 27.9  | 1.55 (1.44, 1.67) |
| Not admitted           | 20,407      | 2301               | 89.9                                          | 74.5   | 11.2  | 1.00 (Reference) |
| Not reported           | 2383        | 808                |                                               |        |       |

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*a* Including California [excluding Los Angeles County], Georgia, Houston, Kansas, Los Angeles County, Massachusetts, Maryland, Michigan, Minnesota, Missouri, Nebraska, Nevada, New Jersey, New York [excluding New York City], North Dakota, Pennsylvania [excluding Philadelphia], Puerto Rico, Tennessee, Vermont and Washington.

*b* Multiple imputation with a fully conditional specification was conducted and analysed for all variables in the table, with 50 imputations.

*c* Values reflect percentages from the fully imputed data set. No missingness is present in the fully imputed data set.

*d* For each characteristic, the adjusted prevalence ratio (aPR) is calculated using a modified Poisson model with robust standard errors to regress the prevalence of having test data reported on the characteristic and adjusted for jurisdiction and days from maternal SARS-CoV-2 infection to delivery (continuous). The aPRs reflect separate models for each characteristic. For example, Tested (0, 1) = \( \beta_{\text{jurisdiction}} + \beta_{\text{days from positive to delivery}} + \beta_{\text{characteristic of interest}} \). Because of sparse data, records from Vermont and North Dakota were excluded from the multivariable models (n = 8).

*e* Includes cardiovascular disease, chronic hypertension, chronic lung disease, diabetes mellitus (type 1 or type 2), immunosuppression and obesity (body mass index ≥30 kg/m²).

*f* Inclusive of preeclampsia, eclampsia or HELLP (haemolysis, elevated liver enzymes and low platelet) syndrome. Does not include chronic hypertension. Hypertensive disorders of pregnancy were only considered as underlying conditions for individuals with third trimester infection.

*g* The multivariable model for trimester of infection was adjusted for reporting jurisdiction only because trimester of infection and days from maternal infection to delivery were too collinear, affecting model convergence and variance estimates.

*h* Defined as weight <10th percentile for sex (presumed female if missing) and gestational age using the INTERGROWTH-21st online percentile calculator [http://intergrowth21.ndog.ox.ac.uk](http://intergrowth21.ndog.ox.ac.uk). Some gestational ages were reported in completed weeks only (rather than in weeks and days).
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CONFLICT OF INTEREST

All authors have no conflicts of interest to disclose.

AUTHOR CONTRIBUTION

All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

DISCLAIMER

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention (CDC). Of note, SET-NET does not collect data on sex or gender of the birthing individual. We use the term ‘maternal’ throughout this publication to describe characteristics of birthing individuals, although they may be of any gender. We continue to work through the challenge of finding the most inclusive language that is clear and scientifically accurate.

DATA AVAILABILITY STATEMENT

The SET-NET data are not available at this time.

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SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher’s website.

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