RESEARCH LETTER

Association of SARS-CoV-2 Test Status and Pregnancy Outcomes

Associations of coronavirus disease 2019 (COVID-19) and pregnancy outcomes remain unclear because most studies are case reports or case series without contemporary comparators.[1]

We compared pregnant persons in labor who were infected with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) compared with those uninfected.

Methods | We identified all persons presenting in labor at Karolinska University Hospital, Stockholm, Sweden, from March 25 to July 24, 2020. From March 25, reverse transcriptase-polymerase chain reaction (RT-PCR) testing of nasopharyngeal swabs was performed on all persons in labor regardless of symptoms. If test results were positive, patients were asked to describe any symptoms, which were documented in the medical record. If a patient tested positive during pregnancy (inpatient visit) but negative when presenting in labor, she was considered exposed (n = 11). During the study period, 3 patients tested positive for antibodies against SARS-CoV-2 during pregnancy and were not tested with RT-PCR; they were considered exposed. Maternal and neonatal data were collected from the Swedish Pregnancy Register[2] and medical records.

Patients testing positive were matched to those testing negative on multiple pregnancies and a propensity score (estimated with logistic regression) including age, parity, early-pregnancy body mass index, educational level, birth country, smoking, living with partner, and prepregnancy comorbidity.

Using generalized estimating equation models with robust sandwich estimators clustered on the matching set

Table. Characteristics of SARS-CoV-2–Positive Pregnant Patients and Matched[a] SARS-CoV-2–Negative Pregnant Patients

	SARS-CoV-2 test status, No. (%)		Standardized difference
	Positive (n = 155)	Matched negative (n = 604)	
Maternal age, mean (SD), y	32.1 (4.9)	32.0 (5.0)	0.012
13-24	12 (7.7)	44 (7.3)	0.012
25-29	39 (25.2)	134 (22.2)	0.050
30-34	55 (35.5)	241 (39.9)	-0.065
≥35	49 (31.6)	185 (30.6)	0.015
Nulliparous	60 (38.7)	247 (40.9)	-0.032
Multiple pregnancies	3 (1.9)	7 (1.2)	0.045
Prepregnancy comorbidity[b]	18 (11.6)	68 (11.3)	0.008
BMI, mean (SD)	26.5 (4.8)	26.5 (5.5)	-0.007
<18.5	1 (0.6)	6 (1.0)	-0.027
18.5-<25	70 (45.2)	276 (45.7)	-0.008
25-<30	43 (27.7)	168 (27.8)	-0.001
≥30	37 (23.9)	142 (23.5)	0.006
Missing	4 (2.6)	12 (2.0)	0.028
Educational level, y			
≤9	30 (19.4)	114 (18.9)	0.009
10-12	48 (31.0)	171 (28.3)	0.041
>12	55 (35.5)	226 (37.4)	-0.028
Missing	22 (14.2)	93 (15.4)	-0.024
Smoking status			
Nonsmoker	147 (94.8)	566 (93.7)	0.034
Smoker	4 (2.6)	22 (3.6)	-0.043
Missing	4 (2.6)	16 (2.6)	-0.003
Country of birth			
Nordic	52 (33.5)	224 (37.1)	-0.052
Europe (non-Nordic)	15 (9.7)	43 (7.1)	0.065
Middle East/Africa	62 (40.0)	228 (37.7)	0.033
Other	12 (7.7)	47 (7.8)	-0.001
Missing	14 (9.0)	62 (10.3)	-0.030
Living with partner	137 (88.4)	541 (89.6)	-0.027

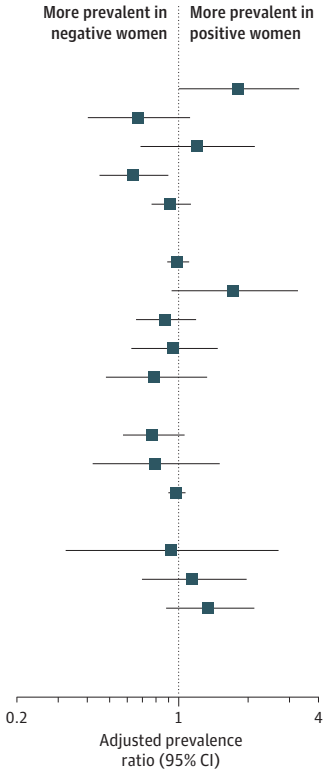
Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.

[a] Direct matching on multiple birth and on a propensity score including maternal age, parity, early-pregnancy BMI, educational level, country of birth, smoking status, living with partner, and prepregnancy comorbidity.

[b] Diabetes, hypertension, cardiovascular disease, kidney disease, or lung disease.

Figure. Maternal Outcomes by SARS-CoV-2 Test Results

	SARS-CoV-2 test status, No. (%) of women		
	Positive women (n = 155)	Negative matched women[a] (n = 604)	Adjusted prevalence ratio (95% CI)[b]
Maternal outcomes			
Preeclampsia	12 (7.7)	26 (4.3)	1.84 (1.00-3.36)
Gestational diabetes	14 (9.0)	79 (13.1)	0.67 (0.40-1.12)
Preterm birth (<37 wk)	14 (9.0)	45 (7.5)	1.21 (0.68-2.15)
Induction of labor	29 (18.7)	179 (29.6)	0.64 (0.45-0.90)
Epidural analgesia[c]	63 (47.0)	267 (51.4)	0.92 (0.76-1.13)
Mode of delivery			
Spontaneous vaginal	107 (69.0)	419 (69.4)	1.00 (0.89-1.11)
Instrumental	12 (9.0)	26 (5.0)	1.76 (0.93-3.32)
Cesarean delivery	36 (23.2)	159 (26.3)	0.88 (0.65-1.19)
Planned	21 (13.5)	85 (14.1)	0.96 (0.62-1.48)
Emergency	15 (9.7)	74 (12.3)	0.79 (0.48-1.33)
Postpartum hemorrhage			
>500 mL[d]	37 (23.9)	188 (31.1)	0.77 (0.57-1.06)
>1000 mL[d]	10 (6.5)	50 (8.3)	0.80 (0.42-1.51)
Breastfeeding at discharge[e]	126 (81.3)	499 (82.6)	0.99 (0.90-1.07)
Infant outcomes			
5-min Apgar score <7[f]	4 (2.5)	17 (2.8)	0.94 (0.32-2.73)
Large for gestational age[g]	16 (10.1)	53 (8.7)	1.16 (0.69-1.98)
Small for gestational age[g]	22 (13.9)	64 (10.5)	1.37 (0.88-2.14)
Major birth defect	2 (1.3)	15 (2.5)	
Stillbirth[h]	1 (0.6)	4 (0.7)	



[a] Direct matching on multiple births and on a propensity score including maternal age, parity, early-pregnancy body mass index, educational level, country of birth, smoking status, living with partner, and prepregnancy comorbidity (yes/no).

[b] Variables in the regression models were age (continuous), body mass index (<30/≥30), country of birth (Nordic/non-Nordic), parity (nulliparous/parous), living with partner (yes/no), and prepregnancy comorbidity.

[c] Analyses performed on all deliveries except elective cesarean.

[d] Data were missing for n = 3 (1.9%) in the group with positive test results and n = 28 (4.6%) in the group with negative ones.

[e] Missing data for n = 21 (13.5%) in the group with positive test results and n = 88 (14.6%) in the group with negative ones.

[f] Missing data for n = 4 (2.5%) in the group with positive test results and n = 20 (3.3%) in the group with negative ones.

[g] Defined as greater than 90th (large) or less than 10th (small) percentile by gestational age and sex. Birth weight was missing for n = 5 (3.2%) in the group with positive test results and n = 39 (6.4%) in the group with negative ones.

[h] Death before delivery from 22 weeks 0 days.

in SAS version 9.4, we estimated prevalence ratios assuming a Poisson distribution to test associations between SARS-CoV-2 infection and adverse pregnancy, delivery, and neonatal outcomes. A sensitivity analysis excluding those testing positive in pregnancy was conducted. Two-sided $P < .05$ indicated statistical significance.

The study was approved by the Swedish Ethical Review Authority, who deemed that informed consent was not required.

Results | Among 2682 patients presenting in labor, 156 (5.8%) were SARS-CoV-2 positive (142 [91%] at admission and 14 [9%] during pregnancy). Gradients were observed across educational level (<10 years, 14.2%; 10-12 years, 6.6%; and >12 years, 4.0%) and birth country (Nordic, 3.9%; rest of Europe, 5.7%; and Africa/Middle East, 10.0%). Sixty-five percent testing positive were asymptomatic. We matched 155 patients testing positive to 604 testing negative.

After matching, the groups were well balanced on all covariates (**Table**). Patients testing positive were more likely to have preeclampsia (7.7% vs 4.3%; prevalence ratio, 1.84; 95% CI, 1.004-3.36) and less likely to undergo induction of labor (18.7% vs 29.6%; prevalence ratio, 0.64; 95% CI, 0.45-0.90) (**Figure**). Other maternal outcomes, including mode of delivery, postpartum hemorrhage, and preterm birth, did not significantly differ between groups. Infants did not differ regarding 5-minute Apgar score and birth weight for gestational age (Figure). All results were similar in the sensitivity analysis, although the association with preeclampsia was nonsignificant (prevalence ratio, 1.70; 95% CI, 0.89-3.25).

Discussion | SARS-CoV-2 test positivity in individuals in labor was associated with a higher prevalence of preeclampsia and lower prevalence of induction of labor. COVID-19 is primarily a respiratory infection but also has systemic effects that may resemble preeclampsia.[3] The absence of an increased prevalence of preterm birth is concordant with results of 2 previous studies using comparators.[4,5] The lack of difference in Apgar scores and birth weight for gestational age between groups is similar to that in a US study.[4]

In light of other accumulating data, it is already clear that COVID-19 is less severe in pregnancy than the 2 previous coronavirus infections: severe acute respiratory syndrome-related coronavirus (SARS) and Middle East respiratory syndrome-related coronavirus (MERS). Nevertheless, there are reports of pregnant persons requiring critical care, and there have been other reports of both mother and infant deaths in association with COVID-19.[6]

Strengths of this study include the universal testing, providing pregnancy comparators with negative test results. Limitations include uncertainty regarding generalizability to other countries with different obstetric care, timing of the RT-PCR test, and limited statistical power for rare outcomes and for a stratified analysis by symptoms.

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