



# Clinical Characteristics and Predictive Factors for the Development of Hypoxemia in SARS-CoV-2 Infected Women during Pregnancy

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## ABSTRACTS

**Background:** There is limited information describing the clinical characteristics and prognosis of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection during pregnancy. The clinical features and the predictive factors for development of hypoxemia were investigated in SARS-Cov-2 infected women during pregnancy.

**Methods:** From August 2020 to February 2022, 410 pregnant women were infected with SARS-CoV-2 who admitted to two hospitals, the National Health Insurance Service Ilsan Hospital in Goyang or the Wonju Severance Christian Hospital in Wonju, Korea. The clinical characteristics and prognosis were compared between pregnant women who required oxygen or not during hospitalization.

**Results:** The mean age of the patients was 33.3 years. The hospitalized pregnant women were categorized into two groups such as no oxygen group and oxygen group. Of 410 patients, 100 (24.4%) required oxygen therapy (81 low-flow, 15 high-flow oxygen and 4 mechanical ventilation including 2 extracorporeal membrane oxygenation). In oxygen group, the symptoms such as fever [163 (52.6%) vs 81 (81.0%),  $p < 0.001$ ] and cough [172 (56.4%) vs 73 (73.0%),  $p = 0.003$ ] were frequently observed. In oxygen group, the frequency of whom were not vaccinated was more [264 (85.2%) vs 98 (98.0%),  $p = 0.003$ ], however, that of the SARS-CoV-2 omicron variant infected patients was lower [98 (31.6%) vs 18 (18.0%),  $p = 0.009$ ]. The risk for the development of hypoxemic respiratory difficulty was increased if the SARS-CoV-2 infection during third trimester (OR 5.083, 95% CI 1.095-23.593,  $p = 0.038$ ) and elevated C-reactive protein ( $\geq 1.0$  mg/dL) at admission (OR 5.878, 95% CI 3.099-11.146,  $p < 0.001$ ) in the SARS-CoV-2 infected pregnant women. However, the risk was decreased with vaccination (OR 0.186, 95% CI 0.041-0.838,  $p = 0.028$ ) and omicron variant infection (OR 0.498, 95% CI 0.258-0.961,  $p = 0.038$ ).

**Conclusion:** A quarter of SARS-CoV-2 infected women during pregnancy developed hypoxemic respiratory difficulty. The SARS-CoV-2 infection during third trimester and no vaccination increased the risk for the development of hypoxemic respiratory difficulty in pregnant women.

## Background and Objective

There is limited information describing the clinical characteristics and prognosis of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection during pregnancy. The clinical features and the predictive factors for development of hypoxemia were investigated in SARS-Cov-2 infected women during pregnancy.

## Patients and Methods

### Study population

- From August 2020 and February 2022
- A retrospective observational cohort study of pregnant women infected with SARS-CoV-2 who were admitted to the National Health Insurance Service Ilsan Hospital in Goyang or the Wonju Severance Christian Hospital in Wonju, Republic of Korea
- COVID-19 was laboratory-confirmed in all women by SARS-CoV-2 real-time RT-PCR.

### Definition of characteristics

**Body mass index** (using the proposed weight classification by BMI in adult Asians)  
normal ( $< 25$  kg/m<sup>2</sup>), obese (25–29.9 kg/m<sup>2</sup>), and severely obese ( $\geq 30$  kg/m<sup>2</sup>) at the time of infection using the cut-offs established for the proposed weight classification by BMI in adult Asians

### Pregnancy period at the time of infection

first trimester (1–14 gestational weeks), second trimester (15–28 gestational weeks), and third trimester ( $\geq 29$  gestational weeks).

### Vaccination status

Complete vaccination: the receipt of the second dose in a two-dose vaccine series (BNT162b2, ChAdOx1 nCoV-19, or mRNA-1273 vaccine) or a single-dose vaccine (Ad26.COV2.S vaccine) at least 2 weeks before the diagnosis of COVID-19.

Partial vaccination: the receipt of at least one dose without meeting the complete vaccination criteria

Booster vaccination was defined as the receipt of a vaccine dose after complete vaccination.

**Omicron variant** if an infection occurred since January 2022

**Comparison** between pregnant women who required oxygen therapy or not during hospitalization.

## Results

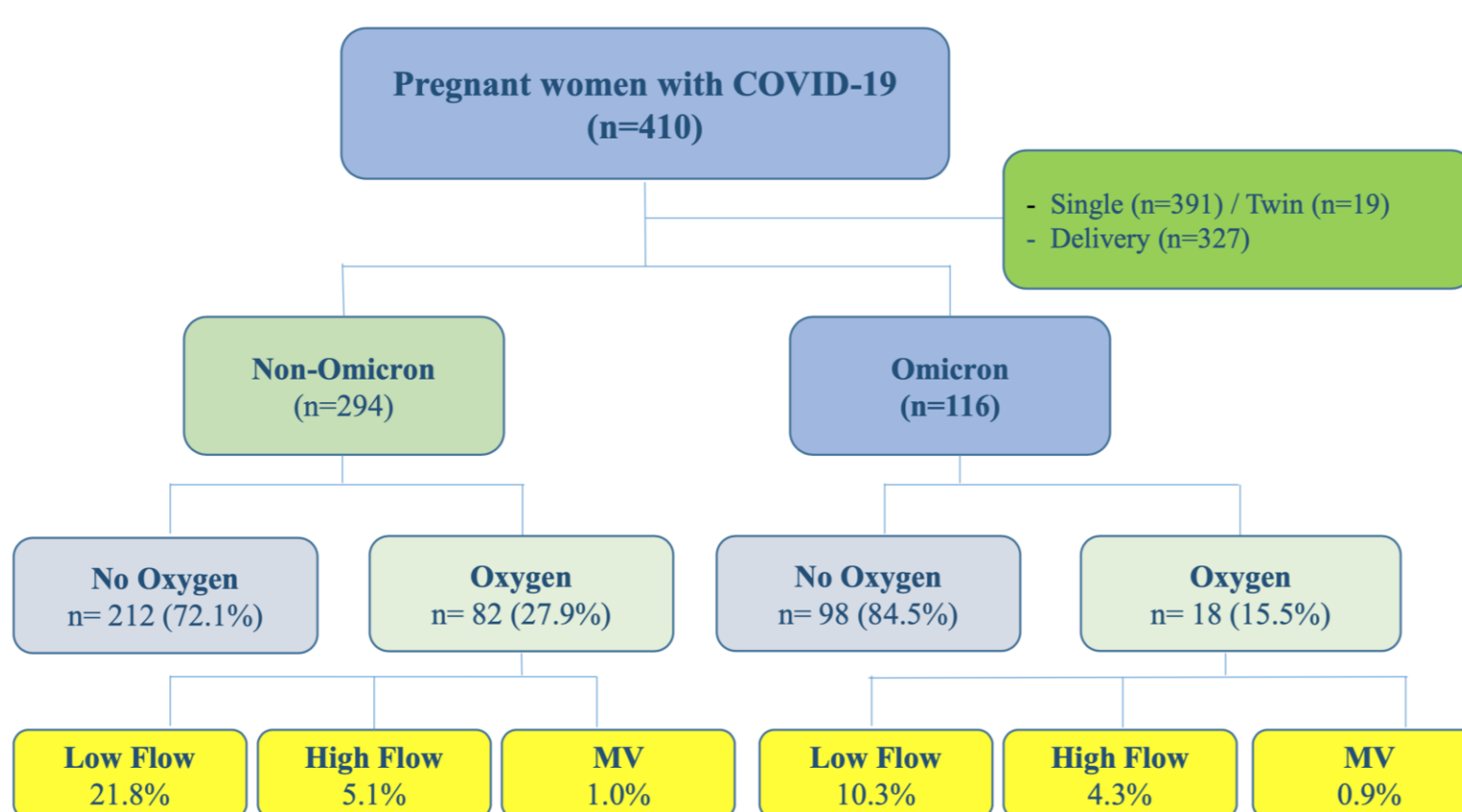


Figure 1. Prognosis of pregnant women with COVID19

Table 1. Demographics and baseline characteristics of the 410 pregnant women infected with SARS-CoV-2

Characteristics	Total (n=410)	No oxygen requirement (n=310)	Oxygen requirement (n=100)	p-value
Age, mean (SD)	33.26 (4.44)	33.16 (4.49)	33.56 (4.28)	0.437
IUP, median (range)	28.04 (9.37)	27.33 (9.93)	30.22 (6.99)	0.001
Symptoms, n (%)				
Fever	244 (59.5)	163 (52.6)	81 (81.0)	$< 0.001$
Cough	245 (60.5)	172 (56.4)	73 (73.0)	0.003
Myalgia	142 (35.1)	103 (33.8)	39 (39.0)	0.342
Anosmia	47 (11.6)	34 (11.1)	13 (13.0)	0.616
Diarrhea	4 (1.0)	3 (1.0)	1 (1.0)	1.000
Presence of pneumonia	160 (39.0)	76 (24.5)	84 (84.0)	$< 0.001$
Body mass index (kg/m <sup>2</sup> )	25.21 (4.80)	24.93 (4.70)	26.06 (5.07)	0.041
RT-PCR Ct value at diagnosis, mean (SD)				
RdRp gene	19.41 (6.21)	19.72 (6.29)	18.49 (5.89)	0.096
E gene	19.44 (5.94)	19.67 (6.08)	18.76 (5.46)	0.206
CRP (mg/dL)	2.27 (2.76)	1.59 (1.85)	4.38 (3.84)	$< 0.001$
Omicron wave	116 (28.3)	98 (31.6)	18 (18.0)	0.009
COVID-19 vaccination status, n(%)				
Not vaccinated	362 (88.3)	264 (85.2)	98 (98.0)	
Partially	12 (2.9)	11 (3.5)	1 (1.0)	0.007
Completely	34 (8.3)	33 (10.6)	1 (1.0)	
Boosted	2 (0.5)	2 (0.6)	0 (0.0)	
Use of remdesivir, n (%)	73 (17.8)	3 (1.0)	70 (70.0)	$< 0.001$
Clinical status, n (%)				
Initial				
No oxygen	399 (97.3)	310 (100)	89 (89.0)	
Low flow oxygen	10 (2.4)	0 (0.0)	10 (10.0)	$< 0.001$
High flow oxygen	1 (0.2)	0(0.0)	1 (1.0)	
Severest during disease progression				
No oxygen	310 (75.6)	310 (100)	0 (0.0)	
Low flow oxygen	81 (19.7)	0 (0.0)	81 (81.0)	$< 0.001$
High flow oxygen	15 (3.7)	0 (0.0)	15 (15.0)	
Mechanical ventilation	4 (1.0)	0 (0.0)	4 (4.0)	

Abbreviations: SD, standard deviation; IUP, intrauterine pregnancy; RT-PCR, Reverse Transcription Polymerase Chain Reaction; Ct, cyclic threshold; CRP, C-reactive protein

Table 2. Severest status during disease progress of the 410 pregnant women infected with SARS-CoV-2 by vaccination status

Vaccine status, n (%)	No oxygen	Low flow oxygen	High flow oxygen	Mechanical ventilation
Unvaccinated (362)	264 (72.9)	79 (21.8)	15 (4.1)	4 (1.1)
Partially (12)	11(91.7)	1 (8.3)	0 (0.0)	0 (0.0)
Completely (34)	33 (97.1)	1 (2.9)	0 (0.0)	0 (0.0)
Boosted (2)	2 (100)	0 (0.0)	0 (0.0)	0 (0.0)

Table 3. Risk factors for the development of hypoxemic SARS-CoV-2 infection (multivariate analysis)

Variables	aOR (95%CI)*	P value
Age ( $\geq 35$ year)	1.386 (0.817-2.351)	0.227
Omicron	<b>0.498 (0.258-0.961)</b>	<b>0.038</b>
Trimester period		
First	Ref.	
Second	4.653 (0.977-22.152)	0.053
Third	<b>5.083 (1.095-23.593)</b>	<b>0.038</b>
Vaccination	<b>0.186 (0.041-0.838)</b>	<b>0.028</b>
RdRp gene	0.983 (0.942-1.027)	0.450
CRP ( $\geq 1.0$ mg/dL) at admission	<b>5.878 (3.099-11.146)</b>	<b><math>&lt; 0.001</math></b>
BMI at SARS-CoV-2 infection		
$< 25$ kg/m <sup>2</sup>	Ref.	
$\geq 25$ kg/m <sup>2</sup>	1.287 (0.742-2.230)	0.369
$\geq 30$ kg/m <sup>2</sup>	2.247 (0.971-5.197)	0.058

Abbreviations: aOR, adjusted odds ratio; CRP, C-reactive protein; BMI, body mass index.

## Conclusion

- Around one-fourth of women infected with SARS-CoV-2 during pregnancy developed hypoxemic respiratory difficulty.
- Among pregnant women, infection in the third trimester and no vaccination increased the risk of hypoxemia requiring oxygen therapy.

