

Journal Pre-proof

Impact of vaccination and the omicron variant on COVID-19 severity in pregnant women

Haemin Kim , Hyo-Shin Kim , Hyun Mi Kim , Mi Ju Kim ,
Ki Tae Kwon , Hyun-Hwa Cha , Won Joon Seong

PII: S0196-6553(22)00592-2
DOI: <https://doi.org/10.1016/j.ajic.2022.07.023>
Reference: YMIC 6309



To appear in: *AJIC: American Journal of Infection Control*

Please cite this article as: Haemin Kim , Hyo-Shin Kim , Hyun Mi Kim , Mi Ju Kim , Ki Tae Kwon , Hyun-Hwa Cha , Won Joon Seong , Impact of vaccination and the omicron variant on COVID-19 severity in pregnant women, *AJIC: American Journal of Infection Control* (2022), doi: <https://doi.org/10.1016/j.ajic.2022.07.023>

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2022 Published by Elsevier Inc. on behalf of Association for Professionals in Infection Control and Epidemiology, Inc.

Highlights

- In Omicron era, the infectivity of COVID-19 was stronger than before Omicron.
- The disease severity of COVID-19 was lower in Omicron era.
- Compared to non-vaccinated patients, vaccinated patients were better protected against COVID-19.

Journal Pre-proof

Title: Impact of vaccination and the omicron variant on COVID-19 severity in pregnant women

Authors: Haemin Kim¹, Hyo-Shin Kim¹, Hyun Mi Kim¹, Mi Ju Kim¹, Ki Tae Kwon², Hyun-Hwa Cha^{1*}, Won Joon Seong^{1*}

ORCID iDs

Haemin Kim <https://orcid.org/0000-0003-4278-6032>

Hyo-Shin Kim <https://orcid.org/0000-0002-8369-417X>

Hyun Mi Kim <https://orcid.org/0000-0002-2985-9965>

Mi Ju Kim <https://orcid.org/0000-0001-9770-1580>

Ki Tae Kwon <https://orcid.org/0000-0003-4666-0672>

Hyun-Hwa Cha <https://orcid.org/0000-0002-4399-7627>

Won Joon Seong <https://orcid.org/0000-0002-8088-2554>

Affiliations:

¹Department of Obstetrics and Gynecology, Kyungpook National University Hospital, Kyungpook National University, School of Medicine, Daegu, Korea

²Division of Infectious Diseases, Department of Internal Medicine, Kyungpook National University, School of Medicine, Kyungpook National University Chilgok Hospital, Daegu, Korea.

*Hyun-Hwa Cha and Won Joon Seong contributed equally to this work as co-corresponding authors.

Address for Correspondence:

1. Hyun-Hwa CHA, MD, PhD

Department of Obstetrics and Gynecology

Kyungpook National University Chilgok Hospital

Kyungpook National University School of Medicine

807 Hoguk-ro, Buk-gu 702-720, Daegu, South Korea

E mail: chh9861@knu.ac.kr

2. Won Joon SEONG, MD, PhD

Department of Obstetrics and Gynecology

Kyungpook National University Chilgok Hospital
Kyungpook National University School of Medicine
807 Hoguk-ro, Buk-gu 702-720, Daegu, South Korea
Tel: +82 53 200 2686
Fax: +82 53 200 2086
E mail: wjseong@knu.ac.kr

Disclosure

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Seong WJ.

Data curation: Kim H, Kim H-S, Kim HM, Kim MJ, Cha H-H, Kwon KT, Seong WJ.

Formal analysis: Kim H, Cha H-H.

Investigation: Kim H, Kim H-S, Kim HM, Kim MJ, Cha H-H, Seong WJ.

Writing - original draft: Kim H, Cha H-H.

Writing - review & editing: Cha H-H, Seong WJ

Ethical statement

The Institutional Review Board and Ethics Committee of Kyungpook National University Hospital (No. 2022-03-027) approved this study. The board waived the requirement for informed consent.

Funding statement

No funding was received for this study.

Abstract

We compared the clinical course of pregnant women with coronavirus disease 2019 (COVID-19) before and after the emergence of the omicron variant and based on vaccination status. We retrospectively reviewed the electronic medical charts of 224 patients and 82 deliveries from November 1, 2020, to March 7, 2022; of these, 42% were diagnosed during the omicron dominance period. Disease severity and morbidity of COVID-19 were significantly decreased during the omicron era. The vaccination rates among the patients were higher after omicron emergence (31.9%) than

before (6.9%). Overall, 4.1% and 25% of patients had severe symptoms, and 2.6% and 16.2% required oxygen therapy in the vaccination and non-vaccination groups, respectively. Overall, patients had a more favorable clinical course in the omicron era; moreover, vaccinated patients were better protected than non-vaccinated patients, indicating the importance of vaccination against COVID-19.

Key words: COVID-19; Pregnancy; Omicron

Introduction

Since the emergence of coronavirus disease 2019 (COVID-19) in February 2020, the number of pregnant women infected with the virus and delivering by cesarean section has been steadily increasing in South Korea.¹ Additionally, pregnancy is considered a high-risk factor for severe COVID-19,² especially in case of infection with the delta variant of SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2). Despite reports showing a more favorable disease outcome with the omicron variant, little is known about its clinical course in pregnant women.^{3,4} Moreover, because little is known about the effectiveness of COVID-19 vaccines in pregnant women in Korea, the vaccination rate is low at only 9.8%.⁵ Herein, we aimed to review the clinical outcomes of pregnancies in women with COVID-19 to evaluate whether the emergence of the omicron variant and vaccination status influence disease severity.

Methods

We retrospectively reviewed the electronic medical charts of all pregnant women admitted to our institution for COVID-19 infection between November 1, 2020 and March 7, 2022. The study cohort was stratified into two groups based on whether their admission date was before or after the omicron variant emergence. The omicron group comprised patients who were admitted to our hospital after January 17, 2022, when omicron became the dominant SARS-CoV-2 strain according to the Korea

Disease Control and Prevention Agency. In addition, the groups were classified according to vaccination status to compare the clinical outcomes. Because of the low vaccination rate among pregnant women, the vaccinated group was defined as patients who received at least one vaccination dose. Clinical severity was classified as “asymptomatic to mild” or “moderate to serious,” based on the patient’s oxygen demand, chest radiograph pneumonia findings, the need for intensive care from infection medical specialists, and intensive care requirement, as per the guidelines of the National Institutes of Health.⁶ Maternal morbidities included pneumonia diagnosed on chest radiograph during the admission period, the need for pulmonology expert transfer, intensive care requirement, and preterm birth (defined as delivery before 37 weeks). Statistical analyses were performed using IBM SPSS version 28.0 (IBM Corp., Armonk, NY, USA) software. The Chi-square test and Fisher’s exact test were used to analyze categorical variables. Continuous variables were analyzed using the Kruskal–Wallis test, Student’s t-test, and Mann–Whitney U test. The statistical significance threshold was set at a p-value < 0.05.

The Institutional Review Board and Ethics Committee of Kyungpook National University Hospital (No. 2022-03-027) approved this study. The board waived the requirement for informed consent.

Results

A total of 224 pregnancies and 82 quarantine deliveries were documented. Table 1 shows the characteristics of the pregnant women before and after omicron emergence. Despite the relatively short period of omicron variant dominance, 42% of patients were classified into the omicron group. The average age of the before-omicron and omicron groups were 32.3±4.9 and 32.1±4.3 years, respectively. In both groups, the proportion of pregnant women in the 3rd trimester was significantly higher than that in any other trimester (53.1% and 73.4%, in the before-omicron and omicron groups, respectively). This could be because many of the patients were admitted for delivery. Interestingly, the vaccination rate was higher in the omicron group (6.9% vs. 31.9%, $p < 0.001$), which may be reflective of the late start of COVID-19 vaccination uptake among pregnant women in Korea. The

rates of “moderate-to-severe” disease and maternal morbidity were reduced after the emergence of the omicron variant (30.0% vs. 10.6%, $p < 0.001$; 27.7% vs. 13.8%, $p = 0.013$, respectively). Oxygen demand was also higher in the before-omicron group (20.0% vs. 5.3%, $p = 0.002$).

Table 1. Comparisons of maternal characteristics and clinical outcomes before and after the emergence of omicron variant

CHARACTERISTICS	BEFORE OMICRON (N=130)	AFTER OMICRON (N=94)	P
Age	32.3 ± 4.9	32.1 ± 4.3	0.754
Nulliparity* (%)	66 (51.6)	47 (50.0)	0.818
GA at admission			
1 st trimester, n (%)	19 (14.6)	13 (13.8)	
2 nd trimester, n (%)	42 (32.3)	12 (12.8)	0.002
3 rd trimester, n (%)	69 (53.1)	69 (73.4)	
Number of Vaccine doses (%)			
None	121 (93.1)	64 (68.1)	
First	3 (2.3)	6 (6.4)	< 0.001
Second	6 (4.6)	21 (22.3)	
Boosted	-	3 (3.2)	
Co-morbidity (%)			
Obesity	14 (10.8)	12 (12.8)	0.645
DM	10 (7.7)	9 (9.6)	0.618
HTN	4 (3.1)	3 (3.2)	1.000
Asthma	3 (2.3)	1 (1.1)	0.641
Clinical severity during admission (%)			
Asymptomatic or Mild	91 (70.0)	84 (89.4)	< 0.001
Moderate or Serious	39 (30.0)	10 (10.6)	

Oxygen support requirement (%)	26 (20.0)	5 (5.3)	0.002
Nasal or Mask	20 (15.4)	5 (5.3)	
High frequency	5 (3.8)	-	0.001
Invasive Mechanical	1 (0.8)	-	
Maternal Morbidity (%)	36 (27.7)	13 (13.8)	0.013
Pneumonia	32 (24.6)	9 (9.6)	0.004
Transfer to Medical specialist	20 (15.4)	5 (5.3)	0.018
ICU care	4 (3.1)	0 (0.0)	0.141
PTB [†]	5 (12.5)	3 (7.1)	0.477

*, n=222; †, n=82 (before omicron: 40, after omicron: 42); Abbreviations: GA, gestational age; DM, diabetes mellitus; HTN, hypertension;

ICU, intensive care unit; PTB, preterm birth

We further compared the clinical outcomes according to the vaccination status (Table 2). Among all infected pregnant women, 185 and 39 were non-vaccinated and vaccinated, respectively. The rates of “moderate-to-severe” disease and oxygen therapy requirement were significantly lower in the vaccinated group than in the non-vaccinated group (25.4% vs. 4.1%, $p = 0.005$; 16.2% vs 2.6%, $p = 0.025$, respectively). Notably, only one patient in the vaccinated group (who had asthma) required oxygen therapy.

Table 2. Comparison of clinical outcomes according to vaccination status

CHARACTERISTICS	NON-VACCINATED	VACCINATED	P
	(N=185)	(N=39)	
Clinical severity during admission (%)			
Asymptomatic or Mild	138 (74.6)	37 (94.9)	0.005
Moderate or Serious	47 (25.4)	2 (4.1)	
Oxygen support requirement (%)	30 (16.2)	1 (2.6)	0.025

Nasal or Mask	24 (13.0)	1 (2.6)	
High frequency	5 (2.2)	-	0.032
Invasive Mechanical	1 (0.5)	-	
Maternal Morbidity (%)	47 (25.4)	2 (5.1)	0.005
Pneumonia	40 (21.6)	1 (2.6)	0.005
Transfer to Medical specialist	24 (13.0)	1 (2.6)	0.089
ICU care	4 (2.2)	-	1.000
PTB [†]	8 (10.4)	-	1.000

†, n=82 (non-vaccinated: 77, vaccinated: 5), Abbreviations: ICU, intensive care unit; PTB, preterm birth

Discussion

This study has several limitations. Firstly, we could not detect the specific strain of SARS-CoV-2 in the infected patients. Considering that omicron accounted for more than half of COVID-19 infections after January 17, 2022, in Korea, we expected that the characteristics of the omicron variant would be reflected in the study population. This interval of time was defined as the omicron period for comparison analysis. Among 9 vaccinated women in the before-omicron group, only one who was obese and over 40 years old showed pneumonia on chest X-ray, but did not require oxygen therapy. Nevertheless, our result is insufficient to conclude whether the lower severity in vaccinated women is due to the vaccination or simply a feature of the omicron variant itself. Additionally, the sample size was small because the study was conducted only at a single institution. However, data from a single institution is reliable owing to consistency in treatment guidelines.

In conclusion, the clinical course of COVID-19 was more favorable in pregnant women in the omicron group than in the before-omicron group. Additionally, disease severity was lower in pregnant women who had received at least one vaccination dose. In fact, more favorable clinical outcomes were observed after the omicron variant dominance. However, more pregnant women were also

vaccinated during this period. Further studies are required to identify whether the outcomes improved due to the decreased severity of the disease caused by the omicron variant or the protective effects of vaccination.

Acknowledgements

We would like to thank all the staff of the quarantine ward and emergency department at the Kyungpook National University Hospital and Kyungpook National University Chilgok Hospital for their work in the management of pregnancies in women with COVID-19.

References:

1. Yang S, Jang J, Park SY, Ahn SH, Kim S-S, Park SB, et al. COVID-19 outbreak report from January 20, 2020 to January 19, 2022 in the Republic of Korea. *Public Health Weekly Reports* 2022;15(13).
2. Kim SH, Choi Y, Lee D, Lee H, Kim JH, Choi ES, et al. Impact of COVID-19 on pregnant women in South Korea: Focusing on prevalence, severity, and clinical outcomes. *Journal of Infection and Public Health* 2022;15(2):270-6.
3. Wang L, Berger NA, Kaelber DC, Davis PB, Volkow ND, Xu R. COVID infection rates, clinical outcomes, and racial/ethnic and gender disparities before and after Omicron emerged in the US. Cold Spring Harbor Laboratory; 2022.
4. Iuliano AD, Brunkard JM, Boehmer TK, Peterson E, Adjei S, Binder AM, et al. Trends in Disease Severity and Health Care Utilization During the Early Omicron Variant Period Compared with Previous SARS-CoV-2 High Transmission Periods — United States, December 2020–January 2022. *MMWR Morbidity and Mortality Weekly Report* 2022;71(4):146-52.
5. National Health Insurance Service. 9 out of 10 pregnant women who were vaccinated against

COVID-19 were not vaccinated. Financial today Available at:
<http://www.ftoday.co.kr/news/articleView.html?idxno=231340> Accessed 1 April 2022.

6. COVID-19 Treatment Guidelines Panel. Coronavirus Disease 2019 (COVID-19) Treatment Guidelines. National Institutes of Health. Available at <https://www.covid19treatmentguidelines.nih.gov/>. Accessed 16 May 2022.

Journal Pre-proof