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## Letter to the Editor

### Clinical features and outcomes of hospitalized patients with COVID-19 during the Omicron wave in Shanghai, China

Dear editor,

A recent letter published in this journal provided the data of COVID-19 naturally recovered cases at the Fangcang shelter hospital, a type of basic medical facility converted from public space to handle asymptomatic cases or low-risk patients with mild symptoms, during the current Omicron outbreak in Shanghai.<sup>1</sup> Since early 2022, the fast spread of the SARS-CoV-2 Omicron variant has fueled a surge in newly-diagnosed cases across China, with the majority occurring in Shanghai.<sup>2</sup> According to the Shanghai Municipal Health Commission, as of May 4, 2022, more than 600,000 people have been infected, most of them with the Omicron BA.2 variant.<sup>3</sup> Although the Omicron BA.2 evolves towards more transmissible, its pathogenicity and clinical severity appear to be weakened compared with previous strains.<sup>4</sup> However, the number of hospital admissions and deaths due to Omicron might still be substantial, depending on the extent to which age, vaccination status, and comorbidities. Here, we aimed to systematically describe clinical features and outcomes in a cohort of hospitalized patients with Omicron infection in Shanghai.

This was a retrospective study involving patients with laboratory-confirmed COVID-19 who were admitted to the Shanghai Ninth People's Hospital, a designated hospital for the treatment of COVID-19, during the Omicron wave between 18 April and 22 May 2022. The institutional ethics committee approved the study (Approval No. SH9H-2022-T117-1). Data on general characteristics, laboratory tests, chest CT reports, treatment, and outcomes were extracted from electronic medical records. During hospitalization, pharyngeal swab specimens were collected daily for detection of SARS-CoV-2 through real-time RT-PCR assay. Patients who received the first and/or the second dose of COVID-19 vaccine were considered partially vaccinated, and full vaccination was defined as completion of 3 doses of vaccine. The primary outcomes were ICU admission, the use of invasive mechanical ventilation, and death in hospital. The second outcomes included the time from hospital admission to first negative conversion of SARS-CoV-2 and the cumulative negative conversion rate. Continuous variables were present as median and interquartile range (IQR) and categorical variables were summarized as counts and percentages. Assessment of the outcomes was performed across age groups according to vaccination status or the presence of comorbidities.

By May 22, 2022, a total of 1965 hospitalized patients with COVID-19 were included in our study. The demographic and clinical characteristics of patients are shown in **Supplementary Table**. The median age was 72 years (IQR, 62–83) and 46% were men. Of the patients, 36.6% had been vaccinated and 71.8% had at least one

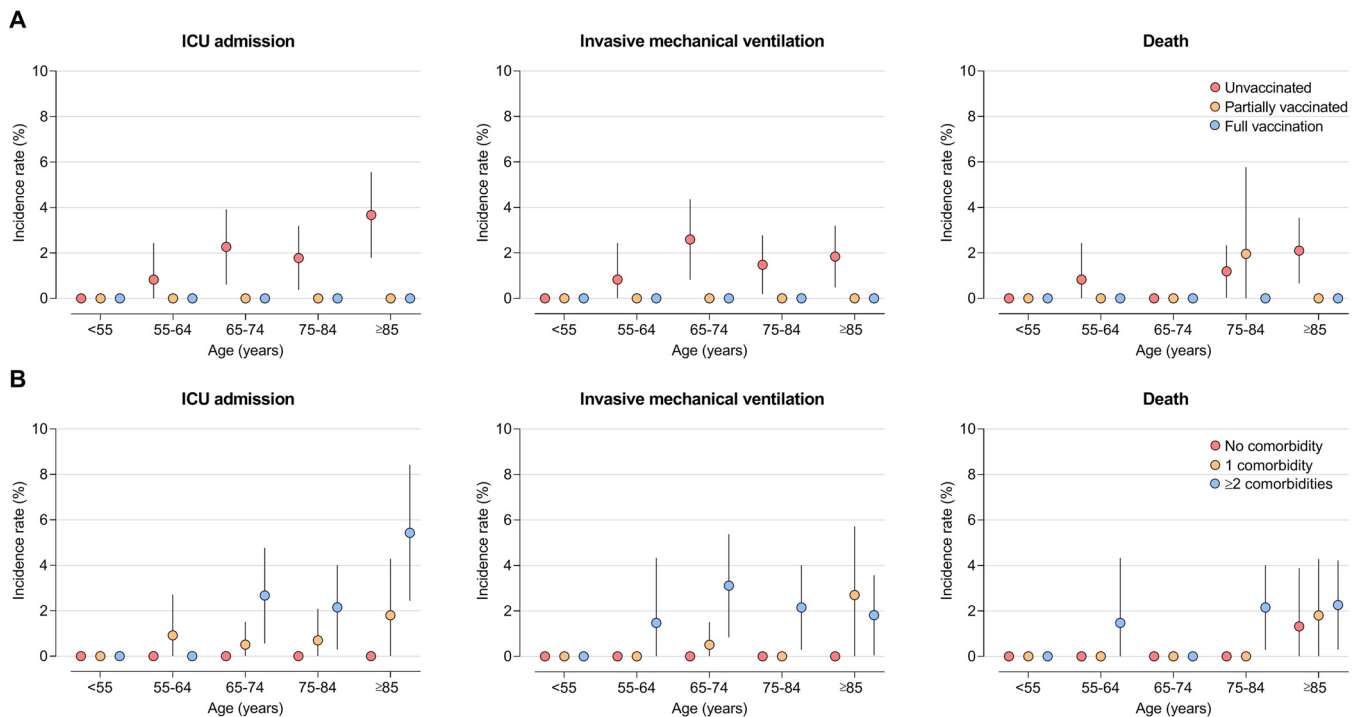
comorbidity. Compared with vaccinated patients, unvaccinated patients were significantly older and more likely to have comorbidities. The proportion of vaccination markedly decreased with increasing age (<40 years: 69.5%, ≥85 years: 6.6%), while the proportion of multicomborbidity increased with age (<40 years: 5.1%, ≥85 years: 54.2%) (Supplementary Figure). On admission, the degree of severity of COVID-19 was categorized as mild in 1664 patients (85.4%), moderate in 262 patients (13.4%), and severe or critical in 23 patients (1.2%). More unvaccinated patients were diagnosed with severe or critical disease than vaccinated patients (1.5% vs 0.6%).

Of 1541 patients with chest CT scans, 661 (42.9%) revealed abnormal results. Bilateral lungs involvement was found in 40.5% of the patients. The most common imaging changes were effusion shadowing (33.9%) and patchy shadowing (20.5%). On admission, leucopenia was present in 23.0% (394/1713) of the patients and lymphopenia in 21.6% (370/1714). The levels of prothrombin time, procalcitonin, D-dimer, and inflammatory markers including IL-1 $\beta$ , IL-2R, IL-6, IL-8, and TNF- $\alpha$  were higher in unvaccinated patients than in vaccinated patients.

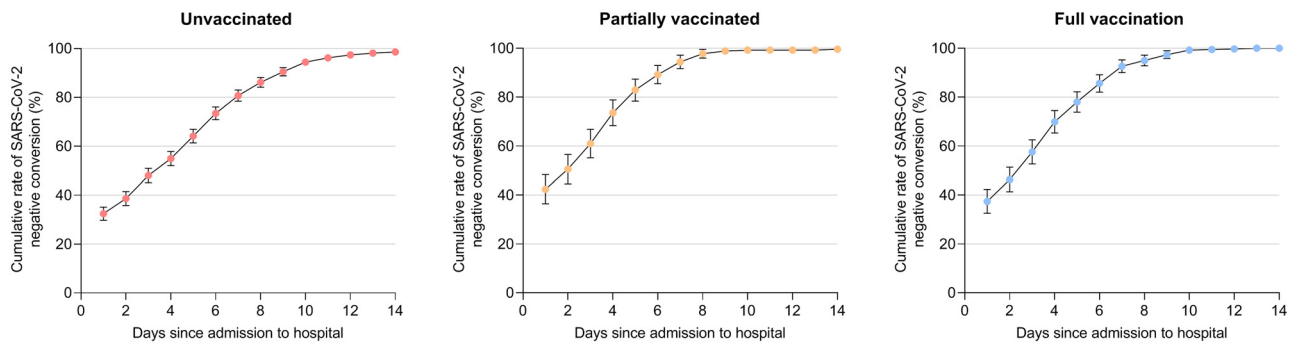
During hospitalization, 14 (0.7%) of 1965 patients died, 28 (1.4%) were admitted to the ICU, and 21 (1.1%) underwent invasive mechanical ventilation. All these outcomes were observed in unvaccinated patients except for one death case (Fig. 1A). The incidence rates of ICU admission (3.67%, 14/381) and death (2.1%, 8/381) were highest in unvaccinated patients over 85 years. Notably, none of the outcomes occurred in patients who had received full vaccination regardless of age groups. There were similar results by comorbidity status (Fig. 1B). Patients with comorbidity, especially those with 2 or more comorbidities in the older age groups, were more likely to experience ICU admission, invasive mechanical ventilation, and death in hospital. In contrast, patients without any comorbidity were largely free of developing severe outcomes.

The median time from admission to first negative conversion of SARS-CoV-2 was 3 days (IQR, 1–6). More than 99% of the patients experienced negative conversion within 14 days after admission. Overall, unvaccinated patients showed a lower negative conversion rate than vaccinated patients (Fig. 2). There was no obvious difference in negative conversion rate between patients who were partially vaccinated and those who had received full vaccination. Furthermore, the time to first negative conversion extended with higher age, and a significant increment was found in patients older than 85 years (median 5 days, IQR).<sup>2–8</sup>

Understanding the clinical spectrum of COVID-19 caused by the novel SARS-CoV-2 variant is crucial to informing public health measures in response to the COVID-19 epidemic. Previous studies suggested that infection with the Omicron variant had different clinical patterns and was associated with better outcomes than



**Fig. 1.** ICU admission, invasive mechanical ventilation, and death of hospitalized patients with COVID-19. (A) Incidence rate according to age and COVID-19 vaccination status. (B) Incidence rate according to age and the presence of comorbidity. The partially vaccinated group consisted of patients who had not completed 3 doses of vaccine (full vaccination). Error bars represent 95% confidence intervals.



**Fig. 2.** Cumulative rate of first negative conversion of SARS-CoV-2 by vaccination status in hospitalized patients. The partially vaccinated group consisted of patients who had not completed 3 doses of vaccine (full vaccination). Negative conversion was confirmed by 2 consecutive RT-PCR tests at least 24 h apart. Error bars represent 95% confidence intervals.

the Delta variant.<sup>5-7</sup> However, higher rates of severe outcomes and mortality have been reported in the elderly, especially those who were unvaccinated. According to the data from Hong Kong in early 2022, 85.8% of hospitalized cases and 95.8% of deaths during the fifth wave of COVID-19 were from the people older than 60 years, and approximately 90% of people deceased in this wave were unvaccinated or received only one dose of vaccine.<sup>8</sup> Likewise, among Chinese adults over 60 years, full vaccination has been associated with reduced risk of developing serious COVID-19.<sup>9</sup> Owing to the insufficient end-point events, special comparisons of the effectiveness between partial and full vaccination in our analysis were limited.

Overall, our study demonstrated mild disease among hospitalized patients with Omicron infection, but those at older ages who had comorbidities or yet to be vaccinated might be particularly susceptible to severe outcomes including death. This underlines that improving accessibility of vaccination service to the older pop-

ulation should be a top priority in strategies against the ongoing COVID-19 pandemic.

Supplementary material: Supplementary material associated with this article can be found, in the online version

**Declaration of Competing Interest**

The authors declare no conflicts of interest.

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## Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:[10.1016/j.jinf.2022.08.001](https://doi.org/10.1016/j.jinf.2022.08.001).

## References

- Ye L, Li WF, Shao J, Xu Z, Ju J, Xu H. Fighting omicron epidemic in China: real-world big data from fangcang shelter hospital during the outbreak in Shanghai 2022. *J Infect* 2022. doi:[10.1016/j.jinf.2022.07.006](https://doi.org/10.1016/j.jinf.2022.07.006).
- The State Council Information Office, P.R.C. press conference held on situation regarding strict prevention and control of COVID-19 epidemic (19 April 2022). Available from: <http://www.gov.cn/xinwen/gwylflkjz193/index.htm> (accessed May 23, 2022).
- Zhang X, Zhang W, Chen S. Shanghai's life-saving efforts against the current Omicron wave of the COVID-19 pandemic. *Lancet* 2022;**399**:2011–12.
- UKHSA. SARS-CoV-2 variants of concern and variants under investigation in England. UKHSA; 2021. Available from: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/1045619/Technical-Briefing-31-Dec-2021-Omicron\\_severity\\_update.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1045619/Technical-Briefing-31-Dec-2021-Omicron_severity_update.pdf) accessed April 19.
- Wolter N, Jassat W, Walaza S, et al. Early assessment of the clinical severity of the SARS-CoV-2 Omicron variant in South Africa: a data linkage study. *Lancet* 2022;**399**:437–46.
- Maslo C, Friedland R, Toubkin M, Laubscher A, Akaloo T, Kama B. Characteristics and outcomes of hospitalized patients in South Africa during the COVID-19 Omicron wave compared with previous waves. *JAMA* 2022;**327**:583–4.
- Bouzid D, Visseaux B, Kassassey C, et al. Comparison of patients infected with delta versus Omicron COVID-19 variants presenting to paris emergency departments: a retrospective cohort study. *Ann Intern Med* 2022;**175**:831–7.
- Cheung PH, Chan CP, Jin DY. Lessons learned from the fifth wave of COVID-19 in Hong Kong in early 2022. *Emerg Microbes Infect* 2022;**11**:1072–8.
- Li M, Liu Q, Wu D, et al. Association of COVID-19 vaccination and clinical severity of patients infected with delta or Omicron variants - China, May 21, 2021-February 28, 2022. *China CDC Wkly* 2022;**4**:293–7.

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