

## Background

Infection severity of COVID-19 has been difficult to measure in the face of rapidly evolving virus variants and changing case ascertainment intensity at different times during the pandemic. Accurate assessments of the severity of COVID-19 are needed to characterize the health burden of the disease and evaluate the public health response. Here we used individual data on COVID-19 patient cases from Hong Kong to estimate three severity measures, and to quantify how different definitions of COVID-19 hospitalization affect the estimation of severity.

## Objectives

The objective of this study is to assess the severity of COVID-19 in Hong Kong during the six waves of activity up to end of January 2023 by estimating the fatality risks especially the case-fatality risk. Based on the severity pyramid structure (Figure 1), we also seek to investigate the impact of hospitalization definition and severity criteria on severity estimation [1, 2].

## Methods

A pyramid approach was adopted to estimate the case fatality risk (CFR), via the case hospitalization risk (CHR) multiplied by the hospitalization fatality risk (HFR). We classified the severity status of confirmed cases into five levels (Figure 1) based on specified criteria. We defined hospitalized cases as patients who were classified with severity of severe or above (severe, critical, or fatal). A Bayesian framework was used to obtain estimates of severity and associated uncertainties. We investigated the impact of hospitalization definition and severity criteria on severity estimation.

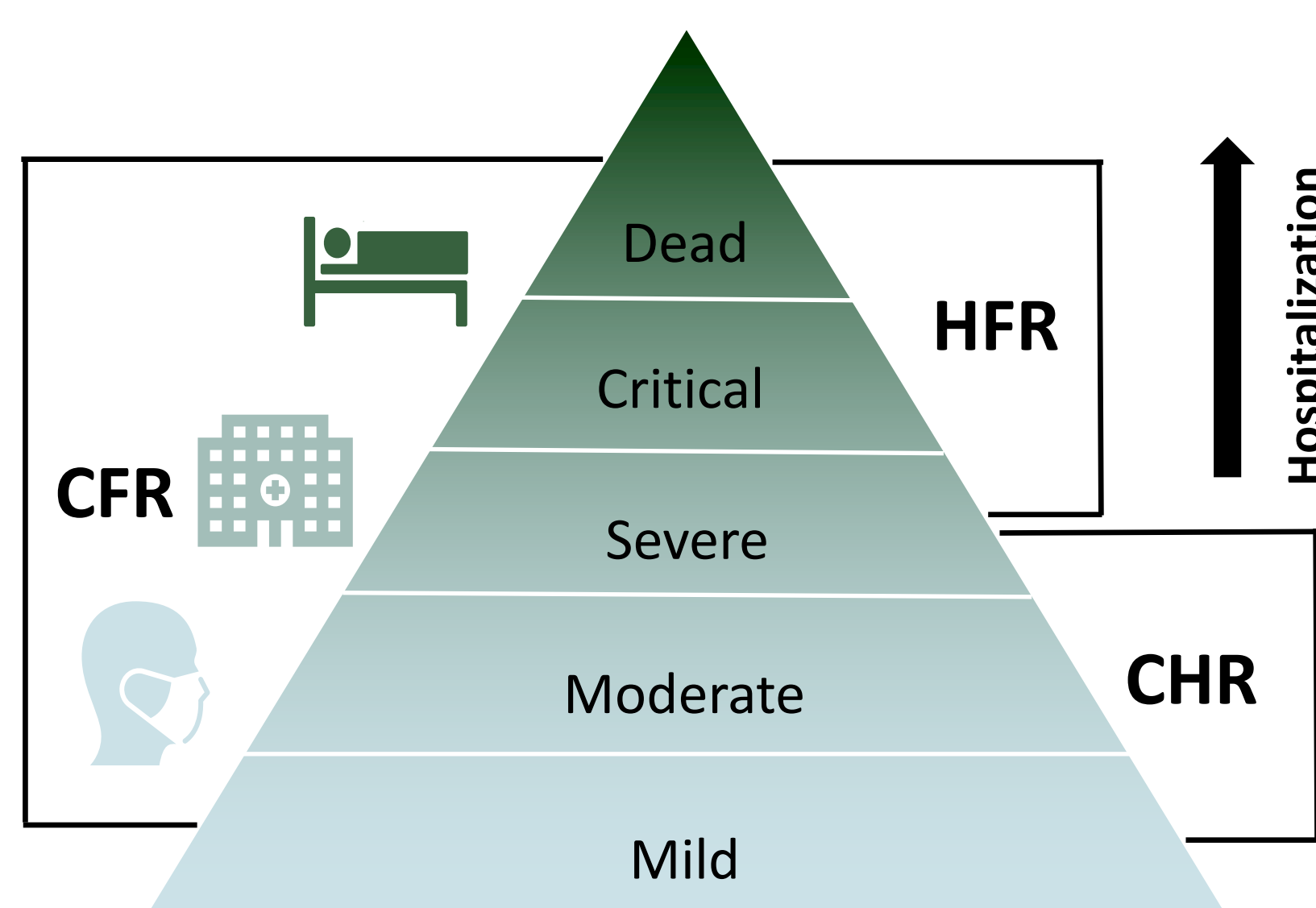


Figure 1. Classification of confirmed COVID-19 cases into a severity pyramid comprising five levels of severity outcomes.

## Results

### Temporal patterns of COVID-19 severity in Hong Kong

Severity generally declined over time in terms of CHR and CFR, while HFR peaked during wave 5 predominated by Omicron BA.2. A consistent increasing trend with age was observed across all metrics.

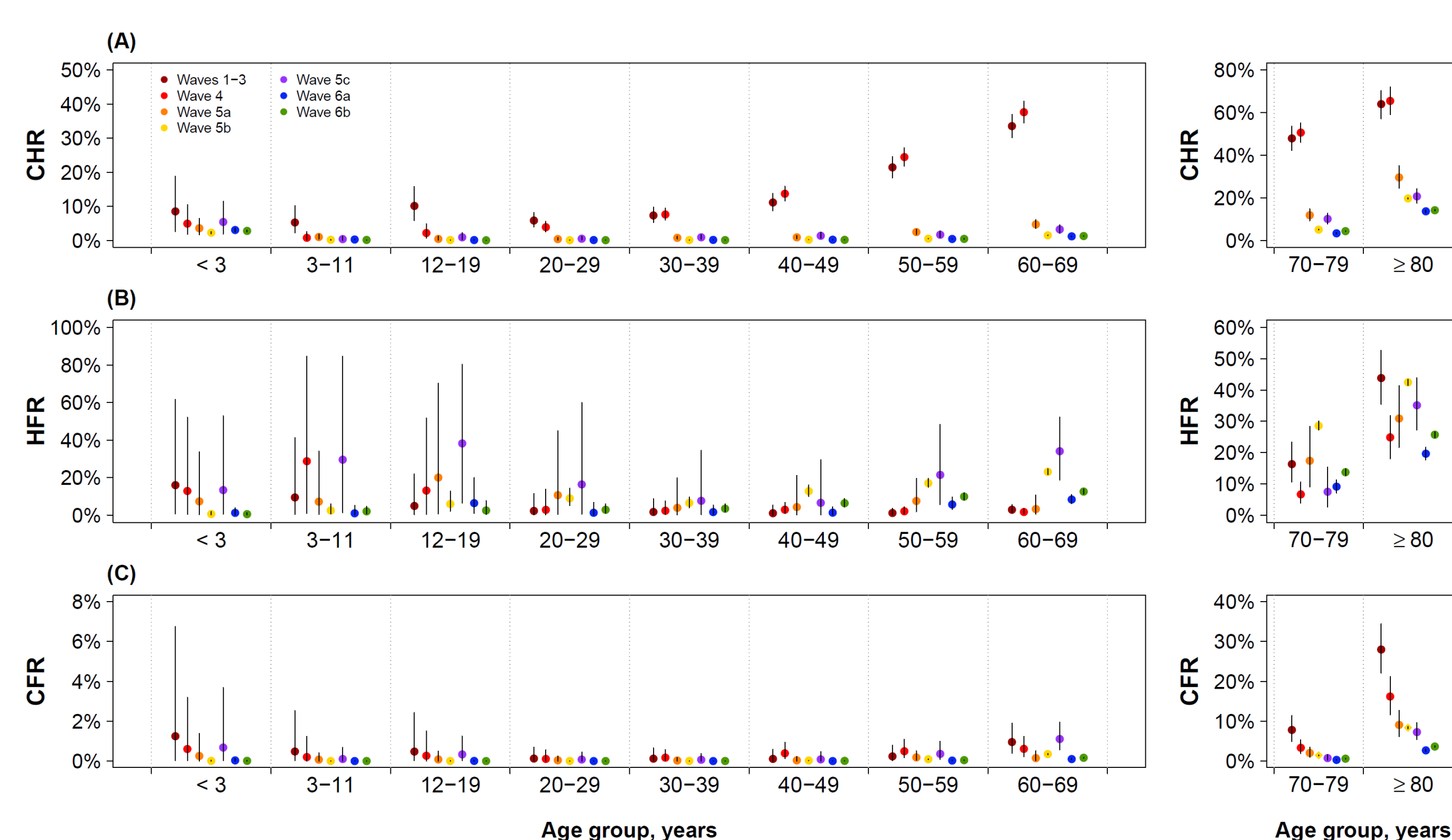


Figure 2. Wave-specific estimates of the (A) case hospitalization risk; (B) hospitalization fatality risk; and (C) case fatality risk for COVID-19 by age in Hong Kong.

## Relative risk of fatality compared to unvaccinated group

Case fatality risk decreased substantially with the doses of vaccine received, especially in older adults. Protection provided by vaccines were more significant in individuals aged 60-69 years and 70-79 years compared to other age groups.

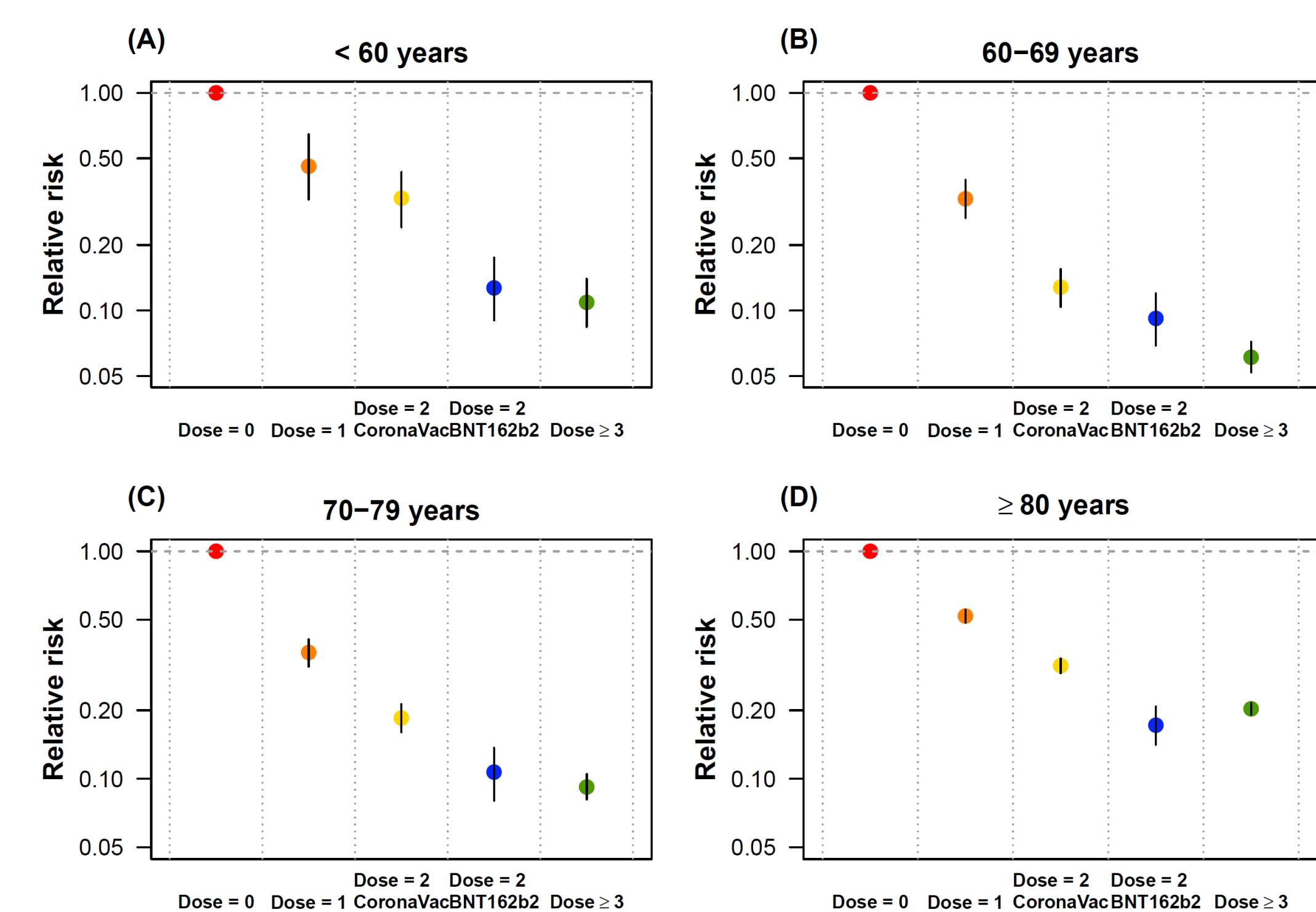


Figure 3. Relative risk of fatality among cases (risk ratio of CFRs) with a specific vaccine dose combination compared to unvaccinated cases by age group.

## Influence of different definitions of hospitalization

We observed significant changes in the estimates of CHR and HFR after changing hospitalization definition. However, the estimates of CFR remained nearly constant across the three different scenarios.

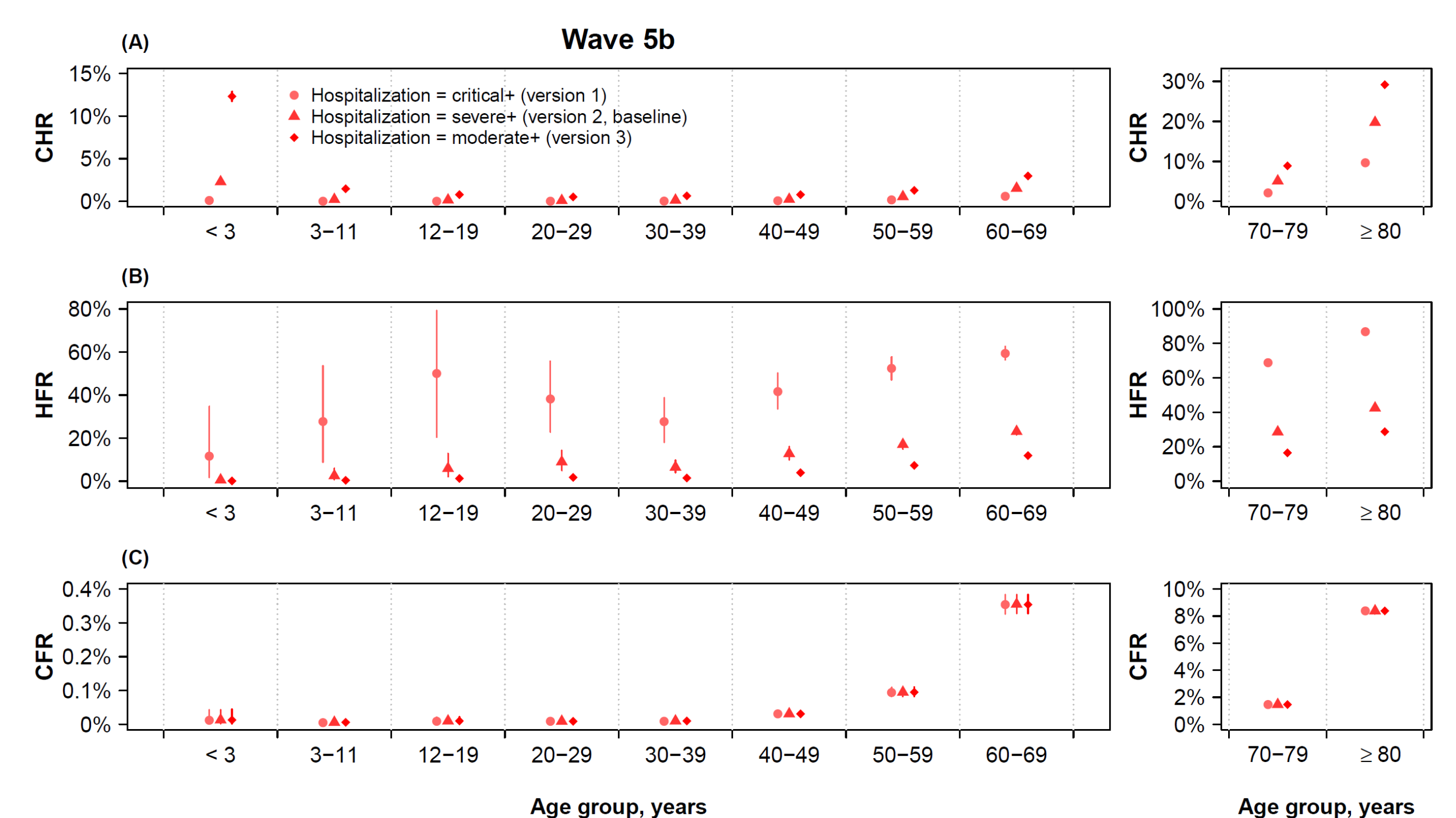


Figure 4. Estimates of age-specific CHR, HFR, and CFR for wave 5b under different versions of hospitalization definition.

## Conclusion

- The results suggested possible reduction in the severity of Omicron infections. Increase in HFR for wave 5 might be attributed to the severely inadequate hospital resources during the peak period.
- Fatality risks increase with age and receiving at least two doses of vaccine can substantially reduce probabilities of severe outcomes.
- The changes in hospitalization definition should be taken into account when making estimation on severity to avoid bias.

## References

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- Presanis AM, Pebody RG, Paterson BJ, et al. Changes in severity of 2009 pandemic A/H1N1 influenza in England: a Bayesian evidence synthesis. *BMJ*. 2011;343:d5408.

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