

Potential association between COVID-19 mortality and health-care resource availability

The ongoing epidemic of coronavirus disease 2019 (COVID-19) is devastating, despite extensive implementation of control measures. The outbreak was sparked in Wuhan, the capital city of Hubei province in China, and quickly spread to different regions of Hubei and across all other Chinese provinces.

As recorded by the Chinese Center for Disease Control and Prevention (China CDC), by Feb 16, 2020, there had been 70 641 confirmed cases and 1772 deaths due to COVID-19, with an average mortality of about 2.5%.¹ However, in-depth analysis of these data show clear disparities in mortality rates between Wuhan (>3%), different regions of Hubei (about 2.9% on average), and across the other provinces of China (about 0.7% on average). We postulate that this is likely to be related to the rapid escalation in the number of infections around the epicentre of the outbreak, which has resulted in an insufficiency of health-care resources, thereby negatively affecting patient outcomes in Hubei, while this has not yet been the situation for the

other parts of China (figure A, B). If we assume that average levels of health care are similar throughout China, higher numbers of infections in a given population can be considered an indirect indicator of a heavier health-care burden. Plotting mortality against the incidence of COVID-19 (cumulative number of confirmed cases since the start of the outbreak, per 10 000 population) showed a significant positive correlation (figure C), suggesting that mortality is correlated with health-care burden.

In reality, there are substantial regional disparities in health-care resource availability and accessibility in China.² Such disparities might partly explain the low mortality rates—despite high numbers of cases—in the most developed southeastern coastal provinces, such as Zhejiang (0 deaths among 1171 confirmed cases) and Guangdong (four deaths among 1322 cases [0.3%]). The Chinese government has realised the logistical hurdles associated with medical supplies in the epicentre of the outbreak, and has strived to accelerate deliveries, mobilise the country's large and strong medical forces, and rapidly build new local medical facilities. These measures are essential for controlling the epidemic, protecting health workers on the front

line, and mitigating the severity of patient outcomes. Acknowledging the potential association of mortality with health-care resource availability might help other regions of China, which are now beginning to struggle with this outbreak, to be better prepared. More importantly, as COVID-19 is already affecting at least 29 countries and territories worldwide, including one north African country, the situation in China could help to inform other resource-limited regions on how to prepare for possible local outbreaks.³

We declare no competing interests.

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- 1 Chinese Center for Disease Control and Prevention. Distribution of new coronavirus pneumonia. <http://2019ncov.chinacdc.cn/2019-nCoV/> (accessed Feb 16, 2020).
- 2 Yu M, He S, Wu D, et al. Examining the multi-scalar unevenness of high-quality healthcare resources distribution in China. *Int J Environ Res Public Health* 2019; **16**: e2813.
- 3 Makoni M. Africa prepares for coronavirus. *Lancet* 2020; **395**: 483.

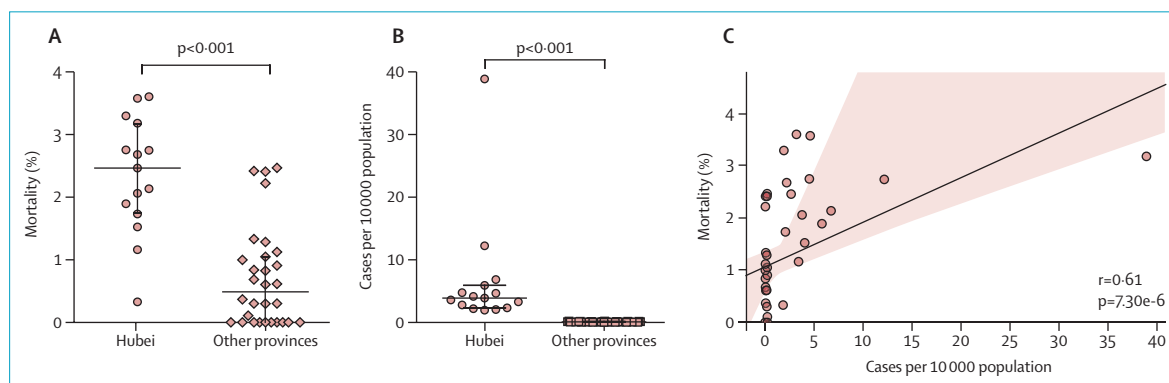


Figure: Mortality and incidence of COVID-19 in Hubei and other provinces of China

Mortality (A) and cumulative number of confirmed cases of COVID-19 since the start of the outbreak per 10 000 population (B) in Hubei and other provinces of China. Horizontal lines represent median and IQR. p values were from Mann-Whitney U test. (C) Correlation between mortality and number of cases per 10 000 population (Spearman method). Data were obtained from the Chinese Center for Disease Control and Prevention to Feb 16, 2020. COVID-19=coronavirus disease 2019.

