OUTBREAK ALERT

Transboundary and Emerging Diseases   WILEY

Decreased Case Fatality Rate of COVID-19 in the Second Wave: A study in 53 countries or regions

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Abstract

The raw case fatality rate (CFR, the reported number of COVID-19 deaths divided by the total number of cases) is an important indicator to quantify the severity or treatment efficacy. In many countries, the pandemic had experienced two waves to date. To our knowledge, no studies have compared the CFR between the two waves. In this work, we reported the CFR of 53 countries or regions with the highest COVID-19 death tolls. Of them, 43 had lower CFR estimates in the ongoing second wave than in the first wave. We discussed the possible reasons. Also, we compared the two-wave pattern of COVID-19 with those of influenza. Influenza activities in the pre-pandemic era provided an indicator for seasonality of climate in a country. The sharp drop in influenza activities in 2020 could an indicator of the effects of social distancing.

KEYWORDS
case fatality rate, COVID-19, influenza

The ongoing COVID-19 pandemic has caused a serious health threat globally. Many countries have seen a two-wave pattern of reported cases, namely a second wave followed the first wave. To our knowledge, there are no studies to date to compare the case fatality rate between these two waves (Figure 1).

We obtained daily confirmations of COVID-19 cases and deaths in 216 countries or regions, during February 2020-August 2020, and weekly influenza confirmations during 2015 to current week, from the World Health Organization (https://covid19.who.int; https://www.who.int/influenza/gisrs_laboratory/flunet/en/). We showed
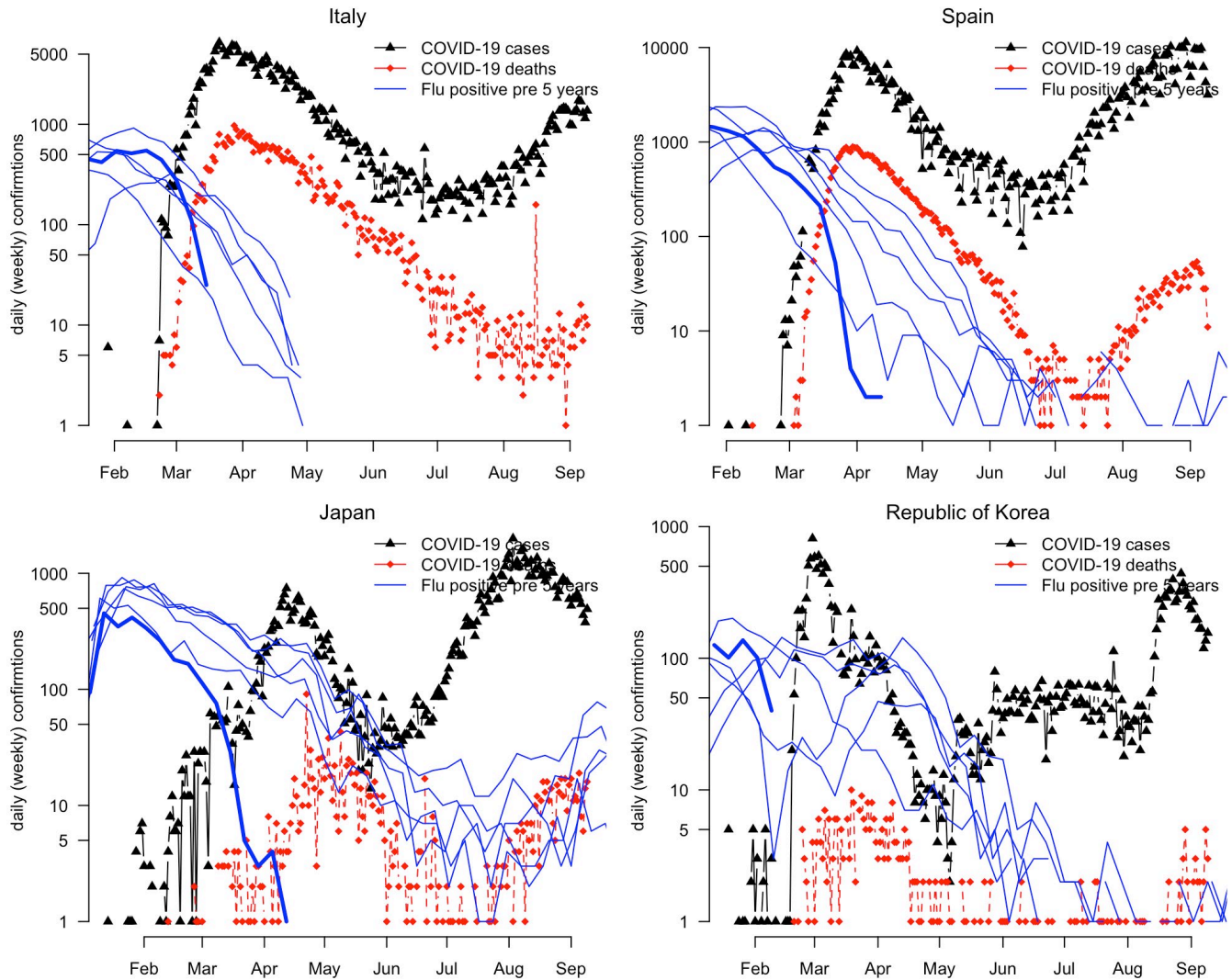
FIGURE 1 Time series plots of daily confirmed COVID-19 cases (in black), COVID-19 deaths (in red) and influenza-positive cases in 2015–2019 (in light blue) and in 2020 (in dark blue)

the data of four countries (two from Europe and two from Asia which caught a lot of attention in the early phase of the pandemic) in Figure 1. The results of the other 49 countries or regions are listed in the Supporting Information. The time series (in common log scale on vertical axis) of confirmed cases showed two waves. Based on this observation, we divided the transmission of the disease into two phases: Phase I before June 1 and Phase II after June 1 for confirmed cases; and Phase I before June 10 and Phase II after June 10 for deaths. For deaths, we choose the truncated time ten days later to account for the delay between confirmation and deaths (Yang et al., 2020). We compared the raw case fatality rate (CFR) of Phase I and Phase II for all countries or regions.

In our Supporting Information data in the appendix, for each country, we break down the data for Phase I or Phase II. The column 'case_pre' is the total of confirmed cases before June 1, and the column 'case_post' is the total of confirmed cases after June 1 up to July 26. Accordingly, the column of 'death_pre' is the infection death before June 10 and the column 'death_post' is the

infection death after June 10 up to August 6. We define the raw case fatality rates (CFR) as $r_1 = \frac{\text{death\_pre}}{\text{case\_pre}}$ and $r_2 = \frac{\text{death\_post}}{\text{case\_post}}$. Then, the change in CFR is reduction $= \frac{r_1 - r_2}{r_1}$. Based on our analysis, among all 53 most affected countries or regions (Table S1), 43 had an apparent reduction in CFR, and the rest ten had an increase in CFR in opposite. The median of the 53 reductions is 0.383, and the first quantile is 0.194. The decrease of CFR might indicate the decreasing severity of the global pandemic, and the potential reasons warrant further investigations. We propose the following hypotheses that could contribute to the decrease of CFR in the second phase. First, the lower CFR in the second phase than in the first phase could be a harvest effect. In other words, a large number of the elderly and those with health conditions (the vulnerable groups) likely had died in the first wave, especially in these countries with a high infection rate. By contrast, if a country or region (such as Hong Kong) was spared from the first phase, it might have an increase in CFR when the virus attacked again. Second, the test capacities and healthcare system in many countries could have been

better prepared in the second phase. As a result, mild and asymptomatic cases were more likely reported in the later outbreaks, and severe cases could have received timely and treatments to greatly reduce the CFR. Third, the age structure of infected people could have changed from the first wave to the second wave due to many reasons. For example, social movement in many countries might involve more healthier young individuals. Fourth, the virus might have evolved to increase its transmissibility in young healthy adults and children, which could be further facilitated by low compliance of social distancing in young people. Last but not least, favourable environmental factors might have led to a reduced CFR (e.g. warmer weather in the Northern Hemisphere and improved air quality due to city lockdown as reported in many studies (Ran, Zhao, Han, Chen, et al., 2020; Ran, Zhao, Han, Liao, et al., 2020; Ran, Zhao, Han, Qiu, et al., 2020). Current evidence remains limited to suggest which of the above hypotheses is more plausible. Nevertheless, according to the classical epidemiologic triangle model, the interactions of the host, pathogen and environment determine the characteristics of outbreaks, rather than one or two factors alone.

We show the time series plots of eight countries in Figures S1 and S2 and summarize the results of 53 countries or regions in Figure S3, and Table S1. Majority of (43 out of 53) countries or regions had a decrease in the raw CFR. 10 countries showed increased raw CFR, which could be due to a variety of reasons, for example being in south hemisphere (Peru and Chile), milder first wave. The weekly influenza laboratory confirmations for the previous five years may be used as a proxy of the seasonality of climate and population global travel pattern in a country (Bedford et al., 2015). Thus, we may wonder whether favourable weather might have contributed to a reduce CFR of COVID-19. The sharp drop in influenza cases in 2020 (dark bold curve), compared to those in previous years, may be due to social distancing and possible interference with COVID-19 infection. Thus, it is informative to compare the COVID-19 and influenza data in these plots. Individual or age-specific data are needed to further investigate the reasons behind changing CFR. The finding is nevertheless of significance to inform the public and policy-makers. Although the lower CFR in the second phase is a positive sign to suggest the decrease severity of COVID-19 infections, the shift to younger age groups could bring more difficulty in containing the pandemic. We also need to stay vigilant for the potential rebound of influenza outbreaks as many countries or regions are planning to lift social distancing control measures.

CONFLICT OF INTEREST

AUTHOR CONTRIBUTIONS

All authors conceived the study, carried out the analysis and drafted the first manuscript. All authors discussed the results, critically read and revised the manuscript, and gave final approval for publication.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The ethical approval or individual consent was not applicable.

DATA AVAILABILITY STATEMENT

All data and materials used in this work were publicly available.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.