

Title:

Positive impact of measures against COVID-19 on reducing influenza in the Northern Hemisphere

Running title:

Attenuated influenza seasons and COVID-19

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Highlight

Social distancing measures against COVID-19 have created positive impacts on the Northern Hemisphere's winter influenza season by shortening seasonal duration, lowering post-season trough and speeding up post-season fall of influenza activities. Such measures could be incorporated as public health interventions in severe influenza season in the future.

Influenza may constitute health threats to travellers going between places with different seasonal patterns.¹ The emergence of the COVID-19 pandemic during the winter influenza season of most countries in the Northern Hemisphere provided an opportunity for examining the interface between the two epidemics in a broad geographical context.

We accessed weekly data of laboratory-confirmed influenza between 2014/15 and 2019/20 from online sources in Hong Kong, South Korea, Taiwan, Europe (50 Member States with routine influenza surveillance systems in the WHO European Region <https://flunewseurope.org/System>) and the United States (US). We calculated the rate of change of the three-week moving average of weekly positive rate of collected biological samples for influenza to determine the time of onset and end of the season. Reported weekly rate was used to determine the following measures for each influenza season: time and level of peak and post-season trough, duration of the season and its descent, amplitude and slope (definitions in **Supplementary Data I**). Compared to the average measures in 2014/15-2018/19, the winter influenza seasons of 2019/20 was attenuated with the following characteristics: First, decrease in seasonal duration, from 27.5 to 13 weeks in Hong Kong, 39 to 25 weeks in the US, 33.2 to 28 weeks in Europe and 15.3 to 15 weeks in Taiwan. Second, an extremely low post-season trough was noted, reaching zero in South Korea, Europe and Taiwan, and 0.2% in Hong Kong and the US. Third, a rapid descent within 7-12 weeks was observed in all places except Taiwan, relative to 8.3-23.4 weeks in 2014/15-2018/19. (**Supplementary Data II and III**). Comparing with the previous seasons, the number of laboratory tests for influenza before the end of the 2019/2020 winter season had not decreased significantly.

Towards the end of the year 2019, China reported an outbreak of a novel coronavirus (subsequently referred as SARS-CoV-2) causing COVID-19 which evolved to become a pandemic.² The correspondence of the timing of the SARS-CoV-2 pandemic and the winter influenza season of the Northern Hemisphere prompted our investigation of the possible relationship between the two epidemics. **Figure 1** shows the temporal association between the winter influenza season 2019/20 and the COVID-19 outbreaks. In Hong Kong, the onset of COVID-19 outbreak, coinciding with the seasonal peak, was followed by steadily weakening influenza activities, whereas in South Korea and Taiwan, where COVID-19 arose after the peak, an abrupt decline of influenza incidence from week 5 to 6 was observed (40.9% to 16.7% and 37.7% to 20.5% respectively). To demonstrate the impacts of human mobility, we aligned the mobility trend in transit stations (Google Community Mobility Report <https://www.google.com/covid19/mobility/> from week 8/2020) with the epidemic curves. In Europe and the US, human mobility plummeted in conjunction with influenza activities from week 10 as COVID-19 arrived before their influenza seasonal peak. In Hong Kong, Taiwan and South Korea, there was generally lower population movement since week 8 compared to baseline. In Asian communities, social distancing interventions including school closures implemented immediately after the Lunar New Year holidays, accompanied by mass masking, might have led to an earlier blunting of the influenza season 2019/20.³⁻⁵

Our analyses highlighted the unintended benefits of social distancing in easing the concurrent influenza epidemics, given the shared transmission route of the two viruses, echoing results of recent studies in the Singapore and China, and news reported in Australia in the Southern Hemisphere.⁶⁻⁸ There was consistently an immediate but indirect effect of COVID-19 on attenuating and shortening the concurrent winter influenza seasons of 2019/20 in widely distributed countries/cities in the Northern Hemisphere. Our use of positive sampling rate

instead of influenza-like illness (ILI) estimate, has served to better reflect the intensity of influenza activity by avoiding the confounding effects of ILI symptoms resulting from COVID-19.

We acknowledge that our study could be limited by the selection bias as a result of accessing data from places with available data in the Northern Hemisphere and the reduction in ILI consultation during the pandemic. Also, without complete and updated data on influenza vaccination coverage in the corresponding places, we could not account for its impacts on the influenza season. Nonetheless, should there be a significant increase of influenza vaccination coverage before the 2019/2020 season, its impact would have been on the peak level of the season instead of seasonal duration, post-season trough or the declining rate of the season. Despite the limitations, the consistent observations of the positive impacts of public health measures in the community called for focussed attention on the strategic application of social distancing. Notably, social distancing could be considered as an intervention for incorporation in future strategy in response to severe influenza seasonal outbreaks.

(765 words)

Author contributions

N.S.W. and S.S.L. conceived the original idea and designed the study. C.C.L. contributed to the interpretation of results. C.P.C performed data analysis and prepared the first draft with input from all authors. All authors provided critical feedback and shaped the manuscript.

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Conflict of interest

The authors have no conflict of interest to declare.

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Figure Legend

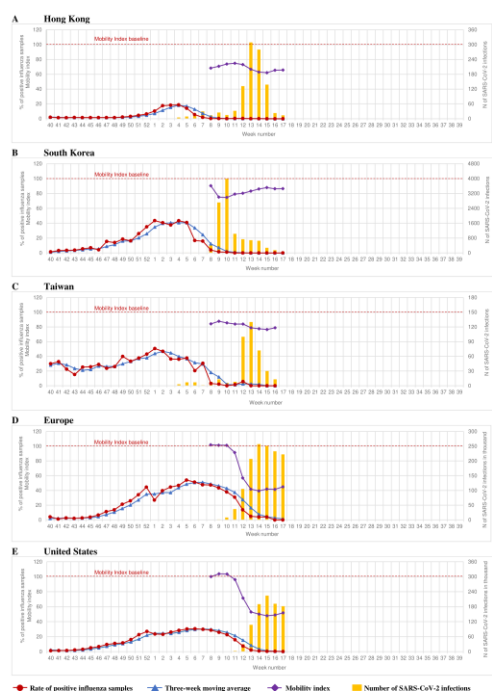


Figure 1. Weekly rate of positive influenza samples, number of SARS-CoV-2 infections and mobility index in the 2019/20 season

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This figure compared the weekly rate of positive influenza samples with the number of SARS-CoV-2 infections and mobility index in the 2019/20 season in Hong Kong (A), South Korea (B), Taiwan (C), Europe (D) and the United States (E). The scales of number of SARS-CoV-2 infections in A-E were different. Mobility index reflected the visits and duration of stay at transit stations compared to the baseline period from 3rd January to 6th February 2020.