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26

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The correlation between COVID-19 and Influenza activity after relaxation of public health and social measures in Hong Kong, 2023

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Background

Since February 2022, strict interventions in Hong Kong SAR have been gradually relaxed due to reduced domestic cases. After the lift of the mask on March 2023, the first COVID-19 outbreak occurred in Hong Kong, lasting for about 22 weeks.

Objectives

We collected the COVID-19 weekly consultation rates starting in February 2023 in Hong Kong. Regarding influenza, we established a proxy for influenza virus activity by multiplying rates of influenza-like illness by the proportion of influenza-positive samples, which could be collected from the Centre of Health Protection, Hong Kong. We also collected the influenza cases in this period and estimated the reproduction numbers of influenza H1N1 and H3N2.

Methods

We collected COVID-19 weekly consultation rates starting in February 2023 in Hong Kong. Regarding influenza, we used an established proxy for influenza virus activity by multiplying rates of influenza-like illness by the proportion of influenza-positive samples [1], which could be collected from the Centre of Health Protection, Hong Kong.

We chose to focus on using the instantaneous R_t to measure time-varying transmissibility in our study. Firstly, we used a previous method [2] to calculate the reproduction number (R_t) using the weekly reported cases. To simplify the model, we assumed that the distribution of infectiousness over time following infection is independent of calendar time. This means that the transmission process can be modeled using a Poisson process. Using Y_k denote the actual (but unobserved) number of new local cases infected on day k. Then, we have:

$$Y_t \sim Poisson\{R_t \sum_{k=1}^{t-1} Y_k \, w_{t-k}\}$$

, in which w_s is a probability distribution of the infectiousness profile since infection. We assumed the prior for R_t is Gamma(1,1.5) with mean and standard deviation equal to 1.5. A Bayesian framework and a Markov chain Monte Carlo (MCMC) algorithm were used to estimate the model parameters. Using the similar method, we calculate the reproduction number of Influenza.

Considering the virus interference, we intercept the weekly H1N1 R_t from 2023-03-05 to 2023-05-20 and the weekly H3N2 R_t from 2023-05-21 to 2023-08-12 and calculated the Pearson correlation and Spearman correlation with corresponding COVID-19 R_t respectively.

Results

We plot the COVID-19 and Influenza activity and R_t in the first outbreak of COVID-19 after the lift of the wearing-mask mandate. Intuitively, we found that the Influenza activity and R_t showed a relation with that of COVID-19, as shown in Figure 1. The Pearson and Spearman correlation of two trajectories is shown in Figure 1 panel B performed in Table 1.

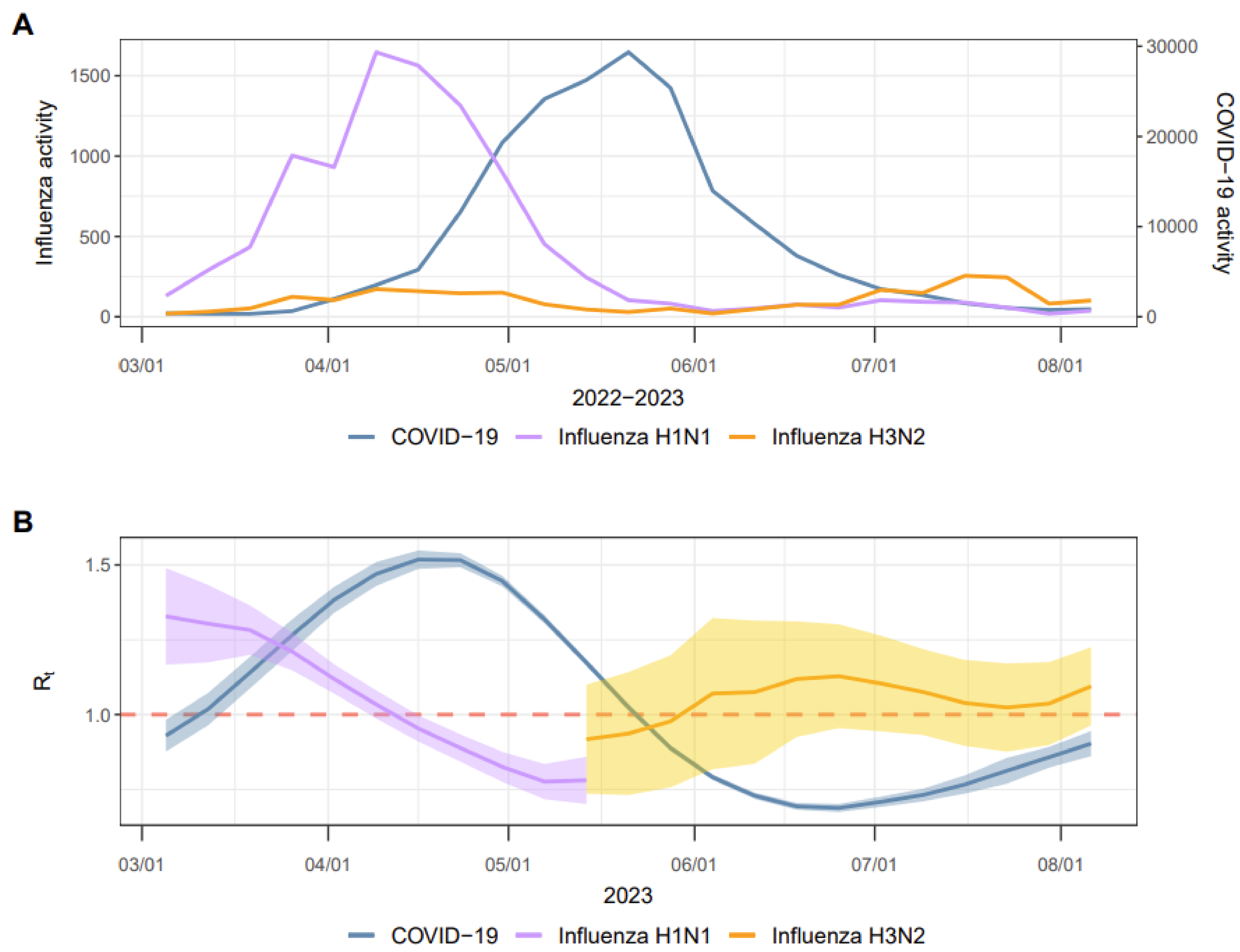

Figure 1. The Influenza and COVID-19 activity and R_t.

Table 1. The Pearson and Spearman correlation of Influenza and COVID-19 R_t.

Pearson correlation:

	COVID-19	H1N1	H3N2
COVID-19	1	-0.63 (-0.89,-0.05)	-0.88 (-0.96,-0.63)
H1N1	-0.63 (-0.89,-0.05)	1	NA
H3N2	-0.88 (-0.96,-0.63)	NA	1

Spearman correlation:

	COVID-19	H1N1	H3N2
COVID-19	1	-0.56	-0.83
H1N1	-0.56	1	NA
H3N2	-0.83	NA	1

Conclusion

By calculating the Pearson and Spearman correlation for Rt of Influenza and COVID-19, we found that a high correlation existed between them during the first COVID-19 outbreak after the lifting of wearing-mask mandating in Hong Kong. The Pearson correlation between COVID-19 and H1N1 is -0.63 (95% confidence interval: -0.89 to -0.05), and the Pearson correlation between COVID-19 and H3N2 is -0.88 (95% confidence interval: -0.96 to -0.63). The Spearman correlation between COVID-19 and H1N1 is -0.56, and the Spearman correlation between COVID-19 and H3N2 is -0.83.

References

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