Short Communication

Exported cases were infected on the way: A conjecture derived from analysis on Hong Kong monthly exported COVID-19 cases

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Dear Editor

During this COVID-19 pandemic, imported cases have played the role of triggering outbreaks in their arrival city and exported cases are used to infer the infection risk in their departure city (Imai et al., 2020; Menkir et al., 2021). Hong Kong, as a hub of international travel, faced this situation in particular. However, we argue that in the current phase of the pandemic, the role of exported cases in inferring the infection risk in their departure city loses its power; we use Hong Kong, an international travel hub, as an example. We collected exported cases of Hong Kong from March 2020 to November 2021 from online sources (Department of Health HKSAR, 2021a; 2021b). The data revealed an anomalous discrepancy in the trend of monthly Hong Kong exported cases compared with the local epidemic severity since April 2021 (supplementary Figure S1). From Figure 1, the aberrant inconsistency can also be observed with respect to the monthly export ratio of airport and the overall ratio, which raised our attention(Department of Health HKSAR, 2021a; 2021b; Immigration Department HKSAR, 2021). With further analysis, we conclude that these exported cases reflect the infection risk on their trips, rather than locally when the pandemic in the departure city is well controlled.

Considering the whole 21-month observation period, the number of exported cases and departure population by road

has demonstrated a positive and significant correlation (r=0.78, p=3.251e-05), whereas the correlation is not significant in the travel-by-air group. Because people leaving by air have a much wider destination range than people leaving by road whose target is Mainland China or Macao, places with a strict COVID-19 prevention policy, the data of export cases by air may suffer from underreporting. This inaccuracy may be the leading factor contributing to the insignificance shown in the Export and Departure correlation test when the data by road and air are added together. Therefore, 2 multiple linear regression models are derived from the overland data only, and then used to estimate the true monthly exported cases of airport. To clarify, recorded exported cases are defined as those who left from Hong Kong and were confirmed in the following 21 days, which is close to the 99th percentile of the incubation period reported by some studies (Qin et al., 2020; Dhouib et al., 2021). True exported cases are defined as those who left from Hong Kong after being infected locally and were confirmed outside Hong Kong. The former model only includes local cases and outward passenger traffic statistics as regressors. The other includes interaction but drops the term of local cases because it is not significant after adding the interaction term. Both models are significant overall, with the p value less than 0.01. The second model performs slightly better in terms of correlation, relative SE, and F statistic. As shown in Figure 2, the prediction results of the 2 models have a similar trend. Before April 2021, prediction results capture the volatility of recorded monthly airport exported cases most of the time. Nevertheless, from April 2021 to September 2021, there is an evident gap between them. This implies that these recorded exported cases contracted the virus during travel or at their destinations, rather than being infected locally. More de-

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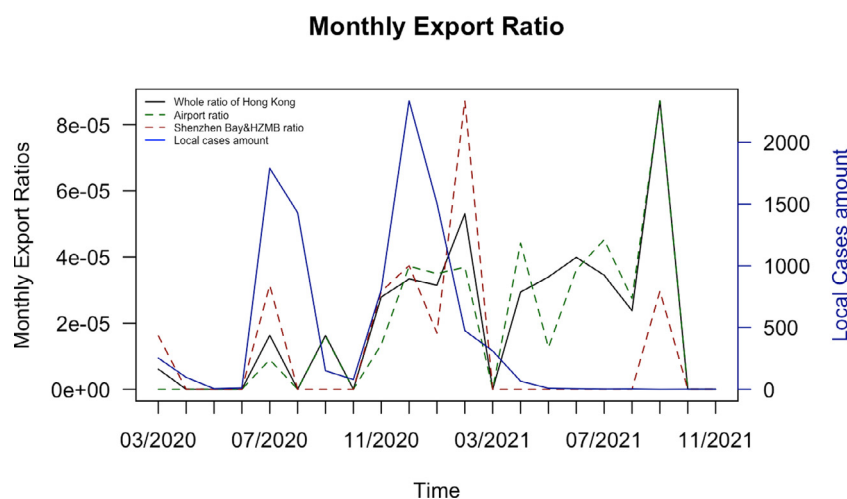
Monthly Export Ratio

Figure 1. The black, green, red, and blue lines represent monthly exported ratio of Hong Kong, monthly exported ratio of Airport, monthly exported ratio of Shenzhen Bay& HZMB, and number of monthly local cases, respectively.
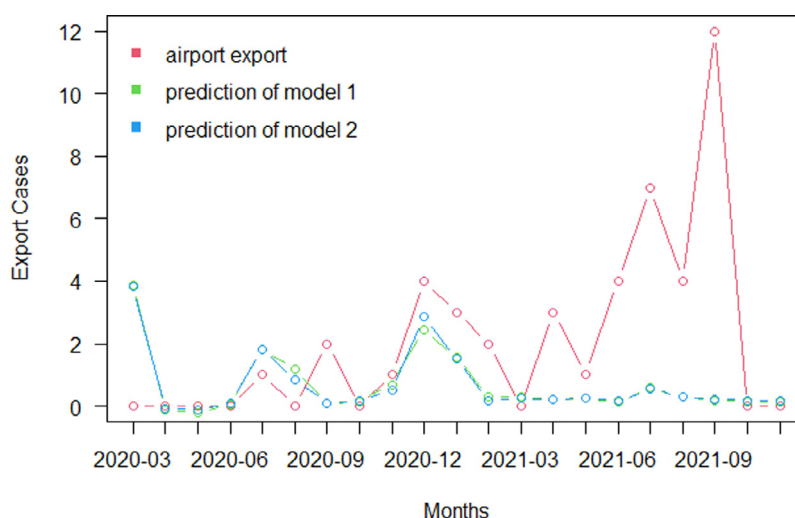

Figure 2. The red, green, and blue lines represent recorded monthly exported cases via airport, prediction results of 2 models (without and with interaction), respectively.

tails about the correlation analysis and multiple linear regression are shown in supplementary Figures S2-S5.

Another supporting evidence is that after each exported case was reported, the Hong Kong government implemented mandatory COVID-19 tests on people who might have been in contact with patients during their incubation period, such as those who had visited the same building, but no corresponding local cases were found. Furthermore, the data of Hong Kong exported cases also have some implications for strategies to enhance the control of COVID-19. First, from supplementary Figure S6, nearly all time intervals (from the departure date to the confirmation date) of exported cases are less than 14 days, which affirms the rationality of the 14-day quarantine policy. In addition, more than 60% of the time interval is within 3 days, which implies that a re-test of COVID-19 on the third day of quarantine would be helpful. Second, we would recommend that stringent epidemic prevention measures should be taken by customs and cross-border transport. Simplifying the exit and entry procedures may also help reduce the risk of infection because it shortens the waiting time when travelers are likely to take off their masks for food or water, or to gather to chat. In addition, travelers are also highly recommended to stay alert to COVID-19 and keep good personal hygiene during travel.

Authors' contributions

All authors conceived the study, carried out the analysis, wrote the draft, revised the manuscript critically, and approved it for publishing.

Ethics approval and consent to participate

This study only reanalyzed publicly available data that were carried out in accordance with relevant guidelines and regulations.

Consent for publication

Not applicable.

Availability of data and materials

All data are publicly available.

Declaration of Competing Interest

The authors report no competing interests.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijid.2022.02.027.

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