Iran J Public Health, Vol. 54, No.4, Apr 2025, pp.795-800

Original Article

A Case Study on Trends in Acute Respiratory Illnesses and Influenza in Singapore: Pre-, during, and Post-COVID-19 Pandemic

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(Received 20 Sep 2024; accepted 24 Dec 2024)

Abstract

Background: We investigated trends in acute respiratory illnesses and influenza activity in Singapore throughout the COVID-19 pandemic.

Methods: Publicly available data from the Ministry of Health, Singapore was used to estimate the number of daily acute respiratory illnesses (ARI) and influenza cases between 2019 and Jun 2023. Overseas travel activity was obtained from the Department of Statistics, Singapore. Trends in ARI and influenza activity during different phases of the COVID-19 pandemic with changes in key public health measures were compared.

Results: Pre-pandemic influenza activity exhibited seasonal peaks in Jan and Jul, with daily estimated cases exceeding 40 during these periods. During the early pandemic, influenza cases declined sharply to close to zero and remained at these levels until mid-2022, even after public health measures were eased. ARI cases followed a similar initial decline but gradually returned to pre-pandemic levels by 2023, with peaks occurring outside the usual seasonal pattern. These trends corresponded with phases of public health measures, including mask-wearing and travel restrictions.

Conclusion: Several hypotheses for these contrasting trends were explored, including increased public health awareness, higher influenza vaccination rates, and potential virus-virus interactions.

Keywords: Acute respiratory illness (ARI); Influenza; COVID-19; Public health measures; Viral interference

Introduction

Singapore has an established influenza surveillance system which monitors acute respiratory illnesses (ARI) and Influenza-like Illnesses (ILI) through data sourced from a national network of primary care clinics and the National Public Health Laboratory.

Previous studies have documented a decline in influenza activity during the early phases of the COVID-19 pandemic in early 2020(1, 2), followed by a rebound in influenza activity reported in many regions post-pandemic, with influenza activity returning to pre-pandemic levels in some countries (3-5). However, research on the local dynamics of ARI and influenza in Singapore across the different phases of the pandemic is limited. The factors influencing these trends, including the potential impact of public health measures, have not been fully explored. Under-

DOI: 10.18502/ijph.v54i4.18417

standing these trends may provide insights into how ARI and influenza activity respond to large-scale behavioral and societal changes, which could help in tailoring and optimizing public health measures for future outbreaks of respiratory diseases.

We aimed to investigate the trends in ARI and influenza activity in Singapore from 2019 to Jun 2023, spanning the pre-pandemic, pandemic and post-pandemic periods. By analyzing publicly available data from the Ministry of Health, Singapore, the study seeks to explore any correlation between these trends and public health measures introduced during the various phases of the COVID-19 pandemic.

Materials and Methods

We charted and compared trends in ARI and influenza activity between 2019 to June 2023 using publicly available data published by the Communicable Diseases Division, Ministry of Health (MOH) (6, 7). These data included the average number of patients seeking treatment in government primary care clinics per day and proportion of patients with ILI, ILI samples tested per week, and percentage influenza positivity. We estimated number of influenza cases per day, as a marker of influenza activity, by multiplying the average number of ILI visits per day with the influenza positivity rate (8). We reviewed trends in ARI and influenza activity during different phases of the COVID-19 pandemic, with changes in key public health measures including mask wearing, restrictions on group sizes, workplace requirements and travel activity. Publicly available data on travel activity was obtained from the Department of Statistics, Singapore website. Ethics approval was not required for this study as it did not involve human participants or identifiable personal data. The analysis was conducted using publicly available and anonymized data.

Results

Prior to the COVID-19 pandemic, influenza occurred all year round in Singapore with peaks in January and again in July. Similarly, ARI showed similar trends with higher peaks at the end of the year (Fig. 1 and 2).

At the start of the COVID-19 pandemic, public health advice to wear a mask when unwell, in addition to travel restrictions and quarantining of returning travelers coincided with a rapid decline in both ARI and influenza activity. Of note, this rapid decline in ARI and influenza activity occurred prior to circuit breaker, mandatory mask wearing and other public health measures such as the restriction of social group sizes and gatherings (Fig. 1 and 2). Circuit breaker (9, 10) was the 2-month period from 7 April 2020 (epidemiological week (Ewk) 15 2020) to 1 June 2020 (Ewk 23 2020) when Singapore implemented significantly stricter measures such as suspension of non-essential businesses, closing restaurants for dining in, adopting full home-based learning for schools and advising the public to stay at home unless absolutely necessary to go out, with mandatory mask wearing outdoors (11, 12).

Even after circuit breaker had ended, Singapore continued to put in place many public health measures such as mandatory mask wearing in public spaces, border restrictions and restrictions on social gatherings and group sizes. Of note, students returned to schools soon after the end of the circuit breaker on 2 Jun 2020 (Ewk 23 2020) (13). The estimated number of influenza cases seen in government primary care clinics remained close to zero after the circuit breaker for a significant duration until June 2022, during the transition phase (14) of the COVID-19 pandemic in Singapore (Fig. 2). On the other hand, shortly after the circuit breaker from Jun 2020, ARI cases began to increase with relaxation of restrictions on social group sizes and workplace requirements shortly after the circuit breaker, with temporary declines in ARI cases when public health measures were tightened, such as during Phase 2 Heightened Alert (15, 16) (Fig. 1).

As Singapore transitioned to living with COVID-19, restrictions on social group sizes, workplace requirements and mask wearing were relaxed gradually from Jan 2022. Relaxation of these measures, coincided with a general increase in ARI cases back to pre-pandemic levels, with peaks occurring outside of the usual middle of year and end of the year period (Fig. 1). In contrast, influenza activity showed only a small increase and remained at levels far lower than the pre-pandemic levels, with a single peak occurring in the second half of 2022, and another in the first half of 2023, both of which were less than 10 cases per day as compared to peaks of more than 40 cases per day seen during 2019 (Fig. 2).

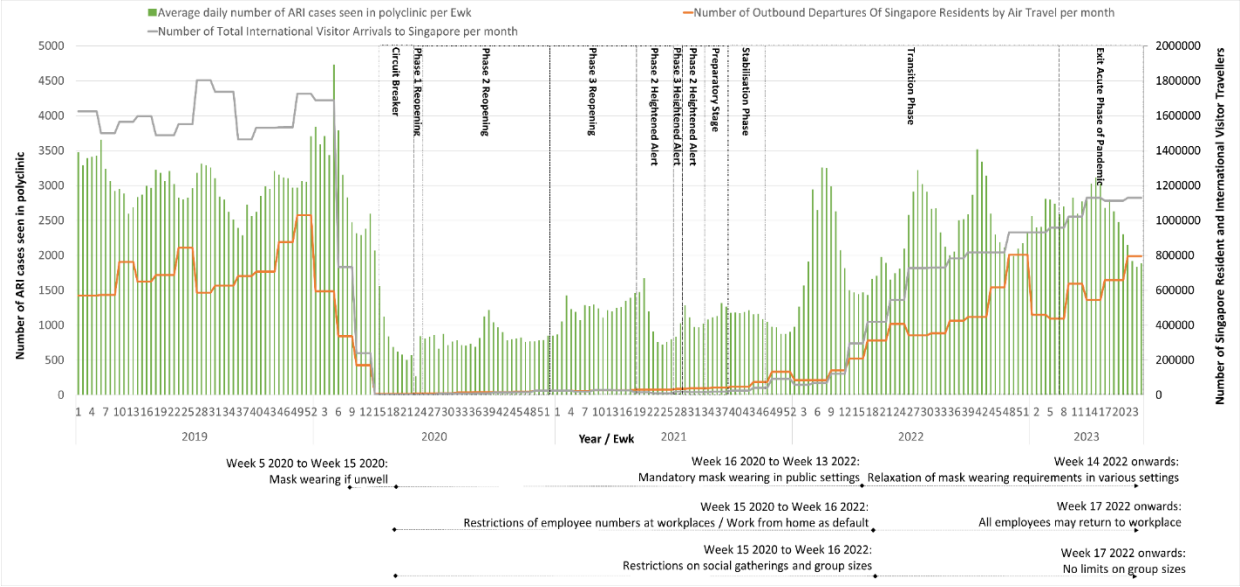

Fig. 1: Average daily number of ARI patients seen in polyclinics per epidemiological week (Ewk) from January 2019 to June 2023

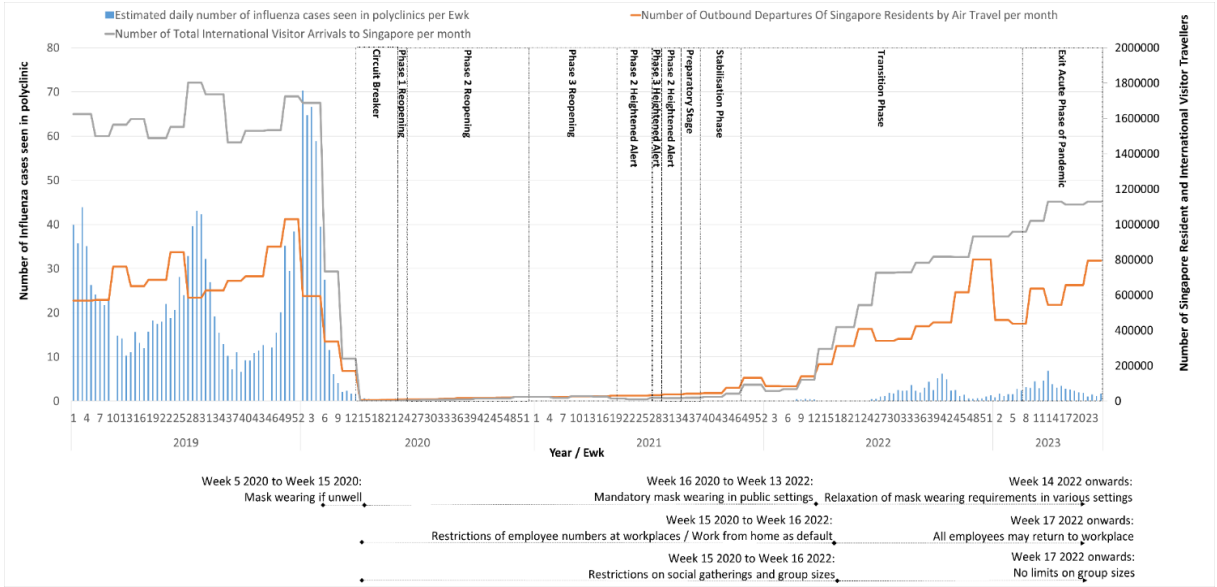

Fig. 2: Estimated daily number of influenza cases seen in polyclinics per epidemiological week (Ewk) from January 2019 to June 2023

Discussion

With the resumption of international travel and relaxation of public health measures post pandemic, it was interesting to note the differing trends in ARI and influenza activity. ARI activity had increased significantly with levels returning to pre-pandemic period in 2019, while influenza activity remained far lower than the pre-pandemic period in 2019. This was on a background of increased number of ILI surveillance samples tested as compared to pre-pandemic levels in 2019. We explored several hypotheses for the observed differences between ARI and influenza activity.

Firstly, public health education during the COVID-19 pandemic could have contributed to greater awareness on the prevention of respiratory illnesses and changes in health seeking behavior. Although most public health measures had been lifted, mask wearing continued to be a requirement in healthcare settings and was encouraged by the government in crowded places, and for individuals who were feeling unwell. Post-pandemic, adoption of hybrid working arrangements and changes in health seeking behavior could have also contributed to increased self-testing and self-management. This hypothesis was, however, unable to explain the rebound in ARI cases if there were indeed changes to health seeking behavior and prevention due to public health education efforts.

Secondly, there had been an increase in annual influenza vaccination rates during and after the COVID-19 pandemic, in a bid to reduce the healthcare burden of respiratory tract infections in the community. From the National Population Health Survey 2022, the overall annual influenza vaccination rates for Singapore residents had increased from 13.1% in 2017 to 17%, 18.7% and 18% in 2020, 2021 and 2022 respectively (17). Although increase in influenza vaccine coverage during the COVID-19 pandemic could have contributed to improved protection against influenza, the magnitude of increase in vaccination was small and unlikely to fully explain reduced influenza activity levels post pandemic.

Lastly, virus-virus interactions could have contributed to the decline in influenza activity during the initial phase of the COVID-19 pandemic in early 2020, as well as post-pandemic. The emergence of novel viruses could limit the spread of existing viral diseases such as influenza, through a process known as negative viral interference or viral competition (18). A literature review by Deleveaux et al. supported the idea that COVID-19 virus interfered with the infectivity of Influenza A but did not appear to have a significant effect on rhinovirus infections (19). This phenomenon could possibly explain the modest increase in influenza activity on a background of a rebound in ARI activity back to pre-pandemic periods.

The study had several limitations which affect the generalizability of the findings. Firstly, the study relied on publicly available data from the Communicable Diseases Division, Ministry of Health, sourced from government primary care clinics. However, these clinics represented only 20% of primary care healthcare demand while private general practitioners accounted for about 80% of primary care demand (20, 21). Secondly, MOH did not publish population level data on the incidence of common respiratory viruses causing ARI, such as respiratory syncytial virus, adenovirus and rhinovirus.

Conclusion

Understanding the circulation pattern of other viruses would allow for further insights into the observed trends in ARI compared with influenza. Lastly, as this study was an ecological study analyzing population level data, causal relationships between public health measures and observed trends could not be established and further research would be required.

Journalism Ethics considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors.

Acknowledgements

The authors thank the colleagues in Staff Health Clinic and Epidemiology Unit assisted in the publication. This research received no external funding.

Conflict of Interest

The authors declare no conflicts of interest.

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