Impact assessment of non-pharmaceutical interventions against COVID-19 and influenza in Hong Kong: an observational study

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ABSTRACT

Background: A range of public health measures have been implemented to delay and reduce local transmission of COVID-19 in Hong Kong, and there have been major changes in behaviours of the general public. We examined the effect of these interventions and behavioral changes on the incidence of COVID-19 as well as on influenza virus infections which may share some aspects of transmission dynamics with COVID-19.

Methods: We reviewed policy interventions and measured changes in population behaviours through two telephone surveys, on January 20-23 and February 11-14. We analysed data on laboratory-confirmed COVID-19 cases, influenza surveillance data in outpatients of all ages, and influenza hospitalisations in children. We estimated the daily effective reproduction number (R_t), for COVID-19 and influenza A(H1N1).

Findings: COVID-19 transmissibility has remained at or below 1, indicating successful containment to date. Influenza transmission declined substantially after the implementation of social distancing measures and changes in population behaviours in late January, with a 44% (95% confidence interval, CI: 34% to 53%) reduction in transmissibility in the community, and a 33% (95% CI: 24% to 43%) reduction in transmissibility based on paediatric hospitalization rates. In the two surveys we estimated that 74.5% and 97.5% of the general adult population wore masks when going out, and 61.3% and 90.2% avoided going to crowded places, respectively.

Implications: Containment measures, social distancing measures and changes in population behaviour have successfully prevented spread of COVID-19. The social distancing measures and behavioural changes led to a substantial reduction in influenza transmission in early February 2020. However, it may be challenging to avoid fatigue

and sustain these measures and population behaviours as COVID-19 continues to

spread globally.

INTRODUCTION

The WHO-China Joint Mission on COVID-19 completed its work and tendered the final
report on February 24, 2020.[1] The mission concluded that there had been a substantial
fall in reported case counts in mainland China since late January. These epidemic trends
resulted from unprecedented, perhaps draconian, non-pharmaceutical interventions
implemented, particularly since the *cordon sanitaire* was imposed on Wuhan and
surrounding municipalities on January 23, 2020. The measures relied heavily on
massive mobility restrictions within and between conurbations, universal fever
screening in all settings, neighbourhood-based, household-focused social distancing
that is enforced by large teams of community workers as well as pervasive deployment
of AI-based, "big data" social media apps, amongst others.[2] Whether some or all of these
would be acceptable and feasible in settings outside of mainland China has been
questioned.[3]

Hong Kong is a Special Administrative Region of China that operates with a large degree
of autonomy. It is located outside the mainland on the southern coast of China,
neighbouring Guangdong province. Guangdong has recorded the most confirmed
COVID-19 cases (n=1356 as of 11 March) outside of Wuhan and its home province
Hubei at the centre of the ongoing global outbreak. Having been one of the most heavily
affected epicentres during the Severe Acute Respiratory Syndrome (SARS) epidemic in
2003, the community in Hong Kong have been particularly well prepared to respond to
emerging infectious diseases. A range of public health measures have been
implemented to delay and reduce local transmission of COVID-19, and there have been
major changes in behaviours of the general public.

5

The containment measures used to control COVID-19 in Hong Kong include intense
surveillance for infections not only in incoming travellers but also in the local
community, with around 500 outpatients and 800 inpatients tested each day in early
March (personal communication, GM Leung). Once cases are identified they are isolated
until they recover and cease virus shedding. Their close contacts are traced (currently
going back as far as two days before illness onset) and quarantined in special facilities,
including holiday camps and newly constructed housing estates. Because not every
infected person will be identified, containment measures only work if social distancing
measures or behavioural changes also reduce "silent transmission" in the community as
a whole.

Hong Kong is an ideal sentinel to study the impact of public health interventions and
population behavioural changes that may be closer to what may plausibly be rolled out
in resource-sufficient settings in the rest of the world. Here, we aimed to quantify the
effect of containment measures on COVID-19. In addition, to determine whether social
distancing and behavioural changes have been important in reducing silent
transmission of COVID-19, we analysed data on influenza activity as a proxy to illustrate
the potential changes in transmission of infection in line with the interventions
implemented, assuming a similar mode and efficiency of spread between influenza and
COVID-19. The specific objective of this study was to quantify population behavioural
changes in Hong Kong during the outbreak of COVID-19, and to describe the impact of
the behavioural changes and public health measures on COVID-19 transmission and
influenza transmission in the community.

METHODS

Sources of Data

Data on laboratory-confirmed COVID-19 cases were obtained from the Centre for

Health Protection who provide daily updates with individual case data on a dedicated

webpage.[4] We conducted two cross-sectional telephone surveys among the general

adult population in Hong Kong. The first survey was conducted on January 20-23, and

the second survey was conducted on February 11-14. Methods and survey instruments

used were similar to those used to surveys during the SARS epidemic in 2003,[5,6] the

influenza A(H1N1)pdm09 pandemic in 2009,[7] and the influenza A(H7N9) outbreak in

China in 2013.[8] Participants were recruited using random-digit dialling of both landline

and mobile telephone numbers. Telephone numbers were randomly generated by a

computer system. Calls were made during both working and non-working hours by

trained interviewers to avoid over-representation of non-working groups. Respondents

were required to be at least 18 years of age and able to speak Cantonese Chinese or

English. Within each household, an eligible household member with the nearest

birthday would be invited to participate in the survey. The same core questions on

behavioural responses to the threat of COVID-19 were used in both surveys, with some

supplementary questions asked in survey 1 or 2 but not both. Items included measures

of risk perception, attitudes towards COVID-19, and behaviours taken against COVID-19

including hygiene, facemasks and reduction of social contacts. In the second survey,

respondents who were parents of school-age children were asked to answer additional

questions about social contact patterns of their children since schools were closed at the

time of interview. Ethical approval for this study was obtained from the Institutional

Review Board of the University of Hong Kong.

7

We obtained sentinel surveillance data on influenza-like illnesses (ILI) in a network of
around 60 general outpatient clinics from the Centre for Health Protection. These
include weekly reports of the proportion of outpatient consultations that were in
patients with influenza-like illness defined as fever plus cough or sore throat. We
obtained laboratory surveillance data from the Public Health Laboratory Services on
influenza testing results on specimens from public hospitals and sentinel surveillance
sites including the weekly number of specimens tested and the number testing positive
for influenza by type/subtype. Data on the current population of Hong Kong by age and
sex were obtained from the Census and Statistics Department of the Hong Kong
Government. We obtained the daily hospitalization rates for influenza positive cases in
Hong Kong, using the daily hospital admissions for influenza to the paediatric
departments of two large hospitals in Hong Kong and the relevant catchment
populations.[9]

Statistical analysis

Means and proportions of survey responses were directly weighted by sex and age to
the general population. Categorical variables with ordinal Likert-type response scales
including risk perception and attitudes towards COVID-19 were first dichotomized
either above or below a threshold.

We estimated changes in COVID-19 transmissibility over time via the effective
reproduction number, R_t, which represents the mean number of secondary infections
that result from a primary case of infection at time t. Values of R_t exceeding 1 indicate
that the epidemic will tend to grow, while values below 1 indicate that the epidemic will
tend to decline. We used a Poisson transmission model to estimate the time-varying

reproduction numbers from serial intervals and incidence over time.[10,11] Time-varying

estimates of reproduction numbers were made with a 7-day sliding window using the R

package EpiEstim, accounting for imported cases and assuming a serial interval of 4.7

days and a standard deviation of 2.9 days.[12]

To measure changes in influenza transmissibility over time, we first calculated the "ILI+"

proxy[13,14] for influenza A(H1N1) during the 2019/20 winter by multiplying together the

weekly ILI consultation rates with the weekly proportions of specimens positive for

influenza A(H1N1), which was the predominant strain. The ILI+ proxy is a better

correlate of the incidence of influenza virus infections in the community than either ILI

rates alone or laboratory detection rates alone.[14] We interpolated daily ILI+ proxy

values from the weekly influenza ILI+ proxy values by using flexible cubic splines.[15]

Using the daily ILI+ proxy, we estimated daily transmissibility via the effective

reproduction number, R_t. We used a simple branching process model for epidemic

spread to estimate the time varying intensity of transmission.[16] We assumed the serial

interval distribution for influenza followed a gamma distribution with a mean of 2.85

days and standard deviation of 0.93 days.[17] We repeated these analyses for the daily

influenza A(H1N1) hospitalization rates among children in two large local hospitals. We

evaluated the changes in transmissibility by comparing the R_t values during two weeks

before and after the start of the school closure (including Chinese New Year holidays)

for the 2019/20 winter influenza season. We compared the reductions in 2019/20 with

reductions in previous years when the Chinese New Year holidays occurred during

influenza epidemics. All analyses were conducted with R version 3.6.2 (R Foundation

for Statistical Computing, Vienna, Austria).

RESULTS

As of 11 March 2020, Hong Kong has confirmed 129 cases of SARS-CoV-2 infection,

including 39 cases in persons that were presumed to have acquired infection outside of

Hong Kong ("imported infections"), 30 cases that could not be linked to any other case

("unlinked infections") and 60 cases that were linked to the other known cases (Figure

1). Among these 129 cases of SARS-CoV-2 infection, 15 were asymptomatic infections,

while 114 were confirmed COVID-19 cases. Figure 1 shows the timeline of interventions

that were implemented by the government in Hong Kong (Figure 1), including border

restrictions, flexible working arrangements, and school closures from kindergartens up

to tertiary and post tertiary institutions and including tutorial centres. By mid-February,

some schools in Hong Kong had resumed teaching activities via the internet. Some

religious organizations have cancelled services since February 13, and many

conferences and other local mass gatherings have been cancelled. Quarantine orders

have been issued to close contacts of confirmed cases, as well as travellers arriving from

affected countries including mainland China, South Korea, Italy and Iran, and affected

regions in France, Germany and Spain. To date, a total of 24,125 (20,516 residents and

3,609 non-residents) have undergone quarantine at several locations including at home,

at hotels, and at designated quarantine facilities.[18]

While unlinked COVID-19 cases as well as a number of clusters of cases have been

detected, indicating that limited local transmission has been occurring, there is no

evidence of exponential rise in the incidence of unlinked cases over time. Figure 2A

shows the incidence of those unlinked cases. The estimated daily effective reproductive

number which has remained below 1 throughout February and early March (Figure 2B).

10

Data on influenza activity based on the community ILI+ proxy were very consistent with
the rate of hospitalizations in children in Hong Kong (Figure 3A and 3B). Influenza
activity peaked in the second week of January, with influenza A(H1N1) predominating,
and declined to low levels by the second week of February. The effective reproductive
number gradually declined from the second week of January to below 1 before Chinese
New Year, rebounded to above 1 around Chinese New Year, and then declined again in
early February (Figure 3C and 3D). The estimated R_t was 1.28 (95% confidence interval,
CI: 1.26–1.30) before the start of the school holidays/closure and 0.72 (95% CI: 0.70–
0.74) during the holiday/closure weeks, corresponding to a 44% (95% CI: 34%–53%)
reduction in transmissibility (Figure 3C). Similarly, the R_t, calculated from
hospitalization data dropped significantly after the start of the school holiday/closure
by 33% (95% CI: 24%–43%) (Figure 2D). In comparison, we estimated the reduction in
R_t to be a maximum of 15% (95% CI: 11%–19%) during the 2010/11 winter and 14%
(95% CI: 7%–22%) during the 2014/15 winter due to the Chinese New Year holidays
alone (Figure 4).

In our two surveys, we interviewed a total of 1008 and 1000 participants, respectively,
with response rates among eligible respondents of 22% and 23% (Appendix Figure 1).
Respondents included a broad cross-section of the adult population of Hong Kong
(Table 1). Respondents perceived that they had similar susceptibility to COVID-19 as
seasonal influenza, but that COVID-19 was much more serious infection, and around
80% of respondents reported worrying about being infected with COVID-19 (Table 2).
In survey 2, 76% of respondents agreed with the statement that complete border
closure would be effective in preventing the spread of COVID-19 to Hong Kong, 84.1%

11

were worried about medical supplies including face masks, but only 27.7% were

worried about the living supplies in Hong Kong (Table 2).

We also identified considerable increases in the use of preventive measures in response

to the threat of COVID-19. In recent years, face mask use in the general community has

generally been restricted to individuals who are ill and those who feel particularly

vulnerable to infection and want to protect themselves. In our first and second surveys

we estimated that 74.5% and 97.5% of the general adult population wore masks when

going out, 61.3% and 90.2% avoided going to crowded places, and 71.1% and 92.5%

reported washing or sanitizing their hands more frequently, respectively (Table 2). In

survey 2, 88.0% reported staying at home as much as possible.

In our second survey which was conducted from Tuesday 11 February through Friday

14 February, we also asked the subset of respondents who were parents of school-age

children about their support for school closures and the activities of their children

during the school closures. Among respondents who were parents, 249/261 (95.4%)

agreed or strongly agreed that school closure is needed as a control measure for COVID-

19 in Hong Kong, and 207/261 (79.3%) responded that their children had no contact

with persons other than their household members on the preceding day. More detailed

information on behaviours of children during the school closures will be reported

separately.

DISCUSSION

Our findings suggest that the package of non-pharmaceutical interventions that Hong

Kong has implemented since the latter part of January 2020 have succeeded at

12

containing spread of COVID-19 with little evidence indicating sustained local spread

beyond sporadic cases and known clusters, seven weeks (also about six generation

times) since the first known case showed symptoms in Hong Kong. If our findings are

borne out elsewhere, they support the perspective that COVID-19 can be meaningfully

controlled, or at least mitigated, by familiar social distancing and population

behavioural changes short of the draconian measures introduced in mainland Chinese

cities.

It would however be premature to conclude at this early date that COVID-19 is being

completely contained. However, our findings here indicate that control measures and

changes in population behaviour have led to a substantial reduction in influenza

transmission in early February 2020 (Figure 3). While it is not possible to distinguish

the specific effects of each community measure, it is clear from Figure 1 that the travel

restrictions have reduced the number of imported cases, with very few detected during

February, and only a resurgence in early March with imported cases from Europe and

the middle East.

Medical isolation of cases and intensive contact tracing and strict quarantine should

have limited onwards transmission from locally confirmed cases and their contacts.

However, it is likely that some infected persons have not been identified. Figure 1 shows

the onset dates of 30 unlinked cases, i.e. cases for whom the infector could not be

determined. If there were an increase over time in unlinked cases, it would indicate that

incidence in the community could be increasing through silent transmission. However,

our analyses suggest that reductions in population mixing have substantially reduced

influenza transmission (Figure 3). If COVID-19 transmission occurs through similar

modes and routes to influenza virus transmission, we would also expect substantial reductions in COVID-19 transmissibility, although a potentially higher basic reproductive number for COVID-19 indicates that it might be more difficult to control than influenza.[19]

The estimated 44% reduction in transmission in the general community in February 2020 (Figure 3C) was much greater than the estimated 10% to 15% reduction in transmission conferred by school closures alone during the 2009 pandemic,[20] and the 16% reduction in transmission of influenza B conferred by school closures during the 2017/18 winter in Hong Kong.[21] We therefore conclude that the other social distancing measures and avoidance behaviours have had a substantial effect on influenza transmission on top of the effect of school closures. However, we note that if the basic reproductive number of COVID-19 in Hong Kong exceeds 2, noting that it was 2.2 in Wuhan,[19] we would need more than a 44% reduction in COVID-19 transmission to completely avert a local epidemic. A reduction of this magnitude could, however, substantially flatten the peak and area under the epidemic curve, thus reducing the risk of exceeding the capacity of the healthcare system, and potentially saving hundreds or even thousands of lives especially amongst older adults.

The postponement of class resumption in local schools in Hong Kong is strictly speaking a class dismissal or suspension rather than a school closure, because most teachers are still required to go to school premises to plan e-learning activities and set homework. School closures have been implemented locally in previous years, including during the SARS epidemic in 2003,[6], during the influenza pandemic in 2009,[20] and to control seasonal influenza epidemics in 2008 and 2018.[21,22] While school closures can have

considerable effects on influenza transmission, their role in reducing COVID-19

transmission would depend on the susceptibility of children to infection and their

infectiousness if infected. Both of these are major unanswered questions at present.[23,24]

Despite this acknowledged uncertainty, our survey revealed considerable local support

for school closures at present.

The general community in Hong Kong have also changed their individual behaviours in

response to the threat of COVID-19. People have been choosing to stay at home more,

and in our most recent survey more than 90% of respondents reported to avoid going

to crowded place and 98% of them wearing face masks when leaving home (Table 2).

Using similar surveys, face mask use during SARS in 2003 was 79%,[5] but at most 10%

during the influenza A(H1N1) pandemic in 2009.[7] These major changes in behaviour

indicate the level of concern among the local population for this particular infection, and

the level of voluntary social distancing in addition to the distancing created by school

closures.

There are some limitations of our study. First, we cannot identify whether containment

measures, social distancing measures or behavioural changes are most important in

suppressing COVID-19 transmission. It is likely that each plays a role, noting that

unlinked cases have been identified in the community and will continue to be identified,

indicating that not every chain of transmission has been identified by contact tracing

from known cases. While we have demonstrated major effects of control measures and

behavioural changes on influenza transmission (Figure 3), we can only infer similar

changes in COVID-19 transmissibility if the two viruses share similar dynamics of

transmission. Second, our survey of population behaviours could have been affected by

response bias, since we relied on self-reported data, and could have been affected by selection bias away from working adults, although this should have been reduced by conducting surveys in non-working as well as working hours. Without data on the non-respondents, we were unable to assess potential selection bias. Without a baseline survey before 23 January we could not compare changes in behaviours, although we have published the results of similar surveys from previous epidemics which can be used for comparison.[6-8,19] Finally, while we identified reductions in the incidence of influenza virus infections in outpatients and paediatric inpatients (Figure 3), it is possible that these time series were affected by reduced health-care seeking behaviours and limited healthcare access that probably resulted from private clinic closure, which occurred around the period of the Chinese New Year holiday.

In conclusion, measures taken to control the spread of COVID-19 have been effective and have also had a substantial impact on influenza transmission in Hong Kong. While the transmission dynamics and modes of transmission of COVID-19 have not been precisely elucidated, they are likely to share at least some characteristics with influenza virus transmission, as both are directly transmissible respiratory pathogens with similar viral shedding dynamics.[25] The measures implemented in Hong Kong are less drastic than those used to contain transmission in Wuhan in the past month, but are probably more feasible in most locations. If these measures and population responses can be sustained, avoiding fatigue among the general community, they should meaningfully mitigate the impact of a local epidemic of COVID-19.

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FIGURE LEGENDS

Figure 1. Detection of COVID-19 cases in Hong Kong by reporting date (panel A) and by onset date (panel B), with information on control measures implemented, and dates of population surveys. The Chinese New Year, a major winter festival in Hong Kong, began on Saturday January 25 and there were public holidays on January 25-28. Most schools started holidays on January 22 and were scheduled to resume on February 3. Due to the detection of COVID-19 cases in Hong Kong, the government deferred class resumption on January 27, January 31, February 13 and February 25 to February 16, March 2, March 16 and then April 20 at the earliest, respectively.

Figure 2. Panel A: Incidence of unlinked cases of COVID-19 in Hong Kong (blue bars). Panel B: Estimates of the daily effective reproductive number R_t of COVID-19 over time, with the gray shaded area indicating the 95% pointwise confidence intervals. The dotted line indicates the critical threshold of R_t=1, if the reproductive number exceeds that for a prolonged period we would expect an epidemic to occur.

Figure 3. Panel A: weekly incidence rates of ILI+ for influenza A(H1N1), calculated as the weekly influenza-like illness rate multiplied by the proportion of laboratory specimens testing positive for influenza A(H1N1). Panel B: daily incidence rates of hospitalization with influenza A(H1N1) in children in two large hospitals in Hong Kong. Panel C: estimated effective reproductive number R_t in Hong Kong based on the ILI+ data, with 95% confidence interval indicated by the shaded region. Panel D: estimated effective reproductive number R_t in Hong Kong based on the hospitalization rate data, with 95% confidence interval indicated by the shaded region. Red dashed lines indicate

21

transmission threshold (R_t=1); Shaded bars show the dates of school holidays (Chinese

New Year, in light blue) and school closure (in gray).

Figure 4. Weekly incidence rates of ILI+ for influenza (all type and subtypes), calculated

as the weekly outpatient influenza-like illness rate multiplied by the proportion of

laboratory specimens testing positive for influenza (A) for 2010/11 winter influenza

season and (B) for 2014/15 winter influenza season. The estimated effective

reproductive number R_t in Hong Kong based on the ILI+ data, with 95% confidence

interval indicated by the shaded region (C) for 2010/11 winter season and (D) for

2014/15 winter season. Red dashed lines indicate transmission threshold (R_t=1);

Shaded bars show the dates of school holidays (in gray) and Chinese New Year timing

(in light blue).

Appendix Figure 1. Flow chart of calls made, calls answered, and respondents

successfully interviewed in two telephone surveys in Hong Kong, on 20-23 January and

11-14 February, respectively.

Table 1. Characteristics of respondents in two telephone surveys in Hong Kong.

Characteristics	Survey 1 (20-23 January) (N=1008)	Survey 2 (11-14 February) (N=1000)
	n (%)	n (%)
Sex		
Male	472 (46.8)	431 (43.1)
Female	536 (53.2)	569 (56.9)
Age group, years [†]		
18-24	99 (9.8)	92 (9.2)
25-34	170 (16.9)	209 (20.9)
35-44	189 (18.8)	176 (17.6)
45-54	162 (16.1)	181 (18.1)
55-64	172 (17.1)	165 (16.5)
65 or above	202 (20.0)	163 (16.3)
Education level [†]		
Not educated/ pre-elementary	15 (1.5)	17 (1.7)
Primary	82 (8.1)	59 (5.9)
Secondary	386 (38.3)	387 (38.7)
Tertiary	521 (51.7)	531 (53.1)
Occupation [†]		
Executive and professional	281 (27.9)	231 (23.1)
Clerical and service worker	251 (24.9)	258 (25.8)
Production worker	73 (7.2)	61 (6.1)
Student	63 (6.2)	54 (5.4)
Homemaker/ housewife	126 (12.5)	139 (13.9)
Retired person	185 (18.4)	173 (17.3)
Unemployed or not working for other reason	15 (1.5)	31 (3.1)
Others	1 (0.1)	42 (4.2)

[†] 14 (1.4%) respondents did not report their age in both surveys, 4 (0.4%) and 6 (0.6%) respondents did not report their education level in survey 1 and 2, 13 (1.3%) and 11 (1.1%) respondents did not report their occupation in survey 1 and 2.

Table 2. Public attitudes, risk perceptions and behavioural responses towards COVID-19 [a] and seasonal influenza in two telephone surveys in Hong Kong.

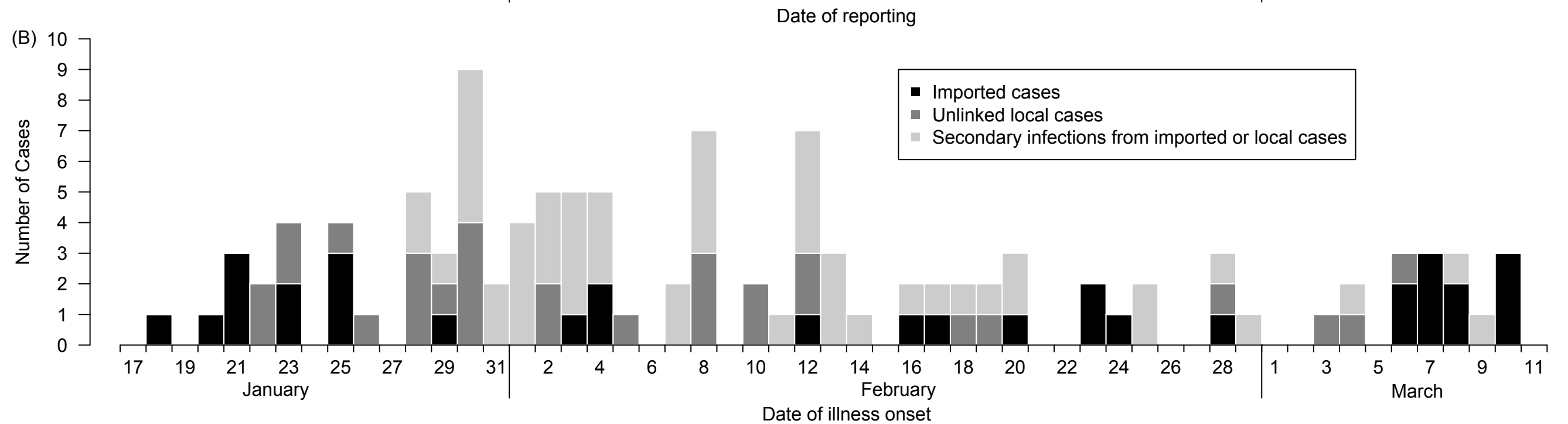| Items	Survey 1 (21-23 January) (n=1008) % (95% CI) [b]	Survey 2 (11-14 February) (n=1000) % (95% CI) [b]
Risk perception of COVID-19		
Perceived susceptibility to COVID-19 ("How likely do you think it is that you will contact COVID-19 over the next one month?" -- likely/very likely/ certain rather than never/very unlikely/unlikely/evens)	18.9 (16.0, 21.9)	17.4 (14.8, 20.1)
Perceived severity of COVID-19 (serious/ very serious rather than very mild/mild/moderate)	89.6 (85.8, 93.3)	90.5 (86.4, 94.7)
Worry about being infected with COVID-19 (moderately/ very much worried rather than not at all worried or slightly worried)	52.5 (48.7, 56.3)	53.9 (49.9, 57.9)
Risk perception of seasonal influenza		
Perceived susceptibility to seasonal influenza ("How likely do you think it is that you will contact seasonal influenza over the next one month?" -- likely/ very likely/ certain rather than never/very unlikely/unlikely/evens)	25.1 (22.0, 28.3)	22.5 (19.4, 25.6)
Perceived severity of seasonal influenza (serious/ very serious rather than very mild/mild/moderate)	42.3 (38.4, 46.3)	32.7 (28.9, 36.6)
Worry about being infected with seasonal influenza (moderately/ very much worried rather than not at all worried or slightly worried)	36.5 (32.9, 40.0)	30.3 (26.6, 33.9)
Attitudes towards COVID-19 (agree/ strongly agree to statements)		
I'm confident that I can take measures to protect myself against COVID-19	50.5 (46.6, 54.4)	59.2 (54.9, 63.5)
I believe that the Hong Kong government can take effective measures to control the spread of COVID-19 in Hong Kong	33.5 (29.9, 37.1)	31.8 (27.8, 35.8)
I believe that the Central Chinese government can take effective measures to control COVID-19	31.7 (28.1, 35.3)	39.0 (34.8, 43.2)
I believe that complete border closure is an effective measure to prevent COVID-19 from spreading from mainland China to Hong Kong	- [c]	76.4 (72.3, 80.5)
Complete border closure will seriously affect the life of citizens	- [c]	33.2 (29.2, 37.1)
I worry about the medical supplies such as facemask in Hong Kong	- [c]	84.1 (80.0, 88.2)
I worry about the living supplies in Hong Kong due to border closure	- [c]	27.7 (24.0, 31.4)
Preventive measures taken against COVID-19		
In the past 7 days, did you take the following measure to prevent yourself from contracting COVID-19?		
Avoid going to crowded places	61.3 (57.2, 65.4)	90.2 (86.2, 94.2)
Avoid visiting mainland China	78.1 (73.9, 82.2)	- [c]
Avoid contact with people with respiratory symptoms	66.8 (62.7, 70.9)	80.0 (76.0, 84.0)

Use facemasks	74.5 (70.4, 78.6)	97.5 (93.5, 100)
Wash hands more often (including using hand sanitizer)	71.1 (67.0, 75.2)	92.5 (88.6, 96.5)
Avoid touching public objects or use protective measures when touching public objects (e.g. use tissue)	36.4 (32.3, 40.5)	73.8 (69.8, 77.9)
House disinfection	- [c]	89.3 (85.2, 93.4)
Using serving utensils when eating	- [c]	66.0 (61.9, 70.1)
Stay at home as much as possible	- [c]	88.0 (83.9, 92.1)
Avoid going to health care facilities	- [c]	81.0 (77.0, 85.1)

[a] In the interviews, "武漢肺炎" (Wuhan pneumonia) was used because this term was most frequently used in the media while surveys were conducted

[b] Proportions were weighted by age and sex to the adult population in Hong Kong

[c] Questions not asked

Abbreviation: CI = confidence interval

(A)

Survey 1

Chinese New Year

Survey 2

Flexible working hours and working from home arrangements

School holiday for Chinese New Year

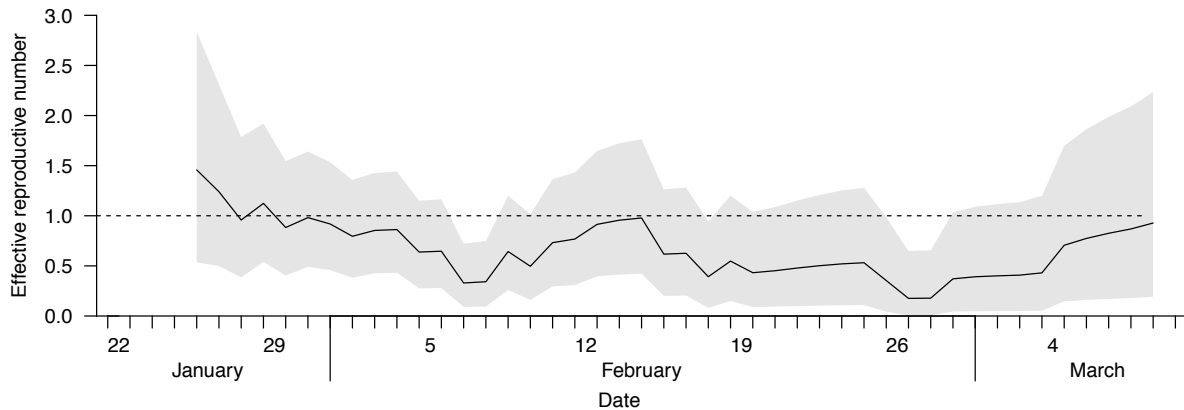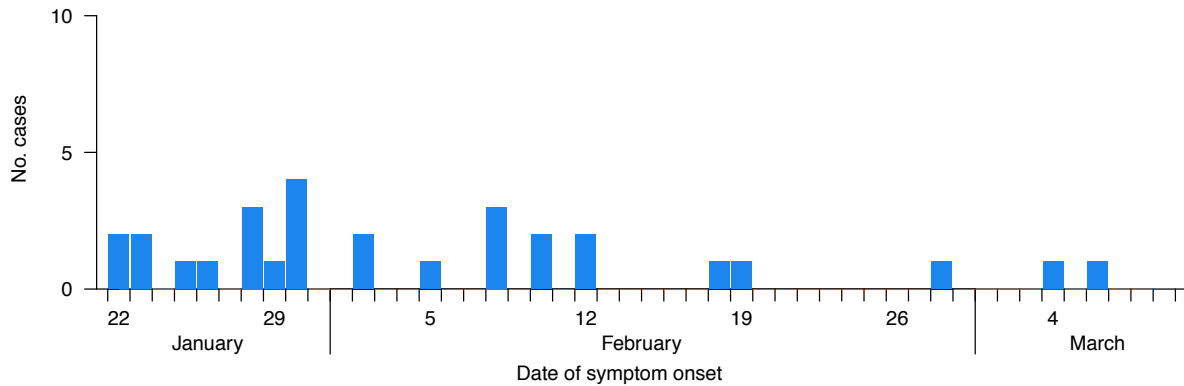Postponement of school reopening until April 20 the earliest

Issue travel alert against non-essential travel to Italy and affected regions in France, Germany, Japan and Spain

Issued travel alert against non-essential travel to affected regions in Italy and Iran

Closure of 6 border control points
Reduction of mainland flights by half
Reduction of cross-border bus services

Enhance laboratory surveillance with testing for COVID-19 at clinics of private medical practitioners

Barred entry of travellers from South Korea
Quarantine Hong Kong residents arriving from South Korea

Barred entry of Hubei residents and visitors to Hubei Province in the last 14 days
Flight suspension between Hong Kong and Wuhan
Quarantine people with travel history to Hubei Province in the past 14 days

Mandatory 14-day quarantine travellers from Mainland China

Issued travel alert against non-essential travel to South Korea

Quarantine inbound travellers arriving from affected regions in Italy and Iran

Declared a state of emergency
Closure of theme parks

Further closure of 4 border control points

Date of reporting

(B)

- Imported cases
- Unlinked local cases
- Secondary infections from imported or local cases

Date of illness onset

note: two cases with unknown onset date were not shown in panel B
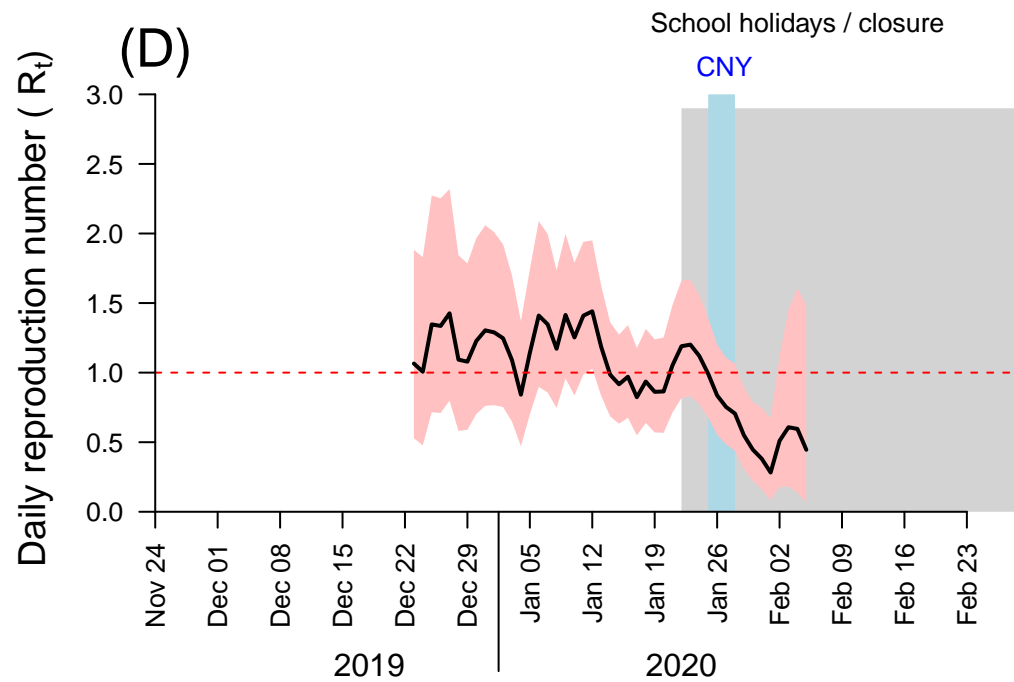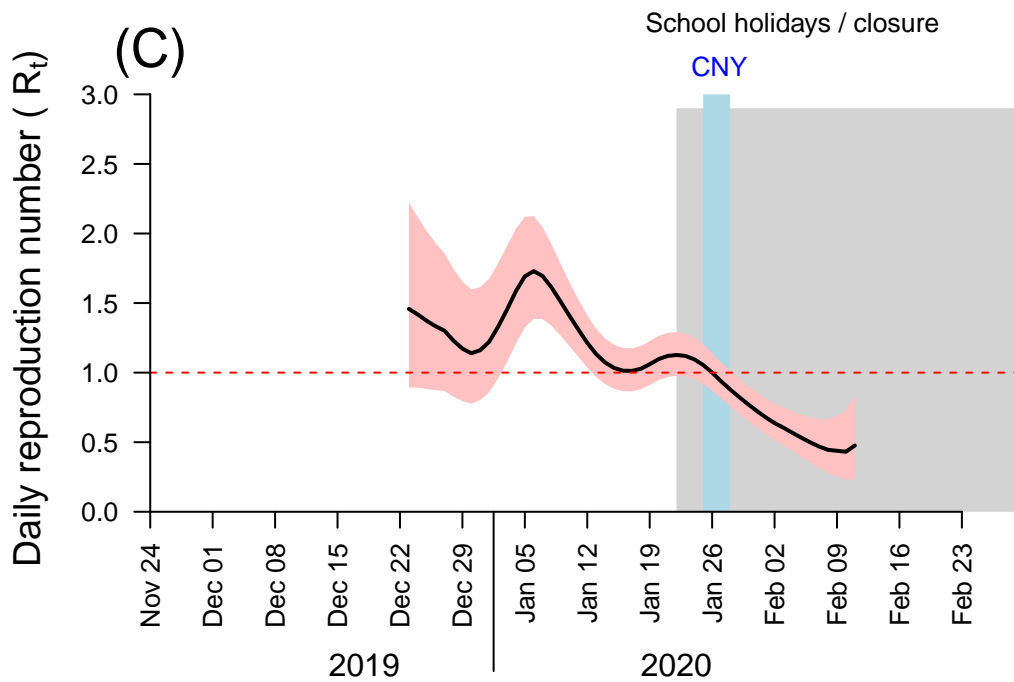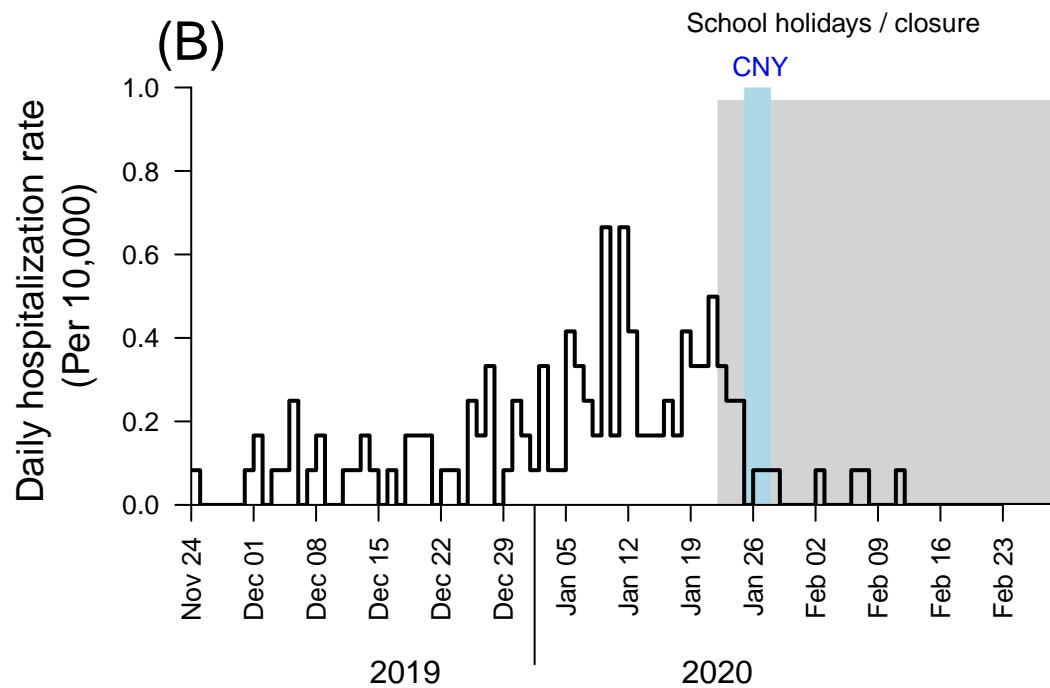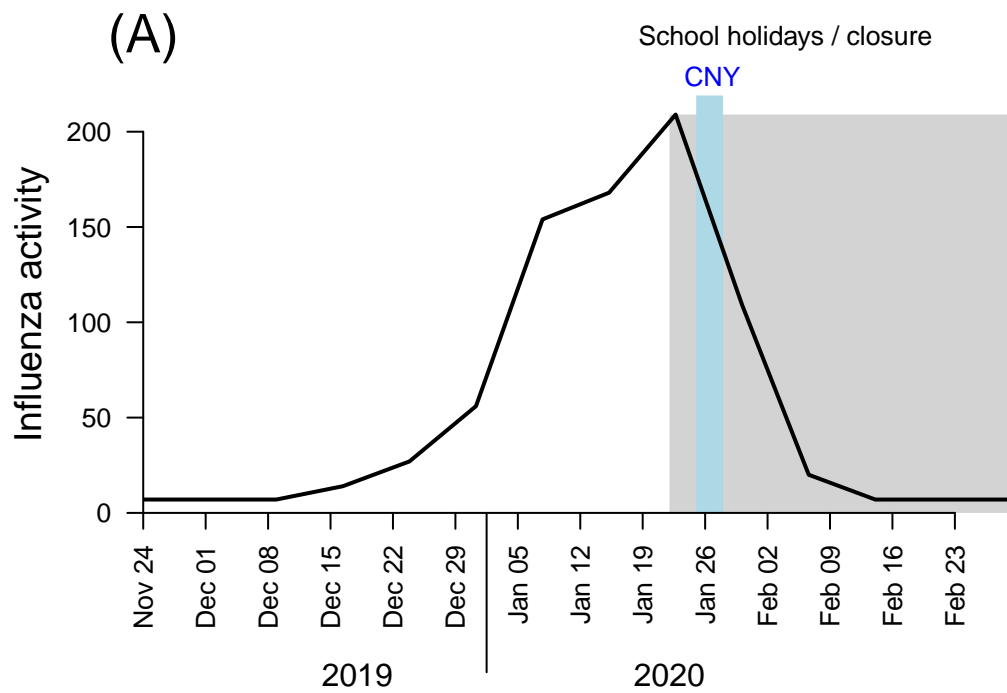
Influenza in 2010/11 winter

(A)

School holidays
CNY

Influenza activity

400
300
200
100
0

Dec 12 Dec 19 Dec 26 Jan 02 Jan 09 Jan 16 Jan 23 Jan 30 Feb 06 Feb 13 Feb 20 Feb 27 Mar 06 Mar 13 Mar 20 Mar 27 Apr 03
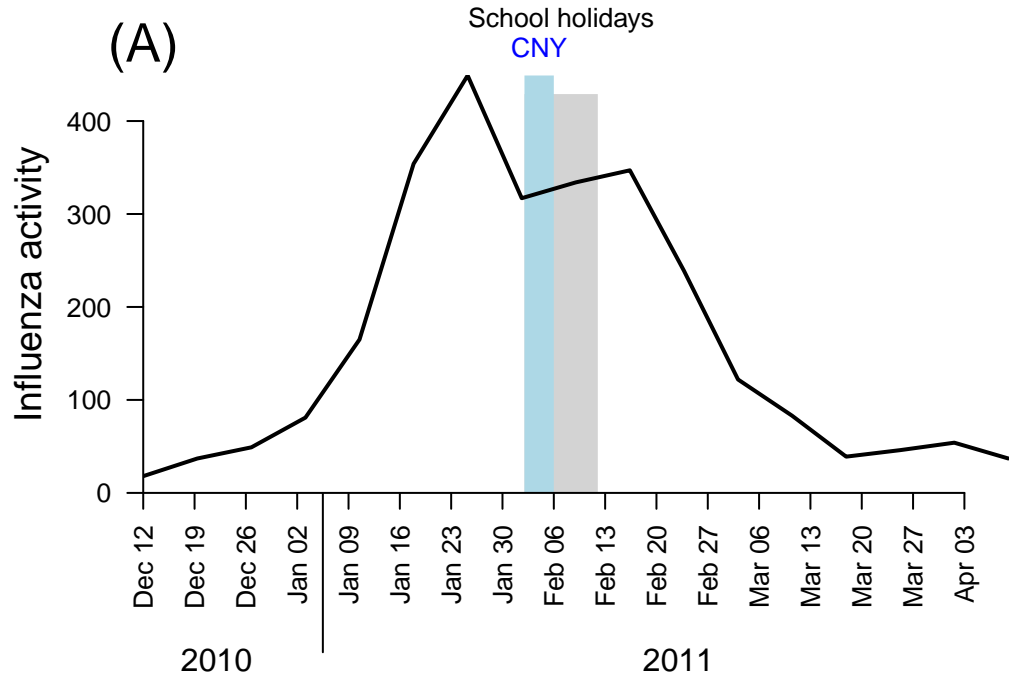
2010   2011

Influenza in 2014/15 winter

(B)

School holidays
CNY

Influenza activity

500
400
300
200
100
0

Dec 07 Dec 14 Dec 21 Dec 28 Jan 04 Jan 11 Jan 18 Jan 25 Feb 01 Feb 08 Feb 15 Feb 22 Mar 01 Mar 08 Mar 15 Mar 22 Mar 29 Apr 05 Apr 12 Apr 19 Apr 26 May 03

2014   2015

(C)

School holidays
CNY

Daily reproduction number (R_t)

3.0
2.5
2.0
1.5
1.0
0.5
0.0

Dec 12 Dec 19 Dec 26 Jan 02 Jan 09 Jan 16 Jan 23 Jan 30 Feb 06 Feb 13 Feb 20 Feb 27 Mar 06 Mar 13 Mar 20 Mar 27 Apr 03

2010   2011

(D)

School holidays
CNY

Daily reproduction number (R_t)

3.0
2.5
2.0
1.5
1.0
0.5
0.0

Dec 07 Dec 14 Dec 21 Dec 28 Jan 04 Jan 11 Jan 18 Jan 25 Feb 01 Feb 08 Feb 15 Feb 22 Mar 01 Mar 08 Mar 15 Mar 22 Mar 29 Apr 05 Apr 12 Apr 19 Apr 26 May 03

2014   2015