COLUMBIA UNIVERSITY | MAILMAN SCHOOL of PUBLIC HEALTH
BIOSTATISTICS

Effects of school breaks on influenza-like illness incidence in a temperate Chinese region: an ecological study from 2008 to 2015

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Introduction

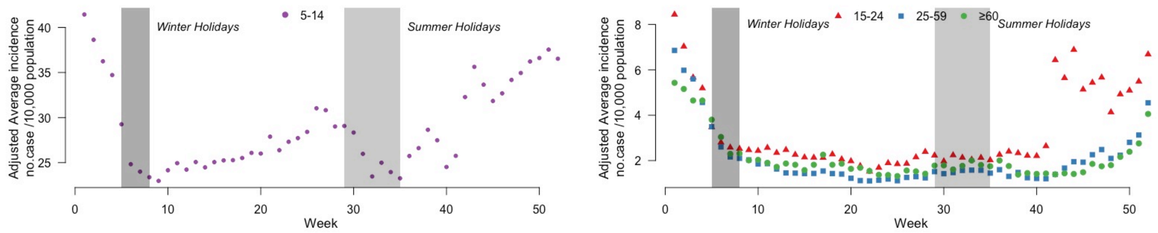
- Schoolchildren play a major role in the spread of influenza considering their high clinical attack rates, high social contact rates and increased viral shedding compared with adults.
- Reactive school closure at the initial phase of a pandemic is considered as an effective non-pharmaceutical intervention to mitigate the spread of influenza.
- Several empirical studies have confirmed the effects of school closure on reducing influenza virus transmission after immediate closure of schools at an early stage of a pandemic
- Our study aims to assess the effects of winter/summer school breaks on ILI incidence in Xicheng District, Beijing, China.

Methods

- We compared schoolchildren-to-adults incidence rate ratios before, during and after the winter/summer breaks using two-sided Z tests.
- In order to control the effects of unmeasured confounders of long-term and seasonal trends, we built a Serfling-specified Poisson regression model to assess the effect of winter breaks
- As weekly adjacent ILI visits were temporally correlated, we further added an auto-correlated regression term to adjust for autocorrelation in the Poisson model.

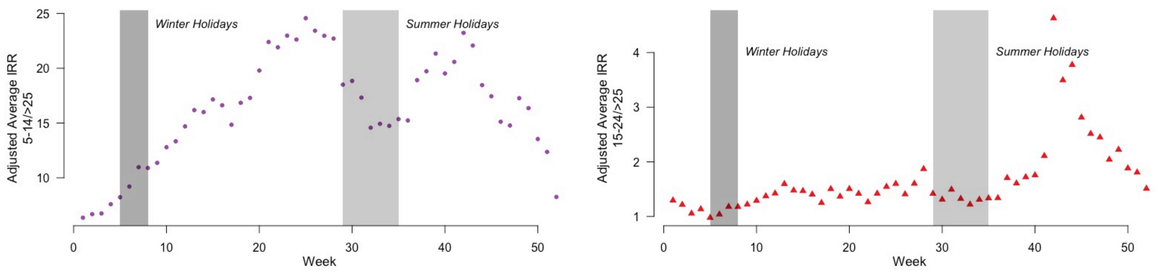
Results

Figure 1. Adjusted average ILI incidence per 10,000 persons by week (ILI, influenza-like illness)



- During the winter school breaks, ILI incidence decreased substantially in age groups of 5–14 and 15–24, but modestly in age groups over 25. During the summer school breaks, only ILI incidence in age group of 5–14 reduced dramatically, while levelled off for other age groups.

Figure 2. Adjusted average ILI incidence rate ratio of schoolchildren-to-adult by week. IRR, incidence rate ratio



- IRRs of younger schoolchildren aged 5–14 to adults was higher during winter school breaks than before breaks, while the opposite was true for the IRRs of older schoolchildren aged 15–24 to adults. During summer breaks, schoolchildren-to-adults IRRs were significantly lower than those of 2-week before or after school breaks.

Table 1. Estimated ILI IRRs of visits by Poisson regression surrounding winter breaks, by age group, Beijing, 2008–2015

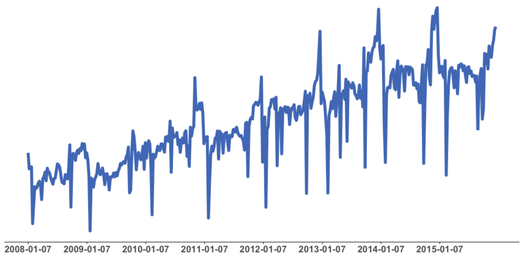
Age	During Winter Break				After Winter Break			
	1st Week	2nd Week	3rd Week	4th Week	1st Week	2nd Week	3rd Week	4th Week
0-5	0.96	**0.89**	**0.89**	**0.84**	**0.86**	1.00	1.03	1.07
5-15	**0.89**	0.89	**0.84**	**0.84**	**0.81**	1.02	1.03	1.03
15-25	**0.61**	**0.60**	**0.65**	**0.64**	0.76	0.80	0.91	0.96
25-60	0.92	**0.76**	**0.72**	0.80	0.90	0.86	1.07	1.10
>60	0.90	0.76	**0.61**	0.68	**0.64**	0.83	0.82	0.88

- Boldface indicates statistically significant changes at the 0.05 confidence level.
- IRRs were used to estimate whether incidence of ILI-associated visits in a particular week were lower, higher, or did not deviate from the expected seasonal ILI patterns. Each row represents a separate regression model.
- ILI, influenza-like illness; IRR, incidence rate ratio.

Discussion

- We infer the enhanced IRRs of schoolchildren aged 5–14 to adults in winter breaks are due to integrated effects of Spring Festival, population migration and changes in health-seeking behavior.

Figure 3.Time series of weekly total outpatient visits in Xicheng District, Beijing China from 2008 to 2015



Conclusions

- Both winter and summer breaks were associated with reductions of ILI incidences among schoolchildren and adults.
- Our study contributes additional evidence on the effects of school breaks on ILI incidence, suggesting school closure could be effective in controlling influenza transmission in developing countries

Future Work

- Environmental or social data may be incorporated to better clarify the relationship between age-specific influenza activity and winter breaks.
- Laboratory surveillance data are necessary for further conclusions on age-specific seasonal influenza activities from a public health perspective.

Acknowledgements

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Technical Appendix

- The following Poisson model was used to fit weekly influenza-like illness (ILI) for each age group separately:

$$In(\mu_t) = In(P_t) + \beta_0 + \beta_1 \boldsymbol{Y_t} + \beta_2 \boldsymbol{W_t} + \beta_3 \sin\left(\frac{2\pi t}{52}\right) + \beta_4 \cos\left(\frac{2\pi t}{52}\right) + \beta_5 \sin\left(\frac{4\pi t}{52}\right) + \beta_6 \sin\left(\frac{4\pi t}{52}\right) + \varepsilon_t$$

where $\varepsilon_t = \varphi\varepsilon_{t-1} + \delta_t$ and $\delta_t \sim N(0, \tau^2)$. $ILI_t \sim Poisson(\mu_t)$