The impact of national health insurance policy for respiratory syncytial virus antigen test on its incidence in Japan: A difference-in-differences study

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Introduction

- Difference-in-Differences (DID), a quasi-experimental design, that makes use of longitudinal data to obtain an appropriate counterfactual to estimate a causal effect, with the parallel trends assumption.

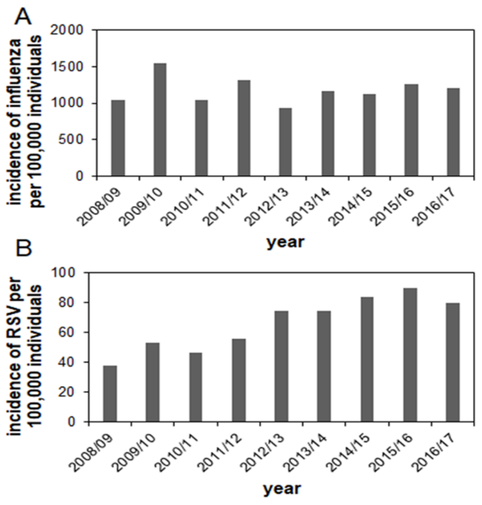


Figure 1. The incidence trends of influenza and RSV infection in Japan, 2008/09 – 2016/17.

- Japanese national health insurance originally covered the cost of respiratory syncytial virus (RSV) antigen testing among hospitalized patients.
- However, since 17 October 2011, it was extended its coverage to all infants under 12 months of age as well as to outpatients for whom palivizumab is indicated. (*NIID*, 2014)
- Since 2011/12, incidence of RSV infection has shown an increasing trend, while constant trend was observed in incidence of influenza.
- To estimate **the impact of a change in the national health insurance policy on the reporting of RSV infection,** applying a **DID design**, using **influenza as a control group.**

Methods

- **Epidemiological data**
  - The present study was conducted using publicly available datasets of the number of influenza cases and RSV infections, as **reported by sentinel surveillance institutes and clinics** across Japan from **2008–2017.**
  - **Influenza** was selected as a control group, because of parallel trend in pre-intervention period and similar epidemiological characteristics with RSV infection.

① **Prefecture-dependent incidence data** (NIID, Japan)
- Incidence rates for 47 prefecture were amassed.

② **Age-dependent incidence data** (NIID, Japan)
- The number of reported cases for the entire population, split into five-year age groups with an emphasis on children.
- Subjected age-groups; **0–4, 5–9, 10–14, 15–19, and ≥20 years.**

- **Parallel trend between influenza and RSV infection**
  - To validate the parallel trend assumption, the difference in the slope of linear trend during the pre-intervention period between influenza and RSV infection was estimated by age group, via linear regression model.

- **Quasi-experimental analysis**

$$E(Y_{gt}) = \alpha + \beta(T_g P_t) + \gamma T_g + \delta P_t$$

$$T_g = \begin{cases} 1\ for\ RSV\ group \\ 0\ for\ influenza\ group \end{cases} \qquad P_t = \begin{cases} 1\ for\ t \geq 2012/13 \\ 0\ otherwise \end{cases}$$

- α : baseline incidence for both infections
- β : causal effect of the change in national health insurance on RSV antigen detection testing
- γ : difference in baseline incidence for RSV infection compared to influenza
- δ : time dependent effect on infections of RSV and of influenza

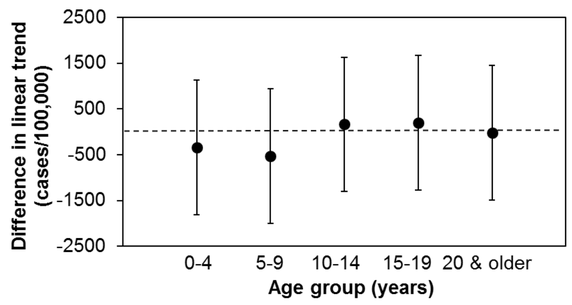
- **The dataset of age-dependent incidence was analyzed in similar way.**

- **Model comparison**
  - Possible combinations of time-dependence in the baseline trend and causal effect were considered as alternative models.
  - **Models with constant baseline trends and causal effects** yielded the lowest AIC values, for both prefecture- and age- dependent incidence data.

Data	Models	Number of parameters	AIC value
Age	time-dependent α, β	25	563
Age	constant α, β	20	552
Age	constant α, time-dependent β	25	558
Age	time-dependent α, constant β	20	544
Prefecture	time-dependent α, β	5	4164
Prefecture	constant α, β	4	4161
Prefecture	constant α, time-dependent β	4	4164
Prefecture	time-dependent α, constant β	5	4159

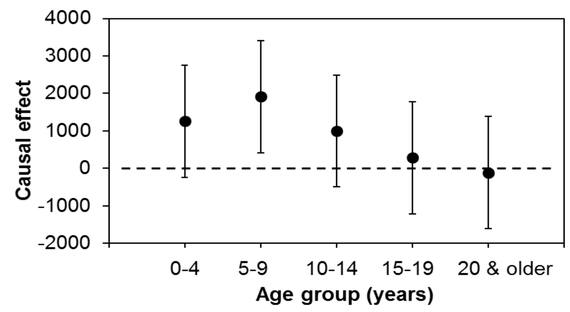
Results

Figure 2. Difference in the linear trend slope between influenza and RSV infection during the pre-intervention period in Japan.



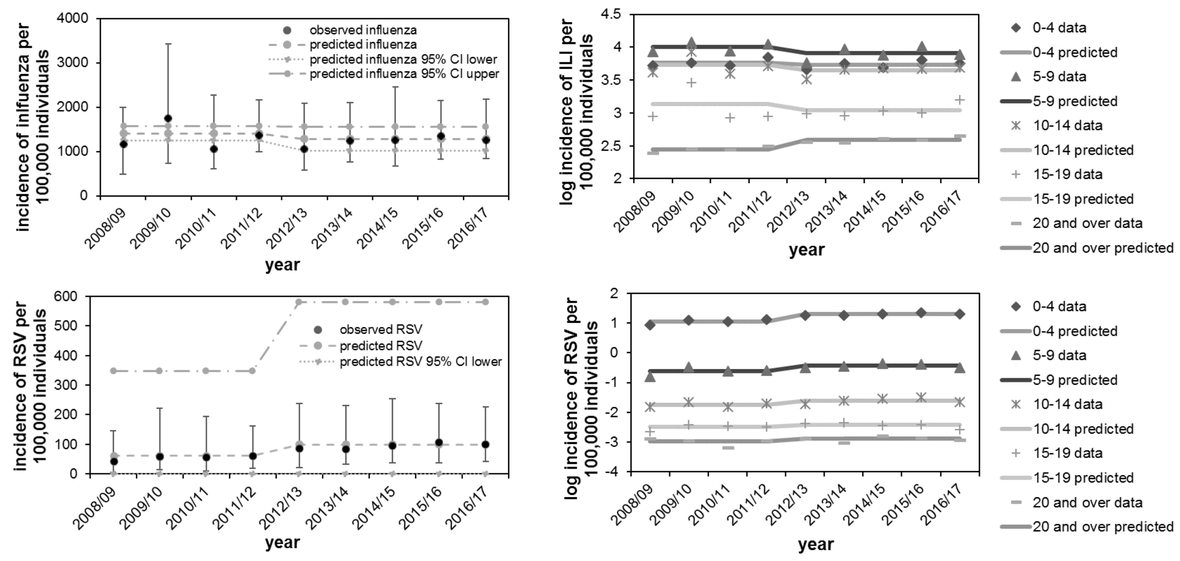
The estimated difference contained the value zero within the 95% confidence intervals for each age-group, demonstrating a parallel trend between influenza and RSV infection during pre-intervention period.

Figure 3. Age-specific causal effect of national health insurance policy change in RSV antigen detection test.



The causal effect of RSV testing on the increase in yearly RSV infection incidence was greatest among children aged 5– 9 years (an additional 1,912 cases (95% CI: 418 – 3,406).

Figure 4. Comparison of observed and predicted incidence from the analyses of prefecture- and age-dependent data.



Conclusion

- The significant causal effect was revealed among those aged 5–9 years, as 1,912 additional cases per 100,000 persons, from the 2012/13 season onward.
- However, this effect was substantially diluted by those aged 10 years and older and was also adjusted by group effect and time effect.
  → The actual increase across all age-group was about 43 additional cases per 100,000 individuals.
- The present study is **the first study clearly quantify the causal impact of the change in national health insurance policy on the RSV infection incidence in Japan.**
- The recent increase **should not immediately be perceived as indicative of a natural increase in the incidence of RSV infections.**

- **Limitations**
  - Only sentinel surveillance data was examined.
  - There remains the possibility that RSV infection cases partially contaminated the datasets of influenza reporting, although rapid diagnostic testing is performed to diagnose influenza in Japan.

References

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- **No potential conflict of interest to disclose.**

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