

The impact of childhood pneumococcal conjugate vaccine immunisation on all-cause pneumonia admissions: a 14-year population-based interrupted time series analysis

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Introduction

- Nine years after its first introduction in the US, Hong Kong (HK) introduced the pneumococcal conjugate vaccine (PCV) to the universal childhood immunisation programme in 2009
- However, the burden of pneumonia remains high in the post-PCV period
- The impact of childhood PCV among vaccinated children on pneumonia is less well-described, particularly in countries with a delayed vaccine introduction

Objective

To assess the impact of childhood PCV immunisation on all-cause pneumonia (ACP) admission among the overall population of HK

Methods

Data source: Clinical Data Analysis and Reporting System (CDARS) - a territory-wide population-representative electronic health records (EHR) system developed by the Hospital Authority (HA) of Hong Kong

Study design: A quasi-experimental design with interrupted time series (ITS) analysis using segmented Poisson regression to evaluate the gradual change in the monthly incidence of ACP admissions between pre- and post-vaccination periods

Outcome: The monthly incidence of hospitalised all-cause pneumonia (primary outcome), pneumococcal pneumonia (secondary outcome), limb fracture (negative control outcome)

Subgroup analysis: Stratified the study population into three age groups (0-19y, 20-64y, ≥65y)

Sensitivity analyses: 1) Adding three-months, six-months, and one-year lag on the post-PCV period to assess the time-lag effect of PCV immunisation; 2) Changing admission intervals to be 30-days and 60-days to define one admission episode

Results

- Over the 14-year study period, a total of 587,607 ACP episodes were identified among 357,950 patients in HK
- The monthly age-standardised incidence of ACP fluctuated between 33.4 and 87.4 per 100,000-persons
- There was a marginal decreasing trend of pneumonia admission after PCV introduction among the older adults aged ≥65 years (incidence rate ratio: 0.9944, 95% CI: 0.9921-0.9968) but not in the younger age groups or overall population

Table 1. Annual incidence of all-cause pneumonia and pneumococcal pneumonia (per 100,000-persons) between 2004-2017														
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
All-cause <i>pneumonia</i>														
Overall*	634	755	659	677	699	661	813	727	769	713	693	660	742	679
0-19 y	232	388	424	272	270	257	548	334	443	527	436	364	626	478
20-64 y	77.1	96.1	94.0	88.7	89.6	97.9	142	126	134	136	134	132	166	149
≥ 65 y	2664	3166	2733	3061	3283	3149	3662	3503	3673	3278	3263	3147	3254	3061
Pneumococcal <i>pneumonia</i>														
Overall*	17.4	18.5	16.5	16.3	15.9	13.8	13.1	15.4	14.8	14.1	13.4	13.0	12.6	12.2
0-19 y	11.4	11.8	12.2	10.2	9.87	8.34	9.67	10.6	12.4	13.9	13.9	14.6	15.5	13.7
20-64 y	4.13	4.44	3.87	3.93	4.03	3.70	3.87	5.24	4.23	5.04	4.98	5.47	5.46	5.08
≥ 65 y	65.0	71.5	63.0	65.9	67.2	58.9	53.3	61.3	60.8	52.6	47.8	42.8	39.6	40.1
*Age-standardised incidence using HK census population in 2017 as reference														

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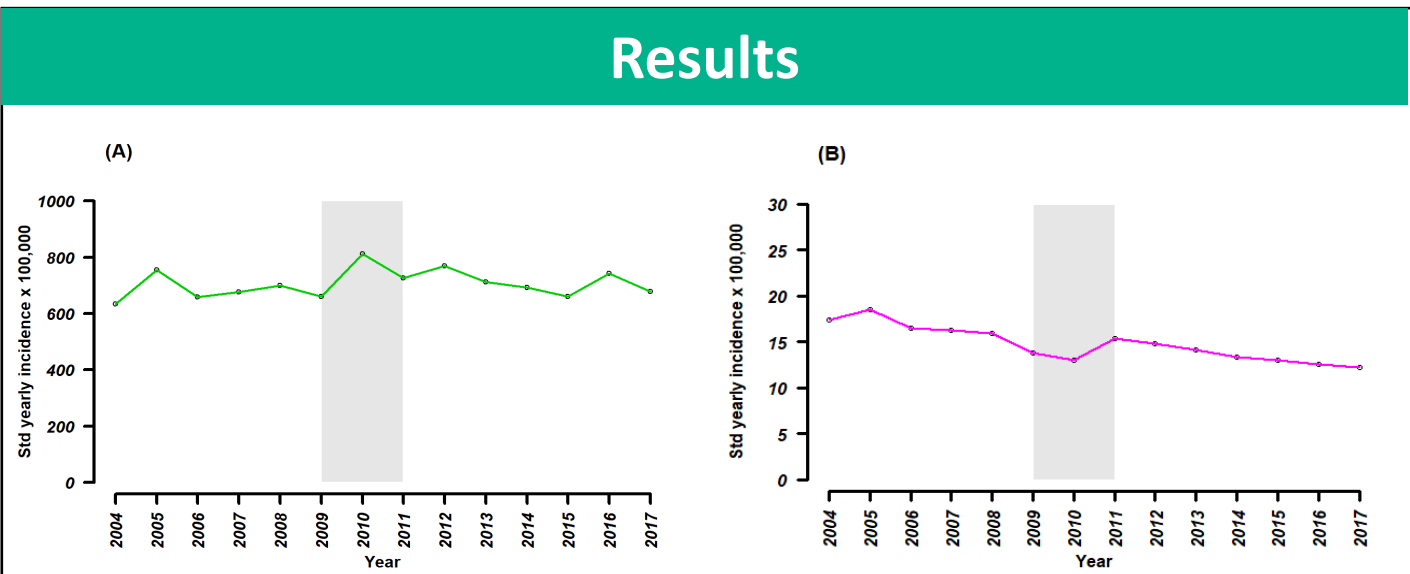


Figure 1. The age-standardised annual incidence of (A) all-cause pneumonia and (B) pneumococcal pneumonia. Grey areas: transition period of PCV implementation

Interrupted time series analysis:

- Throughout the post-PCV period, the monthly incidence of ACP declined gradually by 0.11% without statistical significance (P=0.1587)
- For PP as the secondary outcome, a slight decreasing slope change without statistical significance was observed after PCV introduction (P=0.1348)

Table 2. Slope change effect of childhood PCV immunisation, overall and by age-group			
Age groups	IRR	95% CI	P-value
All-cause pneumonia			
Overall	0.9989	0.9973-1.0004	0.1587
0-19 y	1.0022	0.9971-1.0074	0.4029
20-64 y	1.0010	0.9984-1.0036	0.4633
≥ 65 y	0.9944	0.9921-0.9968	< 0.05
Pneumococcal pneumonia			
Overall	0.9977	0.9946-1.0007	0.1348
0-19 y	1.0053	0.9989-1.0117	0.1096
20-64 y	1.0010	0.9959-1.0061	0.7063
≥ 65 y	0.9912	0.9879-0.9945	< 0.05
Fracture			
Overall	1.0027	1.0018-1.0036	< 0.05
0-19 y	1.0049	1.0033-1.0065	< 0.05
20-64 y	1.0041	1.0031-1.0051	< 0.05
≥ 65 y	1.0000	0.9988-1.0011	0.9700

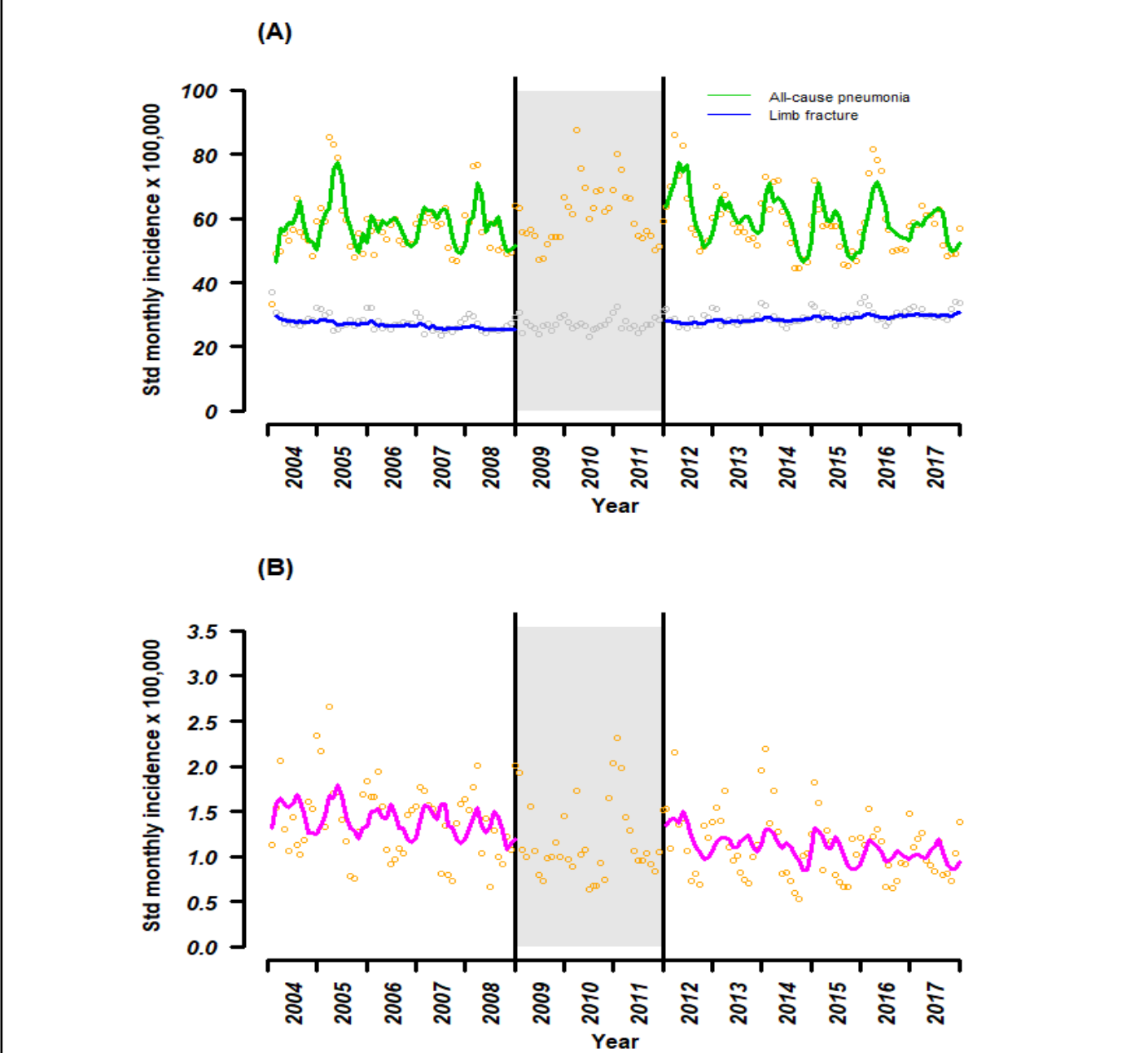


Figure 2. The estimated monthly incidence of overall (A) all-cause pneumonia and limb fracture and (B) pneumococcal pneumonia

Conclusion

- Up to eight years after the PCV introduction, there was no significant trend change of all-cause pneumonia admission in HK
- The results imply the complexity of using non-specific endpoint measuring the vaccine effect and the necessity of enhancing serotype surveillance system for replacement monitoring