Population-Based Disease Burden Associated with Respiratory Syncytial Virus in Hong Kong

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Background

Respiratory syncytial virus (RSV) widely circulates, but the virus associated disease burden has not been well characterized. We aimed to estimate the age-specific and cause-specific RSV-associated hospitalizations and deaths in Hong Kong.

Methods

RSV activity measured by weekly hospitalization rate of acute bronchiolitis associated with RSV in children <1y from 1998 to 2019 was obtained from the Hospital Authority. Influenza sentinel surveillance data was provided by the Centre for Health Protection of Hong Kong, and the age-specific weekly hospitalization and mortality data were obtained from the Hospital Authority and the Census and Statistics Department, respectively. We applied age-specific multiple linear regression models to examine the potential associations between the temporal RSV activity and hospitalization or death rates adjusting for influenza virus activities, meteorological factors including temperature and absolute humidity, possible differences in health seeking behaviors and healthcare during public holidays, potential impact of transition of coding system from ICD-9 to ICD-10. The age-specific RSV-associated excess hospitalization and mortality with 95% credible intervals (CrIs) were estimated in a Bayesian framework using the Markov Chain Monte Carlo method.

Table 1. Average annual RSV-associated excess respiratory hospitalization and death by age group in Hong Kong, 1998-2019.

	RSV-associated excess respiratory hospitalization/death rate, per 100,000 person-years (95% CrI)	Average annual number of RSV-associated excess respiratory hospitalizations/ deaths (95% CrI)	Proportion of respiratory hospitalizations/ deaths associated with RSV (%)
Hospitalization			
0-<1y	2047 (1861, 2234)	980 (891, 1069)	14.2 (9.0, 19.3)
1-4y	1044 (873, 1214)	2126 (1778, 2472)	24.4 (20.1, 28.6)
5-14y	-66 (-95, -38)	-444 (-632, -255)	-7.8 (-12.5, -3.1)
15-64y	9 (4, 13)	443 (197, 691)	2.8 (-0.0, 5.6)
≥ 65y	302 (221, 382)	451 (208, 694)	4.3 (2.7, 5.9)
≥ 75y*	449 (290, 608)	1047 (664, 1430)	5.0 (3.3, 6.6)
≥ 85y*	707 (382, 1027)	2884 (2115, 3651)	4.5 (2.7, 6.3)
Death			
≥ 65y	18 (8, 28)	172 (71, 271)	2.3 (0.9, 3.6)
≥ 75y*	34 (12, 55)	144 (51, 237)	2.2 (0.8, 3.6)
≥ 85y*	96 (34, 157)	113 (38, 184)	2.8 (0.9, 4.6)

*The results for age groups ≥75y and ≥85y were estimated with the data in 1998-2017.

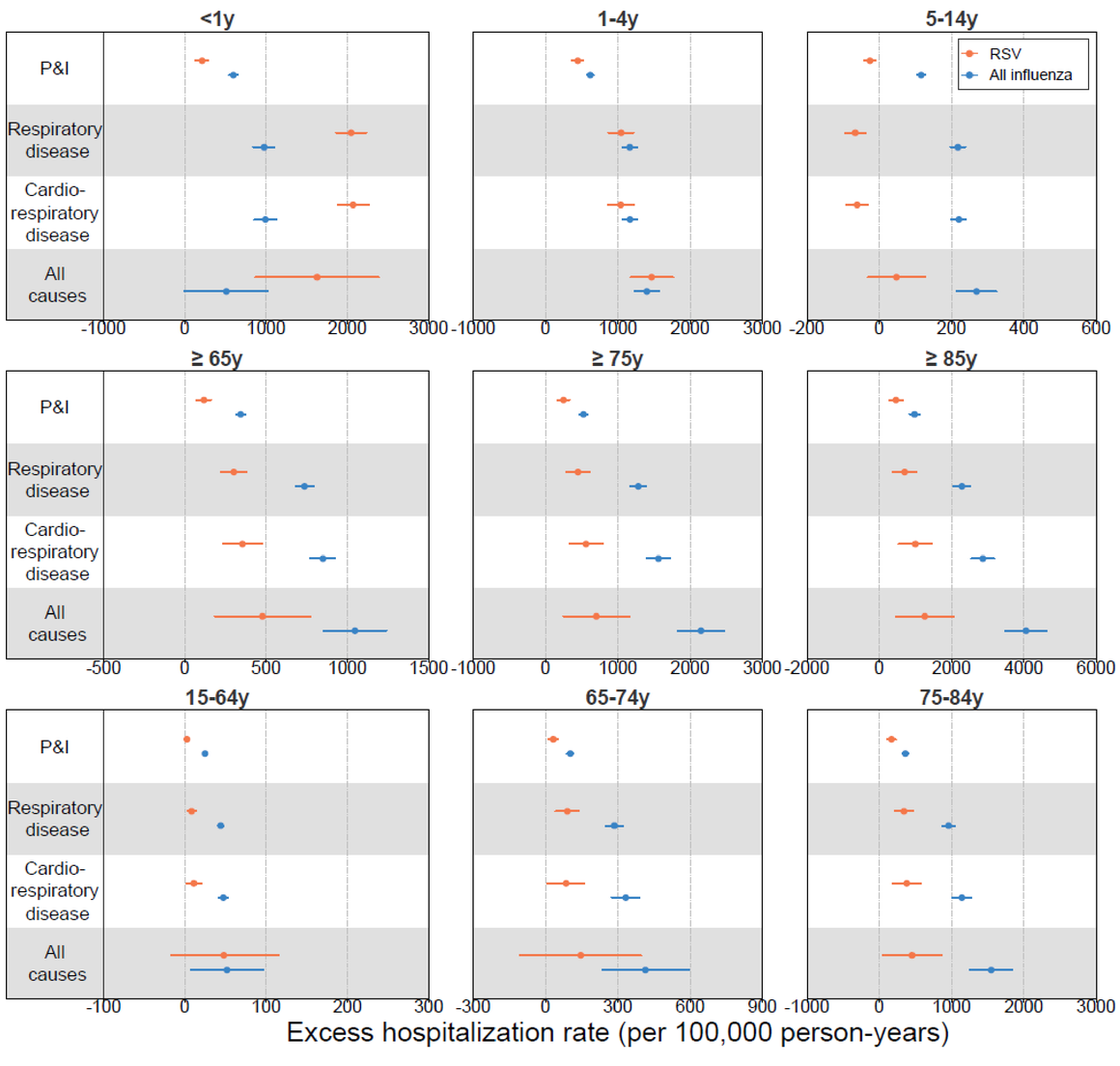

Figure 1. Age group- and cause-specific average annual excess hospitalization rate (per 100,000 person-years) associated with RSV and influenza in the Hong Kong population, 1998-2019.

Results

In Hong Kong, the highest annual excess respiratory hospitalization rate associated with RSV was estimated for individuals at 0-<1y (mean: 2047; 95% CrI: 1861, 2234 per 100,000 person-years) (Table 1), accounting for 18.3% (14.3%, 19.9%) of the total respiratory hospitalizations every year, followed by 1-4y (1044; 873, 1214, 17.1%). An age-dependent disease burden was estimated for older adults, with the highest in ≥85y (707; 382, 1027), similar estimates for ≥65y (302 per 100,000 person-years) and ≥75y (449) (Figures 1-2). A reduced respiratory hospitalization (-66; -95, -38 per 100,000 persons-years) potentially related to RSV activities was estimated for children at 5-14y, accounting for 6.5% (-6.5%; -9.2%, -3.7%) of the respiratory admissions in that age group. RSV was associated with 18 (8, 28), 34 (12, 55), and 96 (34, 157) excess respiratory deaths every 100,000 persons per year in individuals ≥65y, ≥75y, and ≥85y, respectively, and a minimal number of excess respiratory deaths was estimated for 65-74y annually in Hong Kong. RSV was mostly associated with hospitalization and mortality from respiratory disease, while notable hospitalizations and deaths from cardiovascular disease and non-cardiorespiratory disease were attributed to RSV in the age group ≥75y.

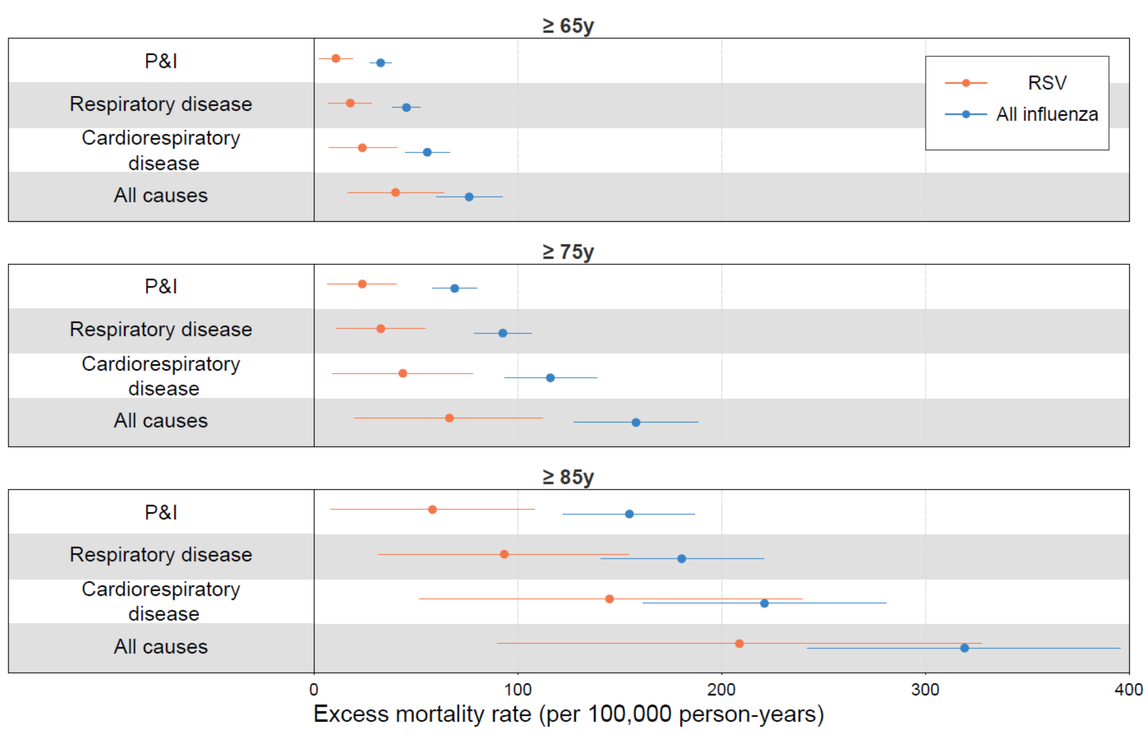

Figure 2. Age group- and cause-specific average annual excess mortality rate (per 100,000 person-years) associated with RSV and influenza in the Hong Kong population, 1998-2019.

Compared with influenza, in most age groups RSV was associated with relatively lower excess hospitalizations and/or mortality, with the only exception in the age group <1y where RSV was associated with 2-fold higher excess respiratory hospitalizations than influenza (Figures 1-2). The ratio of excess respiratory deaths to excess respiratory hospitalizations for RSV (mean: 13.8; 95% CrI: 4.2, 28.5 per 100 hospitalizations) was higher than influenza (7.8; 5.9, 9.8) in adults ≥85y, but comparable in adults ≥65y (RSV: (6.0; 2.3, 10.3); influenza: (6.2: 5.2, 7.2)) (Table 2).

Table 2. Ratios of the RSV-associated and Influenza-associated annual excess respiratory deaths to the excess respiratory hospitalizations in different age groups in Hong Kong population, from 1998 through 2019.

Age group	Excess respiratory deaths per 100 excess respiratory hospitalizations (95% CrI)	
	RSV	All influenza
≥65y	6.0 (2.3, 10.3)	6.2 (5.2, 7.2)
≥75y	7.4 (2.3, 13.9)	7.1 (5.9, 8.4)
≥85y	13.8 (4.2, 28.5)	7.8 (5.9, 9.8)

Conclusion

RSV infection was associated with substantial disease burden in Hong Kong over the past two decades particularly on hospitalizations in young children and fatality in elderly. The age- and cause-specific population-level estimates of health impact provided critical evidence to guide implementation of novel preventive measures against RSV.

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