The seasonality of respiratory syncytial virus and associated hospitalizations in high-risk population in Hong Kong

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Background

Respiratory syncytial virus (RSV) causes acute respiratory tract infections in humans every year, particularly bronchiolitis and pneumonia in children under five years and insidious respiratory illness in the elderly, leading to an enormous public health burden worldwide. Our study aims to characterize the seasonality of RSV and estimate the burden of associated hospitalizations in high risk population in Hong Kong.

Methods

Age-specific weekly hospitalizations from 1998 to 2015 were obtained from the Hospital Authority of Hong Kong. Distributed lag non-linear models and quasi-poisson generalized additive models were applied to analyze the association between the weekly respiratory hospitalization rates and the weekly RSV activity measured by sentinel surveillance data from 1998 to 2015 in Hong Kong allowing for other covariates. A moving epidemic method (MEM) combined with wavelet analysis was used to identify the seasonality of RSV circulation in Hong Kong.
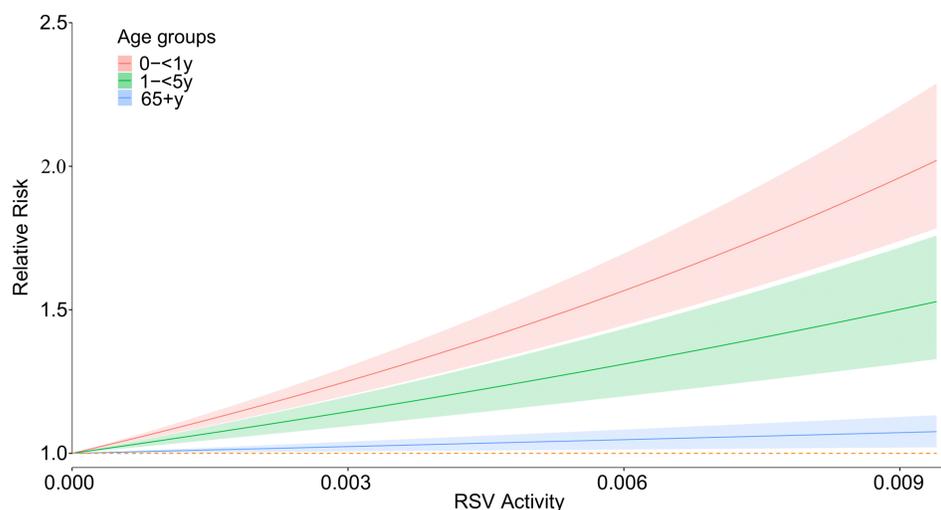
Figure 1. Intensity-dependent association (mean estimates of relative risk [RR] (solid lines) with 95% confidence intervals, and RR=1.0 (dashed lines)) between RSV activity and respiratory hospitalization in high risk population.
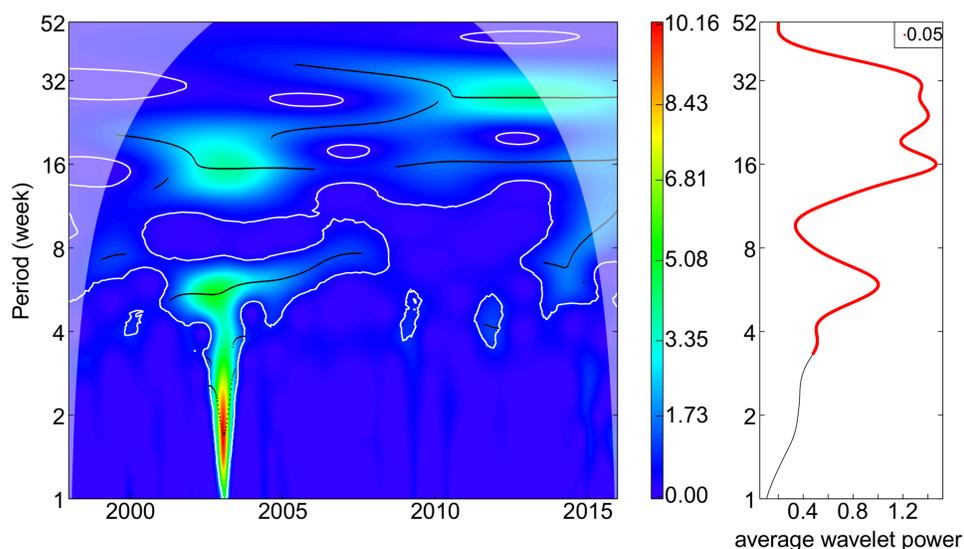
Figure 2. RSV seasonal pattens indicated by the wavelet power spectrum and average wavelet power of log-transformed and normalized weekly RSV-associated respiratory hospitalization in Hong Kong from 1998 through 2015 (Excluding Week 53 in some years and the time periods of the SARS epidemic and the 2009 influenza A(H1N1) pandemic in estimation of excess hospitalization, and plotted the relevant weeks as zero in this figure).

Results

On average 15.3% [95% eCI: 12.9%, 17.7%], 8.8% [95% eCI: 6.2%, 11.5%], 1.5% [95% eCI: 0.4%, 2.6%] of the respiratory hospitalization were attributable to RSV in individuals aged 0-<1y, 1-<5y and 65+y, respectively, in Hong Kong each year from 1998 through 2015 (Table 1). The regression models indicated that the overall intensity-dependent association between RSV activity and respiratory hospitalization was greatest in infants, followed by young children (Figure 1). The MEM suggested that RSV epidemics often started at week 11 [95%CI: 9,17], and RSV seasons lasted approximately 24 weeks [95%CI: 19, 31] in a year covering 70.9% of all RSV diagnoses. The wavelet analysis implied that there were biannual RSV peaks in some years, leading to an extension of the RSV season from week 4 to 40 (Figure 2).

Table1. Attributable risk of RSV on respiratory hospitalization in high risk population, 1998 -2015

Year	Attributable Fraction (%, 95%eCI)		
	0-<1y	1-<5y	65+y
1998	15.4 (13.1,17.8)	8.8 (6.1,11.5)	1.6 (0.5,2.6)
1999	25.2 (21.6,28.8)	14.8 (10.3,19.2)	2.8 (0.8,4.7)
2000	18 (15.1,20.9)	11.3 (7.9,14.7)	1.9 (0.5,3.3)
2001	19.9 (16.8,22.9)	11.4 (7.9,15)	2.1 (0.6,3.6)
2002	18.7 (15.8,21.6)	11.4 (7.9,14.9)	2 (0.6,3.3)
2003	13.4 (11.2,15.7)	8.3 (5.7,11)	1.4 (0.4,2.5)
2004	10.8 (9,12.5)	6.2 (4.2,8.1)	1.2 (0.4,2)
2005	20 (17,23.1)	11.6 (8.1,15)	2.1 (0.6,3.7)
2006	16.6 (14.1,19.2)	9.8 (6.8,12.7)	1.6 (0.5,2.8)
2007	19 (16,21.9)	10.9 (7.6,14.3)	2 (0.6,3.4)
2008	13.8 (11.6,16)	8.7 (5.9,11.4)	1.4 (0.4,2.4)
2009	7.8 (6.5,9.1)	4.6 (3.1,6.1)	0.7 (0.2,1.2)
2010	7.6 (6.3,8.9)	4.7 (3.2,6.2)	0.8 (0.2,1.3)
2011	13.4 (11.2,15.7)	8.1 (5.6,10.7)	1.4 (0.4,2.5)
2012	9.8 (8.2,11.3)	5.8 (3.9,7.6)	1 (0.3,1.7)
2013	9.1 (7.6,10.6)	5.1 (3.5,6.7)	1 (0.3,1.6)
2014	10.3 (8.6,12)	6.1 (4.2,7.9)	1 (0.3,1.7)
2015	9.6 (7.9,11.2)	5.8 (3.9,7.6)	1 (0.3,1.7)
Annual mean, 1998-2015	15.3 (12.9,17.7)	8.8 (6.2,11.5)	1.5 (0.4,2.6)

Note: 95%eCI = empirical 95% Confidence Intervals

Conclusions

A substantial burden of respiratory hospitalization was attributable to RSV infection particularly in children under five years, associated with a prolonged season of RSV each year in Hong Kong. The findings of our study could inform the timing to implement the prophylactic intervention on high-risk populations.

Acknowledgements

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