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Influenza vaccination and hospitalisation in Elderly Health Centres

Key Messages

1. A cohort of Elderly Health Centres was examined to determine whether influenza vaccination decreased hospitalisation and mortality.
2. In the influenza season, influenza vaccination reduced all-cause mortality by half and cardiorespiratory hospitalisation by a quarter. The extent to which influenza vaccination protects older people from serious morbidity and mortality needs to be confirmed in appropriately designed studies, so that scarce health care resources can be used effectively.

Introduction

In Hong Kong, influenza-associated morbidity and mortality are similar to those in temperate climates.[1] The World Health Organization (WHO) reports that influenza vaccination for older people (age ≥65 years) in the community may reduce hospitalisation by 25 to 39% and overall mortality by 39 to 75% during influenza seasons. These estimates are substantiated by reviews and meta-analyses,[2] but are increasingly controversial. First, it is difficult to reconcile them with seasonal influenza-related mortality,[3] because such a reduction in mortality in older people during the main influenza season could prevent more deaths than are caused by influenza. Second, the plausibility of influenza vaccination being most effective at preventing non-specific outcomes (such as all-cause mortality) and least effective at preventing influenza has been questioned.[2] Third, concerns have been raised as to whether the people most liable to die from influenza, ie the very old, are capable of mounting an effective immunological response to the vaccine.

Effectiveness of influenza vaccine against influenza or influenza-like illness has been assessed in older people in five randomised control trials,[2] whereas such effectiveness against hospitalisation and mortality has been obtained from observational studies comparing older people who volunteered for influenza vaccination with those who did not. This may create biases if those vaccinated and unvaccinated are systemically different. Observational evidence can be soundly based, but is not always confirmed in trials. Effectiveness of influenza vaccination in tropical and sub-tropical regions is less known, because most such research comes from temperate climates with a well-defined influenza season, whereas in tropical and sub-tropical regions, influenza may circulate at lower levels throughout the year.[4] Subsequent to the severe acute respiratory syndrome (SARS) outbreak in Hong Kong in 2003, influenza vaccination has become more common among community-dwelling older people. Previously, influenza vaccination was only provided to older people living in institutions. This change enables examination of influenza vaccination in reducing morbidity and mortality of older people living in the community.

Methods

This study was conducted from 15 June 2006 to 15 September 2007. Since July 1998, 18 Elderly Health Centres have been established to deliver health examinations and primary care services for older adults by the Department of Health of Hong Kong. All elderly residents in Hong Kong aged ≥65 years were encouraged to enrol. This study covered all community-dwelling enrolees from July 1998 to December 2001. More women enrolled than men; otherwise the enrolees were similar to the general elderly population in terms of age, socio-economic status, current smoking status, and hospital use. Record linkage by unique Hong Kong identity card numbers was used to obtain all deaths and admissions to public hospitals, which accounts for almost 95% of hospital use by older people.

Multivariable negative binomial and Poisson regression was used to compare the risk of hospital admission or death in this cohort in the 2 years prior to SARS

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(2001/2) and the 2 years after SARS (2004/5). Relative risks (incident rate ratios) with 95% confidence intervals were reported. The exposure was the length of time the Elderly Health Centre client was potentially exposed to influenza infection in 2001-2 and/or 2004-5, ie the duration of survival in each period. Exposure time started at the beginning of the relevant period, but at least one year after enrolment, because an older person capable of attending the Elderly Health Centre is unlikely to die immediately from a complication of influenza. As the same person may have exposure in both periods, which artefactually reduces the variance, we used the average estimates and standard errors from 100 different random splits of the cohort into two equally sized halves. Patient age, sex, education levels, and smoking status were adjusted for.

Different associations in potentially more vulnerable groups, such as older people, from the heterogeneity of effect across strata and the significance of interaction terms were examined, as were different associations in people receiving financial assistance (CSSA) or in poor health, because these people might be more likely to have been vaccinated. Admission and mortality in the high and low influenza seasons were compared. Based on surveillance data,[4] the influenza high season was defined as 3 months from 1 February in 2001, 2004, and 2005 and from 1 January in 2002. The influenza low season was defined as 3 months from 1 September in all 4 years. A telephone survey was carried out to check the vaccination rate in the Elderly Health Centre cohort.

This study obtained ethical approval from the Joint Institutional Review Board of The University of Hong Kong and Hospital Authority West Cluster, and the Ethics Committee of the Department of Health, Hong Kong.

Results

In a telephone survey from October 2006 to January 2007, of 286 randomly selected Elderly Health Centre enrolees, 207 (72%) responded; 6% reported an influenza vaccination in 2000 to 2002, and 36% in 2003 to 2005. There were 66 820 enrolees at the Elderly Health Centres between July 1998 and December 2001. After excluding 2630 living in institutions, 742 who had died before the start of 2001 or within one year of enrolling, and 145 with no date of death, 63 105 remained. Of these, 17 324 were admitted to hospital and 1582 died in 2001/2; 60 393 survived to the start of 2004, of whom 19 489 were admitted to hospital and 2546 died in 2004/5.

Overall, adjusted admissions for any cause were lower in the 2 years after SARS, with fewer admissions for injury and poisoning (Table), but not pneumonia or respiratory disease. Mortality was similar in both periods, including for injury and poisoning. In the younger age-group, admission was lower for cardiovascular and cardiorespiratory diseases. There was no evidence of different patterns for cardiorespiratory admissions or all-cause mortality by smoking status, self-rated health, overall health status or CSSA status either for all ages or for the younger age-group.

Comparing cardiorespiratory admissions and all-cause mortality by age-group for each possible pair of years in the high and low influenza seasons, there was no discernable pattern of reductions in the high influenza season which were not evident in the low influenza season (Fig).

Discussion

After the SARS outbreak in 2003, the influenza vaccination

Table. Adjusted relative risks* (incident rate ratios) for numbers of admission and mortality in 2004/5 (post-SARS) versus in 2001/2 (pre-SARS) by cause and age-group in the Elderly Health Centre Cohort

Variable	Incident rate ratio (95% CI)		
	All ages	65-74 years	≥75 years
No. of admission (ICD9 CM codes)			
Cancer (140-239)	1.02 (0.88-1.18)	1.03 (0.82-1.28)	1.00 (0.82-1.22)
Cardiovascular (390-459)	0.94 (0.88-1.01)	0.88 (0.78-0.97)	1.01 (0.91-1.11)
Respiratory (11 & 460-519)	0.96 (0.88-1.05)	0.91 (0.78-1.06)	1.01 (0.90-1.13)
Pneumonia (480-487)	3.10 (1.87-5.13)	2.49 (1.17-5.31)	3.54 (1.75-7.16)
Cardiorespiratory	0.95 (0.90-1.01)	0.89 (0.82-0.99)	1.01 (0.93-1.10)
Injury & poisoning (800-999 or E codes)	0.83 (0.78-0.89)	0.81 (0.71-0.92)	0.86 (0.77-0.96)
All other	0.88 (0.85-0.92)	0.84 (0.80-0.89)	0.93 (0.88-0.98)
All	0.91 (0.88-0.95)	0.87 (0.83-0.92)	0.96 (0.92-1.01)
Mortality (ICD10 codes)			
Cancer (C00 to D49)	1.04 (0.90-1.19)	1.06 (0.83-1.34)	1.02 (0.85-1.22)
Cardiovascular (I00-I99)	0.97 (0.82-1.15)	0.72 (0.56-0.93)	1.08 (0.86-1.34)
Respiratory (J00-J99 except J969 and A162, A165, A168, A169)	1.40 (0.98-2.00)	1.08 (0.62-1.87)	1.50 (0.99-2.27)
Pneumonia (J09-J18)	1.63 (0.92-2.88)	1.68 (0.35-8.14)	1.61 (1.52-1.71)
Cardiorespiratory	1.11 (0.95-1.29)	0.83 (0.65-1.05)	1.22 (0.99-1.50)
Injury & poisoning (S00-T98)	1.06 (0.58-1.94)	1.22 (0.36-4.19)	1.03 (0.50-2.14)
All other	1.11 (0.84-1.46)	1.01 (0.61-1.70)	1.14 (0.82-1.58)
All	1.07 (0.97-1.18)	0.97 (0.83-1.14)	1.12 (0.99-1.26)

* Model adjusted for sex, age, education level, and smoking status

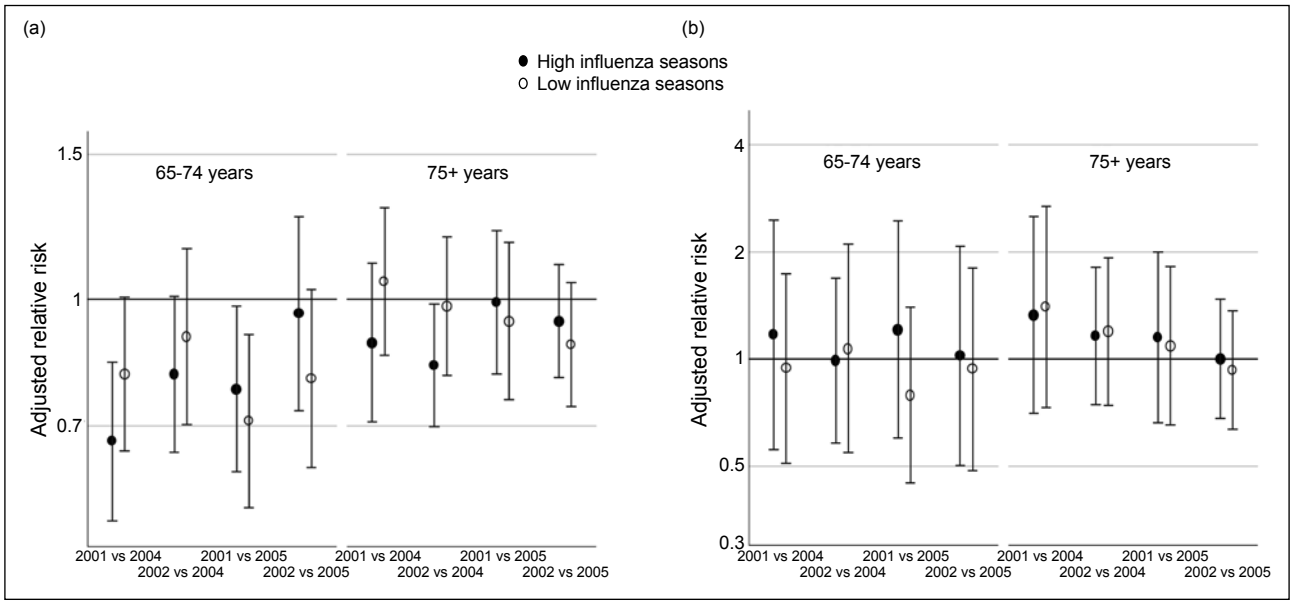

Fig. Adjusted relative risks (incident rate ratios) for (a) cardiorespiratory admission and (b) all-cause mortality in the high and low influenza seasons by age-group for each possible of years

rate in community-dwelling older people increased from low levels to over 35%. Influenza activity in Hong Kong peaked early in the year and dipped in the autumn. In the Elderly Health Centre cohort, there was an 11% reduction in cardiorespiratory hospitalisation in older people aged 65 to 74 years, and possibly a 28% reduction in cardiovascular mortality in the same age-group in the 2 years (2004/5), with more widespread influenza vaccination. These findings are consistent with a review suggesting that influenza vaccination reduces hospitalisation for respiratory diseases by 22%, for cardiac diseases by 24%, and for all-cause mortality by 48%.[2] Nonetheless, in our study, there was no change in all-cause mortality, with a plausible no change in injury and poisoning mortality. An alternative interpretation is that the reduction in hospital use is not causally related to influenza vaccination. First, there was also a similar reduction in hospitalisation for causes other than cancer, respiratory disease, and cardiovascular disease and a larger reduction for injury and poisoning. Moreover, reductions were not specific to the high influenza seasons. Second, following the SARS outbreak more attention in Hong Kong has been focused on preventing the spread of infections, which could lead to lower disease transmission. Third, an 11% reduction in cardiorespiratory hospitalisation is equivalent to an absolute decrease of 566 hospitalisation per 100 272 person years, whereas the number of cardiorespiratory hospitalisation due to influenza is estimated at 723 per 100 000 person years.[5] Reducing the number of cardiorespiratory hospitalisation due to influenza by 78% when vaccinating 36% of the cohort seems unlikely. Nevertheless, the possibility of a smaller beneficial effect of vaccination on hospitalisation cannot be ruled out. In addition, we were not able to consider less serious illnesses not requiring hospitalisation, which may make a difference to an older person's quality of life.

Limitations

First, this study was limited by lack of information on individual vaccination records, which are not centrally accessible. Those unvaccinated in the first period were not unvaccinated by self-selection, but by a policy decision, thus removing some of the potential volunteer bias. It is possible that mainly 'healthy users' who were not susceptible to the complications of influenza received vaccination, although vaccination was targeted at the needy and those with chronic diseases and there was no evidence of different effects by health status. Second, the study only considered a limited number of influenza seasons, which are not directly comparable. Nonetheless, the seasons in 2002 and 2004 appear similar, and a comparison of these influenza seasons found little difference in hospitalisation or mortality. The influenza strains in circulation have not changed greatly in several years,[3] so many older people may have already acquired natural immunity. Third, hospitalisation and death rates for pneumonia were higher post-SARS, which could represent an increase in pneumonia or more likely greater vigilance and more complete ascertainment of pneumonia. Finally, the model may be mis-specified, however, hospitalisation for cancer was similar in both periods, as were deaths from injury and poisoning.

Conclusions

Influenza vaccination may be beneficial and may protect older people from morbidity and mortality, but it is unlikely that influenza vaccination in Hong Kong would reduce all-cause mortality in the influenza season by half, or cardiorespiratory hospitalisation by a quarter. To what extent influenza vaccination protects older people in sub-tropical regions from serious morbidity and mortality needs

to be confirmed in appropriately designed studies, so that scarce health care resources can be used effectively.

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