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Household characteristics and influenza vaccination uptake in the community-dwelling elderly: a cross-sectional study

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ABSTRACT

Elderly people are at higher risk of influenza diseases. The morbidity benefit of vaccination is often offset by its low and variable coverage in elderly people in the community.

To assess household and individual factors associated with influenza vaccination uptake in the community-dwelling elderly of age ≥65, data from a cross-sectional Thematic Household Survey conducted in 2011/12 in Hong Kong were analysed, using vaccination in the past 12 months as the outcome variable. Households comprising an elderly person living with non-elderly member(s) of age ≤64 were also evaluated. Data fields included socio-demographics, household structures, health status, eligibility to financial subsidy, and subscription to health insurance.

The influenza vaccination rate was 27% in 4204 elderly persons from 3224 households. Being male, being economically active, attaining primary education, having smoking behaviours were negatively associated with vaccination, while chronic illness and age ≥70 were positively associated factors. Elderly people living alone gave a variable rate of vaccination ranging from 16.4% in males of age 65–69 to 36.3% in females ≥70. Household size *per se* was not associated with vaccination, but a positive correlation could be seen if the household was composed of vaccinated non-elderly member(s).

Influenza vaccination uptake in the community-dwelling elderly is dependent on both individual and household characteristics, the latter including the influence of vaccinated non-elderly member(s). The low vaccination coverage of "younger" (age 65–69) elderly men living alone is particularly worrisome. Interventions focusing on vulnerable elderly people and their social networks would be desirable.

Background

Influenza vaccination serves 2 inter-related health purposes: controlling virus transmission in the community, and the reduction of influenza-associated morbidity and mortality. Naturally, determinants of the effectiveness of influenza vaccination vary somewhat between the 2 purposes. Whereas broad coverage of vaccination is crucial for effective control of virus transmission, the morbidity/mortality benefits are achieved by specifically targeting people at risk, especially older adults above the age of 50 or 65 (Chen et al., 2015) because of the latter's weakened immunity against infection. In a meta-analysis involving 35 case-control studies, vaccination was shown to be effective against laboratory-confirmed influenza diseases in people of age 60 or above during an influenza season (Darvishian et al., 2014). Such benefit could be significantly higher if there's a good antigenic match between the virus strain in the vaccines and the circulating virus even during inter-seasonal periods (Darvishian et al., 2014). In studies conducted nationally, influenza mortality was disproportionately higher in people at or above the age of 65, though the precise level of benefit from vaccination has remained controversial (Thompson et al., 2003; Simonsen et al., 2007). In one study, vaccine effectiveness to avoid an influenza-attributable death was estimated to be 35%, a figure that would also likely vary with vaccination coverage in the population (Bonmarin et al., 2015). While reduction of influenza-related morbidity is the prime focus of vaccination of the elderly, optimal coverage would also contribute to the reduction of transmission, as evidenced from the control of outbreaks in nursing homes where elderly people resided (Arden et al., 1988).

As a public health measure, influenza vaccination is offered to elderly people through national programmes which may be at no direct cost to the vaccinees (Aguilar et al., 2012; Ohkusa, 2005; Ng et al., 2011). The uptake rate is expected to be high among residents of elderly care homes, as long as an efficient vaccination delivery system is in place (Leung, 2007; Monto et al., 2004). The situation is however more

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complicated for the community-dwelling elderly as they constitute a diverse population composing of individuals who may make their own decision about receiving vaccination. The uptake rate is therefore likely to be highly variable, as this could be under the influence of not just national policy but attitudes of the individuals. In evaluating factors associated with influenza vaccination uptake in the community-dwelling elderly, we hypothesise that this could be affected by one's network, a phenomenon inferred from the association reported between vaccination uptake and the influence of people one was acquainted with (Looijmans-van den Akker et al., 2009). Similarly, it has been shown that health behaviours of elderly people are related to the configuration of their social networks (Ashida and Heaney, 2008; Shiovitz-Ezra and Litwin, 2012). As household forms the closest linkage unit between elderly people and the society, an exploration of household factors may uncover important determinants of influenza vaccination uptake in the aged population. To test this hypothesis, we accessed data from a territory-wide cross-sectional survey conducted in 2011, a year after the H1N1 pandemic in Hong Kong, to evaluate household as well as individual factors associated with vaccination of the elderly, the latter defined as people of age ≥65.

Methods

In Hong Kong, thematic household survey (THS) is a cross-sectional population-based survey conducted regularly by the Government's Census and Statistics Department, a programme that has been in place since 1999. As the specific themes vary from survey to survey, we specifically looked for recent surveys with household data that could allow us to examine the association of influenza vaccination coverage with health status and demography at individual and household levels. As regards influenza in Hong Kong, there are usually 2 seasons per year – winter season in February and summer season in August/September – while vaccination is normally administrated before the winter season. Between October 2011 and January 2012, a THS was administered that had captured the influenza vaccination history of citizens in the community. Elderly people receiving residential care, e.g. those who live in a nursing home, residents living on board vessels (e.g. in typhoon shelter), and foreign domestic helpers were specifically excluded. Elderly interviewees recruited in the THS are considered to be representative of community-dwelling elderly people in Hong Kong. Overall, a total of 13,411 households had been approached with a 75% response rate, the sampling methods of which were described in the survey report (Census and Statistics Department and Hong Kong Special Administrative Region, 2013). In brief, selection was made from a sampling frame of all permanent quarters and quarters in segments wholly or partially for residential uses. The anonymous household survey data were obtained after data access approval, in compliance with the Personal Data (Privacy) Ordinance. Ethical approval was obtained from the Chinese University of Hong Kong Committee on Survey and Behavioural Research Ethics.

To study the vaccination coverage in community-dwelling elderly people, we analysed the data at 2 levels, i.e., individual and household. Data fields used in the analyses were 1) socio-demographic factors: gender, economic status, education level, and smoking habit; 2) health status: chronic illnesses and history of medical consultation; 3) subscription to health insurance and subsidy; 4) household characteristics. In this study, elderly people were defined as household members aged ≥65 at the time of the survey. Factors associated with vaccination were determined in logistic regression model and Mann–Whitney *U* test. At individual level, only elderly people were selected for analysis, while the outcome variable was influenza vaccination in the preceding 12 months. Association between vaccination rates of elderly people by age/gender and characteristics of the household structures were examined in logistic regression models. The household structures were differentiated into those composing of an elderly person living (a) alone, (b) with other elderly people, (c) with 1–2, or ≥3 non-elderly family members aged ≤64.

At household level, those with at least 1 elderly person aged ≥65 living with non-elderly family member(s) of age ≤64 were included in the subsequent analyses. The household dataset was created by aggregating individual level data of the elderly. The outcome variable in the analysis for households with 1 elderly person was his/her vaccination status. Odds ratio (OR) and multivariable logistic regression (backward) were performed to examine its association with household characteristics. For households with more than 1 elderly person, the outcome variable was classified into households with (a) unvaccinated, (b) some vaccinated, and (c) all vaccinated elderly people. Household was the analysis unit in these analyses. Chi-square test, Fisher's exact test (for variables with >20% of expected values <5), and multivariable ordinal regression (negative log–log function) were used to test for characteristics that were significantly different among the 3 groups. To examine the possible influence of family members in the household on the vaccination uptake of the elderly, characteristics of non-elderly household members aged ≤64 were manipulated as independent variables. Analyses were performed in IBM SPSS Statistics 21.

Results

Data of 29,187 residents in 10,065 households were available for analyses. Of these, 4204 residents from 3224 households were aged ≥65. About half of the elderly were male, 72% were of aged ≥70, and nearly 70% had received no formal education or have attained, as a maximum, primary school level education, while 60% reported having chronic illnesses. Financially, 8% of these elderly people were supported by "Comprehensive Social Security Assistance" (CSSA), a government-run mean-tested subsidy programme offered to local citizens who cannot financially support themselves, while 12% were covered by medical insurance or other medical benefits at the time of survey. For household structure, a majority (70%) were composed of 2–4 persons. Some 16% of the elderly were living alone, while 14% were members of bigger households (arbitrarily defined as ≥5 members per household).

The influenza vaccination coverage in the elderly was 27% (1154 out of 4204 persons) at individual level. Table 1 shows the characteristics of the elderly people and their associations with vaccination. Socio-demographically, male gender (OR = 0.81, 95% CI = 0.71–0.93), being economically active (OR = 0.3, 95% CI = 0.2–0.44), attaining only primary school level education (adjusted OR (aOR) = 0.77, 95% CI = 0.65–0.9) compared to no schooling, and currently smoking (OR = 0.51, 95% CI = 0.38–0.68) were less likely to be associated with vaccination in the year prior to the survey. The household size (median = 3) did not differ between vaccinated and unvaccinated elderly people. Large household size (≥5) was generally uncommon, accounting for 13.9% of all respondents, yet it gave a slightly lower vaccination rate (23% vs 28%, OR = 0.76, 95% CI 0.62–0.94, p = 0.01). Individual factors positively associated with influenza vaccination were presence of chronic illnesses (OR = 2.03, 95% CI = 1.76–2.36) and having consulted doctors for cold/flu in the past one year (OR = 1.41, 95% CI = 1.16–1.72). Older elderly people (age ≥70) were also more likely to have been vaccinated (OR = 2.02, 95% CI = 1.71–2.38). In Hong Kong, citizens aged ≥70 were eligible for joining the Elderly Health Care Voucher scheme, which provides financial subsidy at limited scale for attending private healthcare services for any medical conditions. However, only a few of them (40 out of 415) have reported voucher usage, and the latter was not associated with vaccination. Other indicators of financial status, including subscription to medical insurance or medical benefit and CSSA, were not significantly associated with influenza vaccination.

The inter-relationships between vaccination rate and the elderly by age, gender, and one's household compositions were further explored. The interaction of gender and age speared to play an important role in determining the vaccination uptake, as illustrated in Table 2. For elderly people living alone, the vaccination rate was lowest for males of age

Table 1
Individual level characteristics associated with influenza vaccination in community-dwelling elderly people aged ≥65 (n = 4204) in Hong Kong, 2011/2012.

	Vaccination		Total	Odds ratio (OR)	
	Count	%		OR	95% CI
Socio-demographics					
Gender					
Female	653	29%	2223		
Male	501	25%	1981	0.81	0.71–0.93
Economic status					
Economically inactive	1126	29%	3940		
Economically active	28	11%	264	0.30	0.2–0.44
Education level					
No schooling	338	31%	1103	*ref*	
Primary school	448	25%	1773	0.77	0.65–0.9
Secondary school	284	27%	1050	0.84	0.7–1.01
Post-secondary	84	30%	278	0.98	0.74–1.31
Health and behavioral status					
Having chronic illnesses					
No	321	19%	1661		
Yes	833	33%	2543	2.03	1.76–2.36
Medical consultation for cold/flu in the past 1 year					
No	982	27%	3695	1.41	1.16–1.72
Yes	172	34%	509		
Ever smoked					
No	957	28%	3409		
Yes	197	25%	795	0.84	0.71–1.01
Currently smoking					
No	1099	28%	3874		
Yes	55	17%	330	0.51	0.38–0.68
Household structure					
Living alone					
No	947	27%	3535		
Yes	207	31%	669	1.22	1.02–1.47
Large household size ≥5					
No	1019	28%	3618		
Yes	135	23%	586	0.76	0.62–0.94
Private housing					
No	449	28%	1592		
Yes	705	27%	2612	0.94	0.82–1.08
Financial subsidy and health insurance entitlement					
Having medical insurance/benefit					
No	1013	27%	3705		
Yes	141	28%	499	1.05	0.85–1.29
Eligibility for Voucher scheme (aged > =70)					
No	217	18%	1188		
Yes	937	31%	3016	2.02	1.71–2.38
Voucher used[‡]					
No	157	42%	375	0.53	0.26–1.09
Yes	11	28%	40		
CSSA[#]					
No	1058	27%	3849		
Yes	96	27%	355	0.98	0.77–1.25

[‡] Voucher—elderly health care voucher scheme, which provides financial subsidy, in limited scale, for attending private healthcare services for any medical conditions.

[#] CSSA—Comprehensive Social Security Assistance, which is a government-run means-tested subsidy programme offered to local citizens who cannot financially support themselves

65–69 (16.4%), and highest for females ≥70 (36.3%). Vaccination uptake in elderly people aged ≥70 was higher compared to those of age 65–69 (31% vs 18%, OR = 2.02, p < 0.001). Overall, vaccination uptake appeared to be higher in those living alone (31%) versus those living with other members, which was partly contributed by the high proportion (53.5%) of older women (age ≥70) in this subset of the study population. A slightly higher proportion of the "younger" elderly (aged 65–69) lived in households composing ≥3 non-elderly members (i.e. ≤64) with zero vaccination uptake, compared to older elderly aged ≥70 (87% vs 83%), though the difference was not statistically significant.

The influenza vaccination coverage of elderly people by household was 28% (708/2555). To further investigate the impacts of household characteristics, 2110 households comprising elderly people living with non-elderly family member(s) aged ≤64 were analysed. In households composing of one elderly person, 353 (22%) had received influenza vaccination in the preceding year, with females being more likely to be vaccinated than males (OR = 1.53, 95% CI = 1.2–1.95) (Table 3). Having at least 1 vaccinated non-elderly family member was strongly associated with the vaccination of elderly person in these households (OR = 8.03, 95% CI = 5.79–11.13). In addition, an elderly person was less likely to have been vaccinated if he/she belonged to households with ≥1 non-elderly family member who had attained only primary school education level (OR = 0.77), received no schooling (OR = 0.62), or were currently receiving education (OR = 0.71). Households with vaccinated elderly people were less likely to have family members without medical insurance (OR = 0.58). In the final multivariable logistic regression (backward), the following characteristics remained as significant predictors for vaccination of the elderly in the households: female gender (aOR = 1.62, p < 0.001), having household non-elderly members aged ≤64 who were vaccinated (aOR = 10.49, p < 0.001), no previous schooling (aOR = 0.48, p = 0.004), currently receiving education (aOR = 0.55, p < 0.001), and not subscribing to medical insurance (aOR = 0.66, p = 0.003).

Households accommodating >1 elderly person were classified into those with none, some, and all of these individuals having been vaccinated. In households with all elderly members unvaccinated, the proportion of vaccinated non-elderly members (aged ≤64) was 6% (20/334), compared to 17% (12/69) in households with some vaccinated, and 33% (39/118) in those with all vaccinated. The difference in vaccination status of non-elderly household members was statistically significant ($X^2 = 55.21$, p < 0.001). Separately, the proportion of household members subscribing to comprehensive medical insurance was 34%, 43%, and 46% ($X^2 = 6.36$, p = 0.04) for households with all elderly members unvaccinated, some vaccinated, and all vaccinated, respectively. Other household characteristics did not show any significant difference. In multivariable ordinal regression, having members aged ≤64 who were unvaccinated (estimates = −1.47, p < 0.001) and have attained primary school or higher education level (estimates = 0.66, p = 0.015) were significant predictors of higher vaccination coverage among the elderly in the respective household.

Discussions

Our study gave an influenza vaccination coverage rate of 27% in the community-dwelling elderly in Hong Kong, or that 28% of households with at least one elderly member of age ≥65 had been vaccinated, in the time period before the 2011–12 influenza season. The figure was close to the 31.2% vaccination uptake among community-dwelling elderly people who had ever been vaccinated as elicited in a telephone survey conducted in 2004 (Lau et al., 2006) but in stark contrast to the 90% coverage reported in a study on residents of elderly care homes, the latter providing different levels of residential services to old people in Hong Kong (Kung and Lau, 2006). Apparently vaccination coverage varies significantly between elderly people in the community and those receiving residential care. Interestingly, one study recruiting community-dwelling persons ≥65 years old from non-residential elderly social centres gave a coverage rate of 62.4%, a figure somewhere between the 2 extremes (Lau et al., 2009). In Hong Kong, elderly citizens living in residential care homes accounted for about 1% of the population of age ≥65, while some 15% of people aged ≥60 have enrolled in social centres (http://www.socialindicators.org.hk/). Their access to health and social care may explain their higher uptake rate compared

Table 2
Influenza vaccination rates in elderly people (age ≥65) and their association with age, gender, and household compositions in Hong Kong, 2011/2012.

Age/gender category	Male aged 65–69			Female aged 65–69			Male aged ≥70			Female aged ≥70		
Household structures of the elderly	Vaccinated	%	N	Vaccinated	%	N	Vaccinated	%	N	Vaccinated	%	N
Living alone	9	16.4%	55	12	18.5%	65	56	29.3%	191	130	36.3%	358
Living with other elderly	26	17.3%	150	81	22.6%	359	268	32.8%	816	219	35.3%	621
Living with 1–2 family members aged ≤64	45	18.8%	239	20	20.0%	100	48	21.8%	220	116	28.9%	402
Living with ≥3 family members aged ≤64	19	11.3%	168	5	9.6%	52	30	21.1%	142	70	26.3%	266
Total	99	16.2%	612	118	20.5%	576	402	29.4%	1369	535	32.5%	1647

to community-dwelling elderly people in general. The high vaccination coverage of elderly people in residential care had been reported in other studies in the US (Monto et al., 2004). On a population level, ≥60% of the elderly had reportedly received influenza vaccination in US, Canada, and some European countries (Zimmerman et al., 2003; Müller and Szucs, 2007; Lu et al., 2013). Comparing between countries, vaccination coverage in the elderly did vary considerably, for example, between 1% and 82% in different European countries, as reported before the 2008–2009 season (Mereckiene et al., 2014). The diversity could have arisen from the different national vaccination policy enforced, survey methodology, residence type (i.e. community-dwelling vs living in residential care homes), as well as individual's access to health/social care. While data between countries may not be comparable, it is evident that the influenza vaccination coverage in the community-dwelling elderly in Hong Kong falls short of the 75% target advocated by World Health Organisation (WHO) (OECD, 2012). As a densely populated metropolitan city under recurrent threats of influenza outbreaks, the health impacts of influenza could be substantial. In the latest influenza season, for example, over 130 elderly citizens were admitted to intensive care units or have died from influenza-related illnesses in the first month of 2015, a figure much higher than in previous years (Centre for Health Protection and Hong Kong Special Administrative Region, 2015). While this could be partly due to the antigenic mismatch between the circulating H3N2 virus and the strain incorporated in the seasonal vaccine, the suboptimal vaccination coverage might also have contributed to the phenomenon.

Apart from confirming the low vaccination coverage in the elderly, our study has specifically examined factors associated with influenza vaccination in community-dwelling elderly people in Hong Kong. Knowingly, other studies' uptake have already identified a good range of individual factors associated with influenza vaccination uptake, e.g., older age, male gender, education levels, ethnicity, and co-existence of chronic diseases, as described in a recent review (Bish et al., 2011). These associations generally apply to our population though the difference in demography, social-economic background, and vaccination policy may lead to implications in a different context. Our study highlighted that "younger" elderly males of age 65–69 living alone in Hong Kong gave an extremely low rate of influenza vaccination uptake. While these people were mobile and did not require residential care support, they might also be least likely to enrol in social centres where healthcare access could be channelled efficiently, including the provision of influenza vaccination. In elderly people of age ≥65 using social care services, the proportion of males was similarly low at 19% (Lau et al., 2009), echoing the low vaccination uptake of elderly males living alone. In the absence of specially designed senior housing facilities, it is likely that community-dwelling elderly people in Hong Kong have not been optimally networked for access to healthcare.

Through the analysis of household factors, our results revealed that influenza vaccination uptake is under the influence of vaccination experience of non-elderly household members. There was demonstrable positive association between vaccination of the elderly and that of members below the age of 65 in the same household. The rate of

Table 3
Comparison between households composing of a/an (a) vaccinated elderly person or (b) unvaccinated elderly person (aged ≥65) living with non-elderly family member(s) (aged ≤64) in Hong Kong, 2011/2012.

	(a) Households with unvaccinated elderly member (N = 1236)		(b) Households with vaccinated elderly member (N = 353)		Odds ratio (OR)	
	Count	%	Count	%	OR	95% CI
Economic situation						
Average monthly household income ≥ HKD10000^	956	77.3%	279	79.0%	1.10	0.83–1.47
Private housing	802	64.9%	212	60.1%	0.81	0.64–1.04
≥1 Economically active member	1004	81.2%	292	82.7%	1.11	0.81–1.51
≥1 Member receiving CSSA#	32	2.6%	8	2.3%	0.87	0.4–1.91
Health and behavioural status of non-elderly member(s)						
Influenza vaccination received	71	5.7%	116	32.9%	8.03	5.79–11.13
Chronic illness(es) reported	264	21.4%	91	25.8%	1.28	0.97–1.68
Medical consultation(s) made for cold/flu in the past 1 year	216	17.5%	77	21.8%	1.32	0.98–1.76
≥1 current smoker in the family	207	16.7%	56	15.9%	0.94	0.68–1.29
Education status of non-elderly member(s)						
Maximum education level attained:						
No schooling	150	12.1%	28	7.9%	0.62	0.41–0.95
Primary school	468	37.9%	113	32.0%	0.77	0.6–0.99
Secondary school	934	75.6%	254	72.0%	0.83	0.64–1.08
Post-secondary	375	30.3%	127	36.0%	1.29	1.01–1.65
≥1 member receiving education	361	29.2%	80	22.7%	0.71	0.54–0.94
Health insurance cover of non-elderly member(s)						
Comprehensive	385	31.1%	137	38.8%	1.40	1.1–1.79
Partial	442	35.8%	142	40.2%	1.21	0.95–1.54
None	850	68.8%	198	56.1%	0.58	0.46–0.74

^ HKD—Hong Kong dollar.
# CSSA—Comprehensive Social Security Assistance, a government-run mean-tested subsidy programme offered to local citizens who cannot financially support themselves.

vaccination of elderly people was also associated with the presence of chronic illness in other household members, who were naturally more likely to be vaccinated because of the health status. Higher education level of other household members and their subscriptions to medical insurance were other predictors of the elderly's vaccination, reflecting the importance of family support provided to old people under the same roof. Our results echoed the phenomenon of the clustering of vaccination decision observed in an international survey, attributing higher vaccination uptake to the sharing of advice among household members (Taylor et al., 2015). Unlike other published reports, however, household size *per se* in Hong Kong was not positively associated with vaccine uptake. This might be related to the difficulty in drawing comparison when the household sizes were uniformly small, with a median of 3 in the study population. While a small number of households (<15%) were composed of ≥5 members, there was no positive association between a large household size and the vaccination of the elderly. Apparently, networking of the elderly with vaccinated non-elderly members, rather than the household size alone, was the key determinant of influenza vaccination of the elderly (Looijmans-van den Akker et al., 2009; Ashida and Heaney, 2008; Shiovitz-Ezra and Litwin, 2012). Our results are therefore compatible with our pre-set hypothesis that influenza vaccination of the elderly is under the influence of one's network.

When addressing the healthcare needs of elderly people, our results lend support to the strategic planning of influenza vaccination programme so that maximum morbidity/mortality benefits can be derived. In Hong Kong and places with similar social-demographic characteristics, it is important to note that "younger" elderly male living alone constitute a particularly vulnerable community. Their mobility and independence mean that they could be at higher risk of exposure to influenza-infected people from other age groups. Their morbidity risk from influenza is in fact similar to middle-age adults, as reported in studies locally and other parts of the world (Van Kerkhove et al., 2011; Lee et al., 2013). Instead of general publicity, it is vital that tailored intervention be developed that targets these needy not-too-old elderly people. Apparently, peer influence and social connectivity could be strategically utilised to support the health decisions of the community-dwelling elderly (Taylor et al., 2015). The household influence reported in our study is clearly a perspective that could be incorporated in the development of vaccination strategy. Conveying health messages to households linked with the elderly and convincing their significant others to go for vaccination would probably achieve more than media campaigns. While these approaches may not benefit the elderly living alone, the principles of building or using networks that extend to vulnerable community should be translated into innovative healthcare practice.

We acknowledge that this study carries some limitations. Foremost, we have embarked on the analyses of data retrieved from the territory's regularly conducted thematic surveys to test our pre-set hypothesis. These secondary data suffer from the drawback of the lack of some data fields, e.g. actual age, further age breakdown beyond 70 years old, where and how influenza vaccination was administered, out-of-pocket payment for vaccination, etc., to name a few. Another major limitation was the timing of the study as it covered the vaccination history during one specified interval, i.e. Oct 2011 to Jan 2012, which might not directly overlap the pre-seasonal period. Finally, it was impossible to draw conclusion on the cause-and-effect relationship between household factors and influenza vaccination coverage despite the positive association noted. In-depth qualitative study or other research approaches would therefore need to be conducted to validate the results. Despite these shortcomings, we envisage that THS can be turned into a platform for the surveillance of influenza vaccination coverage, as the survey is conducted from time to time using similar sampling strategy. The household approach has also allowed us to examine vaccination uptake in the elderly from a different angle instead of treating them as a homogeneous population.

In conclusion, our results suggested that influenza vaccination uptake in the community-dwelling elderly is dependent both on one's demographics, namely age and gender, as well as the household structures. Elderly males of age 65–69 living alone in Hong Kong were least likely to go for vaccination, while the presence of vaccinated family members from other age group was positively associated with the elderly's vaccination. As the study was conducted in one city, extrapolation of the findings to other cities/countries should be cautioned. Nevertheless, the observations implied that the connection of elderly people to social and residential care services could be the primary determinant of influenza vaccination uptake, a conclusion which should also apply to localities with similar socio-demographic characteristics.

Conflicts of interest

The authors declare that there are no conflicts of interest.

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