11.検査業務

WHO information for laboratory diagnosis of pandemic (H1N1) 2009 virus in humans update. Geneva, World Health Organization, 2009
(http://www.who.int/entity/csr/resources/publications/swineflu/WHO_Diagnostic_Recommendationsh1n1_20090521.pdf, accessed 11 November 2009).

Instructions for storage and transport of suspected or confirmed human and animal specimens and virus isolates of pandemic (H1N1).
Geneva, World Health Organization, 2009
(http://www.who.int/entity/csr/resources/publications/swineflu/storage_transport/en/index.html, accessed 6 November 2009).

Guidance on regulations for the transport of infectious substances 2009–2010 (WHO/HSE/EPR/2008.10).
Geneva, World Health Organization, 2009
(http://www.who.int/entity/csr/resources/publications/biosafety/WHO_HSE_EPR_2008_10.pdf, accessed 6 November 2009).

Laboratory biorisk management for laboratories handling human specimens suspected or confirmed to contain influenza A (H1N1) causing the current international epidemics. Geneva, World Health Organization, 2009 (http://www.who.int/entity/csr/resources/publications/swineflu/Laboratorybioriskmanagement.pdf, accessed 6 November 2009).

Laboratory biosafety manual (third edition). Geneva, World Health Organization, 2004
(http://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf, accessed 6 November 2009).

12.その他

A practical tool for the preparation of a hospital crisis preparedness plan, with special focus on pandemic influenza. Copenhagen, World Health Organization Regional Office for Europe, 2007
(http://www.euro.who.int/Document/e89763.pdf, accessed 6 November 2009).

WHO checklist for influenza pandemic preparedness planning.
Geneva, World Health Organization, 2005
(http://www.who.int/csr/resources/publications/influenza/WHO_CDS_CSR_GIP_2005_4/en, accessed 6 November 2009).

General recommendations for the organisation of health care facilities in countries where cases of influenza A (H1N1) virus have not yet been reported: technical document 1.
Washington, DC, Pan American Health Organization, 2009
(http://new.paho.org/hq/index.php?option=com_docman&task=doc_download&gid=1384&Itemid, accessed 6 November 2009).

General recommendations for clinical management of influenza H1N1 infection cases: technical document 2.
Washington, DC, Pan American Health Organization, 2009
(http://new.paho.org/hq/index.php?option=com_docman&task=doc_download&gid=1529&Itemid, accessed 6 November 2009).

General recommendations for the organization of health care facilities for the care of A (H1N1) influenza cases: technical document 3. Washington, DC, Pan American Health Organization, 2009
(http://new.paho.org/hq/index.php?option=com_docman&task=doc_download&gid=1533&Itemid, accessed 6 November 2009).

Interim guidelines for avian influenza case management.
New Delhi, WHO Regional Office for South-East Asia, 2007
(http://www.searo.who.int/LinkFiles/Publication_CD-167-Interim-guidelines-AI.pdf, accessed 6 November 2009).

Pandemic influenza preparedness and response: a WHO guidance document.
Geneva, World Health Organization,2009
(http://www.who.int/csr/disease/influenza/pipguidance2009/en/index.html, accessed 6 November 2009).

HHS pandemic influenza plan. Washington, DC, US Department of Health and Human Services, 2005
(http://www.hhs.gov/pandemicflu/plan/pdf/HHSPandemicInfluenzaPlan.pdf, accessed 6 November 2009).

Surge hospitals: providing safe care in emergencies. Washington, DC, Joint Commission on Accreditation of Healthcare Organizations, 2006
(www.jointcommission.org/NR/rdonlyres/802E9DA4-AE80-4584-A205-48989C5BD684/0/surge_hospital.pdf, accessed 6 November 2009).

Epidemic- and pandemic-prone acute respiratory diseases: infection prevention and control in health care. Aide memoire. Geneva, World Health Organization, 2008
(http://www.who.int/entity/csr/resources/publications/EPR_AM3_E3.pdf, accessed 11 November 2009).

Infection control strategies for specific procedures in health-care facilities: epidemic-prone and pandemic-prone acute respiratory diseases, a quick reference guide.
Geneva, World Health Organization, 2008
(http://www.who.int/csr/resources/publications/WHO_CDS_HSE_2008_2/en/index.html, accessed 6 November 2009).

WHO guidelines on hand hygiene in health care (advanced draft): a summary. Clean hands are safer hands.
Geneva,World Health Organization, 2005 (whqlibdoc.who.int/hq/2005/WHO_EIP_SPO_QPS_05.2.pdf, accessed 5 November 2009).

Hospital Safety Index. Guide for Evaluators.
Washington, DC, Pan American Health Organization, 2008
(http://www.preventionweb.net/files/8974_SafeHosEvaluatorGuideEng1.pdf, accessed 6 November 2009).

監訳者・訳者紹介

[監訳者]

押谷　仁（おしたに　ひとし）

東北大学大学院医学系研究科 微生物学分野 教授

1987年東北大学医学部卒業。国立仙台病院にて、小児科・臨床ウイルス学を研修後、1991年JICA専門家としてザンビアでウイルス学の指導に従事。1995年医学博士。1997年テキサス大学公衆衛生修士。1998年新潟大学医学部公衆衛生学助手、1999年同講師。1999年世界保健機関（WHO）西太平洋事務局・感染症地域アドバイザー。2005年より現職。

[訳者]

石丸　知宏（いしまる　ともひろ）

株式会社日立製作所 日立横浜病院 小田原健康管理センタ、産業医

2008年産業医科大学医学部卒業。北九州市立医療センター、産業医科大学産業医実務研修センター等での勤務を経て、2012年より現職。

吉川　徹（よしかわ　とおる）

公益財団法人 労働科学研究所 副所長、医師

1996年産業医科大学医学部卒業。東京都立墨東病院、駒込病院等での勤務を経て、2000 年より労働科学研究所。同職場環境リスク研究グループ等を経て、現職。

和田　耕治（わだ　こうじ）

北里大学医学部 公衆衛生学 准教授

2000年産業医科大学医学部卒業。臨床研修医、企業での専属産業医を経て、2006年McGill（マギル）大学産業保健修士。2007年北里大学大学院博士課程修了。2012年より現職。

Hospital preparedness checklist for pandemic influenza
Focus on pandemic (H1N1) 2009

パンデミック・インフルエンザに対する病院管理体制チェックリスト
パンデミック(H1N1)2009を中心に
-新型インフルエンザ等発生時の診療継続計画作成のために-

2013年5月31日　第1刷発行

監訳者　押谷 仁
訳　者　石丸 知宏、吉川 徹、和田 耕治
発行者　酒井一博
発行所　公益財団法人 労働科学研究所
〒216-8501
川崎市宮前区菅生2-8-16
電話044-977-2121(代)FAX 044-976-8190
URL ..http://www.isl.or.jp　E-mail t.hara@isl.or.jp
デザイン　株式会社クルーズ
印刷所　オリジンシステムソリューション株式会社

ISBN978-4-89760-324-7 C3047

ISBN978-4-89760-324-7
C3047

世界保健機関(WHO)
欧州地域事務局

世界保健機構は国連の一機関であり、国際保健や公衆衛生上の課題に対応するために1947年に設立された。世界には6つの拠点があり、世界保健機関欧州地域事務局はその中の一つである。各事務局では各地域の健康問題に対応するために独自のプログラムを展開している。

加盟各国

Albania
Andorra
Armenia
Austria
Azerbaijan
Belarus
Belgium
Bosnia and Herzegovina
Bulgaria
Croatia
Cyprus
Czech Republic
Denmark
Estonia
Finland
France
Georgia
Germany
Greece
Hungary
Iceland
Ireland
Israel
Italy
Kazakhstan
Kyrgyzstan
Latvia
Lithuania
Luxembourg
Malta
Monaco
Montenegro
Netherlands
Norway
Poland
Portugal
Republic of Moldova
Romania
Russian Federation
San Marino
Serbia
Slovakia
Slovenia
Spain
Sweden
Switzerland
Tajikistan
The former Yugoslav
Republic of Macedonia
Turkey
Turkmenistan
Ukraine
United Kingdom
Uzbekistan

世界保健機構(WHO)欧州地域事務局

Scherfigsvej 8,
DK-2100 Copenhagen O,
Denmark

Tel.: +45 39 17 17 17. Fax: +45 39 17 18 18.

E-mail: postmaster@euro.who.int

Web site: www.euro.who.int

ガイドライン・マニュアル

成果物 No.3 「市町村（保健所を設置していない）のための新型インフルエンザ等対策特別措置法に関連した行動計画作成ツール」は、平成 25 年度分担研究報告書（P269）を参照のこと

OPEN ACCESS Freely available online

PLoS one

Risk Factors of Household Transmission of Pandemic (H1N1) 2009 among Patients Treated with Antivirals: A Prospective Study at a Primary Clinic in Japan

Nobuo Hirotsu[1], Koji Wada[2]*, Hitoshi Oshitani[3]

1 Hirotsu Clinic, Kawasaki, Japan, **2** Department of Public Health, Kitasato University School of Medicine, Sagamihara, Japan, **3** Department of Virology, Tohoku University Graduate School of Medicine, Sendai, Japan

Abstract

Background: Household transmission of influenza can affect the daily lives of patients and their families and be a trigger for community transmission, thus it is necessary to take precautions to prevent household transmission. We aimed to determine the risks of household transmission of pandemic (H1N1) 2009 influenza virus from an index patient who visited a primary clinic and was treated with antiviral drugs.

Methods: We followed up all the patients who were diagnosed with influenza A by rapid diagnostic test with a questionnaire or interview from July 2009 to April 2010. Secondary cases were defined as patients visiting the clinic or other clinics and being positive for influenza A by rapid diagnostic test within 7 days of onset of an index patient. Logistic regression analysis was used to explore the association between household transmission and the studied variables.

Results: We recruited 591 index patients and 1629 household contacts. The crude secondary attack rate was 7.3% [95% confidence interval (CI): 6.1–8.7]. Age of index patients (0–6 years old: odds ratio 2.56; 95% CI: 1.31–4.01; 7–12 years old: 2.44, 1.31–3.72; 30–39 years old 3.88; 2.09–5.21; 40 years old or more 2.76; 1.17–4.53) and number of household members with five or more (3.09, 2.11–4.07), medication started ≥48 hours from the onset of fever (2.38, 1.17–3.87) were significantly associated with household transmission.

Conclusions: Household transmission was associated with index patients aged ≤12 years old and adults ≥30 years with children, with more than five persons in the household, and medication initiated ≥48 hours from the onset of fever among the population, in which, antiviral treatment was given to all patients. We need to warn patients at high risk of household transmission to take additional precautions.

Citation: Hirotsu N, Wada K, Oshitani H (2012) Risk Factors of Household Transmission of Pandemic (H1N1) 2009 among Patients Treated with Antivirals: A Prospective Study at a Primary Clinic in Japan. PLoS ONE 7(2): e31519. doi:10.1371/journal.pone.0031519

Editor: Benjamin J. Cowling, University of Hong Kong, Hong Kong

Received September 23, 2011; **Accepted** January 9, 2012; **Published** February 16, 2012

Funding: This study was funded by a research project for emerging and re-emerging infectious diseases, Ministry of Health, This work was supported by Labour and Welfare (H23-Emerging infectious diseases-003). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing Interests: The authors have declared that no competing interests exist.

* E-mail: kwada-sgy@umin.ac.jp

Introduction

The household of an influenza patient could be at high risk of infection [1–3]. The secondary attack rate (SAR) of pandemic (H1N1) 2009 in 2009 was 10–45% [1–7]. Household transmission could result in the burden of taking care of patients at home for several days and affect their daily lives, and an additional financial burden because parents cannot go to work [8,9]. Household transmission could also be a trigger of community transmission. Understanding risk factors of household transmission is critical for minimizing the impact of influenza. A variety of risk factors have been identified, such as age of the index patient and number of household members [2–4,6,10,11]. Household transmission can be reduced if additional precautions, such as maintaining distance between patients and healthy household members, are implemented in household.

In Japan, the case fatality rate of influenza was relatively low comparing with other countries [12,13]. One of the reasons could be the accessibility of antiviral medications for patients at primary clinics because of universal health coverage [13,14]. However, treatment with neuraminidase inhibitors zanamivir or oseltamivir, for patients who are infected with influenza virus is not conclusive for prevention of household transmission of influenza [15,16], even though the mechanisms of neuraminidase inhibitors interfere with the release of progeny influenza virus from infected cells, and are effective for treatment and resolving viral shedding [16,17]. There have been studies on household transmission of influenza in cases when not all the patients have taken antiviral drugs, however, there has been few studies on risk factors of household transmission when all patients have been prescribed antiviral medication. The aim of the this observational cohort study in Japan was to determine risks of household transmission of

pandemic (H1N1) 2009 virus from index patients who visited a primary clinic and took an antiviral drug during the first wave of influenza in 2009.

Materials and Methods

Data collection

We implemented this prospective cohort study at a primary clinic in Kawasaki city, Kanagawa, Japan (population 1,410,000) from 22 July 2009 to 19 April 2010 when the first epidemic wave of influenza occurred in Japan after the identification of pandemic (H1N1) 2009 influenza virus in Mexico in April 2009 [18].

We obtained clinical information on prescribed antiviral medicine from the medical chart and disseminated a self-administered questionnaire to all the index patients or their families. A questionnaire comprised the number in the household (including the index patient), time from onset of fever of the index patient to initiating drug treatment and to onset of symptoms of household members who had secondary transmission of influenza A, and the existence of household members who were diagnosed with influenza A within 7 days of onset of the index patient. A questionnaire was returned to the clinic by FAX, or by mail, or submitting at the counter of the clinic. In the case of a questionnaire not being returned, we contacted the patient or patient family to ask them to send it back or to be interviewed.

Definition of index patient

We defined an index patient as the first person that had influenza-like symptoms, which were fever (≥37.5°C) plus cough and/or sore throat in his/her household, and were identified with influenza A virus by a rapid diagnostic test. In patients who had influenza-like illness but who were negative by a rapid diagnostic test, and the time interval from onset of symptoms to visiting the clinic was <24 hours, we performed a rapid diagnostic test on the next day, and prescribed antiviral medication based on diagnosis by a clinician. Households that consisted of at least two persons were eligible for study participation.

Definition of household transmission

We defined household transmission as a household member who visited the same clinic or other clinics, who was then diagnosed with influenza A by rapid diagnostic test within 7 days after the index patient started to develop influenza like symptoms.

Drug administration

All index patients received treatment with oseltamivir or zanamivir twice daily for 5 days, with the dose based on their body weight, as soon as patients were diagnosed with influenza. The choice of antiviral drug was not randomized and took into consideration patients' preferences for either oral or inhalational administration. In Japan, there are concerns that oseltamivir administration in teenagers can cause psychological and neuro-psychiatric side effects [19]. Thus, in this study, oseltamivir for teenagers were prescribed only when the index patient seemed not to be able to inhale zanamivir. We did not prescribe antiviral drugs for prophylaxis for healthy household individuals.

Statistical analysis

SARs were calculated according to the number of persons who were determined as "household transmission" divided by the total number of enrolled household members excluding the total number of index patients. Pearson's χ^2 test was used to compare categorical variables and the t test for continuous variables. Logistic regression analysis with a generalized estimating equation was used to determine the association between household transmission and the studied variables. We first examined the variables by univariate analysis, and then by multivariate analysis without factors not significant at $P = 0.10$ in univariate analysis. All analyses were performed using IBM SPSS Statistics 19. Since the incidence of household transmission was not rare, we corrected odds ratio with Zhang's formula [20].

Ethics statement

The Human Research Committee at the Kitasato University School of Medicine approved this study. We obtained a written consent with submitting a voluntary questionnaire.

Results

We recruited 591 index patients and 1629 household contacts. Eighty-six patients did not return the questionnaire or respond to the interview and were excluded from the study. Table 1 shows the characteristics of index patients according to age group. The peak age band of index patients was 7–12 years old. Overall, 119 secondary cases occurred among 1629 household contacts, giving a SAR of 7.3% (95% CI: 6.1–8.7). Ninety-seven percent of index patients started antiviral medication within 48 hours of the onset of fever.

Figure 1 shows the distribution of days from onset of fever in the index patients to onset of influenza-like illness in the secondary cases. Half of the secondary cases developed fever within 48 hours after the index patient had fever. However, there were a few cases of household transmission at 96 hours after development of symptoms in the index patients.

Table 2 shows the association of household transmission with the study variables. The rate of household transmission by age of the index patient peaked among patients aged 30–39 years old with a SAR of 19.7 (11.8–31.0). For patients aged ≥30 years, only two index patients did not have any children, while the others with secondary transmission were mothers (22.9% of index mother patients) and fathers (36.8% of index father patients). The SAR were higher in households with more than five people (11.1 (7.7–14.5)) among patients who took oseltamivir (9.7 (7.7–11.8)); and when the time from onset of fever to initiating medication was 48 hours or more (18.3 (8.5–28.1)).

Table 3 shows logistic regression analysis between household transmission and the studied variables. Age of index patients [0–6 years old, odds ratio (OR): 2.56, 95% CI: 1.31–4.01; 7–12 years old, 2.44, 1.31–3.72; 30–39 years old 3.88, 2.09–5.21; ≥40 years old, 2.76, 1.17–4.53] and number of household members (five or more 3.09, 2.11–4.07) were significantly associated with household transmission. Differences in antiviral medication were significantly associated with household transmission in univariate analysis, however, it was not significantly associated in multivariate analysis. Initiation of antiviral medicine after 48 hours (2.38, 1.17–3.87) was significantly associated with household transmission.

Discussion

The present prospective cohort study elucidated the risk factors that were associated with household transmission among the patients infected with influenza A, with antiviral drug treatment (oseltamivir or zanamivir) during the first wave of pandemic influenza virus (H1N1) 2009 at a primary clinic in Japan. We found that age ≤12 and ≥30 years old with children, households with more than five members, and initiation of antiviral therapy ≥48 hours were associated with household transmission. Differences in antiviral drug treatment were not significantly associated

Table 1. Characteristics of the index patients according to age group.

	Total		0–6 Yr		7–12 Yr		13–19 Yr		20–29 Yr		30–39 Yr		≥40 Yr	
Category	**(n = 591)**		**(n = 158)**		**(n = 232)**		**(n = 111)**		**(n = 32)**		**(n = 26)**		**(n = 32)**	
Number of household contacts (including the index patient)														
Two to three	229	(39)	59	(37)	104	(45)	31	(28)	8	(25)	14	(54)	13	(41)
Four	283	(48)	82	(52)	101	(44)	59	(53)	16	(50)	9	(35)	16	(50)
Five or more	79	(13)	17	(11)	27	(11)	21	(19)	8	(25)	3	(11)	3	(9)
Number of secondary cases in household														
None	494	(84)	127	(80)	193	(83)	103	(93)	28	(88)	17	(65)	26	(81)
One	80	(14)	25	(16)	36	(16)	5	(5)	3	(9)	6	(23)	5	(16)
Two	12	(2)	6	(4)	1	(0)	1	(1)	1	(3)	2	(8)	1	(3)
Three	5	(1)	0	(0)	2	(1)	2	(2)	0	(0)	1	(4)	0	(0)
Treatment														
Zanamivir	296	(50)	22	(14)	149	(64)	103	(93)	7	(22)	6	(23)	9	(28)
Oseltamivir	295	(50)	136	(86)	83	(35)	8	(7)	25	(78)	20	(77)	23	(72)
Time interval from onset of fever to take the first medication														
Less than 48 hours	571	(96)	155	(98)	224	(97)	105	(95)	31	(97)	24	(92)	32	(100)
48 hours or more	20	(4)	3	(2)	8	(3)	6	(5)	1	(3)	2	(8)	0	(0)

CI; Confidence interval.

doi:10.1371/journal.pone.0031519.t001

with household transmission based on logistic regression analysis, even though the SAR of zanamivir was significantly lower than that of oseltamivir.

The most identified type of influenza A virus from 22 July 2009 to 19 April 2010 according to national influenza surveillance in Japan was pandemic (H1N1) 2009 [21]. In the present study, we identified influenza A with a rapid antigen diagnostic test, and polymerase chain reaction testing was conducted by the Kawasaki City Institute for Public Health to confirm the pandemic (H1N1) 2009 virus for all 224 cases that were positive for influenza A until 21 October 2009. All the 242 cases were confirmed to be infected with pandemic (H1N1) 2009. We assumed that most patients were infected with pandemic (H1N1) 2009 virus in the study period. Vaccination against pandemic (H1N1) 2009 virus in Japan had been provided according to the list of prioritized groups from November 2009 and became available for everyone from January 2010. Thus, we did not take the effect of vaccination into account in this study.

The age group that was most frequently infected by pandemic (H1N1) 2009 virus in Japan in 2009 was 10–19 years old, and 65% of this age group were infected in the first wave of 2009, according to a national survey of antibody titer [22]. In our study, the rate of secondary transmission among the index patients who were 13–19 years old (3.3%) and 20–29 years old (5.1%) was lower compared with other age groups. It is possible that those aged 13–29 years maintained a distance from other household contacts to avoid

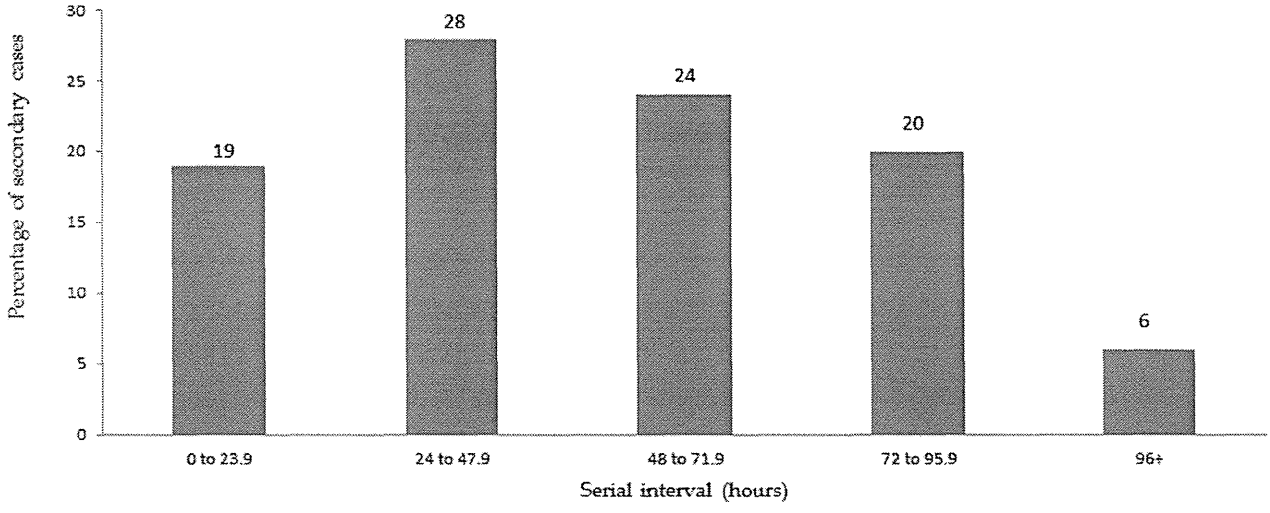

Figure 1. Distribution of days (serial interval) from onset of illness in the index patient to onset of influenza-like illness in the secondary case, Kawasaki, Japan 2009 (n = 97).

doi:10.1371/journal.pone.0031519.g001

Table 2. Association between household transmission and the studied variables.

Category	With household transmission n = 97	Total n = 591	SAR (95% CI), %		P
Age of index patients, years					
0–6	31	158	8.8	(6.5–11.9)	<0.01
7–12	39	232	7.2	(5.5–9.6)	
13–19	8	111	3.3	(1.8–5.9)	
20–29	4	32	5.1	(1.9–11.6)	
30–39	9	26	19.7	(11.8–31.0)	
≥40	6	32	8.5	(3.9–16.9)	
Number of household contacts (including the index patient)					
Two to three	26	229	6.3	(4.0–8.5)	<0.01
Four	45	283	6.5	(4.8–8.2)	
Five or more	26	79	11.1	(7.7–14.5)	
Treatment					
Zanamivir	38	294	5.0	(3.5–6.6)	<0.01
Oseltamivir	59	293	9.7	(7.7–11.8)	
Time interval from onset of fever to taking the first medication					
Less than 48 hours	90	571	6.9	(5.7–8.2)	<0.01
48 hours or more	7	20	18.3	(8.5–28.1)	

CI: confidence interval.
SAR: secondary attack rate.
doi:10.1371/journal.pone.0031519.t002

secondary transmission at home. It has been shown previously that there is a high risk of household transmission when index patients are preschool age [4,6,23–25], whereas we found that people aged ≥30 years also had a high risk of household transmission, as well as those who were ≤12 years old. All of those who were ≥30 years of age in the present study were parents, and it is possible that they might not avoid close contact when taking care of their children at home. Children aged ≤12 years old tend to have longer periods of shedding influenza virus and do not comply with hygiene and precautions against infection [4,25–27].

Table 3. Risk factors for household transmission of pandemic H1N1 (2009) from index patients treated with antiviral medicine.

	Univariate analysis		Multivariate analysis	
Category	OR	(95%CI)	OR	(95%CI)
Age of index patients, years				
0–6	2.32	(1.30–3.56)	2.56	(1.31–4.01)
7–12	2.06	(1.14–3.24)	2.44	(1.31–3.72)
13–19	1		1	
20–29	1.62	(0.56–3.43)	1.44	(0.44–3.35)
30–39	3.49	(1.90–4.86)	3.88	(2.09–5.21)
≥40	2.24	(0.96–3.94)	2.76	(1.17–4.53)
Number of household contacts (including the index patient)				
Two to three	1		1	
Four	1.37	(0.90–2.00)	1.51	(0.98–2.19)
Five or more	2.62	(1.75–3.56)	3.09	(2.11–4.07)
Treatment				
Zanamivir	1		1	
Oseltamivir	1.55	(1.09–2.11)	1.20	(0.75–1.83)
Time interval from onset of fever to taking the first medication				
Less than 48 hours	1		1	
48 hours or more	2.19	(1.09–3.60)	2.38	(1.17–3.87)

doi:10.1371/journal.pone.0031519.t003

Our study showed that a larger household with more than five members or more was a risk factor even though some studies indicated household size has not been determined as a risk factor for domestic transmission [4,22]. Family size and the number of children are recognized as risk factors for household transmission in previous studies [5,28,29]. However, contact between patients and healthy persons in the household could differ based on cultural and familial factors and the size of the house [24].

The effectiveness of antiviral medication (zanamivir or oseltamivir) to reduce household transmission in index patients is controversial [16,30–32]. Antiviral medication for patients could have some effect on preventing household transmission. Nishiura et al. have shown that zanamivir reduces the risk of household transmission among patients who are infected with pandemic (H1N1) 2009 virus in Japan [33]. In our study, there was a significant difference of the SAR between zanamivir and oseltamivir for the index patients with regard to household transmission; however the logistic regression analysis did not identify a significant difference. This was possibly due to the limited number of participants, which influenced our ability to detect the difference. Based on the age stratified analysis, the population treated with zanamivir had a lower risk of secondary transmission even though there was a bias for prescribing zanamivir for 10–19 year-old patients who had lower secondary attack rate resulting in risk of indicating a spurious preventing effect. Further studies are needed to elucidate the effectiveness of each antiviral medication for prevention of household transmission.

Early antiviral medication might minimize the risk of household transmission. Ng et al. have shown that treatment by oseltamivir within 24 hours reduced household transmission of influenza significantly compared with no antiviral treatment [16]. Pebody et al. have shown a significant reduction of influenza with antiviral treatment of the index patient within 48 hours [32]. Our study also showed that antiviral treatment after 48 hours resulted in a higher risk of household transmission, when compared with a group with early antiviral treatment, although there were a limited number of patients who had antiviral treatment after 48 hours. However, the interval before secondary transmission indicates how quickly an epidemic can evolve in a household [2,6]. Half of patients with household transmission of influenza have symptoms within 48 hours of symptom onset in index patients. Transmission occurs very early in the development of symptoms in the index patient, which might not be preventable by early antiviral treatment because of the time required to obtain antiviral medicine at a clinic. In addition, shedding of seasonal influenza virus has been identified before one day of peak of influenza like symptoms [34]. Further studies are needed to elucidate how much early treatment could be effective for preventing household transmission, and how early people should take antiviral medication for preventing household transmission. Physical intervention for preventing household transmission is also needed, such as hand washing, especially in the early phase of illness. However, measures such as maintaining distance from or isolation of the patient is difficult if small children are infected [35,36].

Some of the secondary household transmission cases in this study might have been caused by infections from outside of their household, as many people were infected with pandemic (H1N1) 2009 in their communities during the study period. However, the partial correlation coefficients between the weekly accumulated secondary transmission cases, and the weekly-accumulated number of influenza patients who did not have any family members diagnosed with influenza within seven days, which could reflect the community transmission in this data setting was -0.00019. This was adjusted for the weekly-accumulated numbers of first patients in their households. Thus, the number of patients infected with pandemic (H1N1) 2009 outside of their household was likely to be minimal, although further studies are still needed to elucidate the impact of these cases on secondary household transmission of influenza with mathematical modeling.

There were a few limitations in our study. First, the generalizability of our results was limited to the population treated with antiviral medicine. Second, we neither followed-up patients by home visits nor disregarded the possible significance of subclinical or asymptomatic infection. Third, biases could have further arisen from the potential that all index patients recruited had to be sick enough to initially seek medical attention, thus selecting for "sicker" patients who may have had a higher degree of "infectiousness".

Household transmission was associated with index patients aged <12 years old and adults ≥ 30 years with children; more than five persons in the household; initiation of treatment at ≥ 48 hours from onset of fever within the population treated with antiviral medicine. We need to warn patients at high risk of household transmission to take additional precautions.

Author Contributions

Conceived and designed the experiments: NH KW. Performed the experiments: NH KW. Analyzed the data: KW HO. Contributed reagents/materials/analysis tools: NH KW. Wrote the paper: NH KW HO.

References

1. Papenburg J, Baz M, Hamelin ME, Rheaume C, Carbonneau J, et al. (2010) Household transmission of the 2009 pandemic A/H1N1 influenza virus: elevated laboratory-confirmed secondary attack rates and evidence of asymptomatic infections. Clin Infect Dis 51: 1033–1041.
2. Suess T, Buchholz U, Dupke S, Grunow R, an der Heiden M, et al. (2010) Shedding and transmission of novel influenza virus A/H1N1 infection in households–Germany, 2009. Am J Epidemiol 171: 1157–1164.
3. Simmerman JM, Suntarattiwong P, Levy J, Gibbons RV, Cruz C, et al. (2010) Influenza virus contamination of common household surfaces during the 2009 influenza A (H1N1) pandemic in Bangkok, Thailand: implications for contact transmission. Clin Infect Dis 51: 1053–1061.
4. Carcione D, Giele CM, Goggin LS, Kwan KS, Smith DW, et al. (2011) Secondary attack rate of pandemic influenza A(H1N1) 2009 in Western Australian households, 29 May–7 August 2009. Euro Surveill 16: pii:19765.
5. Savage R, Whelan M, Johnson I, Rea E, Lafreniere M, et al. (2011) Assessing secondary attack rates among household contacts at the beginning of the influenza A (H1N1) pandemic in Ontario, Canada, April–June 2009: A prospective, observational study. BMC Public Health 11: 234.
6. France AM, Jackson M, Schrag S, Lynch M, Zimmerman C, et al. (2010) Household transmission of 2009 influenza A (H1N1) virus after a school-based outbreak in New York City, April–May 2009. J Infect Dis 201: 984–992.
7. Yang Y, van Boven M, Donker T, van der Lubben M, van Gageldonk-Lafeber RB, et al. (2010) Transmission of Novel Influenza A(H1N1) in Households with Post-Exposure Antiviral Prophylaxis. PLoS One 5: e11442.
8. Meltzer MI, Cox NJ, Fukuda K (1999) The economic impact of pandemic influenza in the United States: priorities for intervention. Emerg Infect Dis 5: 659–671.
9. Carrat F, Sahler C, Rogez S, Leruez-Ville M, Freymuth F, et al. (2002) Influenza burden of illness: estimates from a national prospective survey of household contacts in France. Arch Intern Med 162: 1842–1848.
10. Cowling BJ, Chan KH, Fang VJ, Lau LL, So HC, et al. (2010) Comparative epidemiology of pandemic and seasonal influenza A in households. N Engl J Med 362: 2175–2184.
11. Yang Y, Sugimoto JD, Halloran ME, Basta NE, Chao DL, et al. (2009) The transmissibility and control of pandemic influenza A (H1N1) virus. Science 326: 729–733.

12. Kamigaki T, Oshitani H (2009) Epidemiological characteristics and low case fatality rate of pandemic (H1N1) 2009 in Japan. PLoS Curr 1: RRN1139.
13. Wada K, Nishiura H, Kawana A (2010) An epidemiological analysis of severe cases of the influenza A (H1N1) 2009 virus infection in Japan. Influenza Other Respi Viruses 4: 179–186.
14. Ikeda N, Saito E, Kondo N, Inoue M, Ikeda S, et al. (2011) What has made the population of Japan healthy? The Lancet 378: 1094–1105.
15. Hayward A (2010) Does treatment with oseltamivir prevent transmission of influenza to household contacts? Clin Infect Dis 50: 715–716.
16. Ng S, Cowling BJ, Fang VJ, Chan KH, Ip DK, et al. (2010) Effects of oseltamivir treatment on duration of clinical illness and viral shedding and household transmission of influenza virus. Clin Infect Dis 50: 707–714.
17. Moscona A (2005) Neuraminidase inhibitors for influenza. N Engl J Med 353: 1363–1373.
18. Center for Disease Control and Prevention (2009) Outbreak of swine-origin influenza A (H1N1) virus infection - Mexico, March–April 2009. MMWR Morb Mortal Wkly Rep 58: 467–470.
19. Hama R (2007) Oseltamivir's adverse reactions: fifty sudden deaths may be related to central suppression. BMJ 335: 59.
20. Zhang J YK (1998) What's the relative risk? a method of correcting the odds ratio in cohort studies of common outcomes. JAMA 280: 1690–1691.
21. National Institute of Infectious Diseaes, Japan (2009) Current situation of pandemic influenza A (H1N1). Available: http://idsc.nih.go.jp/disease/swine_influenza/2009idsc/09idsc29.html.
22. National Institute of Infectious Diseaes, Japan (2009) Report of a survey on antibody of Influenza A/California /7/2009pdm. Available: http://idsc.nih.go.jp/yosoku/Flu/2010Flu/Flu10_1.html.
23. Komiya N, Gu Y, Kamiya H, Yahata Y, Yasui Y, et al. (2010) Household transmission of pandemic 2009 influenza A (H1N1) virus in Osaka, Japan in May 2009. J Infect 61: 284–288.
24. Cauchemez S, Donnelly CA, Reed C, Ghani AC, Fraser C, et al. (2009) Household transmission of 2009 pandemic influenza A (H1N1) virus in the United States. N Engl J Med 361: 2619–2627.
25. Hirotsu N, Iwaki N, Kawai N, Ikematsu H, Kashiwagi S (2007) Intra-Familial Transmission of Influenza A and Influenza B. In: Kats JM, ed. Toronto, Canada: International Medical Press,Atlanta,GA. pp 54–56.
26. Longini IM, Jr., Koopman JS, Monto AS, Fox JP (1982) Estimating household and community transmission parameters for influenza. Am J Epidemiol 115: 736–751.
27. Ling LM, Chow AL, Lye DC, Tan AS, Krishnan P, et al. (2010) Effects of early oseltamivir therapy on viral shedding in 2009 pandemic influenza A (H1N1) virus infection. Clin Infect Dis 50: 963–969.
28. Goldstein E, Cowling BJ, O'Hagan JJ, Danon L, Fang VJ, et al. (2010) Oseltamivir for treatment and prevention of pandemic influenza A/H1N1 virus infection in households, Milwaukee, 2009. BMC Infect Dis 10: 211.
29. Loustalot F, Silk BJ, Gaither A, Shim T, Lamias M, et al. (2011) Household transmission of 2009 pandemic influenza A (H1N1) and nonpharmaceutical interventions among households of high school students in San Antonio, Texas. Clin Infect Dis 52 Suppl 1: S146–153.
30. Halloran ME, Hayden FG, Yang Y, Longini IM, Jr., Monto AS (2007) Antiviral effects on influenza viral transmission and pathogenicity: observations from household-based trials. Am J Epidemiol 165: 212–221.
31. Looker C, Carville K, Grant K, Kelly H (2010) Influenza A (H1N1) in Victoria, Australia: a community case series and analysis of household transmission. PLoS One 5: e13702.
32. Pebody RG, Harris R, Kafatos G, Chamberland M, Campbell C, et al. (2011) Use of Antiviral Drugs to Reduce Household Transmission of Pandemic (H1N1) 2009, United Kingdom. Emerg Infect Dis 17: 990–999.
33. Nishiura H, Oshitani H (2011) Household Transmission of Influenza (H1N1-2009) in Japan: Age-specificity and Reduction of Household Transmission Risk by Zanamivir Treatment. J Int Med Res 39: 619–628.
34. Carrat F, Vergu E, Ferguson NM, Lemaitre M, Cauchemez S, et al. (2008) Time lines of infection and disease in human influenza: a review of volunteer challenge studies. Am J Epidemiol 167: 775–785.
35. Cowling BJ, Chan KH, Fang VJ, Cheng CK, Fung RO, et al. (2009) Facemasks and hand hygiene to prevent influenza transmission in households: a cluster randomized trial. Ann Intern Med 151: 437–446.
36. Jefferson T, Del Mar CB, Dooley L, Ferroni E, Al-Ansary LA, et al. (2011) Physical interventions to interrupt or reduce the spread of respiratory viruses. Cochrane database of systematic reviews: CD006207.

Wada et al. BMC Public Health 2012, 12:1065
http://www.biomedcentral.com/1471-2458/12/1065

BMC Public Health

RESEARCH ARTICLE Open Access

Wearing face masks in public during the influenza season may reflect other positive hygiene practices in Japan

Koji Wada[1*], Kuniko Oka-Ezoe[1] and Derek R Smith[2]

Abstract

Background: Although the wearing of face masks in public has not been recommended for preventing influenza, these devices are often worn in many Asian countries during the influenza season. In Japan, it is thought that such behavior may be an indicator of other positive hygiene practices. The aim of this study, therefore, was to determine if wearing a face mask in public is associated with other positive hygiene practices and health behaviors among Japanese adults.

Methods: We initially recruited around 3,000 Japanese individuals ranging from 20 to 69 years of age who were registered with a web survey company. Participants were asked to recall their personal hygiene practices during the influenza season of the previous year. Logistic regression analysis was then used to examine the associations between wearing a face mask in public and personal hygiene practices and health behaviors.

Results: A total of 3,129 persons responded to the survey, among whom 38% reported that they had worn a face mask in public during the previous influenza season. Wearing a face mask in public was associated with various self-reported hygiene practices including: frequent hand washing (adjusted Odds Ratio [OR]: 1.67; 95% Confidence Interval [95%CI]: 1.34-1.96), occasional hand washing (OR: 1.43; 95%CI: 1.10-1.75), frequently avoiding crowds (OR: 1.85; 95%CI: 1.70-1.98), occasionally avoiding crowds (OR: 1.65; 95%CI: 1.53-1.76), frequent gargling (OR: 1.68; 95%CI: 1.51-1.84), occasional gargling (OR: 1.46; 95%CI: 1.29-1.62), regularly avoiding close contact with an infected person (OR: 1.50; 95%CI: 1.33-1.67), occasionally avoiding close contact with an infected person (OR: 1.31; 95%CI: 1.16-1.46), and being vaccinated of influenza in the last season (OR: 1.31; 95%CI: 1.17-1.45).

Conclusions: Overall, this study suggests that wearing a face mask in public may be associated with other personal hygiene practices and health behaviors among Japanese adults. Rather than preventing influenza itself, face mask use might instead be a marker of additional, positive hygiene practices and other favorable health behaviors in the same individuals.

Keywords: Face mask, Health behavior, Hygiene practices, Influenza

Background

Wearing a face mask in public has not been recommended for preventing influenza virus infection [1]. Even though a face mask might provide some protection from inhaling larger droplets and hindering hand contact to the mouth and nose, the mask itself does not fit tightly enough to block droplets from entering between the face and mask [2]. In some Asian countries including Japan, many healthy people wear face masks in public during the influenza season, with an expectation that it helps prevent respiratory infections [3,4].

The effectiveness of wearing a face mask in certain settings with a high risk of influenza infection such as staying with influenza patients at home and shared living setting has been demonstrated in some studies. When a face mask is used correctly by infected individuals, it may help prevent household transmission by hindering the spread of infective respiratory droplets [5-7].

* Correspondence: kwada-sgy@umin.ac.jp
[1]Department of Public Health, Kitasato University School of Medicine, 1-15-1 Kitasato, Minami-ku, Sagamihara, Kanagawa 252-0374, Japan
Full list of author information is available at the end of the article

Wearing a facemask as well as adopting positive hand hygiene practices has been shown to reduce respiratory illness in shared living settings among young adults [8,9] with a relatively high compliance when wearing a mask. However, some other research has shown that compliance when wearing a face mask is low, especially in non-randomized studies [10,11].

On the other hand, it is reasonable to suggest that wearing face masks in the community might be an indicator of positive personal hygiene practices, health behaviors and perceptions of disease prevention. Despite this fact, no studies appear to have explored the association between face mask use and other personal hygiene practices and health behaviors. Aside from the potential public health benefits, examining these associations would also be very helpful to help minimize statistical confounding during research on the effectiveness of face masks in non-randomized studies. The aim of this study, therefore, was to determine if wearing a face mask in public is associated with other hygiene practices and health behaviors among Japanese adults.

Methods

Data collection

This study originally sought to recruit 3,000 Japanese individuals aged 20 to 69 years who were registered in a web survey company (among randomly selected 7,937 persons in a total 1.60 million registrants) in September 2011. The web survey company invited adults who were interested in being part of a survey that included some financial incentives for participating. The company then requested selected registrants to respond and ceased recruitment when the total number of participants exceeded our target of 3,000 individuals. Participants were classified into 5 groups by age range: 20–29, 30–39, 40–49, 50–59 and 60–69 years, as we estimated that a sample size of 300 participants per age group for each gender would be required. Individuals who agreed to participate in the study then completed an anonymous online questionnaire which included various questions regarding their hygiene practices and health behaviours during the October 2010 to March 2011 influenza season in Japan.

Questions included basic demographic information (age and sex), hygiene practices (wearing a face mask in public, hand washing, gargling, and avoiding crowds and infected people) and health behaviours (sleep quality and influenza vaccination status). We also asked the following questions about hygiene practices: "As a method to prevent influenza, to what extent do you practice the following methods? For each question, select the implementation status that applies to you the most during the periods when influenza spreads (winter)." For this section, we provided six items, as follows: "I wear a surgical mask in public during influenza season," "I wash my hands," "I try to avoid going to places where there are lots of people," "I gargle," "I try not to go near people who are infected," and "I try to have a good sleep." For each item, a four-point scale was provided, with the options: "I do this frequently," "I do this occasionally," "I don't do this often," and "I don't do this." We also asked the participants to indicate their influenza vaccination status in the previous winter.

Statistical analysis

Logistic regression analysis was used to explore statistical associations between wearing a face mask in public during the influenza season and personal hygiene practices and health behaviors. Results were displayed as Odds Ratios (OR) with 95% Confidence Intervals (95% CI). We combined the responses: "I don't do this often" and "I don't do this" as the reference group. We also combined: "do frequently" and "do occasionally" as outcomes for the question: "I wear a surgical mask in public during influenza epidemic season." We initially examined the variables using univariate analysis, and then by multivariate analysis to include factors that had been shown to be significant at the P=0.10 level during univariate analysis. All analyses were performed using IBM SPSS Statistics 19. As the outcome of interest (the incidence of household transmission) was common and this can affect the approximation of relative risk [12], we used Zhang's formula to correct the odds ratios [13].

Ethics

This study was approved by the Human Research Committee of the Kitasato University School of Medicine in Japan.

Results

A total of 3,129 individuals, including 1,549 males and 1,580 females, participated in the study (Table 1). Approximately 20% were distributed in each age group. Participants who answered that they frequently or occasionally wore a face mask in public constituted 38.4% of the total participants (n=1,203). Table 2 indicates personal hygiene practices and other health behaviors by face mask wearing status. The highest proportion of face mask wearing was reported by the oldest age group (60–69 years), while the lowest proportion was reported by the youngest age group (20–29 years). Approximately half of all female participants reported wearing a face mask, while only a third of all male participants reported having done so. High proportions of both the face mask and non-face mask wearing groups reported hand washing. Compared to the non-face mask wearing group, a larger proportion of the face mask wearing group reported that they undertook regular gargling.

Table 1 Participants characteristics and responses

	n=3129	(%)
Age (years)		
20–29	618	(19.8)
30–39	628	(20.1)
40–49	627	(20.0)
50–59	632	(20.2)
60–69	624	(19.9)
Sex		
Male	1549	(49.5)
Female	1580	(50.5)
I wear a face mask in public during the influenza season		
Frequently	476	(15.2)
Occasionally	727	(23.2)
Not often/not do	1926	(61.6)
I wash my hands		
Frequently	1799	(57.5)
Occasionally	1098	(35.1)
Not often/not do	232	(7.4)
I try to avoid going to places where there are lots of people		
Frequently	504	(16.1)
Occasionally	1318	(42.1)
Not often/not do	1307	(41.8)
I gargle		
Frequently	1230	(39.3)
Occasionally	1110	(35.5)
Not often/not do	789	(25.2)
I avoid close contact with people who are infected		
Frequently	769	(24.6)
Occasionally	1621	(51.8)
Not often/not do	739	(23.6)
I try to have a good sleep		
Frequently	971	(31.0)
Occasionally	1512	(48.3)
Not often/not do	646	(20.6)
I was vaccinated last influenza season		
Yes	500	(16.0)
No	2629	(84.0)

Logistic regression analysis revealed that wearing a face mask in public and personal hygiene practices and health behaviors were significantly associated (Table 3). Wearing a face mask in public was associated with various self-reported hygiene practices including: frequent hand washing (adjusted Odds Ratio [OR]: 1.67; 95% Confidence Interval [95%CI]: 1.34-1.96), occasional hand washing (OR: 1.43; 95%CI: 1.10-1.75), frequently avoiding crowds (OR: 1.85; 95%CI: 1.70-1.98), occasionally avoiding crowds (OR: 1.65; 95%CI: 1.53-1.76), frequent gargling (OR: 1.68; 95%CI: 1.51-1.84), occasional gargling (OR: 1.46; 95%CI: 1.29-1.62), regularly avoiding close contact with an infected person (OR: 1.50; 95%CI: 1.33-1.67), occasionally avoiding close contact with an infected person (OR: 1.31; 95%CI: 1.16-1.46), regularly trying to have good sleep (OR:1.17; 95%CI: 1.01-1.34), occasionally trying to have good sleep (OR:1.19; 95%CI: 1.04-1.34) and being vaccinated against influenza (OR: 1.31; 95%CI: 1.17–1.45).

Discussion

This study provides some compelling evidence that wearing a face mask in public is associated with other positive personal hygiene practices and health behaviors among Japanese adults. Participants who wore a face mask were more likely to report practicing additional preventive hygiene measures including hand washing, gargling, avoiding crowds and close contact with ill people, having good quality sleep and being vaccinated against influenza.

Previous research conducted elsewhere has also elucidated the prevalence of hygiene practices with respect to influenza. A study from Korea for example, conducted during the early phases of the influenza pandemic in 2009, reported that 57% of female and 34% of male participants washed their hands five times a day [14]. Similarly, Lau and colleagues reported that 22% of their study subjects in Hong Kong wore face masks regularly in public during the early phases of the pandemic, while 45% of them washed their hands more than 10 times [15]. The prevalence of positive hygiene practices reported in studies conducted during the 2009 influenza pandemic appears to be higher than during the 'general' influenza season. In fact, a much lower prevalence of preventive measures than that of the 2009 pandemic have been observed, even in outbreak situations. For example, less than 10% of participants implemented preventive measures (including frequent hand washing, wearing face masks and getting more sleep) in a study of Dutch and Finnish individuals during the SARS outbreak of 2003 [16]. Presumably, the risk of being affected by a disease within a community and country influences the distribution and uptake of preventive hygiene measures.

We hypothesize that various factors probably contributed to the significant associations between face mask use and other hygiene practices and health behaviors during the Japanese influenza season. Firstly, they might reflect a high level of social and cultural acceptance of hygiene practices and health behaviors in this country [4], generally, as personal preventive measures are deeply engrained in cultural attitudes and behaviors within the Japanese community – including in the workplace [17]. All hygiene practices and health behaviors investigated during the current study are recommended by Japanese health authorities such as the Ministry of Health,

Table 2 Personal hygiene practices and other health behaviors by face mask wearing status

	Wearing a face mask		Not wearing a face mask	
	n =1203	(%)	n = 1926	(%)
Age (years)				
20–29	194	(31.4)	424	(68.6)
30–39	246	(39.2)	382	(60.8)
40–49	249	(39.7)	378	(60.3)
50–59	242	(38.3)	390	(61.7)
60–69	272	(43.6)	352	(56.4)
Sex				
Male	467	(30.1)	1082	(69.9)
Female	736	(46.6)	844	(53.4)
I wash my hands				
Frequently	890	(49.5)	909	(50.5)
Occasionally	293	(26.7)	805	(73.3)
Not often/not do	20	(8.6)	212	(91.4)
I try to avoid going to places where there are lots of people				
Frequently	321	(63.7)	183	(36.3)
Occasionally	626	(47.5)	692	(52.5)
Not often/not do	256	(19.6)	1051	(80.4)
I gargle				
Frequently	688	(55.9)	542	(44.1)
Occasionally	394	(35.5)	716	(64.5)
Not often/not do	121	(15.3)	668	(84.7)
I avoid close contact with people who are infected				
Frequently	440	(57.2)	329	(42.8)
Occasionally	625	(38.6)	996	(61.4)
Not often/not do	138	(18.7)	601	(81.3)
I try to have a good sleep				
Frequently	493	(50.3)	488	(49.7)
Occasionally	563	(37.0)	959	(63.0)
Not often/not do	147	(23.5)	479	(76.5)
I was vaccinated last influenza season				
Yes	228	(43.8)	292	(56.2)
No	975	(36.8)	1674	(63.2)

Labour, and Welfare. Secondly, it is reasonable to suspect that individual risk perceptions might have influenced the statistical association we elucidated in the current study. An investigation from Hong Kong, for example, looked at hygiene behaviors during the early phases of the influenza A(H1N1) 2009 pandemic [15] and revealed that wearing a face mask in public was associated with a perception of the effectiveness of face mask use versus the dangers of influenza A(H1N1). Although previous studies have been conducted in culturally different settings and at different times (such as in the early phase of a pandemic), the current research nevertheless suggests that significant associations might have been influenced by individual perceptions. As such, further studies regarding the impact of individual perceptions are needed for verification [18].

Although the effectiveness of wearing a face mask for preventing infectious diseases has been investigated in various other studies [5,7,9,10,19,20], most have not considered possible associations between wearing a face mask and additional hygiene practices. However, we should note that a randomized controlled study which allocated face masks only revealed no statistically significantly differences in hand hygiene practices [8]. As such, it can be seen that any additional research to assess the contribution of face masks in preventing respiratory infections, will clearly need to monitor other health behaviors as part of their investigation.

Table 3 Statistical associations between wearing a face mask in public and personal hygiene practices and health behaviors

Variables	Crude		Adjusted	
	OR	(95% CI)	OR	(95% CI)
I wash my hands				
Frequently	2.25	(2.09–2.37)	1.67	(1.34–1.96)
Occasionally	1.84	(1.56–2.07)	1.43	(1.10–1.75)
I try to avoid going to places where there are lots of people				
Frequently	2.13	(2.04–2.21)	1.85	(1.70–1.98)
Occasionally	1.82	(1.72–1.91)	1.65	(1.53–1.76)
Not often/not do	1		1	
I gargle				
Frequently	2.12	(2.02–2.20)	1.68	(1.51–1.84)
Occasionally	1.70	(1.56–1.83)	1.46	(1.29–1.62)
Not often/not do	1		1	
I avoid close contact with people who are infected				
Frequently	2.04	(1.93–2.14)	1.50	(1.33–1.67)
Occasionally	1.64	(1.51–1.76)	1.31	(1.16–1.46)
Not often/not do	1		1	
I try to have a good sleep				
Frequently	1.75	(1.62–1.87)	1.17	(1.01–1.34)
Occasionally	1.42	(1.28–1.55)	1.19	(1.04–1.34)
Not often/not do	1		1	
I was vaccinated last influenza season				
Yes	1.19	(1.06–1.31)	1.31	(1.17–1.45)
No	1		1	

OR: adjusted Odds ratio; CI: confidence interval.

Given that our research was one of the first of its kind, we acknowledge that the study might have incurred some limitations. Firstly, the generalizability of the results might be limited because the study participants were recruited using an online survey tool. This population would, presumably, have had internet access and therefore, might be more aware of preventive measures against influenza – especially those promoted on the internet [21]. In addition, as this study utilized an internet survey, we do not have any information on the non-respondents. Secondly, there is the possibility that it may be difficult for people to accurately recall their hygiene practices of the previous year in detail. A bias may exist among people who wear masks if they are more inclined to report undertaking other positive hygiene practices at higher rates than individuals who report lower mask use. Thirdly, as our current study was conducted in only one country (Japan), further research is therefore needed to determine the situation in other countries, especially those with a relatively lower rate of face mask use in the general population. Lastly, given that our study was cross-sectional in design, we are unable to confirm the existence of causal relationships.

Conclusions

Overall, this study suggests that wearing a face mask in public may be associated with other personal hygiene practices and health behaviors among Japanese adults. Rather than preventing influenza itself, face mask use might instead be a marker of additional, positive hygiene practices and other favorable health behaviors in the same individuals.

Competing interests

The authors declare that they have no competing interests.

Authors' contribution

KW conceived and implemented the study. All the authors contributed to writing and revising the manuscript. All authors read and approved the final manuscript.

Acknowledgements

This work was supported by a Grant-in-Aid for Young Scientist (B) (23790705) and Keyaki-kai research fund, provided by Kitasato University School of Medicine Alumni Association. The funder had no role in study design, data collection and analysis, or the decision to publish.

Author details

[1]Department of Public Health, Kitasato University School of Medicine, 1-15-1 Kitasato, Minami-ku, Sagamihara, Kanagawa 252-0374, Japan. [2]School of Health Sciences, Faculty of Health, University of Newcastle, Brush Road, Ourimbah, New South Wales 2258, Australia.

Received: 10 October 2012 Accepted: 7 December 2012
Published: 10 December 2012

References

1. *Interim Recommendations for Facemask and Respirator Use to Reduce 2009 Influenza A (H1N1) Virus Transmission*. [http://www.cdc.gov/h1n1flu/masks.htm].
2. Institute of Medicine: *Preventing Transmission of Pandemic Influenza and Other Viral Respiratory Diseases*. Washington DC: The National Academies; 2011.
3. Kawaguchi R, Miyazono M, Noda T, Takayama Y, Sasai Y, Iso H: **Influenza (H1N1) 2009 outbreak and school closure, Osaka prefecture.** *Japan. Emerg Infect Dis* 2009, **15**(10):1685.
4. Burgess A, Horii M: **Risk, ritual and health responsibilisation: Japan's 'safety blanket' of surgical face mask-wearing.** *Sociol Health Illn* 2012, **34**(8):1184–1198.
5. Canini L, Andreoletti L, Ferrari P, D'Angelo R, Blanchon T, Lemaitre M, Filleul L, Ferry JP, Desmaizieres M, Smadja S, *et al*: **Surgical mask to prevent influenza transmission in households: a cluster randomized trial.** *PLoS One* 2010, **5**(11):e13998.
6. Tracht SM, Del Valle SY, Hyman JM: **Mathematical modeling of the effectiveness of facemasks in reducing the spread of novel influenza A (H1N1).** *PLoS One* 2010, **5**(2):e9018.
7. Cowling BJ, Chan KH, Fang VJ, Cheng CK, Fung RO, Wai W, Sin J, Seto WH, Yung R, Chu DW, *et al*: **Facemasks and hand hygiene to prevent influenza transmission in households: a cluster randomized trial.** *Ann Intern Med* 2009, **151**(7):437–446.
8. Aiello AE, Murray GF, Perez V, Coulborn RM, Davis BM, Uddin M, Shay DK, Waterman SH, Monto AS: **Mask use, hand hygiene, and seasonal influenza-like illness among young adults: a randomized intervention trial.** *J Infect Dis* 2010, **201**(4):491–498.
9. Aiello AE, Perez V, Coulborn RM, Davis BM, Uddin M, Monto AS: **Facemasks, hand hygiene, and influenza among young adults: a randomized intervention trial.** *PLoS One* 2012, **7**(1):e29744.
10. Ferng YH, Wong-McLoughlin J, Barrett A, Currie L, Larson E: **Barriers to mask wearing for influenza-like illnesses among urban Hispanic households.** *Public Health Nurs* 2011, **28**(1):13–23.
11. Larson EL, Ferng Y, Wong-McLoughlin J, Wang S, Haber M, Morse SS: **Impact of non-pharmaceutical interventions on URIs and influenza in crowded, urban households.** *Public Health Rep* 2010, **125**(2):178.

12. Beh EJ, Smith DR: **Real world occupational epidemiology, part 1: odds ratios, relative risk, and asbestosis.** *Arch Environ Occup Heal* 2011, **66**(2):119–123.
13. Zhang J, Yu KF: **What's The relative risk? a method of correcting the odds ratio in cohort studies of common outcomes.** *JAMA* 1998, **280**(19):1690–1691.
14. Park JH, Cheong HK, Son DY, Kim SU, Ha CM: **Perceptions and behaviors related to hand hygiene for the prevention of H1N1 influenza transmission among Korean university students during the peak pandemic period.** *BMC Infect Dis* 2010, **10**:222.
15. Lau JT, Griffiths S, Choi KC, Lin C: **Prevalence of preventive behaviors and associated factors during early phase of the H1N1 influenza epidemic.** *Am J Infect Control* 2010, **38**(5):374–380.
16. Vartti AM, Oenema A, Schreck M, Uutela A, de Zwart O, Brug J, Aro AR: **SARS knowledge, perceptions, and behaviors: a comparison between Finns and the Dutch during the SARS outbreak In 2003.** *Int J Behav Med* 2009, **16**(1):41–48.
17. Smith DR, Mihashi M, Adachi Y, Shouyama Y, Mouri F, Ishibashi N, Ishitake T: **Organizational climate and its relationship with needlestick and sharps injuries among Japanese nurses.** *Am J Infect Control* 2009, **37**(7):545–550.
18. Aiello AE, Coulborn RM, Aragon TJ, Baker MG, Burrus BB, Cowling BJ, Duncan A, Enanoria W, Fabian MP, Ferng YH, *et al*: **Research findings from nonpharmaceutical intervention studies for pandemic influenza and current gaps in the research.** *Am J Infect Control* 2010, **38**(4):251–258.
19. Del Valle SY, Tellier R, Settles GS, Tang JW: **Can we reduce the spread of influenza in schools with face masks?** *Am J Infect Control* 2010, **38**(9):676–677.
20. MacIntyre CR, Cauchemez S, Dwyer DE, Seale H, Cheung P, Browne G, Fasher M, Wood J, Gao Z, Booy R: **Face mask use and control of respiratory virus transmission in households.** *Emerg Infect Dis* 2009, **15**(2):233.
21. Kontos EZ, Emmons KM, Puleo E, Viswanath K: **Contribution of communication inequalities to disparities in human papillomavirus vaccine awareness and knowledge.** *Am J Public Health* 2012, **102**(10):1911–1920.

doi:10.1186/1471-2458-12-1065
Cite this article as: Wada *et al.*: Wearing face masks in public during the influenza season may reflect other positive hygiene practices in Japan. *BMC Public Health* 2012 **12**:1065.

Iwasa and Wada *BMC Public Health* 2013, **13**:647
http://www.biomedcentral.com/1471-2458/13/647

BMC Public Health

RESEARCH ARTICLE Open Access

Reasons for and against receiving influenza vaccination in a working age population in Japan: a national cross-sectional study

Tsubasa Iwasa[1] and Koji Wada[2*]

Abstract

Background: To improve influenza vaccination coverage in the working age population, it is necessary to understand the current status and awareness of influenza vaccination. This study aimed to determine influenza vaccination coverage in Japan and reasons for receiving the vaccine or not.

Methods: An anonymous internet-based survey was performed in September 2011. Our target study size was 3,000 participants between 20 and 69 years of age, with approximately 300 men and 300 women in each of five age groups (20–29, 30–39, 40–49, 50–59, and 60–69). We asked the history of influenza vaccine uptake in the previous year, and reasons for having vaccination or not.

Results: There were 3,129 respondents, of whom 24.2% of males and 27.6% of females received influenza vaccination between October 2010 and March 2011. Among those who were vaccinated, the main reasons for receiving the influenza vaccine were "Wanted to avoid becoming infected with influenza virus" (males: 84.0%; females: 82.6%) and "Even if infected with influenza, wanted to prevent the symptoms from becoming serious" (males: 60.7%; females: 66.4%). Among those not vaccinated, the most frequent reasons for not receiving the influenza vaccine included "No time to visit a medical institution" (males: 32.0%; females: 22.4%) and "Unlikely to become infected with influenza" (males: 25.1%; females: 22.7%).

Conclusions: The reasons for receiving the influenza vaccine varied between age groups and between sexes. To heighten awareness of influenza vaccination among unvaccinated working age participants, different intervention approaches according to sex and age group may be necessary.

Keywords: Influenza vaccination, Attitude, General population, Japan

Background

Influenza vaccination is an effective preventive measure [1], and is recommended for all individuals 6 months of age or older in the United States [2]. Although influenza vaccination of healthy working adults may not be cost-saving [3], influenza vaccination can reduce the proportion of people developing influenza-like illness, the number of lost work days, and physician visits during the influenza epidemic season [4]. In the United States, where adults are encouraged to receive influenza vaccination, influenza vaccination coverage was 35.8% for individuals 18–49 years old and 51.0% for those 50–64 years old [5]. Influenza vaccination among working age Japanese people is also optional as in the United States and whether to be vaccinated or not is left to the individual. Influenza vaccination coverage in the working population of Japan [6] was approximately 30% before the influenza A (H1N1) pandemic in 2009.

Increasing uptake of influenza vaccination is an important issue to be addressed worldwide [7-9]. To increase influenza vaccination coverage, it is important to understand the motivation for and barriers against influenza vaccination uptake. Reasons for being vaccinated have been reported in previous studies, and include: the presence of chronic disease [10,11]; perceived susceptibility to influenza with a desire to avoid contracting seasonal influenza; knowing someone who became ill from seasonal influenza; protecting oneself from illness; protecting close

* Correspondence: kwada-sgy@umin.ac.jp
[2]Department of Public Health, Kitasato University School of Medicine, 1-15-1 Kitasato, Minami-ku, Sagamihara, Kanagawa 252-0374, Japan
Full list of author information is available at the end of the article

relatives by receiving the vaccine [12,13]; reducing transmission to others [14]; being advised by a family doctor/nurse to be vaccinated [15,16]; having knowledge that influenza is a serious illness [16,17]; and having knowledge of the national vaccination strategy [18]. These reasons varied by age and sex. Reasons for not being vaccinated against influenza include: believing that influenza vaccine was unnecessary [19,20]; being concerned about side effects of vaccination [12,14,19]; believing oneself to be unlikely to contract influenza [16,17]; being unconcerned about influenza [21]; and lack of convenient access to vaccination [22].

We consider it necessary to understand the current status and awareness of influenza vaccination in order to promote influenza vaccination uptake among working age people in Japan. The aim of this study was to investigate the history of influenza vaccination in 2010 in Japanese men and women of working age (20–69 years), and to identify reasons for receiving or not receiving this vaccine.

Methods

This study recruited 3,000 Japanese individuals aged 20–69 years who were registered by a web survey company in September 2011. People who were interested in taking part in a survey, with financial incentives for responding, registered voluntarily on the company website. The company randomly selected 7,937 subjects from a total of 1.60 million registrants based on the company protocol considering the estimated response rate to recruit 3000 participants within a week, and sent out invitations by e-mail to take part in the survey.

With regard to sample size, we determined 267 sample size needed per each gender (men and women) and 10 year age band (20–29, 30–39, 40–49, 50–59, and 60–69). based on the assumption as follows: confidence level 95%, margin of error 6, and 7 million population based on the Japanese population structure. Then, we decided to recruit 300 sample size in each gender and 10 year age band as a stratified random sampling method. The company ceased recruitment in each category once the desired number agreed to participate. We obtained agreement and consent of all subjects for participation in the survey when they completed their answers.

This study was approved by the Kitasato University School of Medicine Ethics Committee prior to implementation.

We asked participants if they had received an influenza vaccination in the period from October 2010 to March 2011, offering three possible responses: yes, no, and do not remember. Questions were formulated after reviewing previous studies [12-22] and are shown in Table 1.

Statistical analysis

We conducted univariate analysis using Pearson's chi-squared test to examine the potential relationships between men and women in the rate of vaccination uptake. All analyses were performed using IBM SPSS Statistics v. 19 (IBM Corp, Armonk, NY, USA), with statistical significance set at $p < 0.05$.

Table 1 Questions asked in this study

I. Of those who had received an influenza vaccination, we inquired about reasons for receiving vaccination (allowing each respondent to give as many answers as they wished
   1. Wanted to avoid becoming infected with influenza virus.
   2. Even if infected with influenza, wanted to prevent the symptoms from becoming serious.
   3. Living with family members at high risk of influenza becoming serious such as children, the elderly or pregnant women.
   4. Received financial assistance for vaccination.
   5. At high risk of becoming infected with influenza.
   6. Employer ordered the vaccination.
   7. At high risk of influenza symptoms becoming serious if infected.
   8. Family, friends, and acquaintances recommended it.
   9. Family doctor recommended it.

II. Of those who had not received an influenza vaccination, we asked the reasons for not being vaccinated (multiple choices were allowed).
   1. No time to visit a medical institution.
   2. Believed oneself unlikely to be infected with influenza.
   3. Could not afford vaccination.
   4. Lack of confidence that influenza vaccinations are effective.
   5. Believed that disease would not likely become severe even if infected with influenza.
   6. Concerned about adverse reactions that might occur with vaccinations.
   7. Dislike of injections.
   8. Lack of knowledge about where to be vaccinated.
   9. Prior experience of an adverse reaction after being vaccinated for influenza or another disease.

Results

A total of 3,129 participants participated in the survey (response rate:39.4%). We recruited approximately equal numbers of males and females, and participants were relatively equally distributed among the age groups (Table 2). With respect to influenza vaccination, 24.2% of males and 27.7% of females had been vaccinated against influenza (Table 3). A slightly higher proportion of females were vaccinated than males, but there were no significant differences in the vaccination rates in any age group. The age group with the highest proportion of vaccination was aged 60–69, with 28.3% of males and 30.4% of females in this age group vaccinated.

The reported reasons for receiving influenza vaccination are shown in Table 4. The major reasons in descending order were "Wanted to avoid becoming infected with influenza virus" (84.0% of males and 82.6% of females

Table 2 Characteristics of participants

	N = 3129	(%)
Sex		
Male	1,572	(50.2)
Female	1,557	(49.8)
Age (years)		
20-29	510	(16.3)
30-39	659	(21.1)
40-49	647	(20.7)
50-59	601	(19.2)
60-69	712	(22.8)

vaccinated); "Even if infected with influenza, wanted to prevent the symptoms from becoming serious" (60.7% of males and 66.4% of females); "Living with family members at high risk of influenza becoming serious, such as children, the elderly or pregnant women" (18.4% of males and 31.5% of females); and "Received financial assistance for vaccination" (18.6% of males and 21.0% of females). A large proportion of females aged 30–39 years reported "Living with family members at high risk of influenza becoming serious, such as children, the elderly or pregnant women" (52.8%), and many males and females aged 20–29 years gave the response that "Family, friends, and acquaintances recommended it" (20.4% of males and 16.5% of females).

Table 5 shows the reported reasons for not being vaccinated against influenza. In males, "No time to visit a medical institution" was the most frequent reason among those aged 20–59 (32.3-42.8%), whereas "Believed oneself unlikely be infected with influenza" was the most frequent reason among those aged 60–69 (39.2%). In contrast, among females, the most frequent reasons for not being vaccinated were "No time to visit a medical institution" in those aged 20–29 (33.9%), "Could not afford vaccination " in those aged 30–39 (35.2%) and 40–49 (28.6%), "Concern about adverse reactions that might occur with vaccinations" in those 50–59 (22.7%), and "Lack of confidence that influenza vaccinations are effective" in those aged 60–69 (31.0%).

Table 3 Vaccination coverage in the year up to September 2011 by sex and age (%)

	Male	Female	
Age group (years)	Number vaccinated (% of total age group)	Number vaccinated (% of total age group)	p-value
20-29	54/262 (20.6)	68/248 (27.4)	0.19
30-39	80/332 (24.1)	93/327 (28.4)	0.35
40-49	79/326 (24.2)	75/321 (23.4)	0.86
50-59	68/302 (22.5)	85/299 (28.4)	0.21
60-69	99/350 (28.3)	110/362 (30.4)	0.69
Total	380/1572 (24.2)	431/1557 (27.7)	0.90

Discussion

This study aimed to determine the current status of influenza vaccination uptake in a working population (20–69 years) in Japan, and reasons for this population receiving or not receiving the vaccine. Overall, the most frequent reasons for receiving the vaccine were the desire to avoid infection with the influenza virus, and the desire to prevent symptoms becoming serious if already infected with the virus. The primary reasons for not receiving the vaccine included no time to visit a medical institution, the belief of being unlikely to become infected with influenza, and the inability to afford the vaccine, although there were variations in reasons according to sex and age.

Prevention of the onset of influenza and preventing influenza symptoms from becoming serious were the two major reasons given by individuals who received influenza vaccination. The influenza vaccine provides modest protection against the onset of influenza, with the efficacy rate reportedly being 51-67% in individuals aged 18–65 years [23]. Furthermore, 33 healthy adults need to be vaccinated to avoid one incurring influenza symptoms [24]. Twenty one percent of respondents chose "Lack of confidence that influenza vaccinations are effective" as a reason not to be vaccinated. They may be rightly critical of vaccine efficacy because of possible mismatching between circulating virus strains and the strains in the vaccine itself. The limitations of vaccine efficacy should be communicated to the general public, to maintain realistic expectations of the vaccine [15] .

The reasons for receiving influenza vaccination varied according to sex and age. Among those aged 30–39 years, a substantial proportion reported that they were vaccinated because they were living with family members at high risk of influenza becoming serious, such as children, the elderly, or pregnant women. Maternal influenza immunization is a strategy with substantial benefits for both mothers and infants [25], reflecting the fact that people aged 30–39 are commonly rearing children. Among those aged 20–29 years, a relatively higher proportion cited recommendations from family, friends, or acquaintances as the reason for accepting the influenza vaccine. These results suggest that educational messages should aim to address a wide range of possible concerns, and to improve targeted outreach to specific groups of workers.

The reasons for not receiving influenza vaccination also varied according to sex and age group. Among men aged 20–59 years, the most frequent reason for not receiving the vaccine was lack of time to visit a medical institution. A lack of time has also been cited as a major reason for healthcare workers not receiving the influenza