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SCIENTIFIC LITERATURE

RESEARCH ARTICLE

Clinical Features of Influenza in Healthcare Personnel and Non-Healthcare Personnel from 2009/10 to 2014/15: A Cross-Sectional Study at three University Hospitals

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ARTICLE INFO

Article history:
Received: 30 June 2017
Accepted: 27 July 2017
Published: 04 August 2017

Keywords:
Influenza;
Healthcare;
Personnel;
Children;
Vaccination

Citation this article: Tarumoto N, Yoshihara M, Matsumoto C, Mizukami Y, Miyazato A et al.,Clinical Features of Influenza in Healthcare Personnel and Non-Healthcare Personnel from 2009/10 to 2014/15: A Cross-Sectional Study at three University Hospitals.SL Clin Med Res. 2017; 1(1):112.

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ABSTRACT

Purpose: The efficacy of the influenza vaccine in the 2014/15 season was lowover the past decade, and many healthcare personnel developed influenza at our medical facilities. To identify risk factors associated with influenza among health care personnel and non-healthcare personnel in the 2014/15 season and the past 5 years, we did a cross-sectional study at three university hospitals in Saitama prefecture, Japan.

Methods: we used an anonymous questionnaire to survey the employeesof multiple medical facilities regarding sex, age, occupation, workplace, co-habitation, co-habiting children, onset of influenzaand vaccination status from 2009/10 to 2014/15.

Results: A total of 3,000 questionnaires were analyzed after excluding 87 questionnaires with missing data. Influenza occurred in 300 (10%) subjects. The results indicated that 96% of the subjects who suffered from influenza had received the influenza vaccination. The incidence rate in the healthcare personnel was 10.5%. Multivariable analysis showed that the incidence rates were significantly higher in employees living with children for the 2014/15 season [odds ratio (OR) 1.37, $p = 0.048$] and for the past 5 years (OR 1.46, $p < 0.001$). The incidence rate was low in employees who had received the influenza vaccination every year (OR 0.77, $p = 0.022$).

Conclusion: The results suggest that employees living with children should receive not only influenza vaccination every year but also education regarding infection countermeasures that can be implemented at home.

Introduction

Seasonal influenza is an infectious disease that is prevalent every year. The negative repercussions of infection include excess mortality due to complications and social loss due to recuperation at home [1]. Since influenza in clinical settingsrepresent animportant problem for infection control [2], medical facilities are expected to adhere to standard precautions and droplet

precautions, and make additional efforts to reduce nosocomial infections, such as those to increase the hospital employee vaccination rate [3,4]. In Japan, trivalent inactivated vaccines are used. Influenza vaccine effectiveness can vary by influenza virus type and subtype, which was 61% for H1N1pdm09, 33%for H3N2, 23% for variant H3N2, 54% for type B [5] and the meta-analysis data from randomized controlled studies estimated the efficacy of inactivated vaccines to be 59% [6]. Furthermore, the vaccination offers insufficient outcomes when there is low antigen homology between the epidemic strain and vaccine strain [7,8]. Worldwide, the efficacy of the influenza vaccine in the 2014/15 season was lowover the past decade [9,10], including Japan [11], because ≥90% of A(H3N2), which was the epidemic strain in the 2014/15 season, was subclade 3C.2a or 3C.3a. These subclades have antigen mutations and as evident in a phylogenic tree, they are genetically too far from A/New York/39/2012, which was the vaccine strain used in Japan for the 2014/15 season [11]. Therefore, we conducted an anonymous questionnaire-based multicenter survey to investigate the influenza incidence rateby self-reportingand related risk factors of healthcare personnel and non-healthcare personnelat our hospitalsin the 2014/15 season and from 2009/10 to 2013/14 season.

Methods

From July to September 2015, we used an anonymous questionnaire to survey all employeesat three university hospitals, which has 2290 bedsand 5129 employeesin total, including non-clinical staffsuch as office staff. The selectivesurvey implementedusing paper and questions were comprised of sex, age, occupation, workplace, co-habitation, co-habiting children, onset of influenza in the 2014/15 season (period from October 2014 through May 2015), and history of contracting influenza and vaccination history over the past 5 years excluding the 2014/15 season. If a subject developed influenza during the 2014/15 season, his/her influenza vaccination status was confirmed.The written paper were collected and added up.In incomplete check (for example, unchecked) and non-responders, that questionnaire was excluded from analysis.

For statistical analysis, R (The R Foundation for Statistical Computing) and the EZR graphical user interface (Saitama Medical Center, Jichi Medical University) were used. For univariate analysis, statistical differences were investigated using Fisher's exact test and $p < 0.05$ was considered to be statistically significant. For items that exhibited a p value of <0.1 with univariate analysis, multivariable analysis was performed using logistic regression analysis.

This study was approved by the local institutional review boards and ethics committees in each institute.

Results

From the three facilities, 3,000 completed questionnaires were received (response rate: 3,000/5,129 = 58.5%). The results are sumarized in Table 1. The overall incidence rate was 10.0%in 2014/15 season, and the vaccine uptake amongst the subjects who had developed influenza was 96.0%. Amongst the healthcare personnel (medical doctors, nurses, and paramedicals) excluding office staff, the incidence rate was 10.5% (278/2,657)in 2014/15 season. Meanwhile, the incidence rate amongst non-healthcare personnel was 6.9%, indicating that the incidence was significantly higher amongst healthcare personnel ($p = 0.02$). On the basis of age, the incidence rate was the highest for the age group 30–39 years at 12.6%, and the vaccination rate amongst these subjects was also high at 98.2%. Conversely, incidence rates in the age groups 20-29 years and 50–59 years were 8.3% and 6.7%, respectively, which were lower than those of the other age groups. The vaccination rate was slightly lower for the age group 50–59 years at 88.9%. On the basis of occupation, the incidence rate was high for nurses at 11.7%, but the vaccination rate in this subpopulation was not low (97.1%).

The results of univariate analysis showed that self-reported incidence of influenza were significantly higher for the age group 30–39 years, nurses, those working at outpatient clinics, or those living with children. Furthermore, incidence rates were significantly lower for

Table 1: Influenza cases among employees of the medical institutes in 2014/15 season.

	Total	Flu Infection		Uni		Multi		Vaccination
	n	n	(%)	OR	*p* value value	OR	*p* value	coverrage (%)
Overall	3000	300	(10.0)	-	-	-	-	96.0
sex								
female	2164	230	(10.6)	0.77	0.067	0.92	0.609	96.5
age group(y-o)								
20-29	1308	108	(8.3)	0.7	0.006	0.67	0.033	95.4
30-39	879	111	(12.6)	1.48	0.003	0.99	0.949	98.2
40-49	450	51	(11.3)	1.18	0.307	-	-	96.1
50-59	270	18	(6.7)	0.62	0.056	0.61	0.084	88.9
60-	93	12	(12.9)	1.35	0.377	-	-	91.7
Occupation								
MD	370	32	(8.6)	0.83	0.405	-	-	90.6
Nurses	1751	206	(11.8)	1.64	<0.001	1.51	0.079	97.1
Paramedicals	536	40	(7.5)	0.68	0.032	0.96	0.892	97.5
Non-HCP	343	22	(6.4)	0.59	0.017	0.85	0.626	90.9
Workplace								
OP	427	58	(13.6)	1.54	0.008	1.28	0.159	93.1
IP	1618	170	(10.5)	1.13	0.329	-	-	97.6
OP/IP	243	24	(9.9)	0.99	1.000	-	-	91.7
Other	718	48	(6.7)	0.58	<0.001	0.76	0.183	95.8
co-habitation								
with family	1838	198	(10.8)	1.25	0.080	1.08	0.616	96.5
with child	674	94	(13.9)	1.67	<0.001	1.37	0.048	96.8

Abbreviations: MD: Medical Doctor; HCP: Healthcare Personnel; OR: Odds Ratio: OP: Outpatient; IP: Inpatient; Uni: Univariate Analysis; Multi: Multivariate Analysis

the age group 20-29 years, paramedicals, non-healthcare professionals, or those working at sites other than outpatient clinics or wards. The results of the multivariable analysis showed that incidence rates were significantly higher for subjects living with children and significantly lower for the age group 20-29 years. Furthermore, the incidence rates tended to be higher for nurses and lower for the age group 50-59 years, although the differences were not statistically significant.

The history of influenza onset for the past 5 years excluding the 2014/15 season was assessed by the questionnaires received from 2,783 subjects (reponse rate: 2,783/5,129 = 54.3%) (Table 2). There were 1,138 subjects (40.9%) with a history of influenza onset. On the basis of age, there was a tendency for a higher prevalence of history of onset in the age group 20-29 years and a lower prevalence of history of onset in the age group ≥50 years. On the basis of occupation, the

Table 2: 5-years cumulative incidence among employees of the medical institutes from2009/10 to 2013/14 season.

	Total	cumulative incidence		Uni		Multi	
	n	n	(%)	OR	*P* value	OR	*p* value
Overall	2783	1138	-40.9	-	-	-	-
Sex							
Female	2023	836	-41.3	0.94	0.462	-	-
Age group (y-o)							
-29	1212	540	-44.6	1.3	<0.001	1.24	0.022
30-39	833	330	-39.6	0.93	0.377	-	-
40-49	420	181	-43.1	1.11	0.332	-	-
50-59	235	65	-27.7	0.53	<0.001	0.65	0.008
60-	83	22	-26.5	0.51	0.006	0.67	0.132
Occupation							
MD	341	128	-37.5	0.85	0.196	-	-
Nurses	1629	721	-44.3	1.4	<0.001	1.11	0.428
Paramedicals	502	187	-37.3	0.83	0.071	0.89	0.439
Non-HCP	311	102	-32.8	0.67	0.002	0.78	0.176
Workplace							
OP	395	149	-37.7	0.86	0.185	-	-
IP	1499	657	-43.8	1.3	<0.001	1.09	0.438
OP/IP	227	89	-39.2	0.93	0.622	-	-
Other	662	243	-36.7	0.79	0.013	1.04	0.779
co-habitation							
with family	1083	691	-63.8	0.97	0.752	-	-
with child	639	293	-45.9	1.3	0.004	1.46	<0.001
Others							
yearly vaccine	2383	954	-40	0.78	0.028	0.77	0.022

Abbreviations: MD: Medical Doctor; HCP: Healthcare Personnel; OR: Odds Ratio; OP: Outpatient; IP: Inpatient; Uni: Univariate Analysis; Multi: Multivariate Analysis

prevealence of history of onset tended to be higher in nurses and lower in non-healthcare personnel. For the healthcare personnel, the onset risk was significantly higher than that for non-healthcare personnel ($p < 0.01$). On the basis of the workplace, the prevalence of history of onset tended to be higher in subjects working in wards and lower in subjects working at non-medical sites. Multivariable analysis indicated that the proportion of subjects with a history of influenza onset was significantly higher in subjects living with children and lower in subjects aged 20-29 years. The influenza-affected proportion was significantly lower for subjects who had been vaccinated every year.

Discussion

The high influenzaincidence rates in the 2014/15 seasonwere evident at medical facilities; hence, we used a questionnaire to survey the employees at healthcare facilities to evaluate incidence rates and risk factors.The results showed that the incidence rate for healthcare

personnel at our medical facilities during the 2014/15 season was 10.5%, which was higher than the rates in previous reports of healthcare personnel influenzaif the self-reported incidence of influenza reflected real prevalence [12]. These reports have also shown that high rate of influenza vaccination was related to low incidence rate of influenza, and those institutes with healthcare personnel receiving influenza vaccine in high rate showed decreased patient mortality and incidence rates [4], also decreased absent days and overwork [13,14]. To the contrary, when vaccination rate is low, incidence rate will elevate, but at our facilities, the vaccination rate was 96% in the 2014/15 season. Therefore, it was seemed that one of the reasons of the elevation of incidence rate was the low efficacy of the influenza vaccine in the 2014/15 season [9-11]. Investigation of the effects of the influenza vaccination over the past 5 years excluding the 2014/15 season indicated that incidence rates were lowered by receiving vaccination every year. Although it is difficult that we suppose what subtype (H1 or H3) of influenza A will come in next season, and vaccine effectiveness varies with subtypes or its variant, we believe that vaccination for healthcare personnel remains necessary and that additional precaution may be also needed in the season when low vaccine effective subtype like H3 circulates.

The results showed that the incidence rate for healthcare personnel, such as nurses and those working at outpatient clinics, at our medical facilities during the 2014/15 season was 10.5%. According to previous reports, the influenza incidence rate was 6.5% for healthcare personnel who received the vaccine and 18.7% for those who did not [15]. In this study, incidence rates were significantly higher for healthcare personnel than for non-healthcare personnel. This may be because healthcare personnel are more exposed to influenza patients than non-healthcare personnel. These results show that being a healthcare professional is a risk factor for influenza onset. Furthermore, the spread of influenza from healthcare personnel to patients could cause a hospital-acquired influenza outbreak [16]; hence, efforts need to be made to reduce incidence rates in employees. In other study, asymptomatic viral shedding was detected by PCR in 10 percent of cases [17]. When healthcare personnelswho were infected with influenzahave respiratory symptom with afebrile, more active receive the rapid test of influenza in addition to standard precaution and droplet precaution, which might follow to decrease second nosocomial infection.

An additional risk factor for influenza onset was living with children. Incidence rates were higher for both the 2014/15 season and over the past 5 years for subjects who lived with children. The same results were noted in a previous report on the risk factors for healthcare personnel [18]. Interestingly, this German report suggested that the risk for influenza onset in healthcare personnel increased proportionally to the number of children they lived with [18]. There have been several reports regarding infections from children [19-21] and it is considered easy to contract influenza secondarily from children [20]. The reasons include group living, lack of immunity to past forms of influenza, ease of virus excretion [22,23] and that vaccinations might be ineffective for infants [24,25]. Thus, although our survey was unable to clarify the onset in children directly, infection within families could be one cause of the higher incidence rates.

This study had some limitations; namely, because a questionnaire was used for the survey, results may have been influenced by various types of bias, such as self-selection bias and recall bias. Moreover, as we excluded questionnaires with missing data, which characteristics of employees was unknown, accurate incidence rates are unknown. We believe that to properly evaluate whether the incidence rates and risk factors found in this study were limited to this influenza season, the questionnaire contents need to be updated and implemented every year.

In conclusion, we evaluated influenza incidence rates and related risk factors in employees at three university hospitals. Consistent with previous reports, influenza incidence rates were lower for employees who received the influenza vaccine every year. However, higher incidence rates were noted in healthcare personnel and those who lived with children in particular, which

appeared to be risk factors. These results suggested that it is important that the measures such as hand hygiene and mask to prevent infection for employees should be strengthened at hospitals and at home.

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