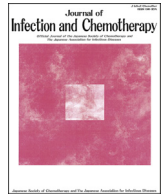




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## Original Article

## Individual background factors associated with vaccination for seasonal influenza in Japanese schoolchildren

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## ABSTRACT

There is little evidence about how individual background factors affect seasonal influenza vaccination of children. At the end of the 2014/2015 influenza season, a cross-sectional questionnaire survey of all elementary schoolchildren in 29 schools in Matsumoto City, Japan, was conducted to obtain information about vaccine uptake activity and individual background factors. Of the 10,524 subjects who responded, 5063 (48.1%) had been vaccinated. Grade in school, underlying disease, number of siblings, and diagnosis with and vaccination for influenza during the previous influenza season differed significantly in vaccinated and unvaccinated groups. Multivariate logistic regression showed that underlying disease and vaccination during the previous influenza season was associated with a higher rate of vaccination, whereas higher grade in school and having  $\geq 3$  siblings was associated with a lower rate of vaccination. The findings may be useful to promote a vaccination policy recommending financial support to households with many children or to encourage higher uptake of vaccination in higher grade children.

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## 1. Introduction

Vaccination is the most important method of preventing seasonal influenza transmission among people, and both the World Health Organization (WHO) [1] and Centers of Disease Control and Prevention (CDC) [2] have recommended that people be vaccinated yearly. Influenza vaccination, especially of children, can help prevent seasonal influenza epidemics in the community [3,4]. However, seasonal influenza vaccination does not completely reduce the risk of illness, with vaccine effectiveness reported to range from 10 to 60% [5]. Thus, influenza vaccination differs from vaccination that can induce permanent immunity. Other issues associated with seasonal influenza vaccination include its cost and vaccine coverage ability, especially in children [6]. Thus, methods are needed to both enhance the effectiveness of vaccination and to increase vaccine coverage in the population.

Vaccination of adults has been associated with various individual factors. For example, in general populations vaccination coverage is associated with age and having chronic diseases [7]. In medical workers, age [8] and correct knowledge about vaccines [9]

are associated with vaccination rates. Household income and number of children are also associated with attitudes toward vaccination [10]. In contrast to adults, who make their own decisions about vaccination, vaccination of children depends on decisions by their guardians and may be affected by other factors. A web-based survey showed that vaccination in children was associated with household income and recommendations by a nurse [11]; however, these results were limited because of the low sample number, possible selection bias or interpreted in only household unit. Therefore, further research is necessary to determine individual background factors associated with the vaccination of children in large, community-based populations. Clarification of these factors may help in formulating policy regarding vaccination.

The author previously conducted an observational epidemiological study to determine time dependent epidemic changes and vaccine effectiveness among schoolchildren in an entire city [12,13]. The author found that about half of these schoolchildren had been vaccinated, but the author did not determine individual factors related to vaccination. In the present study, the author further evaluated these cross-sectional epidemiological data to determine individual background factors associated with vaccination of these schoolchildren.

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## 2. Materials and methods

### 2.1. Study subjects

The population and methods of our previous observational epidemiological study evaluating seasonal influenza prevalence in elementary schoolchildren during the 2014/2015 season have been described [12,13]. This study evaluated the individual background factors associated with vaccination. Briefly, a questionnaire was distributed by school nurses to all 13,217 elementary schoolchildren attending 29 public schools in Matsumoto City, Nagano, Japan, at the end of February 2015. The parents/guardians of these schoolchildren were asked to complete the questionnaires. Responses were obtained from parents/guardians of 11,390 (86.2%) of these children. After excluding questionnaires with missing data, responses from parents/guardians of 10,524 (79.6%) children were analyzed.

### 2.2. Ethics statement

The study was reviewed and approved by the Medical Ethics Board of Shinshu University School of Medicine (approval number 2715). Because this study was performed anonymously and questionnaires were returned voluntarily, informed consent was not obtained from study subjects.

### 2.3. Individual background factors and vaccine information

In this study, the answers to the questionnaire [13] were reviewed to evaluate individual factors associated with vaccination. Individual factors recorded included vaccination during the 2014/2015 influenza season (yes/no); grade of the child in school (description); sex (male/female), having underlying disease, including cardiovascular disease, pulmonary disease, kidney disease, liver disease, nerve disease, muscle disease, blood disease and diabetes (yes/no); number of siblings (description), seasonal influenza diagnosis during the previous influenza season (yes/no), and vaccination during the previous season (yes/no). Because the ages of elementary schoolchildren in Japan correspond with grades 1–6 (Must be already 6 years old at the start of their first school year, April through March. Grades thus include ages 6–7, 7–8, 8–9, 9–10, 10–11 and 11–12 years), grade was evaluated instead of age.

The study investigate uptake of vaccination during the 2014/2015 influenza season. In this year, three strains of inactivated vaccine were used for all of vaccination; A/California/7/2009(H1N1) pdm09, A/New York/39/2012(H3N2) and B/Massachusetts/2/2012 according to National Institute of Infectious Diseases of Japan [14].

### 2.4. Statistical analyses

Category variables were compared in the vaccinated and unvaccinated groups by Chi square tests. Univariate and multivariate logistic regression analyses were used to estimate odds ratios (ORs) and 95% confidence intervals (CIs). Multi-collinearity was evaluated by Spearman's test, which showed absence of multi-collinearity among all variables ( $\rho$  (rho) < 0.3). All statistical analyses were performed using SPSS ver 22.0 (CA, USA).

## 3. Results

Of the 10,524 subjects, 5063 (48.1%) had been vaccinated and 5461 (51.9%) had not. Grade in school, underlying disease, number of siblings, diagnosis with influenza during the previous season and vaccination during the previous season differed significantly in these two groups. Vaccination was more frequent in children in

lower than in upper grades, in children with underlying diseases, in those with fewer siblings, in children who were not diagnosed during the previous influenza season, and in children who were vaccinated during the previous influenza season (Table 1).

Multivariate logistic regression analysis showed that grade in school, underlying disease, number of siblings and vaccination during previous season remained significant independent factors associated with vaccination during the 2014/2015 influenza season. Vaccination rate was significantly lower in children in grade 5 than in grade 1 (reference) and in those with  $\geq 3$  siblings than with 1 sibling, but was significantly higher in children with than without underlying disease and in those who were than were not vaccinated during the previous season (Table 2). Among individual factors, vaccination during the previous season showed the strongest association with vaccination during 2014/2015 (OR 48.27, 95% CI 42.89–54.31).

## 4. Discussion

The author assessed the epidemiological data in an observational study of all children attending public schools in Matsumoto City, Japan, during the 2014/2015 influenza season. The survey revealed the proportion of children vaccinated was low at below 50%. This low proportion might be associated with household economic factors [11]. To explore associations between vaccine uptake and background factors at an individual level, a further study was planned. Finally, the author found that vaccination during that season was associated with grade in school, having underlying disease, number of siblings and vaccination during the previous season. The strength of this study was its being a complete survey of one Japanese city, enabling large samples to be analyzed. By assessing all schoolchildren, the author believes that sampling bias was reduced as much as possible.

ORs of vaccination tended to decrease in higher grade children. Relative to children in first grade, the lowest OR was

**Table 1**  
Characteristics of background factors in schoolchildren vaccinated and unvaccinated for seasonal influenza.

Factors	Vaccinated (%) 5063 (48.1)	Unvaccinated (%) 5461 (51.9)	P-value#
Sex			0.80
Male	2578 (48.0)	2794 (52.0)	
Female	2485 (48.2)	2667 (51.8)	
Grade			<0.01
1	995 (54.0)	849 (46.0)	
2	910 (50.7)	885 (49.3)	
3	866 (49.3)	890 (50.7)	
4	818 (47.2)	916 (52.8)	
5	742 (43.9)	950 (56.1)	
6	732 (43.0)	971 (57.0)	
Underlying diseases			<0.01
Yes	687 (61.6)	429 (38.4)	
No	4376 (46.5)	5032 (53.5)	
Siblings			<0.01
1	811 (51.2)	773 (48.8)	
2	2915 (51.4)	2758 (48.6)	
3	1193 (42.7)	1604 (57.3)	
$\geq 4$	144 (30.6)	326 (69.4)	
Diagnosed in previous season			0.049
Yes	1569 (46.7)	1790 (53.3)	
No	3494 (48.8)	3671 (51.2)	
Vaccination in previous season			<0.01
Yes	4549 (84.6)	825 (15.4)	
No	514 (10.0)	4636 (90.0)	

#Chi-square test.

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