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Prevalence and associated factors of influenza vaccination coverage in Korean adults with cardiovascular disease

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Abstract

Infection with influenza virus increases morbidity and mortality in patients with risk factors, including cardiovascular disease (CVD). This study aimed to evaluate factors associated with influenza vaccination coverage in Korean CVD patients.

We included 19,599 adults from the 2010 to 2012 Korea National Health and Nutrition Examination Survey. Influenza vaccination rates were compared in subjects with and without CVD. Logistic regression analysis was performed to identify factors associated with influenza vaccination in Korean adults with CVD before and after stratification for age (<65 and ≥65 years).

Significantly higher vaccination rates were observed in individuals with CVD than in those without CVD (61.4% vs 31.0%, $P < .001$). However, young individuals (19–49 years) had decreased influenza vaccination rates, with no difference based on CVD status (20.3% vs 21.6%, $P = .859$). A lack of private insurance (odds ratio [OR], 0.47; 95% confidence interval [CI], 0.23–0.98) and recent health screening (OR, 4.56; 95% CI, 1.90–10.92) were independent factors for influenza vaccination in CVD patients aged <65 years, whereas female sex (OR, 3.71; 95% CI, 1.24–11.07) and less education (OR, 4.59; 95% CI, 1.27–16.61) were independent factors in CVD patients aged ≥65 years.

Improving influenza vaccination coverage for Korean adults with CVD is important, especially in young patients. For young patients with CVD, influenza vaccination status is independently associated with the presence of private insurance and recent health screening. This finding could help establish public health policies to promote influenza vaccination in this population.

Abbreviations: BMI = body mass index, CI = confidence interval, CVD = cardiovascular disease, KCDC = Korean Center for Disease Control and Prevention, KNHANES = Korea National Health and Nutrition Examination Survey, OR = odds ratio.

Keywords: cardiovascular disease, influenza, Korean, vaccination

1. Introduction

Influenza is an acute respiratory illness caused by influenza A or B viruses. It occurs in epidemics nearly every year, mainly during the winter season in temperate climates. Annual influenza vaccination is an important public health measure for preventing influenza infection. Prevention is key because influenza infection is associated with increased morbidity and mortality not only in infants, pregnant women, and elderly but also in people with cardiovascular disease (CVD), diabetes mellitus, asthma, obstructive pulmonary disease, and malignancy who are more vulnerable to serious complications.[7,18]

CVD continues to be a major public health problem worldwide. An estimated 17.9 million people died from CVD in 2016, accounting for 31% of all global deaths. Of these deaths, 85% were because of heart attack and stroke.[2] In Korea, CVD is now one of the leading preventable causes of death, resulting in 22% of all deaths in 2011.[1] For patients with CVD, the risk of mortality and serious complications owing to influenza infection is especially high.[3,4,11,14,19] In addition, cardiovascular-related death is the leading cause of mortality during the influenza season.[4,14,19] Numerous studies have suggested an association between influenza and increased risk of cardiovascular events. For example, meta-analyses and systematic reviews suggested that influenza serves as a trigger for acute myocardial infarction.[3,8,19] Although recent studies have focused the early detection and risk stratification of CVD with advanced imaging techniques,[10,21,22] it is important to prevent complications by preventing potential risks for public health.

Current guidelines from the Centers for Disease Control and Prevention highly recommend annual influenza vaccinations for adults and children with CVD (excluding isolated hypertension).[7] Some studies have examined the prevalence of influenza vaccination coverage and the associated factors among Korean

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populations.[9,12,16,17] However, influenza vaccination rates and factors associated with vaccination status have not been evaluated among Korean adults with CVD. It is important to clarify the rate of influenza vaccination among individuals with CVD and identify associated factors that affect influenza vaccination rates. These findings may help identify subgroups that benefit from preventative interventions. Therefore, this study examined factors associated with the vaccination rate in Korean adults with CVD using nationally representative data.

2. Methods

2.1. Study population

We used data collected during the fifth Korea National Health and Nutrition Examination Survey (KNHANES), which was conducted by the Korean Center for Disease Control and Prevention (KCDC) from January 2010 to December 2012.

KNHANES is a cross-sectional, nationally representative, and reliable study for determining the health and nutritional status of the civilian, noninstitutionalized, Korean population. The survey includes health and household interviews, nutrition surveys, and direct standardized physical examinations. KNHANES was approved by the institutional review board of the KCDC, and all participants signed a written consent form. The present study and the use of KNHANES data were approved by the KCDC.

For KNHANES, participants were selected by proportional allocation-systematic sampling with multistage stratification (age, sex, and region). Of the 19,599 adults (>19 years old) that participated in KNHANES (2010–2012), 17,872 adults with available information regarding CVD and influenza vaccination were included in the analysis.

2.2. Variables

2.2.1. CVD. A history of CVD was defined as a physician's diagnosis of any of the following: stroke, myocardial infarction, or angina.

2.2.2. Influenza vaccination. Information on the seasonal influenza vaccination status in the past 12 months was obtained.

2.2.3. Independent variables. Independent variables that have been associated with screening practice included socio-demographic variables (age, sex, marital status, education level, and household income, insurance status, private insurance, and body mass index [BMI]) and health-related lifestyle factors (drinking and exercise), and health status (history of chronic disease such as hypertension, diabetes, and dyslipidemia, and perceived health status) as well as recent health screening.

Socio-demographic variables were current age (19–49, 50–64, and ≥65 years), marital status (unmarried, separated, widowed, and divorced subjects were allocated a "no spouse" status), national insurance state (national health insurance, medical aid, or not involved in either), private health insurance (no, yes), and obesity (BMI <25 or ≥25 kg/m^2).[6] BMI was calculated by dividing weight (kg) by the square of height (m^2). Household income level was divided into national quartile groups (lowest quartile, 2nd and 3rd quartile, highest quartile). Education level was categorized as less than elementary, middle/high, or college and higher.

For health-related lifestyle factors, drinking behavior was assessed using the Alcohol Use Disorders Identification Test (in which scores ≥12 and <12 indicate heavy and nonheavy drinkers, respectively).[13] Routine exercisers were defined as people who performed at least low-intensity physical activity, which was defined as walking or commuting for >30 minutes more than 3 times per week.

Comorbidities include self-reported physician's diagnosis of hypertension, diabetes, and dyslipidemia, and perceived health status (good, normal, bad). Participants provided "yes" or "no" responses to questions regarding recent health screening, such as "have you undergone a health check-up within the last 2 years?"

2.3. Statistical analysis

Results are presented as percentages (± standard errors of percentages) for categorical variables and estimated means (± standard errors of means) for continuous variables. Categorical variables and continuous variables were compared using the Chi-square test or Student *t* test for comparison between respondents with and without CVD.

Influenza vaccination coverage according to variables was compared in subjects with and without CVD. Finally, logistic regression analysis was used to identify factors associated with influenza vaccination in Korean adults with CVD before and after stratification for age (age, <65 and ≥65 years).

All analyses were adjusted for the complex survey design in KNHANES using the complex sample analysis program in PASW 18.0 (SPSS Inc, Chicago, IL, USA). A *P*-value of <.05 (2-sided) was considered significant.

3. Results

Information regarding CVD and influenza vaccination was available in 17,872 adults involved in the survey. Their clinical characteristics are summarized in Table 1. Higher proportions of old age, obesity, low house income, less education, more medical aid, poorer self-rated health, more health screenings within the last 2 years, and more comorbid diseases (hypertension, diabetes, hyperlipidemia, cancer) were observed in the CVD group than in the non-CVD group.

Comparisons of influenza vaccination coverage between subjects with and without CVD are shown in Table 2. The overall vaccination rate was significantly higher in the CVD group than in the non-CVD group (61.4% vs 31.0%, $P < .001$). The subgroup analysis showed that except in the young age group (19–49 years) and those receiving medical aid, the influenza vaccination rate was significantly higher for individuals with CVD.

Table 3 shows the univariable and multivariable logistic regression analyses for influenza vaccination coverage among subjects with CVD. Old age (odds ratio [OR], 19.09; 95% confidence interval [95% CI], 6.76–53.90) and recent health screening (OR, 3.07; 95% CI, 1.69–5.55) were independent factors associated with influenza vaccination in the CVD group.

After stratification for age (<65 years and ≥65 years), the significant predictors of influenza vaccination were slightly different (Table 4); for subjects aged <65 years, lack of private insurance (OR, 0.47; 95% CI, 0.23–0.98), recent health screening (OR, 4.56; 95% CI, 1.90–10.92) were independent factors associated with vaccination status. Whereas in individuals ≥65 years, female sex (OR, 3.71; 95% CI, 1.24–11.07) and less

Table 1

Characteristics of Korean adults with and without cardiovascular disease (CVD).

Characteristics	With CVD (%) (n = 815)	Without CVD (%) (n = 17,057)	*P*-value
Sex, male	53.0 (2.2)	50.0 (0.3)	.206
Age (mean, yr)	64.8 (0.5)	44.9 (0.2)	<.001
Age group			<.001
19–49	7.6 (1.3)	63.2 (0.7)	
50–64	39.3 (2.3)	23.5 (0.5)	
≥65	53.1 (2.3)	13.3 (0.4)	
BMI (mean, kg/m^2)	24.5 (0.1)	23.7 (0.0)	<.001
Obesity (BMI ≥25 kg/m^2)	41.6 (2.2)	31.7 (0.5)	<.001
Spouse, yes	77.5 (1.8)	87.2 (0.4)	<.001
House income			<.001
Lowest quartile	40.1 (2.2)	15.7 (0.5)	
2nd and 3rd quartile	44.3 (2.2)	56.6 (0.8)	
Highest quartile	15.6 (1.7)	27.7 (0.7)	
Education			<.001
Less than elementary school	49.9 (2.1)	17.8 (0.5)	
Middle or high school	39.3 (2.0)	49.3 (0.6)	
College and above	10.8 (1.3)	32.8 (0.7)	
Insurance			<.001
National health insurance	93.6 (1.1)	97.4 (0.2)	
Medical aid	6.4 (1.1)	2.6 (0.2)	
Private Insurance	40.3 (2.0)	75.7 (0.6)	<.001
Alcohol drinking	14.8 (1.9)	23.9 (0.5)	<.001
Current smoking	18.9 (1.9)	26.3 (0.5)	.001
Routine exerciser	43.1 (2.2)	48.0 (0.5)	.011
Hypertension	62.2 (2.0)	15.8 (0.4)	<.001
Diabetes mellitus	25.8 (1.8)	5.6 (0.2)	<.001
Hyperlipidemia	32.7 (2.1)	7.0 (0.2)	<.001
Cancer	5.0 (0.8)	2.5 (0.1)	<.001
Perceived health status			<.001
Good to very good	13.4 (1.4)	35.1 (0.5)	
Normal	37.9 (2.1)	48.4 (0.6)	
Poor to very poor	48.7 (2.1)	16.5 (0.4)	
Health screening	61.0 (2.1)	54.4 (0.6)	.003
Influenza coverage rate	61.4 (2.2)	31.0 (0.6)	<.001

Values are weighted means (standard errors of means) or weighted percentages (standard errors of percentages).
BMI = body mass index.
*Chi-squared test or Student *t* test.

Table 2

Influenza vaccination status according to variables in Korean adults with and without cardiovascular disease (CVD).

	With CVD (%) (n = 815)	Without CVD (%) (n = 17,057)	*P*-value
Overall	61.4 (2.2)	31.0 (0.6)	<.001
Socioeconomic factors			
Gender			
Male	56.4 (3.2)	26.4 (0.7)	<.001
Female	67.1 (3.0)	35.4 (0.7)	<.001
Age group			
19–49	20.3 (7.0)	21.6 (0.6)	.859
50–64	39.6 (3.8)	31.1 (0.9)	.020
≥65	83.4 (2.0)	77.4 (0.9)	.008
Spouse			
Yes	59.49 (2.6)	32.9 (0.7)	<.001
No	70.1 (4.4)	53.9 (1.4)	.001
House income			
Lowest quartile	70.6 (3.5)	47.9 (1.5)	<.001
2nd and 3rd quartile	55.6 (3.4)	28.8 (0.7)	<.001
Highest quartile	52.3 (6.0)	26.4 (0.8)	<.001
Education			
Less than elementary school	69.8 (2.8)	57.1 (1.1)	<.001
Middle or high school	55.3 (3.8)	25.5 (0.7)	<.001
College and above	44.9 (6.3)	25.0 (0.8)	<.001
Insurance			
National health insurance	61.7 (2.2)	30.7 (0.6)	<.001
Medical aid	56.6 (9.0)	43.8 (3.3)	.199
Private Insurance			
Yes	52.2 (3.5)	27.3 (0.6)	<.001
No	66.7 (2.8)	43.2 (1.0)	
Health-related factors			
BMI			
BMI ≥25 kg/m^2	63.1 (3.3)	31.9 (0.8)	<.001
BMI <25 kg/m^2	59.9 (2.9)	30.6 (0.7)	<.001
Alcohol drinking			
Yes	40.7 (6.9)	22.1 (0.9)	.002
No	62.4 (2.7)	31.1 (0.6)	<.001
Current smoking			
Yes	42.5 (5.7)	21.7 (0.8)	<.001
No	65.4 (2.3)	34.2 (0.6)	<.001
Routine exerciser			
Yes	60.2 (3.2)	30.0 (0.7)	<.001
No	62.2 (2.9)	31.6 (0.7)	<.001
Hypertension			
Yes	68.4 (2.6)	53.2 (1.2)	<.001
No	49.9 (3.7)	26.9 (0.6)	<.001
Diabetes mellitus			
Yes	69.3 (3.8)	54.7 (1.9)	.001
No	58.7 (2.6)	29.6 (0.6)	<.001
Hyperlipidemia			
Yes	59.8 (4.1)	47.4 (1.7)	.006
No	62.2 (2.5)	29.8 (0.6)	<.001
Cancer			
Yes	74.4 (8.8)	49.2 (2.8)	.017
No	60.7 (2.3)	30.5 (0.5)	<.001
Perceived health status			
Good to very good	66.1 (5.4)	26.0 (0.8)	<.001
Normal	59.2 (3.6)	31.2 (0.7)	<.001
Poor to very poor	61.8 (3.1)	40.9 (1.2)	<.001
Health screening			
Yes	67.7 (2.6)	26.2 (0.7)	<.001
No	51.4 (3.8)	24.8 (0.7)	<.001

BMI = body mass index.

education (OR, 4.59; 95% CI, 1.27–16.61) were independent factors associated with influenza vaccination coverage.

4. Discussion

We demonstrated that influenza vaccination coverage was significantly higher in subjects with CVD than in those without CVD. Furthermore, old age (≥65 years) and recent health screening were independent predictors of influenza vaccination in Korean adults with CVD. Our study showed that 83.4% of elderly (≥65 years) CVD patients received influenza vaccinations. However, the vaccination rates of young (19–49 years) and middle-aged (50–64 years) individuals with CVD were only 20.3% and 39.6%, respectively. This finding is in contrast to current recommendations for individuals with CVD to receive the influenza vaccination, regardless of age, to prevent serious morbidity and mortality. In the young age group, the influenza vaccination rate was not significantly different in subjects with and without CVD. Thus, Korea requires a policy to increase influenza vaccine uptake in risk groups, especially in CVD patients younger than 65 years old.

High levels of influenza vaccination uptake among older individuals may be explained by Korean policies with offer influenza vaccination free of charge to the elderly but not younger individuals. The Ministry of Health and Welfare, together with

Table 3

Variables associated with influenza vaccination status among Korean adults with cardiovascular disease.

Characteristics	Unadjusted OR	(95% CI)	Adjusted OR	(95% CI)
Gender				
Male	Reference		Reference	
Female	1.58	(1.07–2.31)	1.49	(0.84–2.64)
Age group				
19–49	Reference		Reference	
50–64	2.57	(1.03–6.43)	1.40	(0.54–3.67)
≥65	19.72	(8.11–47.93)	19.09	(6.76–53.90)
Spouse				
Yes	0.62	(0.39–1.00)	0.76	(0.35–1.67)
No	Reference		Reference	
House income				
Lowest quartile	2.19	(1.22–3.96)	0.83	(0.35–1.95)
2nd and 3rd quartile	1.14	(0.65–2.01)	0.81	(0.36–1.84)
Highest quartile	Reference		Reference	
Education				
Less than elementary school	2.84	(1.56–5.15)	1.66	(0.67–4.07)
Middle or high school	1.52	(0.85–2.71)	1.67	(0.74–3.78)
College and above	Reference		Reference	
Insurance				
National health insurance	Reference		Reference	
Medical aid	0.81	(0.39–1.69)	0.55	(0.17–1.81)
Private Insurance				
Yes	Reference		Reference	
No	1.83	(1.26–2.67)	0.60	(0.34–1.05)
BMI				
BMI ≥25 kg/m^2	1.15	(0.79–1.67)	1.26	(0.71–2.24)
BMI <25 kg/m^2	Reference		Reference	
Alcohol drinking				
Yes	0.41	(0.22–0.77)	0.45	(0.19–1.09)
No	Reference		Reference	
Current smoking				
Yes	0.39	(0.24–0.65)	0.74	(0.37–1.46)
No	Reference		Reference	
Routine exerciser				
Yes	0.92	(0.65–1.30)	0.74	(0.45–1.23)
No	Reference		Reference	
Hypertension				
Yes	2.176	(1.49–3.19)	1.43	(0.81–2.52)
No	Reference		Reference	
Diabetes mellitus				
Yes	1.59	(1.05–2.40)	1.33	(0.77–2.30)
No	Reference		Reference	
Hyperlipidemia				
Yes	0.90	(0.61–1.35)	1.21	(0.66–2.23)
No	Reference		Reference	
Cancer				
Yes	1.88	(0.74–4.77)	0.87	(0.31–2.44)
No	Reference		Reference	
Perceived health status				
Good to very good	Reference		Reference	
Normal	0.74	(0.43–1.29)	0.57	(0.24–1.36)
Poor to very poor	0.83	(0.47–1.46)	0.70	(0.30–1.62)
Health screening				
Yes	1.98	(1.34–2.92)	3.07	(1.69–5.55)
No	Reference		Reference	

BMI = body mass index, CI = confidence interval, OR = odds ratio.

the KCDC, offers free influenza immunization for the elderly (≥65 years). Furthermore, older individuals are more likely to suffer from chronic illnesses such as diabetes and hypertension, which can lead to more physician visits and follow up and increases the likelihood of a receiving an immunization recommendation.[5,15] After stratification for age in subjects with CVD, female sex and less education were significant indicators for influenza vaccination coverage in the old age group (≥65 years) and presence of private insurance and recent health screenings were independently associated with influenza vacci-

Table 4

Multivariable logistic regression analysis for influenza vaccination status in Korean adults with CVD according to age.

Characteristics	Age <65 (n=299, 36.7%)		Age ≥65 (n=516, 63.3%)	
	Adjusted OR	(95% CI)	Adjusted OR	(95% CI)
Socioeconomic factors				
Gender				
Male	Reference		Reference	
Female	1.27	(0.57–2.80)	3.71	(1.24–11.07)
Spouse				
Yes	0.56	(0.18–1.72)	2.10	(0.76–5.81)
No	Reference		Reference	
House income				
Lowest quartile	0.87	(0.29–2.65)	0.85	(0.30–2.44)
2nd and 3rd quartile	0.79	(0.31–1.73)	1.01	(0.34–2.95)
Highest quartile	Reference		Reference	
Education				
Less than elementary school	1.24	(0.44–3.47)	4.59	(1.27–16.61)
Middle or high school	1.74	(0.72–4.25)	3.00	(0.99–9.11)
College and above	Reference		Reference	
Insurance				
National health insurance	Reference		Reference	
Medical aid	0.78	(0.13–4.59)	0.32	(0.09–1.17)
Private Insurance				
Yes	Reference		Reference	
No	0.47	(0.23–0.98)	0.89	(0.41–1.92)
Health-related factors				
BMI				
BMI ≥25 kg/m^2	1.28	(0.58–2.81)	1.20	(0.59–2.41)
BMI <25 kg/m^2	Reference		Reference	
Alcohol drinking				
Yes	0.48	(0.14–1.62)	0.54	(0.22–1.33)
No	Reference		Reference	
Current smoking				
Yes	0.69	(0.26–1.84)	0.77	(0.30–2.04)
No	Reference		Reference	
Routine exerciser				
Yes	0.67	(0.32–1.41)	0.86	(0.43–1.71)
No	Reference		Reference	
Hypertension				
Yes	1.60	(0.73–3.48)	1.29	(0.56–3.00)
No	Reference		Reference	
Diabetes mellitus				
Yes	1.54	(0.72–3.31)	1.03	(0.49–2.18)
No	Reference		Reference	
Hyperlipidemia				
Yes	1.28	(0.55–3.01)	1.31	(0.64–2.68)
No	Reference		Reference	
Cancer				
Yes	0.48	(0.04–5.10)	1.15	(0.21–6.43)
No	Reference		Reference	
Perceived health status				
Good to very good	Reference		Reference	
Normal	0.73	(0.22–2.39)	0.36	(0.12–1.08)
Poor to very poor	0.81	(0.25–2.62)	0.41	(0.14–1.18)
Health screening				
Yes	4.56	(1.90–10.92)	1.85	(0.88–3.92)
No	Reference		Reference	

BMI = body mass index, CI = confidence interval, OR = odds ratio.

nation in the young age group (<65 years). The present study did not show that health-related factors except recent health screening was associated with influenza vaccination rates, whereas other studies have shown that regular exercise is a positive predictor of vaccination uptake.[20]

Based on the prevalence of influenza vaccine uptake in CVD patients, this study suggests that public health policy should target groups according to age. The low vaccination rate among young CVD patients suggests the need for social and financial support for this population. In addition to the typical barriers

(availability of vaccine, cost), young CVD patients may not perceive the need for vaccination. Thus, healthcare workers should encourage the use of the influenza vaccination in CVD patients, especially for those <65 years of age.

This study has several limitations. First, some response bias may have been introduced when subjects were asked questions about influenza vaccination. This survey explored whether participants were vaccinated during the past year, so there is a potential for recall bias as well. Furthermore, this question could not reflect previous vaccine history and the reason why they vaccinated or not. Second, the cross-sectional study design was inherently constrained by the retrospective use of an existing health data set which did not assess severity of CVD. Nonetheless, the results of this study are reliable and of value because the study was conducted using nationally representative, population-based data.

5. Conclusions

In conclusion, it is important to improve influenza vaccination coverage for Korean adults with CVD, especially in non-elderly individuals. For non-elderly CVD patients, significant predictors for influenza vaccination are the presence of private insurance and recent health screening. This finding could help establish public health policy to promote influenza vaccine uptake rates in this population to decrease mortality and morbidity at the risk of influenza infection.

Author contributions

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