

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

Eun Young Kim, MD, PhD^{a,b}, Jae Ho Ko, BSc^c, Young Saing Kim, MD, PhD^{d,*}, Pyung Chun Oh, MD, PhD^d

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

Editor: Mehmet Bakir.

EYK and JHK contributed equally to this work and share first authorship.

This research was supported by MD-PhD research through the Korea Research-Driven Hospital (grant 2018-5287) and the National research foundation of Korea (grant NRF-2018R1C1B5086352).

The authors have no conflicts of interest to disclose.

^a Department of Radiology, Gil Medical Center, Gachon University College of Medicine, Incheon, ^b Department of Information and Statistics, Korea National Open University, Seoul, ^c School of Medicine, Gachon University College of Medicine, ^d Department of Internal Medicine, Gachon University Gil Medical Center, Incheon, South Korea.

* Correspondence: Young Saing Kim, Division of Medical Oncology, Department of Internal Medicine, Gil Medical Center, Gachon University College of Medicine, 21, Namdong-daero 774 beon-gil, Namdong-gu, Incheon 21565, Republic of Korea (e-mail: zoomboom@hanmail.net).

Copyright © 2020 the Author(s). Published by Wolters Kluwer Health, Inc. This is an open access article distributed under the terms of the Creative Commons Attribution-Non Commercial License 4.0 (CCBY-NC), where it is permissible to download, share, remix, transform, and buildup the work provided it is properly cited. The work cannot be used commercially without permission from the journal.

How to cite this article: Kim EY, Ko JH, Kim YS, Oh PC. Prevalence and associated factors of influenza vaccination coverage in Korean adults with cardiovascular disease. Medicine 2020;99:1(e18540).

Received: 25 July 2019 / Received in final form: 6 November 2019 / Accepted: 30 November 2019

http://dx.doi.org/10.1097/MD.00000000018540

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 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 \geq 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 \geq 25 kg/m²).^[6] BMI was calculated by dividing weight (kg) by the square of height (m²). 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 (\pm standard errors of percentages) for categorical variables and estimated means (\pm 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 \geq 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 \geq 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).

	With CVD (%)	Without CVD	
Characteristics	(n=815)	(%) (n=17,057)	<i>P</i> -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 \geq 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.

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 vaccina

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)	<i>P</i> -value
Overall	61 4 (2 2)	31.0.(0.6)	< 001
Socioeconomic factors	01.4 (2.2)	51.0 (0.0)	<.001
Gender			
Male	56 (1 (3 2)	26.4.(0.7)	< 001
Female	67 1 (3.0)	25.4 (0.7)	< 001
	07.1 (0.0)	JJ.+ (0.7)	<.001
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
Snouse	00.1 (2.0)	11.1 (0.0)	.000
Yes	59.49 (2.6)	32.9 (0.7)	< .001
No	70.1 (4.4)	53.9 (1.4)	.001
House income			
l owest 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	0210 (010)	2011 (010)	1.001
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	1110 (010)	2010 (010)	1.001
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
$BMI < 25 \text{ kg/m}^2$	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		00.0 (0.7)	0.01
Yes	60.2 (3.2)	30.0 (0.7)	<.001
NO	62.2 (2.9)	31.6 (0.7)	<.001
Hypertension	(0, 1, (0, 0))		- 001
res No	00.4 (2.0)	00.2 (1.2)	< .001
NU Diabataa mallitua	49.9 (3.7)	20.9 (0.0)	<.001
Voo	60 2 (2 0)	547 (10)	001
No	59.3 (3.0)	20.6 (0.6)	.001
Hyperlinidemia	JU.7 (2.0)	29.0 (0.0)	<.001
Voe	50.8 (1.1)	17 1 (1 7)	006
No	62 2 (2 5)	29.8 (0.6)	/ 001
Cancer	02.2 (2.0)	23.0 (0.0)	<.001
Yes	74 4 (8 8)	49 2 (2 8)	017
No	60 7 (2.3)	30.5 (0.5)	< 001
Perceived health status	0011 (2.0)	00.0 (0.0)	2.001
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.

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.

Gender Reference Reference Reference Male Reference 1.49 (U.17–2.31) 1.49 (U.17–2.31) Age group 19–49 Reference Reference 10 Reference 10 <t< th=""><th>Characteristics</th><th>Unadjusted OR</th><th>(95% CI)</th><th>Adjusted OR</th><th>(95% CI)</th></t<>	Characteristics	Unadjusted OR	(95% CI)	Adjusted OR	(95% CI)
Male Reference Reference Female 1.58 (1.07-2.31) 1.49 (0.1 19-49 Reference Reference </td <td>Gender</td> <td></td> <td></td> <td></td> <td></td>	Gender				
Fenale 1.58 (1.07-2.31) 1.49 (0.1) Age group	Male	Reference		Reference	
Age group Reference Reference 19-49 Reference Reference 2-65 19.72 (8.11-47.93) 1.40 (0.1) ≥056 19.72 (8.11-47.93) 19.09 (6.5) Spouse	Female	1.58	(1.07-2.31)	1.49	(0.84-2.64)
14-4 Reference Reference 50-64 2.57 (1.03-6.43) 1.40 (0.1 265 19.72 (8.11-47.93) 19.09 (6. Spouse	Age group				
50-64 2,57 (1,03-6,43) 1.40 (0.1 ≥65 19.72 (8,11-47,93) 19.09 (6.5) Spouse	19–49	Beference		Beference	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	50-64	2.57	(1.03-6.43)	1.40	(0.54-3.67)
Los Los Los Los Los Los Yes 0.62 (0.9-10.0) 0.76 (0.1 No Reference Reference Reference Lowest quartile 1.14 (0.65-2.01) 0.81 (0.1 Lowest quartile 1.14 (0.65-2.01) 0.81 (0.1 Highest quartile Reference Reference Reference Less than elementary school 2.84 (1.56-5.15) 1.66 (0.1 Middle or high school 1.52 (0.85-2.71) 1.67 (0.2 Insurance Reference Reference Reference Reference Insurance Reference R	>65	19 72	(8 11–47 93)	19.09	(6.76–53.90)
cprode 0.62 0.9-1.00 0.76 (6.) No Reference Reference Reference Lowest quartile 2.19 (1.22-3.96) 0.83 (0.) 2nd and 3rd quartile 1.14 (0.65-2.01) 0.81 (0.) Highest quartile Reference Reference Reference Education Italian (0.35-2.01) 1.67 (0.) Middle or high school 1.52 (0.85-2.71) 1.67 (0.) College and above Reference Reference Reference Insurance Reference Reference<	Spouse	10.72	(0.11 47.00)	10.00	(0.70 00.00)
No Reference Reference Reference House income 1.14 (0.66-2.01) 0.81 (0.10) Lowest quartile 1.14 (0.66-2.01) 0.81 (0.10) Highest quartile Reference Reference Reference Eucation Reference Reference Reference Less than elementary school 2.84 (1.56-5.15) 1.66 (0.1) Middle or high school 1.52 (0.85-2.71) 1.67 (0.1) College and above Reference Reference Reference Insurance Reference Reference (0.1) National health insurance Reference Reference (0.1) Yes Reference Reference (0.1) No 1.83 (1.26-2.67) 0.60 (0.2) BMI ≥25 kg/m ² 1.15 (0.79-1.67) 1.26 (0.1) BMI ≥25 kg/m ² 1.61 (0.22-0.77) 0.45 (0.2) No Reference Reference Reference <td>Voc</td> <td>0.62</td> <td>(0.30-1.00)</td> <td>0.76</td> <td>(0.35_1.67)</td>	Voc	0.62	(0.30-1.00)	0.76	(0.35_1.67)
No Determine Interaction Determine Lowest quartile 2.19 (1.22–3.96) 0.83 (0.12) 2nd and 3rd quartile 1.14 (0.65–2.01) 0.81 (0.12) Highest quartile Reference Reference Reference Education	No	Poforonco	(0.33-1.00)	Poforonco	(0.00-1.07)
Process		Nelelelice		Nelelelice	
LUKes qualitie 2.19 (1.22-3.90) 0.33 (U. And and Stri quaritie 1.14 (0.65-2.01) 0.81 (O. Highest quaritie Reference Reference Reference Education 1.52 (0.85-2.01) 1.66 (O.1) Less than elementary school 1.52 (0.85-2.71) 1.67 (O.1) College and above Reference Reference (D.3) (O.1) (D.3) (O.1) Insurance Reference Reference Reference (D.3) (D.3) (D.3) Insurance Reference Reference (D.3) (D.3) (D.3) (D.3) (D.3) Private Insurance Reference Reference (D.3) (D.3) (D.3) (D.3) (D.3) BMI 25 kg/m² 1.15 (D.79-1.67) 1.26 (D.3) BMI 25 kg/m² 1.15 (D.2-0.77) 0.45 (D.3) Ves 0.39 (D.2-0.73) 0.45 (D.3) (D.4) </td <td></td> <td>0.10</td> <td>(1.000.00)</td> <td>0.02</td> <td></td>		0.10	(1.000.00)	0.02	
201 and sfr quartile 1.14 (0.65-2.01) 0.81 (0. Highest quartile Reference Reference Reference Education	Lowest quartile	2.19	(1.22-3.96)	0.83	(0.35-1.95)
Highest quartile Hederence Hederence Less than elementary school 2.84 (1.56-5.15) 1.66 (0.4 Less than elementary school 1.52 (0.85-2.71) 1.67 (0.7 College and above Reference Reference Reference Insurance Reference Reference (0.7 Medical aid 0.81 (0.39-1.69) 0.55 (0.7 Vess Reference Reference (0.7 (0.60) (0.7 BMI 25 kg/m² 1.15 (0.79-1.67) 1.26 (0.7 BMI 25 kg/m² 1.15 (0.22-0.77) 0.45 (0.7 BMI 25 kg/m² 0.41 (0.22-0.77) 0.45 (0.7 No Reference Reference Reference (0.7 (0.45 (0.7 Ves 0.39 (0.24-0.65) 0.74 (0.2 (0.7 (0.46 (0.4 (0.4 (0.4 (0.4 (0.4 (0.4 (0.4 (0.4 (0.4 (0.4<		1.14	(0.65–2.01)	0.81	(0.36-1.84)
Education Education 1.63 (0.1 Less than elementary school 1.52 (0.85–2.71) 1.67 (0.1 College and above Reference Reference (0.1 College and above Reference (0.1 College and above Reference (0.1 College and above Reference Reference Reference Medical aid 0.0 0.0 (0.1 Reference	Highest quartile	Reference		Reference	
Less than elementary school 2.84 (1.56–5.15) 1.66 (0.1 Middle or high school 1.52 (0.85–2.71) 1.67 (0.1 College and above Reference Reference Insurance Insurance Insurance Insurance Reference Reference Reference Reference Reference Insurance I	Education				
Middle or high school 1.52 $(0.85-2.71)$ 1.67 (0.7) College and above Reference Reference Insurance Reference Reference Mational health insurance Reference Reference Medical aid 0.81 $(0.39-1.69)$ 0.55 $(0.7)^2$ Private Insurance Reference Reference Reference $(0.7)^2$ (0.60) $(0.7)^2$ No 1.83 $(1.26-2.67)$ 0.60 $(0.7)^2$ $(0.60)^2$ $(0.60)^2$ $(0.7)^2$ $(0.60)^2$ $(0.7)^2$ $(0.60)^2$ $(0.7)^2$ $(0.60)^2$ $(0.7)^2$ <	Less than elementary school	2.84	(1.56–5.15)	1.66	(0.67-4.07)
College and above Reference Reference Insurance Reference Reference Medical aid 0.81 (0.39–1.69) 0.55 (0. Private Insurance Reference Reference Netforal Insurance Netforal Insurance Netforance Netforance <t< td=""><td>Middle or high school</td><td>1.52</td><td>(0.85–2.71)</td><td>1.67</td><td>(0.74–3.78)</td></t<>	Middle or high school	1.52	(0.85–2.71)	1.67	(0.74–3.78)
Insurance Reference Reference National health insurance Reference Reference Yes Reference Reference Yes Reference Reference No 1.83 (1.26–2.67) 0.60 (0.3) BMI 1.83 (1.26–2.67) 0.60 (0.3) BMI 1.83 (1.26–2.67) 1.26 (0.3) BMI 255 kg/m² 1.15 (0.79–1.67) 1.26 (0.3) BMI < 255 kg/m²	College and above	Reference		Reference	
National health insurance Reference Reference Medical aid $(0.39-1.69)$ 0.55 (0.75) Private Insurance Reference Reference Reference Yes Reference Reference Reference $(0.39-1.69)$ (0.55) (0.75) BM 255 kg/m² 1.83 $(1.26-2.67)$ 0.60 (0.75)	Insurance				
Medical aid 0.81 $(0.39-1.69)$ 0.55 (0.57) Private Insurance Reference Reference <t< td=""><td>National health insurance</td><td>Reference</td><td></td><td>Reference</td><td></td></t<>	National health insurance	Reference		Reference	
Private Insurance Reference Reference Yes Reference Reference No 1.83 (1.26–2.67) 0.60 (0.1 BMI ≥ 25 kg/m ² 1.15 (0.79–1.67) 1.26 (0.1 BMI ≥ 25 kg/m ² Reference Reference Reference Reference Alcohol drinking Reference Reference (0.7 No No Reference (0.7 No No Reference Reference (0.74 (0.7 No No Reference Reference (0.74 (0.7 No No No Reference Reference Reference (0.74 (0.7 No No Reference No No No No Reference Reference Reference Reference Reference No No Reference No No Reference Reference No No No Reference Reference Reference Reference No No No No N	Medical aid	0.81	(0.39-1.69)	0.55	(0.17-1.81)
Yes Reference Reference No 1.83 (1.26–2.67) 0.60 (0.100000000000000000000000000000000000	Private Insurance		()		
No 1.83 (1.26–2.67) 0.60 (0.1 BMI 1.15 (0.79–1.67) 1.26 (0.7 BMI <25 kg/m²	Yes	Reference		Beference	
No 1.05 (1.25 L.07) 0.05 (0.4 BMI 25 kg/m ² 1.15 (0.79–1.67) 1.26 (0.7 BMI <25 kg/m ² Reference Reference Reference Reference Alcohol drinking	No	1.83	(1 26-2 67)	0.60	(0.34-1.05)
BMI ≥25 kg/m² 1.15 (0.79–1.67) 1.26 (0.79–1.67) BMI ≥25 kg/m² Reference Reference Reference Alcohol drinking	BMI	1.00	(1.20 2.07)	0.00	(0.04 1.00)
bMi 223 kg/m² Reference Reference BMi <25 kg/m²	$PMI > 25 kg/m^2$	1 15	(0,70, 1,67)	1.06	(0.71.0.04)
Init < 25 kg/m Reference Reference Alcohol drinking	DIVIL ≥ 23 Kg/III DML ≤ 25 kg/m ²	1.10 Deference	(0.79–1.07)	1.20 Deference	(0.71-2.24)
Alcono of inking Pres 0.41 (0.22–0.77) 0.45 (0.7) No Reference	DIVII < 23 Ky/III	Reference		Reference	
Yes 0.41 (0.22–0.77) 0.45 (0.7) No Reference Reference Reference Current smoking 0.39 (0.24–0.65) 0.74 (0.7) Yes 0.39 (0.24–0.65) 0.74 (0.7) No Reference Reference Reference Routine exerciser Reference Reference Yes 0.92 (0.65–1.30) 0.74 (0.4) No Reference Reference Reference Hypertension Reference Reference Reference Ves 2.176 (1.49–3.19) 1.43 (0.4) No Reference Reference Reference Diabetes mellitus (0.7) No Reference Reference Reference Yes 0.90 (0.61–1.35) 1.21 (0.6)	Alcohol drinking			0.45	(0.1.0.1.00)
No Reference Reference Current smoking	Yes	0.41	(0.22–0.77)	0.45	(0.19–1.09)
Current smoking Yes 0.39 (0.24–0.65) 0.74 (0.74) No Reference <	No	Reference		Reference	
Yes 0.39 (0.24–0.65) 0.74 (0.74) No Reference Reference Reference Reference Yes 0.92 (0.65–1.30) 0.74 (0.4) No Reference Reference Reference Hypertension reference Reference Reference Yes 2.176 (1.49–3.19) 1.43 (0.4) No Reference Referenc	Current smoking				
No Reference Reference Routine exerciser 0.92 (0.65–1.30) 0.74 (0.400000000000000000000000000000000000	Yes	0.39	(0.24–0.65)	0.74	(0.37–1.46)
Routine exerciser Yes 0.92 (0.65–1.30) 0.74 (0.4 No Reference <	No	Reference		Reference	
Yes 0.92 (0.65–1.30) 0.74 (0.4 No Reference Refer	Routine exerciser				
No Reference Reference Hypertension (1.49–3.19) 1.43 (0.47 No Reference Reference (0.47 No Reference Reference (0.47 Diabetes mellitus	Yes	0.92	(0.65-1.30)	0.74	(0.45-1.23)
Hypertension Yes 2.176 (1.49–3.19) 1.43 (0.47 No Reference	No	Reference		Reference	
Yes 2.176 (1.49–3.19) 1.43 (0.4 No Reference Refe	Hypertension				
No Reference Reference Diabetes mellitus	Yes	2.176	(1.49-3.19)	1.43	(0.81 - 2.52)
Diabetes mellitus 1.59 (1.05–2.40) 1.33 (0.75–2.40) No Reference Reference </td <td>No</td> <td>Reference</td> <td>(</td> <td>Reference</td> <td>()</td>	No	Reference	(Reference	()
Yes 1.59 (1.05–2.40) 1.33 (0.7 No Reference Reference Reference Hyperlipidemia 0.90 (0.61–1.35) 1.21 (0.6 No Reference Reference Reference Cancer Yes 1.88 (0.74–4.77) 0.87 (0.5	Diabetes mellitus	Hereitere		Herefolde	
No Reference Reference Reference Hyperlipidemia 0.90 (0.61–1.35) 1.21 (0.6 No Reference Reference Reference Cancer 1.88 (0.74–4.77) 0.87 (0.5	Voc	1 50	(1.05-2.40)	1 33	(0 77_2 30)
Horizontal Herefore Herefore Hyperlipidemia 0.90 (0.61–1.35) 1.21 (0.6 No Reference Reference Cancer Ves 1.88 (0.74–4.77) 0.87 (0.5	No	Beference	(1.03-2.40)	Beference	(0.77-2.30)
Type inploenda 0.90 (0.61–1.35) 1.21 (0.6 No Reference Reference Cancer 7es 1.88 (0.74–4.77) 0.87 (0.5	Huporlinidomio	Nelerence		Herefelice	
Yes 0.90 (0.01-1.33) 1.21 (0.01-1.33) No Reference Reference Reference Cancer Yes 1.88 (0.74-4.77) 0.87 (0.31)	Vee	0.00	(0.61.1.25)	1 01	(0.66, 0.00)
No Reference Reference Cancer 7es 1.88 (0.74–4.77) 0.87 (0.32)	Yes	0.90	(0.61–1.35)	1.21	(0.66–2.23)
Ves 1.88 (0.74–4.77) 0.87 (0.5	NO	Reference		Reference	
Yes 1.88 (0.74–4.77) 0.87 (0.3	Cancer				
	Yes	1.88	(0.74–4.77)	0.87	(0.31–2.44)
No Reference Reference	No	Reference		Reference	
Perceived health status	Perceived health status				
Good to very good Reference Reference	Good to very good	Reference		Reference	
Normal 0.74 (0.43–1.29) 0.57 (0.4	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 (0.4	Poor to very poor	0.83	(0.47-1.46)	0.70	(0.30-1.62)
Health screening	Health screening		. ,		. ,
Yes 1.98 (1.34–2.92) 3.07 (1.6	Yes	1.98	(1.34-2.92)	3.07	(1.69-5.55)
No Reference Reference	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.

CharacteristicsAdjusted OR(95% Ci)Adjusted OR(95%Socioeconomic factors GenderReferenceReferenceReferenceMaleReferenceReferenceReferenceFemale1.27 $(0.57-2.80)$ 3.71 $(1.24-1)$ SpouseYes0.56 $(0.18-1.72)$ 2.10 $(0.76-5)$ NoReferenceReferenceReferenceHouse incomeUU $(0.29-2.65)$ 0.85 $(0.30-2)$ Lowest quartile 0.87 $(0.29-2.65)$ 0.85 $(0.30-2)$ Lowest quartile 0.79 $(0.31-1.73)$ 1.01 $(0.34-2)$ Less than elementary school 1.74 $(0.72-4.25)$ 3.00 $(0.99-9)$ College and aboveReferenceReferenceInsuranceInsuranceReferenceReferenceMederenceNational health insuranceReferenceReferenceNoYesReferenceReferenceNo 0.47 $(0.23-0.98)$ 0.89 $(0.41-1)$ Health-related factor	
Socioeconomic factors Reference Reference Gender Male Reference Reference Female 1.27 (0.57–2.80) 3.71 (1.24–1 Spouse Yes 0.56 (0.18–1.72) 2.10 (0.76–5 No Reference Reference House income Hous	CI)
Gender Reference Reference Male Reference Reference Female 1.27 (0.57–2.80) 3.71 (1.24–1) Spouse	
Male Reference Reference Female 1.27 (0.57–2.80) 3.71 (1.24–1) Spouse	
Female 1.27 (0.57–2.80) 3.71 (1.24–1) Spouse	
Spouse Yes0.56(0.18–1.72)2.10(0.76–5NoReferenceReferenceReferenceNoHouse income0.87(0.29–2.65)0.85(0.30–2Lowest quartile0.87(0.29–2.65)0.85(0.34–2Highest quartileReferenceReferenceReferenceEducation1.24(0.44–3.47)4.59(1.27–1Middle or high school1.74(0.72–4.25)3.00(0.99–9College and aboveReferenceReferenceInsuranceInsuranceReferenceReferenceInsuranceYesReferenceReferenceReferenceNo0.47(0.23–0.98)0.89(0.41–1)Health-related factorsInsuranceReferenceInsuranceBMI ≥25 kg/m²1.28(0.58–2.81)1.20(0.59–2BMI <25 kg/m²	1.07)
Yes 0.56 (0.18–1.72) 2.10 (0.76–5 No Reference	
NoReferenceReferenceHouse income	.81)
House incomeLowest quartile0.87(0.29–2.65)0.85(0.30–22nd and 3rd quartile0.79(0.31–1.73)1.01(0.34–2Highest quartileReferenceReferenceReferenceEducation1.24(0.44–3.47)4.59(1.27–1Middle or high school1.74(0.72–4.25)3.00(0.99–9College and aboveReferenceReferenceInsuranceInsuranceReferenceReferenceInsuranceNational health insuranceReferenceReferenceInsuranceYesReferenceReferenceInsuranceNo0.47(0.23–0.98)0.89(0.41–1)Health-related factorsInsuranceInsuranceInsuranceBMI ≥25 kg/m²1.28(0.58–2.81)1.20(0.59–2BMI <25 kg/m²	
Lowest quartile 0.87 (0.29–2.65) 0.85 (0.30–2 2nd and 3rd quartile 0.79 (0.31–1.73) 1.01 (0.34–2 Highest quartile Reference Reference Reference Reference Education	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$.44)
Highest quartileReferenceReferenceEducationEducation1.24(0.44–3.47)4.59(1.27–1Middle or high school1.74(0.72–4.25)3.00(0.99–9College and aboveReferenceReferenceInsuranceInsuranceReferenceReferenceReferenceNational health insuranceReferenceReference(0.09–1)Private Insurance0.78(0.13–4.59)0.32(0.09–1)Private InsuranceVessReferenceReferenceNo0.47(0.23–0.98)0.89(0.41–1)Health-related factorsBMI ≥25 kg/m²1.28(0.58–2.81)1.20(0.59–2)BMI < 25 kg/m²	.95)
EducationLess than elementary school1.24 $(0.44-3.47)$ 4.59 $(1.27-1)$ Middle or high school1.74 $(0.72-4.25)$ 3.00 $(0.99-9)$ College and aboveReferenceReferenceReferenceInsuranceReferenceReferenceReferenceNational health insuranceReferenceReference $(0.13-4.59)$ 0.32 $(0.09-1)$ Private InsuranceVessReferenceReference $(0.13-4.59)$ 0.32 $(0.09-1)$ Private InsuranceVessReferenceReference $(0.13-4.59)$ 0.32 $(0.09-1)$ Private InsuranceVessReferenceReference $(0.13-4.59)$ 0.32 $(0.09-1)$ Private InsuranceVessel (datase)No 0.47 $(0.23-0.98)$ 0.89 $(0.41-1)$ Health-related factorsBMISt g/m² 1.28 $(0.58-2.81)$ 1.20 $(0.59-2)$ BMI MI <25 kg/m²	
Less than elementary school1.24 $(0.44-3.47)$ 4.59 $(1.27-1)$ Middle or high school1.74 $(0.72-4.25)$ 3.00 $(0.99-9)$ College and aboveReferenceReferenceInsuranceReferenceReferenceNational health insuranceReferenceReferenceMedical aid0.78 $(0.13-4.59)$ 0.32 $(0.09-1)$ Private InsuranceYesReferenceReferenceNo0.47 $(0.23-0.98)$ 0.89 $(0.41-1)$ Health-related factorsBMI25 kg/m²1.28 $(0.58-2.81)$ 1.20 $(0.59-2)$ BMI ≥55 kg/m²ReferenceReferenceReference	
Middle or high school1.74(0.72–4.25)3.00(0.99–9College and aboveReferenceReferenceReferenceInsuranceReferenceReferenceReferenceNational health insuranceReferenceReference(0.09–9)Medical aid0.78(0.13–4.59)0.32(0.09–1)Private InsuranceYesReferenceReference(0.09–1)YesReferenceReferenceReference(0.09–1)No0.47(0.23–0.98)0.89(0.41–1)Health-related factorsBMI25 kg/m²1.28(0.58–2.81)1.20(0.59–2)BMI ≥25 kg/m²ReferenceReferenceReferenceReference	6.61)
College and aboveReferenceReferenceInsuranceReferenceReferenceNational health insuranceReferenceReferenceMedical aid0.78 $(0.13-4.59)$ 0.32Private InsuranceYesReferenceYesReferenceReferenceNo0.47 $(0.23-0.98)$ 0.89Ultarrelated factorsBMI25 kg/m²BMI $\geq 25 kg/m²$ 1.28 $(0.58-2.81)$ 1.20BMI 25 kg/m²Reference	.11)
Insurance National health insurance Medical aid Private Insurance Yes No No No No No No No No No No	,
National health insuranceReferenceReferenceMedical aid0.78 $(0.13-4.59)$ 0.32 $(0.09-1)$ Private InsuranceYesReferenceReferenceYes0.47 $(0.23-0.98)$ 0.89 $(0.41-1)$ Health-related factorsBMI25 kg/m²1.28 $(0.58-2.81)$ 1.20 $(0.59-2)$ BMI <25 kg/m²	
Medical aid 0.78 (0.13–4.59) 0.32 (0.09–1 Private Insurance Yes Reference Reference Reference No 0.47 (0.23–0.98) 0.89 (0.41–1 Health-related factors BMI ≥ 25 kg/m² 1.28 (0.58–2.81) 1.20 (0.59–2 BMI ≥ 25 kg/m² 1.28 (0.58–2.81) 1.20 (0.59–2	
Private InsuranceReferenceReferenceYesReference0.47 $(0.23-0.98)$ 0.89 $(0.41-1)$ Health-related factorsBMI $\geq 25 \text{ kg/m}^2$ 1.28 $(0.58-2.81)$ 1.20 $(0.59-2)$ BMI < 25 kg/m²	.17)
YesReferenceReferenceNo0.47 $(0.23-0.98)$ 0.89 $(0.41-1)$ Health-related factorsBMIBMI $\geq 25 \text{ kg/m}^2$ 1.28 $(0.58-2.81)$ 1.20 $(0.59-2)$ BMI $< 25 \text{ kg/m}^2$ ReferenceReference	,
No 0.47 (0.23–0.98) 0.89 (0.41–1 Health-related factors BMI 25 kg/m² 1.28 (0.58–2.81) 1.20 (0.59–2 BMI <25 kg/m²	
Health-related factors Image: Construction of the sector of	92)
BMI ≥25 kg/m² 1.28 (0.58–2.81) 1.20 (0.59–2 BMI <25 kg/m²	
BMI ≥25 kg/m ² 1.28 (0.58–2.81) 1.20 (0.59–2 BMI <25 kg/m ² Reference Reference	
BMI <25 kg/m ² Reference Reference	41)
Alaahal drinking	,
Yes 0.48 (0.14–1.62) 0.54 (0.22–1	33)
No Bafarance Bafarance	.00)
Ves 0.69 (0.26–1.84) 0.77 (0.30–2	04)
No Bafaranca Bafaranca	.0-1)
Ruitine everciser	
Vac 0.67 (0.32–1.41) 0.86 (0.42–1	71)
No Bafaranca Bafaranca	.(1)
Ivo hereite hereite	
Vec 1.60 (0.72–2.48) 1.20 (0.56–2	00)
165 1.00 (0.10-3.40) 1.29 (0.00-3 No Pafaranca Pafaranca	.00)
No neteretice neteretice	
Vac 154 (0.72-2.31) 1.03 (0.40-2	18)
165 1.04 (0.72-0.07) 1.00 (0.42-2	.10)
Ivo nelelelice nelele	
Trypenipuorina Voc 1.29 (0.55.2.01) 1.21 (0.64.2	68)
165 1.20 (0.0-5.01) 1.31 (0.0-2	.00)
Van 0.42 (0.04.5.10) 1.15 (0.21.6	12)
165 0.46 (0.04-0.10) 1.10 (0.21-0	.43)
NU NUELELE NEELE	
Perceived Itealiii Status	
Council Relief elice Relief elice Namel 0.72 (0.00.0.00) 0.00	0.01
INUTITIAL U.13 (U.22–2.39) U.36 (U.12–1	.UX)
Poor to very poor U.81 (U.25–2.62) U.41 (U.14–1	.18)
	00
res 4.56 (1.90–10.92) 1.85 (0.88–3	.92)

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

Conceptualization: Pyung Chun Oh.

Data curation: Eun Young Kim.

Formal analysis: Eun Young Kim.

Funding acquisition: Eun Young Kim.

Methodology: Eun Young Kim, Young Saing Kim.

Resources: Eun Young Kim, Young Saing Kim.

Validation: Eun Young Kim, Pyung Chun Oh.

Writing – original draft: Eun Young Kim, Jae Ho Ko.

Writing – review & editing: Eun Young Kim, Jae Ho Ko, Young Saing Kim, Pyung Chun Oh.

Young Saing Kim orcid: 0000-0003-0207-2617

References

- [1] National Bureau of Statistics, Republic of Korea. Annual report on the cause of death statistics. Seoul, Republic of Korea, 2011
- [2] World Health Organization. Cardiovascular diseases (CVDs) [Data file]. Available at: http://www.who.int/mediacentre/factsheets/fs317/en/index. html. Accessed: August, 9 2019.
- [3] Barnes M, Heywood AE, Mahimbo A, et al. Acute myocardial infarction and influenza: a meta-analysis of case-control studies. Heart 2015;101:1738–47.
- [4] Caldeira D, Ferreira JJ, Costa J. Influenza vaccination and prevention of cardiovascular disease mortality. Lancet (London, England) 2018;391:426–7.

- [5] Chung JH, Kim TH, Han CH. Factors influencing influenza vaccination among South Korean adult asthma patients: a nationwide populationbased cross-sectional study. J Asthma 2018;55:294–9.
- [6] WHO Expert ConsultationAppropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004;363:157–63.
- [7] Grohskopf LA, Sokolow LZ, Broder KR, et al. Prevention and control of seasonal influenza with vaccines: recommendations of the advisory committee on immunization practices - United States, 2017-18 influenza season. MMWR Recommend Rep 2017;66:1–20.
- [8] Gross PA, Hermogenes AW, Sacks HS, et al. The efficacy of influenza vaccine in elderly persons. A meta-analysis and review of the literature. Ann Intern Med 1995;123:518–27.
- [9] Kwon DS, Kim K, Park SM. Factors associated with influenza vaccination coverage among the elderly in South Korea: the Fourth Korean National Health and Nutrition Examination Survey (KNHANES IV). BMJ Open 2016;6:e012618.
- [10] Liu X, Wang Y, Zhang H, et al. Evaluation of fractional flow reserve in patients with stable angina: can CT compete with angiography? European radiology 2019;29:3669–77.
- [11] MacIntyre CR, Mahimbo A, Moa AM, et al. Influenza vaccine as a coronary intervention for prevention of myocardial infarction. Heart 2016;102:1953–6.
- [12] Oh MG, Han MA, Yun NR, et al. A population-based, nationwide crosssectional study on influenza vaccination status among cancer survivors in Korea. Int J Environ Res Public Health 2015;12:10133–49.
- [13] Osaki Y, Ino A, Matsushita S, et al. Reliability and validity of the alcohol use disorders identification test - consumption in screening for adults with alcohol use disorders and risky drinking in Japan. Asian Pac J Cancer Prev 2014;15:6571–4.
- [14] Reichert TA, Simonsen L, Sharma A, et al. Influenza and the winter increase in mortality in the United States. Am J Epidemiol 2004;160:492–502.
- [15] Ryu SY, Kim SH, Park HS, et al. Influenza vaccination among adults 65 years or older: a 2009-2010 community health survey in the Honam region of Korea. Int J Environ Res Public Health 2011;8:4197–206.
- [16] Shin HY, Chung JH, Hwang HJ, et al. Factors influencing on influenza vaccination and its trends of coverage in patients with diabetes in Korea: a population-based cross-sectional study. Vaccine 2018;36:91–7.
- [17] Shin HY, Hwang HJ, Chung JH. Factors influencing influenza vaccination among patients with chronic obstructive pulmonary disease: a population-based cross-sectional study. Asia-Pacific J Public Health 2017;29:560–8.
- [18] Simonsen L, Clarke MJ, Williamson GD, et al. The impact of influenza epidemics on mortality: introducing a severity index. Am J Public Health 1997;87:1944–50.
- [19] Warren-Gash C, Smeeth L, Hayward AC. Influenza as a trigger for acute myocardial infarction or death from cardiovascular disease: a systematic review. Lancet Infect Dis 2009;9:601–10.
- [20] Wu S, Yang P, Li H, et al. Influenza vaccination coverage rates among adults before and after the 2009 influenza pandemic and the reasons for non-vaccination in Beijing, China: a cross-sectional study. BMC Public Health 2013;13:636.
- [21] Xu L, Huang X, Ma J, et al. Value of three-dimensional strain parameters for predicting left ventricular remodeling after ST-elevation myocardial infarction. The international journal of cardiovascular imaging 2017;33:663–73.
- [22] Zhang N, Yang G, Gao Z, et al. Deep Learning for Diagnosis of Chronic Myocardial Infarction on Nonenhanced Cardiac Cine MRI. Radiology 2019;291:606–17.