Factors associated with influenza vaccination coverage and willingness in the elderly with chronic diseases in Shenzhen, China

Hongbiao Chen1, Qiushuang Li2, Minyi Zhang2, Zihao Gu3, Xiaofeng Zhou3, He Cao3, Fei Wu4, Minyi Liang4, Liting Zheng5, Juxian Xian5, Qing Chen5, and Qihui Lin4

*Department of Epidemiology and Infectious Disease Control, Longhua Key Discipline of Public Health for the Prevention and Control of Infectious Diseases, Longhua Centre for Disease Control and Prevention, Shenzhen, Guangdong, China; †Department of Epidemiology, School of Public Health, Guangdong Provincial Key Laboratory of Tropical Disease Research, Southern Medical University, Guangzhou, Guangdong, China

ABSTRACT

Elderly individuals with chronic illnesses are more prone to get influenza. We aimed to investigate the factors associated with influenza coverage and willingness in chronic disease patients aged ≥60 years in Longhua district, Shenzhen City of southern China. Data collected in October 2020 were used in this work. The immunization status of older persons with chronic conditions and their willingness to receive the vaccine were assessed. Multivariable logistic regression was employed to determine the respective independent factors related to vaccination coverage and willingness for influenza. Only 4.8% of 5045 people were immunized against influenza, whereas 92.7% of the individuals agreed to receive the vaccine. Individuals between the ages of 70 and 79 (adjusted OR [aOR] 1.47, P = .012), those with higher education levels (aOR 1.53, P = .005 for high school; aOR 2.44, P < .001 for college or above), those who use of a family doctor (aOR 2.91, P < .001), those who frequently have physical examinations once a year (aOR 2.52, P < .001), and those who have never smoked (aOR 1.62, P = .018) were positively associated with the influenza vaccination. Meanwhile, older age was adversely linked with influenza vaccination willingness (aOR 0.68 for 70–79 years, P = .003; aOR 0.55 for ≥80 years, P = .025) in contrast to those aged 60–69. High willingness to get vaccinated was more frequent in people with a high school diploma (aOR 1.33, P = .037). In this work, we observed that the coverage is poor but the immunization desire is high regarding influenza vaccination. Interestingly, older age was associated with higher coverage and lower willingness. These suggest that raising immunization rates among older people with chronic conditions and strengthening health education for caregivers should be the primary concerns.

Introduction

Globally, seasonal influenza is a significant public health issue that causes considerable morbidity and mortality. The World Health Organization (WHO) reports that seasonal influenza results in more than one billion infections and between 290,000 and 650,000 fatalities per year. The seasonal influenza continues to be a serious problem in China, where it annually causes around one million cases of influenza-associated respiratory disease. Because of a weakened immune system, older adults with chronic conditions are more vulnerable to get influenza. People with diabetes were shown to have a 9-times higher chance of being hospitalized for influenza than the general population. Prior studies also demonstrated that individuals with liver disorders had a 3.3-fold higher chance of being hospitalized for influenza than people in good health. Additionally, a wide range of complications can be resulted from influenza virus infection, including pneumonia, acute respiratory distress syndrome, and encephalitis, particularly in high-risk groups. The mortality rate is 50–100 times greater in older adults with chronic conditions due to comorbidities. Several studies have shown that non-pharmaceutical interventions during the COVID-19 pandemic collaterally decreased influenza cases and immunity, making those with chronic illnesses more susceptible to the virus during the following influenza season. Previous studies also demonstrated that vaccination was the most effective way to prevent influenza in high-risk groups, lowering the risk of influenza infection (29%), hospitalization (16%), and mortality (50%) and reducing hospital costs by $1282. Consequently, the WHO and the Chinese Center for Disease Control and Prevention (CDC) designate the elderly with chronic illnesses as a priority group for influenza vaccination. From another point of view, getting vaccinated against influenza helps to lower the chance of contracting COVID-19 in hospitals by decreasing the frequency of medical visits. As such, influenza vaccination coverage is linked to fewer COVID-19 spreading and less severe clinical outcomes.

In China, older adults with chronic conditions had a lower vaccine coverage for influenza (0.4–5.1%) than healthy...
people (9.4%). An earlier study in Beijing, China revealed that the free vaccination policy significantly boosted the vaccination rate (20.6%) among people aged ≥60 years. Since 2016, Shenzhen’s government has established regulations offering free influenza vaccination to people aged ≥60 years, although our prior research has identified an extremely low coverage of influenza vaccination (4.7%) among older patients with hypertension during the 2018/2019 season. For thoroughly comprehension, we undertook this study to further analyze the respective factors of coverage and willingness toward influenza vaccination among older adults with any chronic diseases (except for hypertension) during the COVID-19 pandemic in Shenzhen, China.

Methods

Study design and participants

This study was a component of an online large-scale cross-sectional study conducted in October 2020 to assess vaccination coverage and willingness toward influenza and pneumonias, together with their associated factors among older people in Longhua district, Shenzhen City of southern China. Ethics approval for this work was obtained from the Longhua CDC.

A self-administered questionnaire was adopted to the current study. Based on the literature review on the given topic, a panel consisting of CDC researchers and experts in epidemiology and infectious diseases was convened to create the questionnaire for this research. The CDC researchers designed and prepared the original version of the questionnaire. The accuracy and consistency were then assessed using a pretest based on fifty older adults other than those included in this study. Eventually, the original version of the questionnaire was reviewed again and modified by the CDC researchers and experts. We could not conduct face-to-face interviews for the participants because of the social restrictions during the outbreak of COVID-19. To collect as many samples as possible, we sent the electric questionnaires to the primary and secondary schools covering the whole of Longhua, an urban district in Shenzhen city. According to our guideline, the parents of the students were responsible for obtaining information on older adults aged over 60 years in their families; and it was unnecessary to fill in the questionnaire repeatedly if there are multiple students in the same family. We believed that older adults were more willing to cooperate with this survey when interviewed by their family members, and thereby the data quality can be improved to some extent. The questionnaires were distributed through the most extensive online survey platform in China, Wen Juan Xing (Changsha Ranxing Information Technology Co., Ltd., Changsha, China) that would check the completeness of questionnaires before submission. Consequently, only the completed questionnaires would be submitted successfully. Rewards such as an e-coupon were provided as incentives for participation through a lottery after completion. In line with a pertinent study, we used convenience sampling procedure to gather information on the elderly people more than 60 years of age who self-reported having chronic conditions, such as diabetes, chronic respiratory diseases, and other chronic diseases other than hypertension. The disease information for each participant was not further confirmed via any medical records as it was an online anonymous survey. A brief description of the study’s purposes and the informed consent information were included on the front of the questionnaire. Only those who gave consent to be a part of the investigation were recruited as participants. In addition, participants would be rolled out when met one of the following exclusion criteria: (1) duplicate questionnaires submitted by participants using the same IP address; (2) respondents who took less than 300 seconds to finish the questionnaire; (3) or questionnaires with logical or enter errors. Eventually, 5045 older adults with chronic conditions in total were enrolled in this work. All collected data were kept strictly confidential and only used for research purposes. Detailed procedures and some findings of the cross-sectional survey have been described elsewhere.

Study outcome and variables

Two outcomes were analyzed in the current study. The first outcome was the influenza vaccination coverage among older people with chronic illnesses. Participants who received an influenza vaccine during the 2019/2020 season were separated into the vaccinated group and those who did not were classified into the unvaccinated group. In parallel, the second outcome of this study was the willingness toward influenza vaccination. Similarly, participants were assigned into two groups based on whether they were willing to be vaccinated against influenza.

Participants were asked to report their sociodemographic variables, including gender (male, female), age (60–69, 70–79, or ≥ 80 years), marital status (married, divorced, or widowed), education level (middle school or lower, high school, or college or above), and monthly household income (< USD 1449, USD 1449–7246, or > USD 7246). The variables of the health-related behaviors contained the use of a family doctor, frequency of physical examinations, smoking, drinking, and exercise. The information of monthly household income was presented in US dollars (USD) with an average exchange rate of Chinese yuan (CNY) 6.9 per USD in 2020, as already described.

Statistical analysis

The participants’ sociodemographic and health-related variables for the individuals were analyzed using descriptive statistics. All of the variables were categorical and were presented as frequencies and proportions. Pearson’s chi-squared tests or Fisher’s exact tests were performed as appropriate to estimate the statistical significance. Both unadjusted and adjusted analyses were generated to identify the independent factors by calculating the odds ratios (ORs) and 95% confidence intervals (CIs). A bivariate logistic regression model initially estimated the association between each variable and the coverage and willingness of influenza vaccination, respectively. Variables with a statistical significance in the bivariate analyses were further brought into the corresponding multivariable logistic regression model. All analyses were performed using IBM SPSS Statistics for Windows, version 25 (IBM Corp., Armonk, NY, USA).
A two-sided p-value < 0.05 was considered statistically significant.

Results

Overall, we involved 5045 older people with chronic illnesses in October 2020. The respondents were under quality control, and there was no missing data from the responses. Descriptive characteristics of the participants are presented in Table 1. The proportion of participants who were willing to receive an influenza vaccine during the study period was high (92.7%), yet only 4.8% of participants had gotten it during the last influenza season. In this work, 52.5% were female older adults, and the vast majority of participants were aged from 60 to 69 years (77.2%). Three-quarters (76.3%) of the participants were married. The majority (69.1%) of the elderly with chronic diseases had an education level of middle school or lower. Greater than half of the participants (54.7%) had a monthly household income ranging from USD 1449 to USD 7246. In terms of health-related information, only one-quarter of participants (26.7%) responded to the use of a family doctor and a few participants (29.8%) indicated that they had a health examination at least once a year. Additionally, most older adults with chronic illnesses never smoked (81.1%), never drank alcohol (80.4%), and exercised for more than half an hour each day (75.6%). Among all variables of interest, the coverage of influenza vaccination differed across age, education level, the use of a family doctor, frequency of physical examination, and smoking. Meanwhile, the willingness toward being vaccinated against influenza varied by age, education level, and marital status.

Using the action toward being vaccinated as the first study outcome, bivariate and multivariable logistic regression analyses were generated to identify the independent factors related to influenza vaccination among older people with chronic diseases (Table 2). The findings of bivariate analyses are shown in the Appendix Table A1. The results of bivariate regression analysis demonstrated the underlying characteristics, including age, education level, the use of a family doctor, frequency of physical examination, and smoking, that significantly associated with the influenza vaccination coverage. Yet, the findings of the multivariable logistic regression analysis were generally in line with those of the bivariate ones. Individuals aged between 70 and 79 years (aOR 1.47, 95%CI 1.09–1.99), with higher education levels (aOR 1.53, 95%CI 1.14–2.06 for high school; aOR 2.44, 95%CI 1.62–3.70 for college or above). The usage of a family doctor (aOR 2.91, 95%CI

| Table 1. Characteristics of the elderly with chronic disease by the coverage and willingness of influenza vaccination, respectively. |
|---|---|---|---|---|---|---|---|
| Variables | N (%) | Coverage | | | Willingness | |
| | | No | Yes | | No | Yes | |
| Total | 5045 | 4803 | 242 (4.8) | 367 | 4678 (92.7) |
| Sociodemographic | | | | | | |
| Gender | | | | | | |
| Male | 2395 (47.5) | 2289 (47.7) | 106 (43.8) | 168 (45.8) | 2227 (47.6) |
| Female | 2650 (52.5) | 2514 (52.3) | 136 (56.2) | 199 (54.2) | 2451 (52.4) |
| Age (years) | | | | | | |
| 60–69 | 3894 (77.2) | 3730 (77.7) | 164 (67.8) | 252 (68.7) | 3642 (77.9) |
| 70–79 | 997 (19.8) | 931 (19.4) | 66 (27.3) | 96 (26.2) | 901 (19.3) |
| ≥80 | 154 (3.1) | 142 (3.0) | 12 (5.0) | 19 (5.2) | 135 (2.9) |
| Education level | | | | | | |
| Middle school or lower | 3487 (69.1) | 3351 (69.8) | 136 (56.2) | 278 (75.7) | 3209 (68.6) |
| High school | 1248 (24.7) | 1174 (24.4) | 74 (30.6) | 72 (19.6) | 1176 (25.1) |
| College or above | 310 (6.1) | 278 (5.8) | 32 (13.2) | 17 (4.6) | 293 (6.3) |
| Marital status | | | | | | |
| Married | 3851 (76.3) | 3669 (76.4) | 182 (75.2) | 255 (69.5) | 3596 (76.9) |
| Divorce | 84 (1.7) | 78 (1.6) | 6 (2.5) | 8 (2.2) | 76 (1.6) |
| Widowed | 1110 (22.0) | 1056 (22.0) | 54 (22.3) | 104 (28.3) | 1006 (21.5) |
| Monthly household income | | | | | | |
| < USD 1449 | 1614 (32.0) | 1545 (32.2) | 69 (28.5) | 115 (31.3) | 1499 (32.0) |
| USD 1449–7246 | 2762 (54.7) | 2629 (54.7) | 133 (55.0) | 200 (54.5) | 2562 (54.8) |
| > USD 7246 | 669 (13.3) | 629 (13.1) | 40 (16.5) | 52 (14.2) | 617 (13.2) |
| Health-related behaviors | | | | | | |
| Use of a family doctor | | <0.001 | | | 0.759 |
| No | 3697 (73.3) | 3576 (74.5) | 121 (50.0) | 272 (74.1) | 3425 (73.2) |
| Yes | 1348 (26.7) | 1227 (25.5) | 121 (50.0) | 95 (25.9) | 1253 (26.8) |
| Frequency of physical examination | | <0.001 | | | 0.085 |
| <1 | 3540 (70.2) | 3419 (71.2) | 121 (50.0) | 243 (66.2) | 3297 (70.5) |
| ≥1 | 1505 (29.8) | 1384 (28.8) | 121 (50.0) | 124 (33.8) | 1381 (29.5) |
| Smoking | | | | | | |
| No | 4093 (81.1) | 3880 (80.8) | 213 (88.0) | 287 (78.2) | 3806 (81.4) |
| Yes | 952 (18.9) | 923 (19.2) | 29 (12.0) | 80 (21.8) | 872 (18.6) |
| Drinking | | | | | | |
| No | 4055 (80.4) | 3853 (80.2) | 202 (83.5) | 295 (80.4) | 3760 (80.4) |
| Yes | 990 (19.6) | 950 (19.8) | 40 (16.5) | 72 (19.6) | 918 (19.6) |
| Exercise | | 0.107 | | | 0.412 |
| No | 1229 (24.4) | 1181 (24.6) | 48 (19.8) | 96 (26.2) | 1133 (24.2) |
| Yes | 3816 (75.6) | 3622 (75.4) | 194 (80.2) | 271 (73.8) | 3545 (75.8) |
2.25–3.78), frequent physical examinations (aOR 2.52, 95%CI 1.93–3.29), and never smoking (aOR 1.62, 95%CI 1.09–2.42) were all positively correlated with influenza vaccination coverage, as was to be predicted. Likewise, the bivariate and multivariable logistic regression models were additionally employed using the willingness to be vaccinated as the second study outcome (Table 2). Age, marital status, and educational attainment were the main factors identified by the bivariate analysis. Following adjustment for these factors, older adults with chronic diseases were less willing to get vaccinated against influenza with increasing age (aOR 0.68, 95%CI 0.53–0.88 for 70–79 years; aOR 0.55, 95%CI 0.33–0.93 for ≥80 years). It did, however, show a favorable correlation between having a high school diploma (aOR 1.33, 95%CI 1.01–1.75).

### Discussion

Overall, this study indicated that the coverage rate of influenza vaccination in older adults with chronic conditions was quite low (4.8%), whereas it was of interest to demonstrate a very high willingness to get vaccinated in the upcoming influenza season (92.7%). The vast difference between these two values may be addressed by the explanations that follow. First, the severity of the COVID-19 pandemic may have an impact on people’s willingness to receive the influenza vaccine because people may become more interested in being vaccinated against diseases that have comparable symptoms to the epidemic.23,25,26 Second, the procedure for the influenza vaccine is not as well understood among older people with chronic disease.27 Third, those do not pay enough attention to the dangers of influenza.28 Further government efforts are needed to address the gap in vaccination rates and willingness.

4.8% of the participants in this study reported having received an influenza vaccine during the 2019/2020 season, which was more than that reported in Shanghai, China in 2017.29 In contrast to the immunization rates reported in the United States (61.6%)30 and Australia (67.6%),31 the coverage in our study is noticeably much lower. Cultural diversity and different vaccination policies may be to account for the significant disparity in influenza vaccination coverage between China and other nations. In regard to the willingness of influenza vaccination, this study indicated that 92.7% of the participants were willing to be vaccinated. A previous study in China indicated merely 19.6% of patients with type 2 diabetes mellitus were willing to get vaccinated during the 2016/2017 influenza season.32 Another research suggested that 20% of Canadian individuals aged over 50 years who had planned to skip the influenza shot had changed their minds in light of COVID-19 in the 2020/2021 season.33 These suggested that the COVID-19 pandemic had an impact on raising public awareness of health issues and disease prevention.

The decision-making process for health authorities would be facilitated by identifying the significant factors related to influenza vaccination. The coverage of influenza vaccination among elderly adults with chronic conditions may vary for a number of reasons. On the one hand, people with chronic diseases do not always have proper knowledge, awareness, or attitude regarding the influenza vaccination.34 This might prompt them to query the immunization effect in patients with chronic diseases, for instance, in the case of a chronic inflammatory condition.35,36 On the other hand, the actual coverage is limited by the accessibility of the influenza vaccine.21 These factors could be investigated in future research but weren’t discovered in the current study. Prior studies have shown a substantial correlation between older age with actual influenza vaccination coverage and willingness.37,38 In the current study, comparable findings for influenza vaccination coverage.

| Variables                  | Coverage | Willingness |
|----------------------------|----------|-------------|
|                           | aOR      | 95%CI       | P-value | aOR | 95%CI | P-value |
| **Sociodemographic**       |          |             |         |     |       |         |
| Age (years)                |          |             |         |     |       |         |
| 60–69                      |          |             |         |     |       |         |
| 70–79                      | 1.47     | 1.09–1.99   | 0.012   | 0.68| 0.53–0.88| 0.003   |
| ≥80                        | 1.69     | 0.90–3.16   | 0.099   | 0.55| 0.33–0.93| 0.025   |
| **Education level**        |          |             |         |     |       |         |
| Middle school or lower     |          |             |         |     |       |         |
| High school                | 1.53     | 1.14–2.06   | 0.005   | 1.33| 1.01–1.75| 0.037   |
| College or above           | 2.44     | 1.62–3.70   | <0.001  | 1.48| 0.89–2.47| 0.127   |
| **Marital status**         |          |             |         |     |       |         |
| Married                    |          |             |         |     |       |         |
| Divorce                    | -        | -           | -       | 0.66| 0.32–1.40| 0.279   |
| Widowed                    | -        | -           | -       | 0.80| 0.62–1.03| 0.085   |
| **Health-related behaviors**|      |             |         |     |       |         |
| Use of a family doctor     |          |             |         |     |       |         |
| No                         | 2.91     | 2.25–3.78   | <0.001  | -   | -     | -       |
| Frequency of physical examination |    |             |         |     |       |         |
| <1                         | 2.52     | 1.93–3.29   | <0.001  | -   | -     | -       |
| ≥1                         |          |             |         |     |       |         |
| Smoking                    |          |             |         |     |       |         |
| No                         | 1.62     | 1.09–2.42   | 0.018   | -   | -     | -       |
| Yes                        |          |             |         |     |       |         |

aOR: adjusted odd ratio; CI: confidence interval.
were also noted. Participants’ perception that the risk of influenza complications increased with age played a role in their decision to go inoculated.99 Nevertheless, in this study, older age is the main barrier to the participants’ willingness to receive an influenza vaccine. The large gap between coverage and willingness remains a conundrum. This suggests that the coverage rate of the elderly may be influenced by younger people in the family or caregivers.90 In line with the findings of the current study, other surveys have indicated the critical role that higher education level plays in promoting vaccination coverage and willingness.33,37,41 Higher education level continues to be a key driver of raising utilization of health care.38 Furthermore, better access to information about vaccination efforts may result from frequent use of health services. This was also supported by a study in the United States, suggesting patients who frequently used medical services were more likely to receive vaccinations.99 In spite of this, higher education levels failed to consistently correlate favorably with influenza vaccination across nations. Greater education was found to be a barrier to immunization in a Canadian study.42

This study also demonstrated substantial relationships between influenza vaccination coverage and health-related behaviors, such as the usage of a family doctor, the frequency of physical examinations, and smoking. Notably, the recommendation from a physician is believed to be a significant factor in raising influenza vaccine uptake. In this aspect, our finding was corroborated by other relevant studies indicating that older patients with a family physician were more likely to be immunized than those without.43,44 Similar results also appeared in earlier research,45,46 and the vaccine recipients reported their decision was influenced by a family medical recommendation.47 Patients claimed that the main factor driving low vaccination rates may be a lack of sufficient information from medical staff.48 These may be the results of advice from physicians to increase vaccination acceptability and control attitudes toward vaccination refusal among elderly patients.49,50

It is of importance to note that participants who had undergone physical examinations were more likely to receive an influenza vaccine, which was consistent with prior studies.31,51,52 This may be due to the fact that people who had frequent physical examinations are more aware of their self-health status,53 and hence they had more favorable attitudes toward influenza vaccination.54 Furthermore, older adults who followed healthy lifestyles, such as nonsmoking, were more likely to receive vaccinations.42,55 In consistency with relevant studies, we found that nonsmoking remained a crucial motivator for influenza vaccination.56 This can be linked to the fact that individuals who lead healthy lifestyles tend to engage in healthy activities and show interest in getting vaccinated against influenza.56,57 Interestingly, these findings also suggest that, despite being one of the individuals at most risk of developing influenza infection, smokers are the group of older people with chronic conditions who are least protected.58

**Strengths and limitations**

This study examined influenza vaccination coverage prior to the COVID-19 pandemic (2019/2020 influenza season) and the willingness toward influenza vaccination during the period of COVID-19 (2020/2021 influenza season) among older adults with chronic conditions in Shenzhen City of southern China. These results may provide evidence for increasing influenza vaccination coverage during the superposition of the COVID-19 and influenza pandemics. The study does, however, have some shortcomings. The causal association cannot be explained by a cross-sectional study design. In addition, this self-reported questionnaire may result in recall bias.

**Conclusion**

In this work, only 4.8% of participants with chronic conditions had been vaccinated against influenza before the period of COVID-19, but interestingly, 92.7% of them are eager to receive an influenza vaccine during the COVID-19 pandemic. These results demonstrated that the spread of infectious diseases can strengthen public awareness of disease prevention. Additionally, we found that vaccination coverage and willingness may differ depending on factors like age and educational attainment, this suggests raising immunization rates among older people with chronic conditions and strengthening health education for younger people in the family or caregivers should be the first priority. Increasing awareness of undertaking physical examinations for older people with chronic conditions, especially among smokers, would also support the actual vaccination practices.

**Disclosure statement**

No potential conflict of interest was reported by the author(s).

**Funding**

This research was funded by the Science and Technology Innovation Funding Project of Shenzhen Longhua (grant number 2020206) and the Key Discipline of Control and Prevention of Infectious Diseases and Public Health of Shenzhen Longhua.

**Author contributions**

Conceptualization, H.C. (Hongbiao Chen), Q.L. (Qiushuang Li) and M.Z.; Formal analysis, Z.G., H.C (He Cao); Investigation, H.C. (Hongbiao Chen), X.Z. and F.W., J.X. L.Z., M.L; Supervision, Q.L. (Qiuhui Lin); Writing – original draft, H.C. (Hongbiao Chen), Q.L. (Qiushuang Li); Writing – review & editing, Q.C and M.Z.

**Institutional review board statement**

The study was conducted according to the guidelines of Helsinki and approved by the Longhua Center for Disease Control and Prevention, Shenzhen.

**Informed consent statement**

Informed consent was obtained from all subjects involved in the study.

**Data availability statement**

Access to the data presented in this study can be acquired by connecting to the corresponding authors via e-mail. The data are not publicly available due to restrictions of privacy.
## Appendix

### Table A1. Factors for influenza vaccination among the elderly with chronic disease.

| Sociodemographic | Coverage | Willingness |
|------------------|----------|-------------|
|                  | N (%) | OR | 95% CI | P | N (%) | OR | 95% CI | P |
| **Gender**       |        |    |        |   |        |    |        |   |
| Male             | 106 (4.4) | Ref. |        |   | 2227 (93.0) | Ref. |        |   |
| Female           | 136 (5.1) | 1.17 | 0.90–1.52 | 0.24 | 2451 (92.5) | 1.08 | 0.87–1.33 | 0.5 |
| **Age (years)**  |        |    |        |   |        |    |        |   |
| 60–69            | 164 (4.2) | Ref. |        |   | 3642 (93.5) | Ref. |        |   |
| 70–79            | 66 (6.6) | 1.61 | 1.20–2.16 | <0.001 | 901 (90.4) | 1.54 | 1.2–1.97 | <0.001 |
| ≥80              | 12 (7.8) | 1.92 | 1.04–3.54 | 0.04 | 135 (87.7) | 2.03 | 1.24–3.34 | 0.01 |
| **Education level** |        |    |        |   |        |    |        |   |
| Middle school or lower | 136 (3.9) | Ref. |        |   | 3209 (92.0) | Ref. |        |   |
| High school      | 74 (5.9) | 1.55 | 1.16–2.08 | <0.001 | 1176 (94.2) | 0.71 | 0.54–0.92 | 0.01 |
| College or above | 32 (10.3) | 2.84 | 1.89–4.25 | <0.001 | 293 (94.5) | 0.67 | 0.4–1.11 | 0.12 |
| **Marital status** |        |    |        |   |        |    |        |   |
| Married          | 182 (4.7) | Ref. |        |   | 3596 (93.4) | Ref. |        |   |
| Divorce          | 6 (7.1) | 1.55 | 0.67–3.61 | 0.31 | 76 (90.5) | 1.48 | 0.71–3.11 | 0.3 |
| Widowed          | 54 (4.9) | 1.03 | 0.76–1.41 | 0.85 | 1006 (90.6) | 1.46 | 1.15–1.85 | <0.001 |
| **Monthly household income** |        |    |        |   |        |    |        |   |
| < USDA 1449      | 69 (4.3) | Ref. |        |   | 1499 (92.9) | Ref. |        |   |
| USD 1449–7246    | 133 (4.8) | 1.13 | 0.84–1.53 | 0.41 | 2562 (92.8) | 1.02 | 0.8–1.29 | 0.89 |
| ≥ USD 7246       | 40 (6.0) | 1.42 | 0.95–2.13 | 0.08 | 617 (92.2) | 1.1 | 0.78–1.54 | 0.59 |
| **Health-related behaviors** |        |    |        |   |        |    |        |   |
| **Use of a family doctor** |        |    |        |   |        |    |        |   |
| No               | 121 (3.3) | Ref. |        |   | 3425 (92.6) | Ref. |        |   |
| Yes              | 121 (9.0) | 2.91 | 2.25–3.78 | <0.001 | 1253 (93.0) | 0.95 |        |   |
| **Frequency of physical examination** |        |    |        |   |        |    |        |   |
| <1               | 121 (3.4) | Ref. |        |   | 3297 (93.1) | Ref. |        |   |
| ≥1               | 121 (8.0) | 2.47 | 1.91–3.20 | <0.001 | 1381 (91.8) | 1.22 | 0.97–1.53 | 0.09 |
| **Smoke**        |        |    |        |   |        |    |        |   |
| No               | 213 (5.2) | 1.75 | 1.18–2.59 | 0.006 | 3806 (93.0) | 0.82 | 0.64–1.10 | 0.14 |
| Yes              | 29 (3.0) | 2.47 | 1.91–3.20 | <0.001 | 872 (91.6) | Ref. |        |   |
| **Drink**        |        |    |        |   |        |    |        |   |
| No               | 202 (5.0) | 1.25 | 0.88–1.76 | 0.22 | 3760 (92.7) | 1.00 | 0.77–1.31 | 1.0 |
| Yes              | 40 (4.0) | Ref. |        |   | 918 (92.7) | Ref. |        |   |
| **Exercise**     |        |    |        |   |        |    |        |   |
| No               | 48 (3.9) | Ref. |        |   | 1133 (92.2) | Ref. |        |   |
| Yes              | 194 (5.1) | 1.32 | 0.95–1.82 | 0.09 | 3545 (92.9) | 0.9 | 0.71–1.15 | 0.41 |

OR: odd ratio; CI: confidence interval; Ref., reference. n indicates the numbers for influenza vaccine coverage and willingness of each category. % indicates the influenza coverage rates.