



Article

# Factors Associated with Annual Influenza Vaccination Uptake in U.S. Older Adults from 2019 to 2020

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**Abstract:** Annual influenza vaccination is important for older adults to prevent morbidity and mortality from seasonal influenza. Although the United States has had limited success in increasing influenza vaccination, the rise of the COVID-19 pandemic in 2020 may have changed older adults' approach to vaccination. The objective of this study is to determine factors associated with influenza vaccination in 2019 and 2020 and compare their degree of associations across the two years. Data from the 2019 and 2020 National Health Interview Survey, a nationally representative cross-sectional interview, were collected for variables relating to annual influenza vaccination and possible associated factors. Data were analyzed using chi-square tests and multiple logistic regression. The results show that never having received a vaccination for pneumonia increased the odds of receiving an influenza vaccination by 6.79–7.80 times. Recent specialist care for eye or oral health significantly increased the odds of receiving an influenza vaccination. Being a smoker, identifying as African American, and considering oneself to have excellent overall health were associated with significantly lower odds of receiving a vaccination. Although self-reported feelings of anxiety were not associated with vaccination in 2019, they increased the odds in 2020. Overall, influenza vaccination in older adults may be tied to reliable healthcare access and perceived susceptibility to infectious respiratory diseases.

**Keywords:** infectious disease; influenza; flu; older adults; prevention; public health; vaccination



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## 1. Introduction

Annual vaccination against influenza is particularly important for adults aged 65 and older [1]. Partially because of age-related changes in the immune system, older adults are at higher risk than younger adults for serious complications [1]. The Centers for Disease Control and Prevention (CDC) estimates that between 50% and 70% of seasonal influenza-related hospitalizations occur in adults aged 65 or older, and between 70% and 85% of seasonal influenza-related deaths occur in this age group [1]. The vaccine has been shown to effectively reduce the risk for influenza-related medical visits and hospitalizations, making it the best form of protection for older adults and most other people [1]. The United States government has previously attempted to increase vaccination rates by mandating insurance coverage without co-pay or co-insurance through the Affordable Care Act [2], but despite no costs to patients, vaccination rates remain below the U.S. Department of Health and Human Services 2020 Healthy People goal of 70% for the overall U.S. population [3]. In the 2017–2018 season, approximately 59.6% of adults aged 65 and older received an influenza vaccination, but this number jumped to 68.1% for the 2018–2019 season and 69.8% for the 2019–2020 season [1]. These numbers are closer to the Healthy People benchmark but still leave many older adults exposed to the influenza virus.

Fall and winter 2020 was the first flu season to overlap with the COVID-19 pandemic, and while COVID-19 was the infectious disease of the moment, influenza vaccines were more important than ever for reducing the burden on the American healthcare system [3]. However, concerns remained that goals for increased and more equitable vaccination

would fall flat as they have in years past, citing longstanding apathy and opposition [3]. Additionally, vaccine misinformation was already circulating in 2020 to deter people from recommended influenza inoculations [3]. To counter these issues, local, state, and national efforts began to encourage and facilitate influenza vaccination, even in the limited COVID-19 environment [3].

With the current rise of the Omicron variant of the SARS-CoV-2 virus, the COVID-19 pandemic threatens to remain a major factor in infectious disease care [4]. As of November 2022, over 800,000 U.S. adults aged 65 and over have died of COVID-19, comprising more than 75% of all U.S. COVID-19 deaths [5]. Reducing the spread of influenza via vaccination can continue to alleviate healthcare conditions this year and in the future [4]. Moreover, recent data suggest that the influenza vaccine itself may reduce morbidity and mortality due to COVID-19: patients with a recent influenza vaccination had 7% lower odds of requiring intensive care treatment and 16% lower odds of death from COVID-19 [6]. Understanding if and how vaccination and its socioecological influences changed with the advent of COVID-19 may provide guidance going forward for both influenza and COVID-19 vaccination efforts. For the above listed reasons, this is especially important for older adults, who are similarly vulnerable to COVID-19 [7]. This is an exploratory study of potential influenza vaccination predictors, with an emphasis on health behaviors and the social determinants of health. Our purpose is to determine and compare potential factors associated with influenza vaccination in U.S. older adults using a broad range of sociodemographic and health-related characteristics. We predict that adhering to other recommended health behaviors, such as other vaccinations, preventive care, and abstention from smoking, will be positively associated with vaccination rates, while factors related to systemic barriers to health, such as being a person of color, having a low income and limited education will be negatively associated with vaccination.

## 2. Materials and Methods

### 2.1. Data Source

We retrieved data from the National Health Interview Survey (NHIS), a cross-sectional series of U.S. personal household interviews conducted by the CDC's National Center for Health Statistics [8,9]. The survey covers a comprehensive range of health and sociodemographic variables that range from immunizations, to history of cancer, to food security, among many others [8,9]. The NHIS samples were collected from noninstitutionalized civilians with permanent addresses in all 50 states and the District of Columbia using geographically clustered sampling techniques [8,9]. Data collection was continuous from January to December of each year, and each month's sample was nationally representative [8,9]. Both the 2019 and the 2020 interviews were analyzed and compared. The 2019 wave was primarily conducted through computer-assisted personal interviews with telephone follow-ups [8], while telephone interviews comprised the majority of interviews in 2020 [9]. Throughout 2020, the United States experienced the first, second, and third waves of COVID-19 [10], although no recognized variants had made significant headway in the country by the end of the year [11]. Around 5.7 million doses of COVID-19 vaccines had been distributed by 31 December 2020, across the whole U.S. population [12]. Responses from both years of the NHIS were restricted to individuals aged 65 or older in the sample.

### 2.2. Variables

#### 2.2.1. Dependent Variable

The outcome variable for this study was a "yes" or "no" response to the question, "There are two types of flu vaccinations. One is a shot and the other is a spray, mist, or drop in the nose. During the past 12 months, have you had a flu vaccination?"

#### 2.2.2. Independent Variables

The primary independent variables for this study consisted of a number of survey questions regarding physical, mental, and preventive health. Variables were limited to

those consistently included and worded between 2019 and 2020 due to changes in the survey between the two years. The interviewees were asked if they had ever received a pneumonia vaccination. They were given a choice of “yes” or “no”, with the question: “A pneumonia shot is also known as a pneumococcal vaccine. Have you ever had a pneumonia shot?” They were also asked whether they had received an eye exam within the past twelve months: “During the past 12 months, have you had an eye exam from an eye specialist such as an optometrist, ophthalmologist, or eye doctor?” The interviewees could answer “yes” or “no.” Another question asked about the length of time since the sample person’s last dental examination or cleaning: “About how long has it been since you last had a dental examination or cleaning?” The responses included within the past year; within the past two, three, five, and ten years; more than ten years ago; and never. A fourth question was “How often do you feel worried, nervous, or anxious? Would you say daily, weekly, monthly, a few times a year, or never?”. The interviewees were also asked about their current and past usage of cigarettes. This variable is based on the questions “Have you smoked at least 100 cigarettes in your entire life?” and “Do you now smoke cigarettes every day, some days or not at all?” The responses were coded into “nonsmoker”; “former smoker”; “current, some-days smoker”; and “current, every-day smoker.” Finally, the interviewees were questioned on their perceived overall health: “Would you say your health in general is excellent, very good, good, fair, or poor?”

This study also controlled for a number of variables representing social and demographic factors. These variables included gender (male or female); disability status (has disability or does not have disability); racial identity (White, Black/African American, Asian, American Indian/Alaskan Native, American Indian/Alaskan Native and any other group, and multiple and/or other races); and Hispanic ethnicity. Education status, categorized as never or only kindergarten; grade 1–11; 12th grade or equivalent (combined from 12th grade no degree, GED or equivalent, or high school graduate); some college with no degree; associate degree (combined from associate degree for occupational, technical, or vocational program and associate degree for academic program); bachelor’s degree; master’s degree; and combined professional and doctoral degrees. Marital status was also recoded into being married or otherwise living with a partner, or neither. Finally, adult family income was analyzed in the ranges of USD 0–34,999; USD 35,000–49,999; USD 50,000–74,999; USD 75,000–99,999; and USD 100,000 or higher.

### 2.3. Analysis Plan

The bivariate analysis consisted of chi-square tests between each health variable and influenza vaccination status. These tests were conducted for both years. All independent variables were placed into multiple logistic regression models, separately for each year, to examine which factors were associated with influenza vaccination. SPSS version 27 was used for all analyses (IBM Corp. Released 2020. IBM SPSS Statistics for Windows, Version 27.0. Armonk, NY, USA: IBM Corp) with two-tailed tests at a 0.05 significance level.

## 3. Results

### 3.1. Descriptive Statistics

The sample characteristics remained similar between 2019 and 2020, as seen in Table 1. More interviewees were women than men, and 17.3–19.5% had a disability. The majority identified as White and about 6% identified as Hispanic. The most common education level was high school graduate, GED, 12th grade without a degree, or another equivalent (27.7–29.0%), and the most common income range was USD 0–34,999 (35.4–38.8%). Approximately 47% were married or lived with a partner.

Annual influenza vaccination rates increased from 71.3% to 73.1% between 2019 and 2020. Around 68.6% to 70.6% had never been vaccinated against pneumonia, and 65.9–72.0% had received an eye exam in the past year. Nearly two thirds of interviewees (66.1–66.8%) had received preventive dental care in the past 12 months. The interviewees most commonly reported never feeling worried, nervous, or anxious (39.0–39.7%); over half (52.3–53.2%)

had never smoked cigarettes, and their general overall health was typically very good (30.2–32.0%) or good (31.9–33.0%).

**Table 1.** National Health Interview Survey sample characteristics.

Characteristics	2019 (n, %)	2020 (n, %)
<b>Demographics</b>		
<b>Gender</b>		
Female	5364 (57.7%)	5791 (57.8%)
Male	3931 (42.3%)	4234 (42.2%)
Has disability	1809 (19.5%)	1732 (17.3%)
<b>Racial identity</b>		
White	7795 (85.7%)	8442 (86.1%)
Black/African American	822 (9.0%)	857 (8.7%)
Asian	309 (3.4%)	323 (3.3%)
American Indian/Alaskan	55 (0.6%)	54 (0.6%)
<b>Native</b>		
American Indian/Alaskan	79 (0.9%)	80 (0.8%)
<b>Native and any other group</b>		
Multiple and/or other races	40 (0.4%)	50 (0.5%)
Hispanic ethnicity	581 (6.3%)	645 (6.4%)
<b>Education status</b>		
None, or less than	46 (0.5%)	31 (0.3%)
than kindergarten		
Grades 1–11	952 (10.3%)	827 (8.3%)
Grade 12 or		
equivalent	2681 (29.0%)	2761 (27.7%)
Some college, no degree	1470 (15.9%)	1606 (16.1%)
Associate degree	1141 (12.3%)	1323 (13.3%)
Bachelor's degree	1690 (18.3%)	1901 (19.0%)
Master's degree	914 (9.9%)	1124 (11.3%)
Professional and/or doctoral degree	345 (3.7%)	408 (4.1%)
Married or living with a partner	4283 (47.3%)	4627 (47.6%)
<b>Family income range</b>		
USD 0 to 34,999	3602 (38.8%)	3549 (35.4%)
USD 35,000 to 49,999	1442 (15.5%)	1572 (15.7%)
USD 50,000 to 74,999	1656 (17.8%)	1858 (18.5%)
USD 75,000 to 99,999	968 (10.4%)	1151 (11.5%)
USD 100,000 or greater	1627 (17.5%)	1895 (18.9%)
<b>Health</b>		
Has received influenza vaccination in past twelve months	6550 (71.3%)	7250 (73.1%)
Has never received pneumonia vaccination	6177 (68.6%)	6847 (70.6%)
Has had an eye exam in the past twelve months	6606 (72.0%)	6524 (65.9%)
<b>Time since last preventive dental care</b>		
Within past twelve months	6082 (66.1%)	6628 (66.8%)
Within past two years	823 (8.9%)	1066 (10.7%)
Within past three years	433 (4.7%)	459 (4.6%)
Within past five years	473 (5.1%)	463 (4.7%)
Within past ten years	444 (4.8%)	415 (4.2%)
More than ten years ago	894 (9.6%)	844 (8.5%)
Never	51 (0.5%)	47 (0.5%)
<b>Frequency of worry, nervousness, and/or anxiety</b>		
Never	3613 (39.7%)	3836 (39.0%)
A few times a year	3210 (35.3%)	3528 (35.9%)
Monthly	694 (7.6%)	785 (8.0%)
Weekly	722 (7.9%)	846 (8.6%)
Daily	864 (9.5%)	832 (8.5%)

**Table 1.** *Cont.*

Characteristics	2019 (n, %)	2020 (n, %)
Cigarette smoking status		
Non-smoker	4739 (52.3%)	5228 (53.2%)
Former smoker	3570 (39.4%)	3803 (38.7%)
Current, some-days smoker	133 (1.5%)	159 (1.6%)
Current, every-day smoker	620 (6.8%)	636 (6.5%)
General health status		
Excellent	1340 (14.4%)	1457 (14.5%)
Very good	2807 (30.2%)	3207 (32.0%)
Good	2969 (31.9%)	3310 (33.0%)
Fair	1555 (16.7%)	1518 (15.2%)
Poor	619 (6.7%)	527 (5.3%)

### 3.2. Bivariate Analysis

All chi-square tests for the health variables were statistically significant, as seen in Table 2. Influenza vaccination rates were higher among those who had never received a pneumonia vaccination than not, both in 2019 ( $\chi^2(1) = 1859.4, p < 0.001$ ) and in 2020 ( $\chi^2(1) = 1802.7, p < 0.001$ ), at 85.2–85.4% compared to 40.8–43.4%. Having an eye exam in the past year also raised influenza vaccination rates from 60.0–63.2% to 75.7–78.2% (2019:  $\chi^2(1) = 221.1, p < 0.001$ ; 2020:  $\chi^2(1) = 256.2, p < 0.001$ ). In 2019 ( $\chi^2(6) = 143.6, p < 0.001$ ) and in 2020 ( $\chi^2(6) = 231.4, p < 0.001$ ), the highest rates of vaccination were among those who had received preventive dental care in the past year (75.3–77.8%); however, the lowest rates in 2019 were in those who had never received preventive dental care (56.5%), and the lowest rates in 2020 were in those who had not received dental care in over ten years (60.3%).

Vaccination rates were similar between the interviewees who reported feeling anxious any amount from a few times a year to daily in both years, but vaccination was lower (69.0–69.5%) among those who said that they never felt anxious (2019:  $\chi^2(4) = 17.7, p = 0.001$ ; 2020:  $\chi^2(4) = 42.5, p < 0.001$ ). In 2019, influenza vaccination rates were highest among former smokers (74.2%) and lowest among current, some-days smokers (53.8%;  $\chi^2(3) = 91.2, p < 0.001$ ). In 2020, former smokers once again had the highest rates (75.7%), but current, every-day smokers had the lowest rates (52.4%;  $\chi^2(3) = 174.6, p < 0.001$ ). In terms of general health status, vaccination was the highest among those who rated their health as fair (73.2%) and lowest among those who rated it as excellent (65.9%) in 2019 ( $\chi^2(4) = 23.9, p < 0.001$ ). The next year, vaccination remained lowest among those with excellent health, (69.1%), but it was highest among those with very good health (75.2%;  $\chi^2(4) = 22.7, p < 0.001$ ).

### 3.3. Multiple Logistic Regression

#### 3.3.1. Health Factors

Odds ratios (OR) and their 95% confidence intervals (95% CI) were determined with multiple logistic regression, as shown in Table 3. The regression model was statistically significant ( $\chi^2(39) = 1948.1, p < 0.001$ ) and correctly classified 73.3% of the observations, indicating good model fit. No variable had a variance inflation factor (VIF) greater than ten, and the average VIF was approximately one; thus, there was no evidence for multicollinearity.

For both 2019 and 2020, pneumonia vaccination had the highest magnitude for odds of influenza vaccination when controlling for all other factors. In 2019, the odds ratio was 7.69 (95% CI: 6.88–8.58) and in 2020, it was 6.80 (95% CI: 6.10–7.58). Although these odds decreased in 2020, the change was not significant. Having an eye exam in the past twelve months also significantly increased older adults’ odds of influenza vaccination when controlling for all other factors. These values were similar for both 2019 (OR: 1.50, 95% CI: 1.33–1.68) and 2020 (OR: 1.49, 95% CI: 1.34–1.67). The time interval since the last time of preventive dental care was significant for some categories when controlled: in 2019, those who had last received dental care more than two years ago were significantly less likely to have recently received an influenza vaccination than an older adult who had received

dental care within the prior twelve months. In 2020, those who had received preventive dental care previously but not the past year had significantly lower vaccination rates than those who had received dental care over the past year. The differences between the years were not significant.

**Table 2.** Comparison of vaccinated and not vaccinated groups stratified by year.

Variable	2019 ( $\chi^2$ , <i>p</i> )		2020 ( $\chi^2$ , <i>p</i> )	
	Vaccinated (n, %)	Not Vaccinated (n, %)	Vaccinated (n, %)	Not Vaccinated (n, %)
Has never received pneumonia vaccination	$\chi^2(1) = 1859.4$ , <i>p</i> < 0.001		$\chi^2(1) = 1802.7$ , <i>p</i> < 0.001	
Yes	5255 (85.2%)	916 (14.8%)	5836 (85.4%)	1000 (14.6%)
No	1153 (40.8%)	1672 (59.2%)	1237 (43.4%)	1616 (56.6%)
Has had an eye exam in the past twelve months	$\chi^2(1) = 221.1$ , <i>p</i> < 0.001		$\chi^2(1) = 256.2$ , <i>p</i> < 0.001	
Yes	4993 (75.7%)	1605 (24.3%)	5094 (78.2%)	1416 (21.8%)
No	1535 (60.0%)	1023 (40.0%)	2122 (63.2%)	1237 (36.8%)
Time since last preventive dental care visit	$\chi^2(6) = 143.6$ , <i>p</i> < 0.001		$\chi^2(6) = 231.4$ , <i>p</i> < 0.001	
Within the past 12 months	4552 (75.3%)	1491 (24.7%)	5131 (77.8%)	1460 (22.2%)
Within the past two years	542 (66.3%)	276 (33.7%)	708 (67.0%)	349 (33.0%)
Within the past three years	270 (62.9%)	159 (37.1%)	292 (64.2%)	163 (35.8%)
Within the past five years	295 (62.8%)	175 (37.2%)	293 (63.6%)	168 (36.4%)
Within the past ten years	283 (64.3%)	157 (35.7%)	257 (62.4%)	155 (37.6%)
More than ten years ago	546 (61.8%)	337 (38.2%)	503 (60.3%)	331 (39.7%)
Never	26 (56.5%)	20 (43.5%)	30 (63.8%)	17 (36.2%)
Frequency of worry, nervousness, and/or anxiety	$\chi^2(4) = 17.7$ , <i>p</i> = 0.001		$\chi^2(4) = 42.5$ , <i>p</i> < 0.001	
Never	2491 (69.0%)	1119 (31.0%)	2660 (69.5%)	1165 (30.5%)
A few times a year	2327 (72.6%)	877 (27.4%)	2642 (75.0%)	880 (25.0%)
Monthly	517 (74.6%)	176 (25.4%)	600 (76.6%)	183 (23.4%)
Weekly	523 (73.1%)	232 (26.9%)	646 (76.7%)	196 (23.3%)
Daily	629 (73.1%)	232 (26.9%)	616 (74.4%)	212 (25.6%)
Cigarette smoking status	$\chi^2(3) = 91.2$ , <i>p</i> < 0.001		$\chi^2(3) = 174.6$ , <i>p</i> < 0.001	
Non-smoker	3378 (71.5%)	1349 (28.5%)	3870 (74.2%)	1344 (25.8%)
Former smoker	2646 (74.2%)	920 (25.8%)	2872 (75.7%)	923 (24.3%)
Current, some-days smoker	71 (53.8%)	61 (46.2%)	91 (57.6%)	67 (42.4%)
Current, every-day smoker	356 (57.6%)	262 (42.4%)	333 (52.4%)	303 (47.6%)
General health status	$\chi^2(4) = 23.9$ , <i>p</i> < 0.001		$\chi^2(4) = 22.7$ , <i>p</i> < 0.001	
Excellent	871 (65.9%)	451 (34.1%)	998 (69.1%)	447 (30.9%)
Very good	2015 (72.4%)	769 (27.6%)	2392 (75.2%)	787 (24.8%)
Good	2111 (71.9%)	825 (28.1%)	2420 (73.8%)	859 (26.2%)
Fair	1123 (73.2%)	411 (26.8%)	1068 (71.7%)	422 (28.3%)
Poor	429 (70.7%)	178 (29.3%)	366 (71.3%)	148 (28.8%)

**Table 3.** Multiple logistic regression of factors associated with influenza vaccination stratified by year.

Factor	2019 OR (95% CI)	2020 OR (95% CI)
Has never received a pneumonia vaccination	7.69 (6.88–8.58) *	6.80 (6.10–7.58) *
Has had an eye exam in the past twelve months	1.50 (1.33–1.68) *	1.49 (1.34–1.67) *
Time since last preventive dental care visit		
Within past twelve months	Reference	Reference
Within past two years	0.89 (0.73–1.08)	0.72 (0.61–0.85) *
Within past three years	0.73 (0.56–0.93) *	0.73 (0.57–0.93) *
Within past five years	0.73 (0.57–0.93) *	0.68 (0.54–0.87) *
Within past ten years	0.73 (0.57–0.94) *	0.71 (0.55–0.93) *
More than ten years ago	0.66 (0.54–0.79) *	0.61 (0.51–0.74) *
Never	0.85 (0.42–1.73)	1.54 (0.68–3.50)
Frequency of worry, nervousness, and/or anxiety		
Never	Reference	Reference
A few times a year	1.05 (0.93–1.19)	1.14 (1.01–1.29) *
Monthly	0.97 (0.69–1.36)	1.30 (1.05–1.61) *
Weekly	1.00 (0.74–1.35)	1.28 (1.03–1.58) *
Daily	0.85 (0.64–1.13)	1.23 (1.00–1.52)
Cigarette smoking status		
Non-smoker	Reference	Reference
Former smoker	1.10 (0.98–1.24)	1.00 (0.89–1.12)
Current, some-days smoker	0.64 (0.43–0.97) *	0.63 (0.43–0.94) *
Current, every-day smoker	0.67 (0.55–0.83) *	0.49 (0.40–0.61) *
General health status		
Excellent	Reference	Reference
Very good	1.37 (1.16–1.62) *	1.31 (1.11–1.54) *
Good	1.46 (1.23–1.74) *	1.39 (1.18–1.64) *
Fair	1.59 (1.29–1.96) *	1.39 (1.13–1.71) *
Poor	1.45 (1.08–1.92) *	1.33 (0.99–1.79)
Female	0.93 (0.83–1.04)	1.06 (0.95–1.19)
Has disability	1.03 (0.88–1.21)	0.95 (0.81–1.11)
Racial identity		
White	Reference	Reference
Black/African American	0.74 (0.62–0.89) *	0.71 (0.60–0.85) *
Asian	1.66 (1.21–2.28) *	1.17 (0.87–1.58)
American Indian/Alaskan Native	0.74 (0.38–1.44)	0.77 (0.40–1.50)
American Indian/Alaskan Native and any other group	0.66 (0.39–1.13)	1.11 (0.62–2.00)
Multiple and/or other races	1.37 (0.60–3.11)	1.00 (0.48–2.07)
Hispanic ethnicity	1.07 (0.83–1.39)	0.85 (0.66–1.09)
Married or living with a partner	1.08 (0.96–1.22)	1.02 (0.91–1.15)
Education		
None or kindergarten only	Reference	Reference
Grade 1–11	0.95 (0.41–2.20)	0.34 (0.09–1.28)
Grade 12 or equivalent	0.80 (0.35–1.83)	0.31 (0.08–1.19)
Some college, no degree	0.82 (0.36–1.89)	0.29 (0.07–1.10)
Associate degree	0.83 (0.36–1.93)	0.28 (0.07–1.08)
Bachelor’s degree	0.91 (0.40–2.10)	0.32 (0.08–1.21)
Master’s degree	0.91 (0.39–2.13)	0.41 (0.11–1.59)
Professional and/or doctoral degree	1.20 (0.50–2.90)	0.48 (0.12–1.89)
Income group		
USD 0–34,999	Reference	Reference
USD 35,000–49,999	1.02 (0.86–1.20)	1.16 (0.98–1.37)
USD 50,000–74,999	0.95 (0.80–1.12)	1.15 (0.98–1.35)
USD 75,000–99,999	1.03 (0.84–1.27)	1.27 (1.04–1.55) *
USD 100,000 or more	1.25 (1.02–1.52) *	1.26 (1.05–1.52) *

\* Denotes statistically significant with  $p < 0.05$ .

Feelings of anxiety were not significantly associated with influenza vaccination at any frequency in 2019 when controlled for all other factors. However, older adults were more likely to be vaccinated in 2020 when they felt anxiety a few times a year (OR: 1.14, 95% CI: 1.01–1.29), on a monthly basis (OR: 1.30, 95% CI: 1.05–1.61), and on a weekly basis (OR: 1.28, 95% CI: 1.03–1.58); however, these changes were not significant when compared between 2019 and 2020. Meanwhile, current smokers were significantly less likely to be vaccinated than non-smokers when other factors were controlled. These odds ratios were 0.64 (95% CI: 0.43–0.97) for some-days smokers and 0.67 (95% CI: 0.55–0.83) for every-day smokers in 2019, and they were 0.63 (95% CI: 0.43–0.94) for some-days smokers and 0.49 (95% CI: 0.40–0.61) for every-day smokers in 2020. There was no significant difference between the years for any category. Older adults who did not report excellent general health were more likely to vaccinate than those who did, with all other factors controlled. This was true for very good, good, fair, and poor health in 2019, and true for very good, good, and fair health in 2020. Poor health was no longer a significant variable in 2020.

### 3.3.2. Sociodemographic Factors

Black or African American older adults had significantly lower odds of influenza vaccination than White older adults both in 2019 (OR: 0.74, 95% CI: 0.62–0.89) and in 2020 (OR: 0.71, 95% CI: 0.60–0.85) when all other factors were controlled. Asian older adults had significantly higher odds in 2019 (OR: 1.66, 95% CI: 1.21–2.28) but not 2020. American Indians, Alaskan Natives, and older adults of other or mixed ancestry did not have significantly different odds compared to White older adults in either year. Neither having a disability nor being female were significant variables in either year, nor were Hispanic ethnicity or marital status. None of the categories for either education status or income group were significant.

## 4. Discussion

This study revealed a significant and sizeable association between prior pneumonia vaccination and annual influenza inoculation in adults aged 65 and over. For older adults who are capable and willing to receive one vaccine, they may be able to receive later and regular vaccinations. While individuals already motivated and able to be vaccinated are rarely the targets of campaigns to expand vaccination, retaining prior influenza vaccine recipients is still an important issue as vaccine misinformation continues to circulate and as individuals age. Due to the association in uptake rates between different types of vaccines, these results may also have implications for concurrent COVID-19 vaccination efforts.

The study results also found that recent specialist care—in this case eye and dental care—increased older adults' odds of receiving vaccination. As with prior vaccination, this association may be due more to other confounding factors such as healthcare access, quality of care, and health literacy [13,14]. However, more research might determine that providers who may not directly work with influenza do in fact have influence over their patients' decisions to be vaccinated. If this is the case, expanded messaging for vaccination in all healthcare settings could increase overall uptake.

Some factors, however, were more associated with decreased odds of vaccination. In both 2019 and 2020, Black and African American older adults had significantly lower odds of receiving a vaccination. This finding is supported by other work, which has found influenza vaccination rates as low as 49% in underserved African American older adults [13,14]. Despite the higher rates of influenza morbidity among this demographic, under-vaccination persists due to unequal primary care access and, consequently, worse vaccine education [13]. Vaccination campaigns for influenza and other diseases must continue to work to build trust with Black and African American older adults in order to reduce vaccine hesitancy, as should they advocate for more equitable healthcare access overall.

Lower vaccination odds were found in current smokers as well. Prior studies on influenza vaccination and smoking have found both positive and negative associations, but the above results are supported by other work [15]. This association with smoking

may be due to lessened concerns for one's own health or with less access to health information [15]. Additionally, the decrease in influenza vaccination rates for current, every-day smokers between 2019 and 2020 was notable, if not significant, and healthcare professionals may wish to consider smoking status as a potential predictor of patient acceptance when administering vaccines from this time onwards.

Finally, two of the more subjective measures from the study did have significant associations with influenza vaccination rates. Reporting excellent health decreased one's odds of having received a vaccine for both years, as did claiming to have never experienced worry, nervousness, or anxiety in 2020. The former result, which has precedence [14,16,17], may be due to less regular healthcare exposure or to beliefs that someone in excellent health does not need the vaccine's protection. The latter has been found to be the most common reason for influenza vaccine non-compliance in some samples of older adults [18]. Meanwhile, 2020 saw the rise of COVID-19-related anxiety across the globe, and individuals who perceived themselves to be at greater risk for COVID-19, especially older adults, were more likely to have COVID-19-related anxiety [19]. Evidence suggests that increased COVID-19-related anxiety translates to greater vaccine acceptance [20]. With the COVID-19 vaccine still in development and production for much of 2020, this vaccine acceptance may have transferred to available vaccines instead, such as that for influenza, potentially explaining anxiety as a newly significant factor associated with influenza vaccination. Future research can compare the 2020 findings with those of 2021 and 2022 when the COVID-19 and influenza vaccines coexist, and it can explore how perceived susceptibility affects both.

The limitations for this study include the cross-sectional nature of the NHIS data, which prevents longitudinal analysis. The NHIS, while invaluable in its breadth, was not specifically designed for vaccination-related research either, and difficulties conducting interviews in 2020 further limited the variables that were available and relevant for this study. Finally, most factors were self-reported, leading to potential bias; the health-related variables may not necessarily match the individual's medical history. Despite these limitations, our study analyzes data from a large, nationally representative sample size of older adults. Consequently, the results from this study are more likely to be generalizable to the broader civilian, non-institutionalized U.S. older adult population.

## 5. Conclusions

Following the outbreak of COVID-19, preventing the spread of infectious disease is as important as ever for older adults. Annual influenza vaccination is one critical way to reduce respiratory diseases, but vaccination campaigns in the United States have consistently failed to achieve national goals. Additionally, vaccine hesitancy has gained ground in the American imagination due to the political controversies surrounding COVID-19. This study investigated factors associated with influenza vaccination in 2019 before COVID-19 reached the United States and in 2020 after its arrival, using a large national survey of adults aged 65 and older. For the most part, the factors associated with vaccination did not change. Never having received a pneumonia vaccine significantly increased the odds of influenza vaccination in both years, as did receiving preventive eye care and preventive dental care within the past twelve months. In 2019 and in 2020, being a current smoker, African American or Black, or of excellent health predicted significantly lower odds of influenza vaccination. One factor did change, however, with self-reported anxiety becoming a positive predictor of vaccination in 2020, despite not being associated with it in 2019. Although this change may demonstrate greater awareness of the dangers of infectious diseases in the COVID-19 era, pre-existing factors would appear to still dominate the influenza vaccination landscape.

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**Data Availability Statement:** The data used in this study are publicly accessible: <https://www.cdc.gov/nchs/nhis/2019nhis.htm> (accessed on 5 November 2021); <https://www.cdc.gov/nchs/nhis/2020nhis.htm> (accessed on 5 November 2021).

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