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Human Vaccines & Immunotherapeutics

ISSN: 2164-5515 (Print) 2164-554X (Online) Journal homepage: www.tandfonline.com/journals/khvi20

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To cite this article: Mohsen Saffari , Mei-Dan Lai , Jiajia Ye , Mark D. Griffiths , Servet Üztemur , Musheer A. Aljaberi , Po-Ching Huang & Chung-Ying Lin (2026) Investigating how sociodemographic factors and vaccination attitudes explain awareness, experience, and willingness toward COVID-19 and influenza vaccination among Taiwan residents, Human Vaccines & Immunotherapeutics, 22:1, 2609360, DOI: 10.1080/21645515.2025.2609360

To link to this article: https://doi.org/10.1080/21645515.2025.2609360

HUMAN VACCINES & IMMUNOTHERAPEUTICS
2026, VOL. 22, NO. 1, 2609360
https://doi.org/10.1080/21645515.2025.2609360

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RESEARCH ARTICLE

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Investigating how sociodemographic factors and vaccination attitudes explain awareness, experience, and willingness toward COVID-19 and influenza vaccination among Taiwan residents

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ABSTRACT

Sociodemographic factors and individual attitudes may influence individuals' decisions for vaccination against infectious diseases. The present study aimed to identify how these factors were associated with COVID-19 and influenza vaccination experiences among Taiwanese individuals. Using a cross-sectional design, 914 individuals (female = 58%; aged 50 years or above = 43.1%) completed an online survey between October and November 2024. Chi-squares and odds ratios (ORs) derived from logistic regression were used to examine the associations and perform predictive analysis. Results showed that 54% were undecided (those who answered 'not sure') or reluctant (those who answered 'no') about receiving a COVID-19 booster vaccine, while 65% were willing to get the next influenza vaccine. Factors such as age, employment, and education were significantly associated with awareness and experience for both types of vaccination. Older people had a higher awareness of the vaccination and were more likely to receive the vaccines. Individuals who worked in health-related settings or had an education in a related field, along with those with higher education, showed increased awareness and experience of vaccination. After controlling for sociodemographic factors, attitude (i.e., vaccination readiness and conspiracy belief) predicted vaccination willingness for both vaccines (pseudo-R^2 = 0.28–0.33). Moreover, factors such as age, education, occupation, and attitudes (readiness, conspiracy beliefs) may be associated with awareness, experience, and willingness to receive COVID-19 and influenza vaccines among Taiwanese individuals. Developing awareness programs for younger and less educated people, and those who work in non-health-related sectors, may be helpful to encourage individuals to get vaccinated.

ARTICLE HISTORY
Received 10 September 2025
Revised 12 December 2025
Accepted 21 December 2025

KEYWORDS
Awareness; coronavirus disease 2019; influenza; vaccination; willingness; conspiracy belief; readiness

Introduction

One of the most effective strategies that finally controlled the COVID-19 pandemic was vaccination. Vaccines such as *Pfizer-BioNTech COVID-19*, *Moderna*, *AstraZeneca*, and *Sinovac* have been authorized

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Supplemental data for this article can be accessed online at https://doi.org/10.1080/21645515.2025.2609360

and distributed worldwide.[1–3] However, the speed for developing and distributing the first vaccines against the disease raised some concerns regarding the safety of the produced vaccines. Moreover, the evolution of the virus through various mutations and observed cases of reinfections, particularly among vaccinated individuals, further heightened public doubts about the effectiveness of available vaccines.[4]

Influenza is another infectious disease that generally causes respiratory symptoms and annually infects nearly one billion individuals and may account for 300,000 to 650,000 deaths worldwide.[5] Vaccination against the disease may effectively provide protection against severe illnesses related to influenza and notably reduce the economic burden of disease in healthcare systems by decreasing the number of individuals who may need hospitalization, outpatient, or intensive care.[6] Studies have shown that if influenza vaccination rates reach 40% at a national level, it is an effective way to prevent the disease from becoming an epidemic.[7]

According to the World Health Organization (WHO), receiving the influenza vaccine before the influenza season may help prevent COVID-19 and influenza overlapping (the so-called 'twindemic'). The cooccurence of these infectious diseases may overwhelm individuals' capacity for recovery and cause a serious overload on healthcare systems.[8] Therefore, designing strategies to increase vaccination coverage for both diseases, particularly when there is an increased risk of their co-occurrence, is an important public health goal that may require new approaches to better understand population attitudes and behaviors toward such vaccines.

A systematic review found varying acceptance rates for COVID-19 vaccination across countries.[9] The highest vaccine uptake rates were for countries such as Ecuador, Malaysia, and China (greater than 90%), while countries such as Kuwait and Jordan had the lowest vaccine uptake rates (less than 30%). Meanwhile, developed countries such as Italy, Russia, the United States, and France had an average rate of 50%-60%. This review demonstrated that COVID-19 vaccine uptake varies across countries worldwide and that factors such as access to vaccines, perceived susceptibility to the disease, vaccine safety, and disease severity may influence vaccine uptake.[9] In another survey, despite warnings of a twindemic, the rate of taking influenza vaccines provided for free through the government in South Korea reduced from 73% to 64% between 2019 and 2020, while the COVID-19 pandemic was in its primary stages.[10] Other studies have also demonstrated the significant roles of variables such as age, sex, income, education, and occupation as the most important sociodemographic factors that may affect individual attitudes toward COVID-19/influenza vaccination.[11,12] For influenza vaccination, factors such as risk perception, severity of being affected, benefits and side effects of vaccines, individual knowledge of the disease process, trust in developers and authorities, and demographic factors have also been recognized as effective in decision-making regarding vaccination uptake.[13,14] These suggest hesitancy to get vaccinated may be related to a wide range of factors, from sociodemographic variables to concerns regarding the efficacy and safety of developed vaccines.

According to the WHO, vaccine hesitancy, as a delay in getting vaccinated or being uninterested in getting vaccinated, was a serious threat, particularly during the COVID-19 pandemic, and willingness to get vaccinated varied by country based on different socio-cultural variables.[15] This problem is a complex and context-based issue that may differ across time, setting, and type of vaccines. More frequent reasons for COVID-19 vaccine hesitancy include feeling that the risks of getting vaccinated outweigh the benefits, inadequate knowledge and awareness of the severity of the disease and effectiveness of vaccines, and competing religious beliefs.[16,17]

Investigations into vaccine hesitancy and factors that might have influence on individuals' choices and willingness to uptake such vaccines are helpful in identifying factors associated with these issues, particularly among unvaccinated or reluctant populations. Such investigations would also help public health scientists and authorities to find more effective ways to encourage individuals to take necessary vaccines and deliver tailored messages regarding the benefits or likely complications of vaccination.[18] Moreover, convincing vaccine-hesitant individuals to get vaccinated against COVID-19 and influenza via awareness campaign development in promoting vaccination[19] is crucial to decrease levels of virus circulation that may lead to the emergence of new variants and help reach an accelerated herd immunity.

Misinformation and the formation of conspiracy theories have also been negatively associated with the intention of vaccination.[20,21] However, evidence remains insufficient regarding how sociodemographic factors associate with individuals' willingness and awareness of concurrent vaccination against these two diseases. Moreover, the role of cultural differences among different nations has

also been less investigated. Therefore, there is a need for studies to identify likely factors in different regions and countries, especially crowded regions (e.g., East Asian countries), that may influence individuals' intention to get vaccinated against such diseases. To address the aforementioned literature gap, the present exploratory study examined how sociodemographic factors and personal attitudes among the Taiwanese population (i.e., a densely populated region in East Asia) affect their awareness, experiences, and willingness to receive vaccines against COVID-19 and influenza.

Methods

Participants and procedures

The present cross-sectional study employed convenience and snowball sampling methods to recruit participants. More specifically, the researchers first sent the online survey hosted on *SurveyMonkey* to their acquaintances via e-mails (the e-mail recipients were university students, and they were encouraged to send the link to their family members) and posted this information on social media (e.g., *Facebook* across different webpages, including hospital, university, and community clubs) to promote data collection. In the e-mail and social media posts, the researchers encouraged individuals to forward the online survey to their friends. The *SurveyMonkey* platform automatically restricted each device to a single entry. In addition, data screening identified and removed potential duplicates based on matching e-mail addresses and device identifiers. A total of 1063 participants initially completed the survey. Data were screened for (i) completeness of required items and (ii) eligibility criteria, including residence in Taiwan, absence of uniform responses across items, and no more than one failed attention check.

The survey took place between October and November 2024, when the Taiwan government-funded COVID-19 and influenza vaccination programs had just been announced in multiple ways, such as through flyers, press releases, and doctors in their clinics. In addition, Taiwan adopted a universal government-funded COVID-19 vaccination program in 2024–25 (i.e., everyone was eligible for a free vaccine), while the influenza vaccination program set out risk-based eligibility criteria for the limited supply of vaccines as in previous years.

Eligibility criteria included (i) living in Taiwan during the survey period, (ii) having the ability to read traditional Chinese characters, and (iii) being aged 18 years or older (because 18 years is the legal age of adulthood in Taiwan and individuals can decide their own vaccination willingness at this age). Participants were excluded if they had (i) a confirmed diagnosis of cognitive impairment or (ii) any physiological conditions that were not suitable for vaccination. More specifically, following the national immunization guidelines and manufacturer labeling for both influenza vaccines and Spikevax (mRNA-1273), participants were considered not suitable for vaccination if they had: (i) a history of severe allergic reaction (including anaphylaxis) to any active ingredients or excipients of the vaccine; (ii) experienced a severe adverse reaction following a previous dose of the same vaccine (e.g., prior anaphylaxis to Spikevax or influenza vaccine); or (iii) been previously evaluated by a physician as medically unsuitable for vaccination.

The present study was conducted in accordance with the Declaration of Helsinki. An online survey was created using *SurveyMonkey*, with informed consent presented on the first page before the survey began. By clicking 'yes,' participants indicated their consent to participate and were able to proceed with the survey session. By clicking 'no,' the survey directly ended and could not be further accessed. Participants who completed the survey received 100 New Taiwan Dollars (approximately $3.30 [US]) as compensation. The study protocol was approved by the National Cheng Kung University Human Research Ethics Committee (approval no.: NCKU HREC-E-113–621-2).

Measures

Demographics

Participants' baseline characteristics, including sex, age, employment status, education level, and region of residence, were collected. In addition, self-designed scales were conducted to assess the participants'

vaccination awareness, experience, and willingness. (Please see supplementary material for all the measures used.)

COVID-19 Vaccination Readiness Scale (CVRS) and Influenza Vaccination Readiness Scale (IVRS)

The CVRS and IVRS were used to assess individuals' readiness to get vaccinated against COVID-19 and influenza, respectively. Originally translated from the 7Cs of the Vaccination Readiness Scale,[22] both the CVRS and IVRS comprise seven constructs, each containing three items, resulting in a total of 21 items. Responses are rated on a 7-point Likert-like scale (1 = completely disagree, 7 = completely agree), yielding total scores ranging from 21 to 147. Higher scores indicate higher readiness for a particular vaccination. A sample item is "*I make sure to receive the COVID-19/influenza vaccinations in good time.*" The psychometric properties of both scales have been found to be satisfactory in prior studies.[22–24] The internal consistency of the scales in the present study was good (Cronbach's alpha [α] = 0.87 for CVRS and 0.87 for IVRS).

COVID-19 Conspiracy Beliefs Scale (CCBS) and Influenza Conspiracy Beliefs Scale (ICBS)

The CCBS and ICBS were used to assess the extent to which individuals endorse conspiracy-related beliefs about COVID-19 and influenza, respectively. Consisting of two constructs, both the CCBS and ICBS have 13 items rated on a 5-point Likert-like scale (1 = completely disagree, 5 = completely agree), yielding total scores ranging from 13 to 65. Higher scores indicate higher conspiracy beliefs toward the particular vaccination. A sample item is "*In my opinion, COVID-19/influenza is a myth that forces people to vaccinate.*" Psychometric properties of both scales have been found satisfactory in prior studies.[22,25] The internal consistency of the scales in the present study was excellent (α = 0.93 for CCBS and 0.96 for ICBS).

Statistical analysis

Baseline characteristics and responses to the self-designed survey were summarized using descriptive analysis. Chi-square tests were conducted to examine whether there were significant differences in vaccine awareness and vaccination experience across demographic subgroups. Subgroup analyses by age group were additionally conducted and compared with nationally reported COVID-19 XBB booster rates. After identifying significant demographic variables (i.e., age, education, and employment), two logistic regression analyses were conducted to examine (i) the associations of demographic variables with awareness of vaccination eligibility and vaccination experience for both COVID-19 and influenza, and (ii) whether demographic variables associated with vaccination readiness and conspiracy beliefs with vaccination willingness. In the logistic regression analyses, age, sex, education, employment, residence, awareness of eligibility, and prior vaccination experience were controlled for because they are potential confounding variables indicated in the literature.[26–29] Odds ratios (ORs) and 95% confidence intervals (CIs) are reported, with statistical significance determined when the 95% CI did not include 1. Pseudo-R^2 was additionally reported in the second logistic regression model to evaluate model fit and to compare the relative explanatory power of models with and without demographic confounders. Pseudo-R^2 ranging between 0.2 and 0.4 is considered indicative of good model fit in logistic regression,[30] with higher values suggesting better predictive power. Multicollinearity of the predictors included in the logistic regression models were checked using adjusted Generalized Variance Inflation Factor (GVIF). The adjusted GVIF values ranged from 1.03 to 1.22, well below the conventional threshold of 2.0, indicating no multicollinearity concerns. All analyses were conducted using *R* software (version 4.4.3), with the significance level set at *a p-level* lower than 0.05.

Results

After excluding 149 invalid responses (117 incomplete, four duplicates, two living outside Taiwan, four uniform responses, and 22 with more than one failed attention check), 914 valid questionnaires were retained, yielding a completion rate of 86.0% (914/1,063). Table 1 presents the baseline characteristics of participants (N = 914), who were predominantly female (n = 536, 58.6%) and aged between 50 and 59 years (n = 259, 28.3%). Most of them worked in commerce or industry fields

Table 1. Participants' characteristics (N = 914).

Variable	n (%)
Sex	
Female	536 (58.6%)
Male	378 (41.4%)
Age (in years)	
18–29	173 (18.9%)
30–39	208 (22.8%)
40–49	138 (15.1%)
50–59	259 (28.3%)
60–64	79 (8.6%)
Over 65	57 (6.2%)
Employment	
Student	47 (5.1%)
Healthcare worker	122 (13.4%)
Public health-related	30 (3.3%)
Education-related	88 (9.6%)
Commerce or industry	282 (30.9%)
Service sector	154 (16.9%)
Homemaker	58 (6.4%)
Retired	63 (6.9%)
Others	70 (7.7%)
Education	
Junior high school or below	28 (3.1%)
Senior high school or vocational school	79 (8.6%)
Associate degree	101 (11.1%)
Undergraduate degree	465 (50.1%)
Postgraduate degree	241 (26.4%)
Residence	
Northern Taiwan	390 (42.7%)
Central Taiwan	158 (17.3%)
Southern Taiwan	331 (36.2%)
Eastern Taiwan and outlying islands	35 (3.8%)

Table 2. Results of a self-designed survey in assessing vaccination awareness, experience, and willingness (N = 914).

Item	n (%)
Were clear about the eligibility for government-funded COVID-19 vaccination	
Yes	767 (83.9%)
Not sure	147 (16.1%)
Were clear about the eligibility for government-funded influenza vaccination	
Yes	730 (79.9%)
Not sure	184 (20.1%)
Received at least one dose of a COVID-19 booster between October 1, 2023, and September 30, 2024.	
Yes	515 (56.4%)
No/Not sure	399 (43.7%)
Received at least one dose of an influenza vaccination between October 1, 2023, and September 30, 2024	
Yes	507 (55.5%)
No/Not sure	407 (44.5%)
Willingness to receive a new COVID-19 vaccine if available	
Yes	419 (45.8%)
No/Not sure	495 (54.2%)
Willingness to receive a new influenza vaccination if available	
Willingness to receive it through the government-funded vaccination program.	590 (64.6%)
Willingness to pay for influenza vaccination if not eligible for free vaccination	79 (8.6%)
No/Not sure	245 (26.8%)

(n = 282, 30.9%), held an undergraduate degree (n = 465, 50.1%), and resided in the northern part of Taiwan (n = 390, 42.7%). Their responses to the self-designed questionnaire are listed in Table 2. In brief, most of the participants were aware of their eligibility for government-funded vaccination (n = 767 [83.9%], for the COVID-19 vaccine, and n = 730 [79.9%], for the influenza vaccine) and had received at least one vaccination (n = 515 [56.4%], for COVID-19 booster, and n = 507 [55.5%] for influenza vaccination) within the year prior to the study (i.e., October 1, 2023, and September 30, 2024). However, more than half of participants reported refusing or being uncertain about the future COVID-19 booster vaccination (n = 495, 54.2%), yet were more willing to be vaccinated in the future for influenza (n = 590, 64.6%).

Table 3. Age-specific comparison of COVID-19 booster coverage and influenza vaccination coverage between this study and national data.

Age group	Received at least one dose of the COVID-19 booster in the present sample (%)	National COVID-19 XBB booster rate (%)[a]	Received at least one dose of influenza vaccination in the present sample (%)	National influenza vaccination rate (%)[b]
18–29	73 (42.2%)	4.6%	69 (39.9%)	–[c]
30–49	157 (45.2%)	6.9%	133 (38.4%)	–[c]
50–64	243 (71.9%)	10.2%	255 (75.4%)	18.8%
Over 65	42 (73.7%)	21.3%	50 (87.8%)	53.6%

The present sample's data were collected from October and November 2024, with the participants reporting their vaccination condition between 1 October 2023 and 30 September 2024.

[a]Data derived from 26 September 2023 to 30 September 2024 and retrieved from https://www.cdc.gov.tw/Category/Page/9jFXNbCe-sFK9ElmRRi2Og (accessed date: 1 October 2024).

[b]Data derived from 2 October 2023 to 30 September 2024 and retrieved from https://www.cdc.gov.tw/Category/MPage/JNTC9qza3F_rgt9sRHqV2Q (accessed date: 1 October 2024).

[c]No national data.

Compared to national COVID-19 XBB booster and influenza coverage rates, the participants in the present study exhibited a higher overall vaccination coverage (Table 3). However, the age-specific trend remained consistent with national data, showing substantially higher vaccination coverage among older adults and lower coverage among younger groups.

Regarding co-administration of COVID-19 and influenza vaccination (i.e., a policy Taiwan has promoted since 2024–25) in the present sample, only 18.8% (n = 172) received both vaccines during the same visit (i.e., co-administration). However, over two-fifths (n = 391; 42.8%) reported receiving both vaccines, not necessarily on the same visit. Moreover, 44.1% (n = 403) expressed a willingness to receive both vaccines (either at the same visit or separate visits).

Table 4 presents the results of chi-square tests examining the associations between demographic variables and participants' vaccination awareness and experiences. Age, employment status, and education level were significantly associated with awareness of and experiences with COVID-19 and influenza vaccination. Therefore, these three variables were further identified as significant demographic factors for further analysis.

In the first logistic regression model, demographic variables were categorized and included to evaluate their predictive power. The results are presented in Table 5. For age, those aged over 50 years were more likely to report higher awareness of both COVID-19 and influenza vaccination (ORs = 2.88 and 3.83 for those aged 50–59 years; ORs = 22.26 and 41.22 for those aged 60 years or older) and were more likely to have had these vaccinations (ORs = 2.85 and 4.52 for those aged 50–59 years; ORs = 4.69 and 8.03 for those aged 60 years or older).

In addition, both awareness of and experience with influenza vaccination were significantly predicted by employment status. More specifically, those working in healthcare (ORs = 7.15 and 7.23 for influenza awareness and experience), public health-related sectors (ORs = 8.72 and 3.39), and education-related fields (ORs = 2.91 for influenza awareness) were all associated with an increased likelihood. Moreover, vaccination awareness for both vaccines was positively associated with educational level above senior high school. More specifically, those with a postgraduate level of education showed the highest predictive value (ORs = 25.28 and 20.29 for COVID-19 and influenza vaccination), followed by undergraduate degree (ORs = 23.16 and 21.04), associate degree (ORs = 18.74 and 21.20), and senior high or vocational school (ORs = 10.15 and 19.73).

Table 4. Results of Chi-square examining the significance of demographic variables.

	Eligibility for COVID-19 vaccination		Eligibility for influenza vaccination		Experience of COVID-19 vaccination		Experience of influenza vaccination	
	χ^2 (df)	*p*	χ^2 (df)	*p*	χ^2 (df)	*p*	χ^2 (df)	*p*
Sex	0.245 (1)	.621	0.162 (1)	.687	0.557 (1)	.455	4.780 (1)	**.029***
Age	18.231 (4)	**.001****	46.526 (4)	**<.001*****	73.289 (4)	**<.001*****	134.591 (4)	**<.001*****
Employment	17.528 (8)	**.025***	54.556 (8)	**<.001*****	31.776 (8)	**<.001*****	98.204 (8)	**<.001*****
Education	37.814 (4)	**<.001*****	34.88 (4)	**<.001*****	32.284 (4)	**<.001*****	41.830 (4)	**<.001*****
Residence	7.307 (3)	.0627	6.00 (3)	.112	11.540 (3)	**.009****	16.147 (3)	**.001****

*$p < .05$; **$p < .01$; ***$p < .001$. Significant results are shown in **bold**.

Table 5. Odds ratio of significant demographic variables on vaccination eligibility awareness and vaccination experience.

	Eligibility for COVID-19 vaccination		Eligibility for influenza vaccination		Experience of COVID-19 vaccination		Experience of influenza vaccination	
	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)	OR	(95% CI)
Age (in years)								
18–29	1	–	1	–	1	–	1	–
30–39	1.00	(0.566, 1.774)	1.28	(0.766, 2.142)	0.99	(0.631, 1.563)	0.88	(0.537, 1.443)
40–49	1.03	(0.547, 1.938)	2.17	**(1.176, 3.990)**	0.98	(0.593, 1.619)	0.80	(0.461, 1.376)
50–59	2.88	**(1.452, 5.715)**	3.83	**(2.048, 7.175)**	2.85	**(1.758, 4.606)**	4.52	**(2.663, 7.665)**
60 years or older	22.26	**(6.193, 79.998)**	41.22	**(10.659, 159.385)**	4.69	**(2.420, 9.104)**	8.03	**(3.874, 16.626)**
Employment								
Student	1	–	1	–	1	–	1	–
Healthcare worker	2.70	(0.908, 8.028)	7.15	**(2.592, 19.739)**	1.58	(0.737, 3.385)	7.24	**(3.112, 16.627)**
Public health-related	4.35	(0.484, 39.105)	8.72	**(1.030, 73.873)**	1.52	(0.537, 4.299)	3.39	**(1.076, 10.646)**
Education-related	0.70	(0.252, 1.966)	2.91	**(1.079, 7.835)**	1.12	(0.491, 2.533)	1.82	(0.761, 4.362)
Commerce and industry	0.98	(0.399, 2.384)	1.14	(0.540, 2.390)	1.46	(0.707, 2.995)	1.15	(0.531, 2.497)
Service sector	0.85	(0.323, 2.211)	1.03	(0.455, 2.320)	1.59	(0.734, 3.453)	1.51	(0.665, 3.448)
Homemaker	0.75	(0.225, 2.471)	0.75	(0.261, 2.127)	1.28	(0.495, 3.310)	0.98	(0.356, 2.696)
Retired	0.28	(0.069, 1.106)	0.87	(0.215, 3.526)	0.90	(0.338, 2.390)	0.88	(0.309, 2.514)
Others	0.70	(0.261, 1.884)	1.09	(0.466, 2.538)	0.67	(0.289, 1.537)	0.37	(0.145, 0.978)
Education								
Junior high school or below	1	–	1	–	1	–	1	–
Senior high school or vocational school	10.15	**(3.467, 29.720)**	19.73	**(5.994, 64.951)**	0.77	(0.230, 2.566)	0.37	(0.078, 1.767)
Associate degree	18.74	**(6.157, 57.043)**	21.20	**(6.583, 68.294)**	0.35	(0.111, 1.124)	0.18	(0.039, 0.824)
Undergraduate degree	23.16	**(8.403, 63.859)**	21.04	**(7.153, 61.913)**	0.48	(0.156, 1.476)	0.24	(0.053, 1.056)
Postgraduate degree	25.28	**(8.689, 73.554)**	20.29	**(6.585, 62.535)**	0.35	(0.112, 1.109)	0.15	(0.032, 0.660)

OR, odds ratio; CI, confidence interval. Significance shown in **bold** was determined when the 95% confidence interval did not include 1.

Table 6. Logistic regression model in analyzing vaccination readiness and conspiracy beliefs on vaccination willingness.

	OR (95% CI)	Pseudo-R^2	OR (95% CI)	Pseudo-R^2
	Unadjusted demographic variables		Adjusted demographic variables	
COVID-19 vaccination readiness	**7.80 (5.78, 10.74)**	0.22	**7.74 (5.44, 11.30)**	0.52
Influenza vaccination readiness	**15.56 (10.47, 23.88)**	0.30	**11.59 (7.43, 18.75)**	0.52
COVID-19 conspiracy beliefs	0.98 (0.97, 1.00)	<0.01	**0.97 (0.96, 0.99)**	0.36
Influenza conspiracy beliefs	0.97 (0.96, 0.99)	0.01	**0.97 (0.96, 0.99)**	0.35

OR, odds ratio; CI, confidence interval. Demographic variables including age, employment status and education level, residence, eligibility, and vaccination history. Significance shown in **bold** was determined when the 95% confidence interval did not include 1.

In the second logistic regression model, demographic variables were controlled for as covariates to examine their influence on the association between vaccination readiness, conspiracy beliefs, and vaccination willingness. The results are presented in Table 6. When assessing the predictive value of vaccination readiness for willingness to be vaccinated for COVID-19 and influenza, both unadjusted (ORs = 7.80 and 15.56) and adjusted (ORs = 7.74 and 11.59) models showed significant associations. The adjusted models showed a better model fit, as indicated by a higher pseudo-R^2 value (0.35–0.52 vs. 0.22–0.30 for adjusted vs. unadjusted models). In contrast, vaccination willingness was predicted by the adjusted logistic regression model (ORs = 0.97 for both COVID-19 and influenza).

Discussion

The present study was carried out to examine how sociodemographic factors and individual attitudes may play a role in explaining the willingness, awareness, and experience of vaccination against two common infectious respiratory diseases (i.e., COVID-19 and influenza) among Taiwanese individuals. Findings showed that although most participants were aware of the availability of the vaccines funded by the government (80%–84%) and had received at least one dose of the vaccine during the past year (55%–56%), more than 50% of participants were uncertain or reluctant to receive booster vaccination against COVID-19 (compared to 65% who said they would get the next dose of influenza vaccine). Nevertheless, comparing the results of this study with those related to national data on COVID-19 booster and influenza coverage rates indicates the participants in the present

study exhibited a higher overall vaccination coverage. This discrepancy likely reflects the online sampling approach, where participants tend to be more health-conscious and more likely to have received a vaccination.

The acceptance and vaccination rates are somewhat comparable to the literature assessing coadministration of COVID-19 and influenza vaccines: Domnich et al.[31] found the acceptance rate of coadministration of COVID-19 and influenza vaccines was 22.9% among 2463 Italians; Hussein et al.[32] found the acceptance rate was 43.3% among 3300 participants from 11 countries in the Eastern Mediterranean Region; and Kwon et al.[33] found the vaccinated rate of coadministration of COVID-19 and influenza vaccines was 10.1% among the Korean population aged 65 years or older (N = 8,086,682).

Age, employment, and education were identified as likely factors associated with willingness and experience regarding vaccination. Further analysis of these factors showed that being older increased the likelihood of higher awareness and willingness toward vaccination, as did working in healthcare settings/public health sectors and having higher education levels. There were also significant associations between vaccination readiness, conspiracy beliefs, and vaccination willingness. Moreover, despite the consistent results between the age-specific trend of vaccination in the present study and national data, it should be considered that younger adults (<50 years) in the present sample may include both those that pay for their own vaccinations and those that are eligible for free vaccinations (e.g., healthcare workers, public health and epidemic prevention personnel, chronic disease patients, and pregnant women).

More specifically, in the present study, age was significantly associated with both awareness and experience of vaccination for COVID-19 and influenza. Older people may perceive themselves as vulnerable to diseases and therefore actively seek information on vaccination to be aware of the eligibility criteria for receiving vaccines. This may also indicate their subsequent readiness and willingness to take these vaccines, as demonstrated in prior studies.[11,13] In a study that was conducted among US older adults, those who are more vulnerable (e.g., with dementia and living in rural areas) were more likely to receive both vaccines. [34]

Indeed, older age remains an important predictor of experience with COVID-19/influenza vaccination: those aged 50 years or older were more likely to accept COVID-19/influenza vaccines, although the magnitudes differed between the two types of vaccines. This finding is consistent with findings from Xhaferi et al.[35] Xhaferi et al.[35] examined the sociodemographic factors related to COVID-19/influenza vaccines among Albanians during 2022–2023.[35] When comparing those aged 45 years or older with those aged 34 years or younger, the adjusted OR was 4.89 in receiving COVID-19 vaccines and 1.59 in receiving influenza vaccines. These findings, consistent with those of the present study, indicated that specific sociodemographic factors may affect an individual's willingness to vaccinate against COVID-19 and influenza. However, it is assumed that sociocultural factors and context may also contribute to identifying different factors in similar studies. Therefore, the magnitudes (i.e., ORs) found in the present study are somewhat different from those reported in the literature.[35]

Music et al. additionally investigated the attitudes and beliefs of older people regarding COVID-19 and influenza vaccines in Canada. They found that safety, trust/mistrust, healthcare experience, and communication about such vaccines were the most important considerations in their decision to vaccinate.[36] Therefore, factors such as a feeling of vulnerability against the disease, along with the trust in safety and efficacy of such vaccines, particularly among the older adults, may play important roles in making decisions on vaccination against these diseases anywhere. This may also indicate that a vaccine which is more well-known and has robust evidence on its safety and effectiveness (such as the influenza vaccine in the present study), compared to newly developed vaccines, may further encourage people to get vaccinated, particularly when it is funded and free of charge. Therefore, the side effects and the less well-recognized process of developing such a new vaccine may have deterred individuals from getting vaccinated.

Regarding the employment status, individuals working in healthcare-related settings showed a greater willingness and awareness to participate in such vaccination programs than others in the present study. For a fatal disease such as COVID-19, especially during the emergence of the disease when the mortality was high and there were no other alternative methods for prevention and treatment, healthcare workers were likely to be involved even in the initial phases of vaccine development.[37] A potential reason to explain the higher acceptance among healthcare workers than those with other types of employment is that better knowledge and higher infection risk increase their willingness to be vaccinated. Indeed, a recent study comparing vaccine acceptance between medical doctors and nurses showed that doctors had higher acceptance than nurses to receive the COVID-19 vaccine.[35]

Caution is needed when interpreting findings in Table 5. As was found, the ORs for vaccination experience were all below 1 and non-significant compared to the low-education reference group (i.e., those with an educational level of junior high school or below), which appears counter-intuitive. Although none of these ORs were significant, some researchers may interpret this as an artifact of model specification. In this regard, future studies are needed to identify if the present findings are accurate.

The present study also found that, after controlling for the confounding effect of sociodemographic variables, readiness for vaccination may predict willingness to receive vaccines. This finding shows that, regardless of a population's sociodemographic characteristics, when they are ready to participate in a COVID-19 and influenza vaccination program, this readiness may eventually translate into a decision to take the vaccines. Another factor that may affect willingness for vaccination is conspiracy beliefs. Indeed, as was found, when individuals face unfounded claims such as vaccines being ineffective, harmful, or even being part of a wider program to affect fertility and population growth, this may negatively impact an individual's decision to get vaccinated and put the community at greater risk of morbidity with preventable diseases. Therefore, as prior studies have also confirmed, any conspiracy theories or suspicious news should be considered as potential risk factors for individuals' readiness to get vaccinated.[11,20] Such influences may further interfere with the decision-making process for involvement and reduce the willingness to receive vaccines. Therefore, developing practical interventions to increase readiness for participation and neutralize unconfirmed beliefs about side effects or likely complications of such vaccines may ultimately increase willingness to vaccinate among the target populations.

Another point that should be addressed is that in the location of the present study (i.e., Taiwan), a government-funded COVID-19 and influenza vaccination program was implemented in 2024. Everyone is eligible for free vaccination against COVID-19, while influenza vaccination programs usually set out risk-based eligibility criteria to get the vaccine. Such a difference is an important piece of information that should be addressed when discussing or comparing the readiness and willingness for participation in vaccination programs. In other words, when a program for both vaccines is available for everyone, the situation would be different from when only limited access to particular vaccines is offered. In such a situation, and when vaccines are free and easily accessible, further readiness and willingness may be observed compared to a limited access situation.[12,38]

Interestingly, perceptions of people regarding their eligibility to receive a vaccine may be somewhat different from their behaviors. More specifically, those who were over 40 years old, with health-related and education-related jobs, and having higher education perceived themselves as eligible people for vaccination, particularly against influenza vaccination. However, higher vaccination rates were observed among those over 50 years old (instead of 40 years old, as shown in perceived eligibility) and in health-related jobs (rather than education-related jobs). Additionally, higher education was not a factor explaining the higher rate of vaccination experience. Therefore, future studies are needed to address the gap between willingness and actual vaccination behavior.

Limitations and strengths

There were some limitations that needed to be addressed. First, the study employed non-probability sampling methods (i.e., convenience and snowball sampling) to recruit participants, which may negatively impact the generalizability of the findings and the sample representativeness. Indeed, most of the sample were social media users, and the findings may not be generalized to those who do not use social media. This may also negatively affect computing the response rate, because there was no information on how many participants saw the survey link and decided not to participate in the study. Second, an online platform (i.e., *SurveyMonkey*) was used to collect data, which, despite its advantages (e.g., reducing social desirability bias and lowering study costs), may exclude potential participants who lack internet access or are less interested in participating in online studies. Third, self-report measures were used to assess participants' viewpoints, and there were no objective measures to increase the credibility of the provided answers. Therefore, the answers may be subject to information bias and/or recall bias. Fourth, a financial incentive was used to motivate individuals to participate in the study. This may have increased the risk of self-selection bias. That is, individuals with a lower level of income to participate may have a higher level of motivation to participate in the survey. Finally, some participant categories, such as those categorized as students within employment status, had relatively small sample sizes, which may have contributed

to the wide CIs observed in the regression estimates. Also, the small number of student participants may cause problems in the imprecise OR.

Despite these limitations, the present study had several strengths, including recruiting a sufficient sample size (n = 914), involving a general population that has been less investigated in this context, applying robust statistical methods to identify potential associations, and using standardized measures to assess the outcomes. The results can be used to inform strategies for specific populations. For example, older adults and less-educated populations may benefit from simplified health communication strategies and community-based outreach programs. Meanwhile, healthcare workers and dual-risk groups may require prioritized access and tailored interventions. Such targeted strategies, informed by the present findings, could contribute to improving population-wide vaccination uptake.

Conclusions

The present study is among the first to investigate the role of sociodemographic variables and the Taiwanese population's attitudes toward knowing and willingness to participate in vaccination programs for COVID-19 and influenza, particularly after the end of the recent COVID-19 pandemic. Considering the likely impact factors of age, education level, and employment status on decision-making to get vaccinated, providing tailored communications based on these variables to encourage participants to vaccinate would be helpful to increase readiness and willingness of the target population to take part in such funded vaccination programs and would improve their efficiency and effectiveness. However, further analysis is needed to assess people's awareness, readiness, and experience with vaccination when policies may change, and to determine whether a risk-based approach may be substituted for the current approach.

Author contributions

CRediT: **Mohsen Saffari:** Conceptualization, Writing – original draft, Writing – review & editing; **Mei-Dan Lai:** Conceptualization, Data curation, Formal analysis, Methodology, Writing – review & editing; **Jiajia Ye:** Methodology, Writing – review & editing; **Mark D. Griffiths:** Methodology, Writing – review & editing; **Servet Üztemur:** Methodology, Writing – review & editing; **Musheer A. Aljaberi:** Conceptualization, Methodology, Validation, Visualization, Writing – review & editing; **Po-Ching Huang:** Conceptualization, Data curation, Validation, Writing – review & editing; **Chung-Ying Lin:** Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Writing – review & editing.

Disclosure statement

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

Funding

This research was supported in part by (received funding from) the National Science and Technology Council, Taiwan [NSTC 114-2321-B-006-012].

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Data availability statement

The data that support the findings of the present study are available from the corresponding author upon reasonable request.

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