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Past behavior predicts future protection: uncovering key drivers of influenza vaccine acceptance in Italy in the post-pandemic era

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A B S T R A C T

Objectives: Influenza is a seasonal viral respiratory disease causing significant global mortality but preventable through vaccination. Despite WHO recommendations, vaccination rates in Italy remain low due to mistrust, misinformation, and vaccine hesitancy. This study investigates determinants of influenza vaccine uptake in the post-COVID-19 era to identify barriers and guide targeted interventions.
Methods: A cross-sectional survey was conducted on a representative sample of 8067 Italian adults between December 2024 and January 2025 through an anonymous online questionnaire. The survey explored sociodemographic characteristics, infectious disease behaviors, COVID-19 pandemic experiences, and vaccination attitudes.
Results: Overall, 33.7% of respondents received the influenza vaccine, while 61.8% reported no vaccination intention. Multinomial logistic regression identified three key domains of predictors. Sociodemographic determinants associated with uptake included age 65-75 years (OR = 1.89; 95% CI: 1.11-3.19), inactive employment status (OR = 1.73; 95% CI: 1.12-2.67), and comorbidities (OR = 1.23; 95% CI: 1.00-1.50). Past vaccination history emerged as the strongest driver of uptake (OR = 8.19; 95% CI: 3.98-16.84). Finally, behavioral factors, specifically the perception of mask usefulness, were significantly associated with vaccination intention among the unvaccinated (OR = 1.39; 95% CI: 1.11-1.75).
Conclusions: Influenza vaccination adherence in Italy is influenced by sociodemographic factors and preventive health practices, but most strongly by past vaccination behavior that should, thus, strength long-term engagement with vaccination programs.

Introduction

Influenza is an acute respiratory disease due to a viral infection of the airways, transmitted by RNA viruses belonging to the genus Orthomyxovirus (Influenza virus type A, B, C). Worldwide influenza causes 290,000 to 650,000 respiratory deaths annually and flu infection typically follows a seasonal trend with typical symptoms such as fever, fatigue, cough, and myalgia, but can progress to more severe manifestations, including serious lower respiratory tract infections and death [1–3].

The primary preventive measure against influenza is vaccination. Although recommendations can vary by country, ranging from universal immunization to targeted strategies, international guidelines consistently prioritize protection for high-risk groups to prevent severe complications [4,5]. Accordingly, the World Health Organization strongly recommends vaccination particularly for children under 2 years of age, older adults, pregnant women, healthcare workers, and immunocompromised individuals or those with comorbidities [6].

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In Italy, the Ministry of Health aligns with international guidelines by offering free influenza vaccination to specific priority groups. These include individuals aged 60 years and older, pregnant women at any trimester and in the postpartum period, children aged 6 months to 6 years, and persons aged 7-60 years with chronic conditions that increase the risk of complications (including chronic respiratory diseases, cardiovascular diseases, diabetes and metabolic disorders, renal or adrenal insufficiency, hematological disorders, cancer, immunosuppression, chronic inflammatory conditions, and hepatopathies) [7]. Vaccination is also recommended for healthcare workers, residents of long-term care facilities, and family members or caregivers of high-risk individuals [7]. The vaccination is administrated through multiple channels including general practitioners, pediatricians, local health services, and community pharmacies, with campaigns typically beginning in October [7]. The national vaccination coverage targets, consistent with WHO recommendations, aim for a minimum of 75% and an optimum of 95% in priority populations [6]. However, coverage among those aged 65 years and older reached only 56.7% in the 2022-2023 season, substantially below the minimum target [8].

Despite such recommendations, there is a variable adherence to vaccination that remains suboptimal in several European Countries, including Italy [9]. This phenomenon, defined by the World Health Organization's Strategic Advisory Group of Experts (SAGE) on Immunization as vaccine hesitancy, refers to the "delay in acceptance or refusal of vaccination despite availability of vaccination services" [10]. Vaccine hesitancy represents a complex behavioral pattern influenced by three key determinants: confidence (trust in vaccine effectiveness and safety), complacency (perceived risk of vaccine-preventable diseases), and convenience (access to vaccination services) [10]. Contributing factors include lack of trust in the benefits of vaccines, insufficient or inaccurate information, misinformation, and various fears and concerns about vaccines that frequently emerge among people [11].

Influenza vaccine hesitancy is associated with substantial healthcare, economic, and societal burdens. Suboptimal vaccination coverage contributes to increased morbidity and mortality, higher healthcare utilization, and broader socioeconomic disruptions, particularly among high-risk populations [12,13]. Therefore, identifying predictors of reduced vaccine compliance is critical. A better understanding of the underlying determinants, whether cognitive, behavioral, structural, or sociocultural, can inform the development of targeted interventions aimed at increasing vaccination uptake. Enhancing coverage rates through such strategies has the potential to significantly mitigate the overall impact of seasonal influenza.

Accounting for the aforementioned considerations, this study is designed to assess factors that predict influenza vaccination uptake in the post COVID-19 era within a large cohort representative of the Italian general population. By investigating these predictors, the study aims to deepen the understanding of the factors acting as barriers or facilitators for the influenza vaccine uptake. This aim is particularly relevant considering that, to date, in Italy as well as in the majority of countries worldwide, there are no established observatories or systematic surveillance systems specifically dedicated to monitoring the underlying reasons for vaccine hesitancy against influenza.

Material and methods

This cross-sectional observational study was conducted on a sample of the Italian general population interviewed between December 2024 and January 2025. The sample consisted of 8067 individuals who were invited to participate based on a weighting process that accounted for age, gender, and geographical residence, to ensure representativeness of the Italian population. Only adult participants, aged 35 and over, were included in the recruitment process. This specific age threshold was selected to focus the investigation on the population segments (middle-aged and older adults) where the burden of influenza-related complications begins to rise and where vaccine uptake is critical for public health outcomes, purposely excluding early adulthood where low uptake is often driven by lower risk perception. The sample size was estimated based on an expected prevalence of vaccine hesitancy of 5% (derived from the 6.7% prevalence of COVID-19 vaccine hesitancy reported in Italy by the "OBVIOUS" study [14]) with a precision of 0.5% and a 95% confidence level. This calculation resulted in an effective sample size of 7298 participants. To accommodate potential missing data and incomplete or invalid questionnaires, the sample size was increased by 15%, resulting in a total of 8393 individuals being invited to participate. The anonymous questionnaire was administered online through a specialized survey company and was primarily completed using smartphones. However, in cases where respondents requested assistance, the survey was conducted through a telephone interview instead.

The questionnaire was constructed using a combination of questions already used and validated in other studies as described in the literature and original items developed specifically to align with the study's research questions and objectives [15–17]. The questionnaire was composed of four different sections. The first part investigated sociodemographic characteristics (gender, age, occupation, living condition etc.). A second part included questions on behaviors and aptitudes in case of spread of emerging or classic infectious agents. The third section of the questionnaire was dedicated to assessing the economic, psychological, and health-related experiences encountered during the COVID-19 pandemic. Finally, the last part of the questionnaire focused on vaccination uptake (influenza and SARS-CoV-2), vaccination aptitudes and individuals' approaches to health-related issues and their interactions with the national healthcare system.

Participants were also asked to report whether they had been diagnosed with specific chronic conditions associated with increased influenza complication risk, including diabetes, kidney failure, chronic respiratory diseases (chronic bronchitis, emphysema, respiratory failure, asthma), cardiovascular diseases (myocardial infarction or other heart diseases), tumors (including leukemia and lymphomas), chronic liver disease or cirrhosis, severe obesity (BMI $>$ 40), and other chronic conditions. A composite variable representing the total number of self-reported comorbidities was created and included in the regression analysis.

The study protocol was approved by the relevant ethics committee of the University Hospital "*Paolo Giaccone*" of Palermo under resolution no. 28, dated December 10, 2024. Prior to the multivariate analysis, a univariate analysis was performed to assess the association between each potential predictor and vaccination uptake using Chi-Square tests or Fisher's exact tests where appropriate. To account for the high number of comparisons a Bonferroni correction was applied to the *P*-values. Variables showing a statistically significant association in the univariate analysis were subsequently included in the multinomial logistic regression model. A Bonferroni corrected *P*-value $<$ 0.05 was considered statistically significant. Analyses were conducted using R (version 4.5.0).

Results

Sociodemographic characteristics

As reported in Table 1, the study recruited a total of 8067 subjects including 4043 (50.1%) males and 4013 (49.7%) females. Overall, 33.71% (n = 2719) of participants had received the influenza vaccine (Uptake group), 4.51% (n = 364) had not yet been vaccinated but intended to do so (Willing group), and 61.78% (n = 4984) had not been vaccinated and did not intend to receive the

Table 1
General and sociodemographic characteristics of the patient sample recruited for the survey. Bonferroni corrected *p*-values of Chi-Square or Fisher tests are reported under the name of the variables.

		Total sample	Influenza vaccination status and intention		
		n (%)	Yes	No but I want	No and I don't want
		8067	2719 (33·71%)	364 (4·51%)	4984 (61·78%)
Age $p < 0.01$	- 35-50	3505 (43·4%)	794 (22·7%)	151 (4·3%)	2560 (73%)
	- 51-65	2929 (36·3%)	955 (32·6%)	144 (4·9%)	1830 (62·5%)
	- 66-75	1473 (18·3%)	854 (58%)	64 (4·3%)	555 (37·7%)
	- >75	160 (2%)	116 (72·5%)	5 (3·1%)	39 (24·4%)
Gender $p = 0.018$	- Female	4013 (49·7%)	1264 (31·5%)	181 (4·5%)	2568 (64%)
	- Male	4043 (50·1%)	1452 (35·9%)	182 (4·5%)	2409 (59·6%)
	- Other	11 (0·1%)	3 (27·3%)	1 (9·1%)	7 (63·6%)
Attained level of education $p < 0.01$	- Elementary School	204 (2·53%)	135 (66·18%)	12 (5·88%)	57 (27·94%)
	- Middle School	1013 (12·56%)	366 (36·13%)	29 (2·86%)	618 (61·01%)
	- High School	4259 (52·8%)	1345 (31·58%)	201 (4·72%)	2713 (63·7%)
	- Degree Or Higher	2591 (32·12%)	873 (33·69%)	122 (4·71%)	1596 (61·6%)
Religion $p < 0.01$	- Catholic	5547 (68·76%)	2049 (36·9%)	244 (4·4%)	3254 (58·66%)
	- Non Catholic	1149 (14·24%)	261 (22·72%)	44 (3·83%)	844 (73·46%)
	- None (Atheist or Agnostic)	1371 (17%)	409 (29·83%)	76 (5·54%)	886 (64·62%)
Italian Region of residency $p = 0.081$	- Center	1718 (21·3%)	610 (35·51%)	91 (5·3%)	1017 (59·2%)
	- North-East	1689 (20·94%)	582 (34·46%)	59 (3·49%)	1048 (62·05%)
	- North-West	2316 (28·71%)	792 (34·2%)	90 (3·89%)	1434 (61·92%)
	- South And Islands	2344 (29·06%)	735 (31·36%)	124 (5·29%)	1485 (63·35%)
Employment status $p < 0.01$	- Unemployed	429 (5·32%)	84 (19·58%)	15 (3·5%)	330 (76·92%)
	- Inactive	2476 (30·69%)	1302 (52·6%)	93 (3·76%)	1081 (43·66%)
	- Employed With On-Call, Seasonal, Casual Work	195 (2·42%)	36 (18·46%)	6 (3·08%)	153 (78·46%)
	- Self-Employed	896 (11·11%)	269 (30·02%)	45 (5·02%)	582 (64·96%)
	- Employed	3886 (48·17%)	1012 (26·0%)	202 (5·2%)	2672 (68·76%)
	- Prefer Not To Answer	165 (2·05%)	10 (6·06%)	3 (1·82%)	152 (92·12%)
	- Student	20 (0·25%)	6 (30%)	0 (0%)	14 (70%)
Marital Status $p<0.01$	- Committed To A Stable Relationship	922 (11·43%)	189 (20·5%)	27 (2·93%)	706 (76·57%)
	- Never Married Or Civilly United	1064 (13·19%)	285 (26·79%)	46 (4·32%)	733 (68·89%)
	- Prefer Not To Answer	293 (3·63%)	41 (13·99%)	13 (4·44%)	239 (81·57%)
	- Separated Or Divorced Or Dissolved Civil Union	715 (8·86%)	221 (30·91%)	38 (5·31%)	456 (63·78%)
	- Married Or Civilly United	4710 (58·39%)	1779 (37·77%)	234 (4·97%)	2697 (57·26%)
	- Widowed	363 (4·5%)	204 (56·2%)	6 (1·65%)	153 (42·15%)
Living with cohabitants $p<0.01$	- No	1762 (21·84%)	523 (29·68%)	83 (4·71%)	1156 (65·61%)
	- Yes Both Types	308 (3·82%)	63 (20·45%)	16 (5·19%)	229 (74·35%)
	- Yes Familiar	5628 (69·77%)	2007 (35·7%)	254 (4·51%)	3367 (59·83%)
	- Yes Not Familiar	369 (4·57%)	126 (34·15%)	11 (2·98%)	232 (62·87%)

vaccine (Unwilling group). Influenza vaccination coverage increased with age, reaching 72.5% in participants over 75 years, compared to 22.7% in those aged 35-50 years ($P < 0.01$). Vaccination coverage was also higher in males (35.9%, $P = 0.018$), subjects with elementary school education (66.18%, $P < 0.01$), catholics (36.9%, $P < 0.01$), participants with inactive employment status (52.6%, $P < 0.01$), widowed (56.2%, $P < 0.01$) and married (37.77%, $P < 0.01$), and those living with familiars (35.7%, $P < 0.01$).

Behavioral factors and vaccination history

In Table 2 behavioral factors and variables associated with influenza vaccination habits are reported. Higher influenza vaccination uptake was observed among subjects who frequently conduct online research ($P < 0.01$), as well as among those willing to receive vaccination against an emerging pathogen if safe and effective vaccines were approved and made available on the market ($P < 0.01$). Higher influenza vaccination uptake was also observed among individuals who consistently use masks ($P < 0.01$), have been previously vaccinated against influenza or both influenza and COVID-19 ($P < 0.01$), and those who reported increased healthcare spending in recent years ($P < 0.01$). In particular, these last were factors with a very strong effect size.

Predictors of vaccination uptake and intention

A multinomial logistic regression analysis was performed to identify independent predictors of vaccination uptake and intention (Figure 1). The outcome variable consisted of three mutually exclusive categories: "Vaccinated" (Uptake), "Unvaccinated but willing" (Intention), and "Unvaccinated and unwilling" (Reference). Variables showing a statistically significant association in the univariate analysis were included in the model.

Regarding vaccine uptake, significant sociodemographic and health-related predictors included age between 65 and 75 years (OR = 1.885; 95% CI: 1.114-3.19; $P < 0.01$), inactive employment status (OR = 1.726; 95% CI: 1.115-2.671; $P < 0.01$), and the number of self-declared comorbidities (OR = 1.227; 95% CI: 1.002-1.501; $P < 0.05$). Additionally, a higher willingness to vaccinate against emerging pathogens was positively associated with uptake (OR = 1.548; 95% CI: 1.353-1.77; $P < 0.001$). The strongest driver of uptake, however, was vaccination history. Individuals ever vac-

Table 2
Behavioral factors and variables associated with influenza vaccination habits.

		Total sample	Influenza vaccination status and intention		
		n (%)	Yes	No but I want	No and I don't want
Recent searches online for local news related to public health $P < 0.01$	• Never	3076 (38.13%)	942 (30.62%)	80 (2.6%)	2054 (66.78%)
	• Rarely	2069 (25.65%)	648 (31.32%)	107 (5.17%)	1314 (63.51%)
	• Sometimes	2084 (25.83%)	718 (34.45%)	121 (5.81%)	1245 (59.74%)
	• Often	709 (8.79%)	343 (48.38%)	48 (6.77%)	318 (44.85%)
	• Always	129 (1.6%)	68 (52.71%)	8 (6.2%)	53 (41.09%)
In the event of a respiratory infection outbreak, would you reduce your visits to crowded or potentially crowded places (such as gyms, etc.)? $P < 0.01$	• No	526 (6.52%)	60 (11.41%)	16 (3.04%)	450 (85.55%)
	• Yes	7541 (93.48%)	2659 (35.3%)	348 (4.61%)	4534 (60.12%)
How willing would you be to get vaccinated against an emerging pathogen if safe and effective vaccines were approved and made available on the market? $P < 0.01$	• Not at all willing	1254 (15.54%)	112 (8.93%)	16 (1.28%)	1126 (89.79%)
	• Somehow willing	1510 (18.72%)	207 (13.71%)	28 (1.85%)	1275 (84.44%)
	• Quite willing	2500 (30.99%)	857 (34.28%)	137 (5.48%)	1506 (60.24%)
	• Very willing	1427 (17.69%)	674 (47.23%)	95 (6.66%)	658 (46.11%)
	• Extremely willing	1376 (17.06%)	869 (63.15%)	88 (6.4%)	419 (30.45%)
If a respiratory infection were to spread (as happened with the COVID-19 pandemic), would you feel the need to receive psychological support? $P < 0.01$	• No	3594 (44.55%)	1144 (31.83%)	114 (3.17%)	2336 (65%)
	• Yes	4473 (55.45%)	1575 (35.21%)	250 (5.59%)	2648 (59.2%)
In the event of a respiratory infection outbreak, would you prefer to avoid using public transportation (such as buses or the subway)? $P < 0.01$	• Never	525 (6.51%)	95 (18.1%)	8 (1.52%)	422 (80.38%)
	• Rarely	820 (10.16%)	151 (18.41%)	30 (3.66%)	639 (77.93%)
	• Sometimes	1814 (22.49%)	535 (29.49%)	78 (4.3%)	1201 (66.21%)
	• Often	1994 (24.72%)	741 (37.16%)	109 (5.47%)	1144 (57.37%)
	• Always	2914 (36.12%)	1197 (41.1%)	139 (4.77%)	1578 (54.15%)
If infections were to spread (as happened during the COVID-19 pandemic), would you consider wearing masks useful? $P < 0.01$	• Never	411 (5.09%)	18 (4.38%)	0 (0%)	393 (95.62%)
	• Rarely	664 (8.23%)	105 (15.81%)	12 (1.81%)	547 (82.38%)
	• Sometimes	1553 (19.25%)	375 (24.15%)	51 (3.28%)	1127 (72.57%)
	• Often	1909 (23.66%)	644 (33.73%)	89 (4.66%)	1176 (61.6%)
	• Always	3530 (43.76%)	1577 (44.67%)	212 (6.01%)	1741 (49.32%)
Do you think the spread of infections (such as COVID-19) can have a negative impact on people's health? $P < 0.01$	• Not At All	215 (2.67%)	34 (15.81%)	5 (2.33%)	176 (81.86%)
	• Slightly	657 (8.14%)	165 (25.11%)	23 (3.5%)	469 (71.39%)
	• Moderately	2385 (29.56%)	719 (30.15%)	88 (3.69%)	1578 (66.16%)
	• Very	3155 (39.11%)	1116 (35.37%)	153 (4.85%)	1886 (59.78%)
	• Extremely	1655 (20.52%)	685 (41.39%)	95 (5.74%)	875 (52.87%)
Have you ever been vaccinated against seasonal influenza and/or COVID-19? $P < 0.01$	• No, I have never been vaccinated against either seasonal flu or COVID	1755 (21.76%)	50 (2.85%)	24 (1.37%)	1681 (95.78%)
	• Yes, I have been vaccinated against COVID-19	2875 (35.64%)	220 (7.65%)	145 (5.04%)	2510 (87.3%)
	• Yes, I have been vaccinated against seasonal flu	927 (11.49%)	729 (78.64%)	53 (5.72%)	145 (15.64%)
	• Yes, I have been vaccinated against both seasonal flu and COVID-19	2510 (31.11%)	1720 (68.5%)	142 (5.66%)	648 (25.82%)
In the past year (or last winter season), have you been vaccinated against seasonal influenza and/or COVID-19? $P < 0.01$	• No, I was not vaccinated against either seasonal flu or COVID last year	4362 (54.07%)	143 (3.28%)	122 (2.8%)	4097 (93.92%)
	• Yes, I was vaccinated against COVID-19 last year	791 (9.81%)	181 (22.88%)	57 (7.21%)	553 (69.91%)
	• Yes, I was vaccinated against seasonal flu last year	1635 (20.27%)	1366 (83.6%)	114 (6.97%)	155 (9.48%)
	• Yes, I was vaccinated against both seasonal flu and COVID-19 last year	1279 (15.85%)	1029 (80.5%)	71 (5.55%)	179 (14%)

(*continued on next page*)

Table 2 (*continued*)

		Total sample	Influenza vaccination status and intention		
		n (%)	Yes	No but I want	No and I don't want
How have your healthcare spending habits changed in recent years (e.g., diagnostic tests, specialist visits, etc.)? $P < 0.01$	• Very decreased	138 (1.71%)	19 (13.77%)	5 (3.62%)	114 (82.61%)
	• Decreased	349 (4.33%)	115 (32.95%)	24 (6.88%)	210 (60.17%)
	• Unchanged	5038 (62.45%)	1412 (28.0%)	185 (3.67%)	3441 (68.3%)
	• Increased	2183 (27.06%)	994 (45.53%)	118 (5.41%)	1071 (49.06%)
	• Very increased	359 (4.45%)	179 (49.86%)	32 (8.91%)	148 (41.23%)
In the past 12 months, have you been on a waiting list for surgery through the National Health Service or privately? $P < 0.01$	• No	6560 (81.32%)	2021 (30.8%)	288 (4.39%)	4251 (64.8%)
	• Yes	1507 (18.68%)	698 (46.32%)	76 (5.04%)	733 (48.64%)

Bonferroni corrected *P*-values of Chi-Square or Fisher tests are reported under the name of the variables.

cinated against influenza alone (OR = 8.185; 95% CI: 3.979-16.836; $P < 0.001$) or against both influenza and COVID-19 (OR = 5.421; 95% CI: 2.941-9.994; $P < 0.001$) showed markedly higher odds of current vaccination. This effect was even more pronounced when considering the previous year: receiving the influenza vaccine last season was associated with an exceedingly high likelihood of revaccination (OR = 55.177; 95% CI: 34.868-87.314; $P < 0.001$), as was receiving both vaccines (OR = 34.125; 95% CI: 21.665-53.75; $P < 0.001$). Prior COVID-19 vaccination alone in the last year also remained a significant predictor (OR = 6.54; 95% CI: 4.15-10.307; $P < 0.001$).

Regarding the intention to vaccinate among the unvaccinated, behavioral factors played a prominent role. Significant predictors included recent online searches for public health news (OR = 1.284; 95% CI: 1.073-1.537; $P < 0.001$), the perception of mask usefulness (OR = 1.392; 95% CI: 1.108-1.749; $P < 0.001$), and willingness to vaccinate against emerging pathogens (OR = 1.482; 95% CI: 1.234-1.781; $P < 0.001$). Vaccination history also influenced intention, albeit with lower odds ratios compared to uptake. Specifically, having been vaccinated against influenza alone in the past (OR = 3.65; 95% CI: 1.34-9.943; $P < 0.01$) or in the last year (OR = 11.985; 95% CI: 6.431-22.335; $P < 0.001$) significantly predicted willingness. Similarly, vaccination against both viruses (OR = 2.985; 95% CI: 1.28-6.961; $P < 0.01$ for ever vaccinated; OR = 5.528; 95% CI: 2.844-10.745; $P < 0.001$ for last year) and COVID-19 alone in the last year (OR = 2.193; 95% CI: 1.225-3.928; $P < 0.001$) were associated with a positive intention to vaccinate.

Discussion

The present study contributes to enriching knowledge on influenza vaccine hesitancy, a subject of enduring public health relevance, particularly given the significant disease burden preventable through widespread immunization.

Our findings indicate that influenza vaccine adherence in Italy remains suboptimal. The 59.4% coverage observed among the primary target population (individuals aged 65 years and older) falls short of the World Health Organization's recommended minimum (75%) and optimal (95%) thresholds [18]. This trend is consistent with historical data, as Italy has not met these targets since 1990, with coverage reaching only 53.3% in the most recent season [8]. Consequently, identifying determinants of vaccine uptake is critical to guide targeted interventions.

The first important finding of our study is that, consistently, with global and national literature, younger individuals demonstrated lower vaccination uptake [19,20]. This is often attributed to a lower perception of disease severity among younger adults, which reduces the perceived urgency of preventive measures [21]. Furthermore, reduced frequency of healthcare contacts limits opportunities for provider recommendations [22], while mistrust and exposure to misinformation may further hinder acceptance [23].

Regarding socio-demographic determinants, our multivariate analysis revealed that individuals inactive in the workforce demonstrated significantly higher levels of vaccine adherence compared to employed individuals, even after adjusting for age. This pattern may be explained by practical and behavioral factors described in the literature. Inactive individuals likely benefit from greater time flexibility to access vaccination services, whereas employed individuals often face structural barriers such as time constraints, lack of paid sick leave, or logistical difficulties in accessing centers during working hours [22,24,25]. Moreover, retirees, also when healthy, often perceive themselves as being at greater health risk, thereby prioritizing preventive healthcare and maintaining more frequent contact with the healthcare system where recommendations are offered [26]. This interpretation is supported by previous international findings indicating that older adults and those outside the labor force generally exhibit higher influenza vaccine uptake [24,25,27]. However, the relationship between employment and vaccination is complex. While our data suggest higher adherence among the inactive, other studies note that specific employed groups, such as healthcare workers, may show high rates due to occupational requirements [28,29], whereas unemployed individuals with lower socioeconomic status might conversely face reduced healthcare access [30]. Thus, while workforce inactivity appears to facilitate uptake in this cohort, the association is likely modulated by broader contextual factors including healthcare accessibility and social determinants.

Behavioral factors, specifically consistent mask use and willingness to accept vaccines against emerging pathogens, were also significant predictors of influenza vaccine uptake. These behaviors likely reflect a higher underlying risk awareness and adherence to public health recommendations. This association is supported by international evidence; for example, studies conducted in South Korea and Europe found that adherence to non-pharmaceutical interventions, such as mask-wearing and social distancing, correlated with higher acceptance of both seasonal and COVID-19 vaccines [31,32]. Similarly, the willingness to vaccinate against novel pathogens serves as a proxy for general pro-vaccine attitudes. Evidence suggests that intention to receive a COVID-19 vaccine is strongly linked to prior influenza vaccination, indicating a clustering of protective health behaviors among vaccine-accepting individuals [33].

Finally, consistent with the "past behavior predicts future behavior" model, previous vaccination history was identified as the most robust predictor of current influenza vaccine uptake. While prior COVID-19 vaccination was significantly associated with current uptake, the strongest independent association was observed among individuals with a specific history of seasonal influenza vaccination. This finding is consistently observed across various studies and contexts [34,35], highlighting the strong behavioral and psychological continuity in individuals' preventive health practices. Previous evidence, such as the study by Lu *et al.* [35], in-

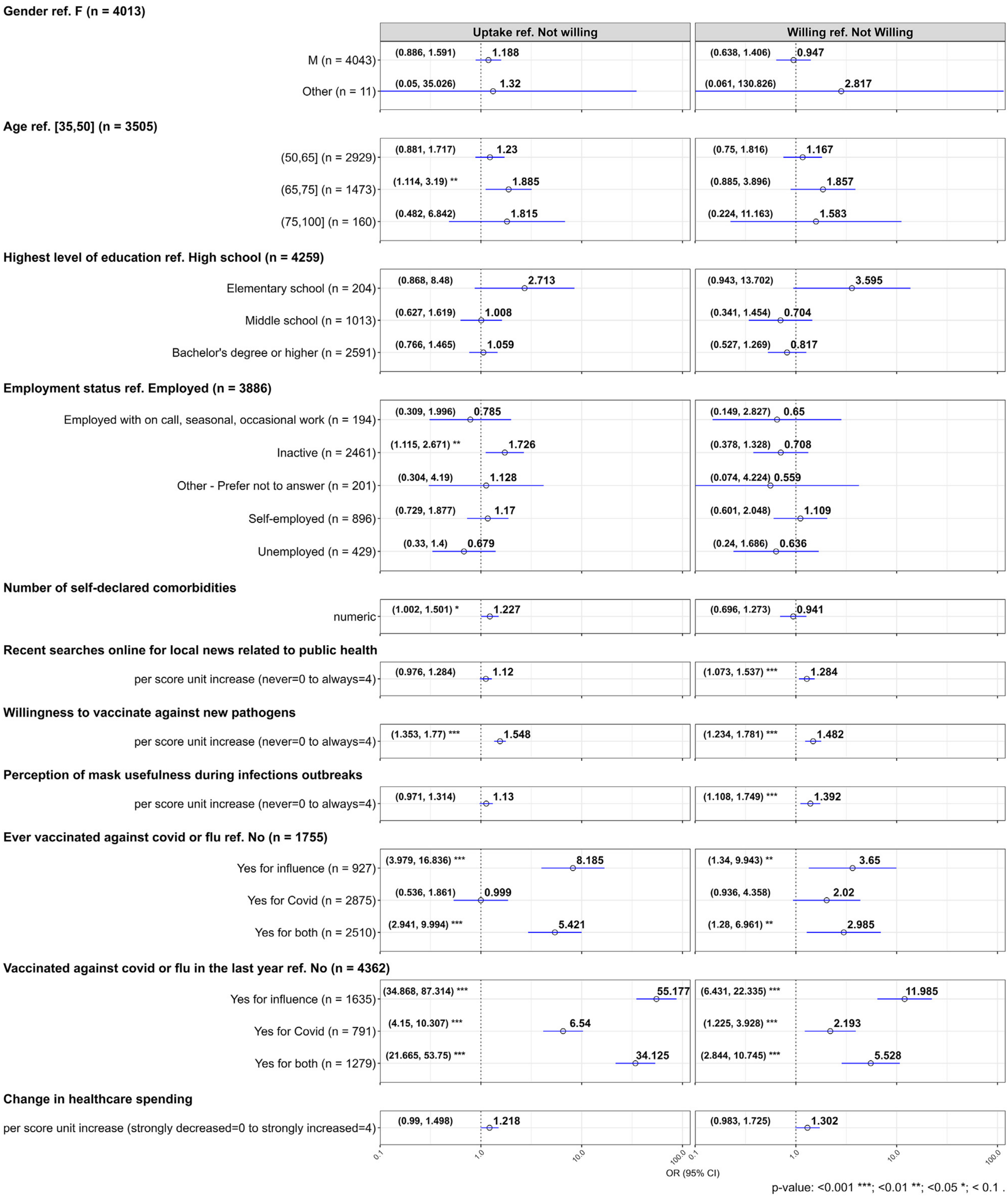

Figure 1. Multinomial logistic regression analysis on variables involved in the decision to accept influenza vaccine or intention to vaccinate.

dicated that prior influenza vaccination is a primary determinant of current-season vaccination across all age groups. Similarly, Di Lorenzo *et al.* [34] demonstrated in the Italian healthcare worker context that prior vaccination behavior significantly influences future vaccine uptake, reinforcing the concept of vaccination as a habitual preventive practice. Regarding the link with COVID-19, European research suggests a correlation between acceptance of pandemic vaccines and other routine immunizations, likely reflecting a general orientation toward preventive health rather than a direct causal effect [36]. Consequently, individual adherence appears to be driven by habit and familiarity with the procedure, which may reduce psychological barriers. From a public health perspective, this implies that promoting the initial vaccination experience is critical, as establishing routine adherence may facilitate sustained participation in future seasonal campaigns. In healthcare settings, where protection of vulnerable patients is paramount, these findings regarding the importance of establishing initial vaccination adherence have particular relevance to ongoing policy debates, including discussions around mandatory influenza vaccination for healthcare workers [34,37]. While such mandates remain subject to debate and must carefully balance individual autonomy with collective responsibility, evidence from Italian healthcare contexts suggests that vaccination requirements can increase coverage rates and may contribute to normalizing vaccination as a routine professional practice, thereby potentially reducing hesitancy over time [34].

To correctly contextualize these results, several methodological limitations must be acknowledged alongside the study's strengths. First, the cross-sectional design allows for the identification of associations but prevents the establishment of causal relationships between predictors and vaccine uptake. Second, the reliance on self-reported data introduces the possibility of recall bias, particularly regarding past vaccination history, and social desirability bias, where respondents may report behaviors they perceive as socially responsible. Third, although the sample was weighted to be representative, the online administration of the survey may have reduced the participation of individuals with limited digital literacy or internet access, potentially leading to selection bias, especially among the oldest age groups, even though it was possible to complete the survey by telephone. Finally, while the questionnaire covered a broad range of determinants, unmeasured confounding factors could still influence the results. The full questionnaire used in this study is available in the Supplementary Material.

Conclusion

This study highlights that influenza vaccination adherence in Italy is influenced by a complex interplay of sociodemographic factors and individual health-conscious behaviors. In terms of predictive factors, our analysis clarifies that while prior COVID-19 vaccination is associated with current uptake, a specific history of past influenza vaccination remains the dominant and most robust predictor. This distinction underscores that habit and familiarity with the specific vaccine are the primary drivers of adherence. These findings emphasize the need for targeted public health strategies that go beyond demographic targeting to foster positive initial vaccination experiences. By converting first-time acceptance into routine habit, health systems can effectively enhance long-term population immunity against seasonal influenza.

Data sharing statement

The dataset analyzed during the current study is not publicly available due to privacy restrictions but can be obtained from the corresponding author upon reasonable request.

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Ethical approval

The study protocol was approved by the relevant ethics committee of the University Hospital "*Paolo Giaccone*" of Palermo under resolution no. 28, dated December 10, 2024.

Author contributions

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ijid.2026.108379.

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