

Factors associated with influenza vaccination uptake among adults with self-reported respiratory diseases in Hungary: a cross-sectional study

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Abstract

Background Influenza is a major global public health challenge, causing seasonal outbreaks of acute respiratory infections across all age groups. Although influenza can affect individuals of all ages, those with chronic conditions, including respiratory diseases, are at higher risk of severe outcomes. For this reason, annual vaccination is recommended for these high-risk groups. The aim of this study was to identify factors associated with influenza vaccination uptake among adults with self-reported respiratory diseases in Hungary.

Methods This study was based on data from the Hungarian waves of the cross-sectional European Health Interview Survey conducted in 2009, 2014, and 2019. Survey-weighted descriptive and bivariate analyses were conducted, and a survey-weighted multiple logistic regression model was fitted among respondents with self-reported respiratory diseases to assess factors associated with influenza vaccination uptake within the previous year. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated.

Results Respondents with self-reported respiratory diseases ($n=1,456$) and those without such conditions ($n=14,975$) were included in the descriptive analyses. Influenza vaccination uptake was higher among respondents with self-reported respiratory diseases than among those without these diseases (24% vs. 12%), although vaccination uptake remained low in both groups. Among respondents with self-reported respiratory diseases, vaccination uptake did not differ significantly across survey years. In the adjusted model, older age was associated with higher odds of vaccination, particularly among those aged ≥ 65 years (AOR = 5.02; 95% CI 2.63–9.56). Lack of recent healthcare contact was associated with lower odds of vaccination, both for doctor visits (AOR = 0.45; 95% CI 0.23–0.91) and specialist visits (AOR = 0.48; 95% CI 0.31–0.75). Cardiovascular or cerebrovascular comorbidity was also associated with higher odds of vaccination (AOR = 1.55; 95% CI 1.09–2.19).

Conclusions Influenza vaccination uptake among Hungarian adults with self-reported respiratory diseases remained low with no significant difference observed across the survey years. Older age, recent healthcare contact, and cardiovascular or cerebrovascular comorbidity were associated with higher vaccination uptake.

Keywords Epidemiology · Influenza · Respiratory diseases · Vaccination

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Gergő Hegyes and Jenifer Pataki contributed equally to this work.



Background

Influenza is one of the most significant public health challenges globally, characterized by seasonal outbreaks of acute respiratory infections caused by influenza viruses, which circulate worldwide and affect people of all ages. According to the World Health Organization (WHO), seasonal influenza affects about a billion people, including 3–5 million cases leading to severe complications, and approximately 290,000–650,000 respiratory deaths annually worldwide [1].

Although everyone is at risk of influenza, certain groups including children, older people, pregnant women and people with chronic medical conditions such as respiratory or cardiovascular diseases are especially vulnerable. For this reason, WHO recommends annual vaccination for these high-risk groups [1, 2]. In addition, according to the Centers for Disease Control and Prevention, chronic diseases, such as diabetes, cardiovascular diseases, respiratory disorders, significantly increase the risk of severe consequences of influenza. This excessive risk is mainly due to influenza infections that can exacerbate these conditions, potentially leading to life-threatening outcomes [3].

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death worldwide, with 3.23 million deaths recorded in 2019. In Europe, COPD is assumed to affect 15%–20% of the population, with 5%–10% living with moderate-to-severe COPD. Similarly, asthma is also considered a serious public health issue because it affected approximately 262 million people in 2019 and was responsible for 455,000 deaths [4–7]. Individuals with asthma or other chronic respiratory diseases are at increased risk of influenza-related complications, disease exacerbations, hospitalization, and mortality, making influenza vaccination an important public health priority in this group. Despite yearly variations in vaccine efficacy and limitations in preventing infections, vaccination could play a vital role in reducing severe health effects and hospitalizations in these high-risk groups [8]. Even so, influenza vaccination has demonstrated effectiveness in reducing mortality and other adverse health outcomes [9–11]. Furthermore, influenza vaccination is significantly associated with a reduction in complications and exacerbations of respiratory diseases, including influenza, secondary pneumonia, and the worsening of chronic lung conditions, such as chronic obstructive pulmonary disease and acute asthma [12–15]. Despite this, influenza vaccination coverage is often not systematically monitored on nationwide level and therefore tends to remain low among high-risk groups. Barriers to vaccine uptake may include a lack of trust in the vaccine or healthcare medical personnel, fear of vaccine reactions, and misconceptions about vaccines; difficulties in accessing healthcare services could also contribute to low vaccination coverage [16, 17]. This is further aggravated by data from the Organisation for Economic Co-operation and Development, indicating that vaccination coverage rates in European Union (EU)/European Economic Area member states remain insufficient, particularly among high-risk populations [18]. In Hungary, influenza vaccination is recommended for high-risk groups and is provided free of charge for eligible risk groups, including older adults and people with chronic conditions. National statistical data indicate substantial annual variations in influenza and influenza-like illness during epidemic periods in Hungary, with reported annual numbers ranging from 93,000 to 810,000 between 2001 and 2025 [19]. However, routinely available indicators of vaccination coverage are mainly reported for older adults, whereas comparable official national data for specific chronic disease groups, including adults with respiratory diseases, remain limited.

Increasing vaccination coverage is an important public health objective, particularly since coverage among individuals with chronic respiratory diseases and other chronic conditions can indicate a country's level of public health preparedness. Despite its relevance as a public health priority in Hungary and globally, national-level evidence on influenza vaccination uptake and its associated factors is limited among adults with respiratory diseases. Thus, identifying population-level factors associated with vaccination uptake may help to better determine which groups are less likely to be vaccinated and where public health efforts could be targeted [20–22].

Aims

The primary aim of this study was to assess influenza vaccination uptake among adults with self-reported respiratory diseases in Hungary and identify sociodemographic, health-related, healthcare utilization, and behavioral factors associated with influenza vaccination uptake.

Methods

Database

Data for this study were derived from the Hungarian implementations of the European Health Interview Surveys (EHIS), which were executed in 2009, 2014, and 2019 [23]. The questionnaire was not developed specifically for this study; rather, the analysis was based on the standardized EHIS questionnaire used in the official Hungarian survey waves. These cross-sectional population health surveys were conducted across EU Member States to provide comparable information on health status, healthcare use, health determinants, and sociodemographic characteristics and support the identification of public health priorities. Data collection was carried out by trained personnel using the standardized questionnaire. The Hungarian Central Statistical Office conducted the surveys and retains the ownership of the primary datasets; therefore, these datasets are not publicly accessible. Stratified probability sampling was used in all studies to ensure representative data for Hungary's adult population living in private households. The consistent methodology utilized across the three survey waves allowed their merging into a single, unified dataset, ensuring comparability and robustness in the analyses conducted.

Data

The main dependent variable was self-reported influenza vaccination uptake within the year preceding each EHIS survey. Respondents were classified as vaccinated if they reported having received their most recent influenza vaccination within the previous 12 months and as unvaccinated if more than 12 months had elapsed since their last vaccination. This approach was used to assess annual influenza vaccination uptake, taking into account the annual nature of influenza vaccination recommendations owing to variations in influenza strains. Respondents with respiratory diseases were identified based on self-reported asthma and/or chronic bronchitis and were classified as having respiratory diseases. These conditions were combined into a single category because the study focused on influenza vaccination uptake in the broader population-based group of adults with chronic respiratory diseases who are at increased risk of influenza-related complications. The analytical dataset did not permit linkage with general practitioner records, immunization registries, or other clinical databases; therefore, the self-reported vaccination and respiratory disease data were not externally validated. Independent variables included sex, age group, and educational attainment. Sex was categorized as male or female, age into 18–34, 35–64, and ≥ 65 years, and educational attainment into primary, secondary, and tertiary levels. Additional covariates included marital status, perceived and objective income, self-rated health, overweight or obesity, physical activity, smoking status, healthcare utilization, satisfaction with healthcare providers, type of residence, cardiovascular comorbidities, study year, and region of residence. Marital status was categorized as living alone or in a marital/partner relationship. Income was measured by perceived financial situation, which was categorized into good and bad conditions, and grouped by objective income quintiles established by the Hungarian Central Statistical Office. Both income-related variables were included because they capture complementary aspects of socioeconomic position: objective relative income and subjective financial adequacy. Self-rated health was grouped into good and bad categories. Body mass index was categorized to distinguish respondents as overweight/obese or not. Physical activity levels were divided into health-enhancing physical activity, minimal activity, and complete inactivity. Smoking status was dichotomized into smokers and non-smokers based on self-reported data. Meetings with healthcare providers were assessed based on whether respondents had visited a doctor or specialist within the past year or not. Satisfaction with doctors and specialists were measured as satisfied or neutral/dissatisfied. The EHIS

Table 1 Comparison of vaccination coverage among individuals with and without self-reported respiratory diseases

Factor	Strata	Self-reported respiratory disease: Yes			Self-reported respiratory disease: No		
		Not vaccinated within a year n (weighted %)	Vaccinated within a year n (weighted %)	p-Value	Not vaccinated within a year n (weighted %)	Vaccinated within a year n (weighted %)	p-Value
Age group	18–34	194 (91%)	17 (9%)	<0.001	3543 (96%)	157 (4%)	<0.001
	35–64	584 (81%)	137 (19%)		6742 (91%)	644 (9%)	
	≥ 65	306 (62%)	189 (38%)		2396 (70%)	988 (30%)	
Sex	Female	689 (76%)	214 (24%)	0.775	6983 (88%)	1002 (12%)	0.312
	Male	419 (77%)	134 (23%)		6159 (88%)	831 (12%)	
Educational level	Primary	261 (71%)	105 (29%)	0.002	2138 (86%)	346 (14%)	<0.001
	Secondary	687 (80%)	178 (20%)		8428 (89%)	1041 (11%)	
	Tertiary	160 (72%)	65 (28%)		2570 (86%)	446 (15%)	
Marital status	Not have a partner	520 (76%)	160 (24%)	0.806	6407 (89%)	802 (11%)	<0.001
	Married or have a partner	580 (77%)	187 (23%)		6617 (87%)	1023 (13%)	
Type of residence	Rural	374 (77%)	118 (23%)	0.857	4376 (89%)	553 (11%)	0.016
	Urban	734 (77%)	230 (23%)		8766 (88%)	1280 (12%)	
Perceived income	Good	531 (77%)	170 (23%)	0.922	7707 (88%)	1064 (12%)	0.462
	Bad	577 (77%)	178 (23%)		5435 (88%)	769 (12%)	
Income quintile	1 (lowest)	319 (76%)	100 (24%)	0.978	2663 (87%)	411 (13%)	0.021
	2	258 (77%)	80 (23%)		2631 (88%)	378 (12%)	
	3	223 (77%)	70 (23%)		2722 (88%)	366 (12%)	
	4	175 (76%)	57 (24%)		2646 (88%)	389 (12%)	
	5 (highest)	133 (78%)	41 (22%)		2480 (90%)	289 (10%)	
Self-perceived health status	Good	788 (80%)	205 (20%)	<0.001	11,915 (90%)	1446 (10%)	<0.001
	Poor	319 (70%)	143 (30%)		1208 (76%)	383 (24%)	
Overweight, obesity status	Overweight or obese	671 (75%)	229 (25%)	0.076	7112 (87%)	1168 (13%)	<0.001
	Not overweight or obese	430 (79%)	119 (21%)		5957 (90%)	653 (10%)	
Smoking status	No	742 (74%)	270 (26%)	<0.001	9168 (86%)	1549 (14%)	<0.001
	Yes	356 (83%)	72 (17%)		3898 (94%)	272 (6%)	
Last meeting with a doctor	≥ 12 months	108 (90%)	14 (10%)	<0.001	3428 (96%)	167 (4%)	<0.001
	< 12 months	1,000 (75%)	334 (25%)		9668 (86%)	1664 (14%)	
Last meeting with a specialist	≥ 12 months	212 (88%)	34 (12%)	<0.001	5532 (92%)	468 (8%)	<0.001
	< 12 months	894 (74%)	314 (26%)		7518 (85%)	1362 (15%)	
Satisfaction with the doctor	Satisfied	897 (76%)	292 (24%)	0.647	10,489 (87%)	1575 (13%)	<0.001
	Not satisfied or neutral	186 (78%)	53 (22%)		2156 (91%)	205 (9%)	
Satisfaction with the specialist	Satisfied	650 (75%)	234 (25%)	0.155	7128 (86%)	1204 (14%)	<0.001
	Not satisfied or neutral	390 (78%)	106 (22%)		4123 (90%)	472 (10%)	
Region (NUTS 2)	Central Hungary	287 (76%)	97 (24%)	0.249	3411 (88%)	510 (12%)	0.002
	Southern Great Plain	148 (80%)	38 (20%)		1811 (89%)	229 (11%)	
	Southern Transdanubia	107 (69%)	50 (31%)		1259 (88%)	182 (12%)	
	Northern Great Plain	196 (79%)	56 (21%)		2165 (90%)	245 (10%)	
	Northern Hungary	164 (79%)	42 (21%)		1609 (87%)	252 (13%)	
	Central Transdanubia	112 (80%)	34 (20%)		1467 (86%)	240 (14%)	
	Western Transdanubia	94 (75%)	31 (25%)		1420 (90%)	175 (10%)	
Physical activity	Complete inactivity	292 (71%)	125 (29%)	0.003	2739 (84%)	522 (16%)	<0.001
	Minimal activity	537 (77%)	162 (23%)		6538 (89%)	845 (11%)	
	Health improving physical activity	279 (82%)	61 (18%)		3865 (90%)	466 (10%)	
Cardiovascular or cerebrovascular disease	No	462 (85%)	81 (15%)	<0.001	8799 (93%)	669 (7%)	<0.001
	Yes	646 (71%)	267 (29%)		4343 (79%)	1164 (21%)	

Table 1 (continued)

Factor	Strata	Self-reported respiratory disease: Yes			Self-reported respiratory disease: No		
		Not vaccinated within a year n (weighted %)	Vaccinated within a year n (weighted %)	p-Value	Not vaccinated within a year n (weighted %)	Vaccinated within a year n (weighted %)	p-Value
Year	2009	411 (77%)	128 (23%)	0.758	3917 (87%)	594 (13%)	0.003
	2014	343 (76%)	112 (24%)		4736 (88%)	633 (12%)	
	2019	354 (78%)	108 (22%)		4489 (89%)	606 (11%)	

Data are presented as unweighted frequencies and survey-weighted percentages. *P*-values were obtained from survey-weighted tests of independence

year was also assessed, along with the seven Hungarian regions, based on the nomenclature of territorial units for statistics (NUTS 2), furthermore urban and rural type of residence.

Statistical methods

Descriptive statistics were calculated separately for respondents with and without self-reported respiratory diseases. Bivariate associations between influenza vaccination uptake and explanatory variables were examined using survey-weighted Pearson chi-squared tests. Results are presented as unweighted frequencies and survey-weighted percentages. Sampling weights provided with the EHIS datasets were applied in all analyses to account for unequal probabilities of selection and improve the population representativeness of the estimates. A confounder-adjusted multiple logistic regression model was fitted to identify factors associated with influenza vaccine uptake. In accordance with the primary objective of the study, the multiple analysis was restricted to respondents with self-reported respiratory diseases. Covariates were selected based on their conceptual relevance to influenza vaccination uptake and their consistent availability across all three survey waves, and all selected variables were entered simultaneously into the model. Adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated to assess associations, accounting for all covariates included in the model. Analyses were conducted using complete cases, without imputation of missing values. Model fit was evaluated using a survey-adjusted goodness-of-fit test, and multicollinearity was assessed using variance inflation factors (VIF). Statistical analysis was conducted using Stata software (version 13.0, StataCorp, College Station, TX, USA). Significance was defined as a two-sided *p*-value < 0.05 for bivariate analyses, whereas significance in the regression model was assessed using 95% CIs for the AORs.

Results

Descriptive and bivariate analyses of factors associated with influenza vaccination uptake.

The initial sample included respondents with self-reported respiratory diseases (*n* = 1,456) and those without such conditions (*n* = 14,975). Influenza vaccination uptake within the past year was higher among individuals with respiratory diseases (24%; *n* = 348) than among those without respiratory diseases (12%; *n* = 1,833). Among respondents with respiratory diseases, vaccination coverage remained stable across survey years (*p* = 0.758), ranging from 23% in 2009 to 24% in 2014 and 22% in 2019, with no significant temporal trend (Table 1). Among respondents without respiratory diseases, vaccination uptake decreased from 13% in 2009 to 12% in 2014 and 11% in 2019, and the difference between survey years was significant (*p* = 0.003).

Vaccination rates significantly increased with age in both groups (*p* < 0.001); among those with respiratory diseases, 9% of individuals aged 18–34 was vaccinated compared with 19% of those aged 35–64 and 38% of those aged ≥ 65. Among those without respiratory diseases, vaccination rates increased from 4% in the youngest age group to 9% and 30% in the middle-aged and older groups, respectively.

Sex was not significantly associated with vaccination uptake in either group. However, among those with respiratory diseases, 23% of male and 24% of female respondents were vaccinated ($p=0.775$). Similarly, among those without respiratory diseases, 12% of both male and female respondents were vaccinated ($p=0.312$).

Educational level was associated with vaccination coverage in both groups based on the univariate analysis. Among respondents with respiratory diseases, those with tertiary education (28%) and primary education (29%) had significantly ($p=0.002$) higher vaccination rates than those with secondary education (20%). For those without respiratory diseases, a similar trend was observed, with vaccination rates of 15%, 14%, and 11% for tertiary, primary, and secondary education levels, respectively ($p<0.001$).

Marital status was not significantly associated with vaccination uptake among individuals with respiratory diseases ($p=0.806$). However, among those without respiratory diseases, respondents who were married or had a partner were slightly more likely to be vaccinated (13%) than those without a partner (11%; $p<0.001$).

Type of residence showed a significant association with vaccination among those without respiratory diseases, with urban residents being slightly more likely to receive the influenza vaccine (12%) than residents from rural area (11%; $p=0.016$). No significant difference was observed for individuals with respiratory diseases for this stratum ($p=0.857$).

Self-perceived income showed no significant association with influenza vaccination among respondents with respiratory diseases ($p=0.922$) because rates were 23% for both groups. Among those without respiratory diseases, the vaccination rates were the same (12%) in both groups ($p=0.462$). Income measured in quintiles was not significantly associated with vaccination among individuals with respiratory diseases ($p=0.978$), with rates consistently at 22%–24% across all strata. Among respondents without respiratory diseases, income quintile was significantly associated with vaccination uptake, although absolute differences were small, with rates ranging from 10% to 13% ($p=0.021$).

Self-perceived health status was strongly associated with vaccination uptake in both groups. Among individuals with respiratory diseases, those with poor self-perceived health had higher vaccination rates (30%) than those with good self-perceived health status (20%; $p<0.001$). A similar trend was seen among those without respiratory diseases, in which vaccination rates were 24% in individuals with poor health compared with 10% in those with good health ($p<0.001$).

Being overweight or obese was not significantly associated with influenza vaccination among individuals with respiratory diseases ($p=0.076$); thus, vaccination coverage was 25% for those who were overweight or obese and 21% for those who were not overweight or obese. Among individuals without respiratory diseases, a significant association was observed ($p<0.001$) regarding this factor, with higher vaccination rates among those who were overweight or obese (13%).

Smoking status was associated with vaccination uptake in the bivariate analysis, as smokers with respiratory diseases were less likely to be vaccinated (17%) than non-smokers (26%; $p<0.001$). Among those without respiratory diseases, vaccination rates were considered as low, with 6% and 14% for smokers and non-smokers, respectively ($p<0.001$).

Among individuals with respiratory diseases, those who visited a doctor within the past year were significantly ($p<0.001$) more likely to be vaccinated (25%) than those whose last visit was over a year ago (10%). Similarly, for those without respiratory diseases, recent doctor visits were associated with higher vaccination rates (14% vs. 4%; $p<0.001$). Specialist visits showed a similar trend and association. Among respondents with respiratory diseases, 26% of those who met a specialist within the past year were vaccinated compared with 12% of those who had not ($p<0.001$). For those without respiratory diseases, vaccination rates were also higher among those with more frequent specialist visits (15% vs. 8%; $p<0.001$).

Satisfaction with these healthcare providers was not significantly associated with vaccination rates among individuals with respiratory diseases ($p=0.647$), with rates of 24% for those satisfied and 22% for those neutral or dissatisfied. However, among those without respiratory diseases, satisfaction was significantly associated with higher vaccination rates. Satisfied individuals had a vaccination rate of 13% compared with 9% for those neutral or dissatisfied ($p<0.001$). Among respondents with respiratory diseases, vaccination rates were higher for those

satisfied with their specialist (25%) than for those neutral or dissatisfied (22%; $p=0.155$); however, this result was not significant. For those without respiratory diseases, vaccination rates were higher among those who were satisfied with their specialist (14% vs. 10%; $p<0.001$).

No significant association was found between regions and vaccination rates among individuals with respiratory diseases ($p=0.249$) with vaccination rates ranged from 20% to 31% across regions. Among those without respiratory diseases, regional differences were significant ($p=0.002$), with vaccination rates ranging from 10% to 14%.

Physical activity showed a negative gradient, since higher vaccination rates were observed among those who were not engaging in health-improving activities ($p=0.003$; $p<0.001$) in both groups.

Cardiovascular or cerebrovascular disease, evaluated as comorbidity, was significantly associated with vaccination rates. Among individuals with respiratory diseases, those with cardiovascular disease were more likely to be vaccinated (29%) than those without (15%; $p<0.001$). In the group without respiratory diseases, vaccination rates were 21% for individuals with cardiovascular disease and 7% for those without ($p<0.001$).

Multiple logistic regression analysis of factors associated with influenza vaccination uptake

Based on the results obtained from the multiple regression executed among respondents with self-reported respiratory disease, age group was found to be a significant factor, with individuals aged 35–64 having 2.18 (AOR = 2.18 [1.17–4.06]) times higher odds of being vaccinated against influenza compared with those aged 18–34 (Table 2). Furthermore, the oldest age group (≥ 65 years) had even greater odds (AOR = 5.02 [2.63–9.57]) than the youngest age group. Sex was not a significant factor; however, compared with males, females (AOR = 0.87 [0.64–1.19]) had slightly lower odds of vaccination. Educational level did not show a consistent effect on vaccination odds because respondents with secondary education (AOR = 0.77 [0.54–1.11]) had lower, but not statistically significant, odds of vaccination than those with primary education. Thus, those with tertiary education had slightly higher odds of vaccination; however, this was also not significant (AOR = 1.30 [0.77–2.19]). Smoking status was not a significant factor regarding vaccination uptake, with non-smokers having 33% (AOR = 1.33 [0.94–1.88]) higher odds of vaccination than smokers. Healthcare utilization was significantly associated with influenza vaccination uptake. Respondents whose last doctor or specialist visit had occurred > 12 months had lower odds of vaccination than those who had visited these providers within the previous 12 months (doctor, AOR = 0.45; 95% CI 0.23–0.91; specialist, AOR = 0.48; 95% CI 0.31–0.75). In contrast, satisfaction with the doctor or specialist was not significantly associated with vaccination uptake. The presence of cardiovascular or cerebrovascular diseases was associated with 55% (AOR = 1.55 [1.09–2.19]) higher odds of vaccination. Survey year was not significantly associated with vaccination uptake in the adjusted model, since compared with 2009, the odds of vaccination did not differ significantly in 2014 (AOR = 0.99; 95% CI 0.68–1.44) or 2019 (AOR = 0.75; 95% CI 0.52–1.09).

Several variables were not significantly associated with vaccination uptake in the adjusted model, including sex, educational level, marital status, type of residence, income indicators, self-perceived health, overweight or obesity, smoking status, satisfaction with healthcare providers, physical activity, region, and survey year.

The final regression model was based on complete cases (unweighted $n=1,314$). The model showed no evidence of poor fit ($p=0.883$), and multicollinearity diagnostics did not indicate substantial collinearity affecting the main estimates (mean VIF = 2.16).

Discussion

In this study, factors associated with influenza vaccination uptake among adults were examined with self-reported respiratory diseases in Hungary, using representative data from the Hungarian waves of the EHIS conducted in 2009, 2014, and 2019.

Table 2 Results of the multiple regression regarding factors associated with influenza vaccination among individuals with respiratory diseases

Factor	Level	Respiratory disease: Yes		
		Adjusted Odds Ratio	95% Confidence Intervals	
Age group	35–64/18–34	2.18	1.17	4.06
	≥ 65/18–34	5.02	2.63	9.57
Sex	Female/male	0.87	0.64	1.19
Educational level	Secondary/primary	0.77	0.54	1.11
	Tertiary/primary	1.30	0.77	2.19
Marital status	Married or have a partner/not have a partner	0.92	0.68	1.25
Type of residence	Urban/rural	0.93	0.67	1.28
Perceived income	Bad/good	0.84	0.41	1.76
Income quintile	2/1	1.01	0.66	1.53
	3/1	0.85	0.37	1.97
	4/1	1.16	0.50	2.68
	5/1	1.30	0.53	3.15
Self-perceived health status	Poor/good	1.16	0.84	1.62
Overweight, obesity status	Not overweight or obese/overweight or obese	1.05	0.77	1.43
Smoking status	Non-smoker/smoker	1.33	0.94	1.88
Last meeting with a doctor	≥ 12/<12 months	0.45	0.23	0.91
Last meeting with a specialist	≥ 12/<12 months	0.48	0.31	0.75
Satisfaction with the doctor	Not satisfied or neutral/satisfied	1.06	0.71	1.57
Satisfaction with the specialist	Not satisfied or neutral/satisfied	0.92	0.67	1.26
Region (NUTS 2)	Central Hungary	Reference		
	Southern Great Plain	0.76	0.46	1.25
	Southern Transdanubia	1.48	0.88	2.50
	Northern Great Plain	0.77	0.49	1.21
	Northern Hungary	0.90	0.55	1.48
	Central Transdanubia	0.87	0.51	1.49
	Western Transdanubia	0.98	0.56	1.71
	Minimal activity/complete inactivity	0.88	0.64	1.22
Physical activity	Health-enhancing physical activity/complete inactivity	0.75	0.48	1.15
Cardiovascular or cerebrovascular disease	Yes/no	1.55	1.09	2.19
Survey year	2014/2009	0.99	0.68	1.44
	2019/2009	0.75	0.52	1.09

Estimates were weighted using the survey sampling weights. All variables shown were included simultaneously in the model. The analysis was based on complete cases (unweighted $n=1,314$)

Our analysis showed low influenza vaccination rates among individuals with self-reported respiratory diseases over the total study period. Although minor differences were observed between survey years, vaccination coverage did not change significantly in this group, highlighting persistently suboptimal coverage instead of a temporal improvement. This finding is concerning because individuals with chronic respiratory diseases represent a high-risk group for influenza-related complications. Further aggravates the fact that the similar challenges have also been reported among other high-risk populations, including older adults and individuals with cardiovascular disease, suggesting that insufficient vaccination uptake is not limited to adults with respiratory diseases [24, 25]. Thus, several factors may contribute to low vaccination coverage, including vaccine hesitancy, changing public perceptions about vaccination, limited perceived risk and potential barriers in healthcare access or delivery [26–31]. These findings highlight the urgent need to better understand barriers to vaccination uptake among high-risk groups such as those with respiratory diseases. Therefore, strengthened communication between healthcare providers and patients, targeted outreach, and policy-level strategies may be relevant considerations for future public health efforts targeting vaccination uptake in this high-risk groups [32–38].

Among the factors analyzed, age was one of the most imperative factors associated with influenza vaccination uptake, with older individuals being more likely to receive the influenza vaccine. This finding is consistent with prior research highlighting the older group as a key target group for influenza vaccination owing to their increased risk of severe complications [24, 39, 40]. However, the overall vaccination coverage remained suboptimal even among older adults with respiratory diseases, suggesting that age-based recommendations alone may not be sufficient to achieve adequate vaccination coverage in this risk group.

Recent healthcare contact was also significantly associated with influenza vaccination uptake. Individuals who had visited a doctor or a specialist within the previous 12 months were more likely to be vaccinated than those without recent healthcare contact. This association may reflect the essential role of healthcare professionals including greater healthcare engagement, more frequent opportunities for vaccine recommendation, or closer follow-up. It may also be a marker of greater disease severity or other unmeasured differences between respondents rather than a direct effect of healthcare utilization. Previous studies have also emphasized the role of healthcare professionals as trusted sources of information and the importance of provider recommendations in vaccination decisions [41–44]. However, owing to the cross-sectional design of this study, this association should not be interpreted as causal. Nevertheless, routine healthcare encounters may represent important opportunities to discuss and recommend influenza vaccination to patients with chronic respiratory diseases. Cardiovascular or cerebrovascular comorbidity was significantly associated with higher influenza vaccination uptake among individuals with respiratory diseases. This may reflect greater perceived vulnerability, more frequent contact with healthcare services, multimorbidity-related clinical and medical attention, or more focused prioritization of vaccination among patients with multiple chronic conditions. Similar findings have been reported in relation to chronic cardiovascular conditions and preventive behavior [25, 29, 45–48]. However, the present study could not directly assess perceived risk, physician recommendation, or individual motivation for vaccination.

Several sociodemographic and lifestyle-related factors were not significantly associated with vaccination uptake in the confounder-adjusted analysis, including sex, educational level, marital status, type of residence, perceived financial situation, region, smoking status, physical activity, and self-perceived health. These findings suggest that among respondents with self-reported respiratory diseases, vaccination uptake was more strongly associated with age, comorbidity, and recent healthcare contact than with broader sociodemographic or lifestyle characteristics. Although smokers had lower vaccination uptake in the bivariate analysis, this association was attenuated after adjustment, suggesting that other factors, such as age, comorbidity, or healthcare utilization, may partly explain the crude difference. However, the lack of significant associations should not be interpreted as evidence that socioeconomic, behavioral, or territorial barriers are absent because the study did not directly measure access to vaccination, health literacy, vaccine recommendation, or affordability-related barriers.

In summary, the presented findings highlight the persistently low influenza vaccination uptake among Hungarian adults with self-reported respiratory diseases. Vaccination coverage remained suboptimal even among older adults and those with cardiovascular or cerebrovascular comorbidity, who are at increased risk of influenza-related complications. Rather than indicating a clear temporal decline, the results suggest a lack of meaningful improvement over time. Therefore, more focused and proactive approaches may be needed to improve vaccination uptake in this high-risk group, including the systematic use of routine healthcare encounters to recommend influenza vaccination and the consideration of high-risk groups beyond age-based criteria in vaccination-related public health strategies.

Strengths and limitations

Study strengths include the use of large, nationwide population-based datasets from three waves of the EHIS and the application of survey weights to improve the population representativeness of the estimates with robust multiple analysis adjusted for potential confounding factors. The study also assessed influenza vaccination uptake

specifically among adults with self-reported respiratory diseases, a high-risk group for whom routinely available national vaccination coverage indicators are limited.

However, several limitations should be considered. First, influenza vaccination uptake and respiratory disease status were based on self-reported questionnaire data, which may have introduced recall bias or misclassification. The respiratory disease group was defined based on self-reported asthma and/or chronic bronchitis, and information on physician-confirmed diagnosis, disease severity, treatment, or clinical phenotype was not available. Therefore, disease-specific or severity-based analyses could not be performed. Second, the survey data could not be linked to general practitioner records, immunization registries, or other clinical databases; therefore, self-reported vaccination status could not be externally validated. Third, the cross-sectional design precludes causal interpretation of the observed associations. Factors such as vaccine hesitancy, physician recommendation, access barriers, health literacy, and previous vaccination history were not available in the dataset, although they may influence vaccination uptake. Finally, missing covariate data were handled using complete-case analysis; although survey weights were applied, separate sampling strata and primary sampling unit identifiers were not available in the analytical dataset; therefore, variance estimates may not fully reflect all elements of the original complex survey design. Because several bivariate comparisons were performed, the possibility of type I error due to multiple testing should also be considered; therefore, these results should be interpreted primarily as descriptive and exploratory.

Conclusions

This study highlights low influenza vaccination coverage among individuals with self-reported respiratory diseases in Hungary. Although vaccination uptake was higher in this group than among respondents without respiratory diseases, it remained suboptimal given their increased risk of severe influenza-related complications. No significant difference in vaccination uptake was observed across the survey years. Older age, recent healthcare contact, and cardiovascular or cerebrovascular comorbidity were associated with higher vaccination uptake. These findings suggest that younger adults with respiratory diseases and those with less frequent healthcare contact may require greater attention in vaccination promotion. Furthermore, routine healthcare encounters may provide important opportunities to recommend influenza vaccination as part of chronic disease management.

Abbreviations

AORs	adjusted odds ratios
95% CI	95% confidence intervals
EHIS	European Health Interview Survey
EU	European Union
VIF	variance inflation factors

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Data availability The data that support the findings of this study are available from the Hungarian Central Statistical Office, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. The data are, however, available from the corresponding author upon reasonable request and with the prior permission of the Hungarian Central Statistical Office.

Declarations

Ethics approval and consent to participate The research was carried out in accordance with the Declaration of Helsinki's principles, and it received approval from the University of Debrecen's Ethics Committee (5609–2020) in accordance with Regulation 2016/679—Protection of Natural Persons regarding the Processing of Personal Data and on the Free Movement of Such Data and repealing Directive 95/46/EC (General Data Protection Regulation). Informed consent was obtained from all the participants by the Hungarian Central Statistical Office. Clinical trial number: not applicable.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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