Eilers et al. BMC Public Health (2025) 25:1124
https://doi.org/10.1186/s12889-025-22144-1

BMC Public Health

RESEARCH

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Influence of perceived influenza-like symptoms on intention to receive seasonal influenza vaccination

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Abstract

Background The increase in the older adult population over the coming decades emphasizes the importance of vaccinations to prevent infectious diseases among this population. Acceptance of vaccination is crucial for a successful vaccination program and insight in the motives of acceptation is therefore important. This study explores specifically the association between experiencing influenza-like illness (ILI) and other determinants for older adults on seasonal influenza vaccination acceptance. Furthermore, differences in acceptance of pneumococcal, influenza, herpes zoster and pertussis vaccines between various age groups were studied.

Methods Three prospective observational studies (2011/2012, 2012/2013 and 2014/2015) were performed in community-dwelling older adults (≥ 60 years) to monitor ILI. During home visits, throat/nose swabs, a blood sample and a questionnaire on demographics and general health were collected. An additional questionnaire was added to the 2014/2015 study on motives and intention of older adults to accept seasonal influenza and other vaccinations, including knowledge statements on vaccination in general ($n = 1647$). Random Forest analyses were used to identify predictors of intention to accept seasonal influenza vaccination.

Results Univariate analyses showed that males, persons with limited contact with children, people who have received seasonal influenza vaccination in 2014/2015, persons reporting co-morbidity, persons reporting a lower perceived health and persons with more knowledge about vaccination have a significantly higher intention to accept seasonal influenza vaccination. The univariate and prediction analyses showed no association between having experienced ILI and the intention to receive seasonal influenza vaccination. Previous influenza vaccination had by far the most predictive value; when excluding this factor, age and perceived health were the best predictors. Except for pertussis vaccination, persons aged ≥ 70 years had a higher intention to vaccinate compared to persons aged 60–69 years.

Conclusions Our study showed that there is no association between having experienced ILI and the intention to receive seasonal influenza vaccination. Instead, previous influenza vaccination had the highest predictive value. Therefore, efforts should be made to make vaccination a habit to ensure annual vaccination. Healthcare workers, such

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as general practitioners (GPs) could play an important role in this because of frequent contact between older adults and GPs and the perceived importance of the advice of the GP.

Trial registration NTR4818 (30-09-2014).

Keywords Vaccine acceptance, Determinants, Influenza vaccination, Influenza-like illness

Background

The older adult population will increase over the coming years due to, among other things, the increasing life expectancy [1]. For the EU-28 countries, it is projected that the proportion of people aged 65 years and older of the whole population will increase from 19% in 2016 to 30% in 2050 [2]. With increasing age, also the burden of disease will increase, leading to more hospitalizations and deaths among older adults compared to the younger population (≤60 years). As a result, healthcare costs for this older population will rise significantly [2]. One of the measures that could prevent or reduce part of the disease burden, and could therefore contribute to healthy ageing, is vaccination against infectious diseases.

Vaccination programs with a focus on older adults of 60 or 65 years and older are implemented in most European countries. This mostly concerns influenza vaccination but also pneumococcal, herpes zoster and pertussis vaccination [3]. In the Netherlands, influenza vaccination is offered to people aged 60 years and older and specific medical risk groups. During the 2021 campaign, 58.3% of these vaccine eligible individuals were vaccinated. In 2018, the Dutch Health Council advised that persons aged 60 years and older should also be vaccinated against pneumococcal disease. As a result, pneumococcal vaccination was implemented in the Netherlands in autumn of 2020, starting with 73 to 79 year-olds of whom 73% was vaccinated that season [4]. This age group has the highest risk of serious pneumococcal infection-related complications or severe COVID-19 [5]. For herpes zoster, a new positive advice of the Health Council was published in 2019, but since a large scale vaccination program was not considered cost-effective the program has so far not been implemented [6]. For pertussis vaccination there is no specific advice from the Dutch Health Council for the older adult population [7].

For a vaccination program to be successful as an intervention to reduce the number of infectious diseases-related hospitalisations, the acceptance of vaccination is crucial to reach the highest possible vaccination coverage [8]. Vaccination acceptance rates have fluctuated since the implementation of vaccination programs. Since vaccination decision-making is considered behavioural science, insight in the motives and intention of older adults to accept influenza vaccination and other vaccinations is important. It becomes increasingly important as the acceptance rate for influenza vaccination has slowly been declining in the Netherlands, from a vaccination coverage of 75.4% in 2010 to 54.8% in 2019 and 55% in 2023 [9–11].

Vaccination of older adults is especially important because immunosenescence, which is the gradual deterioration of the immune system, co-morbidity, and general frailty are all highly prevalent in this target population. This results in a higher susceptibility to infectious diseases and higher mortality and morbidity rates in older persons than in young adults. In addition, infections may result in irreversible frailty and, thereby, increased dependence on long-term healthcare. Vaccinating persons aged 50 and older against vaccine-preventable diseases (VPDs) can be a strategy to promote healthy aging [10].

Determinants that play a role in the vaccination decision-making of Dutch older adults were identified in an earlier literature review [12] and a focus group study [13]. These studies showed that the advice of the general practitioner was an important factor. Other factors involved in decision making were general attitude towards vaccination, beliefs regarding the effectiveness and side-effects of the vaccine in general, and beliefs regarding the severity of and susceptibility to vaccine preventable diseases [12, 13]. Also, an international review of studies on the barriers of influenza vaccination intention and behaviour found that similar psychological determinants, as mentioned above, were related [14]. In this same review, nine studies related experiencing an episode of influenza to vaccine uptake: individuals who did not suffer from influenza before were less likely to be vaccinated in subsequent seasons [14]. However, none of these studies included older adults.

In the current study, we investigated if there is an association between experiencing influenza-like illness (ILI) and the intention of older adults to accept seasonal influenza vaccination. In addition, reasons for acceptance and refusal of previous seasonal influenza vaccination were addressed and differences in acceptance of pneumococcal, influenza, herpes zoster and pertussis vaccination between various age groups were determined. The results of this study could be used as input for yearly national vaccination campaigns to increase the acceptance of influenza vaccination and vaccination in general among older adults.

Methods

Study design, population and data collection

Three prospective observational studies "Identification of potential pathogens responsible for influenza-like illness and evaluation of humoral and cellular immunity against identified microorganisms in elderly in the Netherlands " (ILI-1 (2011/2012), ILI-2 (2012/2013) and ILI-3 (2014/2015) studies were performed in community-dwelling older adults, aged ≥ 60 years, from the North Western part of the Netherlands, to monitor ILI incidence during the influenza season (October-April) and determine the contribution of influenza virus and other respiratory pathogens to ILI [15, 16]. At time of inclusion of the ILI-3 (2014/2015) study, data on demographics was collected for all participants. When the older adults reported ILI, based on the criteria of Pell [17], which is defined by fever (≥ 37.8°C) with at least one other symptom of headache, myalgia, sore throat, coughing, rhinitis, or chest pain, a home visit was performed by a research nurse within 72 hours of ILI onset ('ILI-group'). During this visit, a second questionnaire on co-morbidities was competed and upper respiratory tract swabs were collected to determine the possible causative agents of the ILI [15, 16]. The same information and material was collected from a subset of participants from the 'no ILI-group', who did not have an ILI up till that moment of the study. These individuals ('no ILI group' subset) were selected based on equal division over the age groups (60–64, 65–69, 70–74, 75–79 and ≥ 80 years) and over the study period from October 2014 to March 2015 [15, 16]. At the end of the study period, all participants of the ILI-3 (2014/2015) study, both the 'ILI group' and the 'no ILI-group' received a questionnaire on motives and intention of older adults to accept seasonal influenza and other vaccinations, including knowledge statements on vaccination in general. The questions were based on a previously performed focus group study on the determinants of vaccine acceptance among older adults [12, 13]. The participants were unaware at this time if their symptoms were caused by an influenza virus infection. No exclusion criteria were defined.

For the ILI-1 (2011/2012) study, 444 of 1046 eligible older adults had been contacted by the general practitioner to participate. All other older adults were approached via the Civil Registry by postal mail. Figure 1 shows a flowchart of the inclusion of the study participants.

The study was performed according to Good Clinical Practice, the Declaration of Helsinki and written informed consent was obtained from all participants. The study was approved by the ethical committee (ICTRP Search Portal (who.int); NTR3386 (06-04-2012) and NTR4818 (30-09-2014).

The questionnaire on 'vaccine acceptance'

The questionnaire consisted of four parts. The questions of the first two parts were based on a previous focus group study on the willingness to accept vaccination [13]. First, participants were asked to indicate what their most important reason was as well as other reasons from a pre-defined list of nine (including other) arguments to accept influenza vaccination and ten arguments (including other) not to accept influenza vaccination (in the past season 2014/2015). These included amongst others the perceived susceptibility, the severity of the disease, the perceived vaccine effectiveness and the advice of the general practitioner (see Results section).

Second, the questionnaire contained questions on the knowledge about vaccination in general. For every statement, participants indicated whether they thought the statement was true, false or did not know. Table 1 shows the included eight statements to measure knowledge on vaccination with the correct answer. A knowledge score was calculated by assigning 1 point to each correct answer.

Third, the intention to accept vaccination was measured. For general intention, the following three statements were used: (1) I am willing to receive a vaccination that protects against infectious diseases, (2) If a vaccine that protects against infectious diseases was offered to me, I will accept this vaccine, (3) I intend to accept a vaccine that protects against infectious diseases. The statements were measured by a 7-point Likert scale ranging from 'totally disagree' to 'totally agree'.

In addition, the intention to accept seasonal influenza vaccination, pneumococcal vaccination, herpes zoster vaccination and pertussis vaccination was measured with one statement using a 7-point Likert scale ranging from 'not at all willing' to 'very willing'.

And fourth and last different demographic variables were included in the questionnaire, such as age, sex, educational level, and household composition (see also variables in Table 2). In addition, participants were asked to evaluate their own health on a scale, derived from the EQ-5D (https://euroqol.org/), and to indicate their fre quency of contact with children < 5 years and whether they received seasonal influenza vaccination in previous years. Note, co-morbidity data were collected by another questionnaire that was filled in during the home visits as was mentioned in the paragraph above. See Table 2 for answer categories.

Statistical analyses

For age, five year age classes were made: 60–64, 65–69, 70–74, 75–79, 80–84 and ≥ 85 years. Only in the analysis studying differences in acceptance of influenza, pneumococcal, herpes zoster and pertussis vaccination between various age groups, age was categorized as 60–70, 70–80

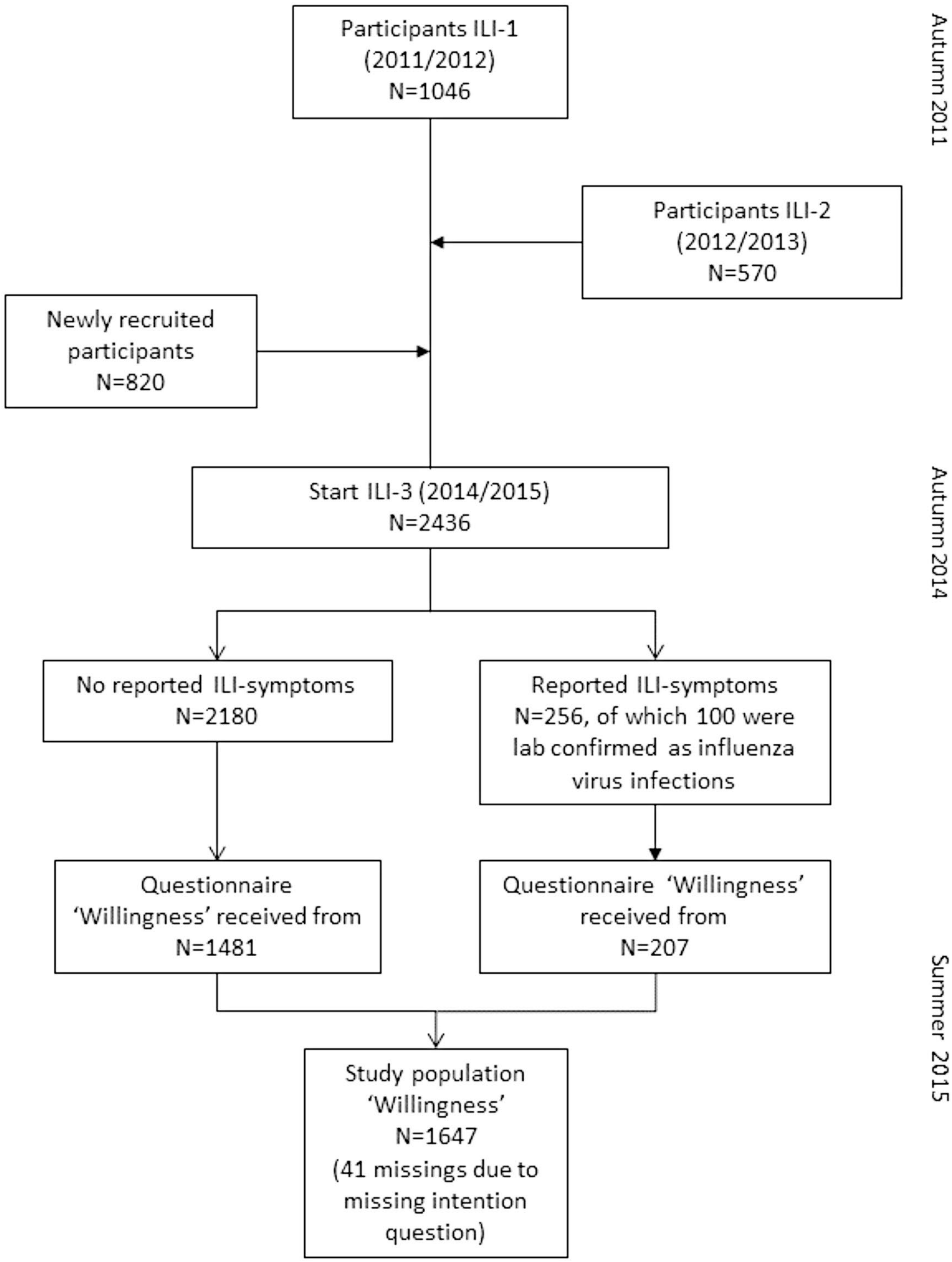

Fig. 1 Flowchart of inclusion of participants in this study. The questionnaires on vaccine acceptance and knowledge statements on vaccination were added to the ILI-3 (2014/2015) study

and ≥ 80 years to be able to make a comparison with other studies. For knowledge and the perceived health score, a median score was calculated and used as a cut-off to create a dichotomous variable to include in the analyses. The three statements on the general vaccination intention were grouped into one variable based on the Cronbach's Alpha score of > 0.6.

Univariate analyses were performed in SAS^{R} (94 M7 English Version) for the following variables (in categories): age, sex, educational level, presence of co-morbidity,

Table 1 Knowledge statements

Statement	Correct answer
Vaccination protects against infectious diseases	True
Vaccination is redundant for healthy people	False
A vaccine is released only after it is has been rigorously tested	True
Vaccinations always protect 100% against the disease for which vaccination is given	False
Vaccination also protects people around you	True
Every vaccination needs to be repeated	False
Vaccinations for traveling abroad are obligatory	False
The flu vaccination is not obligatory	True

household composition, frequency of contact with children < 5 years, having received influenza vaccination (season 2014–2015), having experienced influenza-like illness (2014/2015) during the ILI-3 (2014–2015) study period (October 2014-April 2015), perceived health score and knowledge score to see whether they were related to the outcome variable intention to accept the coming seasonal influenza vaccination (mean scores). In addition, variable 'study group' (i.e. ILI-study year a participant first participated in the longitudinal study) was included in univariate analysis, where 726 participants participated in all three ILI-studies (group ILI-1 (2011/2012)), 402 participants participated in the ILI-2 (2012/2013) and ILI-3 (2014/2015) study (group ILI-2 (2012/2013)) and 518 only participated in the ILI-3 (2014/2015) study (group ILI-3 (2014/2015)) ($N = 1646$). Depending on the outcome measure of the independent variables, either an ANOVA test or an independent t-test was performed. A p-value of ≤ 0.05 was considered statistically significant.

Random Forest is an algorithm that predicts an outcome of an individual by means of predictor variables. One of the things that the Random Forest algorithm does, is to estimate the importance of each variable. In essence, this is defined as the average proportional increase in probability of misclassification (pmc), hence worsening of the predictor's accuracy, that results from replacing the value of the variable in question on an individual whose outcome is to be predicted by a value chosen at random [18]. A prediction model, using R package randomForest [18], was created to identify predictors of the intention to accept the seasonal influenza vaccinations. Intention was dichotomized by taking categories 1–3 (not willing) together and categories 4–7 (willing or neutral). Included predictor variables were all variables shown in Table 2. In addition, variable 'study group' was included in the Random Forest analysis, where 726 participants also participated in the ILI-1 (2011/2012) study, 402 participants also participated in the ILI-2 (2012/2013) study and 518 only participated in the ILI-3 (2014/2015) study ($N = 1646$). The whole study population ($N = 1646$) was taken into account by including missing categories.

A MANOVA-test was used to determine associations between age groups and the intention to accept vaccination against influenza, pneumococcal disease, herpes zoster and pertussis and the general intention to accept vaccination.

Results

Study population characteristics

In total, 2436 participants were included for the ILI-3 (2014/2015) study of which 1046 participants also participated in the ILI-1 (2011/2012) study and 570 participants also participated in the ILI-2 (2012/2013) study (see Fig. 1). During the ILI-3 (2014/2015) study, 256 participants (11%) indicated having experienced ILI in 2014/2015, of which in 100 (39%) persons the influenza virus was detected. 2180 participants did not report any symptoms. For a subgroup of individuals of the 'no ILI-group' individuals ($N = 205$) full information on co-morbidities was available as a home visit was performed [16]. In total, 1688 (69% response) persons returned the questionnaire on vaccine acceptance and knowledge. Of the 1688 persons, 1647 answered the question on the intention to accept influenza vaccination. Table 2 shows the characteristics of the study population. About half of the participants was male, educational level was evenly distributed among the study population, and about half of the participants aged between 60 and 69 years, about 35% between 70 and 79 years of age and 15% aged 80 years or older. Most participants lived with their partner and had seldom or never contact with children < 5 years of age. Co-morbidities were reported by 130 (7.9%) participants, 190 participants (11.5%) indicated having experienced ILI symptoms, and 1111 participants (67.5%) had received an influenza vaccination in 2014/2015.

Univariate analyses

Univariate analyses (Table 2) showed that men compared to women, persons with seldom or never contact with children compared to the other categories, people who have received seasonal influenza vaccination in 2014/2015 compared to those who did not receive vaccination, persons reporting co-morbidity to those who did not report co-morbidity, persons reporting a health score of ≤ 80 compared to those who reported a health score > 80, and persons scoring higher than five on knowledge about vaccination compared to those who scored equal or lower than five had a significantly higher intention to accept seasonal influenza vaccination. Furthermore, persons between the age of 60–64 had the lowest and persons in the three oldest age groups (75–79, 80–84 and ≥ 85 years) had the highest intention to accept the seasonal influenza vaccination. Educational level, household composition, and having experienced ILI were

Table 2 Mean scores for intention to accept seasonal influenza vaccination (sd) by different characteristics of the study population ($N = 1647$)

Characteristics	*N* (%)	Intention to accept seasonal influenza vaccination			
		Mean	**SD**	**t/ F**	**p - value**
Sex					
Male	861 (52.3)	5.45	2.02	t = 3.61	0.0003
Female	786 (47.7)	5.08	2.14		
Age					
60-64[1]	304 (18.5)	4.63[2,3,4,5,6]	2.21	F= 14.52	<0.0001
65-69[2]	564 (34.3)	5.07[1,3,4,5,6]	2.18		
70-74[3]	340 (20.6)	5.47[1,2,4]	1.99		
75-79[4]	228 (13.8)	5.84[1,2,3]	1.70		
80-84[5]	143 (8.7)	5.83[1,2]	1.88		
>85[6]	68 (4.1)	5.88[1,2]	1.65		
Educational level[a]					
Low	557 (33.8)	5.23	2.06	F = 0.18	0.9104
Intermediate	463 (28.1)	5.33	2.07		
High	583 (35.4)	5.28	2.13		
Missing	44 (2.7)	5.32	1.96		
Presence co-morbidity					
Yes[1]	130 (7.9)	5.69[2,3]	1.83	F = 3.05	0.0475
No[2]	188 (11.4)	5.14[1]	2.03		
Missing[3]	1329 (80.7)	5.25[1]	2.11		
Household composition					
Single	460 (27.9)	5.28	2.11	F= 0.28	0.7535
With partner	1170 (71.1)	5.27	2.07		
With ≥ 2 persons	17 (1.0)	5.65	2.15		
Contact children <5 years					
Daily[1]	69 (4.2)	4.64[4]	2.24	F= 6.49	0.0002
Weekly[2]	490 (29.8)	5.15[4]	2.11		
Monthly[3]	222 (13.4)	5.05[4]	2.21		
Seldom or never[4]	866 (52.6)	5.47[1,2,3]	2.00		
Received seasonal influenza vaccination (season 2014/2015)				t = 55.03	<0.0001
Yes	1111 (67.5)	6.44	0.91		
No	536 (32.5)	2.86	1.73		
Experiencing ILI (influenza-likeillness)					
Yes	190 (11.5)	5.11	2.03	t = -1.17	0.2439
No	1457 (88.5)	5.30	2.09		
Perceived health score					
≤80[1]	878 (53.3)	5.52[2]	1.93	F= 18.59	<0.0001
>80[2]	586 (35.6)	4.86[1,3]	2.26		
Missing[3]	183 (11.1)	5.46[2]	2.01		
Knowledge score					
≤5[1]	1036 (62.9)	5.19[2]	2.12	F= 3.11	0.0447
>5[2]	549 (33.3)	5.46[1]	2.03		
Missing[3]	62 (3.8)	5.18	1.97		
Study group					
ILI- 1 (2011/2012) study[1]	**726 (44.1%)**	5.32[2]	**2.25**	F=3.63	0.0267
ILI- 2 (2012/2013) study[2]	402 (24.4%)	5.03[1, 3] 5.36[2]	2.20		
ILI- 3 (2014/2015) study[3]	518 (31.5%)		2.03		

[a].Definitions according to Statistics Netherlands (CBS). Depending on the outcome measure of the independent variables, either an ANOVA test or an independent t-test was performed. A p-value of ≤ 0.05 was considered statistically significant

not associated with intention to accept seasonal influenza vaccination.

Factors associated with intention to accept seasonal influenza vaccination

The performance characteristics of the algorithm for predicting intention to accept seasonal influenza vaccination, based on the variables mentioned above in Table 2, are as follows: probability of misclassification (pmc) = 0.17, sensitivity = 0.72, specificity = 0.87 and area under the curve (auc) = 0.89. Having received seasonal influenza vaccination in 2014/2015 showed by far the largest predictive value for the intention to accept seasonal influenza vaccination in the next season. Having experienced one or more episodes of ILI and also other factors included in the model did not have much predictive value for the intention to receive seasonal influenza vaccination (see Fig. 2). When excluding having received seasonal influenza vaccination in 2014–2015 from the Random Forest analyses it was observed that the variables age-group and perceived health had the most predictive value (see Fig. 3) (pmc = 0.23, sensitivity = 0.06, specificity = 0.97).

Vaccine specific acceptance among different age groups

Table 3 shows the intention to accept general vaccination and the intention to accept seasonal influenza, herpes zoster, pertussis and pneumococcal vaccination for the age groups 60–69 years, 70–79 years and 80 years and older. With the exception of pertussis vaccination, the intention to receive vaccination significantly differs by age, and is highest for the age groups 70–79 years, and 80 years and older.

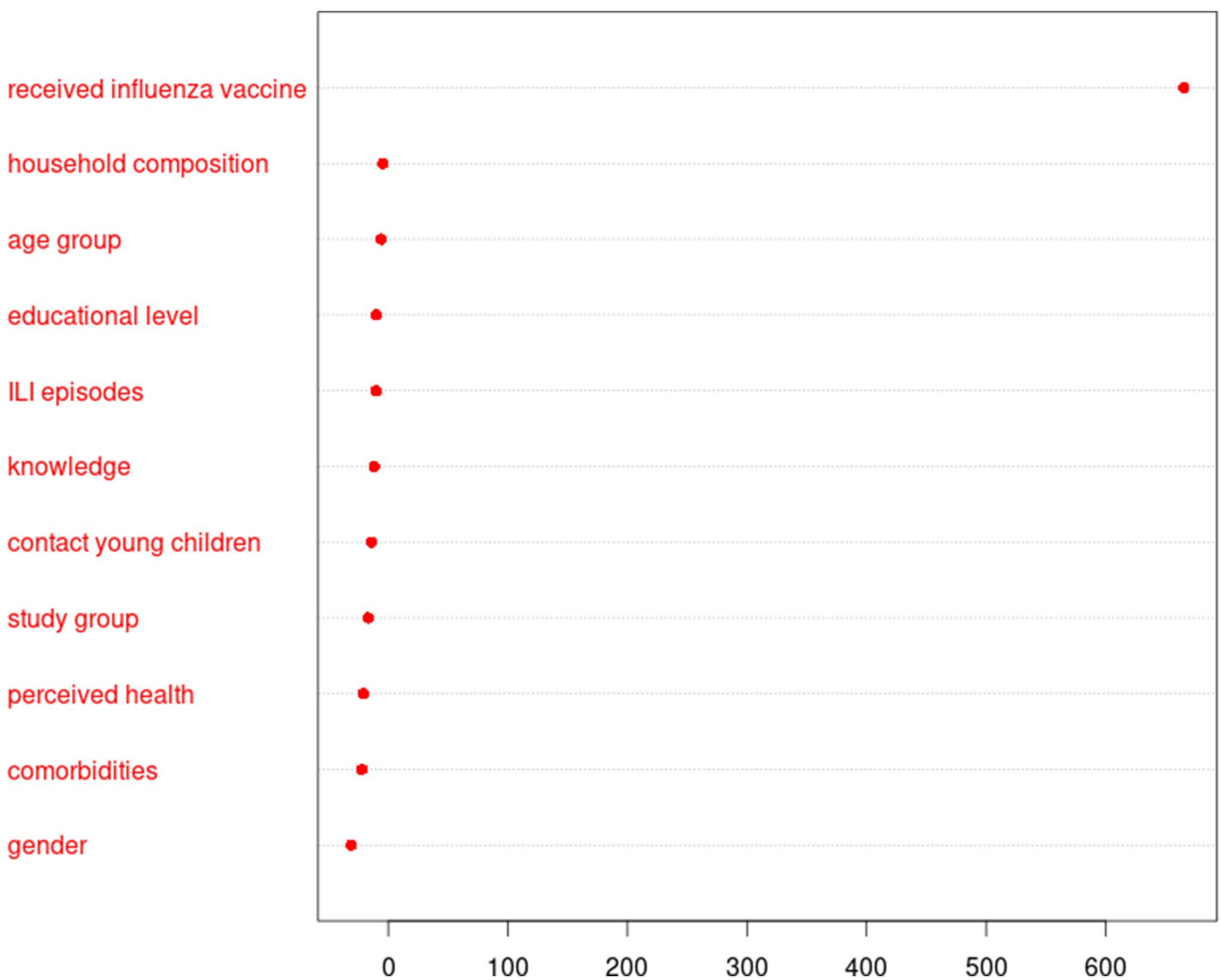

Fig. 2 Prediction analysis: variable importance for intention to accept seasonal influenza vaccination. The Mean Decrease in Accuracy of a given predictor variable is the decrease in the proportion of correct predictions regarding intention to accept seasonal influenza vaccination that results from randomly permuting the values of that variable in the dataset

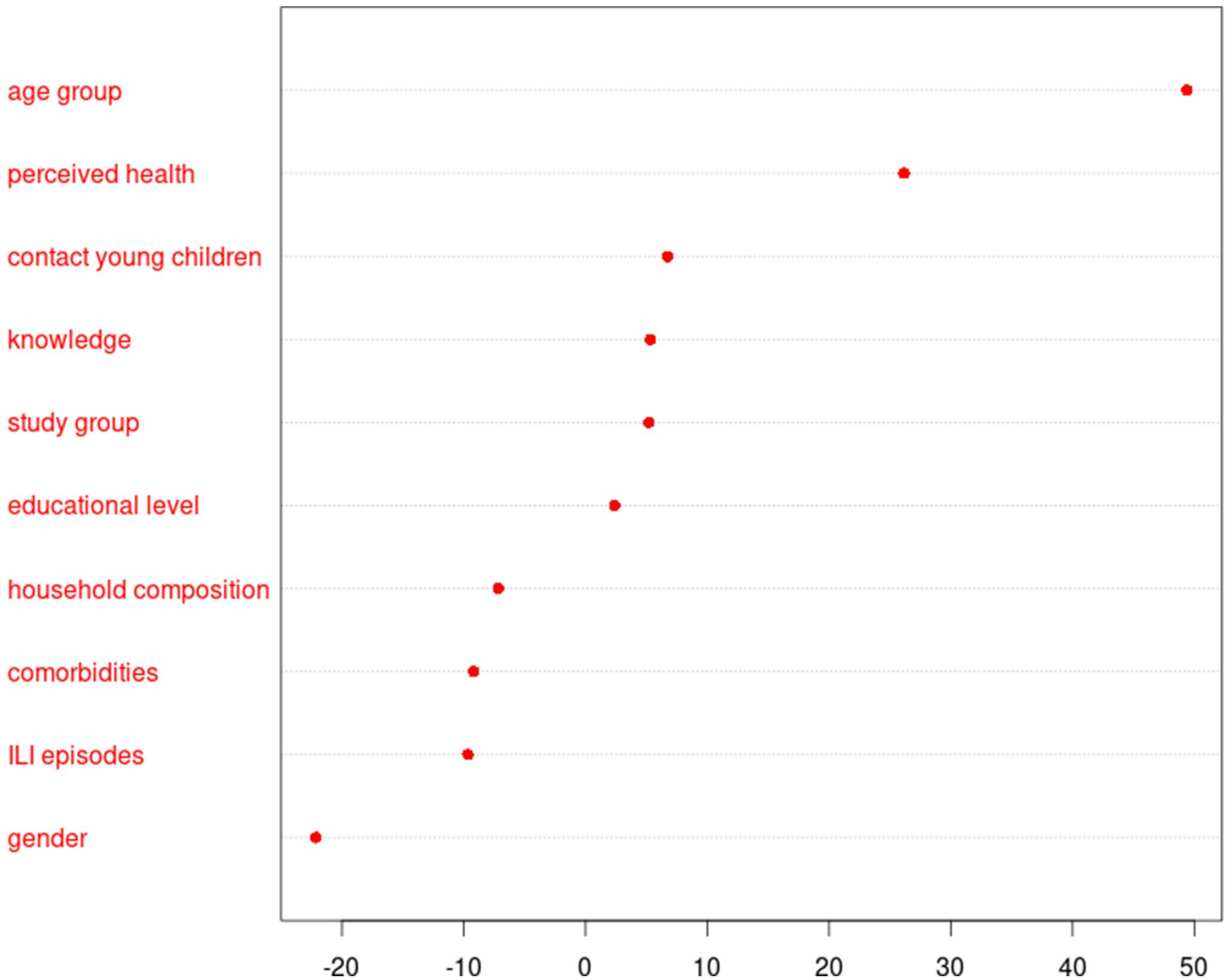

Fig. 3 Prediction analysis: variable importance for intention to accept seasonal influenza vaccination, excluding the factor having received seasonal influenza vaccination in 2014/2015. The Mean Decrease in Accuracy of a given predictor variable is the decrease in the proportion of correct predictions regarding intention to accept seasonal influenza vaccination that results from randomly permuting the values of that variable in the dataset

Table 3 Intention to general vaccination and vaccination against seasonal influenza, herpes zoster, pertussis and Pneumococcal disease by age-group

	60–69[1] *N* = 864 mean (sd)	**70–79[2] *N* = 565 mean (sd)**	**≥ 80[3] *N* = 207 mean (sd)**	**F-value**
Intention general vaccination	4.6 (1.7)[2,3]	4.9 (1.7)[1]	5.0 (1.7)[1]	0.0003
Intention seasonal influenza vaccination	4.9 (2.2)[2,3]	5.6 (1.9)[1]	5.8 (1.8)[1]	< 0.0001
Intention herpes zoster vaccination	4.6 (1.8)[2,3]	4.9 (1.7)[1]	5.0 (1.8)[1]	0.0087
Intention pertussis vaccination	4.6 (1.9)	4.7 (1.7)	4.5 (1.8)	0.4120
Intention pneumococcal vaccination	4.9 (1.9)[2,3]	5.3 (1.6)[1]	5.5 (1.5)[1]	< 0.0001

[1]age-group 60–69 years; [2]age-group 70–79 years; [3]age-group 80 years or higher; A MANOVA-test was used, a p-value of ≤ 0.05 was considered statistically significant

Arguments for (not) accepting seasonal influenza vaccination

The participants reported 'Vaccination protects me against getting the flu' as most important reason for accepting the seasonal influenza vaccination, followed by 'The general practitioner recommended it' (Table 4). The arguments 'I feel healthy therefore I do not need the vaccination' and 'Vaccination does not guarantee I do not get the flu' were most frequently reported as the most important reason not to accept the seasonal influenza vaccination. Arguments that were most often mentioned as other reason were 'I think it is self-evident, it is part of healthy ageing' for accepting the seasonal influenza vaccination and 'Vaccination does not guarantee I do not get the flu' for refusing the seasonal influenza vaccination.

Table 4 Arguments for (not) accepting seasonal influenza vaccination (season 2014–2015)

I did accept the influenza vaccination because (*N* = 1142)*	**Most important reason*****	**Other reasons*****
Vaccination protects me against getting the flu	689 (61.7%)	129 (11.6%)
The general practitioner recommended it	431 (38.6%)	150 (13.4%)
I think it is self-evident, it is part of healthy ageing	377 (33.8%)	232 (20.8%)
I have positive experiences with previous vaccinations	302 (27.1%)	159 (14.2%)
I think flu is a serious disease	266 (23.8%)	189 (16.9%)
I do not want to contaminate other people	239 (21.4%)	176 (15.8%)
I am afraid to lose my self-reliance/independence if I get the flu	199 (17.8%)	154 (13.8%)
People around me, who I care about, got the flu	83 (7.4%)	128 (11.5%)
Other, namely	54 (4.8%)	35 (3.1%)
I did not accept the influenza vaccination because (*N* = **536**)**		
I feel healthy, therefore I do not need the vaccination	191 (37.7%)	120 (23.7%)
Vaccination does not guarantee I do not get the flu	178 (35.2%)	132 (26.1%)
I never get the flu	132 (26.1%)	84 (16.6%)
I do not think the flu is severe enough to justify vaccination	78 (15.4%)	114 (22.5%)
I have negative experiences with previous vaccinations	44 (8.7%)	56 (11.1%)
I am afraid of side effects	23 (4.5%)	70 (13.8%)
Because of negative media attention	18 (3.6%)	61 (12.1%)
Because of anthroposophical, homeopathic or naturopathic convictions	10 (2.0%)	57 (11.3%)
The general practitioner advised against it	6 (1.2%)	53 (10.5%)
Because of my religious beliefs	1 (0.2%)	57 (11.3%)
Other, namely	35 (6.9%)	25 (4.9%)

*Missing: *N* = 26; ** Missing: *N* = 30; *** Percentages add up to > 100% because people indicated more than one reason

Discussion

The main objective of this study was to determine whether experiencing ILI influenced the intention to accept seasonal influenza vaccination. However, we did not find such an association in this study. Earlier studies showed that a higher perceived severity of the disease increases the intention to vaccinate [19]. In our study, the lack of an association may be explained by the observation that no severe infectious disease was reported in the season the study was performed, as described in previous publication on the ILI-3 (2014/2015) study [16].

The most predictive factor for intention to receive upcoming seasonal influenza vaccination was having received seasonal influenza vaccination in 2014/2015. In the systematic review by Schmid et al., 2017 [14] nine studies among elderly also found that individuals who had already been vaccinated against influenza in previous seasons showed higher vaccine uptake. Also, Klett-Tammen et al., had a similar observation [20].

When excluding the factor having received seasonal influenza vaccination from the prediction analyses, it was observed that the variables 'age-group' and 'perceived health' had the most predictive value. The intention to receive influenza vaccination increased with increasing age and persons reporting a low health score had a higher intention to receive seasonal influenza vaccination. Difference between age groups were also seen for vaccination in general, pneumococcal and herpes zoster vaccination but not for pertussis vaccination.

Higher age has been previously related to higher vaccine uptake among elderly, but also inconclusive results with regard to the influence of age have been reported [14], and in a study performed in Poland younger patients (≤70 years) were vaccinated significantly more often than those > 70 years of age [21]. With regard to their own perceived health, other studies found similar results: persons with a poorer health had a higher intention or uptake of seasonal influenza vaccination [14, 20, 21]. When individuals perceived their own health status as good they were less inclined to vaccinate. This correlation, however, was reversed in a few other studies [14].

Furthermore, the univariate analyses also showed that men, presence of co-morbidity, people with seldom or never contact with children (vs. daily/weekly/monthly contact) and persons scoring high on knowledge about vaccination (> 5) (vs. low knowledge score (≤ 5)) had a significantly higher intention to receive seasonal influenza vaccination. In the systematic review by Schmid et al. [14], an inconclusive pattern was observed for sex. In some studies being female was a facilitator, barrier or the data was inconclusive, which was similar for other demographic variables such as for example ethnicity. Regarding co-morbidity, the data of the Netherlands Institute for Health Services Research (NIVEL) also show a higher vaccination coverage for influenza in those individuals with a medical indication in the same age range [10]. Also, in a study performed in Poland [21] and Switzerland [22] results showed that in patients who reported having a chronic disease and those who described their health status as poor/very poor, the percentage of vaccinated individuals was significantly higher than those who did not. The same is concluded in the systematic review; having a pre-existing medical condition was a consistent facilitator of influenza vaccine uptake [14].

The higher mean intention to vaccinate among people who seldom or never have contact with children might be related with age. The oldest age-categories have less contacts with children < 5 of years of age (data not shown) but have a significantly higher intention to vaccinate compared to younger age-categories (Fig. 3). Therefore, the strong relation between age and intention to receive vaccination can have a confounding effect in the association between 'seldom or never contact with children' and 'higher vaccination rate'.

Lack of general knowledge about influenza and the vaccine was also identified as a barrier for vaccine uptake in other studies [14]. For influenza vaccination in a German study [20], participants with a higher knowledge score were 30% more likely to get vaccinated compared to those with a lower knowledge score.

We did not find an association between intention to receive influenza vaccination and educational level, and household composition. In the Poland study there was also no statistically significant difference between patients vaccinated and unvaccinated regarding education level, and also not for gender. With regard to household composition, it was shown that living alone was negatively associated with vaccine uptake [21].

When comparing results from studies in different countries it should be taken into account that the organization, information, culture, (social) media or framing of vaccination in a particular country could be very different between countries, which might also influence outcomes. For example, in the study performed in Poland it was reported that there was a lack of influenza vaccine provision within public health insurance (i.e. it is a recommended vaccination, the vaccine is not free of charge for everybody) and the lack of reimbursement for healthcare practitioners to administer the vaccine. The authors mentioned this as a possible explanation for the poor vaccination rates in Poland [21].

Results about beliefs with regard to influenza vaccination showed that the argument 'Vaccination protects me against getting the flu' was the most important argument to accept influenza vaccination. Arguments not to accept vaccination were 'I feel healthy, therefore I do need the vaccination', 'Vaccination does guarantee I do not get the flu', and 'I never get the flu'. The NIVEL data showed that by far the most important reason to not vaccinate is that people do not believe the vaccination is needed or makes sense [10]. In the Poland study, the main reason to refuse immunization was the lack of vaccine effectiveness [21].

Strengths and limitations

In this study the opportunity was presented to identify variables, such as having experienced ILI, possibly associated with intention to accept seasonal influenza vaccination in older adults. We performed the study in a well-defined cohort with long term follow up. There were some limitations in this study. Participants were recruited from the mid-western part of the country, therefore the results cannot be extrapolated to all the older adults in the Netherlands. Also, we used the Dutch Pel criteria to identify ILI in our cohort. This definition has minor modifications compared to those of the World Health Organisation, the European Centre for Disease Prevention and Control and different countries. However, as evaluated in our previous publications, we do not expect to have missed ILI cases and that the choice of the definition has an impact on these results [15, 16]. In addition, also the vaccine uptake in our study was higher (78%), compared to the whole eligible Dutch population at the time this study was conducted (60%) [23]. The explained variance of our model was not very high, which might be caused by the fact that factors such as attitude, susceptibility and vaccine characteristics have not been investigated. In addition, the arguments in favour or against vaccination could not be included in the model as they had not been measured at a five or seven point Likert scale. This could also have increased the variance of our model.

In this study, we used the questionnaire that we developed previously based on our focus group studies [12, 13] to enable the comparison between our different ongoing studies. There are also internationally, standardized questionnaires are available such as the 5 C scale of vaccination readiness [24]. While there are overlapping concepts between the 5 C scale and our questionnaire, such as vaccine effectiveness, vaccine side-effects and vulnerability, the 5 C model misses certain important concepts specific for the older adult population, such as the role of the general practitioner, the willingness to protect others and ageing in general, encompassing more than psychological antecedents of vaccination [24].

A few years after the data collection, the COVID-pandemic hit. We expect that the results of this study are still valid since the influenza vaccination rates, which showed an increase in the first year of the pandemic, returned to levels comparable to before the pandemic: respectively around 54% before the pandemic (2019), 66% during the pandemic (2021) and 55% after the pandemic (2023) [9–11].

Practical implications

In this study we did not find an association with experiencing ILI symptoms and intention to vaccinate against seasonal influenza. The most important prediction factor was having received seasonal influenza vaccination in 2014/2015. Therefore, it might be important to incorporate stories about elderly who already have received an influenza vaccination and their experiences with the vaccine and protection against disease caused by influenza in communications materials. Furthermore, it is important to acknowledge that receiving vaccinations should become a habit. Healthcare professionals, such as the general practitioner (GP), could play an important role in this, as they are the most trusted source for information and have in general frequent contact with older adults.

Special consultations for older adults could be organized to create awareness and give information on vaccines to facilitate vaccination becoming a habit. In addition, it is important to make receiving vaccinations as accessible as possible without any limitations, e.g. by offering home visits.

In addition, vaccination campaigns should incorporate stories about elderly who already have received an influenza vaccination and their experiences with the vaccine and protection against disease caused by influenza.

Conclusions

Participants who experienced ILI did not have a higher intention to accept seasonal influenza vaccination. Most important determinant for the intention to receive influence vaccination was previous influenza vaccination behaviour. After excluding this variable from the prediction analysis, the intention to receive influenza vaccination was mostly influenced by age and perceived health.

Abbreviations

auc	Area under the curve
CBS	Statistic Netherlands
GP	General practitioner
ILI	Influenza-like Illness
N	Number
NIVEL	Netherlands Institute for Health Services Research
pmc	Probability of misclassification
RIVM	National institute for public health and the environment
sd	Standard deviation
VPDs	Vaccine-preventable diseases

Acknowledgements

We gratefully acknowledge all participants for their time and commitment to the study. We thank the study staff at the Spaarne Hospital, Hoofddorp—Jacqueline Zonneveld, and Greetje van Asselt—for recruiting and enrolling participants and managing visits. We would like to thank José De Sousa Jorge Ferreira for his help with the Random Forest analyses and Alies van Lier for critically reviewing the manuscript.

Author contributions

Conception and acquisition study N.Y.R. and J.B.; conception and acquisition spin-off study R.E. H.E.M, N.Y.R., J.B., analysis and interpretation data R.E., F.H.G., B.A.L., L.M. and J.B, writing draft R.E., L.M., J.B. All authors have read and approved the manuscript.

Funding

This research was funded by the Dutch Ministry of Health, Welfare and Sport.

Data availability

Upon request, the raw data supporting the conclusions of this article will be made available by the authors via the corresponding author Josine van Beek (josine.van.beek@rivm.nl), with consideration of the participants' privacy and ethical rights.

Declarations

Ethical approval and consent to participate

This study concerns a spin-off of an existing study. This study, including this spin-off, was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee METC Noord Holland ICTRP Search Portal (who.int); NTR3386 and NTR4818. In addition, all participants of the study have signed an informed consent.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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Received: 20 October 2023 / Accepted: 28 February 2025
Published online: 24 March 2025

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