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Original article

Knowledge, attitudes, and practices of influenza and pneumococcal vaccines among agricultural workers: results of an Italian a cross-sectional study

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Summary. *Background:* Working age is increasing across Europe. Seasonal influenza (SID) and pneumococcal disease (PND) immunization programmes might be successfully implemented at the workplace. We conducted a cross-sectional survey among to assess SID and PND vaccine status, as well as knowledge, attitudes and practices (KAP) in a representative sample of agricultural workers (AWs) aged ≥55 years in North-Eastern Italy. *Methods:* A structured questionnaire was administered in person by trained personnel. Bivariate and multivariate logistic regression analyses were carried out to identify behavioral and work-related factors associated with SID and PND vaccine uptake. *Results:* Among 707 participants, 238 were aged 55 years or more (33.7% of total). Of them, 39.1% had an up-to-date immunization status towards influenza, and 17.6% towards pneumococcus. Factors associated with inadequate immunization were doubts about influenza vaccine safety (40.0%) and the confidence in natural immunity towards pneumococcus (30.8%). Attitude towards vaccinations was somehow favorable in 44.5% of participants for SID, and 37.8% for PND. Overall, 37.4% and 21.8% workers were aware of national recommendations on SID and PND immunization, respectively. This factor was characterized as a significant predictor for SID vaccination (multivariated Odds Ratio, OR 32.688 95%CI 12.015-88.930), as well as the perception of SID as a severe disease (OR 7.539 95%CI 3.312-17.164), and the perceived value of preventing new infections (OR 3.215 95%CI 1.205-8.578). A somehow favorable attitude towards vaccinations was the main predictor (OR 39.214 95%CI 10.179-151.1) for PND vaccination. *Conclusions:* Our study indicates that older workers lack appropriate knowledge of national recommendations and correct risk perception of SID and PND infections, but also vaccines' side effects. As the latter has been recognized as predictive factor for SID vaccination, our results stress the importance for tailored informative interventions in the workplaces aimed to increase risk perception and vaccine acceptance. (www.actabiomedica.it)

Key words: vaccines, vaccination refusal, vaccine hesitancy, seasonal influenza, pneumococcal diseases

Introduction

Influenza and pneumococcal disease are common vaccine-preventable causes of morbidity and mortality (1). Global annual attack rates for seasonal influenza range from 5 to 10% in adults, whose direct and indirect costs range from 6 to 14 billion € for the EU only (2). Even though severe influenza illness cases are relatively rare, influenza still remains a main trigger for lost workforce productivity (3-7). Also pneumococcal infection is a major cause of morbidity and mortality, both as community-acquired pneumonia

and invasive pneumococcal disease, i.e. pneumococcal invasion of normally sterile sites such as the bloodstream and meninges (8, 9). As older age groups are particularly vulnerable to severe outcomes, World Health Organization (WHO) and European Centre for Disease Prevention and Control (ECDC) strongly recommend seasonal influenza (SIV) and pneumococcal vaccination (PNV) in subjects older than 60 years (1, 2, 9-16). More specifically, the EU Council has recommended that member states achieve SIV coverage rates of 75% in subjects older than 65 years (2, 12), but results still remain suboptimal (13-15, 17), even in high risk groups (1, 9-12, 18). For instance, since 2014 Italian National Immunization Plan (NIP) recommends SIV for subjects 65 years of age or older, while some Italian regions, including Autonomous Province of Trento (APT) have issued similar recommendations regarding PNV (Resolution of Regional Council No. 2071/2014) (14, 19, 20). Both vaccinations are now regularly enforced by Italian NIP 2017-2019 (19, 20).

In recent years, the needs of the aging European workforce, characterized by an increasing share of workers aged 55 years or more, have raised the interest towards occupational policies including SIV and PNV (21-23). Unfortunately, although the uptake of influenza and pneumococcal vaccination in older workers and their determinants have been deeply investigated in healthcare workers (11, 24-26), very little is known about other occupational settings, and in particular for agricultural workers (AWs).

This particularly frustrating, as the 2010 European Union Farm Structure Survey showed that around 25 million people were still engaged in the primary sector, representing 4.6% of total employment, with a total workforce significantly older than most other occupational groups (27, 28). Moreover, even though assessment of *knowledge* (i.e. the awareness of official recommendations), *attitudes* (i.e. propensity towards vaccinations) and *practices* (i.e. actual uptake of vaccinations), or KAP, is acknowledged as necessary in order to a better planning of vaccine campaigns in target populations (29-32), few studies have specifically inquired AWs, in particular in Western Europe (33). Our primary objective was therefore to investigate the coverage rates for SIV and PNV in AWs from the highly developed agricultural settings of the APT (34). APT is located in the Italy's North East, covers a total area of 6,214 km^2 (2,399 sq. mi) and has a population of 537,416 habitants: at 2015 census, prevalence of subjects aged 55 years or more was slightly lower than national level (33.4% vs. 34.3%). According to labor force statistics, the primary sector in APT directly accounts for around 20,000 employees (dependent and self-employed) in 16,446 agricultural farms, including 11,958 agricultural enterprises, usually of small extent (89% are smaller than 5 hectares and 56% smaller than 1 hectare). These figures, however, do not include "hobby farmers" and part-time employees, whose number may largely exceed full-time employees (33-36). Our secondary objective was then to investigate KAP of AWs towards both vaccinations.

Methods

1. Study design and target population

The present investigation was a questionnaire-based cross-sectional study. The target population included AWs from the APT, and the sampling was performed through convenience, involving all consecutive participants to qualification courses held between January and June 2016, and focusing on the occupational use of pesticides (33, 35, 36). In the present study, following excluding criteria were applied: an inadequate ability to understand the Italian language, and age <55 years. A total of 252 consecutive AWs were eventually eligible to participate.

2. Instruments

The instrument used was a specifically designed structured questionnaire. The majority of survey items had been used in previous studies on KAP both in the general population (31, 32), and in occupational settings (29, 30, 33), but were adapted to our specific target population and design. Test-retest reliability of questionnaire items was preventively assessed by having 10 AWs complete the questionnaire at two different points in time. A correlation coefficient was calculated to compare the two sets of responses: items having a coefficient >0.80 were interpreted as consistent,

and were therefore included in the questionnaire used in this survey. All questions were self-reported, and not externally validated. The questionnaire included a total of 22 items divided into four areas of inquiry:

(*1) Information about the interviewee*. Retrieved data included: gender, age, educational level, birthplace (i.e. Italian-born people, IBP vs. Foreign-born people, FBP), main sources for information about health topics (i.e. TV/radio/newspapers, internet, friends, parents, school, healthcare professionals), and whether they had received or not any medical assessment in the previous 5 years, both in general and by an occupational physician.

(2) Knowledge about vaccines. Firstly, participants received a general knowledge test (31, 32), containing a total of 17 true-false statements such as "*vaccinations increase the occurrence of allergies*" (false), covering some typical misconceptions on vaccination and vaccination policies. General knowledge of participants was calculated through the sum of all appropriate answers. The sample was then categorized by mean value in participants having "*high knowledge*" (>median value) vs. "*inappropriate knowledge*" (≤median value). Eventually, participants were asked whether they were aware of official recommendations towards SIV and PNV for people aged ≥65 years, separately, allowing dichotomization in subjects aware vs. non-aware of official recommendations.

(3) Attitudes and Practices. Participants were initially asked to explain why they would get vaccinations (i.e. "*to avoid getting vaccine preventable diseases (VPDs)*", "*to avoid transmitting VPDs", "to avoid complications of VPDs*", "*to avoid VPDs in subjects who cannot be vaccinated*"). Specific propensity towards vaccinations was then assessed through a 5-point Likert scale (i.e. from "*strongly disagree*" to "*strongly agree*"), being ultimately dichotomized in somehow favorable attitude ("*agree*", and "*strongly agree*") vs. somehow contrary attitude (from "*neutral*" to "*strongly agree*"). Similarly, participants were then asked how severe they perceived natural infections in a 5-point scale ranging from "*almost zero*" to "*very high*"). Subsequent Risk Perceptions were eventually dichotomized as "*severe*" (i.e. "*high or rather high*"; "*very high*") vs. "*not severe*" ("*almost zero*"; "*low or rather low*"; "*moderate*") Participants were eventually asked about their immunization status for SIV and PNV: an appropriate SIV status was defined by having received a vaccination shot for seasonal influenza during the winter season 2015-2016, while an appropriate PNV status was defined by having received a vaccination shot for pneumococcus in the previous 10 years.

3. Ethical considerations

Before they give their consent, subjects to be inquired were informed that participation in the present survey was voluntary, and that the questionnaires would be gathered only from subjects expressing preliminary consent for study participation. Participants were guaranteed that they may withdraw from the survey in any time, by simply non delivering the questionnaire at the end of the course session, and that all collected information would be handled anonymously and confidentially. As the questionnaire was strictly anonymous, it is implausible that individual participants could be identified based on the presented material, and ultimately this study caused no plausible harm or stigma to participating individuals. Moreover, as the final examiners of professional courses were totally blind regarding the status of inquired subjects (i.e. whether they had participated or not in the survey), it is also highly unlikely that individual participants have been forced to give their consent. As the study design assured an adequate protection of study participants, and neither included clinical data about patients nor configured itself as a clinical trial, a preliminary evaluation by the Ethical Committee of the Provincial Agency for Health Services (APSS) was not required.

4. Data Analysis

Two independent researchers, one of whom read the responses from each questionnaire while the other reviewed the entered data, ensured the accuracy of data entry. The primary investigator examined unclear responses to determine the correct answer. Questionnaire lacking basic information about the interviewee were excluded from the study.

Continuous variables were expressed as mean ± standard deviation and were preliminarily tested for normal distribution (D'Agostino & Pearson omnibus

normality test): where the corresponding p value was <0.10, normality distribution was assumed as rejected and variables were compared through Mann-Whitney or Kruskal-Wallis test for multiple independent samples. On the other hand, variables passing the normality check (D'Agostino & Pearson p value ≥0.10) were compared using the Student's t test or ANOVA, where appropriate. Categorical variables were reported as per cent values and univariate confrontations between proportions were initially evaluated through Chi-squared test in order to examine correlates of self-assessed vaccination for SIV and PNV (updated vs. not updated) with individual data regarding age (dichotomized as <65 years vs. ≥65 years), sex, education (≤8 years vs. 9 years or more), birthplace, information sources, knowledge of official recommendations, knowledge status, risk perception and attitude towards vaccinations. In a binary logistic regression analysis model (SPSS 25, IBM Corp., Armonk, USA), we assessed the relative influence of individual factors on self-reported immunization status for SIV and PNV through calculation of multivariate Odds Ratios (ORs) with their respective 95% confidence intervals (95%CI). Regression models included as effectors all factors that at univariate analysis were significantly associated with an appropriate vaccination status for SIV and PNV. Significance level was < 0.05 for all calculations.

Results

1. Descriptive analysis of the interviewee

A total of 238 questionnaires were retrieved, with a response rate of 94.4% of the original sample. As shown in Table 1, 67.2% of the participants were aged 55 to 64 years: overall, 89.9% were males and 10.1% females, with 8.8% subjects from a migration background. All the participants had completed at least the primary education (5+3 y), and 52.5% of the respondents had achieved secondary education level (13 y) or higher. The most frequently referred information source was represented by a healthcare professional (70.2%), followed by conventional media (21.8%), friends and relatives (4.2%), whereas the least reported was represented by professional courses (2.1%). Overall, two thirds (67.6%) of participants had received a medical assessment in the previous 5 years, while 45.4% of AWs had been assisted by an Occupational Physician.

2. General knowledge

Internal consistency coefficient of the General Knowledge test (Table 2) amounted to Cronbach's alpha=0.878. Average rate of correct answer was 5.7±4.6 (i.e. 33.3%±26.8), with a median of 5 (29.4%) and actual range 0 to 16 (i.e. 0.0%-94.1%). Regarding the single statements, none of them was correctly recalled by 50% of more of participants. Not only majority of participants claimed the risks associated with vaccination practice are usually hidden from public knowledge, both in general (69.3%) and more specifically by healthcare workers (60.1%), but participants exhibited a significant share of misbelieves about severe vaccine side effects. Actually, 70.2% of them failed to identify severe side effects of immunizations as unusual, in particular as long-term side effects (73.9%), and were unable to recognize as incorrect claims about the risks associated with a high number of vaccines (75.6%), in particular when administered early in life (68.5%). Moreover, the majority of participants claimed for causative associations of vaccines with neurological diseases such as Multiple Sclerosis (76.5%) and autism (71.0%), in particular after measles vaccinations (74.8%), autoimmune disorders (73.9%) and diabetes mellitus (65.5%), but also with allergic disorders such as asthma and atopic dermatitis (66.8%). Uncertainties affected also positive effects of vaccines, as only 46.9% were aware that appropriate pharmacological treatments may be unavailable for all infectious diseases, and 42.9% that immunization elicited by vaccinations is not inferior to that following natural infection, whereas 46.2% correctly recognized that vaccinations were instrumental in smallpox eradication and 45.8% acknowledged that efficacy of vaccinations has been extensively proved.

3. Attitudes and Practices

Overall, 39.1% of respondents reported having been vaccinated against seasonal influenza during the

Table 1. Characteristics of 238 agricultural workers aged ≥55 years from the autonomous province of Trento (2016)

Variable	Total (No. = 238, 100%)
Age groups (No, %)	
55-59	96, 40.3%
60-64	64, 26.9%
65-69	46, 19.3%
70-74	28, 11.8%
≥75	4, 1.7%
Sex (No. %)	
Female	24, 10.1%
Male	214, 89.9%
Migration Background (defined by country of birth) (No., %)	
No	217, 91.2%
Yes	21, 8.8%
Education level (No., %)	
Primary/Secondary School	113, 47.5%
High School	96, 40.3%
University	29, 12.2%
Previous medical assessment (No., %)	161, 67.6%
Previous medical assessment by an Occupational Physician (No., %)	108, 45.4%
Main information source (No., %)	
Healthcare professional	167, 70.2%
Conventional media	52, 21.8%
Friends, relatives	10, 4.2%
Professional courses	5, 2.1%
New Media	4, 1.7%
Knowledge Status >median (No., %)	113, 47.5%
Knowledge of official recommendations (No., %)	
Pneumococcus	52, 21.8%
Seasonal Influenza	89, 37.4%
Natural infection perceived as a severe one (No., %)	
Pneumococcus	108, 45.4%
Seasonal Influenza	87, 36.6%
Somehow favourable towards vaccine (No., %)	
In general	178, 74.8%
Pneumococcus	42, 17.6%
Seasonal Influenza	93, 39.1%
Appropriate vaccination status (No., %)	
Pneumococcus	42, 17.6%
Seasonal Influenza	93, 39.1%
Vaccines avoid (No., %)	
VPD infections	184, 77.3%
VPD transmission	59, 24.8%
VPD complications	50, 21.0%
Communicable VPDs in subjects who cannot be vaccinated	12, 5.0%
Perceived barriers towards vaccinations (No., %)	
Fear of acute side effects	50, 21.0%
Fear of chronic side effects	29, 12.2%
Distrust in Public Health Providers	44, 18.5%
Distrust in National Health Service	36, 15.1%
Difficulties in interaction with Public Health Providers	114, 47.9%
Difficulties in accessing Public Health providers	68, 28.6%
Ethical / Religious barriers	35, 14.7%

Table 2. Knowledge test of 238 agricultural workers aged 55 years or more, from the Autonomous Province of Trento (2016) (31-32)

Statements	Correct answer	No. (%)
1. Additives used in the vaccines are not dangerous for humans	True	82 (34.5%)
2. Neurologic diseases such as Multiple Sclerosis may be induced by HBV vaccine	False	56 (23.5%)
3. Diabetes mellitus may be triggered by vaccination shoots	False	82 (34.5%)
4. Vaccinations increase the occurrence of auto-immune diseases (e.g. rheumatoid arthritis, some thyroid diseases etc.)	False	62 (26.1%)
5. Autism is more frequent in subjects vaccinated against measles	False	69 (29.0%)
6. Severe diseases of the CNS are a possible side effect of measles vaccine	False	60 (25.2%)
7. Vaccinations increase the risk for allergic disorders such as asthma and atopic dermatitis	False	79 (33.2%)
8. Appropriate pharmacological treatments are available for all infectious diseases	False	118 (49.6%)
9. Without massive vaccination programs, smallpox would still exist	True	110 (46.2%)
10. Efficacy of vaccination has been extensively proved	True	109 (45.8%)
11. Children would be more resistant to infections if they were not always treated against all diseases	False	100 (42.9%)
12. Many vaccinations are administered too early. As results, the immune system has no possibility to fully develop by itself	False	75 (31.5%)
13. The immune system may be overwhelmed by a high number of vaccines	False	58 (24.4%)
14. Severe vaccine side effects are usually hidden from public knowledge	False	73 (30.7%)
15. Severe vaccine side effects are unusual	True	71 (29.8%)
16. Severe side effects may develop also several years after vaccination shots	False	62 (26.1%)
17. Healthcare workers usually hidden the risks associated with vaccination practice	False	95 (39.9%)

winter season 2015-2016, while only 42 AW (17.6%) recalled previous PNV. As shown in Figure 1, no significant trend through age groups was recognized. Higher shares for updated SIV status were reported in age group 65-69 years (45.7%), with the lower in older age groups (39.3% and 25.0% in age groups 70-74 and ≥75 years, respectively). Conversely, 65-69 years was associated with lowest rates for PNV (4.3%), while highest rates were identified in age groups 60-64 years (32.8%) and 70-74 years (28.6%).

Focusing on attitudes of participants while the majority of them exhibited a somehow favorable attitude towards vaccines: among the reasons to be vaccinated, the majority of participants recalled prevention of VPD infections (77.3%), followed by avoiding VPD transmission (24.8%), their complications (21.0%), whereas only 5.0% advocated prevention of VPD among people that cannot be vaccinated. However, only 106 participants exhibited a favorable attitude for SIV (44.5%), and 90 AWs were somehow favorable towards PNV (37.8%). Among the barriers towards vaccinations, nearly half of participants complained difficulties in interaction with Public Health Providers (e.g. having explanations about vaccine efficacy and efficiency; how to cope with side effects, etc.), followed by difficulties in accessing Public Health providers (28.6%), fear of acute side effects (21.0%), distrust in Public Health Providers (18.5%) as well as in the National Health service (15.1%), perceived ethical/religious barriers (14.7%), and eventually fear of chronic effects (12.2%).

5. Statistical analysis

In univariate analysis (Table 3), updated PNV and SIV status was significantly associated with a previous

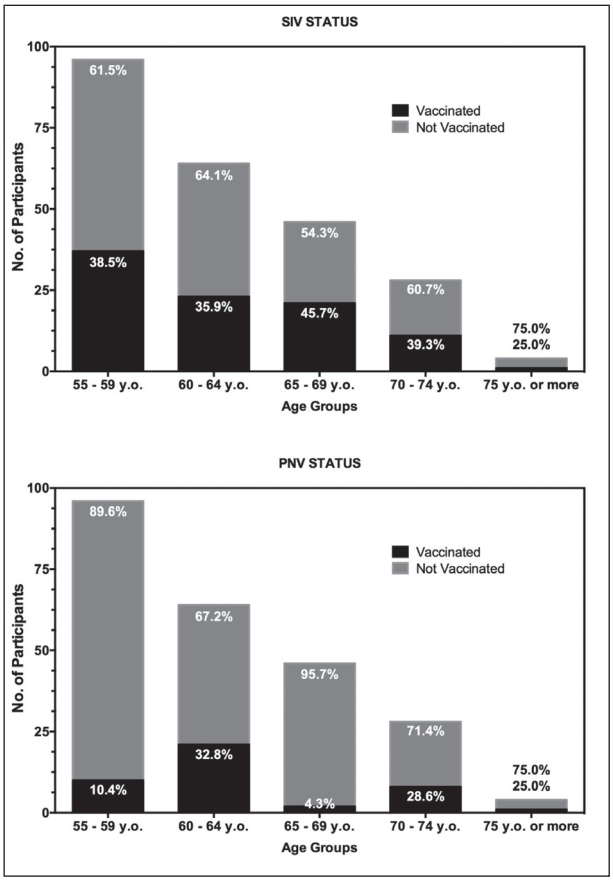

Figure 1. Vaccination status for pneumococcus (PNV) and seasonal influenza (SIV) by age groups in 238 agricultural workers from the Autonomous Province of Trento (2016)

medical assessment by knowledge of official recommendations, perception of natural infections as severe diseases, and a favorable attitude towards vaccination, both in general and specifically toward the specific immunization. Moreover, PNV was specifically association with a higher education level (p=0.018) and having received a medical assessment in the previous 5 years (p=0.017), while willingness to prevent VPD transmission was statistically associated with an updated SIV status (p=0.022). Among perceived barriers towards vaccinations, distrust in National Health Service (p=0.015) and ethical reasons (p=0.025) were significantly associated with a not appropriated PNV status, while inappropriate SIV status was associated with logistical issue (i.e. accessing Public Health providers).

In regression analysis, significant effectors of updated SIV status were identified in knowledge of official recommendations for people ≥65 years (OR 2.662, 95%CI 1.005-7.047), perception of seasonal influenza as a severe disease (OR 7.539, 95%CI 3.312-17.164), and a positive attitude towards vaccination, both in general (OR 6.995, 95%CI 2.895-16.899), as well as specifically for SIV (OR 32.688, 95%CI 12.015-88.930). Focusing on PNV status, a positive attitude towards vaccinations was identified as positive drivers for an updated status (OR 7.996, 95%CI 1.815-35.234 and OR 39.214, 95%CI 10.179-151.1 for vaccinations in general and for PNV, respectively). On the contrary, distrust in National Health Service was identified as negative effectors for an updated PNV status even at multivariate analysis (OR 0.329, 95%CI 0.125-0.867).

Discussion

Our study aimed to estimate SIV and PNV rates and determinants of vaccination status in a sample of AWs aged ≥55 years from North-Western Italy. Despite increasing efforts, vaccination rates for seasonal flu and pneumococcal disease are diffusely disappointing, particularly in Italy (9, 14, 15, 19, 37, 38). For instance, official data suggest that, during winter season 2015-2016, overall SIV rate was around 13.9%. Even though older age groups exhibited higher share for an updated SIV status (i.e. 49.9%), available figures remain largely below the European targets (14). Also APT has been affected by such lack of confidence towards SIV and PNV. On the one hand, during 2015-2016, only 24.3% of residents older than 45 years had received SIV, peaking to 50.2% among subjects older than 65 years. On the other hand, not only the vaccination rates for PNV remained well below 50% of the target population (i.e. 48%), but a negative trend since the beginning of the decade was eventually reported (39).

Our data are somewhat conflicting with national and regional estimates. Vaccination rate for SIV was somewhat higher than that reported in general population (i.e. 39.1%), and a specular ratio between age groups was noticeable, as the share of AWs who had reportedly received SIV was 41% among subjects 55 to 64 year-old, compared to 28.0% among older participants. On the contrary, the share of participants

Table 3. Association between updated vaccination status for Pneumococcus (PNV) and Seasonal Influenza (SIV) and individual characteristics of 238 agricultural workers from the Autonomous Province of Trento (2016). Odds Ratios (OR) and their respective 95% Confidence Intervals (95%CI) were calculated through binary logistics regression analysis including factors significantly associated with updated self-assessed PNV / SIV status at univariate analysis (Note: VPD, vaccine preventable disease; OPh, Occupational Physician)

	Updated self-assessed PNV N = 42, 17.6%			Updated self-assessed SIV N = 93, 39.1%		
	No., %	P value	OR (95%CI)	No., %	P value	OR (95%CI)
Age >65 years	11, 26.2%	1.000	-	26, 28.0%	0.883	-
Male sex	35, 83.3%	0.118	-	86, 92.5%	0.294	-
Education level ≤ 8 years	13, 31.0%	0.018	0.278 (0.105; 0.737)	47, 50.5%	0.449	-
Migration background	2, 4.8%	0.306	-	11, 11.8%	0.191	-
Previous medical assessment	35, 83.3%	0.017	1.918 (0.664; 5.542)	62, 66.7%	0.796	-
Previous assessment by an OPh	21, 50.0%	0.623	-	46, 49.5%	0.379	-
Known recommendation for ≥ 65 years	21, 50.0%	<0.001	1.132 (0.379; 3.380)	45, 48.4%	0.005	2.662 (1.005; 7.047)
High Knowledge status	19, 45.2%	0.881	-	47, 50.5%	0.553	-
Perception as a severe disease	23, 54.8%	0.007	0.975 (0.375; 2.543)	50, 53.8%	<0.001	7.539 (3.312; 17.164)
Attitude somehow favourable towards vaccines (in general)	40, 95.2%	0.002	7.996 (1.815; 35.234)	84, 90.3%	<0.001	6.995 (2.895, 16.899)
Attitude somehow favourable towards specific vaccine	38, 90.5%	<0.001	39.214 (10.179; 151.1)	73, 78.5%	< 0.001	32.688 (12.015; 88.930)
Information sources						
Healthcare professionals	38, 90.5%	1.000	-	69, 74.2%	1.000	-
Conventional Media	0, -	-	-	20, 21.5%	0.714	-
New Media	0, -	-	-	1, 1.1%	0.521	-
Friends, relatives	0, -	-	-	2, 2.2%	0.201	-
Professional courses	1, 2.4%	0.885	-	1, 1.1%	0.359	-
Vaccines avoid						
VPD infections	31, 73.8%	0.550	-	78, 83.9%	0.053	-
VPD transmission	13, 31.0%	0.411	-	31, 33.3%	0.022	0.937 (0.412; 2.130)
VPD complications	12, 28.6%	0.185	-	21, 22.6%	0.633	-
VPDs in subjects who cannot be vaccinated	0, -	0.209	-	7, 7.5%	0.272	-
Perceived barriers						
Fear of acute side effects	7, 16.7%	0.581	-	22, 23.7%	0.522	-
Fear of chronic side effects	5, 11.9%	1.000	-	15, 16.1%	0.198	-
Distrust in Public Health Providers	7, 16.7%	0.908	-	19, 20.4%	0.655	-
Distrust in National Health Service	12, 28.6%	0.015	0.329 (0.125; 0.867)	18, 19.4%	0.203	-
Difficulties in interaction with Public Health providers	26, 61.9%	0.067	-	49, 52.7%	0.293	-
Difficulties in accessing Public Health providers	10, 23.8%	0.572	-	34, 36.6%	0.042	1.786 (0.866; 3.686)
Ethical / Religious barriers	1, 2.4%	0.025	0.485 (0.218; 1.079)	12, 12.9%	0.659	-

reporting a previous PNV shot was even lower than regional figures (i.e. 17.6% for total sample, 26.2% among age group ≥65 year-old) (14, 38-40).

Such data may found some explanations in vaccine and disease specific characteristics, as well as in personal factors, that have been collectively identified

as important effectors in the individual decision making process to accept vaccination of person aged 50 years and older (40-42).

First at all, participants we deliberately sampled were still leading an active life, working either as hobby farmers or professional farmers, and previously reports suggest that subjects who rate their own health status as low or somehow unsatisfying are more likely to receive SIV and PNV compared to a good subjective health status (40-44). Moreover, our study presumptively underrepresented subjects affected by age-related comorbidities (e.g. cardiovascular disorders, respiratory disorders, etc.) that usually mean strong recommendations towards SIV and PNV. In addition, the very same study design also deliberately excluded institutionalized populations, usually targeted by official recommendations, and consequently characterized by very high vaccination rates (41-43). Not coincidentally, a usual barrier towards vaccinations represented by accessibility issues was reported by a relatively reduced share of participants (28.6% of total sample), being ultimately not associated with an inappropriate vaccination status (25, 40-42, 44-46).

Second, the majority of participants exhibited an inappropriate knowledge status, with an insufficient awareness of official recommendations for older age groups. This is of particular interest, as elderly adults who score more highly on knowledge questions are more likely to be vaccinated. Particularly older adults that perceive themselves as healthy, usually prefer prevention against diseases they understand as associated with high mortality rates and high vaccine effectiveness: disregarding actual risks associated with seasonal influenza and pneumococcal infection may therefore affect vaccination rates even more extensively than in younger subjects (40, 41, 43, 44, 47, 48).

Even though previous reports have suggested that perceived severity is weakly correlated with vaccination acceptance, perceiving influenza as a severe disease was identified as a significant effector of the vaccination status (OR 7.539, 95%CI 3.312-17.164), while no significant correlation was found with PNV after multivariate analysis (40-42, 48).

Moreover, available evidence suggests that being aware of vaccine recommendations is strongly associated with vaccine uptake, and also in our study a better awareness was identified as a significant effector of SIV uptake (OR 2.662, 95%CI 1.005-7.047) (42, 44, 48, 49). On this regard, it is of significant interest that only a fourth of participants was reportedly aware of specific advices for PNV, with a nearly double share of AWs that acknowledged similar SIV recommendations (21.8% vs. 37.4%). A possible explanation may found in the heterogeneous nature of specific recommendations before the enforcement of NIP 2017-2019. When the survey was performed, SIV in subjects older than 65 years was implemented by national guidelines, whereas PNV had been introduced only recently, in 2014, and only through a Provincial decree, ultimately limiting the possible awareness of both patients and providers (9, 14, 37, 40).

Third, in our sample overall vaccination propensity was the main effector for an updated vaccination status, but overall figures were somehow unsatisfying. Although around 75% of participants self-assessed as favorable or even highly favorable towards vaccinations, a positive attitude was identified only in 17.6% and 39.1% of them for PNV and SIV, respectively. As recently suggested, behavioral intention may be modeled by specific beliefs and individual evaluation of possible outcomes (44, 48, 49): in this regard, even though 77.3% of participants associated vaccination practice with prevention of VPD infection, other significant drivers such as avoiding VPD transmission, their complications, as well as prevention of VDP in people who cannot be vaccinated, were reported by less than one fourth of sampled AWs. Similarly, our sample was affected by high or relatively high share of perceived barriers and misbeliefs about pros and cons of vaccinations, as well as regarding vaccination services. PNV status in particular was significantly affected by distrust in National Health Service.

Interestingly enough, the potential role of healthcare providers was somewhat conflicting with available evidences. Several reports have suggested that clinician reminders and specific recommendation by a healthcare providers are among the stronger effector for vaccine uptake, particularly for PNV. In other words, information provided by healthcare providers, as well as their throughout support in the promotion of vaccination among older age groups has the potential to significantly improve vaccination propensity (50, 51).

However, even though 70.2% of participants identified healthcare providers as their preferred information source, and a similar share reportedly interacted with healthcare providers on a regular basis, such factors were unrelated with vaccination status. We could speculate that the positive effector represented by interaction with healthcare providers may have been hindered by a diffuse distrust in National Health Service and Health professionals, as well as by the perceived difficulties reported in the interaction with healthcare providers (47.9%). Not coincidentally, referred distrust in National Health Service was a significant effector for an inappropriate PNV status.

However, our study is affected by several limitations. Firstly, vaccination status was self-reported, and subsequent figures may be affected by a significant recall bias and social desirability bias as well. In other words, our results might be affected by an implicit misreporting, because of individuals' recall errors on the one hand, and subjects' answering to questions in a manner that will be viewed favorably rather than factually, on the other hand (52, 53). However, evidence from previous occupational studies hints that questionnaire-based self-reporting of vaccinations usually guarantees a relatively accurate measure of vaccination status (54).

Second, it should be stressed that our sample was of relatively small size, being gathered through convenience sampling and a regional basis, and Italy is highly heterogeneous in terms of socio-economical development, with striking differences in terms of vaccination coverages (14, 19, 55). Moreover, also the study population, i.e. AWs performing pesticide application, included only subjects having a relatively high qualification, both in term of personal education and in empirical experience with farming practices: as a consequence, generalization of our results may be cautiously applied only to similarly highly developed agricultural settings (33, 35, 55, 56).

In conclusion, our study suggests that older workers (i.e. workers aged 55 years or more), and particularly AWs, may exhibit KAP towards SIV and PNV somehow conflicting with available evidences drawn from the general population. The main reason for such heterogeneity may be identified in the relatively healthy, active status of participants deliberately included in this study. Our results were also affected by the ongoing loss of confidence in healthcare professionals and Italian National Health System, stressing the importance of interventions aimed to restore perceived truthfulness on healthcare providers and public health services. On the other hand, the large share of participants who reported to regularly interact with healthcare providers suggests that improving vaccination literacy among older workers, focusing on the awareness of official recommendations as well as the actual risk associated with natural infections, might have a beneficial effect on vaccination coverages.

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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