ORIGINAL ARTICLE

Knowledge, attitudes, beliefs and practices of Occupational Physicians towards seasonal influenza vaccination: a cross-sectional study from North-Eastern Italy

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Keywords

Healthcare workers • Influenza vaccine • Occupational physicians

Summary

Introduction. *The present study aims to characterize personal attitudes and knowledge of a sample of Italian Occupational Physicians (OPh) towards Seasonal Influenza Vaccine (SIV) in healthcare workers (HCWs).*
Methods. *In total, 92 OPh (42.4% males, 57.6% females, mean age of 47.3 ± 10.4 years, 50 specialists in Occupational Medicine, 42 specialists in Hygiene and Public Health) were asked about their attitudes towards influenza vaccine, their general knowledge of vaccine practice, their propensity towards vaccines and, eventually, their risk perception about the influenza and influenza vaccine was investigated. A regression analysis was then performed in order to better characterize predictive factors for vaccine propensity.*
Results. *Influenza was recognized as a vaccination recommended for HCWs in 89/92 of the sampled OPh (96.7%). However, prevalence of misconceptions about vaccines was relatively high, with 26/92 (28.3%) and 24/92 (26.1%) referring vaccinations as eliciting allergic and autoimmune diseases, respectively and identifying lethargic encephalitis (18/92, 19.6%), autism (17/92, 18.5%), diabetes mellitus (15/92, 16.3%) and multiple sclerosis (13/92, 14.1%) as causatively vaccine-related. Propensity towards influenza vaccination found a significant predictor in the general knowledge (beta coefficient 0.213, p value = 0.043), risk perception (beta coefficient 0.252, p value = 0.018) and general propensity towards vaccinations (beta coefficient 0.384, p value = 0.002).*
Discussion. *In spite of a diffuse propensity towards SIV, adherence of OPh was still < 50% of the sample. Moreover, sharing of misbeliefs and misconceptions was significant. As knowledge and risk perceptions were identified as significant predictors of vaccine propensity, our results suggest that information and training programs for OPh should be appropriately designed.*

Introduction

Seasonal influenza (SI) is a highly contagious vaccine preventable infectious disease (VPD), which can result in debilitating illness and potentially fatal complications in subjects at risk, representing a major public health problem with a heavy impact on National Healthcare Systems [1, 2]. Because of theirs professional duties, healthcare workers (HCWs) not only are at high risk of contracting SI, but also represent a significant source of transmission and circulation of the viruses in the community [3, 4]. SI vaccine (SIV) is safe and usually well-tolerated [5-8], and evidence suggests that policies involving immunization of HCWs may cost-effectively decrease employee absenteeism caused by SI. Moreover, by preventing its transmission between HCWs and patients, SIV would ultimately improve patient safety and decrease influenza-related morbidity and mortality [2, 9]. Since 1981, the United States Centers for Disease Control and Prevention (CDC) have therefore advised that HCWs will receive SIV [3, 10, 11], and in 2002 also the World Health Organization (WHO) began encouraging annual immunization where supported by national data and capacities, furtherly strengthening its recommendations during the 2009 H1N1 influenza pandemic [2, 5-8]. Nowadays, several European Public Health Authorities, such as the Italian National Health Service (in Italian: *Servizio Sanitario Nazionale*, SSN), have implemented SIV in HCWs through official recommendations (in Italy: National Immunization Prevention Plan / *Piano Nazionale di Prevenzione Vaccinale* or PNPV) [3, 7, 12-19]. However, vaccination coverage remains heterogeneous and usually unsatisfactory, with rates well below the minimum target of 75% required by the European Commission, as still ranging from about 15% to 50% in different countries [4, 15, 20-23]. Although Italian data on vaccination coverage among

HCWs are not routinely available, recent studied have confirmed an inadequate compliance, suggesting that vaccination rates would have significantly declined since 2009 H1N1 pandemic, being presumptively well below 20% [7, 12 15, 19, 24, 25].

A number of studied have examined specific factors influencing SIV uptake by HCWs, identifying major barriers in system failures (*e.g.* stock-outs, limited availability of vaccination services in terms of time, places, etc.) and in individual factors such as: doubts regarding the preventive usefulness of vaccines and the rationale for vaccination, lack of knowledge regarding natural infection (*i.e.* actual risk for HCWs) and its potential consequences, misbelieves about vaccine-related risks and vaccine safety, as well as a diffuse lack of trust in the health policies and in the health authorities that promote them [2, 16, 26, 27]. In facts, a significant share of HCWs still understand SI as a mild illness not requiring a specific prophylaxis, and that contracting the disease is somehow safer than getting the vaccine [2, 16, 18, 25-31]. Collectively, aforementioned factors concur to the definition of vaccine hesitancy (VE), *i.e.* the continuum between full acceptance of vaccines with no doubts and the complete refusal with no doubts [28-31], and VE would in turn impair proactive behaviors, ultimately contributing to low vaccination rates [2, 16, 18, 25-31].

Occupational Physicians (OPh) are the medical professionals responsible for health promotion on the workplaces [32], and may actively contribute to overcome false attitudes and misconceptions supporting VE. Moreover, OPh inform the workers about the pros and cons of recommended vaccinations, and may therefore undermine or even remove the mutual misunderstanding between public health professionals and vaccine hesitant individuals, eventually maximizing the consent for vaccination programs [32]. Unfortunately, although numerous studies have assessed knowledge, attitudes and practices (KAP) of specific occupational groups regarding vaccinations, and such interventions have been proven as quite efficient in designing appropriate vaccination campaigns, ultimately improving immunization rates [20, 23, 26, 33-35], KAP of OPh about influenza vaccine have been scarcely investigated [32, 36, 37]. Moreover, as determinants of VE are vaccine-, VPD- and context-specific [28, 29], available evidence from general studies about vaccine acceptance in HCWs and more specifically in OPh are of limited generalizability [36, 37].

The aim of this study, therefore, to assess KAP of OPh about SIV and vaccination policies, including both general and specific recommendations for HCWs, and how attitudes and knowledge relate to these recommendations. Eventually, we attempted to identify areas that may be targeted for improvement through specific informative and educative campaigns dedicated to OPh.

Materials and methods

Study design

A cross-sectional questionnaire-based study was performed in the second half of 2015, involving OPh operating in the Autonomous Province (AP) of Trento (North-Eastern Italy). Participants were inquired about their KAP towards vaccinations, and more specifically on the SIV. Sampling was performed through convenience, as the initial population included all OPh participating to a seminar on occupational health that took place in the AP of Trento in October 2015 and assisting at least one healthcare provider in the AP of Trento (n = 105, 43.9% of 239 OPh usually operating in the AP of Trento). All participants giving their preventive agreement in the following weeks received a telephonic interview assessing knowledge and attitudes towards SI and SIV in HCWs.

Questionnaire

Two specifically formed researchers compiled a structured questionnaire through a telephonic interview. The questionnaire was formulated in Italian (an English translation is presented as the Annex 1), and its test-retest reliability was preventively assessed through a survey on 10 health professionals completing the questionnaire at two different points in time. All questions were self-reported, and not externally validated.

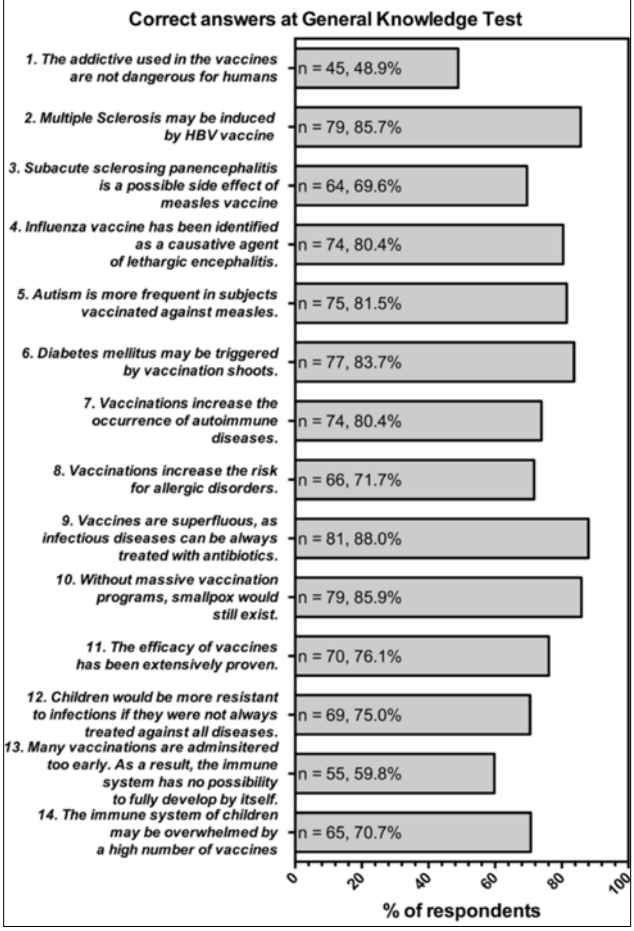
The final questionnaire comprised general demographic information (*i.e.* age, sex, country of origin) and the following areas of inquiry:

(1) Demographic data. Included: age, sex, country of origin (*i.e.* Italian born-people vs. foreign-born people), and medical specialization (*i.e.* in Italy, qualification as OPh is primarily obtained through specialization in occupational medicine, but also specialists in Hygiene and Public Health and in Legal/Forensic Medicine are legally authorized to work as OPh, as well as all physicians who were working as OPh before 1991) [38, 39].

(2) General knowledge. The questionnaire included a general knowledge test originally developed by Zingg and Siegrist [40], and containing a set of true-false statements such as "*vaccinations increase the occurrence of allergies*" (false) that cover some typical misconceptions on vaccination. General knowledge test was able to successfully predict risk perceptions and vaccination intentions in previous studies [32, 40]. A total of 14 statements (Fig. 1) were eventually presented, including the 9 original items from Zingg's questionnaire and 5 further items about vaccine misconceptions designed to better fit Italian settings (*e.g.* causative association between HBV vaccine and multiple sclerosis, influenza and lethargic encephalitis *etc.*). A General Knowledge Score (GKS) was then calculated as the sum of correctly and incorrectly marked recommendations: when the occupational physicians correctly answered, +1 was added to a sum score, whereas a wrong indication or a missing/"don't know" answer added -1 to the sum score.

(3) Risk perception. Perceived risk has been defined as a function of the perceived probability of an event and its expected consequences, and therefore assessed as the mathematical product of subjective probability and disease severity [32, 41]. We inquired the risk perception of OPh about influenza by asking the OPh about: the probability that HCWs get influenza infection, the frequency of vaccine-related adverse effects, and whether

Fig. 1. General knowledge test. The original knowledge test [19, 23] was modified including 5 additional items (n. 2 to 6); as disorders cited in items n. 2-6 were previously presented in the original items 2-3, items 7-9 were subsequently modified.



they perceived the severity of the natural infections and vaccine-related adverse effects. In order to summarize the results, we used a fully labeled 7-point scale (*i.e.* 1, "*almost zero*"; 2, "*low*"; 3, "*rather low*"; 4, "*moderate*"; 5, "*rather high*"; 6, "*high*"; 7, "*very high*"). A Risk Perception Score (RPS) was eventually calculated as cumulative score through the formula:

$$\text{Risk perception} = I^{INF} * C^{INF} - I^{VAC} * C^{VAC}$$

where:

I^{INF} = perceived probability of infection in HCWs

C^{INF} = perceived severity of natural infection in HCW

I^{VAC} =perceived probability of vaccine-related adverse effects

C^{VAC} = perceived severity of vaccine-related adverse effects

(4) Attitudes and Practices. Initially, participants rated their general attitudes towards vaccinations, and the answer was a 7-point Likert scale (*i.e.* 1, "*absolutely against vaccinations*"; 2, "*strongly against vaccinations*"; 3, "*somewhat against vaccinations*"; 4, "*neutral*"; 5, "*somewhat in favor of vaccinations*"; 6, "*strongly in favor of vaccinations*"; 7, "*absolutely in favor of vaccinations*"). The OPh were then asked to rate their attitudes towards influenza vaccine through a similar fully labeled 7-point Likert scale. A cumulative score (*i.e.* "*propensity score*") was calculated, both in general (G-PS) and for influenza vaccine (IV-PS).

Eventually, participants were asked whether they had received SIV during 2014-2015 winter season. Subjects self-assessed as "*not vaccinated*" fulfilled a subsequent set of items exploring the reasons for not having been previously vaccinated. In particular, participants were asked whether: (1) they had organization problems (*i.e.* "*not enough time*"); (2) they felts themselves as already immunized by previous vaccination campaigns; (3) would prefer recur to alternative countermeasures; (4) are not convinced that IV is useful; (5) have fear of injections or (6) of side effects; (7) they understand vaccination as a mild disease, making therefore useless the vaccine and eventually (8) whether IV is contrary to their personal / religious beliefs.

Ethical considerations

Before they give their consent, participants were informed that all information would be gathered anonymous and handled confidentially. Participation was voluntary, and the questionnaire was collected only in subjects who expressed consent for study participation. As individual participants cannot be identified based on the presented material, this study caused no plausible harm or stigma to participating individuals.

As the study design assured an adequate protection of study participants, and neither include clinical data about patients nor configure itself as a clinical trial, a preliminary evaluation by the Ethical Committee of the Provincial Agency for Health Services (in Italian: *Azienda Provinciale per i Servizi Sanitari,* APSS) was statutorily not required.

Data analysis

Two independent researchers, one of whom read the responses from each questionnaire while the other researcher reviewed the entered data, ensured the accuracy of data entry. The primary investigator examined unclear responses to determine the correct answer. We calculated the described indices for general knowledge (GKS), risk perception (RPS) and vaccine propensity (G-PS and IV-PS).

Continuous variables (*i.e.* age, GKS, RPS, G-PS, IV-PS) were expressed as mean ± standard deviation. Categorical variables were reported as percent values. Univariate confrontation between continuous variables was performed through Student's t test for unpaired data, whereas proportions were evaluated through Chi-squared test (with continuity correction). Association of

dichotomous variables was assessed in univariate analysis through calculation of respective Odds Ratios (OR) with their respective 95% Confidence Intervals (95% CI). Relations between the continuous variables were explored through the calculation of the Pearson product-moment correlation coefficient (*i.e.* Pearson's r). A logistic regression analysis (SPSS 23) was performed in order assessed the relative influence of personal attitudes and general knowledge on personal propensity to vaccinate. The analyses were controlled for age, sex, qualification. Odds Ratios similarly adjusted for age, sex, country of origin, and qualification (adjOR) were calculated through a binary logistic regression analysis for factors that in univariate analysis were associated with dichotomized propensity ("*somehow favorable*"/"*somehow against*" influenza vaccination) and previous SIV at $p < 0.150$. Significance level was 5%.

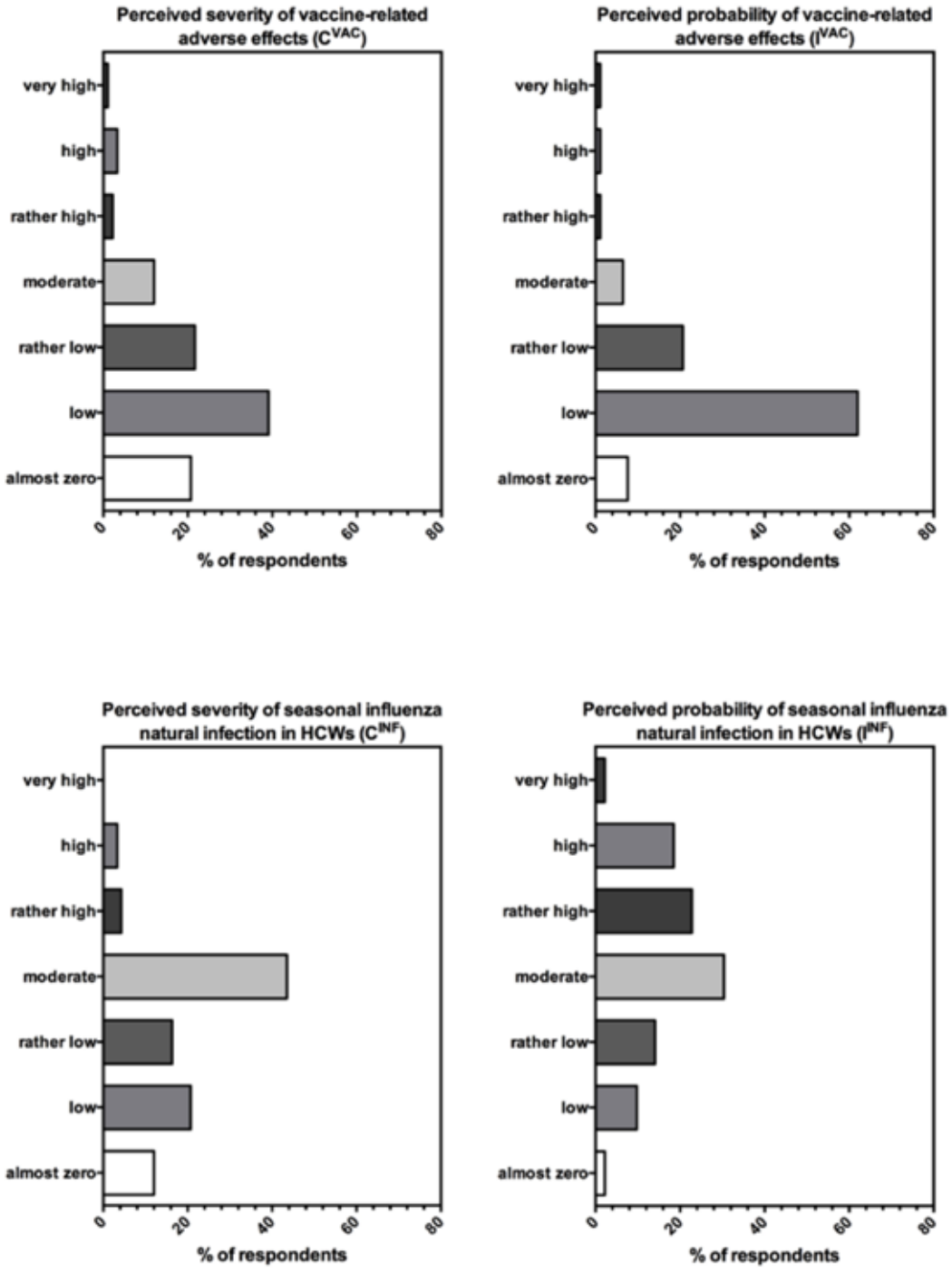
Results

(1) Demographic data. Overall, 95/105 participants (90.5%) gave their consent to the inquiry and 92/105 compiled the questionnaire regarding IV/SIV (87.6%, *i.e.* the 38.5% of all OPh operating in the AP of Trento): as shown in Table I, 39 (42.4%) were males, and 53 (57.6%) females, with a mean age of 47.3 ± 10.4 years (50.4 ± 9.3 in males vs. 49.4 ± 8.1 in females, $p = 0.582$), and 55.4% of the participants (51/92) were > 50 year-old. Among the sampled subjects, 50 (54.3%) were specialists in Occupational Medicine, whereas 42 (45.7%) were qualified as specialist in Hygiene and Public Health.
(2) General knowledge. Overall, 89/92 of the sampled OPh (96.7%) correctly recalled SIV as recommended by PNPV 2012-2014 in HCWs. Focusing on general knowledge test (Fig. 1), despite a potential range of -14 to +14, the actual mean score was 5.9 ± 4.5, and no one among sampled subject reached the maximum score of 14 (actual range: -9 to +11). With the exception of the claims about the safety of vaccine additives, as 47/92 (51.1%) failed to identify them as not dangerous, the majority of participants correctly identified the presented statements. In particular, most of participants were aware that infectious diseases cannot be always treated with antibiotics (88.0%, 81/92), and that without massive vaccination programs, infectious diseases such smallpox would still exist (85.9% of correct answers, 79/92). However, 23.9% of the sample (22/92) questioned the efficiency of vaccines, and 40.2% (37/92) exhibited the misconception that too many vaccinations are administered too early, whereas 29.3% (27/92) claimed that the immune system may be overwhelmed by a high number of vaccines. Eventually, around a fourth of sample erroneously stated that children would be more resistant to infections if they were not always treated against all diseases (23/92, 25.0%), and that vaccines may be causatively related with allergic disorders (28.3%, 26/92) and autoimmune diseases (26.1%, 24/92). More specifically, vaccines were associated with disorders of the immune systems such as diabetes mellitus (15/92, 16.3%) and multiple sclerosis (13/92, 14.1%), but also with neurological diseases such as subacute sclerosing panencephalitis (28/92, 30.4%), lethargic encephalitis (18/92, 19.6%), and even autism (17/92, 18.5%).
(3) Assessment of the risk perception. Despite a potential range -49 to +51, RPS was estimated in 7.5 ± 8.6 (actual range -26 to +27). As shown in Figure 2, not only the majority of participants perceived the potential severity (C^{INF}) of influenza natural infection as "*almost zero*" to "*rather low*" (59.8%, 55/92; mean score 3.2 ± 1.3), but also no one among the sample identified influenza as a VPD with a potentially "*very high*" severity, whereas 26.1% of participants similarly defined potential probability of influenza natural infection in HCWs (I^{INF}) as "*almost zero*" to "*rather low*", with a further 30.4% acknowledging a "*moderate*" probability of natural infection (mean score 4.3 ± 1.4). Regarding the adverse effects, around 90.2% of participants referred to perceive their probability (I^{VAC}) as "*almost zero*" to "*rather low*" (mean score 2.4 ± 0.9), and similarly 81.5% of the participants defined their potential severity as mild (i.e. "*almost zero*" to "*rather low*"; C^{VAC}, mean score 2.5 ± 1.3).
(4) Attitudes and Practices. Mean G-PS was 5.8 ± 1.1, with an actual range of 3 to 7. More specifically, 88/92 (95.6%) identified themselves as somehow favorable to vaccinations. Focusing on IV-PS, a mean score of 3.1 ± 1.8 was identified (actual range: 1 to 7), as 63/92 (68.5%) were somehow favorable to influenza vaccine.
Overall, 46.7% of the participants (43/92) referred to have been vaccinated against seasonal influenza in the previous year, and 49 subjects fulfilled the questionnaire's section exploring the reasons for refusing SIV (Fig. 3). The most frequently referred reason was the lack of time (23/49, 46.9%), followed by the belief to be "*already immune because of previous vaccinations*" (13/49, 26.5%), whereas 9/49 (18.4%) reported the preferential use of "*alternative countermeasures*", and 8/49

Tab. I. Demographic characteristics and qualification of sampled OPh (n = 95).

Characteristics	N (%)
Gender	
Males	39 (42.4%)
Females	53 (57.6%)
Age (years)	
≤ 29	3 (3.3%)
30 – 39	8 (8.7%)
40 – 49	30 (32.6%)
50 – 59	44 (47.8%)
≥ 60	7 (7.6%)
Country of origin	
Italian-born people	86 (93.5%)
Foreign-born people	6 (6.5%)
Medical Specialization	
Occupational Medicine	50 (54.3%)
Hygiene and Public Health	42 (45.7%)
Legal / Forensic Medicine	-
Other	-

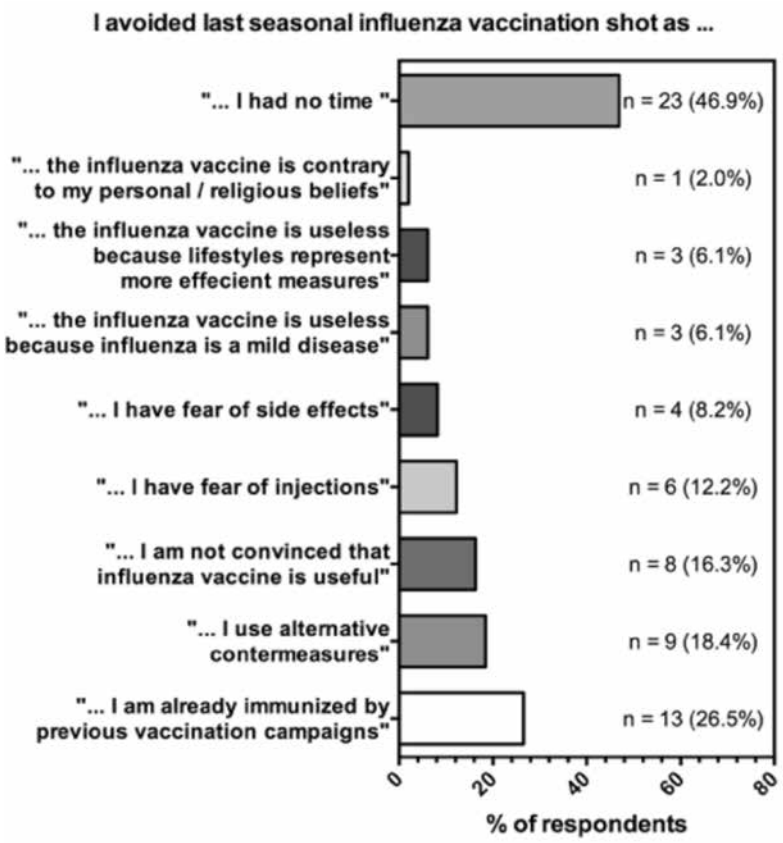
Fig. 2. Components of the Risk Perception Score in 92 Occupational Physicians participating to the survey (HCWs = health care workers).



(16.3%) were "*not convinced that influenza vaccine is useful*", and 4/49 (8.2%) referred "*fear of side effects*".

(5) Univariate analysis. In univariate analysis, although a greater share of participants younger than 50 years exhibited a somehow favorable attitude towards influenza vaccine (78.0% vs. 60.8% in subjects older than 50 years, p = 0.122; OR 2.294 95% CI 0.906-5.808), no significant association was found between demographic factors (*i.e.* gender, age group and country of origin), and vaccination status on the one hand and personal attitude towards seasonal influenza vaccine (Table II). However, focusing on the referred medical specialization, participants having a qualification in Occupational Medicine were associated with a significantly greater share of positive attitude towards seasonal influenza vaccine (90.0% *vs*. 42.9%, p < 0.001; OR 12.000 95% CI 3.964-36.331). Eventually, subjects referring a positive vaccination status more frequently exhibited an attitude somehow

Fig. 3. Reasons advocated by subjects not vaccinated against seasonal influenza during winter season 2014-2015. Because more than a single choice was possible, sum of percentages is not equal to 100%.



against influenza vaccination than participants exhibiting a negative vaccination status (82.9% *vs*. 56.9%, respectively; p = 0.012, OR 3.816 OR 1.422-10.239).

As shown in Table III, subjects correctly identifying as "*true*" the statement that "*the efficacy of vaccines has been extensively proven*" were significantly associated with the recalling of a positive seasonal influenza vaccine status (OR 3.600, 95% CI 1.169-10.83) and a positive attitude towards influenza vaccine (OR 3.741, 95% CI 1.374-10.19).

A positive attitude towards SIV was also significantly associated with the denying of misconceptions as the association between vaccines and autism (p < 0.001; OR 8.188 95%CI 2.528-26.52), the greater resistance to infections of children achieving a "natural" immunity (p = 0.007; OR 4.306; 95% CI 1.590-11.663), and the increased occurrence of auto-immune diseases after receiving vaccinations (p = 0.044; OR 3.000 95% CI 1.137-7.918).

On the contrary, as shown in Table IV, previous vaccination against SI and a favorable attitude towards SIV were not associated with a significantly higher share of the factors included in the assessment of risk perception.

As shown in Table V, both GKS and RPS were significantly higher in subjects younger than 50 y.o. (7.1 ± 3.1 vs. 4.9 ± 4.1, p = 0.009; and 9.6 ± 7.7 *vs*. 5.9 ± 8.9, p = 0.033, respectively), in foreign-born participants than in Italian-born ones (8.7 ± 2.7 *vs*. 5.7 ± 4.3, p = 0.013; and 11.7 ± 10.4 *vs*. 7.2 ± 8.4, p = 0.023, respectively), and eventually in participants referring a specialization in Occupational Medicine than in participants specialists in Hygiene and Public Health (7.0 ± 3.0 *vs*. 4.6 ± 5.1, p = 0.008; and 9.6 ± 7.4 *vs*. 5.1 ± 9.3, p = 0.011, respectively). No significant differences were identified in G-PS throughout assessed demographic factors (all comparison p > 0.05), whereas focusing on IV-PS, subjects younger than 50 y.o. had a significantly higher score than older participants (4.1 ± 1.0 *vs*. 3.5 ± 1.4, p = 0.020).

Bivariate Pearson's correlations among GKS, RPS, G-PS and IV-PS are shown in Table VI. More specifically, GKS was positively correlated with RPS (r =0.317, p = 0.002) and propensity scores, (r = 0.315, p = 0.022 and r = 0.492, p < 0.001 for G-PS and IV-PS, respectively). Focusing on the two propensity scores, G-PS and IV-PS were positively correlated (r = 0.451, p < 0.001). Whereas IV-PS was in turn correlated with RPS (r = 0.280, p = 0.007), G-PS was not (r = 0.203, p = 0.053).

6. Multivariate analysis. Binary logistic regression confirmed that subjects somehow favorable to influenza vaccination more frequently had a positive SIV status (adjOR 5.806 95% CI 1.242-27.15), and correctly identified as misconceptions the association between vaccines and autism (adjOR 25.05 95% CI 2.538-247.3), and that children would be more resistant to infections if they were not always vaccinated against all diseases

Tab. II. Univariate association of influenza vaccination practice and attitude regarding influenza vaccine, with recalled demographic factors in 92 OPh participating to the study (OR = Odds Ratio; 95% CI = 95% Confidence Interval).

	Previously vaccinated against seasonal influenza			Somewhat favorable to influenza vaccination		
	N (%)	P value	OR (95% CI)	N (%)	P value	OR (95% CI)
Gender						
Males	20 (51.3%)	0.368	1.604	30 (76.9%)	0.205	2.020
Females	21 (39.6%)		(0.696 – 3.697)	33 (62.3%)		(0.798 – 5.116)
Age group						
< 50 y.o.	16 (39.0%)	0.455	0.666	32 (78.0%)	0.122	2.294
≥ 50 y.o.	25 (49.0%)		(0.289 - 1.532)	31 (60.8%)		(0.906 – 5.808)
Country of origin						
Italian-born people	39 (45.3%)	0.883	1.660	58 (67.4%)	0.722	0.414
Foreign-born people	2 (33.3%)		(0.288 – 9.547)	5 (83.3%)		(0.046 – 3.716)
Specialization						
Occupational Medicine	25 (50.0%)	0.350	1.625	45 (90.0%)	< 0.001	12.000
Hygiene and Public Health	16 (38.1%)		(0.706 – 3.741)	18 (42.9%)		(3.964 – 36.33)
Vaccination status towards seasonal influenza						
Previously vaccinated	-	-	-	34 (82.9%)	0.014	3.685
Not vaccinated	-	-	-	29 (56.9%)		(1.377 – 9.860)

Tab. III. Univariate analysis of the association between the correct answer to the statements included in the general knowledge test, positive vaccination status and attitude towards seasonal influenza vaccine.

Statement	Previously vaccinated against influenza vaccine (n = 41)		Somehow favorable attitude towards influenza vaccine (n = 63)	
	Unadjusted OR (95% CI)	P value	Unadjusted OR (95% CI)	P value
1. The addictive used in the vaccines are not dangerous for humans (TRUE)	0.830 (0.364 – 1.892)	0.816	1.038 (0.430 – 2.503)	0.888
2. Multiple Sclerosis may be induced by HBV vaccine (FALSE)	1.544 (0.475 – 5.014)	0.671	0.960 (2.280 – 3.418)	0.796
3. Subacute sclerosing panencephalitis is a possible side effect of measles vaccine (FALSE)	0.905 (0.370 – 2.217)	1.000	0.316 (0.514 – 3.372)	0.742
4. Influenza vaccine has been identified as causative agent of lethargic encephalitis (FALSE)	1.734 (0.614 – 4.896)	0.434	2.700 (0.938 – 7.770)	0.110
5. Autism is more frequent in subjects vaccinated against measles (FALSE)	0.451 (0.145 – 1.408)	0.262	8.188 (2.528 – 26.52)	< 0.001
6. Diabetes mellitus may be triggered by vaccinations shoot (FALSE)	0.800 (0.259 – 2.467)	0.916	2.188 (0.708 – 6.763)	0.282
7. Vaccinations increase the occurrence of auto-immune diseases (FALSE)	1.072 (0.421 – 2.730)	1.000	3.000 (1.137 – 7.918)	0.044
8. Vaccinations increase the risk for allergic disorders (FALSE)	1.357 (0.546 – 3.374)	0.671	2.471 (0.957 – 6.378)	0.099
9. Vaccine are superfluous, as infectious diseases can be always treated with antibiotics (FALSE)	0.424 (0.105 – 1.715)	0.365	3.026 (0.840 – 10.90)	0.160
10. Without massive vaccination programs, smallpox would still exist (TRUE)	0.928 (0.286 – 3.012)	1.000	1.856 (0.459 – 7.498)	0.616
11. The efficacy of vaccines has been extensively proven (TRUE)	3.600 (1.169 – 10.83)	0.034	3.741 (1.374 – 10.19)	0.016
12. Children would be more resistant to infections if they were not always treated against all diseases (FALSE)	0.943 (0.364 – 2.441)	1.000	4.306 (1.590 – 11.66)	0.007
13. Many vaccinations are administered too early. As results, the immune system has no possibility to fully develop by itself (FALSE)	0.914 (0.395 – 2.117)	1.000	1.997 (0.817 – 4.882)	0.194
14. The immune system of children may be overwhelmed by a high number of vaccines (FALSE)	1.227 (0.499 – 3.020)	0.830	1.125 (0.432 – 2.993)	0.996

Tab. IV. Univariate analysis of the association between participants' risk perception about influenza and influenza vaccine, positive vaccination status and attitude towards seasonal influenza vaccine.

Variable	Previously vaccinated against influenza vaccine (n = 41)		Somehow favorable attitude towards influenza vaccine (n = 63)	
	Unadjusted OR (95% CI)	P value	Unadjusted OR (95% CI)	P value
Perceived severity of vaccine related adverse effects (C^{VAC}) as rather high to very high	1.263 (0.241 – 6.616)	1.000	0.205 (0.035 – 1.191)	0.144
Perceived probability of vaccine related adverse effects (I^{VAC}) as rather high to very high	0.613 (0.054 – 7.003)	1.000	0.218 (0.019 – 2.505)	0.484
Perceived severity of seasonal influenza natural infection in HCWs (C^{INF}) as rather high to very high	1.730 (0.365 – 8.208)	0.763	0.588 (0.123 – 2.814)	0.804
Perceived probability of seasonal influenza natural infection in HCWs (I^{INF}) as rather high to very high	2.123 (0.916 – 4.920)	0.120	1.396 (0.568 – 3.429)	0.616

Tab. V. Univariate comparison of General Knowledge Score (GKS), Risk Perception Score (RPS), Propensity Score towards vaccines in general (G-PS) and influenza vaccination (IV-PS) by recalled demographic factors in 92 OPh participating to the study.

	GKS		RPS		G-PS		IV-PS	
	Mean ± S.D.	P value	Mean ± S.D.	P value	Mean ± S.D.	P value	Mean ± S.D.	P value
Gender								
Males	6.3 ± 3.4	0.397	9.4 ± 8.3	0.079	5.8 ± 1.1	0.639	4.1 ± 1.1	0.055
Females	5.6 ± 4.9		6.2 ± 8.6		5.7 ± 1.1		3.6 ± 1.4	
Age group								
< 50 y.o.	7.1 ± 3.1	0.009	9.6 ± 7.7	0.033	5.9 ± 1.1	0.256	4.1 ± 1.0	0.020
≥ 50 y.o.	4.9 ± 4.8		5.9 ± 8.9		5.7 ± 1.1		3.5 ± 1.4	
Country of origin								
Italian-born people	5.7 ± 4.3	0.013	7.2 ± 8.4	0.023	5.8 ± 1.1	0.365	3.8 ± 1.3	0.672
Foreign-born people	8.7 ± 2.7		11.7 ± 10.4		6.2 ± 1.0		4.0 ± 1.1	
Specialization								
Occupational medicine	7.0 ± 3.0	0.008	9.6 ± 7.4	0.011	5.9 ± 0.9	0.377	4.4 ± 0.8	< 0.001
Hygiene and Public Health	4.6 ± 5.1		5.1 ± 9.3		5.7 ± 1.3		3.1 ± 1.4	

Tab. VI. Bivariate Pearson's correlation among General Knowledge Score (GKS), Risk Perception Score (RPS), Propensity Score towards vaccines in general (G-PS) and influenza vaccination (IV-PS).

	GKS	RPS	G-PS	IV-PS
GKS	-	r = 0.317 p = 0.002	r = 0.315 p = 0.022	r = 0.492 p < 0.001
RPS	r = 0.317 p = 0.002	-	r = 0.203 p = 0.053	r = 0.280 p = 0.007
G-PS	r = 0.315 p = 0.022	r = 0.203 p = 0.053	-	r = 0.451 p < 0.001
IV-PS	r = 0.492 p < 0.001	r = 0.280 p = 0.007	r = 0.451 p < 0.001	-

(adjOR 15.77 95% CI 2.364-105.2). Similarly, participants acknowledging that the efficacy of vaccines has been extensively proven had significant positive association with positive immunization status towards seasonal influenza (adjOR 3.999 95% CI 1.245-12.84).

Linear regression model included IV-PS dependent variable, GKS, RPS and G-PS as independent variables, and age, sex, medical specialization and immunization status as covariates. Eventually, GKS (beta coefficient 0.213, p value = 0.043), RPS (beta coefficient 0.252, p value = 0.018) and G-PS (beta coefficient 0.384, p value = 0.002) were identified as significant predictors of IV-PS.

Discussion

While in European Countries vaccination rates of HCWs against SI remain far below the target objective of 75%, still ranging between unsatisfactory rates of 14% and 50% [1, 42, 43], a growing number of authorities have developed initiatives aimed to increase SIV uptake among HCWs [2]. Addressing the factors that explain

Tab. VII. Multivariate analysis. The binary logistic regression analysis model evaluated variables that in univariate analysis were associated with vaccination status and favorable attitude towards influenza vaccine having a p value < 0.150, and included age, sex, medical specialization as covariates. Moreover, positive vaccination status was included as a covariate in the multivariate analysis about attitude towards influenza vaccine.

Statement	Previously vaccinated against influenza vaccine (n = 41)		Somehow favorable attitude towards influenza vaccine (n = 63)	
	Adjusted OR (95% CI)	P value	adjusted OR (95% CI)	P value
Previous vaccination against seasonal influenza vaccine	-	-	5.806 (1.242 – 27.15)	0.025
4. Influenza vaccine has been identified as causative agent of lethargic encephalitis (FALSE)	-	-	3.578 (0.760 – 16.86)	0.107
5. Autism is more frequent in subjects vaccinated against measles (FALSE)	-	-	25.05 (2.538 –247.3)	0.006
7. Vaccinations increase the occurrence of auto-immune diseases (FALSE)	-	-	3.810 (0.641 – 22.64)	0.141
8. Vaccinations increase the risk for allergic disorders (FALSE)	-	-	1.363 (0.370 – 6.378)	0.222
11. The efficacy of vaccines has been extensively proven (TRUE)	3.999 (1.245 – 12.84)	0.034	0.433 (0.078 – 2.412)	0.339
12. Children would be more resistant to infections if they were not always treated against all diseases (FALSE)	-	-	15.77 (2.364 – 105.2)	0.004
Perceived severity of vaccine related adverse effects (C^{VAC}) as rather high to very high	-	-	0.117 (0.008 – 1.681)	0.115
Perceived probability of seasonal influenza natural infection in HCWs (I^{INF}) as rather high to very high	2.380 (0.439 – 12.91)	0.120	-	-

insufficient adherence of HCWs to official recommendation about SIV has consequently become a growing focus of attention [15, 18, 25, 44-46]. Sound evidences do suggest that HCWs may share with the general population significant fears of side effects, misconceptions about vaccine safety, and even poor knowledge of vaccine's benefits, ultimately leading them to lower vaccination rates [16, 18, 47]. Moreover, a significant share of HCWs would underestimate not only the actual severity of seasonal influenza natural infection, but also their potential role in transmitting VPDs to the patients [3, 4, 10, 18, 23, 26, 48-51].

Despite the growing number of studies performed in recent years, at our knowledge few researches specifically evaluated KAP of OPh: overall, their knowledge of vaccines and vaccine recommendations were not consistently satisfactory [32,36, 37]. Also in our study, OPh were affected by a relatively high prevalence of misconceptions about vaccines [9]: interestingly enough, participants OPh shared false beliefs and misunderstandings about presumptive association between vaccines and autoimmune diseases (*i.e.* multiple sclerosis, diabetes), and also between certain immunizations and disorders such as autism, subacute sclerosing panencephalitis, and lethargic encephalitis. Worries about such associations were actually raised in the previous decades being then criticized or even largely disproved in the following years [52-54]. Although a significant base of evidence ultimately denies a causality between vaccinations, autoimmune and neuropsychiatric disorders, aforementioned warnings still receive diffuse emphasis on conventional media, remaining very influential on the "new media" (*i.e.* social media, personal blogs, *etc*.) [14, 15, 30, 31, 55, 56]. Interestingly enough, a greater share of false beliefs and misconceptions was identified in older subjects: we could tantalizingly suppose that such information gaps may be understood as a consequence of an insufficient continuous medical education and, as risk perception follows the acquisition of the knowledge [32, 60-62]. Such information gaps may in turn explain why the majority of sampled OPh identified influenza as a substantially indolent disease, and similarly around a quarter of the sample underestimated the probability for HCWs to develop seasonal influenza natural infection (26.1%). Actually, some international reports suggest that HCWs may avoid SIV as they understood its potential adverse effects as more severe and frequent than the avoided consequences of the natural infection [3, 18,20, 43].

Although in our sample doubts inherent vaccine safety were somehow reduced, as 90.2% of participants perceived probability of adverse effects as "*almost zero*" to "*rather low*", and the main reason referred by the participants to have not been vaccinated against SI was the lack of time, OPh with a better trust on the proven efficacy of vaccines, as defined by general knowledge test, more frequently reported vaccination against seasonal influenza (adjOR 3.999 95% CI 1.245-12.84), whereas no significant effect was found on individual vaccine propensity. Regarding the organization issues referred by participants, it should be recalled that Italian OPh are HCWs that usually work as private practitioner: in other words, their adherence to official recommendation towards SIV could have been significantly impaired by factors other than personal beliefs and misconceptions, as the limited availability of vaccination services [4, 11, 14-19].

Similarly, we found a significant correlation between GKS and RPS (r = 0.317, p = 0.002), and such correlation was not unexpected [32, 36], as well as that of both cumulative score with propensity towards SIV (r = 0.492, p < 0.001 and r = 0.280, p = 0.007, respectively). Consistently with previous researches in KAP in HCWs towards vaccinations [4, 11, 14-18, 32, 36], all factors presumptively involved in the building up of personal attitudes (*i.e.* GKS, G-PS, RPS) were then identified as significant predictors of the propensity towards SIV. In other words, a greater knowledge (*i.e.* less misconceptions and/or less personal attitudes guiding the vaccine decisions) of vaccine and vaccine-related disorders on the one hand, and a more accurate risk perception of SI on the other hand were associated with a better attitude towards SIV. In effect, there is a considerable evidence that a better awareness and a greater trust in vaccines increase the individuals' propensity to be vaccinated, and in OPh the latter would be in turn associated with a greater propensity to perform and promote vaccinations on the workplaces [14-16, 32, 67, 68]: in other words, any information gap in OPh would ultimately lead to diffusely hold and diffuse doubts or false beliefs about vaccines rejection of some vaccines [26, 56-59], being significant drivers of a more extended VE in HCWs and in turn in the general population with devastating consequences [32, 36].

However, it should be stressed that several factors not necessarily included in the knowledge and risk perception assessment contribute to building up vaccine confidence (and conversely VE) [63]: although adhesion to the official recommendations is usually characterized as weak driving factors [18, 25, 28, 29], attitudes of OPh may be significantly influenced by concerns about potential legal consequences of their actual implementation. In other words, participants may have reported behaviors unrelated with actual knowledge and risk perception, exhibiting a sort of "*social desirability bias*", *i.e.* the tendency of research subjects to give socially desirable responses instead of choosing responses that are reflective of their true feelings [64, 65]. Also the higher propensity towards SIV in specialists in Occupational Medicine than in specialists in Hygiene and Public Health, the latter assed as a dichotomous attitude (OR 12.000 95% CI, 3.964-36.33) and as a cumulative score as well (IV-PS, 4.4 ± 0.8 *vs*. 3.1 ± 1.4, p < 0.001), and better performances in both the general knowledge tests (7.0 ± 3.0 *vs*. 4.6 ± 5.1, p = 0.008) and in the assessment of the risk perception (9.6 ± 7.4 *vs*. 5.1 ± 9.3, p = 0.011) may be similarly explained. These results were otherwise unexpected, as vaccinology represents a cornerstone of the core curriculum of specialization courses in Hygiene and Public Health, and a significantly higher share of positive attitudes and appropriate knowledge was previously reported in residents in Hygiene and Public Health [66].

As risk perception may be understood as an intermediate step between knowledge and the developing of an attitude [32, 60-62], a self-reported positive vaccination status was unsurprisingly associated with a positive attitude towards vaccination (adjOR 5.806 95% CI 1.242-27.15). In this regard, although vaccination rate was well below 50% (43/92, 46.7%), our survey is consistent with previous studies on HCWs: despite data on European HCWs clearly show a very low compliance towards SIV, physicians have been usually described as more receptive to influenza vaccination than other HCWs, ultimately exhibiting similar vaccination rates [9, 18].

Limits of the study

Several major limitations of the study have to be addressed. For instance, we assessed a sample of relatively small size, gathered through convenience sampling and a regional basis. As Italy is highly heterogeneous in term of vaccination rates and vaccine acceptance, our sample may therefore not represent the whole Italian OPh populations [12]. Second, our sample was drawn from a very selected population that presumptively included OPh more sensitive to medical education themes (*i.e.* subjects participating to a Continuous Medical Education course): a significant selection bias cannot therefore be ruled out, ultimately suggesting that our sample overestimated actual vaccine acceptance of the parent occupational group. Moreover, as our questionnaire did not investigated the information sources from which assessed knowledge and elements of risk perceptions were drawn, we are unable to evaluate whether these results are a serendipitous association in the context of a small sample, or rather the actual consequence of a different post-graduate formation, and this may be acknowledged as another weakness of this study. Generalization of our results may be furtherly compromised by the very same design of the survey. In other words, not only participants may have overrated their actual vaccine propensity and similarly assessed the items of the general knowledge test in terms of "social desirability", but we cannot rule out a substantial lack of specificity in the recalling of vaccination status [9].

Conclusions

In conclusion, our results are consistent with previous reports on HCWs and with the limited available evidence on OPh. More specifically, the majority of OPh were somehow favorable to SIV, but a significant share of misbeliefs and false knowledge were also identified. As knowledge and risk perception were identified as significant predictors of vaccine propensity, our results suggest that that filling information gaps may significantly improve vaccine propensity of OPh, and possibly increase the vaccination rates in HCWs and, in turn, in the general population. Moreover, our results suggest that a significant share of HCWs may benefit from more flexibility, in term of time and accessibility, by healthcare providers performing SIV, and in particular with vaccination services. Their better interaction with OPh would be also useful in order to address personal misconceptions and target false beliefs, ultimately increas-

ing the awareness of the potential of SIV, in the HCWs and, subsequently, in the general population.

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All person who meet authorship criteria are listed as authors, and all authors certify that they have no affiliation with or involvement in any organization or entity with any financial interest, or non-financial interest (such as personal or professional relationship, affiliation, knowledge of beliefs) in the subject matter or material discussed in the manuscript.

Authors' contributions

MR was responsible of study design and data analysis, with the contribution of CS. FC was the main responsible of data collection, with the contribution of GG. Both GG and CS contributed to data analysis and manuscript preparation.

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ANNEX 1. Author's translation of the Questionnaire.

V.01	**Knowledge, attitudes and practices of Healthcare Workers towards vaccines – Section 1: seasonal influenza vaccine** References: Loulergue et al, Vaccine 2009;27:4240-4243 Little et al, Public Health 2015;129:755-762 Betsch e Wicker, Vaccine 2014;32:4478-4484	22.10.2015

Q01. Age: …… **Q02**. Sex: [M] [F] **Q03** Country of Origin: [ITA] [NO ITA]

Q04. Professional qualification:

[ ] Occupational Physician, with medical specialization in:
[ ] Occupational Medicine
[ ] Hygiene and Public Health
[ ] Forensic medicine
[ ] other (D.Lgs 277/91)

[ ] General Practitioner [ ] other _____

Q05. Year of medical qualification: ……..

Q06. At you knowledge, seasonal vaccine influenza is a recommended one among healthcare workers?
[ ] yes [ ] no

Q07. Have you been vaccinated against influenza during last winter season (2014-2015)?
[ ] yes [ ] no

Q08. Whether during last winter season you have not received seasonal influenza vaccination, the reason was …

"I am already immunized by previous vaccination campaigns" [ ]
"I use alternative countermeasures" [ ]
"I am not convinced that influenza vaccine is useful" [ ]
"I have fear of injections" [ ]
"I have fear of side effects" [ ]
"The influenza vaccine is useless because influenza is a mild disease" [ ]
"The influenza vaccine is useless because lifestyles are more efficient measures" [ ]

Q09. Please rate from 1 (almost zero) a 7 (very high) how you perceive …

	Almost zero	Low	Rather low	Moderate	Rather high	High	Very high
… the probability of adverse effects after influenza vaccination	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
… the probability for influenza natural infection in HCWs	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
… the severity of adverse effects after influenza vaccination	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]
… the severity of the influenza natural infection in HCWs	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]	[ ]

Q10. Please self-rate your attitude towards vaccinations (in general):
[ ] absolutely against [ ] strongly against [ ] somewhat against [ ] neutral
[ ] somewhat favorable [ ] strongly favorable [ ] absolutely favorable

Q11. Please self-rate your attitude towards influenza vaccine
[ ] absolutely against [ ] strongly against [ ] somewhat against [ ] neutral
[ ] somewhat favorable [ ] strongly favorable [ ] absolutely favorable

Q12. At your knowledge …

	True	**False**	**Don't know**
The addictive used in the vaccines are not dangerous for humans	[ ]	[ ]	[ ]
Multiple Sclerosis may be induced by HBV vaccine	[ ]	[ ]	[ ]
Subacute sclerosing panencephalitis is a possible side effect of measles vaccine	[ ]	[ ]	[ ]
Influenza vaccine has been identified as causative agent of lethargic encephalitis	[ ]	[ ]	[ ]
Autism is more frequent in subjects vaccinated against measles	[ ]	[ ]	[ ]
Diabetes mellitus may be triggered by vaccination shoots	[ ]	[ ]	[ ]
Vaccinations increase the occurrence of auto-immune diseases	[ ]	[ ]	[ ]
Vaccinations increase the risk for allergic disorders	[ ]	[ ]	[ ]
Vaccine are superfluous, as infectious diseases can be always treated with antibiotics	[ ]	[ ]	[ ]
Without massive vaccination programs, smallpox would still exist	[ ]	[ ]	[ ]
The efficacy of vaccines has been extensively proven	[ ]	[ ]	[ ]
Children would be more resistant to infections if they were not always treated against all diseases	[ ]	[ ]	[ ]
Many vaccinations are administered too early. As results, the immune system has no possibility to fully develop by itself	[ ]	[ ]	[ ]
The immune system of children may be overwhelmed by a high number of vaccines	[ ]	[ ]	[ ]

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