Annali di Igiene 2022 Feb… doi: 10.7416/ai.2022.2502. Online ahead of print

Attitudes toward COVID-19 vaccination in the nursing profession: validation of the Italian version of the VAX scale and descriptive study

M. Tomietto[1*], D. Comparcini[2*], V. Simonetti [3], C.A.M. Papappicco[4], P. Stefanizzi[5], M. Mercuri[6], G. Cicolini[5]

Received: 2021 September 12
Accepted after revision: 2022 January 21
Published online ahead of print: 2022 February

Key words: COVID-19 vaccine, nurses, vaccine hesitancy, vaccination attitudes, validation, Vaccination Attitudes Examination (VAX) Scale
Parole chiave: Vaccino COVID-19, infermieri, esitazione alla vaccinazione, propensione alla vaccinazione, validazione, Vaccination Attitudes Examination (VAX) Scale.

Abstract

Foreward. *Nurses' attitudes towards COVID-19 vaccination is a relevant issue, for the protection of the vulnerable people they care for, and the key role they play in promoting health behaviors that encourage trust and adherence to vaccination among population. This study aimed to validate the Italian version of the Vaccination Attitudes Examination (VAX) scale and to describe nurses' attitudes towards COVID-19 vaccination.*
Design. *A cross-sectional study was carried out from May to June 2021. Descriptive statistics, Explorative and Confirmatory Factor Analyses has been performed.*
Methods. *An online survey was carried out in Italy. The VAX scale referring to the COVID-19 vaccine was used.*
Findings. *430 nurses participated in the study, mainly female (73.2%). Mean age was 40.2 years. VAX scale revealed an optimal reliability; Exploratory Factor Analysis and Confirmatory Analysis supported a*

[1] *Full Professor, Department of Nursing, Midwifery and Health, Faculty of Health Sciences, Northumbria University, Newcastle Upon Tyne, UK*
[2] *Ward Manager, Azienda Ospedaliera Universitaria "Ospedali Riuniti", Ancona, Italy*
[3] *Research Fellow, Department of Biomedical Science and Human Oncology, University "Aldo Moro" of Bari, Italy*
[4] *Department of Intensive Respiratory Care Unit, San Paolo Hospital of Bari, Italy*
[5] *Researcher, Department of Biomedical Science and Human Oncology, University "Aldo Moro" of Bari, Italy*
[6] *Nurse Director, Degree Course in Nursing of Ancona, Politecnica delle Marche University, Ancona, Italy*
** These Authors (MT and DC) contributed equally to this work.*

Annali di Igiene : Medicina Preventiva e di Comunità (Ann Ig)
ISSN 1120-9135 https://www.annali-igiene.it

4-factors model. VAX scale mean scores showed low mistrust about vaccine's benefit (2.03±1.07), concerns about commercial profiteering (2.33±1.39) and preference for natural immunity (2.90±1.37). More worries concerning unexpected future effects were found (4.46±1.36). Gender, taking care of a frail person in family, having children or working in a COVID-19 setting are no significantly related to vaccination attitude. Participants from northern Italy expressed greater confidence in vaccine's benefits, the younger had significant lower scores about commercial profiteering.

Conclusions. *The Italian version of the VAX scale resulted a reliable tool to assess the nurses' attitudes towards anti-COVID-19 vaccination. An overall positive nurses' attitude towards the COVID-19 vaccination was highlighted. The concern about unforeseen future effects suggested the need to increase the information on this issue.*

Clinical relevance. *The results provided a valid and reliable tool to measure vaccination attitudes in the Italian context. This study could strengthen the health policies with educational interventions of healthcare workers through specific vaccination pathways. The healthcare professionals' vaccination attitudes play the key role also in promoting vaccination uptake in the population.*

Introduction

Population attitudes toward vaccination is a relevant issue in public health policies. Despite the wide amount of evidence about the effectiveness of vaccines in preventing communicable diseases and in decreasing morbidity and mortality, vaccination adherence is still a major concern worldwide (1).

Vaccine Hesitancy as an obstacle to the success of vaccination campaigns in general and specifically against COVID-19

Nowadays, due to the COVID-19 pandemic, vaccination uptake is a crucial issue to designing public health's effective approaches and policies in facing the pandemic. The COVID-19 vaccination is considered the most effective measure to prevent the novel coronavirus spread and to reduce the hospital admission rates and deaths (2). The failure to achieve a proper vaccination coverage at the population level is considered as a major global health threat over time and it is a recurrent problem in the seasonal influenza vaccination (1). In the past, H1N1 pandemic already highlighted critical vaccination rate (3). Public health policies for a compulsory vaccination are not an option, and even counterproductive nowadays, due to the individual-oriented societies (4). A most effective approach should consider tailoring public policies and health campaigns in order to promote healthy behaviors in the population and to improve the motivational factors which support adherence to vaccination (4), encouraging confidence in the vaccine rather than a simple acceptance (5). Mandatory vaccination is a controversial issue even regarding HCWs and still-open ethical debate (6, 7) due to it could improve anti-vaccination behaviors and concerns among the population. Deepening the attitudes toward vaccination is a first step in understanding individual adherence to being vaccinated. To achieve an intrinsic motivation towards health recommendations is widely recognized as a gold standard to reach and a more stable outcome over time, when compared to an extrinsic adherence due to a mandatory policy: this effect has already been detected when promoting the quarantine policies for COVID-19 vaccination (8).

Vaccine hesitancy as a specific issue due to healthcare workers

Healthcare workers' (HCWs) adherence to vaccination is an even more critical topic, due to the fact that they are supposed to deliver care to vulnerable people and the vaccine has the purpose to both protect the individual and the community. HCWs are at higher risk of being infected and to be

potential transmitters of the coronavirus in the workplace. In another perspective, HCWs are also an important source of information regarding health behaviors and disease prevention, and they play a key-role in recommending vaccination to the general population; therefore, HCWs can represent one of the strongest determinants of people's willingness to vaccinate (9, 10). In detail, nurses play a key role, not only in terms of vaccine administration but also in terms of education to the patients and the community (11, 12).

Vaccination's adherence by the HCWs has been acknowledged as critical in the past. For example, the yearly flu-vaccine is highly recommended to all HCWs, including nurses; anyway the final vaccination rate is widely below the target of 75% coverage recommended by the World Health Organization (1, 13, 14).

Relating to COVID-19 vaccine, in many countries HCWs have been the first group eligible to be vaccinated, but vaccination hesitancy and uptake among HCWs is still a controversial issue (15, 16).

Failure to vaccinate could depend on many different individual factors: from forgetfulness and lack of time, to concerns about the medical intervention, to medicaments' safety concerns, or to the commercial concerns toward the government or pharmaceutical companies (17, 18). To identify the roots of vaccination hesitancy and the attitudes toward vaccination are pivotal factors to detect the effective interventions in promoting vaccination uptake. First of all, it is crucial to adopt an effective tool to measure vaccination hesitancy, so to support the decision-makers on reliable and valid evidence.

This study aims to validate the Italian version of the Vaccination Attitudes Examination (VAX) scale as a useful tool in addressing effective interventions to promote vaccination and to describe the attitudes of nurses toward COVID-19 vaccination.

Methods

Research design

A multicenter cross-sectional study was carried out during the third wave of COVID-19 pandemic, from May to June 2021. An online survey was publicly spread at National level and promoted through the formal and informal networks of healthcare professionals.

Participants

Overall, 430 nurses participated in the study and sent the filled survey questionnaires back. Participants were recruited with a convenience sampling criterion, a snowball sampling further contributed to survey dissemination. Formal and informal professional networks have been involved to spread the survey among the target population.

Data collection procedures

Data were collected by employing an online survey approach, developed in LimeSurvey. A CAPTCHA system has been implemented to prevent inappropriate accesses to the survey by internet-bots, a cookies recording system was adopted to prevent duplicate imputs from the same user's device (19).

Instrument description

The VAX scale consists of 12 items rated on a Likert scale of agreement ranging from one (totally disagree) to seven (totally agree) (18, 20).

Previous research findings based on an Exploratory Factor Analysis (EFA) and a Confirmatory Factor Analysis (CFA) identified 4 factors: mistrust of vaccine benefit (3 items); worries about unforeseen future effects (3 items); concerns about commercial profiteering (3 items); preference for natural immunity (3 items) (18). The lower the scores in the VAX scale, the higher the positive attitude toward the vaccine.

Three items of scale were reversed, so the score was inverted as well in presenting the results, in order to properly represent the factor. In detail, the items "I feel safe after being vaccinated", "I can rely on vaccines to stop serious infectious diseases" and "I feel protected after getting vaccinated" are intended to represent the factor "mistrust of vaccine benefit" by adopting a reverse scoring.

In this study, participants were asked to fill the VAX scale referring to the COVID-19 vaccine.

Content validity

A forward and backward translation process has ensured content validity: the English version of the VAX scale was translated into Italian by a panel of four researchers confident in Italian and English language and familiar with the topic. The panel achieved a common agreement on the Italian translation of the scale, no items' deletion was necessary neither cultural adaptation of the items. The Italian version was blindly back-translated into English by an English mother tongue. Finally, the original English version and the English back-translated version were blindly compared by another researcher, fluent in English and familiar with the topic. The third independent researcher stated the content equivalence of the two versions and, in this way, the content validity of the Italian translation (21, 22).

Data analyses

Data were analyzed with Stata v12 (23) and SPSS v22 (24). The statistical significance was set at p value <0.05.

Preliminary analyses and sample size

Multivariate normality was previously checked in order to ensure the necessary prerequisite to properly choose the CFA's estimation approach and to properly perform multivariate statistics (25, 26). Due to the data collections criteria, the VAX scale's items were compulsory to fill prior to submit the questionnaire, so no missing data analyses were required. Multivariate outliers were detected by considering Mahalanobis distances and their p-value in the chi-square distribution, taking into account 12 degrees of freedom. In case of multivariate outliers' detection, they would be deleted listwise and multivariate normality further tested (25). The "bacon" package was adopted to detect multivariate outliers (27); multivariate normality was tested considering the Mardia's kurtosis and its p-value in the chi-squared distribution. Finally, construct validity was assessed by performing a Confirmatory Factor Analysis (CFA). In order to properly perform data analyses, it was recommended to achieve a participant to parameter ratio from 10:1 to 20:1 (26, 28). Accordingly, the required sample size was ranging from 120 to 240 participants.

Psychometric testing: reliability and validity

Descriptive statistics were calculated to describe scale items and the sample. Cronbach's alpha was performed to test instrument reliability. Values >0.90 are considered excellent, values >0.70 and ≤ 0.90 are rated as good, while values >0.60 and ≤ 0.70 are acceptable. Values ≤ 0.60 are non-acceptable (29). To identify each item's contribution to the overall scale's reliability, alpha values were calculated adopting the one-by-one deletion of items from each factor; if the scale's reliability increases over 0.10, an item should be deleted (30). Corrected item-to-total correlations were calculated and considered acceptable if they were over 0.30 (29).

Confirmatory Factor Analysis (CFA) was performed to assess the construct validity of the VAX scale. The 4-factor model detected in previous studies (20) was tested with CFA. The Maximum Likelihood (ML) approach would be adopted

to estimate the model's parameters in case of multivariate normality. If a non-normal multivariate distribution would be detected the parameters' estimation approach will be the Asymptotic Distribution Free (ADF) (26, 31). The fit indices were calculated to state the model's validity. Fit indices were considered acceptable for RMSEA (Root Mean Square Error of Approximation) and SRMR (Standardized Root Mean Residual) < 0.08 and CFI (Comparative Fit Index) and TLI (Tucker-Lewis Index) > 0.90 (26, 31). Exploratory Factor Analysis (EFA) was performed to represent items' loadings and the scale variance. EFA was performed by adopting the Principal Component Analysis in order to detect the maximum variance in a given set of factors and items (32) and by using the Varimax rotation approach with a fixed solution for the 4-factor model. Kaiser-Meyer-Olkin (KMO) test and Bartlett's test for sampling adequacy were calculated to test the requirement to properly perform the EFA (32).

Ethical considerations

National and European laws (33) have been adopted to ensure data confidentiality, together with the Personal Data Act (34). Data collection and data analysis phases were performed in order to warrant data confidentiality. The electronic data were saved in a protected folder, accessible only by the principal investigator. The survey platform was protected by a strong-recognized password and a two-step authentication method. Participants received a disclaimer on the first screen of survey presentation that included details about the study as well as information about how participant data would be handled. The submission of the survey's answers stated the participant's consent. Due to the type of data collected and the online data collection approach, no ethical approval neither administrative permissions were necessary.

Results

The sample was distributed for the 26.5% (114/430) in the north of Italy, the 37.7% (162/430) in the center and the 35.8% (154/430) in the south or islands. The participants were mainly female (73.2% - 315/430). The mean age was 40.2 years (SD=11.62; median=40; min=22; max=65). The mean years in the nursing profession were 15.9 years (SD=12.06; median=14.5; min=0.08; max=40), while the years spent in the ward or service where the participant was working at the moment of the survey were 8.8 years (SD=9.73; median=4.0; min=0.08; max=40). A total of 199 (46.3%) participants in the past year worked in a COVID-19 area. The participants' marital status was: 39.1% (168/430) single and 51.9% (223/430) married or a cohabitant couple, the remaining sample was divorced or widow. The 61.4% (264/430) of the sample declared to live or to take care of frail person in their close familiar network and the 51.9% (223/430) had children.

Descriptive statistics showed an overall mean value for the VAX scale of 2.93 (SD=1.01, median=2.75, min=1, max=7). The highest mean score was detected in the "worries about unforeseen future effects"

Table 1 - Factors' descriptive statistics.

Factors	mean (±SD)	median	min	max
Mistrust of vaccine benefit	2.03 (±1.07)	1.67	1	7
Worries about unforeseen future effects	4.46 (±1.36)	4.67	1	7
Concerns about commercial profiteering	2.33 (±1.39)	2.00	1	7
Preference for natural immunity	2.90 (±1.37)	2.67	1	7

Table 2 - Items´ descriptive statistics and factors´ reliability.

Factor	Item	mean (±SD)	median	min	max	skewness	kurtosis	Cronbach alpha if item deleted	Item to total correlation
Mistrust of vaccine benefit (α=0.84)	I feel safe after being vaccinated (R)	2.22 (±1.31)	2	1	7	1.66	5.56	0.88	0.51
	I can rely on vaccines to stop serious infectious diseases (R)	1.67 (±1.11)	1	1	7	2.80	12.42	0.89	0.48
	I feel protected after getting vaccinated (R)	2.21 (±1.24)	2	1	7	1.80	6.60	0.88	0.54
Worries about unforeseen future effects (α=0.77)	Althought most vaccines appear to be safe, there may be problems that we have not yet discovered	5.28 (±1.40)	6	1	7	-1.11	3.68	0.89	0.43
	Vaccines can cause unforeseen problems in children	4.02 (±1.65)	4	1	7	-0.11	2.04	0.88	0.54
	I worry about the unknown effects of vaccines in the future	4.08 (±1.82)	4	1	7	-0.11	1.81	0.88	0.67
Concerns about commercial profiteering (α=0.86)	Vaccines make a lot of money for pharmaceutical companies, but do not do much for regular people	2.74 (±1.70)	2	1	7	1.04	3.14	0.87	0.70
	Authorities promote vaccination for financial gain, not for people's health	2.32 (±1.56)	2	1	7	1.43	4.37	0.87	0.72
	Vaccination programs are a big con	1.94 (±1.42)	1	1	7	1.85	5.97	0.87	0.71
Preference for natural immunity (α=0.84)	Natural immunity lasts longer than a vaccination	3.24 (±1.65)	3	1	7	0.47	2.40	0.88	0.57
	Natural exposure to viruses and germs gives the safest protection	2.92 (±1.57)	2	1	7	0.63	2.51	0.88	0.59
	Being exposed to diseases naturally is safer for the immune system than being exposed through vaccination	2.54 (±1.49)	2	1	7	0.98	3.24	0.87	0.69

factor (4.46±1.36), while the lowest mean score was reported in the "mistrust of vaccine benefit" factor (2.03±1.07). Table 1 reports the detailed descriptive statistics for each factor.

Participants reported the highest level of agreement in the item "althought most vaccines appear to be safe, there may be problems that we have not yet discovered" with a mean score of 5.28 (±1.40). The reversed score for the item "I can rely on vaccines to stop serious infectious diseases" indicates also a high degree of trust in the vaccine to prevent infectious diseases (1.67±1.11). Participants also showed disagreement about the item "vaccination programs are a big con" (1.94±1.42). Table 2 reports the descriptive statistics for each item.

The overall internal consistency was 0.89 and the Cronbach's alpha values ranged from 0.77 to 0.86. Cronbach's alpha values did not increase if each item is deleted one by one, indicating that each item contributes to the overall realiability of the scale. Item-to-total correlations are above 0.30. Table 2 reports the detailed statistics of the scale and the reliability indexes.

EFA showed an overall variance of 76.3%. In detail, the "preference for natural immunity" factor explained the 45.8% of the scale, the "mistrust of vaccine benefit" factor explained the 13.0%, the "worries about unforeseen future effects" factor the 10.6%, while the remaining 6.9% is explaned by the "concerns about commercial profiteering" factor (Table 3).

Preliminary analyses did not detect multivariate outliers in the data distribution, anyway, the multivariate normality was not verified. In detail, Mardia's kurtosis test pointed out a $p<0.001$ (chi-squared=1513.76), indicating a non-normal multivariate distribution. According to this premise, CFA was performed by adopting the ADF estimation approach. The 4-factors model was tested and verified by fit indexes: RMSEA=0.045 (90%CI=0.030-0.059), SRMR=0.349, TLI=0.868, CFI=0.908 (Table 4).

Sensitivity analysis

In order to assess whether some sample characteristics had biased our results, a t-test was performed to check if taking care of a frail person in the close familiar network or having children or working (or having worked) in a COVID-19 clinical setting significantly affected the descriptive statistics: no statistical significant differences were detected in the factors' mean scores related to these charactersitics. Also, no difference based on gender were found and no statistical significance has been detected among age groups, except for the age group up to 25 years, which in the "concerns about commercial profiteering" factor, reported significant lowest scores ($p=0.001$). In the same vein, the difference between the mean scores among the geographical areas have been tested by performing ANOVA: statistical significance in the mean scores' difference has been detected. In detail, the participants from the north of Italy reported significant lowest scores in the "mistrust of vaccine benefit" factor, "concerns about commercial profiteering" factor and "preference for natural immunity" factor ($p<0.05$). No statistical significance has been detected among the geographical area in the "worries about unforeseen future effects" factor. Table 5 reports the mean scores for each factor by geographical area and the ANOVA results.

Discussion

The VAX scale measures the vaccination attitudes, with lowest scores representing a positive attitude. The scale demonstrated an optimal reliability. The 4-factors model explains a high variance of the phenomenon and it is consistent with previous studies. The

Table 3 - EFA, items' loadings.

Items / factors	Mistrust of vaccine benefit	Worries about unforeseen future effects	Concerns about commercial profiteering	Preference for natural immunity
I feel safe after being vaccinated	**0.83**	0.17	0.12	0.11
I can rely on vaccines to stop serious infectious diseases	**0.57**	0.05	0.32	0.12
I feel protected after getting vaccinated	**0.87**	0.12	0.15	0.14
Althought most vaccines appear to be safe, there may be problems that we have not yet discovered	0.03	**0.81**	0.09	0.09
Vaccines can cause unforeseen problems in children	0.16	**0.59**	0.22	0.20
I worry about the unknown effects of vaccines in the future	0.21	**0.64**	0.33	0.24
Vaccines make a lot of money for pharmaceutical companies, but do not do much for regular people	0.22	0.29	**0.66**	0.30
Authorities promote vaccination for financial gain, not for people's health	0.24	0.27	**0.73**	0.28
Vaccination programs are a big con	0.25	0.19	**0.67**	0.37
Natural immunity lasts longer than a vaccination	0.13	0.15	0.25	**0.65**
Natural exposure to viruses and germs gives the safest protection	0.10	0.16	0.16	**0.87**
Being exposed to diseases naturally is safer for the immune system than being exposed through vaccination	0.18	0.21	0.34	**0.69**
Eigenvalues	1.56	1.27	0.83	5.50
Variance (%)	13.0	10.6	6.9	45.8

Table 4 - CFA fit indexes.

Chi-square	p	RMSEA (90%CI)	SRMR	CFI	TLI
85.532	<0.001	0.045 (0.030-0.059)	0.349	0.908	0.868

Table 5 - ANOVA: factors by geographical areas.

	Geographical area				
	North (N=114) mean (±SD)	Centre (N=162) mean (±SD)	South (N=154) mean (±SD)	F	p-value
Mistrust of vaccine benefit	1.83 (±0.83)	2.20 (±1.25)	2.01 (±0.99)	4.23	0.015
Worries about unforeseen future effects	4.41 (±1.21)	4.38 (±1.43)	4.58 (±1.38)	0.98	0.374
Concerns about commercial profiteering	1.91 (±1.05)	2.43 (±1.45)	2.54 (±1.47)	7.85	<0.001
Preference for natural immunity	2.65 (±1.26)	2.89 (±1.41)	3.10 (±1.39)	3.65	0.027

non-normal multivariate distribution of the sample could affect the fit indexes, which, anyway, confirm a satisfactory validity.

Given the growing need to overcome vaccination hesitancy, it is crucial to measure in a reliable and valid way the vaccination attitudes, so to detect the main factors which address people's health behaviors and the willingness to get vaccinated. By detecting these factors, the decision-makers at the public health level can design the vaccination campaigns in a tailored way and they can better tackle on the vaccination uptake in population. This study provided a preliminary validation of the VAX scale in the nursing profession and it is a first pillar to further validate the VAX scale in the general population or to surveying the most reluctant cluster in order to understand the vaccination attitudes.

The validation of the VAX scale also supported a first understanding of nurses' attitude towards COVID-19 vaccine and we detected an overall positive attitude toward the vaccine. Participants reported low mistrust about vaccine's benefit as well as low concerns about commercial profiteering and low preference for natural immunity. However, high scores have been detected about the worries concerning unexpected future effects. Therefore, even if our results showed positive nurses' attitudes towards COVID-19 vaccination, this specific concern about unexpected future side effects should not be underestimated. In fact, this finding suggests to tailor the vaccination campaign on this topic in order to reduce HCWs' hesitancy toward the vaccine and to improve the vaccination rate. -

These descriptive results support public health policies in tailoring educational interventions to improve vacciation uptake in nursing profession.

Our study also provided some findings on the sociodemographic characteristics on the COVID-19 vaccination attitudes. Our findings showed that there are not associations between gender and the main factors of the VAX scale, contrary to results of previous studies in the general population (4, 35) and in the HCWs (36-38), in which female HCWs showed a higher COVID-19 vaccination hesitancy compared to the male HCWs. The age too was not also significantly associated to the attitude towards COVID-19 vaccine in regard of

"mistrust of vaccine benefit", "worries about unforeseen future effects" and "preference for natural immunity". Anyway, our results highlight that the younger HCWs (age group up to 25 years) have significant lower scores in regard of the "concerns about commercial profiteering". However this finding has to be interpreted with caution due to the fact that most of the participants were between 26 and 56 years (n=334), while the 18-25 age category was much less represented (n=63).

Taking care of a frail person in the close familiar network, having children or working (or having worked) in a COVID-19 setting have no significant contribution to explain vaccination attitude.

We also observed a difference between the mean scores across the geographical areas, in particular participants from northern Italy expressed greater adherence to the benefits of the vaccine, and fewer concerns about commercial exploitation. These results could be explained by considering that northern Italian regions have been among the most affected by the spread of the coronavirus since the beginning of the pandemic and some of these regions have continued to record the highest number of cases and deaths due the SARS-Cov-2 (39). To our knowledge, this is the first study performed on italian nurses during the period immediately following HCWs vaccination, but prior to the effective application of the decree in terms of suspensions from the workplace (40); this aspect needs to be taken into account because participants' perceptions were not yet impacted by the recent socio-political climate on this topic.

Limitations

The first limitations of the study is about the distribution of the sample: because multivariate normality was not achieved, the validation of scale, even if performed with a proper approach to managing the non-normal distribution, would benefit more of a larger sample and of multivariate normal distribution.

Second, data were collected from a sample of Italian nurses, therefore, the generalization of our results to a larger population should be considered with caution, due to the national policies and epidemiological situation overtime.

Third, the social desirability and the auto-selection bias should be considered, as nurses with higher motivation in vaccination might have been more prone to fill the questionnaire; similarly, some nurses may have preferred not to participate in the study due to their divergent opinion in respect to the recent Government policies about the vaccination of HCWs. However, the online survey method would mitigate this as the identity of the respondent was unknown.

Moreover, some demographic characteristics, such as gender (male sex) and age classes (18-25 years) were underrepresented in our sample and this aspect did not allow us to better explore the associations between variables. While our sample was adequate to perform a validation study, a larger sample is required to better surveying the population and achiving a more consistent inference on vaccination attitudes.

Conclusions

The Italian version of the VAX scale resulted to be a simple and reliable tool to assess the nurses' attitudes towards anti-COVID-19 vaccination in the Italian context, that could be easly applied in other situantions and settings to understand the dimension of vaccination attitudes in different cathegories of people.

The findings of this study also highlighted an overall positive nurses' attitude toward the COVID-19 vaccination. The main

concern were related to nurses' perception of vaccines safety in terms of unforeseen future effects. In order to promote individual and collective trust in vaccines, a broader approach would be needed: health policies should be supported by a tailored education and information of healthcare workers, due to healthcare workers' play a key role in promoting vaccination adherence by the population.

Implications for research and clinical practice

The vax scale is psychometrically valid as a tool for measuring attitude towards COVID-19 vaccination among nurses and, overall, our results provide evidence supporting the validity and reliability of the italian version of the VAX scale. Therefore, the adoption of the VAX scale is promising in order to measure the vaccination attitudes in a broader perspective. This scale is a simple and quick to fill tool, that could be easily adopted in the clinical practice. Moreover, it represents a reliable and valid instrument to design targeted interventions for each specific factor, so to improve vaccination attitudes.

Acknowledgments: The Authors acknowledge the following nurses for their effort in data collection: Sara Conchedda and Silvia Di Fabio.
Conflicts of interest: None.
Funding Source: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Riassunto

La propensione alla vaccinazione COVID-19 nella professione infermieristica: validazione della versione Italiana della VAX scale e studio descrittivo

Premessa. La propensione alla vaccinazione fra gli infermieri è un elemento rilevante per la protezione della popolazione fragile e per il ruolo che gli infermieri ricoprono nel promuovere comportamenti di salute nella popolazione che possono favorire la vaccinazione e la salute pubblica. Questo studio si propone di validare la versione italiana della Vaccination Attitudes Examination (VAX) scale e di descrivere la propensione degli infermieri verso la vaccinazione COVID-19.

Disegno di studio. È stato condotto uno studio trasversale nel periodo Maggio-Giugno 2021. Sono state elaborate le statistiche descrittive, l'Analisi Fattoriale Esplorativa e Confermativa.

Metodi. E' stata diffusa sul territorio Italiano una survey online. La scala VAX è stata adottata in riferimento alla vaccinazione per COVID-19.

Risultati. Hanno partecipato allo studio 430 infermieri, per la gran parte di genere femminile (73.2%). L'età media era di 40.2 anni. La scala VAX ha mostrato un'affidabilità ottimale; sia l'analisi fattoriale esplorativa che quella confermativa hanno confermato la validità del modello a 4 fattori. La scala VAX ha mostrato valori medi più bassi di esitazione alla vaccinazione nei fattori "sfiducia nel beneficio dei vaccini" (2.03±1.07), "riserve sugli interessi commerciali" (2.33±1.39) e "preferenza per l'immunità naturale" (2.90±1.37). Il maggiore fattore di esitazione è stato "preoccupazioni per futuri effetti inattesi" (4.46±1.36). Il genere, il prendersi cura di una persona fragile nella cerchia familiare, avere figli o prestare servizio presso un'area COVID-19 non hanno mostrato significatività rispetto la propensione alla vaccinazione. I partecipanti delle regioni del nord Italia hanno manifestato maggiore propensione alla vaccinazione e i partecipanti più giovani hanno mostrato minori riserve sugli interessi commerciali relativi ai vaccini.

Conclusioni. Complessivamente, è stata evidenziata un'alta propensione degli infermieri alla vaccinazione. Le preoccupazioni riguardanti futuri effetti inattesi suggeriscono di curare particolarmente questo tipo di informazione. La versione Italiana della VAX scale si è dimostrata affidabile e valida per valutare la propensione degli infermieri alla vaccinazione.

Rilevanza clinica. I risultati di questo studio hanno fornito uno strumento valido ed affidabile per valutare la propensione alla vaccinazione nel contesto italiano. I risultati possono rafforzare le linee di indirizzo di salute pubblica, contribuendo a definire specifici interventi educativi per gli operatori sanitari. Questi ultimi hanno un ruolo centrale nel promuovere la vaccinazione nella popolazione.

References

1. World Health Organization (WHO). Ten Threats to Global Health in 2019. 2019. Available on: https://www.who.int/news-room/spotlight/ten-

threats-to-global-health-in-2019 [Last accessed: 2021 Dec 4].
2. Department of Health & Social Care (DHSC). UK COVID-19 vaccine uptake plan. Policy Paper. 2021. Available on: https://www.gov.uk/government/publications/covid-19-vaccination-uptake-plan/uk-covid-19-vaccine-uptake-plan [Last accessed: 2021 Dec 4].
3. Mesch GS, Schwirian KP. Social and political determinants of vaccine hesitancy: Lessons learned from the H1N1 pandemic of 2009-2010. Am J Infect Control. 2015; **43**(11): 1161-5. doi: 10.1016/j.ajic.2015.06.031.
4. Taylor S, Landry CA, Paluszek MM, Groenewoud R, Rachor GS, Asmundson GJG. A Proactive Approach for Managing COVID-19: The Importance of Understanding the Motivational Roots of Vaccination Hesitancy for SARS-CoV2. Front Psychol. 2020; **11**: 575950. doi: 10.3389/fpsyg.2020.575950.
5. Harrison EA, Wu JW. Vaccine confidence in the time of COVID-19. Eur J Epidemiol. 2020; **35**(4): 325-30. doi: 10.1007/s10654-020-00634-3.
6. Galanakis E, Jansen A, Lopalco PL, Giesecke J. Ethics of mandatory vaccination for healthcare workers. Euro Surveill. 2013; 18(45): 20627. doi: 10.2807/1560-7917.es2013.18.45.20627.
7. Gualano MR, Corradi A, Voglino G, et al. Healthcare Workers' (HCWs) attitudes towards mandatory influenza vaccination: A systematic review and meta-analysis. Vaccine 2021; **39**(6): 901-14. doi: 10.1016/j.vaccine.2020.12.061.
8. Suplico-Jeong L, Bautista Jr RA, Guillen Jr NB, Murad NS. Adherence to quarantine protocols to prevent the spread of COVID-19: the mediating effect of intrinsic and extrinsic motivations. Asian Educ Dev Stud. 2021; ahead-of-print (ahead-of-print): 14.
9. Czajka H, Czajka S, Biłas P, Pałka P, Jędrusik S, Czapkiewicz A. Who or What Influences the Individuals' Decision-Making Process Regarding Vaccinations? Int J Environ Res Public Health. 2020; **17**(12): 4461. doi: 10.3390/ijerph17124461.
10. Reiter PL, Pennell ML, Katz ML. Acceptability of a COVID-19 vaccine among adults in the United States: How many people would get vaccinated? Vaccine. 2020; **38**(42): 6500-7. doi: 10.1016/j.vaccine.2020.08.043.
11. International Council of Nurses (ICN). Success of mass COVID-19 vaccination programmes will depend on frontline nurses and nurse leaders at the highest level of government. 2020. Available on: https://www.icn.ch/news/success-mass-covid-19-vaccination-programmes-will-depend-frontline-nurses-and-nurse-leaders [Last accessed: 2021, Dec 8].
12. Burden S, Henshall C, Oshikanlu R. Harnessing the nursing contribution to COVID-19 mass vaccination programmes: Addressing hesitancy and promoting confidence. J Adv Nurs. 2021; 77(8): e16-e20. doi: 10.1111/jan.14854.
13. Lorenc T, Marshall D, Wright K, Sutcliffe K, Sowden A. Seasonal influenza vaccination of healthcare workers: systematic review of qualitative evidence. BMC Health Serv Res. 2017; **17**(1): 732. doi: 10.1186/s12913-017-2703-4.
14. Squeri R, Di Pietro A, La Fauci V, Genovese C. Healthcare workers' vaccination at European and Italian level: a narrative review. Acta Biomed. 2019; **90**(9-S): 45-53. doi: 10.23750/abm.v90i9-S.8703.
15. Kregar Velikonja N, Dobrowolska B, Stanisavljević S, Erjavec K, Globevnik Velikonja V, Verdenik I. Attitudes of Nursing Students towards Vaccination and Other Preventive Measures for Limitation of COVID-19 Pandemic: Cross-Sectional Study in Three European Countries. Healthcare (Basel). 2021; **9**(7): 781. doi: 10.3390/healthcare9070781.
16. Szmyd B, Karuga FF, Bartoszek A, et al. Attitude and Behaviors towards SARS-CoV-2 Vaccination among Healthcare Workers: A Cross-Sectional Study from Poland. Vaccines (Basel). 2021; **9**(3): 218. doi: 10.3390/vaccines9030218.
17. Hofmann F, Ferracin C, Marsh G, Dumas R. Influenza vaccination of healthcare workers: a literature review of attitudes and beliefs. Infection. 2006; **34**(3): 142-7. doi: 10.1007/s15010-006-5109-5.
18. Martin LR, Petrie KJ. Understanding the Dimensions of Anti-Vaccination Attitudes: the Vaccination Attitudes Examination (VAX) Scale. Ann Behav Med. 2017; **51**(5): 652-60. doi: 10.1007/s12160-017-9888-y.
19. Dillman DA, Smyth JD, Christian LM. Internet, mail and mixed-mode surveys: The tailored design method. 3rd ed. Hoboken: Wiley, 2009.
20. Huza G. The Psychometric Properties of a Romanian Version of the Vaccination Attitudes Examination (VAX) Scale. Int J HIV AIDS Prev Educ Behav Sci. 2020; **6**(1): 25-31. doi: 10.11648/j.ijhpebs.20200601.14.

21. White M, Elander G. Translation of an instrument. The US-Nordic Family Dynamics Nursing Research Project. Scand J Caring Sci. 1992; **6**(3): 161-4. doi: 10.1111/j.1471-6712.1992.tb00145.x.
22. Maneesriwongul W, Dixon JK. Instrument translation process: a methods review. J Adv Nurs. 2004; **48**(2): 175-86. doi: 10.1111/j.1365-2648.2004.03185.x.
23. StataCorp. Stata Statistical Software: Release 12. College Station: StataCorp LP, 2011.
24. IBM Corp. Released. IBM SPSS Statistics for Windows, Version 22.0. Armonk: IBM Corp, 2013.
25. Fidell LS, Tabachnick BG. Preparatory data analysis. In: Schinka JA, Velicer WF, Eds. Handbook of psychology: Research methods in psychology. Hoboken: John Wiley & Sons Inc, 2003: 115-41.
26. Kline RB. Principles and practice of structural equation modeling. New York: Guilford Publications, 2015.
27. Weber S. Bacon: An effective way to detect outliers in multivariate data using Stata (and Mata). Stata J. 2010; **10**(3): 331-8. doi: 10.1177/1536867X1001000302.
28. Schreiber JB, Nora A, Stage FK, Barlow EA, King J. Reporting Structural Equation Modeling and Confirmatory Factor Analysis Results: A Review. J Educ Res. 2006; **99**(6): 323-38. doi: 10.3200/JOER.99.6.323-338.
29. DeVellis RF. Scale development: Theory and applications. Thousand Oaks: Sage Publications, 2016.
30. Ferketich S. Focus on psychometrics. Aspects of item analysis. Res Nurs Health. 1991; **14**(2): 165-8. doi: 10.1002/nur.4770140211.
31. Byrne BM. Structural equation modelling with AMOS: Basic concepts, applications, and programming. London: Routledge, 2016.
32. Pett MA, Lackey NR, Sullivan JJ. Making sense of factor analysis: The use of factor analysis for instrument development in health care research. Thousand Oaks: Sage Publications, 2003.
33. The European Parliament and the Council of the European Union. Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation). Official Journal of the European Union of 4 May 2016, n. L 119/1.
34. Finland Ministry of Justice. Personal Data Act (523/1999). Available on: https://www.finlex.fi/en/laki/kaannokset/1999/en19990523.pdf [Last accessed: 2021 Dec 4].
35. Alleaume C, Verger P, Dib F, Ward JK, Launay O, Peretti-Watel P. Intention to get vaccinated against COVID-19 among the general population in France: Associated factors and gender disparities. Hum Vaccin Immunother. 2021 Oct 3; **17**(10): 3421-32. doi: 10.1080/21645515.2021.1893069. Epub 2021 Jul 22.
36. Fu C, Wei Z, Pei S, Li S, Sun X, Liu P. Acceptance and preference for COVID-19 vaccination in health-care workers (HCWs). MedRxiv. 2020. doi: 10.1101/2020.04.09.20060103.
37. Desveaux L, Savage RD, Tadrous M, et al. Beliefs associated with Intentions of Non-Physician Healthcare Workers to Receive the COVID-19 Vaccine in Ontario, Canada. MedRxiv. 2021. doi: 10.1101/2021.02.19.21251936.
38. Li M, Luo Y, Watson R, et al. Healthcare workers' (HCWs) attitudes and related factors towards COVID-19 vaccination: a rapid systematic review. Postgrad Med J. 2021. doi: 10.1136/postgradmedj-2021-140195.
39. Gabutti G, d'Anchera E, De Motoli F, Savio M, Stefanati A. The Epidemiological Characteristics of the COVID-19 Pandemic in Europe: Focus on Italy. Int J Environ Res Public Health. 2021; **18**(6): 2942. doi: 10.3390/ijerph18062942.
40. Repubblica Italiana. Decreto-Legge 1 Aprile 2021, n. 44. Misure urgenti per il contenimento dell'epidemia da COVID-19, in materia di vaccinazioni anti SARS-CoV-2, di giustizia e di concorsi pubblici. Gazzetta Ufficiale della Repubblica Italiana of 1 April 2021, n. L 79/1.

Corresponding Author: Valentina Simonetti (VS), Department of Biomedical Science and Human Oncology, University "Aldo Moro" of Bari, Italy
e-mail: valentina.simonetti@uniba.it