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Vaccination Fear Scale (VFS-6): Development and Initial Validation

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Abstract

Background: The present study presents a first psychometric analysis of the Vaccination Fear Scale (VFS-6) developed to complement clinical efforts in the prevention of hesitance against vaccines.

Methods: The sample comprised 2175 Spanish participants. The items of the VFS-6 were developed from validated Fear Coronavirus Scale (FCV-19S), which has several psychometric tests to ascertain its reliability and validity properties. Several psychometric tests were conducted to ascertain its reliability and validity properties.

Results: After panel review and corrected item-total correlation test, six items with acceptable corrected item-total correlation were retained and then confirmed by significant and strong factor loadings. Exploratory and confirmatory factor analysis supported a bifactorial model (cognitive and physical factors), with robust psychometric properties, good reliability and internal consistency. Our data indicate that fear of vaccination is much more consistently related to the intention to vaccinate than fear of the disease.

Conclusion: The VFS-6 is valid and reliable to assess fear of vaccination among the Spanish population.

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1. Introduction

According to the World Health Organization (WHO), vaccination currently prevents 2 to 3 million deaths a year, and another 1.5 million deaths could be avoided if global coverage improves; being one of the most cost-effective ways to avoid diseases (WHO, 2019). Despite the clear evidence of its benefits, the fear and mistrust of vaccines and the opposition of

vaccination have existed since inoculation was introduced in the 18th century (Poland & Jacobson, 2011). Currently, acceptance of vaccines is eroding (Opel et al., 2013) and the refusal to vaccinate, despite the availability of vaccines, threatens to reverse the progress made in reducing vaccine-preventable disease (Pimlott, 2019). In fact, the WHO (2019) announced that vaccine hesitancy is one of the top 10 threats to global health. Consequently, there is a growing interest in understanding the barriers to acceptance, and to developing and evaluate potential interventions that would address these barriers (Opel et al., 2013).

In this context, a study on vaccine confidence, conduced across 149 countries between 2015 and 2019, evidenced that research in the area is hampered by the absence of a similar and robust monitoring system across the world (de Figueiredo et al., 2020), with duly validated measurement tools.

A review of the literature shows the existence of some tools on vaccination hesitancy. The most known existing tools are the Vaccination Confidence Scale (Gilkey et al., 2014), which measures the confidence of adolescents in vaccination; the SAGE Vaccine Hesitancy Scale (Shapiro et al., 2018), which measures parental vaccine hesitant; the Vaccine Confidence Index (Opel et al., 2013), which measures individual parental perceptions on the safety, importance, effectiveness, and religious compatibility of vaccines; the Vaccine Hesitancy Scale (Luyten et al., 2019), which targets attitudes to vaccination in the general population; and the 5-C scale (Betsch et al., 2018), which identifies psychological barriers of vaccination behaviour. Despite the existing tools, we have not found scales that monitor the emotional intensity of vaccination refusal.

Fear, an unpleasant emotional state triggered by the perception of a threatening stimulus (de Hoog et al., 2008), is behind inhibitory behaviours such avoidance (Reynolds et al, 2018); and may explain why the anticipation of possible adverse effects of vaccines drops intention of vaccinate (Mellers & McGraw, 2001; Sotiriadis et al., 2012). In fact, the fear of adverse reactions or the occurrence of diseases caused by the vaccine, are frequent arguments to reject vaccination (Hortal & Di Fabio, 2019). Thus, the public requests that vaccines have been proven to be safe (Schuster et al., 2015), questioning the lack of long-term studies that demonstrate their safety (Karafillakis & Larson, 2017) and are afraid of their side effects (Dannetun et al., 2005), which, although they exist, are usually less than those that can be avoided (Segura-Benedicto, 2012). It has also been documented a common mistrust of pharmaceutical companies and politicians, considering them profit-making and irresponsible in their messages to citizens (Casiday et al., 2006). In fact, uncertainty and perceived threat increase when trust in politicians decreases (Lalot et al., 2021). It has been observed, in COVID-19 context, that uncertainty has played an

important predictive role in distrust (Szczygielski et al., 2021) and in the development of mental illness in the citizens (Merlo et al., 2021). It was found that intolerance to uncertainty increased the illness fears during pandemic outbreak (Gori et al., 2021; Wheaton et al., 2021) and was related to mental health indicators and adherence to preventive measures; being the social support (Gori et al., 2021; Koçak, 2021; Nitschke et al., 2021) and receiving clear messages from the authorities (Bavolar et al., 2021) a way to reduce the mental problems.

Fear is a much researched psychological construct (Settineri & Merlo, 2020), and has a crowd of psychometric scales that allows to measure it in a lot of situations and contexts (Pakpour & Griffiths, 2020). In the context of vaccination, there are scales created to assess fear of injections and its interference with receiving vaccines (e.g., Mulder et al., 2013), and other authors have created instruments to assess fear of diseases (e.g., Ahorsu et al., 2020; Bouton et al., 1987), demonstrating relationships with preventive behaviours (Pakpour & Griffiths, 2020; Zhang et al., 2015) including intention to vaccinate (Mesch & Schwirian, 2019). But, to the authors' knowledge, no validated scale exists that explicitly evaluates vaccination fear.

1.1 Aims

So, our goal is to develop and validate a scale to measure fear of vaccination. Because, even if the cause is not eliminated, fear can be prevented and treated through appropriate interventions (Reyes & López, 2019; Settineri & Merlo, 2020), so having standardized measurement tools allows to monitor and make decisions on intervention plans (Ahorsu et al., 2020; Pakpour & Griffiths, 2020), and therefore may be useful to advance in the understanding of fear of vaccines, on vaccine hesitancy and on acceptance rates.

2. Method

2.1 Participants

Two thousand one hundred seventy-five Spanish adults recruited online participated in the study, 32.7% men and 67.3% women, with a mean age of 37.60 (SD: 12.98). The sample was composed of teachers of all educational levels (67.2%), university students (21.5%), health personnel (7.9%) and other professionals (3.4%). Most of the sample was coupled or married (59.7%), followed by single (35.9%), divorced or separate (3.9%) and widowed (0.5%). Regarding cohabitation, the vast majority was living accompanied by dependents (49.1%) or non-dependents (45.9%), with a 5.1% leaving alone.

2.2 Procedure and ethics

Instruments were administered online. Recruitment was carried out with a message containing the study link, which was distributed via email to all potential participants. Participation was completely voluntary. A consent form was inserted at the beginning of the study to inform the participants of the aim of the research and the protection of privacy. To continue with the administration of the questionnaires, each participant had to accept the terms of the study that complied with the Helsinki declaration.

2.3 Context

Similar to Mesch & Schwirian (2019) in his study of vaccination hesitancy, which used a context based on upcoming exposure expectancy of an Ebola outbreak to assess causes of fear and hesitancy of vaccination; we applied the survey in the COVID-19 context, during the month of December 2020, in the second wave of the pandemic and very close to the vaccination plan implementation against the disease, in a moment when the ease of access was close, the perceived risk of disease is high (Benassi et al., 2020; Moroianu et al., 2021; Urban & Urban, 2020), the importance of immunization was maximum, and when the proximity to the vaccination campaign was forcing people to recognize and face their fears to vaccine.

2.4 Instruments

Sociodemographic information. We asked about socio-demographic information of participants, specifically, we collected information about age, gender, marital situation, cohabitation and employment.

VFS-6. Fear of Vaccination Scale is a six-item scale assessing the vaccination fear. The scale is obtained from the Spanish version of the Fear of COVID–19 Scale (Martínez et al., 2020); following the same methodology of Yıldırım & Güler (2020) to design the COVID-19 Risk Perception Scale (CRPS) from SARS Risk Perception Scale (SRPS). To adapt it, we changed the original items replacing "in COVID-19" with "getting vaccinated against COVID-19". The initial scale was composed by 7 items, but after the first psychometric analysis, the item-4 was reformulated to make it more understandable, and one item was eliminated, obtaining the final scale. Like FCV-19 scale, the six items of VFS-6 were rated on a 5-point scale, from 1 (strongly disagree) to 5 (strongly agree) with scores ranging from 6 to 30. Higher scores reflect higher levels of fear related to vaccination. In this study, the psychometric properties of the VFS-6 were investigated.

FCV–19S. The Spanish version of Fear of COVID–19 Scale (Martínez et al., 2020) was also administered. It's a seven-item scale rated on a 5-point scale from 1 (strongly disagree) to 5 (strongly agree) with scores ranging from 7 to 35. This scale has been validated in various countries and languages, demonstrating robust psychometric properties, and seem a reliable and valid instrument in assessing fear of COVID-19 among the general population (Ahorsu et al., 2020). All and it, there's no consensus with the factorial structure of the scale, with authors finding a unifactorial structure (e.g., Alyami et al., 2020; Satici et al., 2020) and others a bifactorial one (e.g., Bitan et al., 2020; Reznik et al., 2020). In Spanish we also met two validation studies with mixed results (e.g. Barrios et al., 2020; Huarcaya et al., 2020; Martínez et al., 2020).

Intention to vaccinate: We assessed the intention to vaccinate using the following single dichotomous question *"Do you intend to get vaccinated for covid-19 disease?"*.

2.5 Statistical analysis

Demographic characteristics of the sample were studied via frequency analysis and descriptive calculation. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were conducted to examine the factor structure of VFS-6. To achieve this, participants were randomly split into two subsamples of roughly equal size (split-half method; Anderson & Gerbing, 1988; Lloret et al., 2014; Malas et al., 2018). Differences in demographics between the subsamples were studied using t Student-Fisher, or Fisher Chi-square, as appropriate. Subsample 1 (n = 1103) was used for EFA and Subsample 2 (n = 1071) for CFA.

For EFA, means and standard deviations were calculated for items and subscales. Additionally, we calculated skewness and kurtosis values and Kolgorof-Smirnov normality test to check the normal distribution of data. Corrected item-total correlations were then calculated. The factorial structure was analysed using principal axis and promax rotation. Internal consistency was calculated by Cronbach's alpha. The scree plot and the parallel analysis test was used to determine the most appropriate number of dimensions (Timmerman & Lorenzo, 2011).

CFA was performed in the other subsample. Findings from the hypothesized measurement model extracted by EFA was evaluated using common indices and their cut–off points where Tucker-Lewis index (TLI), Comparative fit index (CFI), Incremental fit index (IFI) and Normed Fit Index (NFI) ≥0.90 and ≥0.95 refer to adequate and good-data model fit, respectively; and root mean square error of approximation (RMSEA) ≤0.10, ≤0.08, ≤0.05 refer to acceptable, adequate, and good data-model fit, respectively (Hu & Bentler, 1999; Kline, 2015).

Since there is no consensus in the factorial structure of FCV-19S, with authors suggesting a unifactorial structure (Barrios et al., 2020) and others suggesting a bifactorial one (Huarcaya et al., 2020), we also investigate the factorial structure of the scale in our sample, following the same explained procedure.

Using dimensional and categorical data (median-split method to standard the cut-off; Iacobucci et al., 2015) correlations and t-test between scores and intention of vaccination were examined to produce further information about the construct validity of the scale. Gender differences, occupation and cohabitation were also investigated using T Student-Fisher and Fisher Chi-square, as appropriate. Finally, a binary logistic regression analysis was performed, taking vaccination intention as the dependent variable and the dimensions of VFS-6 as independents. Statistical analyses were conducted using the SPSS v.23 and AMOS v.24 package.

3. Results

3.1 Demographic characteristics

Table-1 show the demographic characteristics used in the study in the full sample and in the randomly split two subsamples. The total sample displays a higher proportion of women than men, with a mean age of 37.60 (SD: 12.98). There were no significant differences in demographic characteristics between the subsamples.

Table 1. Demographic characteristics of study population

	Total	Subsample1	Subsample 2	Comparisons
Age	M: 37.60 (SD: 12.98)	M: 37.80 (SD: 12.99)	M: 37.39 (SD: 12.97)	t-test:-.888, p < 0.375
Sex				
Males	711 (32.7%)	336 33.2%)	345 (32.2%)	chi2= 0.1868, p < .666
Females	1462 (67.3%)	737 (66.8%)	727 (67.8%)	
Marital situation				
Coupled	1299 (59.7%)	646 (28.6%)	653 (60.9%)	chi2=1.3604, p < .715
Single	780 (35.9%)	408 (37%)	372 (34.7%)	
Separate/Divorced	85 (3.9%)	43 (3.9%)	42 (3.9%)	
Widower	11 (0.5%)	6 (0.5%)	5 (0.5%)	
Cohabitation				
Living alone	110 (5.1%)	56 (5.1%)	54 (5%)	chi2= 1.3114, p < .519
Living with dependents	1067 (49.1%)	528 (47.9%)	539 (50.3%)	
Living with non-dependents	998 (45.9%)	519 (47.1%)	479 44.7%)	
Occupation				
Health personnel	172 (7.9%)	93 (8.4%)	79 (7.4%)	chi2= 3.4038, p < .334
Teachers	1462 (67.2%)	722 (65.5%)	740 (69%)	
University students	468 (21.5%)	251 (22.8%)	217 (20.2%)	
Others	73 (3.4%)	37 (3.4%)	36 (3.4%)	
Total sample	2174	1103	1071	

Note: M: Mean, SD; Standard deviation.

3.2 Descriptive statistics of VFS-6 items

For VFS-6, initially, 7-items were proposed. Descriptive statistics for each item are presented in Table-2. The reliability ranged from 0.70 to 0.74, suggesting a satisfactory internal consistency of all items.

Table 2. Descriptive statistics of the initial seven items proposed (n=1103)

	Mean	SD	Skew	Kurt	Kolgorof-Smirnov Z (p)	Corrected item total correlation
1. You are very afraid to get vaccinated against […]	2,72	1,21	0,18	-0,92	5,76 (p < .000)	,740
2. You feel uncomfortable thinking about getting vaccinated against […]	2,85	1,31	0,01	-1,23	6,37 (p < .000)	,761
3. Your hands get wet or sweaty when you think about getting vaccinated with […]	1,72	0,94	1,22	0,91	10,64 (p < .000)	,652
4. You are afraid that the […] vaccine could cause side effects	3,46	1,25	-0,51	-0,72	7,32 (p < .000)	,629
5. When watching news and stories about COVID-19 vaccine on social media, you become nervous or anxious.	2,21	1,07	0,49	-0,66	6,47 (p < .000)	,765
6. You cannot sleep because you are worried about having to get vaccinated against […]	1,55	0,80	1,36	1,32	12,23 (p < .000)	,628
7. Your heart races or beats when you think you need to get vaccinated with […]	1,63	0,88	1,34	1,24	11,48 (p < .000)	,683

For asymmetry and kurtosis, we found that items 1, 4 and 5 fallwithin the range of ± 1, while the other items have higher values. Nonetheless, Kolgorof-Smirnov normality test show that all items were distributed in a non-normal way ($p < 0.001$).

3.3 Exploratory factor analysis

For the exploratory factor analysis, principal components method was used, with promax rotation and Kaiser normalization. Kaiser-Meyer-Olkin value was 0.86 and Bartlett's test of sphericity was significant, $\chi2\ (df = 21) = 5294.653$ $p<0.001$), supporting a rationale for performing EFA. The factorial structure showed a two-factor solution, with eigenvalues of 4.31 and 1.23; also confirmed by scree plot visual examination. The solution explained 79.17% of the variance, 57.57% for F1 and 17.60% for F2.

We assessed statistically meaningful loadings by using the criteria of 0.32 ("poor"), 0.45 ("fair"), 0.55 ("good"), 0.63 ("very good"), and 0.71 ("excellent") (Tabachnick et al., 2007). Factor loadings were very good for all items less item 5, with a factorial load less than 0.50 for the first factor, and a very high load on the second one. Therefore, we decided to repeat the analysis eliminating that item.

Table 3. Factorial analysis of items. Solution of 7 items and 6 items. Principal axis factoring and promax rotation (n=1103)

Item	F1 Somatic	F2 Cognitive	Item	F1 Somatic	F2 Cognitive
I6	**.959**	-.115	I7	**.944**	-.077
I7	**.952**	-.045	I6	**.930**	-.005
I3	**.657**	.152	I3	**.637**	.175
I5	**.461**	.439	I2	.018	**.896**
I2	-.014	**.916**	I1	.007	**.881**
I1	-.021	**.890**	I4	-.005	**.743**
I4	-.031	**.760**			
Cronbach's alpha	.88	.88		.88	.88

*Note: *Advised number of factors: 2*

For the second analysis (Table-3), Kaiser-Meyer-Olkin (0.80) and Bartlett's test of sphericity ($\chi 2$ (df = 15) = 4286.210 $p<0.001$), also showed that data fulfilled the assumptions for conducting EFA. The factorial structure showed the two-factor solution, with eigenvalues of 3.65 and 1.23, explaining 81.38% of the variance, 60.86% for F1 and 20.52% for F2. The correlation between factors was 0.53. Factor loadings were satisfactory for all items and ranged between 0.64 and 0.94, suggesting that all items substantially contribute to their factor. Cronbach's alpha indicates a satisfactory internal consistency in both factors (Cronbach's alpha = 0.88) and did not decrease despite the removal.

3.4. Confirmatory factor analysis

We then examined whether the two-factor measurement model emerged from EFA produced an appropriate representation of the data. CFA was performed using the maximum likelihood method using estimate and the covariance matrix between items as input for analysis, taking the 6 items as observed variables and the two factors as latent.

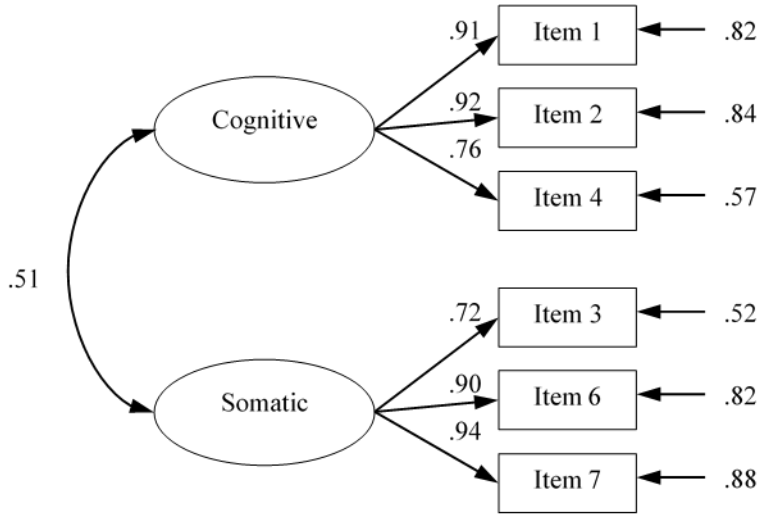

Figure 1. Confirmatory factor structure of the VFS-6 scale

As illustrated in Figure-1, the hypothesized measurement model provided satisfactory data–model fit statistics, $\chi 2$ (df = 8) = 95.551, $p < 0.001$, CFI = 0.99, TLI = 0.99, IFI= 0.99, NFI= 99, RMSEA = 0.10, and the standardized factor loadings ranged from 0.72 to 0.93 for cognitive dimension and from 0.76 to 0.92 for somatic dimension. The correlation between the two dimensions was 0.51.

3.5. Factorial structure and reliability of the Spanish version of FCV-19S in our sample

The seven items of FCV-19S were also analysed following the same procedure as for the VFS-6 scale. Regarding descriptive analysis, means ranged from 1.41 and 3.23 and standard deviations from 0.78 to 1.15. For asymmetry and kurtosis, we found that initial items 1, 2, 4, 5 fall within the range of ± 1, while items 3, 6 and 7 have higher values. Nonetheless, Shapiro-Wilk and Kolgorof-Smirnov normality test show that all items were distributed in a non-normal way ($p < 0.001$). Corrected item total correlations ranged from 0.56 to 0.66 and alpha if element is removed range from 0.822 to 0837, suggesting a satisfactory internal consistency of all items.

For EFA, principal components method was used in the first subsample (N=1103), with promax rotation and Kaiser normalization. Kaiser-Meyer-Olkin value was 0.83 and Bartlett's test of sphericity was significant, $\chi 2$ (df = 21) = 3157.315 $p<0.001$). The factorial structure showed a two-factor solution (cognitive and somatic dimensions), with eigenvalues of 3.62 and 1.11. The solution explained 67.72%% of the variance, 51.83% for F1 and 15.89% for F2.

The cognitive dimension, composed of initial items 1, 2, 4, 5, had a Chronbach's alpha of 0.79, with factorial loads ranging between 0.79 to 0.45. The somatic dimension, composed of items 3, 6, 7, had a Chronbach's alpha of 0.83, with factorial loads ranging between 0.51 to 0.92. Item 5 was the one with the worst factorial load, loading 0.45 in the first factor and 0.31 in the second.

CFA was performed in the second subsample (N=1071) using the maximum likelihood method. The hypothesized two factor measurement provided satisfactory data–model fit statistics, $\chi 2$ (df = 13) = 171.088, $p < 0.001$, CFI = 0.99, TLI = 0.98, IFI= 0.99, NFI= 99, RMSEA = 0.10, and the standardized factor loadings ranged from 0.68 and 0.77 for cognitive dimension and from 0.67 to 0.90 for the somatic dimension. The correlation between the two dimensions was 0.70.

3.6. Vaccination intention, fear to the disease and fear to vaccinate

In our sample, a 47.1% of people indicates no vaccination intention. Table-4 shows the correlations between the factors of VFS-6, FCV-19S and Vaccination intention on the full sample (N = 2175). As can be seen, cognitive and somatic dimensions of the VFS-6 were significantly correlated with both cognitive and somatic dimensions of FCV–19S, and with

vaccination intention (R= 0.66 for cognitive and R=0.36 for somatic; p<0.001). On the contrary, the FCV-19-S scale didn't correlate with vaccination intention, finding no statistically significant correlation for any of the dimensions.

Table 4. Correlations between VFS-6, FCV-19S and Vaccination intention (n=2175)

	VFS-6 Cognitive	VFS-6 Physical	FCV–19S Cognitive	FCV–19S Physical	Vaccination intention
VFS-6 Cognitive	1				
VFS-6 Somatic	,51(**)	1			
FCV–19S Cognitive	,21(**)	,28(**)	1		
FCV–19S Somatic	,13(**)	,50(**)	,58(**)	1	
Vaccination intention	-,66(**)	-,36(**)	-,01	-,04	1

*** The correlation is significant at the 0.01 level (bilateral).*

In the same line, independent t-test analysing the differences in VFS-6, FCV-19S between vaccination intention and no-vaccination intention groups showed statistical differences for cognitive (*t*-test = 40.65, p < 0.001) and somatic dimensions (*t*-test = 18.11, p < 0.001) of VFS-6, but no statistical differences for any of the dimensions of FCV-19S (*t*-test = 0.386, p = 0.70 for the cognitive dimension and *t*-test = 1.78, p = 0.07 for the somatic dimension). Regarding demographics, younger people (*t*-test = -2.36, p < 0.019) and woman (chi2= 88.846 < .05) refer less intention to vaccinate.

Table 5. Results of the logistic regression analysis predicting vaccination intention with respect to VFS-6 dimensions

	B	SE B	Wald's x^2	Sig.	Exp (B)
Intercept	5.389	.024	519,27	.000	219.07
VFS-6 Cognitive	-.573	.026	500,67	.005	.564
VFS-6 Somatic	-.084	.030	7,76	.000	.919

The logistic regression analysis, taking vaccination intention as the dependent variable and the dimensions of VFS-6 as independents (Table-5), showed that VFS-6 could explain a 41% (Cox & Snell R^2) of the total variance of the intention of vaccinate.

3.7 Fear to vaccinate as a categorial measure

We used Median Split method for turning the continuous variables into a categorical one (Iacobucci et al., 2015), obtaining a cut-off of VFS-6-Cogitive ≥ 9 and a VFS-6-Somatic ≥ 4. Using that cut-off, prevalence of fear vaccination in the total sample was 40%. As we expected, there were significant differences between groups in all variables, vaccination intention (t = -32.15 < 0.001), FCV–19S Cognitive (t-test = -10.75, p < 0.001), and FCV–19S Somatic (t = 11.38, p < 0.001).

Regarding demographics (Table-6) we found statistical differences in sex (X2 = 79.238; p < 0,001) but not in age (t-test = 1.74; p<0.82), and we also found differences in marital situation (X2 = 21.563; p < 0,001), cohabitation (X2 = 20.796; p < 0,001) and occupation (X2 = 52.435; p < 0,001). So being a woman, being coupled, living with dependents and working as health personnel showed a higher proportion of fear to vaccines.

Table 6. Differences in demographics between fear to vaccinate and no-fear to vaccinate groups (n=2175)

	Fear to vaccinate	Not fear to vaccinate	Comparisons
Age	M: 38.19 (SD. 11.74)	M: 37.20 (SD. 13.73)	t-test = 1.74; p<0.82
Sex			
Males	189 (26,6%)	522 (73,4%)	
Females	681 (46,5%)	783 (53,5%)	X^2 = 79.238; p < 0,001
Marital situation			
Coupled	570 (43,9%)	729 (56,1%)	
Single	262 (33,6%)	518 (66,4%)	
Separate/Divorced	34 (40,0%)	51 (60,0%)	
Widower	4 (36,4%)	7 (63,6%)	X^2 = 21.563; p < 0,001
Cohabitation			
Living alone	43 (39,1%)	67 (60,9%)	
Living with dependents	478 (44,8%)	589 (55,2%)	
Living with non-dependents	349 (35,0%)	649 (65,0%)	X^2 = 20.796; p < 0,001
Occupation			
Health personnel	82 (47,7%)	90 (52,3%)	
Teachers	642 (43,9%)	820 (56,1%)	
University students	123 (26,3%)	345 (73,7%)	
Others	23 (31,5%)	50 (68,5%)	X^2 = 52.435; p < 0,001
Total sample	870 (40%)	1305%)	

3.8 Original version of FVS-6 Spanish validated scale

Escala de Miedo a la Vacunación (FVS-6)

1. *Le da mucho miedo vacunarse de […]*
2. *Siente incomodidad al pensar en vacunarse de […]*
3. *Las manos se le humedecen o sudan cuando piensa en vacunarse de […]*
4. *Tiene miedo de que la vacuna de […] pueda causarle efectos secundarios*
5. *No puede dormir porque le preocupa tener que vacunarse de […]*
6. *El corazón se le acelera o palpita cuando piensa que tiene que vacunarse de […]*

4. Discussion

This study was designed in order to create and validate the psychometric properties of a new scale, the 6-Items Vaccination of Fear Scale (VFS-6). The VFS-6 scale was obtained from the FVC-19, both being psychometrically analysed. In our study, FCV-19S, as suggested by Huarcaya et al. (2020) or Alyami et al. (2020), advised the use of a bifactorial model, both in the exploratory and confirmatory factor analysis. Thus, our data suggest that the scale is made up of two factors: cognitive (4 items) and somatic (3 items). In the exploratory factorial analysis, the bifactorial structure obtained an adequate factorial structure and good reliability indices (Chronbach alpha of 0.79 for the cognitive dimension and of 0.83 for the somatic dimension) supporting the validity and reliability of the scale. Confirmatory factor analysis also yields acceptable goodness-of-fit indices.

Fear of Vaccination Scale (FVS-6), developed from FCV-19S, as mentioned, initially was made up with 7-items. The results of EFA suggested the use of a bifactorial model for the scale with an identical structure to that found in the psychometric analysis of the FVS-19-S, with the presence of two independent factors (cognitive and somatic dimensions). But in this case, item number 5 ("*When you see news and stories about the need to get vaccinated against COVID-19, you get nervous or anxious*") had a poor factorial load for its factor (Tabachnick et al., 2007). Furthermore, CFA analysis using the 7-item model showed good data-fit for CFI, TLI, IFI and NFI values, but RMSEA was clearly above the acceptable criteria, identifying measurement problems. The pattern of modification indices and correlations between items suggested the presence of a notable error covariance for item 5 that could not be corrected, so we decided to eliminate it.

The 6-item scale obtained can be seen in Annex-1. The EFA of new model showed an adequate factorial structure, also bifactorial, with three items in each factor (Items 1, 2, 4 for cognitive dimension and items 3, 5, 6 for somatic dimension) and good reliability indices (Chronbach alpha of 0.88 in both cognitive and somatic dimensions). In CFA, the deletion of the item allowed to obtain adequate goodness-of-fit indices, with values of CFI, TLI, IFI and NFI of 0.99 and with an acceptable RMSEA (Hu & Bentler, 1999; Kline, 2015).

On the other hand, fear to vaccines measured by VFS-6 is related to a lower intention to vaccinate, regardless of being measured dimensionally or categorically. Categorical data showed a 40% of prevalence of fear vaccination in the total sample, and people with fear to vaccinate showed significantly less vaccination intention and more Covid-19 fear. Furthermore, stepwise linear regression analysis, showed that VFS-6 could explain a 43% of the total variance of the intention of vaccinate, which corresponds to a fairly high percentage. The results allow to

confirm that newly developed VFS-6 have good psychometric properties and it's a valid instrument to evaluate fear to vaccination.

Although fear of Covid-19 and fear to vaccinate have been shown to be related, with positive correlations between both dimensions of SVF-6 and FCV-19-S; in our study we didn't found relationships between fear to covid-19 and vaccination intention, neither by correlations nor by t-test between groups. In this way, our data does not support Mesch & Schwirian (2019) study, which reported that fear to the disease incrassated intention to vaccinate; therefore, as other authors (e.g., Martín et al., 2000), we don't advocate the use of threatening messages in health campaigns. All and it, longer-term studies and/or in different contexts would be necessary to confirm or disprove the theories which recommend the interventions based on increase the fear of the disease to increase vaccination rates.

Finally, regarding intention to vaccinate, in our sample about half of the participants (47.1%) reported having no intention to be vaccinated for Covid-19, which is significantly higher than those found in other studies (Paul et al., 2020; Pogue et al., 2020; Sherman et al., 2020). Possible causes may be the time when the survey was carried out, since strategies to improve vaccination intention had not yet been implemented; or the influence of where the vaccine is developed, having proved influential on acceptance of the vaccine (Harapan et al., 2020; Pogue et al., 2020). Another reason may be caused by our sample, with a high proportion of women and young people. In fact, some investigations suggested that women and younger people (Al-Mohaithef & Padhi, 2020; Rhodes et al., 2020; Ruiz & Bell, 2020) tend to have less intention to vaccinate, results that are also reflected in our study.

5. Limitations and conclusion

Despite the promising results in terms of psychometric properties, further evaluation is needed. As the VFS-6 was evaluated with a sample with a high proportion of people with university studies, women and young, not being representative of the general Spanish population. Furthermore, although we used a large sample of Spanish adults (18 to 70 years) children and adolescents were excluded from this study. So empirical evidence is needed in other samples to test definitely its reliability and validity. In future studies, it would be advisable to test other population groups, which will allow a more precise estimate of the prevalence of fear of vaccination and fear intention. Second, the current study relied exclusively on self-report. The nature of the self-report measures does not allow us to objectively assess the associations between the study variables and they may be affected by factors of social desirability or another

source of bias. Third, the correlation among study variables does not provide causality data, so longitudinal studies are needed to understand the nature of the relationships found in the study.

All and it, our study provides preliminary evidence of the adaptation and validation of SFV-6, and have some implications. In one hand, findings demonstrated that the VFS-6 has a bifactorial structure with robust psychometric properties. This, coupled with the short time needed to complete it, makes it an optimal tool for assessing fear to vaccinate. Furthermore, our scale is very consistently related to the intention to vaccinate, so it can serve as a screening tool to evaluate fear in order to make decisions on intervention plans.

The results open up the possibility of continuing the investigation on this new scale that could be used to assess fear of vaccination with vaccines other than COVID-19. Researchers could use the scale to see if vaccination fear is associated with risk groups or specific personality traits. The collation and application of such data can then be used to devise targeted education and/or prevention programs to help overcome this fear and help such individuals to engage in preventative behaviours.

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Conflict of Interest Statement

The authors declare that the research was conducted in the absence of any potential conflict of interest.

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