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DEVELOPMENT AND VALIDATION OF THE COVID-19 VACCINE HESITANCY (CVH) SCALE

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Working with a wide quota sample of the Italian adult population, surveyed in the 5th wave of the CoCo (Consequences of COVID-19) project (N = 1,143), we developed and validated the COVID-19 Vaccine Hesitancy (CVH) Scale, composed of four 4-category items assessing participants' attitudes toward the COVID-19 vaccine. Structural equations modelling showed that the CVH Scale is unidimensional and invariant across participants' gender, age, area of residence, and perceived economic status. Moreover, the scale had good convergent validity. We discuss the strengths and limitations of the CVH Scale and potential avenues for further research.

Keywords: COVID-19; Vaccine hesitancy; Scale validation; Structural equations models; Attitudes.

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With the introduction of mass vaccination, December 2020 marked a turning point in the battle against the COVID-19 pandemic. In Europe, the first COVID-19 vaccine was approved by the European Medicines Agency on December 21, 2020, and since then at least 13 other vaccines have been approved and administered globally (World Health Organization, WHO, 2021). Many citizens around the world welcomed this news with relief, allowing themselves to imagine the end of restrictive measures, the opportunity to return to their previous lifestyles, and an economic resurgence. However, others viewed this rapid research development with scepticism. This should not be surprising, given that vaccine hesitancy is a well-known and widespread phenomenon. According to the Report of the Sage Working Group on Vaccine Hesitancy, "Vaccination hesitancy refers to delay in acceptance or refusal of vaccines despite availability of vaccination services. Vaccine hesitancy is complex and context specific, varying across time, place and vaccines. It includes factors such as complacency, convenience and confidence" (MacDonald & Sage Working Group on Vaccine Hesitancy, 2015, p. 4163).

Such hesitancy is problematic because it is of the utmost importance that people comply with expert recommendations for safe and preventive behaviors in order to limit and stop the spread of dangerous bacteria and viruses (as has been the case for traditional vaccinations against polio, measles, tetanus, etc.). Delaying vaccination or refusing to get vaccinated may present serious obstacles in the fight against severe disease (Zampetakis & Melas, 2021). Consistent with this, the WHO classed vaccine hesitancy as being among the 10 most severe threats to global health (Geoghegan et al., 2020). Accordingly, the scientific community has conducted multiple studies designed to uncover the social and psychological barriers to vaccine uptake as

well as devising potential effective interventions to counter vaccine hesitancy (e.g., Gallant et al., 2021; Hornsey et al., 2018; Truong et al., 2022).

At the onset of the COVID-19 pandemic, with vaccines in development to be administered to adults around the world, scholars felt it necessary to study citizens' orientation toward COVID-19 vaccine uptake. This was due to the fact that previous knowledge about vaccine hesitancy could not be straightforwardly applied in this case because COVID-19 vaccines are quite different from traditional vaccines. Indeed, COVID-19 vaccines were developed at an unprecedented pace due to the urgent global need for them, and this tremendous progress was essentially achieved through the use of different vaccine technologies in parallel. For example, Pfizer-BioNTech and Moderna focused on an innovative technology called "mRNA vaccine" that, unlike conventional vaccines — which can take longer periods of time to be produced by growing weakened forms of the virus — can be synthesized quickly using only the pathogen's genetic code. Thus, the unique history, context, and characteristics of the COVID-19 vaccines generated a repertoire of responses among the public that should be specifically investigated.

A growing body of literature has compiled a long list of sociodemographic predictors of COVID-19 vaccine hesitancy. For example, a survey conducted on a quota sample of the American general population from May 28 to June 8, 2020 found that women are 71% more likely than men to not pursue COVID-19 vaccination (primarily because they think the vaccine will be neither safe nor effective). In addition, relatively high rates of COVID-19 vaccine refusal were found among Black Americans and individuals with high levels of religiosity, while relatively low rates of refusal were observed in highly educated and wealthy Americans (Callaghan et al., 2021). A longitudinal study carried out in the UK found concordant results: a higher ratio of female participants exhibited vaccine hesitancy (21.0% compared to 14.7% of male respondents); blacks were the ethnic group with the highest rate of vaccine hesitancy (71.8%); and hesitancy was lower among those with a higher level of education (Robertson et al., 2021). Among the socio-political characteristics associated with high COVID-19 vaccine hesitancy, a low level of institutional trust (e.g., Troiano & Nardi, 2021) and a populist orientation (Roccato & Russo, 2021) were found to play critical roles. Other psychological factors linked to COVID-19 vaccine hesitancy include self-interest, belief in conspiracy theories, perceived risk, perceived control, and an intuitive cognitive style (e.g., Murphy et al., 2021).

It is worth noting that the study of COVID-19 vaccine hesitancy predates the availability of the vaccines. In some early studies, participants had to imagine what they would do in a yet-to-come scenario, and a self-reported low intention to vaccinate was accordingly used to operationalize vaccine hesitancy (e.g., Arce et al., 2021; Freeman et al., 2020). For example, Barello et al. (2020) categorized approximately 10% of Italian university students who declared they would not get vaccinated or were not sure they would get vaccinated as hesitant. However, it is plausible that in a real-world scenario where one or more vaccines are available and people in high-risk categories (e.g., health professionals or older people) start to participate in a large-scale vaccination campaign, individuals may reflect and reconsider their position. For example, Fridman et al. (2021) conducted a longitudinal study in the U.S. that showed a significant decrease in generic vaccine acceptance and specific intention of getting vaccinated against COVID-19 after the first vaccine approval.

In line with the definition by MacDonald and Sage Working Group on Vaccine Hesitancy (2015) quoted above, COVID-19 vaccine acceptance rates varied significantly from country to country prior to the start of the worldwide vaccination campaign (Sallam, 2021). These variations can be attributed to countries' unique sociocultural, economic, and political characteristics (e.g., Streefland et al., 1999). According to Sallam (2021), Italy, where we carried out the present study, had a very low rate of COVID-19 vaccine acceptance (53.7%) in December 2020. When we revised this paper (October 2022), a large percentage of the

adult population in Italy had been vaccinated (90.2%; see https://www.governo.it/it/cscovid19/report-vaccini/). However, the vaccine uptake was often motivated by formal constraints — that is, the requirement of a vaccine certificate or recent negative test to work, dine out and go to cinemas and theatres greatly accelerated the vaccination rate — and was therefore not necessarily associated with a reduction in people's scepticism about the vaccine. Even with high vaccination rates, the lingering scepticism toward this vaccine, along with feelings of constraint, may represent a social and political challenge: it might, for example, further erode citizens' trust in institutional authorities and scientists. For this reason, thorough investigation is needed, particularly into the consequences of vaccine hesitancy conceived as an attitude, even with the backdrop of relatively successful vaccination campaigns. A basic condition for this investigation is to be able to rely on a valid instrument to capture individual vaccine hesitancy as an attitude.

Because the vaccine hesitancy literature focuses primarily on attitudes toward childhood vaccination, available scales for operationalizing vaccine hesitancy are mostly directed toward capturing parental attitudes (e.g., Opel et al., 2011). Moreover, scales formulated to measure generic adult vaccine hesitancy — such as Akel et al.'s (2021) adult Vaccine Hesitancy Scale (aVHS) — may fail to capture the attitudes specific to the COVID-19 vaccines, such as the speed of their development and the fact that the process of making them relied on innovative technologies. Indeed, vaccine hesitancy cannot be conceived as a relatively stable personality trait (MacDonald, 2015) because there is evidence that people refuse some vaccines while accepting others (e.g., Benin et al., 2006).

There is significant room for improvement even in the newly developed COVID-19 vaccine hesitancy scales. One example is Liu and Li's (2021) scale, which asks respondents to select from a list of statements that describe their vaccine hesitancy. Their scale gives the researcher three dichotomic hesitancy measures (hesitancy due to confidence, circumspection, and complacency) but does not allow for the quantification of participants' hesitancy. Another example is Bolatov et al.'s (2021) scale, which employs a standard Likert format. However, there is an overlap between COVID-19 vaccine hesitancy and its causes in some of Bolatov et al.'s items — for example, "I refuse vaccination, as the environment in which I grew up (my family, guardians) is against vaccination in general" and "I refuse vaccinations for religious reasons." Moreover, in the present situation, other items in the scale (e.g., "I do not know where and how to get the COVID-19 vaccine") no longer apply, at least not in the most affluent countries of the world. Finally, and most importantly for the scope of our research, Bolatov et al.'s scale is composed of 13 items, making its use problematic with samples extracted from the general population and integrated into surveys aimed at measuring other constructs. This is because, as the methodological literature repeatedly demonstrated, long scales negatively impact the validity of the responses, in that they overburden the cognitive system of the responders and thus reduce their capacity to complete the task effectively (Krosnik & Alwin, 1987). Thus, the activation of the acquiescent response-set is increased. This is especially problematic when using samples extracted from the general population, where every item that is not necessary is detrimental to the scope of the scale (Curran, 2016).

In this study, we aimed to overcome these limitations. Using the aVHS as a reference, we developed and validated the COVID-19 Vaccine Hesitancy (CVH) Scale: a short, unidimensional, balanced scale.

Method

In this study, we aimed to develop and validate the CVH Scale using a wide quota sample of the Italian adult population. We pursued our goal by applying a threefold strategy. First, we tested the scale's

factorial structure using confirmatory factor analysis (CFA). Second, we tested its structural invariance across participants' main sociodemographic characteristics. Third, we tested the scale's convergent validity via a mediated model with CVH serving as mediator. Starting from the left section of the model, we expected the CVH Scale to show a positive association with populist orientation (H1; cf. Roccato & Russo, 2021) and a negative association with perceived vulnerability to COVID-19 (H2; cf. Cesarotti et al., 2021) and trust in the epistemic authorities involved in the management of the pandemic (H3; cf. Cavazza et al., 2022). Concerning the right section of the model, we expected a positive association between the CVH Scale's scores and its direct outcome, COVID-19 vaccine refusal (H4; cf. Akel et al., 2021). We tested the fit of our models using the comparative fit index (CFI), the Tucker-Lewis index (TLI), and the root-mean-square error of approximation (RMSEA). Based on the work of Hu and Bentler (1999), we considered the CFI and TLI satisfactory if they were greater than .90, while the RMSEA was considered satisfactory if it was less than .08. All analyses were performed using Mplus.

Participants and Procedure

We used data from the fifth wave of the Consequences of COVID-19 (CoCo) project (see https://www.researchgate.net/project/CoCo-Consequences-of-Covid-19-Project). The data were collected from a large quota sample of the Italian general population (stratified by gender, age, geographic area of residence, and size of area of residence), who had been surveyed regularly via email since the spring of 2019. The data we used were collected in October 2021 from 1,143 participants (49% men, M_{age} = 47.53, *SD* = 15.77). The research protocol and procedures were approved by the Bio-Ethic Committee of the University of Torino, Italy (approval number: 181488). All the participants signed an informed consent form and were debriefed after they had participated in the survey.

Measures

CVH Scale. To develop a short and suitable instrument to measure COVID-19-specific vaccine hesitancy, we selected and adapted four items from the 10-item aVHS (Akel et al., 2021). The item selection aimed to form a balanced scale, with two items in favor and two against the COVID-19 vaccine. The four items ("Getting a COVID-19 vaccine is a good way to protect me from the disease," "As all new vaccines, the COVID-19 vaccine carries more risks than older vaccines," "I am concerned about serious adverse effects of the vaccine against COVID-19", and "Being vaccinated against COVID-19 is important for the health of others in my community") were taken from a pre-test involving 20 low-educated participants who identified these four items as the easiest to respond to and the least ambiguous items of the original scale. The original scale was adapted primarily by replacing references to generic vaccines with references to the COVID-19 vaccine. The four items of the CVH Scale were translated into Italian by the authors before being backtranslated into English by a professional service and compared with their original versions. Participants expressed their agreement with the four items on a 4-point Likert scale, ranging from *I do not agree at all* to *I strongly agree* (α = .82). Table 1 reports the Italian and English versions of the items and their factorial loadings.

Variables used to test the CVH Scale's convergent validity. We measured populist orientation using Roccato et al.'s (2019) POPulist ORientation (POPOR) Scale, a 6-item, forced-choice balanced scale composed

TABLE 1
The COVID-19 Vaccine Hesitancy Scale: Items and standardized factorial loadings

Items		Standardized factorial loadings	Standardized factorial loadings
Italian version	English version	Unidimensional model	Unidimensional model with the correlated uniqueness correction
Vaccinarsi contro il COVID-19 è un buon modo per essere protetto/a dalla malattia (R)	Getting a COVID-19 vaccine is a good way to protect me from the disease (R)	.92***	.93***
Come tutti i nuovi vaccini, il vaccino contro il COVID-19 è più rischioso dei vecchi vaccini	As all new vaccines, the COVID-19 vaccine carries more risks than older vaccines	.51***	.48***
Sono preoccupato/a per gli effetti collaterali che può avere il vaccino contro il COVID-19	I am concerned about serious adverse effects of the vaccine against COVID-19	.49***	.45***
Vaccinarsi contro il COVID-19 è importante per la salute delle persone della mia comunità (R)	Being vaccinated against COVID-19 is important for the health of others in my community (R)	.89***	.90***

Note. (R) = reversed item. All the reversed items are recoded to indicate high COVID-19 Vaccine Hesitancy scores.
*** $p < .001$.

of items such as "There are those who say that the difference between left and right in politics is still important today. Others say that the difference between left and right in politics doesn't make sense anymore. Where would you place yourself between these opposing opinions?" and "Some people say that politicians, journalists, and financial experts are all part of the same corrupt system that has led Italy into crisis. Others say that it's not right to lump those groups all together, because they have different responsibilities. Where would you place yourself between these opposing opinions?" (con-trait item). Participants responded using a 5-category format. We tested the unidimensionality of the POPOR Scale via CFA. The literature shows that the acquiescent response set often biases the data from samples extracted from the general population (e.g., Winkler et al., 1982). Indeed, as was the case in its previous administrations (e.g., Cena et al., 2022; Roccato et al., 2019), this unidimensional model did not reach a satisfactory fit, $\chi^2(2) = 469.428$, $p < .001$; CFI = .80; TLI = .40; RMSEA = .45 90% CI [.42, .49]. However, when using balanced scales, as in our case, the acquiescent response set can be detected and corrected by employing the correlated uniqueness (CU) approach, which consists of correcting the error variance stemming from acquiescence by correlating the con-trait items (Marsh, 1989). Unsurprisingly, after the CU correction, the fit of the unidimensional solution become satisfactory, $\chi^2(1) = 2.219$, $p = .14$; CFI = 1.00; TLI = 1.00; RMSEA = .03 90% CI [.00, .09]. In the mediated

model we tested to analyze the CVH Scale's validity, we modelled populist orientation as a latent variable measured by the six POPOR items.

Moreover, we measured trust in the epistemic authorities involved in the management of the pandemic via three 10-category items asking participants to report their level of trust in the national health system, civil protection, and scientists (cf. Cavazza et al., 2022). A CFA showed that the battery was unidimensional. Due to the lack of degrees of freedom, we did not analyze the model's fit. However, the high α of the battery (α = .82) reassured us about the unidimensionality of the battery. In the mediated model we tested to analyze the CVH Scale's validity we modelled trust in epistemic authorities as a latent variable measured by the three manifest items we used.

In addition, we measured perceived vulnerability to COVID-19 via the following 4-category item: "How worried are you about the health consequences of COVID-19 for yourself?" (cf. Capone et al., 2021). Finally, we measured the outcome of COVID-19 vaccine hesitancy as vaccine refusal, via the following 3-category item: "Have you been vaccinated for COVID-19?" for which the response categories were as follows: *Yes, also first dose only* (= 1), *No, but I will as soon as possible* (= 2), and *No, and I have no intention to* (= 3; see Roccato & Russo, 2021). In our analyses, we recoded the answers into a dummy variable, contrasting participants who had (= 0) and had not (= 1) been vaccinated.

Control variables. In our convergent validity analyses, we controlled for participants' gender and age as well as their perceived economic status, which was measured using the following European Social Survey item: "Which of the following descriptions comes closest to how you feel about your household's income nowadays?" The response options were the following: *Living comfortably on present income* (= 1), *Coping on present income* (= 2), *Finding it difficult on present income* (= 3), and *Finding it very difficult on present income* (= 4; see Roccato et al., 2020).

Table 2 reports the descriptive statistics for the study variables.

TABLE 2
Descriptives for the study items

Items	Min	Max	*M*	*SE*	Skewness	Kurtosis
Getting a COVID-19 vaccine is a good way to protect me from the disease (R)	1	4	1.69	0.03	1.17	0.63
As all new vaccines, the COVID-19 vaccine carries more risks than older vaccines	1	4	2.33	0.03	0.24	–0.82
I am concerned about serious adverse effects of the vaccine against COVID-19	1	4	2.49	0.03	0.08	–0.94
Being vaccinated against COVID-19 is important for the health of others in my community (R)	1	4	1.59	0.03	1.42	1.17
Woman	0	1	.05	.02	–0.04	–2.00
Age	18	91	47.53	1.51	0.04	–0.90
There are those who say that the difference between left and right in politics is still important today. Others say that the difference between left and right in politics doesn't make sense anymore	1	5	3.39	0.04	–0.33	–0.75

(table 2 continues)

Table 2 (continued)

Items	Min	Max	*M*	*SE*	Skewness	Kurtosis
Some people say that politicians, journalists, and financial experts are all part of the same corrupt system that has led Italy into crisis. Others say that it's not right to lump those groups all together, because they have different responsibilities (R)	1	5	3.00	0.04	1.57	0.07
Some people say that most politicians in Italy today are corrupt. Others say that only a minority of politicians are corrupt (R)	1	5	2.48	0.04	1.39	0.07
There are those who say that ordinary people could easily enter the Parliament and do the job. On the other hand, other people think that political matters are complicated and need to be dealt with by professionals (R)	1	5	3.32	0.04	1.39	0.07
Some people think that the Parliament as a whole best represents the interests of society. Others think that the will of the people can be carried out only by having a strong leader	1	5	2.94	0.03	1.18	0.07
There are those who say that conflicts among people are inevitable because it's just part of human nature. On the other hand, others think that ordinary people are basically good and honest and that it's only because of those in charge that people are set against each other	1	5	2.92	0.04	1.39	0.08
In the next 12 months your household's income will allow you to live…	0	1	.53	.02	0.25	–1.99
How worried are you for the consequences COVID-19 can have on you?	1	4	2.85	0.03	0.81	–0.69
Have you been vaccinated for COVID-19?	0	1	.88	.01	–2.33	3.44
Trust in the national health system	1	10	6.22	0.06	4.74	0.09
Trust in the civil protection	1	10	6.65	0.06	4.71	0.50
Trust in scientists	1	10	7.20	0.06	4.31	0.08

Note. (R) = reversed item. All the reversed items are recoded to indicate high COVID-19 Vaccine Hesitancy and high populist orientation scores.

Data Analyses

As a first step, we analyzed the CVH Scale's factorial structure using CFA. Subsequently, we tested the CVH Scale's structural invariance across participants' gender, age, area of residence, and perceived economic status. Based on Reise et al.'s (1993) approach, we tested the hypothesis of invariance by comparing the χ^2 of a preliminary baseline (B) model tested simultaneously in the groups defined by these variables with that of an invariant (I) model, in which we fixed all the parameters to be equal across the groups. In the case of a significant worsening of the fit (i.e., with a significant χ^2 difference between the I and B models, with the number of degrees of freedom equal to the difference in degrees of freedom of the two models), we would have rejected the hypothesis of invariance.

Finally, we tested the CVH Scale's convergent validity via a structural equations mediated model with (when possible) latent variables. In the model, we used populist orientation, perceived vulnerability to COVID-19, and trust in epistemic authorities as exogenous variables, COVID-19 vaccine refusal as dependent variable and CVH as mediator, while controlling for gender, age, and perceived economic status. The model combined a measurement approach (in that, when possible, we estimated our constructs as latent variables) and a dependency approach.

We performed all the analyses using MPLUS. Due to the skeweness and the kurtosis of some variables, we resorted to the MLR estimator only when dealing with continuous variables and used the WLSMV estimator when testing the validity of the scale (since the dependent variable was a dummy).

Results

A first CFA showed that all the scale's factorial loadings were significant (see Table 1, second to last column). However, the fit of the model was unsatisfactory: $\chi^2(2) = 2323.109$, $p < .001$; CFI = .80; TLI = .40; RMSEA = .45 90% CI [.42, .49]. A second CFA, performed by correcting the factor method stemming from the acquiescent response set, once again led to significant loadings (Table 1, last column) and showed a satisfactory fit: $\chi^2(1) = 2.219$, $p = .136$; CFI = 1.00; TLI = 1.00; RMSEA = .03 90% CI [.00, .09]. Consistent with the assumptions of the CU approach, the two con-trait items' errors were positively correlated: $r = .42$, $p < .001$. Thus, we concluded that, after using the CU approach, the CVH Scale was unidimensional.

Table 3 shows that the CVH Scale's factorial structure was invariant across participants' gender, age, area of residence, and perceived economic status. Table 4 shows that participants' gender and age were not associated with CVH scores and that perceived economic status was negatively associated with the CVH Scale. More pertinent to this study, consistent with H1, H2, and H3, respectively, the CVH Scale had a positive association with populist orientation (measured as a latent variable using the CU approach) and a negative association with perceived vulnerability to COVID-19 and trust in the epistemic authorities involved in the management of the pandemic. Moreover, consistent with H4, CVH scores had a positive association with COVID-19 vaccine refusal. Table 5 shows the indirect associations between the exogenous variables and COVID-19 vaccine refusal. The fit of the model was satisfactory: $\chi^2(108) = 468.926$, $p < .001$; CFI = .94; TLI = .91; RMSEA = .05 90% CI = [.05, .06].

Discussion

In this study, we validated the COVID-19 Vaccine Hesitancy (CVH) Scale, an adaptation of the adult Vaccine Hesitancy Scale (aVHS; Akel et al., 2021). The CVH Scale is a more condensed version of the original (the number of items was reduced from 10 to four) and it is specific to the COVID-19 vaccine, meaning that it is better at capturing the nuances of attitudes toward this vaccine beyond compliance with the institutional requests for vaccination. The CVH Scale is composed of four 4-category items. Validated through strict and advanced psychometric techniques, it is unidimensional, balanced, and invariant across participants' gender, age, area of residence, and perceived economic status. It also has good convergent validity, in that, consistent with our hypotheses, it showed a positive association with populist orientation (H1) and COVID-19 vaccine refusal (H4) and a negative association with perceived vulnerability to COVID-19 (H2) and trust in the epistemic authorities involved in the management of the COVID-19 outbreak (H3).

TABLE 3
Structural invariance of the COVID-19 Vaccine Hesitancy Scale

		χ^2	CFI	TLI	RMSEA [90% CI]	χ^2 difference
Gender (men: *n* = 564, women: *n* = 587)	B model	$\chi^2(2) = 1.540$, $p = .463$	1.00	1.00	.00 [.00, .08]	
	I model	$\chi^2(6) = 5.207$, $p = .518$	1.00	1.00	.01 [.00, .06]	$\Delta\chi^2(4) = 3.667$, $p = .453$
Age (18-30 years old: *n* = 196, 31-60 years old: *n* = 680, at least 61 years old: *n* = 275)	B model	$\chi^2(6) = 13.208$, $p = .040$	1.00	.99	.06 [.01, .10]	
	I model	$\chi^2(11) = 22.287$, $p = .022$	.99	.99	.05 [.02, .08]	$\Delta\chi^2(5) = 9.080$, $p = .106$
Area of residence (North-western Italy: *n* = 311, North-eastern Italy: *n* = 219, Central Italy: *n* = 225, Southern Italy and main Italian islands: *n* = 396)	B model	$\chi^2(10) = 9.427$, $p = .492$	1.00	1.00	.00 [.00, .06]	
	I model	$\chi^2(16) = 13.362$, $p < .646$	1.00	1.00	.00 [.00, .05]	$\Delta\chi^2(6) = 3.935$, $p = .685$
Perceived economic situation (good: *n* = 547, bad: *n* = 604)	B model	$\chi^2(2) = 3.072$, $p = .215$	1.00	.98	.07 [.00, .09]	
	I model	$\chi^2(6) = 7.125$, $p < .310$	1.00	1.00	.02 [.00, .06]	$\Delta\chi^2(4) = 4.053$, $p = .399$

Note. CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation; CI = confidence interval; B = baseline model; I = invariant model.

TABLE 4
Convergent validity tests

Independent variable	Mediator (COVID-19 vaccine hesitancy)		Dependent variable (COVID-19 vaccine refusal)	
	Beta	*SE*	Beta	*SE*
Woman	.03	.03	.04	.02
Age	–.03	.03	.02	.02
Perceived socioeconomic status	.07*	.03	.01	.02
Perceived vulnerability	–.19***	.03	–.00	.03
Populist orientation	.28***	.05	–.03	.05
Trust in epistemic authorities	–.38***	.04	–.05	.04
COVID-19 vaccine hesitancy			.63***	.03
R^2	.36***	.03	.42***	.02

Note. Beta = standardized regression coefficients are displayed.
*** $p < .001$; * $p < .05$.

TABLE 5
Indirect associations between the exogenous variables and COVID-19 vaccine refusal

	Estimate	*SE*	*p*
Perceived vulnerability	–.10	.02	< .001
Populist orientation	.17	.03	< .001
Trust in epistemic authorities	–.23	.03	< .001

As is typically the case, this study has some limitations. First, it is based on a one-shot data collection using a sample from the Italian adult general population. Thus, acquiring more data from samples extracted from specific subpopulations (for example, low-educated or religious people) could help to verify and further support the conclusions drawn in this study. Second, due to the cross-sectional nature of our study, we were unable to test the CVH Scale's convergent validity using a genuinely causal approach. A longitudinal and/or experimental replication of this study would therefore be interesting. In addition, we could not directly compare the correlation patterns of the CVH Scale with the aVHS to determine whether they differ significantly between the two scales to bolster the idea that the CVH Scale can address specific patterns related to COVID-19 vaccine hesitancy.

However, these limitations are compensated for by the CVH Scale's strengths. Among these are, first, the fact that it is short and composed of easy-to-understand items that are accessible to low-educated respondents. This is an advantage because, as is well known, the longer the questionnaire, the higher the probability of collecting data distorted by the acquiescent response set (Curran, 2016). Indeed, even though a 10-item scale, such as Akel et al.'s (2021) aVHS, might not seem that long, our analyses clearly demonstarted symptoms of the acquiescent response-set in an even shorter scale. The risk of collecting data distorted by the acquiescent response set is especially high for samples taken from the general population because such samples consist of individuals who are significantly less culturally equipped to respond to surveys than those who participate in the typical student samples used in psychological research (Sears, 1986). If a survey is administered in a suboptimal context (as is often the case with healthcare surveys), then that can increase the risk of distortion too. Thus, short scales are advantageous because they minimize the negative effects on participants' attention and cognitive workload (Krosnik & Alwin, 1987). Furthermore, they are even more valuable if they are embedded in larger questionnaires, surveying different constructs, as has been shown systematically in psychological research. From this perspective, the 4-item CVH Scale is undoubtedly preferable to the 10-item aVHS not only because of its specific focus on COVID-19 but also because of its shortness. Another strength of the CVH Scale pertains to the process we used for its validation. For the data collection, we worked with a wide quota sample of the Italian population, stratified for the most important sociodemographic variables. This allowed us to show that the scale can be easily employed outside of psychological labs with samples from the general population. This is particularly important because COVID-19 vaccine hesitancy is prevalent among low-educated people (e.g., Robertson et al., 2021). In addition, the data analysis techniques we used are more advanced than those used in the validation of other vaccine hesitancy scales (e.g., Bolatov et al., 2021). Beyond showing the CVH Scale's structural invariance and convergent validity, the structural equations model approach we used also helped us illustrate the risk of a distortion stemming from the acquiescent response set and the possibility of correcting it. Further studies, performed on the usual student samples used in psychological research, could inform researchers of the generalizability

of this bias. Another interesting advancement of this study will be the extension of this validation to other countries, with different incomes and different governing styles, to further test and broaden the generalizability of our results.

At present, however, we believe that the CVH Scale is a useful instrument for assessing COVID-19 vaccine hesitancy in the general population, understanding the dynamics behind COVID-19 vaccine refusal, and designing individual-, community-, and national-level intervention plans aimed at fostering COVID-19 vaccine acceptance.

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