

## Dimensionality of the Attitude Toward COVID-19 Vaccines Scale in Colombian adults: A Validation Study

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### Abstract

It is still crucial to know the attitude towards COVID-19 vaccines and to have valid and reliable measurements. The research objective was to corroborate the dimensionality of the Spanish version of the Attitudes Towards COVID-19 Vaccines Scale among Colombian adults. A validation study was designed in which 450 adults between 18 and 67 years of age ( $M = 31.37 \pm 11.52$ ) participated. Participants completed the Attitudes Towards COVID-19 Vaccines Scale. This instrument consists of eight items with five response options from "completely disagree" to "completely agree" that are scored from zero to four; the higher the score, the better the attitude towards vaccines. The scale showed a one-dimensional structure, with acceptable indicators of goodness of fit: Satorra-Bentler chi-square of 147 (degrees of freedom of 20 and  $p$ -value  $< 0.001$ ,  $X^2 / df = 7.35$ ), RMSEA of 0.12 (CI90% 0.10 - 0.14), CFI of 0.96, TLI of 0.95 and SRMR = 0.02. In conclusion, the Attitudes Towards COVID-19 Vaccines Scale shows a unidimensional structure among Colombian adults. It is necessary to observe the performance of this instrument in other Spanish-speaking samples.

**Keywords:** Attitude; COVID-19 vaccination; Dimensionality; Factor analysis; Validation studies.

Currently, it is necessary to continue the vaccination process against coronavirus disease (COVID-19) for public health reasons (Altmann & Boyton, 2022). Some groups' negative attitude toward vaccination against COVID-19 has constituted a barrier to complete control of the pandemic because the intention and negative attitude towards vaccination has not been reduced; it has even grown during the course of the pandemic (Wang et al., 2021; 2022). It is still crucial to know the attitude toward COVID-19 vaccines (Altmann & Boyton, 2022); therefore,

valid and reliable measurements are necessary (Streiner & Norman, 2008).

The Attitudes Towards COVID-19 Vaccines Scale was designed in Danish and brought together eight items in a single dimension with high internal consistency (De Roos, 2020). Subsequently, a translation into Spanish was done. The one-dimensional scale and high internal consistency of the Attitudes Towards COVID-19 Vaccines Scale were confirmed in Colombian university students between 18 and 29 years old.

In addition, nomological validity was tested by observing scores that indicated a more positive attitude in health sciences students than in students from other areas. However, the Spanish version of item 7, "I am concerned about the possible side effects of the COVID-19 vaccines", showed proportionally low communality or high uniqueness, possibly because it is the only item that required reverse scoring (Campo-Arias et al., 2022).

For the present study, the wording of item 7 in Spanish was revised to improve the item's performance and the global performance of the "Attitudes Towards COVID-19 Vaccines Scale." It is imperative to take care with the wording of the items, especially when translations are made from the original version in another language, because this can cause problems in interpreting or inducing the meaning of the response (Ross, 2022). All situations that can change the original meaning or the linguistic equivalence of the items undermine the properties of health measurement instruments (Cha et al., 2007). The review process of the measurement scales has always been a dynamic and continuous matter to preserve the usefulness of the instruments (Campo-Arias & Pineda-Roa, 2022; Keszei et al., 2010; Streiner & Norman, 2008). It is common to observe significant variations in the performance of health measurement scales because the profile of the participants can account for significant changes in the response pattern of the items (Ross, 2022). In addition, it should be borne in mind that Spanish

is the official language in 21 countries and is the second most used mother tongue, spoken by more than 580 million inhabitants (Fernández, 2019). Most Spanish-speaking countries are categorised as low or middle-income and show high indicators of economic and social inequalities that may explain the low vaccination rates against COVID-19 achieved (Davis Jr et al., 2022; Patwary et al., 2022; Reza et al., 2022).

The study's objective was to corroborate the dimensionality of the Spanish version of the Attitudes Towards COVID-19 Vaccines Scale among adults in the general Colombian community.

## Method

### Design

A validation study was designed without reference criteria.

### Participants

A sample of 450 adults from the general population participated in the research. The ages were between 18 and 67 years old ( $M = 31.37 \pm 11.52$ ). More demographic characteristics are in table 1.

**Table 1**

Demographic and clinical characteristics of the participants.

Variable	n	%
Female gender	337	74.89
Single	293	65.11
Income		
<i>Low</i>	271	60.22
<i>Middle</i>	166	36.89
<i>High</i>	13	2.89

Urban residence	389	86.44
Schooling		
<i>Primary</i>	6	1.33
<i>Middle or high school</i>	171	38.00
<i>College</i>	273	60.67
Medical condition in a chronic situation	318	70.67
Vaccinated	400	88.88

### Instrument

The Attitudes Towards COVID-19 Vaccines Scale consists of eight items, previously adapted to Spanish from a Danish version, with five response options from "completely disagree" to "completely agree" that are scored from zero to four; the higher the score, the better the attitude towards vaccines (De Roos, 2020). However, item 7 was rewritten to have a direct rating like the rest of the items (Campo-Arias et al., 2022).

### Procedure

The participants were contacted by email and social networks between October 2021 and March 2022. The study's objectives, the anonymous nature of the questionnaire responses and the need to sign an informed consent were explained. The demographic questions and the items on the Attitudes Towards COVID-19 Vaccines Scale were displayed upon agreeing to participate.

### Statistical analysis

A confirmatory factor analysis was performed using the maximum likelihood method. The possibility of Promax rotation was considered in the event of poor performance of the one-dimensional solution. The Promax rotation is indicated when it is estimated that the factors of a multidimensional solution present a high correlation between them (Streiner & Norman, 2008).

The factor solution would be classified as satisfactory if it presented three or more goodness-of-fit indicators within the traditionally suggested values: Satorra-Bentler chi-square with p-value  $< 0.001$  or  $X^2 / df < 3$  (Ding et al., 1995), RMSEA  $< 0.07$ , CFI and TLI  $> 0.90$  and SRMR  $< 0.05$  (Hu & Bentler, 1999).

Cronbach's (1951) alpha and McDonald's (1970) omega coefficients were calculated as reliability indicators. Reliability is accepted, showing values between 0.70 and 0.95 (Keszei et al., 2010).

As an external validator, attitudes toward vaccines were compared between vaccinated and unvaccinated subjects using the Student's t-test (1908) after checking for homogeneity of variance with Levene's test (O'Neil & Mathews, 2002). Probability values less than 0.001 were accepted as significant differences, hypothesising that vaccinated people would show a higher score (favourable) towards the vaccines than unvaccinated people. Statistical analysis was performed with the Jamovi version 2.3 program.

### Ethical considerations

A research ethics committee approved the protocol (ordinary virtual session on September 2, 2021). The participants who signed the informed consent completed the research questionnaire under Colombian legislation and the Declaration of Helsinki.

## Results

The Attitudes Towards COVID-19 Vaccines Scale showed a one-dimensional structure. See factor loadings in Table 2. Goodness-of-fit indicators were: Satorra-Bentler chi-square of 147

(degrees of freedom of 20 and  $p$ -value  $< 0.001$ ,  $X^2 / df = 7.35$ ), RMSEA of 0.12 (CI90% 0.10 - 0.14), CFI of 0.96, TLI of 0.95 and SRMR = 0.02.

**Table 2.**

Loadings of the Attitude Towards COVID-19 Vaccines Scale in the general Colombian population.

Item	Loading
1. I plan to get myself vaccinated against COVID-19	0.722
2. I have faith in the COVID-19 vaccines	0.871
3. I think others should also vaccinate themselves with the COVID-19 vaccines	0.867
4. I would recommend the COVID-19 vaccines	0.913
5. I think it is important that the people around me are vaccinated with the COVID-19 vaccines	0.862
6. I think it is important that I get vaccinated with the COVID-19 vaccines	0.918
7. The benefit of COVID-19 vaccines is greater than the possible side effects	0.848
8. I rely on the information provided about the COVID-19 vaccines	0.848

Internal consistency was high: Cronbach's alpha and McDonald's omega of 0.96. The attitude towards COVID-19 vaccines was more favorable among the vaccinated than the unvaccinated [ $27.62 \pm 5.26$  versus  $21.60 \pm 7.67$ ; Levene's  $F$  test = 12.17;  $p < 0.001$ ;  $t$  for non-homogeneous variances = 5.39;  $df = 54.93$ ;  $p < 0.001$ ].

## Discussion

The present study corroborates the unidimensionality of the Attitudes Towards COVID-19 Vaccines Scale among Colombian adults, with three goodness-of-fit indicators within the recommended parameters. In addition, item 7, "I am concerned about the possible side effects of the COVID-19 vaccines", presents a more significant commonality in the new direction for direct rating.

The dimensionality of the Attitudes Towards COVID-19 Vaccines Scale has been previously

observed in Colombian and Danish samples (De Roos, 2020; Campo-Arias et al., 2022). This finding indicates the instrument's validity in quantifying the attitude toward COVID-19 vaccines (Streiner & Norman, 2008). Unidimensionality is required for calculating internal consistency (Campo-Arias & Oviedo, 2008); therefore, the Attitudes Towards COVID-19 Vaccines Scale was expected to show high internal consistency values, as in previous studies (De Roos, 2020; Campo-Arias et al., 2022). Under ideal conditions, the internal consistency measured with Cronbach's alpha and McDonald's omega is between 0.70 and 0.95. Values less than 0.70 suggest a low correlation between the items, which implies low reliability and indirectly poor validity, and data greater than 0.95 implies redundant items, that is, that several items have high collinearity among them or that the scale has more than twenty (Campo-Arias & Oviedo, 2008; Keszei et al., 2010). It is unlikely that a 20-item scale is one-dimensional; in these cases, internal

consistency must be calculated for each identified dimension (Campo-Arias & Oviedo, 2008; Campo-Arias & Pineda-Roa, 2022).

In the same way, the attitude toward COVID-19 vaccines showed nomological validity; as hypothesised, people who had received a COVID-19 vaccine showed significantly more favourable scores towards COVID-19 vaccines than those who had not received a dose. The finding is similar to a previous study that showed that scores were significantly more favourable in health sciences students than in other careers (Campo-Arias et al., 2022). It is essential to guarantee the validity of health measurements for those constructs that lack a gold standard; nomological validity is a practical and straightforward way to add validity indicators to measurements in clinical and epidemiological evaluations (Adcock & Collier, 2001; Davis Jr. et al., 2022; Patwary et al., 2022; Reza et al., 2022).

Health professionals should be attentive to the performance of the items of a scale recently translated into a language. It is mandatory to review the wording of the items that have shown unexpected behaviour in a new language since some linguistic inaccuracy that explains the difficulty is always possible (Cha et al., 2007; Ross, 2022).

Additionally, it is necessary to prefer all items with a direct rating to measure a dimension (Muñiz & Fonseca-Pedrero, 2019; Sonderen et al., 2013). Traditionally, reverse graded items were used to avoid response bias in paper-and-pencil scales with response boxes next to each other (Weijters & Baumgartner, 2012; Weijters et al., 2009). However, reverse-graded items within a one-dimensional scale may cause more harm than good (Herche & Engelland, 1996; Muñiz & Fonseca-Pedrero, 2019; Weijters & Baumgartner, 2012). An effect similar to that produced by the use of negations or negative phrases in the wording of the item (Muñiz & Fonseca-Pedrero, 2019).

This study is an additional contribution to the knowledge of dimensionality, internal consistency and nomological validity in a sample of residents in Colombia. This finding ensures a valid and reliable measurement of attitudes toward vaccines in a population with a high percentage of

unvaccinated amid the emergence of new COVID-19 variants (Altmann & Boyton, 2022). Additionally, the Spanish-speaking community has a simple instrument that is not copyrighted in Spanish and can be translated into other languages without the authors' written permission. However, this study has the limitation of validation studies that only apply to the participating sample (Streiner & Norman, 2008). The performance of a measurement instrument must be calibrated in each application; these scales are constantly under evaluation (Campo-Arias & Pineda-Roa, 2022; Ross, 2022).

In conclusion, the Attitudes Towards COVID-19 Vaccines Scale shows a one-dimensional structure among Colombian adults. It is necessary to observe the performance of this scale in other Spanish-speaking samples.

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#### **Ethics approval:**

The Research Ethics Board of the Universidad del Magdalena, Colombia, approved the project (Ordinary virtual session of September 2, 2021).

#### **Consent to participate:**

All participants signed informed consent.

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#### **Declaration of conflict of interest:**

The authors have no conflict of interest to declare.

**Data Availability Statement:**

Data supporting the findings of this study are available upon reasonable request to the corresponding author (AC-A).

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