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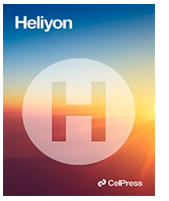

Research article

Evaluation of the psychometric properties of the health care providers' pain and impairment relationship scale (HC-PAIRS) in health professionals and university students from Chile and Colombia

M. Martin-Carbonell [a,*], D. Sequeira-Daza [b], I. Checa [c], J. Domenech [d], B. Espejo [c], G. Castro-Melo [a]

[a] *Universidad Cooperativa de Colombia, Colombia*
[b] *Universidad Central de Chile, Chile*
[c] *Universitat de València, Spain*
[d] *Universidad de Navarra, Spain*

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ABSTRACT

Background: Chronic back pain is a frequent and disabling health problem. There is evidence that ignorance and erroneous beliefs about chronic low back pain among health professionals interfere in the treatment of people who suffer from it. The Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS) has been one of the most used scale to assess these misbeliefs, but no studies have been reported in Latin America. Method: We studied the factorial structure of the HC-PAIRS in health personnel and health sciences university students in two Latin American countries: Colombia (n = 930) and Chile (n = 190). Spain's data was taken of the original study of the Spanish version of the HC-PAIRS (171 Physiotherapy students). Additionally, the measurement invariance of this scale among Chile, Colombia and Spain was evaluated by calculating three nested models: configural, metric and scalar. We used a Confirmatory Factor Analysis (CFA) in both Latin American samples, with Maximum Likelihood Robust (MLR) estimation to estimate the parameters. For the final model in each sample, reliability was assessed with the Composite Reliability (CR) index, and to obtain the proportion of variance explained by the scale the Average Variance Extracted (AVE) was calculated.
Results: The one-factor solution shows an acceptable fit in both countries after deleting items 1, 6, and 14. For the resulting scale, the CR value is adequate, but the AVE is low. There is scalar invariance between Chile and Colombia, but not between these two countries and Spain.
Conclusions: HC-PAIRS is useful for detecting misconceptions about the relationship between chronic low back pain that would cause health personnel to give wrong recommendations to patients. However, it has psychometric weaknesses, and it is advisable to obtain other evidence of validity.

* Corresponding author.
E-mail address: martha.martinc@campusucc.edu.co (M. Martin-Carbonell).

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1. Background

Up to 80 % of people will experience an episode of back pain at some point in their lives [1]. Its prevalence in Latin America is estimated at around 10.5 % [2]. In Colombia, 976 disability-adjusted life years (DALY) have been reported for every 100,000 inhabitants attributable to chronic pain in 2022, with back pain being one of the problems that contributed the most. Back pain related to rheumatic disease has been estimated to affect more than 20 % of Colombians [3]. In Chile, chronic musculoskeletal pain affected 21.8 % of the adult population between 2016 and 2017 (503,919 DALY). Chronic low back pain is the most prevalent among chronic musculoskeletal pain (6.9 %, 142,798 DALY) [4].

There is sufficient evidence that lack of information and erroneous beliefs about chronic back pain among health professionals interfere in clinical work with people who suffer from it [5–7]. Beliefs about back pain can lead to a loss of empathy on the part of healthcare professionals [8] and patients to feel ignored [9]. These beliefs are often combined with stereotypes related to gender, race, and age, increasing the risk of discrimination and undertreatment [10,11]. In the Latin American environment, studies on professional attitudes and practices regarding pain care are insufficient, but the few results found that the view of older adulthood prevails as a stage of life with little participation in society, characterized by having multiple diseases and a considerable increase in disability [12, 13].

Although there are some instruments for the evaluation of stereotypes about back pain [14–18], the Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS) [19] has been one of the most used [20], but to the best of our knowledge, no studies have been reported in Latin America, but to the best of our knowledge.

The Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS) was proposed by Rainville et al., in 1995 to assess the attitudes and beliefs of health care providers about the functional expectation of patients with chronic low back pain. It was developed from the modified Pain-Impairment Relationship Scale (PAIRS) used to assess patients' attitudes and beliefs, and it includes some of the items of the PAIRS. Rainville et al. (1995) performed an Exploratory Factor Analysis (EFA) with Varimax rotation to explore the dimensions of attitudes and beliefs, finding 4 factors that they called "functional expectations" (items 1, 2, 3, 6, 7, 8, 9, 11 and 12), "social expectations" (items 5, 7, 11 and 14), "need to cure" (items 4, 9 and 15) and " projected cognition" (items 10 and 13). In this version, items 4, 6 and 14 must be reversed. Various validation studies carried out subsequently in different countries have reported contradictory results regarding the items of the scale. Specifically, Aksoy et al. (2021) in research carried out with 153 physiotherapists from Turkey found a one-factor structure by eliminating items 4, 14 and 15. Roitenberg (2019) worked with a sample of 213 physiotherapists from Israel and also found a factor, suppressing items 13 and 14. In the Netherlands the authors worked with 156 therapists from various paramedical disciplines [21], finding a good fit of the one-factor structure, and proposed removing items 10 and 13. On the other hand, Ekström et al. (2022) found three factors retaining 11 items (items 4, 10, 13 and 14 were removed) in a sample of 300 Finnish physiotherapists. Likewise, in the Spanish version it was found that the best solution was the unifactorial one, although the elimination of item 4 was proposed, as well as paying attention to the behavior of item 7 [20]). This study by Domenech et al. (2013) is particularly interesting due to the cultural similarities between Spain and Latin America. Both countries have a similar cultural heritage, as Colombia used to be a Spanish colony and they share the same language, religion, and many traditions. In addition, many studies have examined the similarities between both countries in the expression and management of pain [22–25]. Domenech et al. (2013) worked with a sample of family physicians and physiotherapy students. Through an exploratory factor analysis (EFA), with the method of principal axes factorization and oblique rotation, they also found that the best solution was the unifactorial one, suggesting the elimination of items 4 and 7. While some authors have found that the best solution is for a one-dimensional structure [21,26–28], only Ehrström et al. (2022) found that the best solution was with three factors. These differences with the results of Rainville et al. (1995) can be explained, among other reasons, by the statistical analysis strategies used in these new studies because subsequent studies used mainly Confirmatory Factor Analysis (CFA). The CFA estimates the factor loadings of each item on a single factor, while for the others factors the factor loadings of each item are set to 0. For this reason, Rainville et al. (1995) solution cannot be tested with a CFA, since it maintains various items forming part of two factors at the same time (items 7, 9 and 11). Furthermore, in most of the subsequent adaptations of the scale the best solution was that of one factor even though in some cases have been used the EFA. For this reason, most studies have tested the single-factor solution with a CFA, mainly showing good fit of the model, although retaining different items) [26,27,29].

Other psychometric properties that have been studied for the HC-PAIRS have been test-retest reliability with the intraclass correlation coefficient. The results of these test-retest analyzes indicate that the measure is stable over time, after a two or four week gap between both measures [27,28,29,30] Concurrent validity has been studied through correlations with other criteria, such as the Fear Avoidance Beliefs questionnaire, the Tampa Scale of Kinesiophobia for Health Care Providers, the Back Pain Attitudes Questionnaire, or the Pain Attitudes and Beliefs Scale for Physiotherapists [26–28,29,30]. The results indicate that the HC-PAIRS shows good correlations with the considered criteria, therefore it shows good concurrent validity. Convergent validity was studied through correlations with the Attitudes to Back Pain Scale in Musculoskeletal Practitioners only in the Israeli sample [31] with a result indicating good convergent validity.

From the above, the need to evaluate the psychometric properties, and especially the factor structure of the HC-PAIRS in our Latin American environment is evident, and more if one takes into account that when a psychological test has been developed in one culture and is applied in another, reliability and validity cannot be assumed a priori [32].

2. Objectives

In this report we studied the factorial structure of the HC-PAIRS in two samples, one of Colombian and another one of Chilean

health personnel, as well as in health sciences university students. On the other hand, the measurement invariance of this scale between both countries was studied. In addition, we also investigated the measurement invariance with the sample of physiotherapy students on which the original study of the Spanish version of the HC-PAIRS was based, since in no case has measurement invariance been studied between groups of people or between countries, which is important to be able to make comparisons of the observed scores obtained with the questionnaire.

A central aspect of any measurement attitudes is it must measure the constructs identically, especially when the objective is to compare groups. As said Elosua [33] *"… It would be incorrect to interpret the results of a test (or forms thereof) univocally if its application in two contexts is associated with different measurement errors. The relevance of both uses is subject to the measurement invariance of the scores"*. It is important to compare attitudes about chronic back pain in health professionals to develop international educational programs, as its practice is more frequent each time [6,34–37]. Although some studies have compared attitudes toward back pain in health professionals of different countries using HC-PAIRS [12], there is no evidence that this scale has similar psychometric properties in different countries.

3. Methods

3.1. Participants

Table 1 shows more sociodemographic and professional information about Colombian and Chilean samples. The Spanish sample is made up of 171 Physiotherapy students, 39.8 % women, with an average age of 22 years (SD = 4.7, minimum 18, maximum 46 years). The dataset analyzed during the current study is available in the Zenodo repository [38].

3.2. Measurement instrument

The HC-PAIRS consists of 15 items that suggest that pain justifies deterioration and disability. The items are answered using a 7-point Likert scale ranging from 1-strongly disagree to 7-strongly agree. The higher the score on the questionnaire, the greater adherence to the belief that pain justifies disability and requires avoiding activities. The adapted Spanish version of HC-PAIRS was used [20]. Items 4, 6 and 14 must be reversed.

Table 1
Sociodemographic data of Colombian and Chilean samples.

	Colombia (N = 955)	Chile (N = 190)
Area	%	%
Urban	87.5	98.4
Rural	12.5	1.6
Gender		
Male	36.6	11.1
Female	59.7	88.9
Non-binary	1.0	–
Prefer not to say	2.6	–
Student or worker		
Studying	54.1	17.9
Working	44.8	82.1
Missing	1.0	–
Students: Studies carried out	(N = 517)	(N = 34)
Medicine	41.2	11.8
Nursing	30.8	55.9
Psychology	16.8	–
Physiotherapy	2.1	5.9
Social Work	2.3	–
Other degrees related to the health area	6.8	26.5
Workers: Degree (they can have more than one degree)	(N = 438)	(N = 156)
Medicine	32.2	33.9
Nursing	38.1	86.7
Psychology	15.1	7
Social Work	6.4	25
Physiotherapy	5.2	12.8
Occupational Therapy	1.7	14.9
Other studies (university and/or non-university)	26.6	28.1
	Mean/SD	Mean/SD
Age of the total sample	29.0/9.6	41.4/13.4
Workers	N(%)/Mean/SD	N(%)/Mean/SD
Years of experience in the profession that is currently practiced	428(51.8)/9.5/10.8	156(75.3)/18.5/13.2
Years that their work is linked to patients with pain	208(48.6)/6.8/9.4	79(50.6)/10.4/10.2

3.3. Procedure

The first step was to study if the meaning of the items of the Spanish version of the HC-PAIRS [28] is the same for the Chilean and Colombian populations.

An evaluation panel group was formed made up of 9 Colombian and Chilean judges (3 doctors, 3 psychologists, and 3 nurses) with different levels of experience in caring for the elderly and in the use of attitude assessment instruments. They were asked to consider factors such as item clarity (the extent to which the item is easily comprehensible), sensitivity to variations in the measured phenomenon, justification for the inclusion of each item in the instrument, and the item's essentiality or significance. The item was considered adequate when at least 70 % of the experts gave it a score greater than 3 in all the evaluated criteria. The results of the evaluations were discussed in the group, reaching a consensus. So, finally, the items of the version used in Spain were the same as those used in Chile and Colombia, since the results obtained after the evaluation carried out by the judges reported their adequate understanding in both Latin American countries.

Data of Colombia and Chile were collected online between August 1, 2021 and May 20, 2022 using the LimeSurvey platform installed on the servers of the university, to obtain a convenience sample. The survey included questions to obtain sociodemographic and professional information and was completely anonymous and voluntary. In Colombia, the link to it was sent via e-mail and distributed on social networks. In Chile, the link was sent by email to the last-year teachers of health-related university studies, as well as to the social networks of the different trade union organizations of health professionals. In all cases, their collaboration was requested to answer the survey and for its dissemination.

The study was briefly explained before starting the survey and the participants had to accept informed consent. The study was conducted in compliance with Colombian legislation [39] and in compliance with Chilean legislation on protection of the private life of individuals [40], as well as the code of ethics for research with human beings, as established by the Universidad Cooperativa de Colombia, and the Universidad Central de Chile, in accordance with The Code of Ethics of the World Medical Association [41]. Spanish data was taken from the original study of the Spanish version of the HC-PAIRS [20]). The data was collected in 2012, in Valencia, Spain. The authors follow recommendations of The Code of Ethics of the World Medical Association too. The participants answered the questionnaires on paper in their classrooms at the same time.

3.4. Data analysis

To study the factorial structure of the HC-Pairs, the one-factor model was tested using a Confirmatory Factor Analysis (CFA) in both samples, since this structure appears the most valid in the different adapted versions of the instrument. For this purpose, the Maximum Likelihood Robust (MLR) estimation was used to estimate the parameters. Although observed data can be considered ordinal, some authors suggest that MLR estimation can be used in CFA models if the number of response categories for the items is greater than four [42–44] In this case MLR offers less biased standard error estimates, as well as good estimates of the correlations between the factors [45].

Owing to the sensitivity to the sample size of the χ^2 goodness of fit test, other approximate fit indices have been considered: the Comparative Fit Index (CFI), the Standardized Root- Mean-Square Residual (SRMR) and the Root-Mean-Square Error of Approximation (RMSEA). Values of 0.90 for the CFI, and values between 0.08 and 0.10 for the RMSEA and SRMR indicate acceptable model fit. Values above 0.95 for the CFI, and below 0.05 for the RMSEA and SRMR indicate good fit to the model [46,47]. In addition, the Akaike information criterion (AIC), the Bayesian information criterion (BIC) and the Adjusted Bayesian information criterion (aBIC) have been offered, as absolute indicators of fit. The lower the value of each index when comparing models, the better the fit of the model.

For the final model in each sample, reliability was assessed with the Composite Reliability (CR) index [48]. Next, the Average

Table 2
Goodness of fit indicators of the models tested in both samples (Chile and Colombia) using Confirmatory Factor Analysis.[a and b]

Chile	χ^2	df	CFI	RMSEA	RMSEA 90 % CI	SRMR	AIC	BIC	aBIC
Model 1. 1 factor (all the items)	199.5[a]	90	0.697	0.080	0.065, 0.095	0.075	9850.330	9996.446	9853.905
Model 2. 1 factor without items 6 and 14	124.4[a]	65	0.805	0.069	0.051, 0.088	0.065	8488.610	8615.244	8491.708
Model 3. 1 factor without items 1, 6 and 14	110.7[a]	54	0.808	0.074	0.054, 0.094	0.067	7791.028	7907.921	7793.888
Colombia									
Model 4. 1 factor (all the items)	1366.8[a]	90	0.611	0.124	0.118, 0.129	0.117	49389.187	49606.770	49463.854
Model 5. 1 factor (all the items) with correlated errors[a]	970.4[a]	87	0.731	0.104	0.099, 0.110	0.100	48846.945	49079.034	48926.590
Model 6. 1 factor without items 1 and 6	611.8[a]	65	0.775	0.095	0.088, 0.102	0.075	41318.401	41506.973	41383.113
Model 7. 1 factor without items 1 and 6, and correlated error[b]	510.7[a]	64	0.817	0.087	0.080, 0.094	0.069	41173.234	41336.624	41239.606
Model 8. 1 factor without items 1, 6 and 14	451.9[a]	54	0.818	0.089	0.081, 0.097	0.065	37794.416	37968.483	37854.950

Note. df = degrees of freedom; CFI = comparative fit index; RMSEA = Root-Mean-Square error of approximation; CI = confidence interval; SRMR = standardized Root-Mean-Squared residual; AIC = Akaike information criterion; BIC = Bayesian information criterion; aBIC = Adjusted BIC.
$p < .001$.

[a] Model with correlated errors for items 6 and 1, items 6 and 7, items 6 and 14.

[b] Model with correlated error for items 14 and 15.

Variance Extracted (AVE) was calculated to estimate the proportion of variance explained by the obtained factor. Values equal to or greater than 0.70 for the CR, and equal to or greater than 0.50 for the AVE are considered good [49]. The corrected item-total polychoric correlations were calculated as indicators of the corrected homogeneity indices for items with ordinal response scales [48].

Likewise, the measurement invariance across country was studied, evaluated by calculating three nested invariance models: configural, metric and scalar. In addition to studying the invariance between Colombia and Chile, the invariance with Spain has been studied. To assess the degree of invariance among the models, we followed the indications of Meade et al. [50] who recommend the use of CFI and RMSEA, since the χ^2 is greatly affected by sample sizes. Thus, evidence of measurement invariance was supported by the following changes (in absolute terms) in the between-model fit indices: reject if CFI change is greater than 0.010, along with a change of 0.015 or greater in the RMSEA, or a change of 0.030 or greater in the SRMR [51].

To carry out the confirmatory factor analysis, the homogeneity indices and to study the measurement invariance, the Mplus 8.10 software has been used [52]. Finally, to describe sociodemographic variables IBM SPSS 28 was used.

4. Results

Table 2 shows the fit indices of the models tested in both samples. As can be seen, the one-factor model shows an acceptable fit in the Chilean sample for the RMSEA and the SRMR fit indices (Model 1). However, the factor loadings of items 6 ($\lambda = 0.129$) and 14 ($\lambda = 0.031$) were not statistically significant. For this reason, the one-factor model was estimated again by removing these two items (Model 2). Once again, it was observed that in this model the factor loading of item 1 was very low ($\lambda = 0.170$). Despite being statistically significant, the model was estimated again without this item, since such a low factor loading hardly adds variance to the scale (Model 3). This third model showed a better fit in the absolute fit indices, despite observing a slight increase in the RMSEA and SRMR values. However, the values of these two fit indices were below the cut-off point, so this last model was retained.

Regarding the Colombian sample, the one-factor model did not show a good fit (Model 4). In addition, it was observed that several modification indices (MI) presented very high values. Specifically, between items 6 and 1 (MI = 206,429), items 6 and 7 (MI = 163,423), and items 6 and 14 (MI = 127,261), probably because items 1, 6 and 14 are reversed items. For this reason, a one-factor model was tested in which the correlation of errors between these pairs of items were also estimated (Model 5). Although the Chi-square value decreased significantly, the fit of the model was not good either. When observing the factor loadings, we saw that factor loadings for items 1 and 6 were very low (0.109, 0.186, respectively). So, the model was estimated again without these items since these low factor loadings hardly add variance to the scale (Model 6). In this case, all the fit indices improved, and RMSEA and SRMR could be considered acceptable. However, it was also observed that the modification index between items 14 and 15 was very high (MI = 96.686). Again, this model was estimated also considering the correlation between these two items (Model 7). Although the fit indices improved enough, the factor loading of item 14 presented a much lower value than that of the other items ($\lambda = 0.278$). So, we also removed this item and estimated the model again without items 1, 6 and 14 (Model 8), as in the Chilean sample. In this new model, the absolute fit indices (AIC, BIC and aBIC) significantly improved. On the other hand, although RMSEA increases slightly, SRMR decreases, being able to consider both indices with acceptable values.

Table 3
Standardized factor loadings, corrected homogeneity indices of the items with their standard errors (SE), Composite Reliability index (CR) and Average Variance Extracted (AVE) for the final factor in each sample.[a and b]

	Chile ($n = 190$)			Colombia ($n = 930$)		
	Factor loading	Corrected homogeneity index	SE for the corrected homogeneity index	Factor loading	Corrected homogeneity index	SE for the corrected homogeneity index
Item 2	0.475[b]	0.449	0.053	0.611[b]	0.523	0.022
Item 3	0.474[b]	0.453	0.052	0.601[b]	0.511	0.023
Item 4	0.281[b]	0.252	0.061	0.458[b]	0.424	0.021
Item 5	0.472[b]	0.393	0.055	0.566[b]	0.551	0.016
Item 7	0.247[a]	0.231	0.064	0.307[b]	0.341	0.025
Item 8	0.481[b]	0.504	0.045	0.666[b]	0.583	0.019
Item 9	0.619[b]	0.542	0.041	0.613[b]	0.564	0.020
Item 10	0.594[b]	0.505	0.054	0.680[b]	0.581	0.016
Item 11	0.644[b]	0.540	0.053	0.608[b]	0.583	0.018
Item 12	0.479[b]	0.447	0.044	0.602[b]	0.550	0.020
Item 13	0.415[b]	0.358	0.061	0.585[b]	0.539	0.019
Item 15	0.299[b]	0.310	0.056	0.443[b]	0.451	0.025
CR	0.763			0.849		
AVE	0.242			0.349		

Note.
[a] $p < .05$.
[b] $p < .005$.

On the other hand, although in both samples acceptable values can be considered for RMSEA and SRMR, it is observed in all the estimated models that CFI does not exceed the cut-off point required to consider the model to be a good fit. But, although the CFI value is inconsistent with RMSEA and SRMR, this can happen at times. Although these three fit indices are commonly used to assess model fit, CFI and RMSEA do not produce comparable qualitative assessments for any data set. As RMSEA is a non-standardized fit index it can be difficult to interpret, and that's why arbitrary cutoffs are used, while the CFI measures the relative improvement in fit [53]. For this reason, when RMSEA and CFI offer different assessments of the fit of the model, some authors argue that this does not mean that the model is poorly specified or that there is a problem with the data, but rather that these indices may differ in their interpretation because they assess the fit of the model from different perspectives [54]. On the other hand, some authors indicate that SRMR shows higher power to reject models that show poor fit to the data with ordinal responses (as in this case) because it is a standardized fit index, regardless of the number of parameters to be estimated and the sample size [55]. Furthermore, the tests of close fit based on the SRMR yield acceptable type I error rates, and SRMR tests of close fit are also more powerful even than those using the RMSEA. Therefore, the fit of the model can be evaluated, in this case, using the SRMR and the RMSEA, but specially by using the SRMR. For these reasons, we consider that the one-factor model for the HC-Pairs without items 1, 6 and 14 shows an acceptable fit to the data in both samples.

In Table 3 are shown the factor loadings for the final model in Colombia and Chile, the corrected homogeneity index for each item, and the reliability coefficients. All factor loadings were statistically significant. The CR index was satisfactory in both samples, but the AVE was under 0.50 in both cases.

In Table 4 are shown the results of the measurement invariance models by country. It can be seen an acceptable fit of the one-factor model without items 1, 6 and 14 in Chile, Colombia, and Spain. As can be seen, there is no scalar invariance since the cut-off criteria established by Cheung and Rensvold (2009) [51] are not met, so the means of these three countries cannot be compared. For this reason, we have proceeded to study the invariance between Colombia and Chile, since they are Latin American countries, and they have more cultural similarities. The results show the existence of scalar invariance between both countries, so it is possible to compare their means. After setting the latent mean for Colombia to zero, the contrast of hypotheses offered by Mplus confirms that there are no differences in beliefs between Colombia and Chile ($b = -0.116$, $z = -1.473$, $p = 0.141$).

5. Discussion

The objective of this work has been to adapt the Health Care Providers' Pain and Impairment Relationship Scale (HC-PAIRS) in Chile and Colombia, using samples of health personnel and university students from different health science degrees, given the lack of instruments in Latin America. In the original version by Rainville et al. (1995), the exploratory factorial solution yielded four factors. However, in their solution, two items had high factor loadings in two factors (items 9 and 11), so they should have been removed from one of the factors. The final result would have been one large factor of functional expectations and three small factors made up of only two items. In this sense, as a general rule, the more items that exist and accurately measure a factor, the more determined the factor will be and the more stable the factorial solution will be. Different studies indicate a minimum of 3 or 4 items per factor if a minimum of 200 cases is available. Otherwise, it is recommended to retain a greater number of items [56]. Thus, it seems reasonable to consider a one-factor solution as the closest.

Maybe for this reason, subsequent adaptations of this scale in other languages yield a one-factor solution as the best fit. Then, the one-factor solution was tested in the Colombian and Chilean samples. The results obtained indicate that, as we expected, we found adequate psychometric properties for the one-factor solution in the samples from both countries (Colombia and Chile), but after removing items 1, 6 and 14 in both samples. However, it is important to mention that in other countries there have also been problems with some items on this scale, advising the deletion of some of them, and not always the same ones. Item 14 is the one that usually presents greater fit problems in almost all previous studies, recommending its elimination. However, in no previous study is it proposed to remove items 1 and 6, as is this case. In the Chilean sample of this study, furthermore, items 6 and 14 not even show statistically significant factor loadings, and after their removal, item 1's factor loading was too low to contribute a significant amount of variance to the scale, so it had to be deleted too. For the Colombian sample something similar happen. In this sample, all factor loadings were

Table 4
Measurement invariance by country for the one-factor model without items 1, 6 and 14, and goodness-of-fit indices.[a]

Model	χ^2	*df*	$\Delta\chi^2$	Δgl	CFI	RMSEA	SRMR	ΔCFI	ΔRMSEA	ΔSRMR
Three countries										
Colombia	451.4[a]	54			0.818	0.089	0.065			
Chile	110.7[a]	54			0.808	0.074	0.067			
Spain	102.3[a]	54			0.799	0.073	0.067			
Configural	728.6[a]	162	–	–	0.814	0.090	0.066	–	–	–
Metric	745.9[a]	184	17.3	22	0.815	0.084	0.071	0.001	−0.006	0.005
Scalar	1072.9[a]	206	327	22	0.715	0.099	0.101	**−0.100**	**0.015**	**−0.030**
Colombia and Chile										
Configural	608.5[a]	108	–	–	0.815	0.091	0.065	–	–	–
Metric	612.4[a]	119	3.9	11	0.817	0.086	0.068	0.002	−0.004	0.003
Scalar	813.4[a]	130	201	11	0.747	0.097	0.091	−0.070	0.011	−0.023

Note: df = degrees of freedom; $\Delta\chi^2$ = Chi Square change; Δgl = degrees of freedom change; CFI = comparative fit index; RMSEA = Root-Mean-Square error of approximation; SRMR = Standardized Root-Mean-Square Residual; ΔCFI = CFI change; ΔRMSEA = RMSEA change; ΔSRMR = SRMR change.
[a] $p < .001$.

statistically significant, although it was observed that several modification indices showed very high values. These modification indices always affected item 6, so that if a correlation was considered between several pairs of items (6-1; 6–7; and 6–14), the fit of the model would improve (as it did). As indicated in the results, if we look at these items, we can see that the items 6 and 14 are reversed items. This could mean that these reversed items would be contributing variance to the scale not because of what is being measured, but because of the effect of the method. Although reversed items were included to avoid acquiescence bias in the responses of the participants, this practice is currently not recommended because it introduces a method effect (it is preferable to introduce distracting items, if necessary). In many studies, it has been seen that reversed items introduce a method effect, and this affects the reliability of the scale. That is, when a construct is measured, it is expected that the scores obtained with the items reflect the variability in the responses that people offer to that construct. However, introducing reversed items also introduce variance that comes from how the item has been written, not from what it is intended to measure [57,58]. Thus, the final composition of this scale is not very clear, since in all cases there are items that do not work as expected. All these inconsistencies regarding these items may be due to the fact that their content is not the same in each country.

On the other hand, it should also be noted that in both countries the value of the Composite Reliability index of the final one-factor structure (indicating the reliability of the scale) shows a good value in both samples, although the value of the Average Variance Extracted (indicating the proportion of variance explained by the final solution) it is not appropriate. This means that the final solution obtained does not explain too much variance of the construct that is intended to be measured. Perhaps the deletion of certain items produces a decrease in the explained variance, but it must be remembered that the deleted items are the reversed items, which in turn introduce a method effect. Probably keeping these items in the final structure would have explained more variance, but it would have been contaminated by the variance due to the method effect they introduce.

Although the fit of the model could have been improved by removing some other item, we decided to leave this final structure since the fit was acceptable in both samples, and at the same time it allowed us to carry out a study of measurement invariance by country (only possible with the same factor structure). The results obtained allow us to conclude that there is scalar invariance between Chile and Colombia. After comparing the total scores on the scale, the results show there are no differences between these two countries in the attitudes and beliefs of health care providers regarding the functional expectation of patients with chronic low back pain. However, no measurement invariance was observed between these two countries and Spain. It is possible that this is due to the characteristics of the Spanish sample since it is composed of physiotherapy students, and it was collected more than 10 years ago. However, in the Chilean sample nursing professionals predominate, and in the Colombian sample half are health professionals (very few physiotherapists) and the other half are students (not physiotherapists).

On the other hand, we should consider that most of the HC-PAIRS validation studies have been carried out with samples of physiotherapists, who tend to have a better appropriation of the biopsychosocial approach. In contrast, it has been found that other specialties tend to have an unifactorial vision of pain and base their approach on the biomedical model [59,60]. Students and professionals from other specialties predominate in our sample, which could indicate that the HC-PAIRS incompletely covers the beliefs about back pain in these professionals or students.

A possible explanation of the psychometric weaknesses detected in the HC-PAIRS could be the strategy followed for its construction since the author was limited to changing the wording of the items of the PAIRS scale that was originally created and validated for the evaluation of patients' beliefs. To construct the HC-PAIRS, the authors only replaced the first person with the phrase "patients with chronic back pain". However, although there is strong evidence that physicians' beliefs about back pain are associated with the beliefs of their patients [61], it is risky to assume they would be similar between patients and health professionals. In fact, various studies show that the myths about the association between chronic low back pain-disability-rest are increasingly being abandoned by health professionals, despite that they survive in the general population [62,63].

Health care providers' recommendations to their patients can significantly influence the clinical course of Low Back Pain (LBP) by shaping their attitudes and beliefs. When no specific spinal pathology is present, all Clinical Practice Guidelines (CPG) concur in advising patients to remain active despite experiencing pain, continue their usual activities, and promptly return to work. Importantly, engaging in physical activity does not worsen chronic low back pain. The CPG strongly strongly recommend that patients with LBP should avoid rest, maintain a high level of activity despite the pain, and promptly resume work, even if pain persists. The beliefs and attitudes that hold the health care providers about the relation between pain and impairment, and their own fear avoidance beliefs are important predictors of their recommendations for work and activity [62].

Thus, the HC-PAIRS questionnaire plays a crucial role in identifying physicians who hold inaccurate beliefs (such as the notion that limiting activity is essential when experiencing pain). Those with higher scores in this questionnaire may provide incorrect advice to patients, contrary to the evidence-based recommendations provided by the CPG. In such cases, it would be beneficial to conduct educational interventions aimed at updating these professionals and aligning their practices with current evidence.

5.1. Limitations and future studies

The limitations of this study should also be mentioned. On the one hand, the samples are quite different among the three countries, since the Spanish sample is made up of physiotherapy students, the Chilean sample is mostly composed of nurses, and the Colombian sample is made up of almost equal parts by health professionals and students. Furthermore, the sample sizes are very different, which may influence the correct estimation of the existence of measurement invariance.

Web-based surveys have some risks, including sample bias and decepting practices such as participants providing duplicate responses, submitting fraudulent information, or deliberately making erroneous responses. As in a great number of research that use this strategy to collect information [64], in this study was not possible to avoid or detect potential biases due to these risks. On the other

hand, sometimes there is a low response rate. However, the LimeSurvey program that we use allows you to establish the obligation to answer all the questions on a page before moving to the next. In this way we ensure the answers to all the items. Certainly, there are people who decide to stop responding at some point, and therefore from that moment on there are no longer responses. However, since it was a fairly short survey, almost all people responded to all the items. Likewise, you can enter a captcha to avoid repeat responses from the same user. However, we highly doubt that a person will decide that they want to answer the same survey several times, when we already know how difficult it is to get people's participation, especially if they are professionals who are working and respond in their workplace.

There are other existing limitations that need to be emphasized. Specifically, the study focused on factorial structure and reliability but did not investigate other relevant psychometric properties such as concurrent validity, discriminant validity, convergent validity, predictive validity, and test-retest reliability. In that sense, it is recommended future studies include strategies to assess these aspects.

In future studies, it would also be convenient to analyze the functioning of the response scale of the questionnaire. Different investigations have shown that a Likert-type scale with more than 6 response options can affect the reliability of the scale due to the use of a middle response category [65,66] (García-Pérez, 2017; González-Romá et al., 2003). Likewise, the verbal anchors used can influence the responses of the participants, since they can sometimes be interpreted or understood in different ways, and this would affect the validity of the measurement instrument. It would also be convenient to carry out more studies on the validity of this questionnaire, and to verify the possible differences in the beliefs towards the treatment of chronic low back pain between students and health personnel, as well as among different health professionals (like physicians, nurses, or physiotherapists).

On the other hand, a major recommendation derived from this research is the need to use HC-PAIRS to assess health professionals regarding the erroneous belief that chronic low back pain is associated with incapacity and the need to rest and avoid activities. This scale is not useful to assess other types of mistaken beliefs about chronic other types of chronic pain. And last, but not least, other important recommendation is the need for education in the correct management of chronic low back pain for health personnel and health university students.

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Data availability statement

The data that support the findings of this study are openly available Zenodo at https://doi.org/10.5281/zenodo.11094549.

CRediT authorship contribution statement

M. Martin-Carbonell: Writing – review & editing, Writing – original draft, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **D. Sequeira-Daza:** Writing – review & editing, Methodology, Investigation, Conceptualization. **I. Checa:** Writing – review & editing, Methodology, Investigation, Formal analysis, Conceptualization. **J. Domenech:** Writing – review & editing, Methodology, Investigation, Conceptualization. **B. Espejo:** Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **G. Castro-Melo:** Writing – review & editing, Methodology, Investigation.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

Dr. Begoña Espejo and Dr. Irene Checa, co-authors of this manuscript, hold an editor position at Heliyon.

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