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Spanish validation of the cardiac self-efficacy scale: a gender invariant measure

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ABSTRACT

The aim is to validate the Spanish version of the Cardiac Self-Efficacy (S-CSE) Scale by examining its psychometric properties and to test the invariance for women and men. Two groups – 722 and 522- of patients completed the S-CSE Scale and other psychosocial measures during a medical revision several months after being diagnosed with cardiovascular disease. Construct validity was psychometrically evaluated using exploratory factor analysis (EFA) with a split of the first sample and confirmatory factor analysis (CFA) with a second split of the same sample. Scale structure was confirmed using the second sample. Convergent, discriminant, and external validity were tested. Results revealed that the S-CSE Scale was represented by three dimensions (*control symptoms*, *control illness, maintain functioning*) obtaining excellent reliability indexes and it appeared to be invariant for women and men. The S-CSE scale is a useful tool for monitoring the general well-being of these patients to promote individualized interventions.

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Cardiac self-efficacy; Sullivan's scale; Spanish version; validity; gender invariant measure

Introduction

Cardiovascular disease (CVD) is the leading cause of death in the world, with 17.9 million deaths annually (Roth et al., 2018). In Europe, CVD causes about four million deaths every year, accounting for 45% of all deaths according to the European Heart Network (Wilkins et al., 2018). The trend is the same in Spain, where CVD is the main cause of death and responsible for 32.3% of all deaths (INE, 2018). According to the INE, women are almost twice as likely to die from heart failure as men. This gap also manifests itself in total cardiovascular mortality. Although the study by Raeisi-Giglou et al. (2018) highlights the recent significant progress made in improving care, clinical decision-making and policy implications for women with CVD, sex differences could explain different prevalence rates, symptom profiles and even medical outcomes.

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Although Spain has traditionally been one of the countries with the lowest rates of heart disease (mainly due to the positive influence of the Mediterranean diet), we have experienced a significant change in the prevalence and incidence of CVD. A sedentary lifestyle, the abandonment of the Mediterranean diet and an increase in obesity are among the factors that have substantially changed the map of CVD in Spain (Abellán Alemán et al., 2016). Initiatives such as EuroAction (Wood et al., 2008) have emphasized the importance of carrying out a multidisciplinary effort to modify the lifestyle of high-risk individuals and treat their risk factors.

Some researchers have recently found that cardiac patient adherence to a medication regime or level of recovery after transplantation, for example, is influenced by self-efficacy beliefs (Almgren et al., 2021; Meslot et al., 2017). Self-efficacy levels for specific cardiovascular health – related behaviours, such as cardiovascular treatment and activity, are important determinants of cardiovascular health (Dorough et al., 2014). The study of self-efficacy applied to CVD has generated great interest in the prevention of future cardiac events, because it has been shown that self-efficacy plays a relevant role in the recovery from and maintenance of CVD (Brink et al., 2012). From Bandura's theoretical framework, self-efficacy has major implications for the mechanisms through which therapeutic procedures alter behavioural functioning. It is conceptualised as determinant of how much effort people will expend and how long they will persist in the face of obstacles and aversive experiences (Bandura, 1977).

Previous studies have shown that high levels of self-efficacy are associated with beneficial results during cardiac recovery, which are related to a healthier lifestyle (Sol et al., 2011), disease management behaviours, well-being and quality of life (Joekes et al., 2007). Meanwhile, low levels of self-efficacy have been related to an increase in symptoms, as well as greater deterioration in health and quality of life (Sarkar et al., 2007). Low self-efficacy was also found to be an indicator for predicting an increased risk of heart failure and hospitalization (Sarkar et al., 2009).

Psychological factors, and self-efficacy in particular, have an important role in the functional status and quality of life of patients with CVD (Allahverdipour et al., 2013). It is thus necessary to emphasize the evaluation of self-efficacy in supportive and complementary programmes to promote cardiac rehabilitation. To examine the role of self-efficacy in addressing the challenges that arise as a result of CVD, regarding function and symptoms interpretation, the Cardiac Self-Efficacy Scale (CSE Scale) was developed (Sullivan et al., 1998). CSE refers to a person's confidence in his/her ability to manage illness-specific outcomes. The CSE Scale consists of two dimensions: the first represents a person's confidence that he/she can control symptoms (eight items) and the second a person's confidence that he/she can maintain functioning (five items). The CSE Scale has been used in patients with CVD to evaluate correlations between CSE Scale scores and readmission to hospital (Sarkar et al., 2009), health status (Sarkar et al., 2007), and additional predictors (Kang & Yang, 2013). It has been used in its entirety (Kang & Yang, 2013), as well as in part (Lauck et al., 2009). The maintain functioning dimension has been used more frequently than the controlling symptoms dimension (Sarkar et al., 2007, 2009). The scale was validated in Sweden based on three components: controlling symptoms (four items), controlling illness (three items), and maintaining functioning (five items), with a general factor of global cardiac self-efficacy (Fors, Ulin, et al., 2015).

Subsequently, it was translated and psychometrically tested with Chinese patients with the same structure (Zhang et al., 2018).

In contrast to other self-efficacy scales for CVD patients (Maeda et al., 2013), the CSE Scale measures aspects that are not strictly related to disease management, such as the maintenance of social relationships and the maintenance of activities at work in a parsimonious way. A longitudinal study (O'neil et al., 2013) has shown that higher CSE scores at baseline significantly predicted better cardiac functioning and self-rated mental and physical health at both T2 and T3; higher CSE scores resulted in reductions in the likelihood of hospital admissions. CSE at Time 1 has also been shown to have a positive longitudinal effect on perceived health-related quality of life (HRQoL) at Time 2 (Tabernero et al., 2019).

As highlighted at the beginning, women and men are differently exposed to CVD. There are several studies showing that the risk of CVD in women is often underestimated (Gao et al., 2019), and clinical manifestations also differ between men and women (Grazzi et al., 2020). Moreover, differences in psychosocial factors have been shown in coping with stress, depression and anxiety disorders, associated with a greater risk of CVD among women than among men (Low et al., 2010). The World Health Organization (WHO, 2014) warns that modifying one's lifestyle could prevent more than three quarters of all deaths from CVD. Thus, there is a documented need to create interventions as part of the programmes for the rehabilitation and treatment of specific CVD for women using a gender approach (Luque et al., 2020).

Based on the aforementioned evidence, this study sought to validate and test a gender invariant measure of a Spanish version of the CSE (S-CSE) Scale, examining the internal structure of the scale using exploratory (EFA) and confirmatory factor analyses (CFA) with two different samples of CVD patients and testing convergent, discriminant and external validity. Following previous validation of the CSE Scale in a European country (Fors, Ulin, et al., 2015) the present study hypothesized that: (a) the 13-item S-CSE Scale will represent three dimensions: control symptoms, control illness and maintain functioning; (b) the S-CSE Scale will be positively correlated with the Heart Failure Self-Efficacy Scale (Maeda et al., 2013), Global Life Satisfaction and General Health and negatively correlated with Negative Affectivity and Negative Outcome Expectations; and (c) the S-CSE Scale will show a gender invariant structure.

Method

Participants and procedure

The study sample consisted of CVD patients given that they had already suffered a first cardiac event and were a part of the CORDIOPREV study at the Reina Sofia University Hospital of Córdoba and IMIBIC (Instituto Maimónides de Investigación Biomédica de Córdoba) (Delgado-Lista et al., 2016). According to the inclusion/exclusion criteria of the primary study, all participants had an established coronary heart disease (unstable coronary disease, acute myocardial infarction, unstable angina, or chronic coronary disease at high risk for event) without clinical events in the last 6 months (Delgado-Lista et al., 2016). Exclusion criteria included a life expectancy of less than 5 years or presenting chronic or severe disease such as psychiatric ones, uncontrolled diabetes

Table 1. Socio-demographic characteristics of patients in sample 1 $N = 722$) and sample 2 ($N = 522$).

		Sample 1 (N = 722)		Sample 2 (N = 522)	
Variables		N	%	N	%
Educational level	Early childhood education	129	17,9	1	0,2
	Primary or basic education	355	49,2	12	2,3
	Secondary education	90	12,5	289	55,4
	Vocational school	72	10	204	39,1
	College/University	76	10,5	16	3,1
Employment status	Unemployment	57	7,9	27	5,2
	Part-time job	23	3,2	16	3,1
	Full time job	143	19,8	110	21,1
	Retired	499	69,1	341	65,3
Partner	Yes	644	89,2	466	89,3
	No	78	10,8	56	10,7
Marital status	Single	29	4,0	-	-
	Common-law partner	10	1,4	-	-
	Married	609	84,3	-	-
	Separated	15	2,1	-	-
	Divorced	23	3,2	-	-
	Widow/er	36	5,0	-	-
Economic level	Less than<10.800 €	213	29,5	7	1,3
	10.800–22.000 €	303	42,0	75	14,4
	22.000–43.000 €	112	15,5	407	78,0
	More than 43.000 €	25	3,5	33	6,3
	NR/DK	68	9,4	-	-

mellitus or endocrine disorders. Participants in our study were 722 (114 women, 608 men; mean age = 64.37, SD = 9.00) and 522 patients (72 women, 450 men; mean age = 64.54, SD = 9.13). Socio-demographic characteristics are included in Table 1. The study was approved by the Research Ethics Committee of the local government and the hospital where the patients were attended (30 June 2015) and the study conforms to the principles outlined in the Declaration of Helsinki (World Medical Association, 2001). Participation was totally anonymous and voluntary, and participants were informed of the objectives of the research before they provided consent for participation. Participants used a tablet computer to respond to a series of questionnaires created using Unipark (v. 10.9).

In both samples, participants also answered the Heart Failure (HF) Self-Efficacy Scale, which was considered appropriate for testing convergent validity (Nunnally & Bernstein, 1994), because it is supposed to measure a similar construct. Negative Affectivity and Negative Outcome Expectations (only in sample 1) were considered appropriate for testing discriminant validity (Nunnally & Bernstein, 1994). These scales were chosen because we considered it theoretically probable that a person who rates high on negative affect or has negative expectations will rate low on CSE (Bandura, 1977, 2004). Finally, Global Life Satisfaction and Global Health were considered appropriate for testing external validity (Nunnally & Bernstein, 1994), because CSE has been shown to affect health status and quality of life in CVD patients.

Instruments

Cardiac self-efficacy

The original CSE Scale consists of 13 items in English (Sullivan et al., 1998) in which patients were asked to rate: '*how confident are you that you know or can . . .* ' on a five-point Likert scale (0 = not at all, 1 = somewhat confident, 2 = moderately confident, 3 = very confident, 4 = completely confident). The CSE Scale includes two dimensions

(control symptoms and maintain functioning) and demonstrated high internal consistency measured by Cronbach's alpha (0.90 and 0.87, respectively), as well as good convergent and discriminant validity when examined in relation to outcomes from similar and dissimilar scales. The control symptoms dimension consists of eight items (e.g. '*How confident are you that you know how to take your cardiac medication*'). The maintain functioning dimension consists of the remaining five items and captures patient confidence that they could maintain their level of functioning (e.g. '*How confident are you that you can maintain your usual social activities*'). It has been used in other non-English speaking countries (Allahverdipour et al., 2013; Fors, Ekman, et al., 2015; Kang & Yang, 2013; Loo et al., 2016).

To measure cardiac self-efficacy in a Spanish population, the CSE Scale was translated from English to Spanish. The forward translation into Spanish was carried out independently by two Spanish-speaking researchers within the research field. This resulted in a preliminary Spanish version of the CSE Scale based on a synthesis of these two translations. Then, a researcher who is a native speaker of English performed the backward translation into English and discrepancies were resolved. The five-point Likert scale was transformed into a seven-point Likert scale (from 1 = 'not at all confident' to 7 = 'totally confident') to be similar to the rest of measures in the questionnaire used in our samples, with higher scores indicating higher self-efficacy. The response alternative 'non applicable' was also removed as all the items were considered applicable for these samples.

Heart Failure (HF) self-efficacy scale

The HF Self-Efficacy Scale is a 17-item questionnaire that was constructed to assess the patient's degree of confidence in his/her abilities to follow treatment recommendations (Maeda et al., 2013). Items examine participants' confidence in carrying out adherence behaviours in domains targeted for intervention, such as diet, exercise, stress management and other lifestyle changes. In this research a shortened version with 10 items was used and the response scale was from 1 'no confidence' to 7 'total confidence' (e.g. '*How confident I was in my ability to . . . take my medication*'). The total score was an average across items applicable to each participant, with higher scores indicating higher self-efficacy. Internal consistency reliability was high (Cronbach's $\alpha = .78$) for the first sample and for the second one (.80).

Global life satisfaction

This was measured with the Satisfaction with Life Scale (Diener et al., 1985), an instrument psychometrically sounded for its use with patients with cardiovascular disease (Apers et al., 2016; Moons et al., 2005). Participants responded to five items (e.g. '*In most ways life is close to my ideal*') on a seven-point Likert scale (1 = 'Strongly disagree'; 7 = 'Totally agree'), with higher scores indicating higher global life satisfaction. The Cronbach's alpha coefficient for this measure was .86 for the first and second samples.

Global health

Participants' perceptions of their health were evaluated using a Spanish version of the Short-Form 12 (SF-12) health survey in coronary patients (Failde et al., 2010). Participants responded to 12 items (e.g. '*In general, how would you say your health is?*')

on a 7-point Likert scale. This internationally used measure has shown good psychometric values for evaluating subjective health functions in cardiac patients (Abu et al., 2018). Higher scores show better health status. Reliability was high (α = .81 in sample 1; α = .82 in sample 2).

Negative affectivity

We used a short version of the Negative Affect Scale (PANAS) (Watson et al., 1988). The PANAS has previously been used with individuals with CVD (Hu & Gruber, 2008). Participants responded to five items using a seven-point Likert scale (1 = 'strongly disagree'; 7 = 'strongly agree') to indicate the extent to which each item represented how they felt at that moment (e.g. *nervous*). The Cronbach's alpha coefficients for this measure were .80 and .83 for sample 1 and 2, respectively.

Negative outcome expectations

This scale measures the expectations towards integrating healthier nutrition in the diet, one of the most important aspects in the treatment of CVD (Anderson et al., 2007). This scale includes items reflecting negative physical outcomes (i.e. immediate sensory experiences such as taste), social outcomes (i.e. devoting too much time and energy to nutritional goals) and self-evaluative outcomes (i.e. emotional responses to change) answered on a seven-point Likert scale (from 1 = 'strongly disagree' to 7 = 'totally agree'; e.g. '*I will be hungrier*'), with higher scores indicating higher negative expectations. The Cronbach's alpha coefficient for this measure was .73. This scale was used only in sample 1.

Statistical analyses

The CSE Scale was completed by the present study samples (sample 1: $N = 722$; sample 2: $N = 522$), and we psychometrically evaluated the dimensionality of the scale using EFA and CFA. To examine construct validity through EFA and CFA, we first randomly divided sample 1 into two subsamples (split 1: 383 participants and split 2: 339 participants). With the first subsample, we carried out EFA with varimax rotation and using the principal components method to identify subscales within the item pools and, following Fors, Ulin, et al. (2015) and Zhang et al. (2018) found three dimensions in the scale differing from the original scale. The suitability of using factor analysis was assessed using Bartlett's Test of Sphericity (BTS) and the Kaiser – Meyer–Olkin (KMO) statistic. A KMO value of 0.50 or higher is considered acceptable for a satisfactory factor analysis to proceed (Williams et al., 2010). For the BTS, a p value of 0.05 or smaller serves as the criterion for indicating that implementation of factor analysis is possible (Bartlett, 1954).

Afterwards, we performed a CFA with the second subsample ($n = 339$) of the sample 1, using Amos.23. As the chi-square ($\chi 2$) is highly sensitive to the sample size, not too much emphasis was placed on its significance (Schermelleh-Engel et al., 2003), and in counterpart we tested the goodness-of-fit index (GFI), the adjusted goodness-of-fit index (AGFI), the comparative fit index (CFI), the root-mean-square error of approximation (RMSEA) the standardized root mean squared residual (SRMR) and the Tucker-Lewis index (TLI). For interpreting the goodness of fit of the different indices, we used the rules of thumb recommended by Schermelleh-Engel, Moosbrugger and Müller (Schermelleh-

Engel et al., 2003). Values for CFI can range from 0–1, where values over 0.9 are indicative of an acceptable fit, and for an excellent fit, CFI values should be over 0.95. A model that exhibits an acceptable fit should have an RMSEA below 0.08 to be acceptable, whereas to be good, the RMSEA should be below 0.05. The SRMR is considered to indicate a good fit if the value is below 0.08 (Brown, 2006). The factorial structure of the Spanish version of the scale was tested again through CFA analysis with sample 2 ($n = 522$).

To explore the validity of the final scale, correlations between the CSE Scale (and its subscales) and other variables were examined in samples 1 and 2 to determine the consistency of the relationships. Convergent, discriminant and external validity were tested using Pearson's correlation coefficient. Missing data were replaced with the mean.

Results

Exploratory factor analysis

The KMO index (0.85) and BTS ($\chi 2 = 1893.30$; $df = 78$; $p < 0.001$) supported the use of EFA with the first subsample from sample 1 ($n = 383$) and the 13 items from the original scale (Sullivan et al., 1998). The EFA, performed with varimax rotation showed three factors with a balanced factorial structure (see Table 2). These factors explained 61.13% of variance with a Cronbach's alpha value of .84. Factor 1, defined as 'Control Illness', explained 24.24% of the variance, and it was composed of three items from the original eight item-dimension 'Control Symptoms'. Factor 2, defined as 'Control Symptoms', explained 21.32% of the variance and was composed of four items from the original eight item-dimension 'Control Symptoms'. Finally, Factor 3, defined as 'Maintain Functions', explained 15.57% of variance and was composed of five items, four from the original five item-dimension 'Maintain Functioning' and one from the original eight item-dimension 'Control Symptoms' (item 8). In this case we decided to remove item 10 because it does not conceptually fit within the factor where its load is higher. This final structure is similar to Fors, Ulin, et al. (2015) version of the scale, confirming Hypothesis 1.

Confirmatory factor analyses

To test the new dimensionality of the scale, we conducted CFA with the second subsample of the sample 1 ($n = 339$). The model was built with one latent variable for each of the three dimensions (control symptoms, control illness and maintain functions) and one general factor (see Figure 1). Consequently, a three-factor model was tested, resulting in excellent Chi Square values ($\chi 2(gl = 44) = 84.828$, $p < .001$), CFI (0.972) and GFI (0.960), good SRMR (0.039), AGFI (.929) and TLI (.958) and a good RMSEA (0.052 [0.035–0.069]).

To confirm the structure of the Spanish version of the scale, we conducted another CFA with sample 2 ($n = 522$). We found a complete confirmation of the previous model (see Figure 2), with excellent Chi Square values ($\chi 2(gl = 44) = 107.115$, $p < .001$), CFI (0.972) and GFI (0.968), good SRMR (0.038), AGFI (.944) and TLI (.959) and a good RMSEA (0.052 [0.040–0.065]).

Table 2. Results of the exploratory factor analysis of the cardiac self-efficacy scale (12 items, after eliminating item 10) from (Sullivan et al., 1998) and psychometric properties of the items: factor loading and reliability estimates ($n = 383$).

				Psychometric properties		
Items *How confident are you that you know or can: [¿En qué medida se siente capaz de . . .]*	F1. Control Illness	F2. Control Symptoms	F3. Maintain functions	*M* (SD)	Corrected item total correlation	Alpha if item deleted
1.Control your chest pain by changing your activity levels [Controlar su dolor de pecho cambiando sus niveles de actividad]		.854		5.39 (1.52)	.58	.83
2.Control your breathlessness by changing your activity levels [Controlar su dificultad para respirar cambiando sus niveles de actividad]		.804		5.37 (1.43)	.62	.82
3.Control your chest pain by taking your medications [Controlar su dolor de pecho tomando su medicación]		.662		6.07 (1.29)	.55	.83
4.Control your breathlessness by taking your medications [Controlar su dificultad para respirar tomando su medicación]		.739		5.76 (1.50)	.56	.83
5.When you should call or visit your doctor about your heart disease [Saber cuándo debería llamar o visitar a su médico/a por su enfermedad cardíaca]	.711			5.91 (1.35)	.51	.83
6. How to make your doctor understand your concerns about your heart [Hacerle entender a su médico sus preocupaciones sobre su corazón]	.639			5.96 (1.26)	.62	.83
7.How to take your cardiac medications [Saber cómo tomar su medicación para el corazón]	.718			6.56 (0.95)	.52	.83
8.How much physical activity is good for you [Saber cuánta actividad física es buena para usted]			.490	5.71 (1.47)	.52	.83
9.Maintain your usual social activities [Mantener sus actividades sociales habituales]			.406	5.84 (1.31)	.60	.83
10.Maintain your usual activities at work [Mantener sus actividades cotidianas o laborales habituales]			.498	5.86 (1.45)	.59	.83
11.Maintain your sexual relationship with your partner [Mantener relaciones sexuales con su pareja]			.675	4.72 (2.08)	.35	.85
12.Get regular aerobic exercise (work up a sweat and increase your heart rate)[Practicar ejercicio hasta sudar y aumentar su ritmo cardíaco]			.817	4.26 (1.92)	.36	.85
Scale reliability estimates	F1	F2	F3			
Cronbach's alpha values	.74	.84	.71			
Percentage of explained variance	24.24	21.32	15.57			

Convergent, discriminant and external validity

The analysis of convergent, discriminant and external validity confirmed the second hypothesis, that the CSE Scale was associated with other variables in the expected direction. The correlation analyses were performed in both samples showing similar results. First, the three subscales – control symptoms, control illness and maintain functioning – and the total summary score were negatively correlated with the Negative Affectivity scale and with Negative Outcome Expectations (see Table 3). The three CSE Scale dimensions and the scale as a global cardiac self-efficacy dimension were positively correlated with the HF Self-Efficacy Scale. It correlated most strongly with the global cardiac self-efficacy dimension in both samples (see Table 3). Global life satisfaction and general health correlated positively with the three dimensions and the global

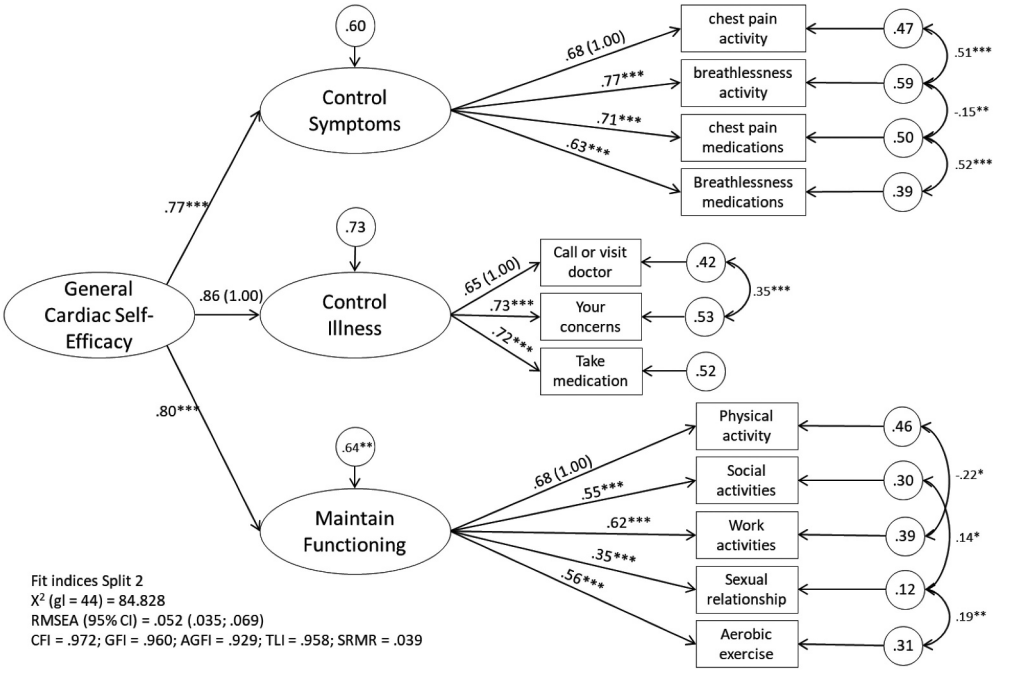

Figure 1. Model structure of the Spanish version of the cardiac self-efficacy scale (S-CSE) (Split 2 of sample 1, $n = 339$).

factor in both samples; this relationship was stronger with the dimension of maintain functions, except for sample 2 and global life satisfaction. In general terms, Hypothesis 2 was confirmed.

Gender invariance

To test measurement invariance across gender, fit indices of the overall sample, of the men sample and of the women sample were tested, and unconstrained and fully constrained models were compared (see Table 4 for Chi Square values and fit indices). Fit indices for all models were excellent. The results showed that the difference between the unconstrained and fully constrained models was non-significant ($\Delta\chi 2(11) = 16.753$, $p = .115$) indicating that the S-CSE Scale is invariant for women and men.

Discussion

The aim of this study was to adapt and validate the CSE Scale for Spanish CVD patients. The first goal was to provide a psychometrically sound scale to assess the level of confidence patients have in their ability to manage aspects of their life and care related to their illness. The second goal was to achieve a gender invariant measure which might provide an equally valid tool for women and men.

This study has shown that cardiac self-efficacy is a multidimensional construct. Both EFA and CFA analyses confirmed a robust adjustment for a three-dimension structure

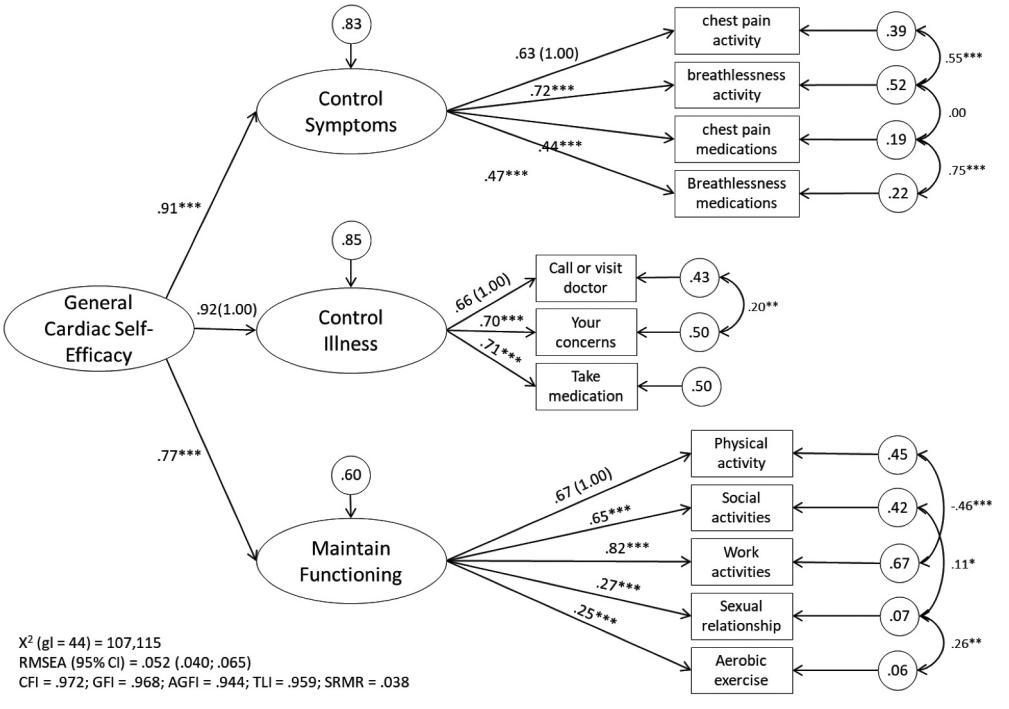

Figure 2. Confirmation of the model structure of the Spanish version of the cardiac self-efficacy scale (S-CSE) (Sample 2, $n = 522$).

Table 3. Correlations between the dimensions of the Spanish version of the cardiac self-efficacy scale (S-CSE Scale) and other measured variables (convergent, discriminant, and external validity).

	1	2	3	4	5	6	7	8	9
1.Control symptoms	-	.523**	.387**	.789**	.442**	−.159**	–	.239**	.202**
2.Control illness	.494**	-	.464**	.739**	.423**	−.172**	–	.256**	.181**
3.Maintain functions	.429**	.493**	-	.840**	.430**	−.249**	–	.314**	.428**
4.Global Cardiac Self-Efficacy	.789**	.737**	.860**	-	.540**	−.252**	–	.342**	.369**
5.Heart Failure Self-Efficacy Scale	.530**	.468**	.548**	.647**	-	−.206**	–	.381**	.348**
6.Negative Affectivity	−.060	−.104**	−.150**	−.138**	−.140**	-	–	−.339**	−.489**
7.Negative Outcome Expectancies	−.142**	−.106**	−.105**	−.112**	−.189**	.154**	-	–	–
8.Global Life Satisfaction	.189**	.154**	.331**	.302**	.345**	−.223**	−.087*	-	.463**
9.SF−12 Health Survey	.266**	.209**	.516**	.452**	.367**	−.298**	−.193**	.380**	-
Mean (SD) Sample 1	5.66 (1.17)	6.20 (0.94)	5.43 (1.05)	5.68 (0.86)	5.55 (0.95)	2.66 (1.21)	3.15 (1.26)	5.13 (1.33)	46.88 (9.97)
Mean (SD) Sample 2	5.75 (1.14)	6.33 (0.86)	5.67 (0.96)	5.85 (0.80)	5.67 (0.90)	2.38 (1.21)	–	5.26 (1.33)	48.29 (10.86)

*p<.05, **p<.01.
Lower triangle depicts correlations in sample 1 (n = 722) and upper triangle correlations in sample 2 (n = 522). Negative Outcome Expectations were not assessed in Sample 2.

with a global score. In contrast with the original scale from Sullivan et al. (1998) and similarly to the Swedish and Chinese versions (Fors, Ulin, et al., 2015; Zhang et al., 2018), the Spanish validation shows three different dimensions: control illness, control symptoms and maintain functions. However, as opposed to these previous versions, we deleted

Table 4. Fit indices and Chi Square values of the compared models for gender invariance assessment.

Model	$\chi 2$	*Df*	p	CFI	GFI	SRMR	AGFI	TLI	RMSEA (95%CI)
Original model (Overall sample; $n = 722$)	112.254	44	.001	.978	.974	.032	.954	.967	.046 [.036; .057]
Men ($n = 608$)	130.923	44	.001	.969	.965	.036	.938	.954	.057 [.046; .068]
Women ($n = 114$)	55.527	44	.114	.968	.930	.060	.876	.952	.048 [.001; .084]
Multigroup unconstrained model	186.639	88	.001	.969	.960	.060	.928	.954	.039 [.032; .047]
Multigroup fully constrained model	203.392	99	.001	.967	.956	.067	.931	.956	.038 [.031; .046]

the item 10 (*Maintain your usual activities at home with your family*) and not item 8 (Fors, Ulin, et al., 2015) or item 12 (Zhang et al., 2018). This item was linked to activities that probably were not very affected by the disease, or not for most of participants with less severe symptoms. The first dimension (*control illness*) was composed of three items, the second dimension (*control symptoms*) was composed of four items and the third dimension (*maintain functions*) was composed of five items. It is valuable to mention that, in our sample, the first dimension to appear was Control Illness, and it was the dimension with higher scores in both samples. These items are more focused on how to control illness through contact with health care professionals and taking daily medications. This should be considered when designing rehabilitation programmes and the role of practitioners in the behaviour change management for these patients. In this sense, practitioners could have an important role in the detection of deviations in the adherence to treatment or in the resolution or clarification of possible doubts in these patients, which could help them to follow the rehabilitation programmes.

The structure of the scale was confirmed twice with CFA in two samples, obtaining excellent fit in both cases. The possibility to use each dimension of the scale or the global measure provides a useful tool in clinical practice to monitor motivation to address new life habits. Self-efficacious patients feel more motivated to adhere to lifestyle modifications (Castillo-Mayén et al., 2020).

The convergent, discriminant and external validity of the scale was assessed through the relationships with different measures. As expected, we found the global CSE scale and the three dimensions to be positively correlated with HF Self-Efficacy scale, global life satisfaction and global health, and negatively correlated with negative affectivity and negative outcome expectations. In accordance with previous studies (Allahverdipour et al., 2013; Sarkar et al., 2007), results have shown that the more confident individuals are in their ability to control symptoms, control illness and maintain functions, the higher their global life satisfaction and perceived health. Further, cardiac self-efficacy has proved to determine quality of life (Barham et al., 2019).

The S-CSE scale also showed negative relationships with negative outcome expectations and negative affectivity. Outcome expectations, or the anticipated consequences of an individual's behaviour, are an important construct within social cognitive theory (Bandura, 2004) that has often been overlooked in the cardiac rehabilitation context (Blanchard et al., 2015). Outcome expectations are dependent on the individual's efficacy beliefs and serve as incentives (or disincentives) for healthier choices (Anderson et al., 2007). In the same vein, cardiac self-efficacy might reverse the detrimental effect of negative emotions on behavioural factors such as smoking, diet, exercise and compliance with medical care, thus increasing the possibilities to reduce the risk of cardiovascular morbidity and mortality (Sirois &

Burg, 2003). In summary, analyses have provided reasonable evidence for the reliability and validity of the S-CSE scale. Cardiac self-efficacy is important for future interventions with cardiac patients, as it could increase the achievement and maintenance of healthy behaviours, as suggested by the European cardiovascular prevention guide (Piepoli et al., 2016). Likewise, there is evidence of self-efficacy for the management of CVD (Mares et al., 2020; Rajati et al., 2014; Steca et al., 2015), if patients with CVD trust in their ability to manage their disease, by following medical recommendations, controlling symptoms of disease and knowledge of risk factors, they will have a better quality of life.

One of the most important results of this study was that the S-CSE showed excellent and similar fits for both female and male patients. To have a gender invariant measure of cardiac self-efficacy will help practitioners and CVD patients to monitor advances in the disease and design personalized healthcare. As Gao et al. (2019) highlight, the consideration of gender differences is relevant for the treatment and management of CVD. As it was highlighted previously, women are almost twice as likely to die from heart failure as men. Some studies have shown the gap in clinical decision-making and medical outcomes (e.g. Raeisi-Giglou et al., 2018). This invariant scale could guarantee to equally detect possible deviations in the adherence to treatments in women and men which can help especially female patients.

Finally, some limitations can be identified. Although the sample size was adequate and allowed for the development of a valid and psychometrically sound scale, and although the results of this study are encouraging, the data are cross-sectional in nature. In future research, studies should be conducted longitudinally. In this sense, the stability of the S-CSE is not confirmed, as we did not carry out test-retest reliability in the current study. Future studies to examine the temporal stability of the S-CSE are recommended. Moreover, in the same samples there were patients with different levels of severity of their CVD. In this sense, the instrument needs to be evaluated in separated groups of patients to confirm that it is valid and reliable in different phases of the disease and for different conditions.

In summary, the absence of scales to measure cardiac self-efficacy for the Spanish population justifies the relevance of this study. The proposed structure of the scale provides practitioners with a relevant tool for assessing cardiac self-efficacy, which will then help them in their prediction of the real functioning of CVD patients and the need of complementary programmes to motivate them to adhere to healthy habits. The S-CSE scale might be a useful tool to detect issues during behavioural changes in CVD patients, both for women and men.

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AA, EC, CT, BL, RC-M, SJR, and TG-D contributed to the development of the study concept and design. GQ-N and PP-M comanaged the access to participants from the primary study. AA and TG-D contributed to data acquisition. AA, EC and CT contributed to data analysis and interpretation. AA, EC and CT drafted the paper. AA, BL, RC-M, GQ-N, PP-M, and SJR contributed to critical revision of the manuscript. BL contributed to project administration. CT and BL obtained funding acquisition. All authors approved the final version of the paper for submission.

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