Life Span and Disability XXIV, 2 (2021), 177-200

Persian version of the Center for Epidemiologic Studies Depression Scale: Factor structure and psychometric properties in patients with Chronic Low Back Pain

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Abstract

The aim of the current study was to investigate the factor structure, reliability, and validity of the Center for Epidemiologic Studies Depression Scale in patients with Chronic Low Back Pain.
The data of 100 patients was obtained through consecutive sampling in the north of Iran. As a first step, an Exploratory Factor Analysis was conducted and the internal consistency reliability was calculated. A test-retest reliability was further evaluated after one month (n = 20). Lastly, three competing models with 10 items and one factor, 10 items and two factors, and 8 items and one factor were tested through Confirmatory Factor Analysis with another separate sample group (n = 151). In order to determine the validity of the criterion used, the patients were asked to complete the Visual Analogue Scale, the 18-item Roland-Morris Disability Questionnaire, and the 6-item Pain Self-efficacy Scale.
Two factors were extracted from the Center for Epidemiologic Studies Depression Scale, namely the depressed affect and the positive affect. The test-retest reliability was obtained equals to .71. The scores of the Center for Epidemiologic Studies Depression Scale were correlated with

Received: November 23, 2020; *Revised:* June 12, 2021; *Accepted:* November 10, 2021

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Acknowledgments: The author would like to thank the physicians and medical personnel of the Emam Reza Clinic in Rasht (Iran) for their support in assisting with the psychological evaluations of the CLBP patients.

Disclosure statement: No potential conflict of interest was reported by the author.

the 18-item Roland-Morris Disability Questionnaire and the 6-item Pain Self-efficacy Scale in the expected positive and negative directions, respectively. The Confirmatory Factor Analysis demonstrated that the most appropriate structure for patients with Chronic Low Back Pain had one factor (depressed affect) and 8 items.

The Persian version and the 8-item Center for Epidemiologic Studies Depression Scale provides repeatable and reliable results with satisfactory validity coefficients.

Keywords: Depressive symptoms; Disability evaluation; Low back pain; Psychometrics; Reliability; Validity.

1. Introduction

Although Chronic Low Back Pain (CLBP) is not an illness, it is one of the most common discomforts affecting the population worldwide (Maher, Underwood, & Buchbinder, 2017). The prevalence of CLBP is estimated at 4.2% in individuals ranging from 24-39 years old and at 19.6% in individuals with an age range of 20-59 years old (Meucci, Fassa, & Faria, 2015). According to the Global Burden of Disease Study, low back pain is a discomfort experienced by people for the largest number of years and ranks sixth in disability-adjusted life years (James, Abate, Abate, Abay, Abbafati, Abbasi *et al.,* 2018). Epidemiological studies performed in the Iranian working community have ascertained that between 51 to 57% of employees have suffered from low back pain (Dehghan, Ghasemi, Rezasoltani, & Pashaee, 2004; Aghayari, Ghasemi, Eshaghian, Ghojoghi, & Haghverdian, 2014; Ahmadi, Farshad, Motamedzadeh, & Mahjob, 2014). Moreover, the one-year prevalence in Iranian Health Care Workers was reported at 25% (Mehrdad, Shams-Hosseini, Aghdaei, & Yousefian, 2016). Therefore, spending $18.5 to $28.2 billion in the health care system by CLBP patients, even in developed countries, is not far-fetched (Walker, Muller, & Grant, 2003).

The strong relationship between CLBP and depressive disorders has been well documented (Rezaei, Afsharnezhad, Kafi, Soltani, & Falah Kohan, 2009; Hong & Shin, 2020). CLBP is a common physical complaint among people with major depressive disorder (Karp, Weiner, Dew, Begley, Miller, & Reynolds, 2010) and CLBP patients report a high degree of disability (Afsharnezhad, Rezaei, & Yousefzadeh, 2010; Rezaei, Yousefzadeh, Afsharnezhad, Asghari Moghadam, & Zarrabi, 2011; Hong & Shin, 2020). Low back pain and its relevant depression may be recognized as the trigger point for long-term disability, feelings of uncertainty for pain control, poor outcome of treatment, and poor quality of life (Dehghan *et al.*, 2004; Rezaei, Afsharnezhad, Moosavi, Yousefzadeh, & Soltani, 2012; Hong, Kim, Shin, & Huh, 2014; Ünal, Akyol, Tander, Ulus, Terzi, & Kuru, 2019). The importance of a careful evaluation of depressed mood is clear given these devastating consequences as well as the heavy economic burden of CLBP on patients and on the health system. Furthermore, it has been revealed that assessing mental status can be beneficial for determining the final outcome of treatment and for identifying subgroups of patients who are at a higher risk (Turk, Dworkin, Trudeau, Benson, Biondi, Katz *et al.,* 2015). Therefore, based on the previous studies, high levels of depressive symptoms are

predicted to be associated with greater disability and pain severity, and to weaker self-efficacy beliefs.

Researchers and clinicians have applied several self-report scales to assess and improve the self-management of chronic pain (Taylor, Carnes, Homer, Pincus, Kahan, Hounsome *et al*., 2016). The Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff, 1977) is one of the measures most widely used. There is strong psychometric evidence concerning the assessment of depression symptoms and the diagnosis of depression for the CES-D (Radloff, 1977; Carleton, Thibodeau, Teale, Welch, Abrams, Robinson *et al.*, 2013; Mueses-Marín, Montaño, Galindo, Alvarado-Llano, & Martínez-Cajas, 2019). The original CES-D version was reduced from 20 items to 10 items to improve clinical utility and facilitate scoring (Andresen, Malmgren, Carter, & Patrick, 1994). This 10-item version (CES-D 10) has proved to be a greatly reliable and valid measure across several subgroups of the general population, such as the elderly (Irwin, Artin, & Oxman, 1999; Lee & Chokkanathan, 2008; Mohebbi, Nguyen, McNeil, Woods, Nelson, Shah *et al.*, 2018), different African communities (Baron, Davies, & Lund, 2017), in psychiatric patients (Björgvinsson, Kertz, Bigda-Peyton, McCoy, & Aderka, 2013), adolescents (Bradley, Bagnell, & Brannen, 2010), in the Hispanic community (González, Nuñez, Merz, Brintz, Weitzman, Navas *et al.*, 2017), in low- and middle-income countries (James, Powell, Seixas, Bateman, Pengpid, & Peltzer, 2020), in non-clinical college students (Yu, Lin, & Hsu, 2013), spinal cord injury patients (Miller, Anton, & Townson, 2008), HIV-positive patients (Zhang, O'Brien, Forrest, Salters, Patterson, Montaner *et al.*, 2012) and in the Chinese population aged 60-92 years old (Cheng, Chan, & Fung, 2006).

The psychometric properties of the CES-D 10 remain unclear in the population of patients with chronic pain. A great deal of studies has been conducted in the general population or in the subgroups described above (such as the elderly, adolescents, psychiatric patients) but with conflicting results. Moreover, there is no information on the factor structure of this scale in the population of patients with chronic pain. Analyses of the underlying factor structure of the CES-D 10 have been typically contradictory. For instance, several studies have demonstrated a two-factor structure, including both a 2-item positive affect factor and an 8-item negative affect factor (Björgvinsson *et al.*, 2013).

Previous studies have provided heterogeneous and contradictory information on the one-factor (Yu *et al.*, 2013; González *et al.*, 2017), two-

factor (Bradley *et al.*, 2010; Björgvinsson *et al.*, 2013; Baron *et al.*, 2017; Mohebbi *et al.*, 2018), three-factor structure (Cheng *et al.*, 2006), and even the application of an 8-item version of this measure (James *et al.*, 2020). Inconsistent results might also be explained by a failure to account for the potential impact of the method effects on the resultant factor structures, an issue that has received little attention in relation to the CES-D 10.

The CES-D 10 validation can be helpful in conducting surveys and in reducing the cost of interviews, especially in patients with low back pain who, at the onset of the pain, are not particularly willing to sit and respond to large-scale questionnaires, for a long time, while suffering the pain. Hence, the objective of the current study was to identify the internal consistency and test-retest reliability, construct validity, and concurrent validity of the CES-D 10 in CLBP patients of the Iranian population.

2. Materials and methods

2.1. Design

The present research was carried out as a validation study with three sub-studies. *First*: an exploratory factor analysis and the determination of the internal consistency reliability (n = 100); *second*: the determination of the test-retest reliability (n = 20), and *third*: the confirmatory factor analysis (CFA) (n = 151). The proposal and ethical approval of this research were reviewed and approved by the Ethics Committee of the Research Council of the Guilan University of Medical Sciences (GUMS) consistent with the Declaration of Helsinki [P / 3/132/8090].

2.2. The CES-D 10 translation procedure

The English version of the CES-D 10 was translated into standard Persian using the translation and back-translation procedure, to allow its use to Iranian patients and medical and rehabilitation personnel. An expert committee (i.e. the translators, the researchers, a physical medicine and rehabilitation specialist, a neurosurgeon, a psychologist, a neurologist, an occupational therapist, and a biostatistic/methodologist) supervised all the translations and the English-Persian adaptation processes. The committee verified that the Persian version of the CES-D 10 was conceptually, culturally, and semantically equivalent to the original tool. The pre-final Persian version of the CES-D 10 was given to 10 Persian-speaking nursing

students and psychology students as a pre-test to identify any spelling or equivocation errors. Subsequently, the Persian version of the CES-D 10 was finalized and its psychometric properties were tested.

2.3. Participants

The study was a secondary data analysis, designed along with three sub-studies, which were conducted at the University of Guilan (North of Iran) in 2020. The statistical population of this study included all patients with CLBP registered in the Guilan province in 2010-2011. All participants in the present study met the pathological criteria for CLBP diagnosis and joined the research through nonprobability and consecutive sampling. CLBP was diagnosed by a neurologist and neurosurgeon at the Imam Reza Specialty and ultra-Specialty Medical Center, PourSina Hospital (Rasht, Iran). The hospital and its associated specialized clinics are the main providers of health services to patients based in northern Iran. As in previous studies, patients met the criteria to be included in the CLBP sample if low back pain did not improve following three months from the initial incidence (Elliott, Smith, Penny, Smith, & Chambers, 1999; Rezaei *et al.*, 2009; Afsharnezhad *et al.*, 2010). Exclusion criteria included: central nervous system symptoms and injuries, progressive motor deficits, sphincter impairment prompted by neurological rationales and urinary tract infections, identified musculoskeletal and peripheral nervous system disorders, degenerative nervous system diseases, referral pains, metastasis, lumbar vertebral fractures, and scoliosis deformity. An informed written consent was obtained from all patients in all three sub-studies and all patients were reminded that their participation was anonymous. In addition, the participants were assured that all their information remained confidential and that the final outcome would be published as a group's general average.

3. Instruments used and variables measured in the study

3.1. Depression

The CES-D 10 has already been used to evaluate the outcome of a chronic disease self-management program in a real-world setting (Lorig, Sobel, Ritter, Laurent, & Hobbs, 2001). It is the translation of a short form of the CES-D 10-item English version introduced by Andresen and colleagues (1994). The items in the scale are designed as multi-alternative

questions (0 = rarely or none of the time, …, 3 = all the time). The higher the score obtained, the higher the level of depression in the patient (all items of the CES-D 10 are presented in Tab. 2). The internal consistency reliability of the CES-D 10 was reported equals to .84 by Lorig and colleagues (2001) in patients with chronic illnesses. Its validity was supported on the basis of the correlation of the CES-D 10 scores with the Physical Function and Mental Health subscales of SF-36 equals to .37 and .71, respectively (Miller *et al.*, 2008).

3.2. Physical disability

The Roland-Morris Disability Questionnaire (RDQ) is one of the tools most widely used, which have been designed for back pain patients. It has been demonstrated to yield reliable measurements, which are valid for inferring the level of disability and to be sensitive to changes over time for groups of patients with low back pain (Roland & Morris, 1983). In the 18-item Roland-Morris Disability Questionnaire (RDQ-18) the patient reads a series of items that are part of the questionnaire and checks the items that properly correspond to his/her health status (Stratford & Binkley, 1997). These statements describe a variety of daily activities that are impaired by low back pain. RDQ-18 is an 18-item self-report measure that assesses disability due to back pain. A sample item is "I walk more slowly than usual because of my back". Total scores range from 0 to 18, with higher scores reflecting greater physical disability. This scale has a good test-retest reliability (r = .91) and appears to be sensitive to treatment-related changes in patients with low back pain (Garratt, Moffett, & Farrin, 2001). RDQ-18 is available in a Persian version. Moreover, in the Iranian population, Afsharnezhad and colleagues (2010) reported the internal consistency of the RDQ-18 to be equals to .88 in CLBP patients.

3.3. Pain severity

The Visual Analog Scale (VAS) of pain is a 10-centimeter un-graded line with scores from zero to one hundred. Zero means no pain and one hundred is the highest amount of pain felt by a patient. The VAS had been used in previous studies and has shown to be an accurate and sensitive tool for the assessment of the level of pain (Ip, Tang, & Goggins, 2009).

3.4. Pain self-efficacy

According to the social-learning theory, self-efficacy refers to one's confidence in the ability to reach a suitable outcome (Bandura, 1977). In this study, the 6-item Pain Self-Efficacy scale (PSE) for chronic disease control was used to measure pain self-efficacy. The scale was developed and validated by Lorig and colleagues (2001) at the Stanford Epidemiological Studies Center (Stanford, USA). The items in this scale are scored from "not at all confident = 0" to "totally confident = 10"; and the higher the scores, the greater the self-efficacy. A sample item is "How confident are you that you can keep the fatigue caused by your disease from interfering with the things you want to do?". This scale was applied to 605 patients with chronic pain and its internal consistency was reported to be equals to .91 (Lorig *et al.*, 2001). Rezaei and colleagues (2012) translated and prepared the Persian version of this scale and obtained a Cronbach's alpha coefficient and a test-retest reliability equals to .87 and .73, respectively. Moreover, the results of the Exploratory Factor Analysis (EFA) in a sample group of 120 patients with chronic low back pain demonstrated that 65.16% of the variance in one factor was attributed to six items.

4. Statistical procedure and sub-studies

All data in the first and second sub-studies were processed using SPSS Ver. 21. The CFA was conducted in AMOS-21.

4.1. Sub-study 1

The recommended ratio of 1 to 10 was utilized for all the 10 items of the CES-D in order to determine the sample size for factor structure and Exploratory Factor Analysis (EFA) (Velicer & Fava, 1998). The required sample size was obtained for 100 CLBP patients. The participants visited the clinic for a neurosurgery visit and the prescribed medication. Furthermore, the internal consistency reliability of the CES-D 10 was calculated using Cronbach's alpha coefficient.

4.2. Sub-study 2

Twenty CLBP patients were randomly chosen out of the initial 100 CLBP patients listed in the first sub-study; they were asked to perform the

same neurosurgery visit one month later and to respond to the questions of the CES-D 10. The test-retest reliability was evaluated by calculating the correlation coefficient of the scores of this scale at the two test times (i.e. first visit vs second visit). In addition, a paired *t*-test was used to measure the difference of scores between the two implementation times of the CES-D 10.

4.3. Sub-study 3

Another independent sample group, consisting of 151 CLBP patients, participated to the Confirmatory Factor Analysis (CFA) through the Maximum Likelihood (ML) method to evaluate the construct validity and the dimensionality of the CES-D 10. In the case of the CFA, ten respondents are required for each free parameter given the *Rule of 10* (Bentler & Chou, 1987); therefore, the sample size was sufficient for the third sub-study considering the number of patients included. In order to evaluate the goodness of fit of the CES-D 10 factor structure model, the Chi-squared test (χ^2), the chi-square to degrees of freedom (χ^2/df), the Root Mean Square Error of Approximation (RMSEA), the Goodness-of-Fit Index (GFI), the Normed Fit Index (NFI) of Bentler-Bonett, the Tucker-Lewis index (TLI), and the Comparative Fit Index (CFI) were used (Brown, 2015). To determine the concurrent criterion validity of the CES-D 10 in this sub-study, its scores were correlated with scores of other variables, such as pain severity (Rezaei *et al.*, 2011; Hong & Shin, 2020), physical disability (Rezaei *et al.*, 2011; Hong & Shin, 2020), and pain self-efficacy (Rezaei *et al.*, 2012; Leung & Cheng, 2018), which was due to theoretical relevance.

5. Results

The demographics of CLBP patients is listed in Table 1. Kline (2016) stated that to determine the normality of the variables, the absolute magnitude of skewness and kurtosis should not exceed 3 and 10, respectively. Univariate normality was thus applicable to our datasets (see Tab. 1 for details).

Table 1 – *Demographic characteristics of CLBP patients in the three sub-studies*

Sub-study	Variables	Description	Min-Max	Skewness	Kurtosis
One (n = 100)	Age	47.31 ± 11.66*	19-69	-.36	-.26
	Gender				
	Male	53 (53%)			
	Female	47 (47%)			
	Marital Status				
	Single	6 (6%)			
	Married	94 (94%)			
	Education years	2.43 ± 1.63*	1-6	.88	-.45
	VAS	6.63 ± 2.83*	1-10	-.65	-.47
Two (n = 20)	Age	44.47 ± 15.64*	21-67	-.16	-1.57
	Gender				
	Male	11 (55%)			
	Female	9 (45%)			
	Marital Status				
	Single	4 (20%)			
	Married	16 (80%)			
	Education years	4.60 ± 2.43*	1-8	-.16	-2.13
	VAS	7.12 ± 2.58*	1.50-13	-.75	-.38
Three (n = 151)	Age	42.46 ± 11.37*	18-72	.04	-.54
	Gender				
	Male	44 (29.13%)			
	Female	107 (70.86%)			
	Marital Status				
	Single	16 (10.6%)			
	Married	131 (86.8%)			
	N R	4 (2.6%)			
	Education years	9.38 ± 5.38*	1-16	.33	-.52
	VAS	6.65 ± 2.39*	1-12	-.62	-.17

* Mean and Standard Deviation; NR: Not Reported; VAS: Visual Analog Scale.

5.1. Sub-study 1

The Kaiser-Meyer-Olkin (KMO) and Bartlett's Sphericity test were carried out prior to the EFA. The coefficient of KMO was .846, indicating that the sample size was satisfactory for analysis. Likewise, Bartlett's test (χ^2 = 246.026, df = 45, p < .0001) was significant, which meant that factor

analysis was appropriate for identifying model structure. Principal Component Analysis (PCA) was initially used in order to analyze the CES-D 10 factors. Given the correlation of the extracted factors with each other, the direct Oblimin rotation method was used as the main method to determine the CES-D 10 underlying factors. Table 2 shows the PCA indices.

Only factors with eigenvalues above 1 are reported in Table 2. Two extracted factors were named as depressed affect and positive affect based on test structure and type of questions. The findings of Pearson's correlation coefficient demonstrated that there was a significant relationship between the two factors (r = .449, p < .0001). Altogether, these two factors accounted for 51.04% of the total CES-D 10 variance.

Table 2 – *EFA results for the Persian version of the CES-D 10 on CLBP patients (n = 100)*

Factors	Items	Loading	h^2	% of Variance	Eigenvalues	Internal consistency
Depressed affect	Q1. I was bothered by things that usually don't bother me	.49	.37	39.68	3.97	α = .82
	Q2. I had trouble keeping my mind on what I was doing	.68	.52			
	Q3. I felt depressed	.50	.58			
	Q4. I felt that everything I did was an effort	.76	.54			
	Q6. I felt fearful	.68	.47			
	Q7. My sleep was restless	.57	.30			
	Q9. I felt lonely	.61	.44			
	Q10. I could not "get going"	.73	.48			
Positive affect	Q5. I felt hopeful about the future	.85	.68	11.36	1.14	α = .66
	Q8. I was happy	.82	.72			

h^2: Communalities; α: Cronbach's alpha.

5.2. Sub-study 2

Pearson's correlation coefficient for CES-D 10 scores, obtained from two measurements following a one-month interval, was .71. Likewise, according

to the paired *t*-test, there was no significant difference between the results of two measurements in this scale ($p > .05$).

5.3. Sub-study 3

Table 3 displays the descriptive indices and the correlation coefficients between the variables. Since all correlation coefficients between the CES-D 10 and other tools were lower than .85, the multi-collinearity error was rejected (Tabachnick & Fidell, 2001). Furthermore, to determine the concurrent criterion validity, the correlation coefficients of .40 and above, which are satisfactory, were emphasized (Fayers & Machin, 2013). As expected, a significant correlation was observed between CES-D 10, RDQ-18, and PSE ($r \geq .40$ and $p < .0001$, refer to Tab. 3 for more details). In other words, the higher depression was associated with higher levels of physical disability, while the lower levels of pain were associated with self-efficacy beliefs. Nonetheless, the concurrent criterion validity of the CES-D 10 did not acquire the level acceptable in terms of correlation with the VAS scores.

Table 3 – *Descriptive statistics and correlation matrix of the study variables (n =151)*

	M ± *SD*	*α*	Skewness	Kurtosis	1	2	3	4
1-CES-D 10	14.18 ± 7.08	.79	-.06	-.96	1			
2-RDQ-18	13.03 ± 5.05	.85	-.56	-.18	.49**	1		
3-VAS	6.65 ± 2.39	-	-.62	-.17	.30**	.51**	1	
4-PSE	30.71 ± 14.13	.92	.25	-.94	-.51**	-.60**	-.36**	1

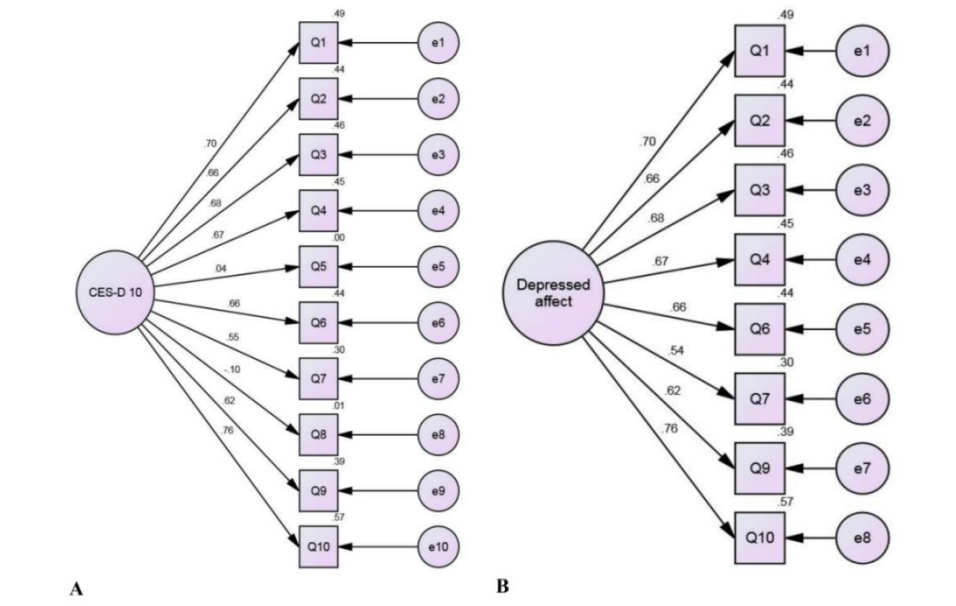
CES-D 10: Center for Epidemiologic Studies short Depression Scale; RDQ-18: 18-items Roland-Morris Disability Questionnaire; VAS: Visual Analog Scale; PSE: Pain Self-Efficacy scale; *α*: Cronbach's alpha.
**$p < .01$.

5.4. Confirmatory Factor Analysis

As the EFA results showed (Tab. 2), the CES-D 10 items were loaded on two independent factors: the depressed affect and the positive affect. A CFA was used in order to determine the construct validity of the extracted factors and compare it to the 10-item version of the CES-D. Table 4 lists the CFA fit indices. To achieve a more appropriate model, the fit indices of the modified model, obtained from the improvement indices based on AMOS outputs, are reported. Weak and non-significant factor loadings were

observed for items five and eight, respectively. The examination of these outputs demonstrated that by releasing the covariance between the latent variables of the depressed affect and positive affect as well as deleting the items 5 (hopeful) and 8 (happy), and thus by eliminating the latent variable of the positive affect, the value of fit indices in CLBP patients exceeded the best known value (Fig. 1).

Figure 1 – *Factor loadings and explained variances of the original (A) and improved CES-D 10 (B) versions in Iranian patients with CLBP*



According to Table 4, the index of χ^2 was significant for both models; however, given its rather large sample size, its validity does not appear to be suitable for the model fit as this index falls under the influence of sample size. The value of χ^2/df was less than 3 in all three models; thus, all three models presented a relatively good fit; however, given the GFI and CFI, the one-factor model (with eight items) presented a better fit in comparison to the other models. Moreover, the value of the AIC in the improved one-factor model (eight items) was lower than that of the other models. The lower value of this index indicates the better repeatability of the model over the other models, bringing to a better fit. Finally, the value of the RMSEA in the improved one-factor model was also lower (.081) than that of the other models, proving a better fit of the 8-item model in Iranian samples in comparison with the original 10-item model.

Table 4 – *One, two and modified One-factor model fit indices of the CES-D 10 (n = 151)*

Fit indices	Original 1-factor model [a]	2-factor model [b]	Improved 1-factor model [c]
$\chi 2$	89.37	71.95	47.85
df	35	34	20
P-Value	.0001	.0001	.0001
$\chi 2/df$	2.554	2.116	2.393
Goodness-of-Fit Index	.89	.91	.92
Normed Fit Index	.82	.86	.89
Tucker-Lewis Index	.85	.89	.91
Comparative Fit Index	.88	.92	.93
Akaike Information Criterion	129.37	113.95	79.85
Root Mean Square Error of Approximation	.102	.086	.081

[a] Observed values in the original 1-factor model with 10 items.
[b] Observed values in the EFA adapted 2-factor model with 10 items.
[c] Observed values in the improved 1-factor model with 8 items.

6. Discussion

The factor structure and psychometric features of the CES-D 10 on Iranian CLBP patients were examined. Although, this scale has been broadly utilized in various population sub-samples, such as the elderly, adolescents, the Chinese population as well as various African and Latino communities (Irwin *et al.*, 1999; Cheng *et al.*, 2006; Lee & Chokkanathan, 2008; Bradley *et al.*, 2010; Baron *et al.*, 2017; González *et al.*, 2017; Mohebbi *et al.*, 2018; James *et al.*, 2020), the information on the validity and reliability of the CES- D 10 in patients with chronic pains is still scarce. The CES-D 10 is a shorter measure that takes less time to run and its application is more practical in clinical and research settings with patients that suffer from pain. Research has also demonstrated that a number of CLBP patients suffer from depression (Rezaei *et al.*, 2009; Karp *et al.*, 2010; Hong & Shin, 2020) and it seems necessary to identify high-risk patients in screening activities and refer them to the rehabilitation team to reduce disability and improve treatment outcomes.

Based on the EFA results, the 10 items of the CES-D 10 loaded on two factors, namely the *depressed affect* and the *positive affect*. Since these two factors were correlated with each other, the Oblimin rotation was utilized to extract the factors and the two factors accounted for 51% of the CES-D 10 variance. A Varimax orthogonal rotation also yielded similar results in the extraction of factors (data not shown). Previous studies have well

documented that the CES-D 10 behaves inconsistently in different populations (Cheng *et al.*, 2006; Yu *et al.*, 2013; González *et al.*, 2017). Nonetheless, some studies (Bradley *et al.*, 2010; Björgvinsson *et al.*, 2013; Baron *et al.*, 2017; Mohebbi *et al.*, 2018) have explicitly reported the two-factor structure of the CES-D 10, as described by the EFA results shown in this study, to have a good fit. However, the problem is that this two-factor structure is not always straightforward (James *et al.*, 2020). The EFA results in the sub-study 1 suggested that the CES-D 10 presented two distinct dimensions of the *depressed affect* (such as *somatic symptoms*) and the *positive affect* (*hopefulness and happiness*).

As previously reported, despite the acceptable internal consistency of the *depressed affect* (α = .82), the internal consistency reliability of the *positive affect* (α = .66) is questionable (Tavakol & Dennick, 2011). One reason is that hopefulness and happiness as *positive affect* are not theoretically and conceptually in common in CLBP patients. On the other hand, *positive affect* items are scored reversely and patients may be confused after answering some positive statements due to exposure to reverse statements. Towards this end, some researchers (Schroevers, Sanderman, van Sonderen, & Ranchor, 2000; Stansbury, Ried, & Velozo, 2006) have recommended to completely eliminate positive affect items; however, it is here suggested that the reversed items should be retained and rewritten symptomatically so that they can be integrated with other items when it comes to scoring. It is also recommended that this process of item modification and of the CES-D 10 re-validation should be conducted in chronic disease settings so that the findings can be comparable to previous studies. As in previous reports (Irwin *et al.*, 1999; Miller *et al.*, 2008; Bradley *et al.*, 2010; Zhang *et al.*, 2012; Björgvinsson *et al.*, 2013; Baron *et al.*, 2017; González *et al.*, 2017; Mohebbi *et al.*, 2018; James *et al.*, 2020), the internal consistency reliability of the total scale and the factor named *depressed affect* were found to be satisfactory in this study. This coefficient, however, was expected as the Cronbach's alpha depends on the number of items. In other words, a higher number of items lead to a higher alpha score.

The test-retest reliability of the CES-D 10 after one month was equal to .71 and significant. Moreover, no significant difference was observed between the two average measurements. This finding is in line with the results of previous studies (Irwin *et al.*, 1999; Miller *et al.*, 2008; González *et al.*, 2017) and suggests that the repeatability of the CES-D 10 results is consistent over time.

The concurrent criterion validity demonstrated that the CES-D 10 overall score was significantly ($r \leq .40$, $p < .0001$) correlated with the RDQ-18 and PSE scores (Tab. 3). This finding can be interpreted from two different perspectives: A) The CES-D 10 is strongly and simultaneously correlated with external criteria of which the psychometric competencies have previously been validated for the Iranian population; B) It is perceived that psychological interventions, conducted to reduce depression in CLBP patients, can help them improve their sense of confidence in controlling their pain and reduce the levels of disability due to low back pain. To support this idea, previous studies (Nash, Ponto, Townsend, Nelson, & Bretz, 2013) figured out that cognitive-behavioral therapy in patients with chronic pain leads to an improved Self-efficacy. Furthermore, it was found that a multi-component depression intervention for the elderly could result in the reduction in functional disability (Gitlin, Szanton, Huang, & Roth, 2014).

The CFA findings demonstrated that the fittest model in CLBP patients included one factor named *depressed affect* with eight items. Some studies have supported the one-factor feature of the CES-D 10, in line with this result (Yu *et al.*, 2013; González *et al.*, 2017). This finding suggests that the one-factor CES-D 10 model is appropriate for Chinese non-clinical participants, Latino/Hispanic communities, and Iranian CLBP patients. The CFA showed that, by eliminating the items characterized by non-significant and weak factor loadings and thus by removing the latent *positive affect* variable (that acquired poor internal consistency in sub-study 1), the 8-item scale was more fit in measuring depression in CLBP patients compared to other models.

Consistent with the findings of this study, Turvey, Wallace and Herzog (1999) called the *positive affect factor* an artifact that is not capable of reflecting an independent dimension of depressive symptoms. Thus, as suggested by the findings of this paper, positive affect items should be removed or revised. Conceptually this factor is different from the symptomology of depression; the factor is scored reversely, it also has weak coefficients of factor loadings and questionable internal consistency reliability. Moreover, Costello and Osborne (2005) suggested that factors containing fewer than three items are generally weak and unstable.

This study involved a homogeneous population of patients with CLBP; however, it is clear that, due to various effects of chronic pain on the different parts of the body, this study cannot be generalized to other subgroups of patients. As was found in the third sub-study, the CLBP female population was approximately twice as much as the male population and the

invariance of models should be tested in the future in terms of gender. Moreover, the diagnostic validity of the CES-D 10 was not examined with a gold standard assessment of depression (e.g., a structured psychiatric interview). Future works can determine the cut-off point of this scale for the screening of patients with chronic pain and depression. Despite these limits, the present study expands the literature in the adoption of the CES-D 10 in low back pain patients and provides important clinical and theoretical rationales for rehabilitation specialists.

7. Conclusions

The Persian 8-item version of the CES-D provides repeatable and reliable results and presents satisfactory validity coefficients. The one-factor model with eight items had the best fitting. This scale can be reliably used in outpatient clinics and rehabilitation centers treating patients with chronic low back pain to assess depression.

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