



## Validity and reliability of the Iranian version of the Cardiac Exercise Self-Efficacy Scale

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### Original Article

#### Abstract

**BACKGROUND:** The assessment of exercise self-efficacy in patients with cardiovascular disease (CVD) is necessary to conduct tailored interventions. The aim of the current study was to validate the Iranian version of the Cardiac Exercise Self-efficacy Scale (CESE) for patients with CVD.

**METHODS:** To develop the Iranian version of the CESE scale, a forward and back translation procedure was followed. Data were collected from 260 patients with CVD who were admitted to Imam Ali Cardiovascular Hospital, Iran, using convenience sampling. Psychometric properties of the scale including validity (face and content validity, discriminant, concurrent, convergent, divergent, and construct validity) and reliability (internal consistency, and test-retest reliability) were assessed. SPSS software was used for statistical analysis.

**RESULTS:** The questionnaire had a good face and content validity and reliability, with Cronbach's alpha of 0.87 and intraclass correlation coefficient (ICC) of 0.42. The questionnaire discriminated well between subgroups according to their medical conditions and the "health transition" item in the Short-Form Health Survey (SF-36). There was a significant correlation between CESE and the physical components of the SF-36 ( $P < 0.001$ ). In addition, a strong to moderate significant correlation was found between the CESE and the Exercise Self-efficacy Scale (ESES) ( $r = 0.77$ ;  $P < 0.01$ ) and between CESE and the Hospital Anxiety and Depression Scale (HADS) total ( $r = -0.45$ ;  $P < 0.001$ ). The exploratory factor analysis (EFA) identified a four-factor structure model, explaining 71.02% of the observed variance.

**CONCLUSION:** The Persian version of the CESE is a valid and reliable instrument for the evaluation of CVD patients' exercise self-efficacy level in performing regular exercise behaviors.

**Keywords:** Exercise, Self-Efficacy, Cardiovascular Diseases, Validity, Reliability, Iran

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#### Introduction

Cardiovascular disease (CVD) is the leading cause of death worldwide, accounting for 50% of deaths in all developed countries. Although the incidence rate of CVD in less developed countries like Iran is lower than in Western countries, it is increasing due to their modernization and shift toward Western lifestyle.<sup>1,2</sup>

Physical activity seems to play an important role in quality of life (QOL),<sup>3</sup> but in patients with CVD there are several factors that may potentially limit a physically active lifestyle, including reduced aerobic exercise capacity and impaired muscle endurance.<sup>4</sup> The reasons for patients' inactivity included cardiac limitations, respiratory causes, and inappropriate advice regarding exercise. In addition to clinical issues, some psychological and cognitive factors affect patients' physical activity.<sup>5,6</sup>

Self-efficacy is a cognitive factor influencing

health and QOL. Perceived self-efficacy is defined as beliefs about one's abilities to perform or maintain a behavior such as compliance to exercise.<sup>7-9</sup> In fact, self-efficacy, as a component of social cognitive theory (SCT), is the beliefs of personal efficacy assigned to the acquisition of knowledge on which training is founded.<sup>10</sup> A high level of self-efficacy is associated with more exercise in patients with CVD. In addition, evidence has been provided for the effectiveness of interventions for improving self-efficacy on controlling cardiovascular risk factors.<sup>11</sup>

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Thus, the evaluation of exercise self-efficacy in patients with CVD will assist health care professionals in the provision of tailored interventions for the improvement of a patient's confidence in performing exercise<sup>12</sup> and health behaviors.<sup>13</sup> Some exercise self-efficacy scales have been developed to assess exercise self-efficacy in Iranian<sup>14</sup> and other languages.<sup>15,16</sup> Nevertheless, to our knowledge, there is a lack of valid disease-specific questionnaire to evaluate exercise self-efficacy in Persian-speaking patients with CVD. The Cardiac Exercise Self-Efficacy Scale (CESE) is a valid and reliable questionnaire developed as a cardiac-specific exercise self-efficacy scale. The reliability and validity of the CESE have been well established in a rehabilitation setting.<sup>17</sup> Therefore, the present study was conducted to translate the CESE into Persian and to evaluate the psychometric properties of the CESE among Persian-speaking patients with CVD.

### Materials and Methods

This study used a methodological design to translate the CESE from English into Persian and to evaluate the validity and reliability of the translated scale in a sample of Iranian patients with CVD. For the validation and adaptation of the questionnaire, the number of participants should be at least 5-10 times of the number of items of an instrument for determining the factor structure.<sup>18</sup> For this purpose, we recruited 260 patients with CVD admitted to Imam Ali Cardiovascular Hospital, Iran, from May to September 2016, using convenience sampling method. Intercultural adaptation was performed according to the study by Aksayan et al.<sup>19</sup>

#### Procedures

**Translation and back translation:** Translation and blind back translation was used to translate the CESE from English into Persian according to the guideline provided by Beaton et al.<sup>20</sup> A bilingual physiotherapist, a health professional, fluent in English, and one translator translated the CESE separately. The three produced versions were cross-examined and compared by the authors and divergences were modified. Thus, the consolidated forward translation version was produced. Then, a panel of committee members including a cardiologist, health educator, and sport medicine physician evaluated the initial version for content equivalence. The expert panel raised some queries for the translators. The discrepancies were modified and resolved by consensus, resulting in the two primary Persian versions of the CESE.

A Persian-English translator and a native-English-speaking translator, who were not familiar with the original version, translated the two primary Persian versions of CESE back into English independently. Following this, each version was cross-examined to produce the back translation version. For content comparison, a bilingual expert panel compared the content of each item in the back-translated version with the corresponding item in the original English version.

The pre-final version of the Persian questionnaire was examined using a pilot study to assess the face validity of the questions. A convenient sample of 35 Iranian patients with CVD admitted to Imam Ali Cardiovascular Hospital participated in this phase. They were asked to respond to the questionnaire and express any problems in understanding to indicate items difficult to understand, offensive, or confusing. Finally, after several revisions based on the results of the pilot study and expert panel opinions, the final version was finalized.

We used face-to-face interviews for data collection to avoid selection bias related to illiterate participants and to reduce the number of non-respondents. All participants were interviewed by a trained interviewer individually. To assess test-retest reliability, 30 patients completed the CESE over 2 weeks. The clinical data, including history of disease, comorbidities, and drug use, were obtained from the patients' medical records.

Ethical approval for the study was obtained from Kermanshah University of Medical Sciences, Iran, (Registration code: 95145). All patients were asked to complete the consent form.

#### The questionnaires

**Demographic questionnaire:** To assess the demographic characteristics and disease-specific characteristics of participants, we developed a 12-item instrument. The open and structured items of this instrument include age, gender, birth date, education level, job, weight, height, smoking duration and cessation duration, positive history of psychiatric disorders, pulmonary, neurologic, digestive, kidney, skeletal, and endocrinology diseases, and history of hyperglycemia, hyperlipidemia, hypertension, obesity, and CVD.

**The Cardiac Exercise Self-Efficacy scale:** The CESE is a 16-item instrument originally developed by Hickey et al. to assess confidence in performing exercise in cardiac patients.<sup>17</sup> Each item is rated on a 5-point Likert-type scale, ranging from 1 (very little confidence) to 5 (highest confidence). Individuals

were asked to assess their confidence level in behaviors such as fitting exercise into a busy day, warming up before exercise, and cooling down after exercise. Cronbach's alpha for the CESE instrument was 0.97 at baseline. In addition, test-retest reliability was estimated at 0.87 using intraclass correlation coefficient (ICC) in a sample of cardiac rehabilitation participants. Known-groups validity was documented in a sample of marathon runners, and this sample reported significantly ( $P < 0.010$ ) higher self-efficacy scores than the participants receiving cardiac rehabilitation.<sup>17</sup>

**Exercise Self-Efficacy Scale:** The Exercise Self-Efficacy Scale (ESES) is an 18-item scale developed by Bandura (1997) to assess exercise behavior in patients with diabetes mellitus (DM).<sup>10</sup> Participants were asked to rate their confidence in getting themselves to perform regular exercise (3 or more times per week). The score scale ranged from 0 (cannot do at all) to 10 (highly certain I can do). The Cronbach's alpha coefficient of the original version of ESES was 0.89, demonstrating a high internal consistency.<sup>15,21</sup> The Persian version of the ESES is well documented and its validity and reliability are acceptable, the Cronbach's alpha for the whole scale has been reported as 0.92.<sup>14</sup>

**Hospital Anxiety and Depression Scale:** Zigmond and Snaith originally developed the Hospital Anxiety and Depression Scale (HADS) to measure anxiety and depression in the setting of a hospital medical outpatient clinic.<sup>22</sup> This 14-item self-report scale consists of the two subscales of anxiety and depression, each including 7 items. The completion of the scale requires 2–5 minutes. Each item is scored within the range of 0–3; this means that a person can score between 0 and 21 in each of the anxiety or depression subscales. Cut-off scores are available for quantification. A score of 0–7 shows normal status, and 8–10 suggests probable depressive and anxiety symptoms. Scores of 11–21 indicate a clinical case of depression or anxiety.<sup>22</sup> The HADS scale has been validated in many languages and settings.<sup>23–30</sup> The Persian version of the HADS is available and its validity and reliability is acceptable, Cronbach's alpha for anxiety and depression subscales was reported as 0.78 and 0.86, respectively. Validity was determined using known-groups comparison analysis, which showed satisfactory results. Furthermore, the results of convergent validity showed that the Pearson correlation coefficient varied from 0.47 to 0.83 for the anxiety subscale and from 0.48 to 0.86 for the depression subscale.<sup>31</sup>

**Short Form-36 Health Survey Scale:** The Short Form-36 Health Survey Scale (SF-36) is a well-known generic scale of health status consisting of 36 items with the 8 domains of physical functioning, mental health, social functioning, vitality, and role limitations due to emotional problems, role limitations due to physical problems, bodily pain, and general health. Question 2 shows the variation in health condition over the past year, which is not scored and is named the "health transition item".<sup>32</sup> The subscales are scored from 0 to 100, with higher scores indicating better health status. We used the Persian version of the SF-36.

The validation of the Iranian version of the SF-36 is well documented with its Cronbach's alpha ranging from 0.77 to 0.90. Validity was assessed using the known-groups and convergent analysis. In addition, known-groups analysis indicated that the SF-36 discriminated well between sub-groups of individuals who differed in sex and age.<sup>33</sup>

Descriptive statistics were calculated for all variables. Data are presented as mean  $\pm$  standard deviation (Mean  $\pm$  SD) for quantitative variables, and frequency of occurrence or percentage for categorical variables. To investigate the normality of distribution of the interval variables, Kolmogorov–Smirnov (K-S) test was used. In addition, floor and ceiling effects were also examined. All statistical analyses were conducted at the significance level of 5% using SPSS software (version 20, IBM Corporation, Armonk, NY, USA).

### **Psychometric analysis**

#### **Validity**

**Face and Content Validity:** The face and content validity of CESE were investigated quantitatively and qualitatively by the related experts. We asked 10 related experts to examine the validity of each item of CESE quantitatively and qualitatively. Content validity ratio (CVR) and content validity index (CVI) were assessed according to the Lawshe method.<sup>34</sup> The validity of each question was evaluated by adding the number of experts who had scored the question as 3 or 4, divided by the total number of experts, using a four-point scale. CVI value for the total set of items was computed using the sum of the "3" and "4" scores (relevancy) percentage from each expert divided by the total number of experts.<sup>35</sup> A CVI score of higher than 0.80 was considered as acceptable.<sup>36</sup> CVR scores were calculated to determine the necessity of each item. A CVR score of equal to or higher than 0.62 was considered a good content validity by 10 experts based on the Lawshe table.<sup>37</sup>

**Floor and ceiling effect:** The floor and ceiling values, respectively, indicate the percentage of the patients who obtained the lowest and highest scores in CESE subscales separately. When more than 15% of the participants obtain the lowest or highest possible scores, floor or ceiling effects are considered present, respectively.<sup>38</sup>

**Construct Validity:** The construct validity of the CESE was determined using exploratory factor analysis (EFA). Factor structure of the Persian version of the CESE was assessed using EFA and utilizing principal component analysis and varimax rotation. Factor loadings of higher than 0.40 were considered as illustrative of a significant relationship between item and scale. Two primary tests were conducted to assess data fit, the Bartlett test to evaluate the factorability of items and the Kaiser-Meyer-Olkin (KMO) test to measure sampling adequacy.

**Concurrent validity:** There is a possible correlation between QOL and self-efficacy in cardiac patients. So, concurrent validity was assessed by measuring the association of the PSES and the SF-36 scores.

**Convergent and divergent validity:** To assess convergent validity, we assumed that there are strong relationships between Iranian versions of the CESE with ESES. Thus, we evaluated the correlation between the mean scores of the CESE and ESES. To examine divergent validity, we assumed that subjects with higher self-efficacy experienced lower levels of anxiety and depression. Thus, we compared the mean score of the Persian version of the CESE with total HADS score and the score of its subscales. We used the Pearson correlation to quantify concurrent, convergent, and discriminant validity. A correlation coefficient of greater than 0.3 between the relevant scales was considered as acceptable.<sup>39</sup>

**Discriminant validity:** We conducted known-groups analysis to determine how well the Iranian version of the CESE discriminates between subcategories of patients who differed in terms of medical condition. To achieve this, patients with CVDs were divided into subcategories including patients who were undergoing coronary artery bypass surgery (CABG), patients with and without heart failure, patients with and without obesity [Body mass index (BMI  $\geq$  30)], and patients with and without dyslipidemia. Dyslipidemia was defined as low-density lipoprotein (LDL) cholesterol  $\geq$  160 mg/dl, high-density lipoprotein (HDL) cholesterol  $<$  40 mg/dl, total cholesterol  $\geq$  240 mg/dl, triglycerides  $\geq$  200 mg/dl, and/or positive history of relevant medication intake.<sup>40</sup> To compare the mean total CESE scores between each subgroup of patients,

we conducted independent t-test. We also assessed the discriminative power of CESE between three groups of patients according to the “health transition” item (item 2 of SF-36), indicating the level of variation in general health over the previous year. This item rates patients based on a 5-point scale ranging from “much better now than one year ago” to “much worse now than one year ago”. We re-categorized patients according to this item into three subgroups including “not changed,” “improved”, and “deteriorated” status. Accordingly, we used ANOVA with Tukey’s post hoc comparisons to evaluate mean differences of total CESE scores between the abovementioned subgroups of patients in terms of health transition item.

### Reliability

**Internal consistency:** The internal consistency of the CESE was calculated using Cronbach’s alpha and item-total correlation. Values  $\geq$  0.70 were accounted satisfactory.<sup>41</sup> A total correlation of an item  $\geq$  0.4 was considered acceptable.<sup>42</sup>

**Test-retest:** Reliability of the CESE was evaluated in a random sample of patients with CVDs, who did not participate in any rehabilitation or intervention program, over a 14-day period by performing ICC analysis (the two-way random model). The same interviewer conducted the test and retest interviews.

ICC values between 0.4 and 0.75 were considered as fair to good, and values higher than 0.75 were considered as excellent. The Bland–Altman method was used to compare scale scores between the test and retest procedures.<sup>43</sup>

## Results

**Participant demographics:** Eligibility screening was conducted on 260 patients with coronary heart disease (CHD) in the current study. All of these patients (100%) completed the whole questionnaire and were included in the final data analysis. The mean age of the participants was  $48.90 \pm 13.77$  years. The majority of the patients were men ( $n = 141$ ; 54.2%). In total, 60% of them had a secondary education. Approximately, 29.2% of patients ( $n = 76$ ) had undergone CABG, 50% of whom ( $n = 38$ ) had undergone CABG more than 1 year ago. Moreover, 78 (30%) patients had had a myocardial infarction (MI) 1-72 months ago. More than one-third of patients underwent coronary stent placement. The majority of the participants had comorbidities including hypertension (80%) and dyslipidemia (68.46%). In addition, more than one-third of the patients had a respiratory disease and DM. The clinical and sociodemographic characteristics of the participants are provided in table 1.

**Table 1.** Clinical and sociodemographic characteristic of the patients (n = 260)

| Variables                                                         | n (%)       |
|-------------------------------------------------------------------|-------------|
| Sex (male)                                                        | 141 (54.23) |
| Smoking (yes)                                                     | 132 (52.30) |
| Level of education                                                |             |
| Illiterate                                                        | 14 (5.38)   |
| pre-diploma and high school diploma                               | 90 (34.61)  |
| Bachelor's degree                                                 | 152 (58.46) |
| Master's and Doctoral degree                                      | 4 (1.53)    |
| CAD subgroup                                                      |             |
| CABG                                                              | 76 (29.23)  |
| MI                                                                | 78 (30.00)  |
| Coronary stent placement                                          | 94 (36.15)  |
| Other diagnosis                                                   | 12 (21.66)  |
| Comorbidity                                                       |             |
| Hypertension                                                      | 220 (80.00) |
| Dyslipidemia                                                      | 178 (68.46) |
| Respiratory disease                                               | 114 (43.80) |
| Diabetes                                                          | 106 (40.80) |
| CNS disease                                                       | 52 (20.00)  |
| Musculoskeletal disease                                           | 40 (15.40)  |
| Renal disease                                                     | 16 (6.20)   |
| Mental disease                                                    | 8 (3.07)    |
| Gastrointestinal disease                                          | 8 (3.07)    |
| Anti-diabetic treatment (insulin, gemfibrozil, and Glibenclamide) | 54 (22.50)  |
| Cardiovascular drugs                                              |             |
| Antiplatelet                                                      | 122 (46.92) |
| Antilipid                                                         | 120 (46.20) |
| B-blocker                                                         | 162 (62.30) |
| ACEI                                                              | 142 (54.60) |
| ARB                                                               | 74 (28.50)  |
| Anti-coagulant                                                    | 12 (4.60)   |

CAD: Coronary artery disease; CABG: Coronary Artery Bypass Surgery; MI: Myocardial infarction; CNS: Central nervous system disease; ACEI: Angiotensin-converting-enzyme inhibitors; ARB: Angiotensin receptor blocker

**The descriptive statistics of the Cardiac Exercise Self-Efficacy Scale:** The K-S test was used to assess the normality of each CESE item. The results showed that data were normally distributed. The mean total score of the CESE was  $(2.62 \pm 0.7)$ .

**Floor and ceiling effects:** No participant scored the highest score for the total CESE, thus providing no ceiling effects of the total scale. Only 1.5% of participants obtained the lowest scores, indicating no/low floor effects for total CESE (Table 2).

### Validity

**Face and content validity:** Based on the responses of the 10 experts, minor changes in the translated items of the final CESE indicated good face validity for the scale. The scale CVI was 0.82 and the item CVIs ranged from 0.76 to 0.88, while the scale CVR was

0.88, and the item CVRs ranged from 0.73 to 0.89, indicating the good content validity of the CESE.

**Table 2.** Assessment of floor and ceiling effect in the Iranian version of the Cardiac Exercise Self-Efficacy Scale (CESE)

| Scale and subscales          | Floor effect<br>[n (%)] | Ceiling effect<br>[n (%)] |
|------------------------------|-------------------------|---------------------------|
| CESE for knowledge           | 6 (2.3)                 | 14 (5.4)                  |
| CESE for Overcoming Barriers | 64 (24.6)               | 4 (1.5)                   |
| CESE for Time Management     | 18 (6.9)                | 10 (3.8)                  |
| CESE for Recovery            | 50 (19.2)               | 0 (0)                     |
| Total                        | 4 (1.5)                 | 0 (0)                     |

CESE: the Cardiac Exercise Self-Efficacy Scale

**Concurrent validity:** To determine concurrent validity, we calculated the correlation between CESE and SF-36. Therefore, the two questionnaires were completed by patients who accepted to fill out both questionnaires. In total, 98 participants completed the CESE and the SF-36 at the same time. Correlations between the CESE scale and SF-36 domains were calculated. These results illustrate that the correlation between the two instruments was acceptable. Physical domains of SF-36 including physical functioning ( $r = 0.54$ ), physical role functioning ( $r = 0.39$ ), bodily pain ( $r = 0.39$ ), general health perceptions ( $r = 0.59$ ), and physical component summary (0.49) significantly correlated with the total score of the CESE ( $P < 0.001$ ). Emotional role functioning and social role functioning were also two mental dimensions that significantly correlated with total CESE ( $r = 0.33$  and  $r = 0.47$ , respectively). However, the correlation between the physical component of SF-36 and CESE was 0.41, while the correlation between the mental component of SF-36 and CESE was 0.34.

**Convergent/divergent validity:** The mean ESES score was  $39.62 \pm 16.43$ . There was a strong correlation between the CESE and ESES ( $r = 0.77$ ;  $P < 0.010$ ), providing a good convergent validity of the CESE.

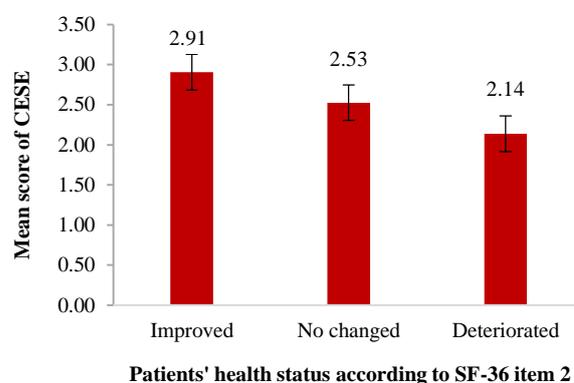
The mean score of the anxiety and depression subscales of the HADS were  $7.63 \pm 3.12$  and  $8.60 \pm 2.98$ , respectively. There was a significant and negative correlation between the mean CESE score and HADS total and subscales scores ( $P < 0.001$ ). The Pearson coefficients between CESE, and the anxiety and depression subscales and total HADS score were -0.45, -0.57, and -0.57, respectively, indicating a high divergent validity of the CESE.

**Discriminant validity:** Known-groups comparison analysis showed significant differences in the total CESE score between patients who had experienced MI and patients who had undergone CABG. Patients who had undergone CABG had significantly lower mean total CESE score than those who had not undergone CABG ( $2.21 \pm 0.64$  vs.  $2.80 \pm 0.65$ ;  $P < 0.001$ ). Similarly, patients with MI had significantly lower total CESE score than those without this clinical diagnosis ( $2.21 \pm 0.66$  vs.  $2.80 \pm 0.66$ ;  $P < 0.001$ ). Obese patients had lower CESE score than patients who had a BMI of lower than 30 ( $2.26 \pm 0.57$  vs.  $2.7 \pm 0.69$ ;  $P < 0.001$ ). In addition, patients with dyslipidemia reported significantly lower mean CESE scores than those without dyslipidemia ( $2.44 \pm 0.61$  vs.  $3.04 \pm 0.69$ ;  $P < 0.001$ ).

In addition, the mean score of CESE was only significantly different between patients who were categorized as “deteriorated” and “improved” (2.17 vs. 2.89;  $P < 0.050$ ) and between “deteriorated” and “not changed” subgroups (2.17 vs. 2.53;  $P < 0.050$ ) in terms of the health transition item (Figure 1).

**Construct validity:** The result of Bartlett’s test of sphericity was significant ( $P < 0.001$ ), indicating the appropriateness of data to perform factor analysis.

The KMO value of sampling adequacy was 0.85, more than the recommended index of 0.60.<sup>44</sup>



**Figure 1.** The mean score of the Cardiac Exercise Self-Efficacy Scale (CESE) according to health status

Viramax rotation was applied for factor analysis. The result showed that the Persian version of the CESE had four factors. As shown in table 3, factor 1, including items 1, 2, 3, 5, 6, 8, 11, 12, and 15, is related to knowledge of the exercise for cardiac patients, thus we called this factor “cardiac exercise self-efficacy in knowledge”.

**Table 3.** The factor structure of the Persian version of the Cardiac Exercise Self-Efficacy Scale by principal components factor analysis

| Item       | Questions                                                      | Factor 1           | Factor 2                     | Factor 3                 | Factor 4          |
|------------|----------------------------------------------------------------|--------------------|------------------------------|--------------------------|-------------------|
|            |                                                                | CESE for Knowledge | CESE for Overcoming Barriers | CESE for Time Management | CESE for Recovery |
| CESE1      | “Warming up” before exercise                                   | 0.535              |                              | 0.585                    |                   |
| CESE2      | Exercising without getting chest pain                          | 0.556              |                              | 0.512                    |                   |
| CESE3      | Knowing when I have exercised too much and need to stop        | 0.831              |                              |                          |                   |
| CESE4      | Exercising when it is inconvenient                             |                    |                              |                          | 0.567             |
| CESE5      | Knowing what my heart rate should be before and after exercise | 0.867              |                              |                          |                   |
| CESE6      | “Cooling down” after exercise                                  | 0.746              |                              |                          |                   |
| CESE7      | Fitting exercise into a busy day                               |                    |                              | 0.782                    |                   |
| CESE8      | Enduring strenuous exercise                                    | 0.532              | 0.547                        |                          |                   |
| CESE9      | Knowing what exercise is healthy for me                        |                    | 0.875                        |                          |                   |
| CESE10     | Knowing when I can increase my exercise level                  |                    | 0.880                        |                          |                   |
| CESE11     | Enduring moderate exercise                                     | 0.862              |                              |                          |                   |
| CESE12     | Taking my heart rate before and after exercise                 | 0.805              |                              |                          |                   |
| CESE13     | Resuming my pre-hospital level of activity                     |                    |                              |                          | 0.825             |
| CESE14     | Enduring light exercise                                        |                    |                              |                          | 0.746             |
| CESE15     | Exercising for at least twenty minutes three times each week   | 0.486              |                              | 0.543                    |                   |
| CESE16     | Exercising at home by myself                                   |                    | 0.537                        |                          |                   |
| % variance |                                                                | 41.650             | 11.210                       | 10.62                    | 7.540             |
| Eigenvalue |                                                                | 6.660              | 1.790                        | 1.700                    | 1.200             |

CESE: Cardiac Exercise Self-Efficacy Scale

The values under 0.45 was removed from the table.

In addition, factor 2, including items 8, 9, 10, and 16, is related to “cardiac exercise self-efficacy for overcoming barriers”. Factor 3, including items 1, 15, and 7, is related to “cardiac exercise self-efficacy in time management”. Factor 4, including items 4, 14, and 13, is related to “cardiac exercise self-efficacy for recovery”. However, items 1, 2, and 15 were loaded on both factors 1 and 3 (Table 3).

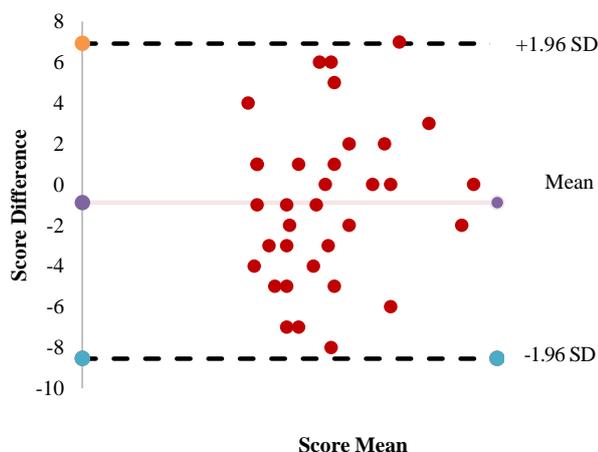
**Reliability:** Cronbach’s alpha for the total score of CESE was 0.87. The correlations between the subscales of CESE and total CESE are presented in table 4. The correlation coefficients between each subscale and the total CESE score ranged from 0.28 (recovery) to 0.92 (knowledge). In test-retest analysis, the ICCs for the total CESE was 0.42 ( $P < 0.001$ ). ICC for each item ranged from 0.51 to 0.74 with a median equal to 0.61, which were within the range of acceptable values.

**Table 4.** Correlations of total Cardiac Exercise Self-Efficacy Scale (CESE) score with each subscale

| CESE subscales      | Correlation with total CESE* |
|---------------------|------------------------------|
| Knowledge           | 0.92                         |
| Overcoming Barriers | 0.70                         |
| Time Management     | 0.80                         |
| Recovery            | 0.28                         |

\*Correlation is significant at the 0.01 level (2-tailed).  
CESE: Cardiac Exercise Self-Efficacy Scale

In the Bland-Altman analysis, difference between the test and the retest scores plotted against the mean results (Figure 2). None of the measurements was out of the  $\pm 2$  SD range. The Bland-Altman analysis showed low bias (-0.88) and limits of agreement (-8.5 to 6.7).



**Figure 2.** Bland-Altman graphic representation of the test and retest. The horizontal purple line shows the mean bias of  $-0.88 \pm 3.90$ .

## Discussion

This study aimed to evaluate the psychometric properties of the Iranian version of the CESE in patients with CVD. The results of our study showed that the Persian version of the CESE has good validity (i.e., high level of construct validity, concurrent validity, convergent/divergent validity, discriminant validity, and construct validity) and reliability (i.e., a medium ICC and high Cronbach’s alpha).<sup>37</sup> CVR and CVI were not reported in the original version of the questionnaire.<sup>17</sup> This study was the first to examine the floor and ceiling effect of the CESE. The CESE has a low floor and no ceiling effect for the total scale, indicating acceptable difficulty in the items for this population. However, such an evaluation has not been implemented in the original version.<sup>17</sup> All items were responded, meaning that all items in the Persian version of the CESE were clear and applicable for patients. However, when we consider individual items, some patients did not respond in a similar range and had a variation, especially for item 13. This item asks the patients to rate their confidence in resuming their pre-hospital level of activity. An explanation for this matter might be that some of the patients were hospitalized more than 1 year ago. Therefore, they had forgotten their level of activity before hospitalization and this may be the cause of their delay in responding.

The concurrent validity of the CESE was approved in our study, in which significant and moderate correlations were found between the CESE scale and all physical subscales of the SF-36. These correlations were significant in only two mental subscales including social role functioning and emotional role functioning. It has been generally accepted that such a moderate correlation is desirable.<sup>38</sup> This is also consistent with the results of some studies indicating a strong correlation between self-efficacy and functional status, exercise behavior, QOL, and social support in patients with CVD.<sup>45-47</sup>

Additionally, the discriminant validity of the CESE was confirmed; significant differences were found in the CESE score between the patients with and without CABG, and MI. Moreover, 2 comorbidities were negatively associated with patients’ level of exercise self-efficacy. In an alternative approach, to examine discriminant validity, we identified individuals with “improved”, “not changed,” and “deteriorated” health status according to their response to the health transition item in the SF-36. The CESE could discriminate between groups that were categorized as

“deteriorated” and those categorized as either “not changed” or “improved” in their health status.

In addition, the CESE demonstrated good convergent validity with significantly strong correlation with the ESES. Noroozi et al. validated the Persian version of Bandura’s ESES in patients with DM.<sup>14</sup> Bandura’s ESES has also been validated in an Australian cardiac rehabilitation setting.<sup>15</sup> Regarding the strong correlation between ESES and CESE, it seems that two items are similar in their concepts. However, the CESE is a cardiac-specific instrument compared to the ESES. Thus, we expected the CESE to be a better tool than the ESES for the measurement of exercise self-efficacy among patients with CVD.<sup>48</sup> The CESE also demonstrated good divergent validity with significantly negative correlations with the total score of the HADS, and its anxiety and depression subscales. This is also consistent with some studies indicating a significant negative relationship between physical activity and emotional problems such as depression and anxiety among patients with coronary artery disease (CAD).<sup>49-51</sup>

An exploratory principal component factor analysis identified a 4-factor structure model, explaining 71.02% of the observed variance (knowledge: 41.65, overcoming barriers: 11.21, time management: 10.62, and recovery: 7.54). Each item had a factor loading of 0.45 or higher, which was considered acceptable.<sup>52</sup> Furthermore, 3 items were loaded on 2 factors. Since the factor loadings were approximately equivalent in magnitude for these items on both factors, they could be categorized under both of them. Therefore, item 1 (“warming up before exercise”), item 2 (“exercising without getting chest pain”), and item 15 (“exercising for at least 20 minutes 3 times each week”) were categorized under both subscales 1 and 3 because the three items could evaluate both knowledge and time management of patients. However, these results were inconsistent with the original version of the CESE that is one-dimensional. This may be due to the difference between the settings of the studies and the inclusion of all general CAD patients in the original study, which was conducted in the cardiac rehabilitation setting. To our knowledge, no further studies have been conducted on the validation of the CESE, and therefore, no well-documented resource is available with which to compare our results. In the study of Dong et al.,<sup>53</sup> in which the psychometric properties of the ESES were evaluated in Chinese-speaking stroke patients, a two-factor model was reported, which was also

inconsistent with the original version of Kim et al.<sup>54</sup> The difference between models reported in these languages might be because patients’ perceptions of their confidence in performing designated exercise behaviors can often differ according to different culture and social contexts.

In the present study, the internal consistency of the CESE was confirmed with a Cronbach’s alpha of 0.87 for the total scale. In addition, test-retest reliability was assessed to evaluate the stability of the CESE over 2 weeks. Moreover, test-retest agreement in the Bland–Altman plot was evaluated. The ICC was lower than we expected (ICC: 0.42;  $P < 0.001$ ). This may be due to some patients’ participation in rehabilitation programs and management by rehabilitation staff during the 2 interval weeks of test-retest. Hence, some patients did not have similar health care conditions during this period. However, the Bland-Altman plot approved the reliability of the questionnaire. This finding was in agreement with those reported in the validation of the ESES.<sup>15</sup>

**Limitations:** This study had four limitations. First, the study participants were recruited from one hospital in Western Iran, which may affect the generalizability of the findings to a wider population in Iran. Second, Although the explanatory factor analysis results indicated that the four-factor structure was perfect, this method is a data-driven method for exploring the factor structure and it should not be used to confirm factor structure.<sup>41</sup> Therefore, further studies are required to confirm the factor structures of the CESE reported in this paper using confirmatory factor analysis. Third, the value of ICC was low, which is probably due to improving patients’ medical condition. Forth, our study was a cross-sectional study; thus, it does not allow the assessment of the responsiveness of the Persian version of the CESE to some patients’ clinical variation over time. Therefore, it is recommended that future studies assess these changes using longitudinal data.

## Conclusion

The study results confirmed that the Persian version of the ESES is a valid and reliable instrument for the assessment of CVD patients’ confidence level in performing regular exercise behaviors. Healthcare professionals can use it in Persian-speaking patients with CVD to conduct psychological interventions to improve their self-efficacy and persistence in exercise behaviors.

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### Conflict of Interests

Authors have no conflict of interests.

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