Prospective Validation of the Chinese Version of the Self-Efficacy for Exercise Scale among Middle-aged Patients with Coronary Heart Disease

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Declaration of Conflicting Interests

The authors declare that there is no conflicts of interest.

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Abstract

Purpose: To further evaluate the psychometric properties of the Chinese version of the Self-Efficacy for Exercise Scale (SEE-C) among middle-aged outpatients with coronary heart disease (CHD).

Design: Psychometric evaluation design

Methods: A convenience sample of 355 CHD patients was recruited and followed up at 3 and 6 months. Cronbach's alpha, construct validity (exploratory factor analysis), and concurrent and predictive validity were examined.

Findings: The SEE-C had a single factor structure that was stable over time and had high internal consistency. Baseline SEE-C scores were significantly and positively associated with quality of life and total exercise time per week, and significantly and negatively associated with anxiety and depression. They also significantly predicted total exercise per week at the 3- and 6-month follow-ups.

Conclusions: The SEE-C is a robust, reliable and valid measure of exercise self-efficacy for middle-aged Chinese CHD outpatients.

Clinical Relevance: The SEE-C can assess patients' exercise self-efficacy, so that appropriate interventions to improve exercise self-efficacy can be provided.

Keywords: Self-efficacy for exercise scale; coronary heart disease; reliability and validity; psychometric properties

Introduction

Heart disease is the number one cause of death worldwide. The most common type is coronary heart disease (CHD), which accounted for 42.3% of all deaths due to heart disease in 2012 (World Health Organization, 2016). The progression of deteriorated cardiac function affects patients' physical and psychological functioning, as well as their quality of life. Anxiety and depression are common emotional sequelae after a severe cardiac event (Chair, Lee, Lopez, & Ling, 2007; Woods, Froelicher, Motzer, & Bridges, 2010). More than 85 million US adults are living with some forms of heart disease (American Heart Association, 2015). Heart disease is also a leading cause of death in both mainland China and Hong Kong. In Hong Kong, those with CHD constitute more than 80% of heart disease patients, and an increasing trend of occurrence has been identified among middle-aged adults aged over 40 (Center for Health Protection, 2013a,b). CHD is a disease caused by unhealthy lifestyles; its progression can be favourably altered with interventions for lifestyle changes and modification of risk factors (Conn, Hafdahl, Moore, Nielsen, & Brown, 2008; Gary, 2006; Sung, 2009). Recent literature emphasizes the importance of improving adherence to physical activity with appropriate strategies to reduce cardiovascular risk and mortality and to improve quality of life (Fleig, Lippke, Pomp, & Schwarzer, 2011; Wang et al., 2012; World Health Organization, 2015).

Self-efficacy refers to confidence in one's ability to perform a behavior in a given

44 situation (Bandura, 1997), which has been recognized as an important psychological
45 construct in behaviour change, including both the behaviour intention at the early stage,
46 motivation, and the maintenance of health behaviour change, such as exercise behaviour,
47 quitting smoking and diet control (Everett, Salamonson, & Davidson, 2009; Lee et al., 2009;
48 Luszczynska & Sutton, 2006). It has been argued that an individual's confidence in carrying
49 out different behaviours may vary across behaviours and contexts (Bandura, 1997). For
50 exercise behaviour, self-efficacy for exercise refers to an individual's resources for coping
51 with different types of stress in sustaining physical exercise, such as the environment,
52 physical condition and social support. People with higher exercise self-efficacy are expected
53 to be more likely to engage in exercise behavior and hence have better adherence and
54 sustainability in exercising (Gary, 2006; Pavey et al., 2012; Zhu, Ho, Sit, & He (2014).
55 Hence, boosting exercise self-efficacy or preventing a reduction in exercise self-efficacy is an
56 important goal for the rehabilitation of patients with CHD.
57 To date, several scales have been developed to measure exercise self-efficacy, including
58 the 9-item Self-Efficacy for Exercise Scale (SEE) (Resnick & Jenkins, 2000), the 16-item
59 Cardiac Exercise Self-Efficacy Instrument (Hickey, Owen, & Forma, 1992), the 18-item
60 Bandura's Exercise Self-Efficacy Scale (Bandura, 2006), the 10-item Spinal Cord Injury
61 (SCI) Exercise Self-Efficacy Scale (Kroll, Kehn, Ho, & Groah, 2007) and the 3-item Tai Chi
62 exercise self-efficacy scale (Li, McAutry, Harmer, Duncan, & Chaumenton, 2001). All five

63 scales have been examined for their psychometric properties, but the last two are too specific
64 – Kroll et al.'s (2007) scale was for patients with spinal cord injury, while Li et al. (2001)
65 focused on Tai Chi exercise. Of the first three scales, the SEE is short, giving it a distinct
66 advantage in terms of its feasibility to be used in a busy clinical setting or studies with
67 multiple measures. The SEE has been shown to have good reliability and validity in a sample
68 of older adults living in a continuing care retirement community, and has been widely used to
69 assess people's confidence in continuing to exercise in the face of barriers to exercise in the
70 US population (Leung, Wing, Kwong, Lo, & Shum, 1999; Resnick & Jenkins, 2000; Resnick,
71 Palmer, Jenkins, & Spellbring, 2000; Resnick, Luisi, Vogel, & Junaleepa, 2004). Later, the
72 scale was translated into Chinese (SEE-C) and validated in terms of internal consistency and
73 concurrent validity in a sample of older adults living in the community in Taiwan (Lee et al.,
74 2009). However, other important properties, such as test-retest reliability and predictive
75 validity, have not been examined. Further, its applicability in middle aged adults in a clinical
76 setting is still uncertain: Item 6 of the scale, 'you were too busy with other activities',
77 included by the original developers, is a common barrier to regular exercise for younger
78 adults, but not for older adults (Resnick & Jenkins, 2000). Given that more patients have
79 CHD at their middle age, the purpose of this study was thus to further investigate the
80 psychometric properties of the SEE-C among middle-aged outpatients with CHD.
81

Methods

Participants and procedure

The present study was based on a baseline cross-sectional survey and two follow-ups of a randomized controlled trial on an e-health educational intervention for exercise adherence among middle-aged patients with coronary heart disease in Hong Kong. The details and procedure of the trial have been reported elsewhere (Wong, Leung, Chair, & Sit, 2013). Chinese patients with CHD attending regular follow-up treatment at the specialist clinics of two regional hospitals in Hong Kong were eligible if aged 30 to 65 and not diagnosed with physical, mental, visual, or cognitive impairments. Patients with contra-indications to physical exercise were excluded. A total of 441 patients were recruited, with 221 allocated to the experimental group receiving the e-health intervention and 220 in the control group receiving usual care from the hospital between June 2013 and May 2014. Participants were asked to provide written consent after receiving an explanation about the study. They then completed the baseline questionnaire, with assistance from a research assistant (RA) if requested. Two consecutive follow-ups, at 3 and 6 months, were conducted by the RA or trained student helpers in a private room at the follow-up clinic. Ethical approval of the study was obtained from the Joint Chinese University of Hong Kong-New Territories East Cluster Clinical Research Ethics Committee (CRE-2011.022-T). Participants were informed that their participation was voluntary and that they were able to withdraw from the study at any time.

Measures

The Chinese version of the Self-Efficacy for Exercise Scale (SEE-C) consists of nine items to measure a participant's confidence in performing exercise under various circumstances that might affect exercise participation (Resnick & Jenkins, 2000). Items are rated on an 11-point Likert scale from 0 (not confident) to 10 (very confident) and are summed to generate a total SEE-C score, with higher scores indicating more confidence in performing exercise. The SEE-C was shown to have good internal consistency (α = 0.75) and construct validity in a sample of Taiwanese older adults (Lee et al., 2009).

The Chinese version of the Hospital Anxiety and Depression Scale (HADS) is used to measure depression and anxiety in participants (Leung, Ho, Kan, Hung, & Chen, 1993). It consists of 14 items and acts as a reliable instrument for detecting states of depression and anxiety, with seven items for each, in the setting of a hospital medical outpatient clinic. Each participant rated his or her feelings on the basis of symptoms that had occurred in the preceding week, using a four-point Likert scale of increasing intensity from 0 (absence of symptoms) to 3 (severe symptoms). Aggregate scores for anxiety and depression were created by summing the scores of the corresponding items, each with a possible range of 0-21, with higher scores indicating more severe anxiety and depressive symptoms. Acceptable reliability of the HADS was reported in Chinese samples from both clinical and community settings (Leung et al. 1999; Chan, Leung, Fong, Leung, & Lee, 2010). Cronbach's alpha values for

anxiety and depression subscales at baseline in the present study were 0.87 and 0.78 respectively.

The Chinese (HK) version of the Health Survey Questionnaire Version 2 (SF-12v2) was used to measure the physical and mental health status of the participants (Lam, Tse, & Gandek, 2005). SF-12v2 consists of 12 questions that are summarized into a physical component (PCS) score and a mental component score (MCS). The SF-12v2 has good psychometric properties, including acceptable internal consistency, test-retest reliability, criterion validity and construct validity in a random sample of Chinese adults (Lam, Lam, Fong, & Huang, 2013). In the present study, the Cronbach's alpha values of PCS and MCS at baseline were 0.703 and 0.753 respectively.

Total exercise time per week was measured by two items regarding the number of exercise sessions and length of each session in minutes that the participant had performed on average in a week. A total exercise per week score was then computed by multiplying the responses from these two items.

Data analysis

Continuous data are expressed as means and standard deviations, and categorical data as percentages. Exploratory factor analyses (EFA) using maximum likelihood estimation with Varimax rotation were used to identify the factor structure of the SEE-C using the baseline data. Sampling adequacy was assessed using Kaiser-Meyer-Olkin (KMO) analysis (Kaiser,

1970). The KMO statistics varied from 0 to 1. Values of the KMO statistic ≥ 0.8 were considered as good, indicating that it is appropriate to perform factor analysis on the items (Hutcheson & Sofronious, 1999). Factor retention was based on three criteria: (1) eigenvalues ≥ 1, (2) scree plot and (3) interpretability of factors. In addition, only items with loadings ≥ 0.3 were retained (Kline, 1994). To test the stability of the factor structure of the scale over time, we performed a cross-validation examination by applying EFA to the data at the 3- and 6-month follow-ups separately. The internal consistency of the scale was determined by Cronbach's alpha using the data collected at baseline and at the 3- and 6-month follow-ups separately. The floor and ceiling effects of the SEE-C scores in the sample at the three data time points were determined by the percentages of lowest and highest possible scores. Floor and ceiling effects lower than 30% were considered acceptable (Kane, 2006). Concurrent construct validity was examined by correlations of SEE-C with total exercise per week, depression and anxiety from HADS, and PCS and MCS from SF-12v2 at the baseline. Predictive validity was checked by whether the SEE-C score at baseline predicted total exercise per week at the 3- and 6-month follow-ups by linear regression with adjustment to other variables. All tests were performed using SPSS version 20.0. For all statistical tests, a p-value <0.05 was considered as statistically significant.

Results

Data treatment and sample characteristics

158 Among the 441 participants, 86 were excluded from the analyses because 75 were lost to
159 follow-up and 11 did not complete the SEE-C in at least one of the three time points. Among
160 the 11 incomplete cases, seven had missing items > 20%. Finally, 355 cases (80.5%) that had
161 provided complete SEE-C data at baseline and the two follow-ups were included in the
162 analyses. The sample consisted of more male subjects (66.2%). They had a mean age of 51.1
163 years (SD=5.0) and a mean BMI of 25.8 kg/m^2 (SD=3.9). The majority of participants were
164 married (80.9%) and employed (79.2%), perceived an average financial status (72.7%), were
165 non-smokers (88.2%), lived with family (91.5%) and had completed secondary school
166 (66.2%) (Table 1).

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167 *Insert Table 1 about here*

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168 *Factor structure*

169 The number of factors of the nine SEE-C items was subjected to exploratory factor
170 analysis. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.885 for the baseline
171 data, 0.897 for the 3-month follow-up and 0.897 for the 6-month follow-up, indicating a
172 'good' level of inter-correlation among the items at all three time points, hence it is
173 appropriate to perform factor analysis (Hutcheson & Sofronious, 1999). The results of EFA
174 revealed the nine SEE-C items loaded on one factor, explaining 56.71% of the variance for
175 the sample at the baseline. The one-factor solution was also retained for the data collected at
176 the 3- and 6-month follow-ups, which explained 62.93% and 66.34% of the variance

177 respectively. All nine items loaded highly on this single component, with factor loadings
178 ranging from 0.647 to 0.900 for the sample at baseline and the two follow-ups, indicating
179 acceptable factor loadings (Kline, 1994) (Table 2).

180 *Insert Table 2 about here*

181 *Reliability and floor and ceiling effects*

182 Cronbach's alpha was calculated for the total SEE-C scale to determine the internal
183 consistency of the scale. The SEE-C demonstrated acceptable internal consistency.
184 Cronbach's alpha values were high in the sample at baseline, 3 months and 6 months (> 0.90)
185 (Table 3). The item-total scale correlations ranged from 0.60 to 0.78 for the scale at baseline,
186 from 0.66 to 0.84 at 3 months, and from 0.55 to 0.85 at 6 months respectively. Several inter-
187 item correlation coefficients were > 0.80, one pair at baseline (Item 8/Item 9), two pairs at 3
188 months (Item 6/Item 7 and Item 8/Item 9) and three pairs at 6 months (Item 6/Item 7; Item
189 7/Item 8; and Item 8/Item 9), indicating item redundancy. Using 30% as the cut-off, there was
190 no floor and ceiling effect for the SEE-C at baseline or at the 3- and 6-month follow-ups.

191 *Insert Table 3 about here*

192 *Concurrent and predictive validity*

193 The results of correlation analysis showed that the SEE-C scores were significantly and
194 positively associated with total exercise time per week and MCS, and significantly and
195 negatively associated with anxiety and depression. All the correlations were in the expected

196 direction, although the extent of the correlations was small, with the exception that with total
197 exercise per week to a moderate extent (Table 4). For predictive validity, linear regression
198 analyses also showed that SEE-C score at baseline was significantly associated with total
199 exercise per week at the 3-month (β = 0.347, $p < 0.001$) and 6-month follow-ups (β =
200 0.274, $p < 0.001$) after controlling for age, gender, educational level, smoking status,
201 employment status and treatment group.

202 *Insert Table 4 about here*

203 **Discussion**

204 This study aims to further examine the psychometric properties of the SEE-C in a
205 sample of Chinese middle-aged patients with CHD living in the community in Hong Kong. In
206 line with Lee et al.'s study (2009), the current results of exploratory factor analyses supported
207 a unidimensional structure of the scale. We were able to replicate the results of the scale's
208 factor structure in the sample with data collected at baseline and at 3-month and 6-month
209 follow-ups, showing the stability of the factor structure of the SEE-C. In particular, the factor
210 loadings of Item 6, 'You were too busy with other activities', was similar to other items,
211 suggesting this item made a similar contribution, rather than a greater contribution, to the
212 underlying concept among middle-aged adults in the current sample. These findings
213 generalize previous findings regarding the factor structure of the SEE-C to the subpopulation
214 of middle-aged adults with CHD in the Chinese context.

The results showed that the SEE-C has high internal consistency. The Cronbach's alpha values of the sample at baseline and at 3- and 6-month follow-ups were similar to those in the other two studies conducted in the West (Resnick & Jenkins, 2000; Rydwik, Hovmoller, & Rostrom, 2014), but higher than those reported by Lee et al.'s study (2009). This discrepancy might be explained by the participants' profiles: as compared to Lee et al.'s study (2009), the participants in the current study were similar to those in the two western studies: they were well educated, more were male, and they had a lower exercise self-efficacy score. Further independent studies examining the individual impacts of the characteristics of the subjects on the internal consistency of the scale are warranted.

Consistent with previous validation studies (Lee et al., 2009; Resnick & Jenkins, 2000; Resnick et al., 2004; Resnick et al., 2000; Rydwik et al., 2014), significant relationships were observed of the SEE-C with total exercise per week, anxiety, depression, mental health and physical health components. The direction of these correlations was as predicted, providing evidence for construct validity of the SEE-C. Our study has generated new knowledge to further support the psychometric properties of the SEE-C in a cardiac rehabilitation setting, including the predictive validity of the SEE-C, by demonstrating its ability to predict total exercise time per week at 3-month and 6-month follow-ups, and the sensitivity to change over time of the scale by showing positive and significant correlations between changes in scores on the SEE-C and changes in total exercise per week from baseline to 3-month and 6-

month follow-ups.

There were a few limitations to the current study. First, the factor structure for the SEE-C was replicated in the same sample, and cross-validation using new samples would be necessary to further confirm its factor structure. Second, the study was limited in that all data were collected in the cardiac clinics of two public hospitals; patients whose follow-ups were held at private clinics were not captured. In Hong Kong, patients who choose to be followed-up in private clinics usually have a better financial status, and this difference might have limited the generalizability of the study results. In addition, we were unable to examine the stability of the scale over time, since all participants had received some forms of intervention. Also, the measure used to quantify total exercise per week in this study only captured the total number of exercise sessions and the length of each session per week on average; it did not adequately measure the intensity of the exercise performed. An objective measurement for exercise, such as accelerometers, could be used in future studies.

Conclusions

The self-efficacy for exercise scale used in this study is a reliable and valid measure, and is appropriate for use in middle aged Chinese CHD patients. In addition to further confirming that the SEE-C has a one-factor structure, acceptable internal consistency, and concurrent construct validity, our findings further support the stability of the factor structure and the predictive validity of the scale over time. The SEE-C is short, easy to understand and

administer, and considered as a feasible and practical measure to be used in evaluation of any intervention in a Chinese CHD population, in particular in a busy clinical setting. Thus, professionals such as rehabilitation nurses, physical therapists, and occupational therapists can use this tool to measure the level of exercise self-efficacy prior to the planning and implementation of health activities in promoting exercise for CHD patients. People with higher exercise self-efficacy are more committed to do physical exercise. On the other hand, in the case of those with low level of exercise self-efficacy, nurse practitioners should be aware of their patients' needs and provide behavioral modelling and verbal persuasion to increase their exercise self-efficacy.

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Table 1. Characteristics of participants (n = 335)

Variable	
Age, mean±SD	51.1±5.0
Gender, n (%)	
Female	120 (33.8)
Male	215 (64.2)
Marital status, n (%)	
Married	284 (80.9)
Single	42 (12.0)
Separated/Divorced/Widowed	25 (7.0)
Unknown	4 (1.1)
Educational level, n (%)	
Below primary school	2 (0.6)
Primary school	45 (12.7)
Secondary school	235 (66.2)
Tertiary	73 (20.6)
Residential status, n (%)	
Live alone	21 (5.9)
Live with family	325 (91.5)
Unknown	9 (2.5)
Employment status, n (%)	
Currently employed	281 (79.2)
Housewife	38 (10.7)
Unemployed	2 (0.6)
Retired	32 (9.0)
Unknown	2 (0.6)
BMI, mean±SD	25.8±3.9
Smoking status, n (%)	
Current smoker	42 (11.8)
Current non-smoker	313 (88.2)
Perceived financial status, n (%)	
Good	73 (20.6)
Average	258 (72.7)
Poor	20 (5.6)
Unknown	4 (1.1)

Table 2. Factor loadings on exploratory factor analysis of SEE-C at baseline, 3-month and 6-month follow-ups (n = 355)

Item	Factor loading		
	Baseline	3-month	6-month
1. The weather was bothering you	0.668	0.747	0.787
2. You were bored by the program or activity	0.656	0.739	0.780
3. You felt pain when exercising	0.732	0.720	0.740
4. You had to exercise alone	0.719	0.693	0.647
5. You did not enjoy it	0.700	0.770	0.775
6. You were too busy with other activities	0.776	0.848	0.881
7. You felt tired	0.818	0.856	0.900
8. You felt stressed	0.842	0.855	0.890
9. You felt depressed	0.839	0.886	0.893
Variance explained	56.71%	62.93%	66.34%

Table 3. Reliability and score distribution of SEE-C at baseline, 3-month and 6-month follow-ups (n = 355)

	Mean±SD	Cronbach's alpha	Floor/ceiling effect	
			Lowest score, %	Highest score, %
Baseline	39.3±20.9	0.903	10.1	0.6
3-month	43.0±22.2	0.925	9.0	1.1
6-month	46.2±23.5	0.935	9.3	2.0

Table 4. Correlations of Self-Efficacy for Exercise scores with health-related variables at baseline (n = 355)

	SEE-C	p-value
Total exercise time per week	0.33	< 0.001
Anxiety	-0.25	< 0.001
Depression	-0.24	< 0.001
Physical Component Score	0.13	0.016
Mental Component Score	0.22	< 0.001