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Testing the Reliability and Validity of the Self-Efficacy for Exercise Scale

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Abstract

Background: The measure for self-efficacy barriers to exercise was developed for adults and revised on the basis of quantitative and qualitative research with older adults so it would be more appropriate for that age group.

Objectives: To test the reliability and validity of the Self-Efficacy for Exercise (SEE) Scale.

Methods: Initial reliability and validity testing was performed using a sample of 187 older adults living in a continuing care retirement community. The average age of the participants was 85 ± 6.2 years, and most were White (98%), female (82%), and unmarried (80%). Face-to-face interviews were completed and included the SEE, the 12-item Short Form Health Survey (SF-12), and the Expected Outcomes and Barriers for Habitual Exercise scale. Exercise activity was based on verbal report of participation in aerobic exercise (walking, swimming, biking, or jogging).

Results: There was sufficient evidence of internal consistency ([alpha] = 0.92), and a squared multiple correlation coefficient using structural equation modeling provided further evidence of reliability (R^2 ranged from 0.38 to 0.76). There was evidence of validity of the measure based on hypothesis testing: Mental and physical health scores on the SF-12 predicted efficacy expectations, and efficacy expectations predicted exercise activity. Lambda X estimates (all estimates >= 0.81) provided further evidence of validity.

Conclusion: Preliminary testing provided evidence for the reliability and validity of the SEE scale. Future testing of the scale needs to be done with young old adults and subjects from different socioeconomic and cultural groups.

The theory of self-efficacy is based on social cognitive theory (Bandura, 1977, 1986, 1995, 1997), which attempts to predict and explain behavior using several key concepts such as self-efficacy expectations, outcome expectations, and incentives. Self-efficacy expectations are defined as an individual's judgment of his or her confidence to carry out specific behaviors (Bandura, 1986). Judgments of self-efficacy expectation play major roles in determining whether to perform the behavior, the degree of effort individuals invest, and the length of time they persist in a given activity. The stronger the individuals' perceived self-efficacy expectations, the more vigorous and persistent their efforts will be (Bandura, 1986; Bandura & Adams, 1977).

Bandura (1977, 1986) identified four sources of information that influence the individual's cognitive appraisal of efficacy expectations: (a) enactive mastery experience, (b) verbal persuasion, (c) vicarious experience, and (d) physiologic and affective cues experienced during an activity such as pain or anxiety.

Self-efficacy expectations are behavior specific in that they are focused on beliefs about personal abilities with regard to carrying out a particular behavior such as dieting or exercise. Moreover, because self-efficacy expectations are highly context or situation dependent, measurement tools must be developed with respect to a specific task or activity, and for each particular population.

Self-efficacy expectations for a behavior are dynamic in nature. Therefore, measures of these expectations should be designed so they can be administered at different points. Additionally, it is important in measuring self-efficacy expectations to (a) rate self-efficacy expectations before measuring any behavior or administering any other scale that could influence the individual's self-efficacy expectation, (b) include a measure of the behavior of interest that corresponds to the items in the self-efficacy scale, and (c) measure self-efficacy expectations only in respondents capable of performing the activity, or the measure will be one of wishful thinking rather than a belief in the individual's ability to perform a behavior realistically (Bandura, 1977, 1986).

Operationalization of self-efficacy constructs is based on Bandura's (1977) early work with snake phobias. Self-efficacy measures were developed as paper-and-pencil measures that list activities, from least to most difficult, in a specific behavioral domain. In Bandura's (1977) early work, participants were asked to indicate whether they could perform the activity (magnitude of self-efficacy expectations), then evaluated on the level of confidence they had in performing the given activity (strength of self-efficacy). Repeated research demonstrated that there is a strong correlation between magnitude and strength of self-efficacy, and that strength is clinically more significant (Vispoel, 1990).

Initially a 100-point scale, divided into 10-unit intervals ranging from 0 (completely uncertain) to 100 (completely certain), was used to identify the extent of the participant's confidence in performing the activity. Some alternative response formats have been used that differ from the 0 to 10 (corresponding with 0% to 100%) confidence continuum. These include a rating scale that consists of choices from 1 to 5 or 1 to 4, and in some cases a yes/no format. Bandura, and others working closely with him, continue to encourage the 0 to 100 format, although it is not based on empirical evidence.

The health benefits of exercise, both physical and mental, in older adults has been well established (Bravo et al., 1996; Chaouloff, 1997; King, Oman, Brassington, Bliwise, & Haskell, 1997; Sharpe et al., 1997). Unfortunately, getting older adults to adhere to regular exercise programs is difficult. Within the first 6 months of starting an exercise program, 50% of older adults drop out (Desharnais, Bouillon, & Godin, 1986;

Dishman, 1991; Ettinger et al., 1997). To improve exercise activity in older adults, it is useful to consider self-efficacy expectations related to exercise, because these beliefs influence motivation to exercise and actual exercise activity.

Self-Efficacy for Exercise Scale

The Self-Efficacy for Exercise (SEE) scale is a revision of McAuley's (1990; unpublished) self-efficacy barriers to exercise measure, a 13-item instrument that focuses on self-efficacy expectations related to the ability to continue exercising in the face of barriers to exercise. This measure was developed initially for sedentary adults in the community who participated in an outpatient exercise program including biking, rowing, and walking. Prior research demonstrated sufficient evidence for reliability (alpha coefficient = 0.93; McAuley, Lox, & Duncan, 1993) and validity, with efficacy expectations significantly correlated with actual participation in an exercise program (McAuley, 1992, 1993).

The revision of McAuley's self-efficacy barriers to exercise measure was based on a combined quantitative and qualitative study exploring factors that influenced adherence to a regular walking program for older adults (Resnick & Spellbring, 2000). Participants in this study were 24 older adults living in a continuing care retirement community. The average age of the participants was 81 ± 7.2 years, and most were women (n = 21; 91%) and unmarried (n = 18; 88%). All the participants were White and had at least completed high school. There was a statistically significant correlation between efficacy expectations related to exercise and adherence to a regular exercise program (r =.42; p < 0.05). Adherence, defined as participating in 20 minutes of walking exercise two to three times per week, was based on verbal report of the participants and confirmed by records kept by the walking program coordinator.

The participants in this exploratory study identified several items in the measure of self-efficacy barriers that were not relevant to them: (a) a question related to the impact of taking a vacation from exercise activity, (b) issues associated with getting to the exercise location, (c) a feeling self-consciousness about one's appearance while exercising, and (d) lack of encouragement from the leader. These questions were therefore removed from the initial measure. Because the participants felt that two questions in the measure were repetitive (both related to the individuals' interest in the activity), these were combined into a single item (Item 5) on the revised measure (see Appendix A). Qualitative interviews indicated that past experiences with exercise, identification of goals, personality, sensations associated with exercise such as pain, and mood all influenced exercise activity. Therefore, appropriate items relevant to these issues (Items 1, 3, and 9) were added to the SEE measure (see Appendix A).

Reliability and Validity Testing

Sample: The sample included older adults in a continuing care retirement community in an East Coast city. Residents were eligible to participate if they (a) were 65 years of age or older and (b) scored 20 or more on a Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975). Of the 188 eligible participants, one refused to participate, stating that she did not want to answer any questions. Therefore, the sample included 187 older adults, with a mean age of 85 ± 6.2 years.

Procedure: The SEE scale was administered using an interview format. Although this approach introduced an increased likelihood of social response set bias, interviewer administration of the SEE was selected because older adults may be unable and/or unwilling to complete a paper-and-pencil measure (Resnick, 1995). All measures were completed in the same order, starting with efficacy measures. The participants were instructed to listen to the statement and then use numbers from 0 (not confident) to 10 (very confident) to rate present expectations in their ability to walk/exercise for 20 minutes three times per week. Prior research (Jenkins, 1985; Resnick, 1998) demonstrated that older adults were able to respond to the 0 to 10 format, so this format was maintained. The scale was scored by summing the numerical ratings for each response and dividing by the number of responses. This score indicated the strength of efficacy expectations.

Other Measures: The following measures were used in addition to the SEE scale: demographic information, exercise activity, the Expected Outcomes and Barriers for Habitual Exercise scale, and the Short Form-12 (SF-12). Demographic information included age, gender, race, education, and marital status. Regular exercise activity was defined as at least 20 minutes of continuous aerobic exercise (walking, swimming, biking, or jogging) two to three times per week.

The 12-item Short Form Health Survey (SF-12) (Ware, Kosinski, & Keller, 1995, 1996), a measure of health status, is an abbreviated version of the SF-36 (from the Medical Outcomes Study). The SF-12 contains 12 items with forced-choice response options. Two scores are calculated and referred to as mental and physical health summary scores. These health dimensions influence exercise (Stewart, King, & Haskell, 1993). Prior research (Ware et al., 1995, 1996) on reliability and validity of the SF-12 supports the psychometric soundness of this measure. Validity studies have indicated that anticipated changes in health and recovery from psychological diseases were noted by SF-12 summary scores.

The Expected Outcomes for Habitual Exercise scale is a 12-item measure based on descriptive epidemiologic studies (Steinhardt & Dishman, 1989) that asks individuals to identify expected positive outcomes of physical activity. Item responses are based on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scale is scored by adding the responses to obtain the total score and dividing by the number of items. The reliability of this measure was demonstrated by an alpha coefficient of 0.78 and a test-retest correlation of $r = 0.89$ ($p < 0.05$) (Steinhardt & Dishman, 1989). Outcome expectations significantly predicted exercise activity (Steinhardt & Dishman, 1989), providing evidence for the validity of the measure.

Exercise activity focused on adhering to a regular exercise program, defined as participating in 20 minutes of continuous aerobic exercise (e.g., swimming, walking, jogging, or biking) three times per week for at least the preceding 3 months. A 3-month period was chosen because reports show that approximately one third of those who initiate an exercise program drop out by this time (Ettinger et al., 1997). Although self-report depends on the participants' ability to remember events and answer accurately, the ability to recall vigorous activity is higher than for all other daily activities (Durante & Ainsworth, 1996). Moreover, the investigators confirmed the exercise self-report through a review of attendance records for an ongoing walking program and use of the exercise room, both of which were in the Continuing Care Retirement Community (CCRC).

Reliability Testing of the Self-Efficacy for Exercise Scale: The internal consistency of the SEE scale was evidenced by an alpha of 0.70 or more (Nunnally & Bernstein, 1994). Because self-efficacy expectations are behavior specific and dynamic, other traditional tests of reliability based on classical test theory, such as

parallel measures and test-retest, were not appropriate. Therefore, an alternative estimate of reliability using a structured equations approach was used (Bollen, 1989). This approach is based on a definition of reliability stating that reliability of X (test score) is, "the magnitude of the direct relations that all variables have on X" (Bollen, 1989, p. 54). Using a measurement model and structural equation modeling, a squared multiple correlation coefficient R^2 was calculated as the estimate of reliability (Bollen, 1989). Specifically, R^2 provides a gauge of the systematic variance in the observed score that can be explained by each item in the measurement model (Bollen, 1989; Jagodzinski & Kuhnel, 1987; Reuterberg & Gustafsson, 1992).

Validity Testing: Construct validity of the SEE scale was tested using two empirically supported hypotheses: (a) Individuals with better health status are more likely to have stronger self-efficacy expectations (Grembowski et al, 1989), and (b) individuals with better mental health are more likely to have stronger self-efficacy expectations (Bandura, 1997; Ruiz, 1992). Criterion-related validity was tested using concurrent validity. Efficacy expectations related to exercise would be significantly related to exercise activity.

Interpretation of criterion-related validity is influenced by the degree of random measurement error variance in the observed score, as well as by measurement error in the criterion score (Andrews, 1984; Gerbing & Anderson, 1984), and construct validity of a measure depends on whether scores on one measure correlate with scores on other measures (Bollen, 1989). Therefore, an alternative approach to validity testing of the SEE scale was included using structural equation modeling. Specifically, an estimate of the correlation between the latent variable (self-efficacy for exercise) and its measure (each item) was estimated (Bollen, 1989; Reuterberg & Gustafsson, 1992). This estimate is referred to as lambda X in structural equation modeling, and values of 0.5 or more are desirable (Bollen, 1989).

Statistical Analysis: Descriptive analysis of the data was performed with all study variables. Multiple regression was used for hypothesis testing, with four variables (age, gender, mental health, and physical health) included as predictors of self-efficacy expectations. Multiple regression also was used for criterion-related validity. Age and gender were controlled, and efficacy expectations were included as predictors of exercise activity. All regression analyses allowed for a subject-to-variable ratio of 15 to 1, which statistically ensures a reliable regression equation (Stevens, 1992). Structural equation modeling (Lisrel VII statistical program) was used to calculate the squared multiple correlation coefficient for each item and the lambda X values. The sample covariance matrix was used as input, and a maximum likelihood solution was sought.

Results

Most of the participants were White (98%), female (82%), and unmarried (80%). All had at least a high school education. The study was approved by the Institutional Review Board at the University of Maryland, and signed informed consent was obtained before data collection. Mean scores for the study participants on the SEE scale, the SF-12 (physical and mental health subscales), and the Expected Outcomes and Barriers for Habitual Exercise scale are presented in Table 1. Of the 187 participants, 71 (38%) participated in regular exercise activity.

Measure	Mean ± *SD*	Range
Self-efficacy for exercise	5.5 ± 3.0	0–10
Expected outcomes and barriers for habitual exercise	2.9 ± 1.1	1–5
Physical component of health	43.9 ± 11.6	11–62.4
Mental component of health	52.9 ± 8.4	19.7–67.3

SD = standard deviation.

TABLE 1. Mean Scores for Study Measures (*n* = 187)

Reliability Testing: An alpha coefficient of 0.92 was sufficient evidence for the internal consistency of the SEE measure. The squared multiple correlation coefficients ranged from 0.38 (Item 6) to 0.76 (Item 2) (see Figure 1), with three items (Items 4, 6, and 7) having a coefficient less than the desired 0.5 (Bollen, 1989; Pedhazur & Schmelkin, 1991).

How confident are you right now that you could exercise three times per week for 20 minutes if:

	Not Confident									Very Confident
1. the weather was bothering you	0	1	2	3	4	5	6	7	8	9 10
2. you were bored by the program or activity	0	1	2	3	4	5	6	7	8	9 10
3. you felt pain when exercising	0	1	2	3	4	5	6	7	8	9 10
4. you had to exercise alone	0	1	2	3	4	5	6	7	8	9 10
5. you did not enjoy it	0	1	2	3	4	5	6	7	8	9 10
6. you were too busy with other activities	0	1	2	3	4	5	6	7	8	9 10
7. you felt tired	0	1	2	3	4	5	6	7	8	9 10
8. you felt stressed	0	1	2	3	4	5	6	7	8	9 10
9. you felt depressed	0	1	2	3	4	5	6	7	8	9 10

FIGURE 1. Self-efficacy for exercise.

Validity Testing: As hypothesized the SF-12 subscale scores, when controlled for age and gender, significantly predicted SEE scores ($F = 38.9$; $p < 0.05$; $F = 24.3$; $p < 0.05$). The SF-12 subscale scores for mental health accounted for 17% of the variance in SEE scores, and the SF-12 subscale scores for physical health accounted for an additional 4% of the variance in SEE scores. When controlled for age and gender, SEE scores significantly predicted exercise activity ($F = 78.8$; $p < 0.05$), accounting for 30% of the variance in exercise activity.

Many factors have been noted to influence exercise activity including knowledge about the benefits of exercise at an advanced age (Dishman, 1994), impaired health (Blair et al., 1996), fear of injury (Dishman, 1994), and unpleasant sensations associated with exercise (Resnick, 1996; Sharon, Hennessy, Brandon, & Boyette, 1997). These factors likely accounted for the remaining 70% of the variance in exercise activity. Lambda X estimates or the correlations between the latent variable (SEE score) and each item were estimated (Bollen, 1989; Joreskog & Sorbom, 1989). These estimates ranged from 0.61 to 0.87, and all were statistically significant ($p < 0.05$) (see Figure 1).

Discussion

This study provided evidence for the reliability and validity of the SEE scale when used with older adults. Evidence for internal consistency was based on alpha coefficients. However, a number of factors can influence alpha including test length, number of subjects, variance of test results, incomplete tests, and score distribution (Waltz, Strickland, & Lenz, 1991). Therefore, further support for the reliability of the SEE scale was provided using the squared multiple correlation coefficient for each item. Most of the items had squared multiple correlation coefficients of at least 0.50, providing evidence for SEE reliability (Bollen, 1989). Three items (Items 4, 6, and 7) were below 0.50. However, these items had a statistically significant effect on the latent variable, the SEE score, thus providing some evidence of reliability. Item six, which had the lowest R^2, focused on the challenge of exercising when "you were too busy with other activities." Whereas this is a common barrier to regular exercise for younger adults (Steinhardt & Dishman, 1989), older adults, particularly those age 85 years and older, do not identify conflicting activities as a major factor in exercise adherence (Boyette, Sharon, & Brandon, 1997; Resnick & Spellbring, 2000; Sharon et al., 1997). Continued research is needed to explore the reliability of this item with different samples, particularly young-old adults (ages 65 to 75 years), or to consider deletion of the item from the measure.

There is sufficient evidence to show the validity of the SEE scale using construct- and criterion-related validity. As hypothesized, individuals with better physical and mental health were more likely to have stronger efficacy expectations. With controls used for age and gender, a significant relationship was shown to exist between efficacy expectations and the criterion, exercise activity.

The validity of the SEE scale was strengthened further by estimates of how well the observed indicators (each item on the measure) served as a measurement instrument for the construct (self-efficacy related to exercise). These lambda estimates all were statistically significant (.61 or more; $p < 0.05$), providing strong evidence that each item reflected self-efficacy expectations.

Continued research is needed to accrue evidence of SEE scale reliability and validity. Of particular concern is the selectivity of the sample, in which most of the participants were White and well educated. Moreover, the participants in this study lived in a continuing care retirement community, which has an ongoing walking program, an exercise room, and a safe indoor environment wherein residents can walk. Consequently, these individuals were exposed to many sources of efficacy information to reinforce a generally high level of efficacy expectations. Further testing of the measure is needed with older adults from other socioeconomic and cultural groups such as African American, Asian, and Mexican, and with young-old adults (ages 65 to 75 years).

The findings from this study provide support for the reliability and validity of the SEE scale. The scale, measuring efficacy expectations related to aerobic exercise, can identify older adults with low self-efficacy expectations.

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Key Words: exercise; measurement; self-efficacy expectations

IMAGE GALLERY

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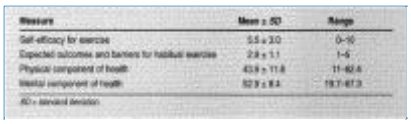

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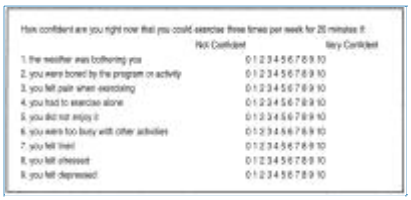
SD = standard deviation

Table 1



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	Not Confident									Very Confident
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3. you felt pain when exercising	0	1	2	3	4	5	6	7	8	9 10
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Figure 1