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RESEARCH BRIEF

Validation of the exercise self-efficacy scale (ESE-S) for increased adherence to physical activity

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ABSTRACT

Background: Various self-efficacy instruments have been used to predict exercise behavior. Many of these scales have been shown to be valid and reliable measures for the strength dimension of self-efficacy, but have overlooked the construct's dimensions of magnitude and generality. This study established the Exercise Self-Efficacy Scale (ESE-S), a measure of the strength, generality, and magnitude dimensions of exercise self-efficacy, as a valid tool towards the promotion and adherence of routine physical activity.

Methods: Using a non-experimental, cross-sectional design, the ESE-S was administered to individuals aged 18 and older (n=270) who were conveniently recruited from a large city located in Ohio. Participants were employees of a large, national company and consented to participate in an employee wellness campaign over a two-day period. Participants completed the 24-item ESE-S onetime and demographic data were not collected. Confirmatory factor analysis was used to examine the 4-factor hypothesized structure of the ESE-S.

Results: The confirmatory analysis showed that the data did not conform to the factorial structure as originally hypothesized, but did retain a 4-four factor solution. Final factors identified from the confirmatory analysis were internal strength, external strength, generality, and magnitude.

Conclusions: This study confirmed a 4-factor, 21-item factorial structure. Although the structure differed from that hypothesized, the results showed that the tool was a valid and reliable instrument to measure the dimensions of exercise self-efficacy commonly overlooked within the literature. Public health professionals and researchers can use the instrument to measure exercise self-efficacy and develop self-efficacy based exercise promotion programs.

Key words: Exercise, self-efficacy, confirmatory factor analysis, physical activity

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INTRODUCTION

Physical activity and exercise can improve overall health including preventing and managing chronic disease. Moreover, engaging in exercise behavior can help control body weight and improve the quality and length of life. In Ohio, 74% of adults report engaging in any exercise in the past 30 days; however, only about 19% meet the physical activity guidelines.[1] Given this low percentage of Ohioans that meet the guidelines, there is a need to develop exercise behavior programs the promote physical activity. Developing effective and efficient theory-based exercise behavior programs is a key public health function.

Self-efficacy is one of the most identified psychosocial determinants of adherence to exercise behavior and routine physical activity. Self-efficacy is defined as an individual's perceived confidence to engage in a particular task.[2] Self-efficacy is not regarded as a construct of one's personal skillset to perform a behavior; rather it is associated with one's individually held beliefs as to whether he or she was able to accomplish a specific behavioral task.[3] For example, with decreased self-efficacy, low expectations regarding routine physical activity often led to avoidance of exercise behaviors; whereas, with increased self-efficacy, high expectations had the potential to lead to increased exercise behavior over time. Given this explanation, exercise self-efficacy had the capacity to explain why exercise behavior and routine physical activity differed widely among individuals, even those with similar knowledge and skillset.[4]

The role of self-efficacy to predict behavioral change with regard to routine physical activity and exercise has been studied by many.[5-11] From this research, three key dimensions of exercise self-efficacy have been established as magnitude, generality, and strength.[10] The first dimension of magnitude refers to the level of task difficulty within the domain of physical performance, when higher self-efficacy reflects the undertaking of a more difficult task.[2,10] The second dimension, known as generality, signifies the wide range of physical activities that necessitates self-efficacy. Generality also reflects to what extent an individual applies his or her perceived level of self-confidence to complete various tasks associated with routine exercise.[2,10] Lastly, the strength dimension represents the degree to which a person's self-efficacy could withstand setbacks or barriers associated with routine exercise, and still persists despite great difficulty with physical activity performance.[2,10] Based on these three established dimensions found to be predictive of exercise behavioral change, a 24-item self-report instrument was developed known as the Exercise Self-Efficacy Scale (ESE-S).

Developed in 1995, the original ESE-S instrument[10] was subjected to exploratory factor with promax rotation using a convenience sample of self-identified service-industry employees (n=380) aged 18 and older recruited from a large city located in Ohio. The purpose of exploratory factor analysis was to establish the psychometric properties on the ESE-S. The average age of the sample was 38 years, of whom 52% were women and most (55%) had completed a college degree. Based on previous work by Stevens,[12] items in the exploratory model were significant for item-to-factor loadings of ≥0.50 specified at the $p<0.01$ level (Table 1). Internal consistency was assessed with Cronbach alpha ($\alpha>.70$) to indicate a reliable measure.[13] The four factors identified

through the exploratory analysis that accounted for 16.6% of the variance were strength in the face of barriers (14-items); magnitude of exercise intensity (4-items); generality for free-living exercise (3-items); and generality for structure-dependent exercise (3-items). Factor and item definitions are presented in Table 2. Internal consistency of the original 24-item instrument and its associated subscales was acceptable, resulting in Cronbach alpha between 0.78 and 0.95. The aim of the present study was to use the validated ESE-S tool to confirm the instrument's internal structure and validate its 4-factor solution.

Table 1. Original (Exploratory) 24-Item Exercise Self-Efficacy Scale Factor Loading*

					Strength	Magnitude	Generality	Generality
No.	Item	Item Description	Factor	Variance Explained	In the Face of Barriers	Exercise Intensity	Free Living Mode	Structure Dependent Mode
1	Goals	Exercise when I haven't reached my exercise goal	1	6.83%	0.59			
2	Family	Exercise when I don't receive support from my family or friends			0.53			
3	Ex. w/no-one	Exercise when I have no one to exercise with			0.62			
4	Enjoy	Exercise when my exercise workout is not enjoyable			0.59			
5	Hectic	Exercise when my schedule is hectic			0.78			
6	Depressed	Exercise when feeling depressed			0.69			
7	Crisis	Exercise during or following a personal crisis			0.74			
8	Tired	Exercise when tired			0.82			
9	Anxious	Exercise when feeling anxious			0.59			
10	Weather	Exercise during bad weather			0.65			
11	Sore	Exercise when slightly sore from last time I exercised			0.54			
12	Vacation	Exercise when on vacation			0.68			
13	Compete	Exercise when there are competing interests (like my favorite TV show)			0.71			
14	Work	Exercise when I have a lot of work to do			0.80			
15	Very Light	Exercise very lightly three times a week for the next six months	2	3.83%		0.77		
16	Light	Exercise lightly three times a week for the next six months				0.79		
17	Moderate	Exercise moderately three times a week for the next six months				0.74		
18	Vigorous	Exercise vigorously three times a week for the next six months				0.53		
19	Walk	Walk three times a week for the next six months	3	3.29%			0.56	
20	Run	Run three times a week for the next six months					0.79	
21	Active	Play active sports three times a week for the next six months					0.64	
22	Weights	Use weight training equipment three times a week for the next six months	4	2.69%				0.54
23	Swim	Swim three times a week for the next six months						0.70
24	Aerobic	Participate in aerobic activity three times a week for the next six months						0.73

*Extraction method: Exploratory principal axis factoring with a promax rotation. Items <0.50 were suppressed.

Table 2. Original (Exploratory) 24-Item Exercise Self-Efficacy Scale Factor and Item Descriptions

No.	Item	Description	Cronbach's α
Factor One (14-items) Strength in the Face of Barriers: defined as the level of perceived confidence to exercise in the face of disconfirming evidence or barriers.			0.95
1	Goals	Exercise when I haven't reached my exercise goal	
2	Family	Exercise when I don't receive support from my family or friends	
3	Ex. w/no-one	Exercise when I have no one to exercise with	
4	Enjoy	Exercise when my exercise workout is not enjoyable	
5	Hectic	Exercise when my schedule is hectic	
6	Depressed	Exercise when feeling depressed	
7	Crisis	Exercise during or following a personal crisis	
8	Tired	Exercise when tired	
9	Anxious	Exercise when feeling anxious	
10	Weather	Exercise during bad weather	
11	Sore	Exercise when slightly sore from last time I exercised	
12	Vacation	Exercise when on vacation	
13	Compete	Exercise when there are competing interests (like my favorite TV show)	
14	Work	Exercise when I have a lot of work to do	
Factor Two (4-items) Magnitude of Exercise Intensity: defined as the level of perceived confidence to exercise across a wide range of task difficulty and intensity.			0.86
15	Very Light	Exercise very lightly three times a week for the next six months	
16	Light	Exercise lightly three times a week for the next six months	
17	Moderate	Exercise moderately three times a week for the next six months	
18	Vigorous	Exercise vigorously three times a week for the next six months	
Factor Three (3-items) Generality for Free-Living Exercise Mode: defined as the mode of exercise that one does not need a facility or physical equipment to perform the behavior.			0.78*
19	Walk	Walk three times a week for the next six months	
20	Run	Run three times a week for the next six months	
21	Active	Play active sports three times a week for the next six months	
Factor Four (3-items) Generality for Structure-Dependent Exercise Mode: defined as the mode of exercise that requires a facility or physical equipment to perform the behavior.			
22	Weights	Use weight training equipment three times a week for the next six months	
23	Swim	Swim three times a week for the next six months	
24	Aerobic	Participate in aerobic activity three times a week for the next six months	

*Generality of Exercise Mode(s) provides internal consistency for the combined scales of Free-living and Structure-Dependent Exercise.

METHODS

Setting:

Participants (n=270) were employees of a large (N=7,000), service-type, national company located in Central Ohio who consented to participate in an employee wellness campaign over a two-day period.

Design:

Non-experimental, cross-sectional design.

Participants and Recruitment:

The paper and pencil ESE-S10 was administered to adults aged 18 and older. Employees who volunteered to participate completed the instrument one time and demographic data were not collected. Although demographic data were not collected, the company's overall demographic characteristics were similar to the sample in the exploratory factor analysis.

Procedures:

Participants that agreed to participate were handed the ESE-S and a pencil to complete during the wellness campaign. To ensure anonymity, once the participant completed the ESE-S, the participant put the questionnaire into a common envelope. A university Institutional Review Board approved the study.

Measures:

The 24-item Exercise Self-Efficacy Scale (ESE-S).10 The one-page instrument directs participants to rate how confident they are to exercise over the next six months for each item on a scale. The participants rated their confidence on a continuous scale from 0% ("I cannot do it at all") to 100% ("Certain I could do it"). The ESE-S takes approximately five minutes to complete.

Statistical Analysis:

Hypothesized Model. Using the previously established psychometric properties[9] with the addition of an exercise time-component item (Exercise when I have not exercised for a prolonged period of time), the ESE-S was subjected to a principal axis factoring analysis (SPSS, v17, Chicago, IL) with a varimax rotation and Kaiser normalization14 to confirm the original

4-factor solution[10] in an independent sample (n=270) of adults. Latent variables were allowed to correlate, and all items were modeled to load on their corresponding factors. Regression weights, expected parameters of change, and modification indices received examination for areas of model misfit. Based on previous work by Stevens,[12] items in the final model were significant for item-to-factor loadings of ≥0.50 specified at the $p<0.01$ level that resulted in eigenvalues greater than 1.0 (Table 3). Internal consistency was assessed Cronbach's alpha at $\alpha>.70$ to indicate a reliable measure.[13]

RESULTS

Final Model and Fit. Results from the confirmatory factor analysis showed that the data did not conform to the original explorative factorial structure but did confirm the existence of a 21-item, 4-factor solution that accounted for approximately 60.44% of the variance (Table 3). Four items failed to load in the final model that were originally identified through the exploratory factor analysis as: work, vacation (factor-1); vigorous (factor-2); and weights (factor-4). The additional exercise-time component that was added loaded on strength-external barriers. The four factors retained through the confirmatory analysis were interpreted as strength-external barriers (7-items), strength-internal barriers (6-items), magnitude of exercise intensity (3-items), and generality of exercise mode (5-items). Factor and item definitions from the confirmatory analysis are presented in Table 4. Internal consistency for the full measure and its associated subscales was acceptable, resulting in Cronbach's alpha between 0.81 and 0.98.

Table 3. Final (Confirmatory) 21-Item Exercise Self-Efficacy Scale Factor Loading and Eigenvalues*†

					Strength	Magnitude	Generality	Generality
No.	Item	Item Description	Factor	Eigenvalue (var. exp**)	External Barriers	Internal Barriers	Exercise Intensity	Exercise Mode
1	Goals	Exercise when I haven't reached my exercise goal	1	10.1	0.66			
2	Family	Exercise when I don't receive support from my family or friends		(40.11%)	0.76			
3	Time	Exercise when I have not exercised for a prolonged period of time			0.72			
4	Ex. w/no-one	Exercise when I have no one to exercise with			0.74			
5	Enjoy	Exercise when my exercise workout is not enjoyable			0.52			
6	Hectic	Exercise when my schedule is hectic			0.52			
7	Compete	Exercise when there are competing interests (like my favorite TV show)			0.56			
8	Depressed	Exercise when feeling depressed	2	2.4		0.73		
9	Crisis	Exercise during or following a personal crisis		(9.87%)		0.73		
10	Tired	Exercise when tired				0.71		
11	Anxious	Exercise when feeling anxious				0.70		
12	Weather	Exercise during bad weather				0.59		
13	Sore	Exercise when slightly sore from last time I exercised				0.51		
14	Very Light	Exercise very lightly three times a week for the next six months	3	1.2			0.91	
15	Light	Exercise lightly three times a week for the next six months		(4.40%)			0.93	
16	Moderate	Exercise moderately three times a week for the next six month					0.77	
17	Walk	Walk three times a week for the next six months	4	1.5				0.57
18	Run	Run three times a week for the next six months		(6.06%)				0.60
19	Active	Play active sports three times a week for the next six months						0.56
20	Swim	Swim three times a week for the next six months						0.78
21	Aerobic	Participate in aerobic activity three times a week for the next six months						0.61

*Extraction method: Confirmatory principal axis factoring with a varimax rotation and Kaiser normalization. Rotation converged in 7 iterations. Items <0.50 were suppressed.

**Var. exp is variance explained

†Items from the exploratory analysis that dropped out in the final model were work, vacation (factor-1); vigorous (factor-2); and weights (factor-4). The additional exercise-time component that was added loaded on strength-external barriers.

Table 4. Final (Confirmatory) 21-Item Exercise Self-Efficacy Scale Factor and Item Descriptions*			
No.	Item	Description	Cronbach's α
Factor One (7-items) Strength in the Face of External Barriers: defined as the level of perceived confidence to exercise in the face of external barriers.			0.98
1	Goals	Exercise when I haven't reached my exercise goal	
2	Family	Exercise when I don't receive support from my family or friends	
3	Time	Exercise when I have not exercised for a prolonged period of time	
4	Ex. w/no-one	Exercise when I have no one to exercise with	
5	Enjoy	Exercise when my exercise workout is not enjoyable	
6	Hectic	Exercise when my schedule is hectic	
7	Compete	Exercise when there are competing interests (like my favorite TV show)	
Factor Two (6-items) Strength in the Face of Internal Barriers: defined as the level of perceived confidence to exercise in the face of internal barriers.			0.91
8	Depressed	Exercise when feeling depressed	
9	Crisis	Exercise during or following a personal crisis	
10	Tired	Exercise when tired	
11	Anxious	Exercise when feeling anxious	
12	Weather	Exercise during bad weather	
13	Sore	Exercise when slightly sore from last time I exercised	
Factor Three (3-items) Magnitude of Exercise Intensity: defined as the level of perceived confidence to exercise across a wide range of task difficulty and intensity.			0.89
14	Very Light	Exercise very lightly three times a week for the next six months	
15	Light	Exercise lightly three times a week for the next six months	
16	Moderate	Exercise moderately three times a week for the next six months	
Factor Four (5-items) Generality for Exercise Mode: defined as the various modes of exercise one uses to perform routine physical activity.			0.81
17	Walk	Walk three times a week for the next six months	
18	Run	Run three times a week for the next six months	
19	Active	Play active sports three times a week for the next six months	
20	Swim	Swim three times a week for the next six months	
21	Aerobic	Participate in aerobic activity three times a week for the next six months	

*Items from the exploratory analysis dropped out in the final model were work, vacation (factor-1); vigorous (factor-2); and weight (factor-4). The additional exercise-time component loaded on strength-external barriers.

DISCUSSION

This study confirmed a 4-factor, 21-item factorial structure of the Exercise Self-Efficacy Scale (ESE-S). Although the confirmed structure differed from that originally hypothesized,[10] the results showed that the ESE-S was a valid and reliable tool to measure the dimensions of exercise self-efficacy commonly overlooked within the literature known as magnitude and generality. This study contributes to the growing body of literature that has demonstrated the need for more valid and reliable measurement on exercise self-efficacy to predict behavior, and further established that exercise self-efficacy cannot be effectively measured as a one-dimensional construct.[2]

The difference in the internal structure of the ESE-S that resulted from the exploratory factor analysis when compared to the confirmatory factor analysis might be partially explained by the unique size and aspects of the two study samples. For instance, in the exploratory analysis, the ESE-S was administered to a sample of self-identified service-industry employees (n=380) aged 18 and older recruited from a large city located in Ohio. Conversely, in the confirmatory analysis, the ESE-S was administered to participants (n=270) identified as employees of a large, national company located in central Ohio. Notwithstanding, it could also be concluded that the difference in the internal structure of the ESE-S could have occurred by chance or error; and that a similar fit between the exploratory and confirmatory models to the data could have been obtained with further revision and testing of the instrument.

Within the final ESE-S measure, all items of magnitude-exercise intensity scale loaded as expected on their respective factor except for vigorous (Exercise vigorously three times a week for the next six months). An explanation as to why this item dropped out of the final model could be that individuals who completed the ESE-S might have associated vigorous exercise with a more moderate intensity of physical activity; or that these individuals did not engage in what they believed to be vigorous activity. For the scales of generality for structure-dependent exercise (exploratory) and generality for free-living exercise (exploratory), all items in the final model loaded on a single factor identified as generality of exercise mode except for the item of weights (Use weight training equipment three times a week for the next six months). Further examination on why this item failed to load revealed that either participants did not engage in this type of activity, or that the physical environment where individuals exercised was not supportive of weight training equipment use.

From the original 14-items believed to represent strength in the face of barriers, all items in the final model loaded on two separate factors identified as strength in the face of external barriers and strength in the face of internal barriers except for the items of work (Exercise when I have a lot of work to do) and vacation (Exercise when on vacation). Additional examination of these scales suggested that personal norms of participants who completed the ESE-S measure may have disconfirmed engagement in exercise during specified periods of work, or while on vacation. More interesting was that the item of weather (Exercise during bad weather) loaded on the strength in the face of internal barriers, which suggested that personal perceptions of weather influenced whether adults engaged in physical activity or routine exercise.

The additional time-component item (Exercise when I have not exercised for a prolonged period), previously excluded from the exploratory analysis, loaded on strength in the face of external barriers. This finding was significant in that it mirrored more recent literature,[15] which has shown that exercise behavior, particularly during high-intensity or high-impact physical activity, can distort one's perception of time. In fact, greater intensity of exercise has been shown to lead to a decreased perception of time, where more time appeared to have passed than what was objectively true.14 Given this notion, time can be perceived as an external source of influence that served to either hinder or support engagement in physical activity based on the level of exertion required. More importantly, an individual must be willing to endure the level of exertion required in order to perform the exercise or routine physical activity for a period of time.[16]

Limitations. Although several methodological strengths existed in the present study, there were some significant limitations that should be taken into consideration. Since participants voluntarily

agreed and consented to complete the ESE-S, there was likely to be some degree of self-selection bias. This inherent limitation led to the sample not being fully representative of the adult population who exercised or performed routine physical activity. Convenience sampling methods were used to recruit participants from a geographically proximal population.

PUBLIC HEALTH IMPLICATIONS

This study validated the 4-factor, 21-item internal structure of the Exercise Self-Efficacy Scale (ESE-S). Confirmation of the final factors (internal strength, external strength, generality, and magnitude) described in this study explained more of the variance when compared to the original model as hypothesized, and should be further assessed in future investigations. To the extent that identified factors represent underlying causal mechanisms of exercise self-efficacy, the ESE-S held important public health implications regarding the future assessment and predictive ability of the tool to explain exercise behavior. In addition, the ESE-S may be used as a diagnostic tool for commercial- and medical-fitness facilities when designing physical activity programs to address clients' needs. Given the current adult physical activity rates in Ohio[17] and that self-efficacy is the most influential psychosocial variable related to physical activity,[5] there is substantial room to improve physical activity rates in Ohio through effective interventions that target self-efficacy. Through greater use, the ESE-S tool can assist researchers and practitioners measure self-efficacy to design and determine the effectiveness of physical activity interventions.

While there has been a concerted effort to modify the built environment to support physical activity behavior, personal decision making and the psychosocial determinants still play a vital role in promoting physical activity behavior. Both the environment and the person are necessary to change physical activity behavior. In order to facilitate this research and promote clinical advancements in the area of exercise self-efficacy, an empirically sound model and associated factor dimensionality of the ESE-S should be identified. This model must be clinically relevant, easily available to practitioners, and appropriate for diverse populations.

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