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Validity and Reliability of the Greek Version of the Exercise Self-Efficacy Scale

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Abstract *— The current study examined the validity and reliability of the Greek version of a five-item Exercise Self-Efficacy Scale (Marcus, Selby, Niaura, & Rossi, 1992). Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were performed in a sample of 360 students (M ± SD = 23.54 ± 5.96 years). In addition, a CFA was applied in a second sample of 726 physically active adults (M ± SD = 38.80 ± 13.64 years). Further, associations were examined among the Exercise Self-Efficacy Scale and physical activity (PA), PA attraction, positive and negative aspects of PA, and various socio-demographic variables. Results indicated: (a) a one-factor solution for the Exercise Self-Efficacy Scale, (b) satisfactory validity and reliability coefficients, (c) positive associations among the scale and PA, PA attraction and positive aspects of PA and (d) a negative association between the scale and negative aspects of PA. In conclusion, the Exercise Self-Efficacy Scale was valid and reliable and could be useful for physical educators and trainers.*

Keywords *— validation, factor structure, test-retest, self-efficacy, exercise.*

I. INTRODUCTION

Physical activity (PA) is an effective strategy for the prevention and treatment of metabolic syndrome and cardiovascular diseases, as well as, for the reduction of mortality rates (Savela, et al., 2010; Warburton & Bredin, 2016; WHO, 2010). Despite the apparent benefits of PA, studies in European Union countries have indicated that more than half of adults never or seldom engage in exercise, sports, or PA (Breda, et al., 2018; European Commission, 2014). These findings have led to an increased scientific interest in investigating several factors that promote participation in PA (Cortis, et al., 2017; Ishii, Shibata, & Oka, 2010).

In particular, recent studies have indicated that psychological variables are important predictors of PA levels (Cortis, et al., 2017; Ishii, et al., 2010). Within the psychological determinants, exercise self-efficacy (ESE) has been found to be a crucial predictor in the promotion of PA participation (Cortis, et al., 2017; Ishii, et al., 2010). Specifically, ESE, which is an important concept of the social cognitive theory and reflects one's confidence in his/her ability to persist in exercising, has been proven to have the highest positive effect on PA than other variables (Ishii, et al., 2010; Theodoropoulou & Karteroliotis, 2017).

Based on the increasingly frequent use of ESE for PA prediction and promotion, it is necessary for valid and reliable instruments assessing it to be used. Particularly, researchers have often used the five-item scale of Marcus, Selby, Niaura, and Rossi (1992) to assess ESE (Marcus, et al., 1992; Mendoza-Vasconez, Marquez, Benitez, & Marcus, 2018). Potential reasons for using the apparent scale are its established psychometric properties (Cardinal, Tuominen, & Rintala, 2003; Marcus, et al., 1992; Mendoza-Vasconez, et al., 2018) and the fact that it can be quickly and easily understood and filled in.

However, no validity or reliability data of the ESE Scale (Marcus, et al., 1992) have been available in the Greek language, hence prompting the present study. Therefore, the purpose of the current study was to examine the factorial and construct validity and reliability of the Greek version of the ESE Scale (Marcus, et al., 1992). The hypotheses were that a one-factor solution for the scale (Marcus, et al., 1992) would provide an appropriate fit to the data, and its validity and reliability properties would be satisfactory.

II. METHOD

A. Participants

a) Criteria of Sample Selection: The participants' selection criteria were the following: (a) participation in PA, (b) 18-65 years old, and (c) no missing values. Two independent, not randomly selected samples were used.

b) First Sample: The first sample consisted of 360 physical education University students, 191 men (53.06%) and 169 women (46.94%) with a mean age of 23.54 years old (*SD* = 5.96 years) (Figure 1).

c) Second Sample: As figure 1 presents, the second sample consisted of 752 participants (n_{men}=212 and n_{women}=540), ranging in age from 18 to 65 years, who agreed to fill in the questionnaires. This sample

participated in various physical activities and exercise programs. However, 26 of the participants were excluded from the analyses due to incomplete information (age, missing values, etc.). The remaining 726 participants consisting of 209 men (28.79%) and 517 women (71.21%) with a mean age of 38.80 years old (*SD* = 13.64 years) were used for the final analyses.

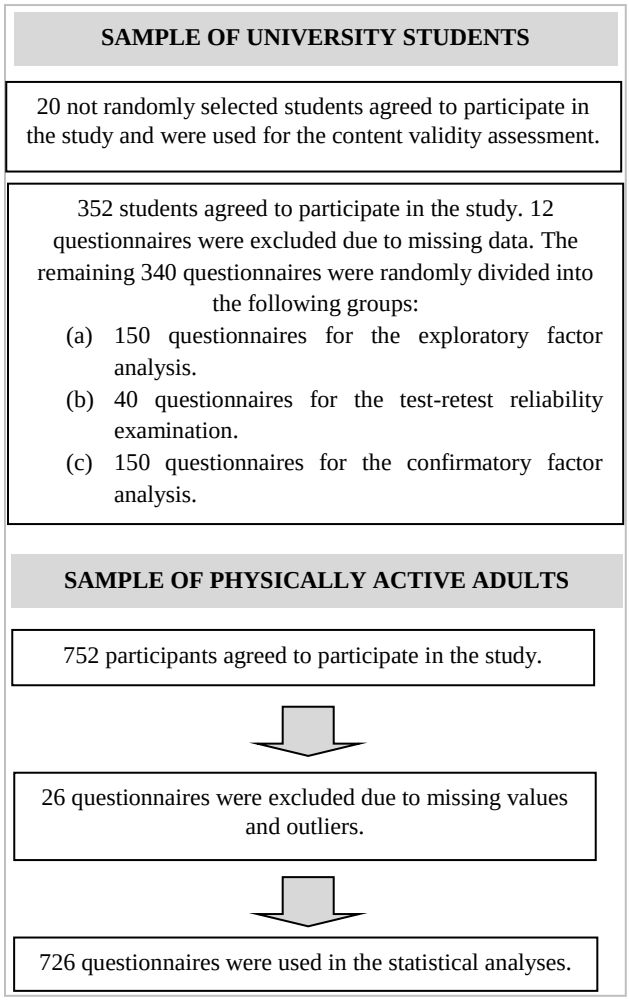

Figure 1. Sampling Diagram

B. Measures

a) Exercise Self-Efficacy Scale: The five-item ESE Scale (Marcus, et al., 1992) is a frequently used instrument assessing ESE. This scale was designed to evaluate one's confidence in his/her ability to persist in exercising under the following adverse situations: tired, bad mood, not having time, on vacation, and raining or snowing. The validity, internal consistency (α = 0.72–0.78) and test-retest reliability (r = 0.90) of the scale are well established (Cardinal, et al., 2003; Marcus, et al., 1992; Mendoza-Vasconez, et al., 2018).

b) International Physical Activity Questionnaire (IPAQ): PA levels were estimated with the International Physical Activity Questionnaire (IPAQ, Craig, et al., 2003). The IPAQ-short form had seven days recall period and consisted of six items measuring exercise frequency and duration and one item about sedentary life. The six items assessed four PA indexes, such as walking PA, moderate PA, vigorous PA, and total PA. The PA indexes are expressed in MET - minutes per week and are calculated as duration X frequency per week X MET intensity. Acceptable validity and reliability properties for the IPAQ have been found (Craig, et al., 2003). These findings were verified for the Greek version of the IPAQ (Papathanasiou, et al., 2009; Papathanasiou, et al., 2010).

c) PA Attraction: PA attraction was assessed with the five-item "attraction" factor of the Leisure Involvement Scale (Kyle & Mowen, 2005). Items' examples are "exercise is very important to me" and "I really enjoy exercise." The validity and internal consistency (α = 0.79-0.87) were acceptable. In line with this, the Greek version of the Leisure Involvement Scale was valid and reliable (α = 0.82-0.92) (Theodorakis, Panopoulou, & Vlachopoulos, 2007).

d) Positive (PROS) and Negative (CONS) Aspects of PA: Perceived PROS and CONS aspects of PA were estimated with the Decisional Balance Scale (DBS) (Marcus, Rakowski, & Rossi, 1992). Particularly, the PROS factor was composed of ten items such as "I would have more energy for my family and friends if I exercised regularly." The CONS factor consisted of six items, such as "I think I would be too tired to do my daily work after exercising." Plotnikoff, Blanchard, Hotz, and Rhodes (2001) found acceptable validity and internal consistency (α = 0.71-0.79) for this scale. Finally, the Greek version of the DBS was valid and reliable (α = 0.81-0.84) (Karteroliotis, 2008).

e) Socio-demographic Variables: Age, gender, educational level, marital status, number of children, type of job, and income were recorded.

C. Study Design and Procedure

All participants were informed about the procedures of this cross-sectional study and signed a written consent form. Institutional ethical approval was obtained through the University. As Figure 1 presents, 20 students completed the scale for the content validity examination. Then, to assess the factor structure and reliability of the scale, 340 students filled in the questionnaires. Furthermore, to test the factorial and construct validity of the scale in a second independent sample, 752 participants filled in the questionnaires (Figure 1).

D. Data Analyses

a) Phase 1. Content Validity, Preliminary Factor Structure, and Reliability Testing: At first, 20 students filled in the ESE scale in order to examine the relevance and clarity of the questions, as well as, the significance and completeness of responses in the scale. Then, two experts separately reviewed the content of the scale to confirm the appropriateness to measure what it claimed to measure. In addition, to assess the factor structure and internal consistency of the scale, 150 questionnaires were randomly selected from the 340 student sample. To examine the factor structure of the scale, an exploratory factor analysis (EFA) was performed. The extraction method employed was principal axis factoring (PAF) followed by Promax rotation (Russell, 2002). The Promax method conducts an oblique rotation, and if the factors are uncorrelated with one another, the procedure will result in varimax rotation. In the case that the factors are correlated with one another, the procedure will result in oblique rotation. The Bartlett's test of sphericity ($p < 0.05$) and the Kaiser-Meyer-Olkin test (> 0.50) were the criteria to test the sampling adequacy and suitability of the scale's items (Tabachnick & Fidell, 2006). The correlation coefficients among the items (> 0.30) were an additional criterion to test items' suitability (Tabachnick & Fidell, 2006). Extraction of factors was based on the Kaiser's (1961) criterion with eigenvalues greater than 1.0 and the Cattell's (1966) scree test. Factor loadings that exceeded the criterion of 0.40 were regarded as significant. The internal consistency of the scale was assessed using the Cronbach's *alpha* (α) coefficient. The SPSS 25.0 statistical software (SPSS Inc., Chicago, IL, USA) was used.

Finally, to examine the test-retest reliability of the ESE Scale, 40 questionnaires that were randomly selected from the remaining data were chosen to be filled in twice with an interval of 15 days between the two assessments. The absolute agreement between the two assessments was conducted using the intraclass correlation coefficient (*ICC*) (Weir, 2005). To describe the variety/difference in the *ICC*, a 95% confidence interval (*CI*) was used.

b) Phase 2. Factor Structure Confirmation in the First Sample: For Phase 2, the remaining 150 questionnaires were used. To confirm the factor structure of the scale found in EFA, a confirmatory factor analysis (CFA) was performed employing the maximum likelihood method (Kline, 2005). Factor loadings that exceeded the criterion of 0.40 were regarded as significant (Kline, 2005). Analysis was conducted by using the AMOS 26.0 statistical software (IBM Corporation, Armonk, NY, USA).

Assessment of model fit was based on the following indexes: (a) the *chi-square* test (χ^2), (b) the Satorra-Bentler χ^2/df ratio, (c) the root mean square error of approximation (*RMSEA*), and (d) standardized root mean square residual (*SRMR*) (Steiger, 1990). Non-significant values of χ^2 and values of χ^2/df ratio smaller than 3.0 indicate an acceptable fit of the model (Kline, 2005). *RMSEA* values lower than 0.05 represent close fit, between 0.05 and 0.08 indicate acceptable fit, whereas *RMSEA* values greater than 0.08 represent poor model fit (Steiger, 1990). *SRMR* values equal to zero indicate perfect model fit. In addition, assessment of model fit was based on the following comparative/incremental fit indexes: (a) Comparative Fit Index (*CFI*), (b) Goodness of Fit Index (*GFI*), (c) Incremental Fit Index (*IFI*), and (d) Tucker and Lewis Index (*TLI*) (Bentler, 1990; Kline, 2005). *CFI, GFI, IFI,* and *TLI* values approximating 1.0 indicate a perfect fit, whereas values above 0.90 represent the acceptable fit of the model. However, Hu and Bentler (1999) supported that values of fit indexes such as 0.95 should be used. Recently, these stringent criteria have been debated (Fan & Sivo, 2005; Marsh, Hau, & Wen, 2004).

c) Phase 3. Factorial and Construct ValidityTesting in the Second Independent Sample: This phase aimed to verify the factor structure of the scale through CFA and investigate its construct validity based on a second independent sample of 726 physically active adults. To confirm the factor structure of the scale found in students, initially, a CFA was performed employing the maximum likelihood method. Secondly, the construct validity of the scales was examined applying correlation coefficients among the ESE Scale and the following questionnaires: (a) IPAQ, (b) "PA attraction" factor, (c) DBS scale, and (d) seven socio-demographic items. The hypothesis was that exercise self-efficacy would be positively associated with the: (a) PA indexes of the IPAQ, (b) PA attraction, and (c) PROS aspects of PA (a negative association was hypothesized for the CONS aspects of PA). To examine the distributions of the apparent variables, the Kolmogorov-Smirnov statistical test was used.

III. RESULTS

A. Phase 1: Content Validity, Exploratory Factor Analysis, and Reliability Testing

With regard to the the content validity, the 20 students did not provide any misunderstandings during the scale's completion; their explanations for each item was in agreement with items' content, sustained that the content of each item matched the content of the scale, and they thought that the items and the response scale were clearly understood. In addition, two experts separately reviewed the content of the scale and did not suggest changes according to their written and oral comments on each item.

Regarding the results of the EFA, skewness, and kurtosis values were acceptable, supporting items' normality (Table 1). As Table 2 presents, the PAF with Promax rotation extracted one factor accounted for 59.54% of the total variability among the items. The factor loadings ranged from 0.48 to 0.82 (Table 2). The items' correlation coefficients ranged from 0.33 to 0.62. The Cronbach's *a* coefficient was

0.83, whereas the *ICC* coefficient was 0.96 (0.92-0.98 95% *CI*).

Table 1. Descriptive Statistics of the Exercise Self-Efficacy Scale (N_1 = 150)

Items	*M*	*SD*	*Min*	*Max*	*Skewness*	*Kurtosis*
1	3.69	1.05	1.00	5.00	-0.55	-0.19
2	3.87	1.12	1.00	5.00	-0.88	0.12
3	3.51	1.13	1.00	5.00	-0.46	-0.42
4	3.74	1.03	1.00	5.00	-0.79	0.35
5	3.71	1.17	1.00	5.00	-0.75	-0.14

Note: *M* = mean, *SD* = standard deviation, *Min* = minimum value, *Max* = maximum value.

Table 2. Exploratory Factor Analysis of the Exercise Self-Efficacy Scale: Factor Loadings and Communalities (N_1 = 150)

Items	LOADINGS	COMMUNALITIES
1	0.76	0.57
2	0.72	0.52
3	0.82	0.68
4	0.48	0.23
5	0.72	0.52
Eigenvalue	2.98	
% Explained variance	59.54	
Kaiser-Meyer-Olkin test = 0.831 Bartlett's test of Sphericity: x^2 = 263.56, *df* = 10, *p* = 0.000		

B. Phase 2: Confirmatory Factor Analysis

The skewness (-0.62 to -0.09) and kurtosis (-0.84 to -0.51) values of the items, as well as, the Mardia's (1970) coefficient (2.55) were acceptable. As Table 3 presents, the one-factor model found in EFA provided an appropriate fit to the data (χ^2 = 9.487, *p* = 0.091, *df* = 5, χ^2/df = 1.897, *CFI* = 0.988, *GFI* = 0.974, *IFI* = 0.988, *TLI* = 0.976, *RMSEA* = 0.078, *SRMR* = 0.029). The factor loadings ranged from 0.56 to 0.84, whereas the items' correlations coefficients varied from 0.41 to 0.72. The Cronbach's *a* coefficient was 0.87.

C. Phase 3: Factorial and Construct Validity Testing in the Sample of Physically Active Adults

The skewness (-0.79 to -0.39) and kurtosis (-0.31 to 0.10) values were acceptable. However, the Mardia's (1970) coefficient (6.99) did not support multivariate normality and CFA was conducted applying bootstrapping with the Bolen-Stine approach (Kline, 2005). The one-factor model provided an adequate fit to the data (χ^2 = 7.508, *p* = 0.095, *df* = 5, χ^2/df = 1.502, *CFI* = 0.995, *GFI* = 0.991, *IFI* = 0.995, *TLI* = 0.989, *RMSEA* = 0.053, *SRMR* = 0.014) (Table 3). The factor loadings ranged from 0.71 to 0.82, whereas the items' correlations coefficients ranged from 0.54 to 0.67. The Cronbach's *a* coefficient was 0.89.

To assess construct validity, Spearman's correlation coefficients were performed due to the non-normally distributed variables. Specifically, the ESE Scale was positively associated with the vigorous (r = 0.28, $p < 0.01$), moderate (r = 0.14, $p < 0.01$), walking (r = 0.09, $p < 0.05$) and total (r = 0.30, $p < 0.01$) PA indexes. In addition, positive associations were observed among the ESE Scale and PA attraction (r = 0.39, $p < 0.01$) and PROS aspects of PA (r = 0.24, $p < 0.01$), whereas a negative correlation was found between the ESE Scale and CONS aspects of PA (r = -0.17, $p < 0.01$).

IV. DISCUSSION

The current study examined the psychometric properties of the Greek version of the five-item ESE Scale (Marcus, et al., 1992) in two independent samples of adults. Specifically, the EFA's results indicated that a one-factor solution for the Scale represented an appropriate fit to the data in the first group of physical education students. This factor structure of the scale was verified by applying CFAs both in the second group of students and in an independent sample of physically active adults. In addition, the current study demonstrated satisfactory internal consistency and test-retest reliability coefficients for the ESE Scale.

The aforementioned findings are in accordance with those of similar studies in other populations (Cardinal, et al., 2003; Marcus, et al., 1992; Mendoza-Vasconez, et al., 2018). Although Mendoza-Vasconez, et al. (2018) found a satisfactory factorial validity of the examined ESE scale, they tried to simplify it by deleting an item with low factor loading. The scale's item pertaining to engagement in exercise during vacation time provided greater unique variance compared to other items (Mendoza-Vasconez, et al., 2018), which is in contrast with the findings of the current study. Despite the item's lowest but acceptable factor loading (0.48) in the EFA's results compared to other items (Table 2), this finding was not confirmed by the CFAs' results of the present research and the findings of other studies (Cardinal, et al., 2003; Marcus, et al., 1992).

Finally, the current study demonstrated positive and low to medium associations among ESE and PA levels and attraction and perceived positive aspects of PA, supporting the construct validity of the scale. This finding indicated that in order to enhance positive perceptions and exercise participation, PA specialists should focus on promoting ESE. One of the ways to enhance ESE is to create successful experiences and positive feelings during PA and promote self-regulatory techniques such as setting behavioral goals and prompting self-monitoring of behavior (French, Olander, Chisholm, & McSharry, 2014).

Table 3. Confirmatory Factor Analyses of the Exercise Self-Efficacy Scale: Fit indexes

Samples	χ^2	*df*	χ^2 / *df*	*CFI*	*GFI*	*IFI*	*TLI*	*RMSEA*	*SRMR*
N_2 **= 150 students**	9.487, p = 0.091	5	1.897	0.988	0.974	0.988	0.976	0.078	0.029
N_3 **= 726 adults**	7.508, p = 0.095	5	1.502	0.995	0.991	0.995	0.989	0.053	0.014

Note: χ^2 = chi-square test, *df* = degrees of freedom, χ^2 / *df* = Satorra-Bentler ratio, *CFI* = comparative fit index, *GFI* = goodness of fit index, *IFI* = incremental fit index, *TLI* = Tucker and Lewis index, *RMSEA* = root mean square error of approximation, *SRMR* = standardized root mean square residual.

However, this study had several limitations that need to be reported. First, measures were self-reported, and problems associated with common method variance should be considered. Second, the samples were not randomly selected and consisted of students and physically active adults. Third, other validity types, such as criterion validity, were not examined. Fourth, objective measures of PA through accelerometers were not used. Despite the apparent limitations, this study had some advantages that should be taken into account. In particular, a key feature of this study was the investigation of factorial validity and reliability of the ESE Scale in two independent and large samples that have not been examined until now. Further, other important aspects were the investigation of test-retest reliability, content validity, as well as, construct validity applying associations among the scale and perceived attraction and perceptions of PA, participation in PA, and various socio-demographic variables.

V. CONCLUSIONS

In conclusion, the Greek version of the ESE Scale was proven to have satisfactory psychometric properties. A stable factor was identified for the scale examining different samples, indicating that this scale can be used to assess individuals' confidence regarding their ability to persist in exercising under adverse situations. Future studies should be carried out to further investigate the scale's validity in sedentary adults and older or younger individuals.

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