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Factorial invariance of the Physical Self-Concept Scale in Mexican students

Invarianza factorial de la escala de autoconcepto físico en hombres y mujeres estudiantes universitarios

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Abstract. The present study analyses the psychometric properties proposed by Blanco, Blanco, Viciana, and Zueck (2015) for the Physical Self-Concept Scale (CAF). The total sample consisted of 1,500 Mexican university students, with a mean age of 20.69 years (± SD = 2.33). Confirmatory factorial analyses showed that a two-factor structure is viable and adequate for both studied groups (men and women). The structure of two factors (motor competence and physical attractiveness), according to statistical and substantive criteria, has shown adequate indicators of reliability and validity adjustment. In addition, the factorial structure, factor loads and intercepts are considered invariant in the two groups studied. However, differences between the two groups for the factor means were found. Further research should replicate these findings in larger samples.
Key words: measurement invariance, factorial structure, construct validation, multi-sample confirmatory factor analysis.

Resumen. El presente estudio analiza las propiedades psicométricas propuestos por Blanco, Blanco, Viciana y Zueck (2015) para la escala de autoconcepto físico (CAF). La muestra total fue de 1500 universitarios mexicanos, con una edad media de 20.69 años (± DE=2.33). Los análisis factoriales confirmatorios mostraron que una estructura de dos factores es viable y adecuada para ambos grupos (hombres y mujeres). La estructura de dos factores (competencia motora y atractivo físico), atendiendo a criterios estadísticos y sustantivos, ha mostrado adecuados indicadores de ajuste de fiabilidad y validez. Además, la estructura factorial, las cargas factoriales y los interceptos se consideran invariantes en las dos poblaciones estudiadas; sin embargo, existen diferencias entre las poblaciones para las medias de los factores. Futuras investigaciones deberían replicar estos hallazgos en muestras más amplias.
Palabras clave: invarianza de medida, estructura factorial, validación de constructo, análisis factorial confirmatorio multimuestra.

Introduction

Self-concept plays a crucial and central role in the development of personality, as noted in the main psychological theories; a positive self-concept is the basis of good personal, social and professional functioning, depending on it, largely, the personal satisfaction, and feeling good about yourself. In particular, physical self-concept proves to be a good indicator of mental health and adjustment with life (Goñi, 2009, Goñi & Infante, 2010; Linares-Manrique et al., 2016; Olmedilla, Ortega-Toro, & Abenza, 2016; Reigal, Videra, Parra & Juárez, 2012) since feeling comfortable with our body helps to generate positive feelings.

Therefore achieving a positive self-concept is one of the most pursued objectives in numerous psychological intervention programs (educational, clinical, community, civic...) for which are demanded strategies and resources for its improvement (Esnaola, Goñi & Madariaga, 2008).

For many years, self-concept has been considered as a one-dimensional and global construct (González, 2005). However, since the last decades self-concept has been accepted as a multidimensional and hierarchical construct, according to which the general self-concept would be at the top, encompassing academic self-concept and non-academic self-concept (Shavelson, Hubner & Stanton, 1976). Non-academic self-concept would in turn encompass personal, social, and physical self-concept (Shavelson, et al., 1976). The four previous domains would also be divided into more specificity dimensions (González, 2005).

Physical self-concept is considered one of the most important markers of people's well-being (Klesges, Haddock, Stein, Klesges & Eck, 1992; Menéndez & Fernández-Río, 2017; Navas & Soriano, 2016). Although today the multidimensional nature of physical self-concept is widely accepted (González, 2005), there is still no conformation about what the dimensions of this construct are (Blanco, et al., 2015, Fox and Corbin 1989, Marsh, Richards, Johnson, Roche & Tremayne, 1994). The four-dimensional model has generally been the most accepted (González, 2005). Fox and Corbin (1989) first proposed a multidimensional physical self-concept model that comprised four dimensions: sports competence, physical fitness, physical attractiveness and strength, giving rise to the *Physical Self-Perception Profile* (PSPP) questionnaire. Later, Goñi, Ruiz de Azúa & Rodríguez (2006), based on the four-dimensional model of Fox & Corbin (1989), redefined sports competition as a physical ability. From this work they obtained the Physical Self-Concept Questionnaire (CAF).

However, one of the main problems of the questionnaires that follow this model is the discriminant validity, due to the presence of a high correlation between the dimensions that compose it (Marsh, et al., 1994; Navas, Soriano & Holgado, 2013). Recently, based on the CAF, Blanco et al. (2015) evaluated the psychometric properties of this instrument in the population of Mexican university students. These authors found a two-dimensional model (motor competence and physical attractiveness), renaming it the modified CAF (CAF-M). In addition to the factorial structure of an instrument, it is necessary to evaluate whether the same factor structure is applicable to different populations (Abalo, Lévy, Rial & Varela, 2006), being gender one of the main personal differences that could influence physical self-concept (Fernández, Contreras, González & Abellán, 2011). Consequently, the objective of the present study was to examine the factorial invariance of CAF-M in men and women Mexican university students.

The present study concerns not only the factorial structure of the instrument, but also the psychometric equivalence of it different groups, since in the context of intergroup comparison, it is essential to consider the need to carry out the adaptation of an instrument of psychological measurement that meets all criteria of equivalence, but above all, consider whether the same factorial structure is applicable to different groups of subjects or, more generically, to different populations (Abalo, et al., 2006).

Methods

Participants

The sample of 1,500 college students 758 women and 742 men, was obtained by sampling for convenience, trying to cover the representation of the different degrees offered in a public university of northern Mexico (Autonomous University of Chihuahua, Faculty of Sciences of Physical Culture). The participants' age ranged from 18 to 36 years, with a mean of 20.69 and a standard deviation of 2.33 years.

Measure

Self-concept Physical Questionnaire (CAF-M) by Goñi et al. (2006) modified by Blanco et al. (2015), which consists of 12 items that are

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grouped into two dimensions or subscales: motor competency (siete items, á=.91) and physical attractiveness (cinco items, á=.89) that are answered according to a Likert scale of 0 to 4 points (figure 1).

Figure 1. Sample response for questionnaire items.

Procedure

Students of the degrees offered at this public university of northern Mexico. Those who agreed to participate signed the consent letter. Then, the instrument described above was applied using a personal computer (administrator module of the instrument of the scales editor of typical execution), in a session of about 20 minutes in the computer labs of the FCCF. At the beginning of each session students were given a brief introduction on the importance of the study and how to access the instrument; they were asked the utmost sincerity and they were guaranteed the confidentiality of the data obtained. Instructions on how to respond were in the first screens; before the first instrument item. At the end of the session they were thanked for their participation. Once the instrument was applied, data was collected by the results generator module of scales editor, version 2.0 (Blanco, et al., 2013).

Data Analyses

The psychometrical analysis was applied in two stages: 1) Factorial Confirmatory Analysis and 2) Invariance Factorial Analysis; so that it could obtain evidence that presents the best properties for the confirmation of the physical self-concept questionnaire (CAF-M) scores in women and men Mexican university students.

A confirmatory factor analysis was conducted for the first subsample using the software AMOS 21 (Arbuckle, 2012). The error variances were specified as free parameters. In each latent variable (factor) one of the structural coefficients associated was fixed to the value of one in order to make its scale equal to one of the observed variables (items). The maximum likelihood estimation method, following Thompson's (2004) recommendations, was conducted to compare the fit indices of several alternative models to select the best one.

In the fit model assessment, the chi-squared test, the adjusted goodness of fit index (GFI), and the root mean square error of approximation (RMSEA) were used as absolute fit indices. The adjusted goodness-of-fit index (AGFI), the Tucker-Lewis index (TLI) and the comparative fit index (CFI) were used as incremental fit indices. Chi-squared divided by degrees of freedom (CMIN/*df*), and the Akaike information criterion (AIC) were used as parsimony fit indices (Byrne, 2010; Gelabert, et al., 2011).

Lastly, a factor invariance analysis of the better model obtained was conducted, following the recommendations of Abalo et al. (2006), the reliability of each of the dimensions was calculated using the Cronbach's alpha and the omega coefficient (Revelle & Zinbarg, 2009; Sijtsma, 2009).

Results

Confirmatory Factor Analysis

According to the results obtained in Table1 in the Confirmatory Factorial Analysis of 12 items grouped in two factors in the sample of women is optimal (GFI .960 y RMSEA .060) and according to the incremental fit measures and Parsimony significantly higher to the independent model and very similar to the saturated model.

Furthermore, the confirmatory factor analysis on men's sample (Table 1) shows again that the measuring model of two factors is optimal (GFI .961 y RMSEA .060) and according to the incremental fit measures and Parsimony significantly higher to the independent model and very similar to the saturated model.

According to the results of Table 2, in both samples, most items saturate above .60 in their predicted dimension (factor), which makes evident an appropriate convergent validity. Also observed moderate intercorrelations among the factors demonstrating adequate discriminant validity between them.

Invariance of the factorial structure among women and men

The fit indexes obtained (Table 3) allow to accept the equivalence of the basic measuring models between the two samples. Although the value of Chi-squared exceeds to that required to accept the hypothesis of invariance, the indexes GFI=.961, CFI=.971, RMSEA=.042 y AIC=478.465 contradict this conclusion, this allows us to accept the base model of invariance (model without restrictions).

Adding to the base model constraints on factor loads we characterize the metric invariance. The values shown in Table 3 allow us to accept this level of invariance. The goodness of fit index (GFI .954) and the root mean square error of approximation (RMSEA .044) continue to provide convergent information in this direction. Also, the Akaike Information Criterion (AIC 515.288) and Bentler comparative fit index (CFI .965) do not suffer large variations over the previous model. Using the criteria for the evaluation of the nested models proposed by Cheung & Rensvold (2002), who suggest that if the calculation of the difference

Table 1.
Absolute, Incremental and Parsimony Fit Indexes for the Generated Models. Confirmatory Factor Analysis for Women and Men.

	Absolute Fit indexes			Incremental Fit indexes			Incremental Fit indexes	
Model	χ^2	GFI	RMSEA	AGFI	TLI	CFI	CMIN/DF	AIC
Factor solution for women								
Two factors	179.684*	.960	.060	.937	.965	.974	3.667	237.684
Saturated	0.000	1.000				1.000		156.000
Independence	5133.224*	.310	.322	.185	.000	.000	77.776	5157.224
Factor solution for men								
Two factors	182.781*	.961	.060	.938	.955	.967	3.730	240.781
Saturated	0.000	1.000				1.000		156.000
Independence	4096.161*	.342	.284	.222	.000	.000	62.063	4120.161

Note: * $p < .05$; GFI= goodness-of-fit index; RMSEA= root mean square error of approximation; AGFI= adjusted goodness-of-fit index; TLI= Tucker-Lewis index; CFI= comparative fit index; CMIN/df= chi-squared fit index divided by degrees of freedom; AIC= Akaike information criterion

Table 2.
Standardized Solutions for the Confirmatory Factor Analysis in Both Samples

	Women		Men	
Item	F1	F2	F1	F2
Factor Loading				
1. I'm good at sports	.69		.56	
2. I have a lot of physical strength	.72		.64	
5. I have more ability than people of my age to play sports	.70		.61	
6. I can run and exercise for a long time without getting tired	.71		.74	
8. I stand out in activities that require physical strength	.74		.63	
10. Playing sports I'm a skillful person	.78		.68	
11. I have a lot of physical energy	.76		.80	
3. I feel happy with my body image		.83		.69
4. Physically I feel satisfied with myself		.82		.73
7. I feel confident about the physical image I transmit		.86		.83
9. My body transmits me positive feelings		.79		.77
12. I like my face and my body		.68		.59
Factor Correlation Matrix				
F1	-		-	
F2	.49	-	.70	-

Note: F1 = Motor Competency F2 = Physical Attractiveness

Table 3.
Goodness of Fit Indexes of Each of the Models Tested in the Factorial Invariance

Model	Fit indexes						
	χ^2	*df*	GFI	NFI	CFI	RMSEA	AIC
Model without restrictions	362.465*	98	.961	.961	.971	.042	478.465
Metric Invariance	419.288*	108	.954	.955	.965	.044	515.288
Strong factor invariance	524.895*	111	.943	.943	.956	.050	614.485

Note: * $p < .05$; GFI = comparative fit index; NFI = normed fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation; AIC = Akaike information criterion

Tabla 4.
Omega and Alpha Coefficients of Each of the Obtained Factors

	Women		Men	
Factor	Ω	α	Ω	α
1. Motor competency	.888	.894	.849	.854
2. Physical attractiveness	.897	.899	.847	.853

of the CFI of both nested models diminish in .01 or less, the restricted model is taken for granted therefore the compliance of the factorial invariance. The difference of the CFIs obtained allows to accept the metrical invariance model. We can conclude up to this point that factorial loads are equivalent in the two samples.

Having demonstrated the metric invariance between the subsamples, we evaluate the equivalence between intercepts (strong factorial invariance). The Indexes (Table 3) show an optimal fit of this model, evaluated independently as well as analyzed toward nesting with the metric invariance model. The difference between the two comparative indices of Bentler is .009; the general fit index is .943 and the root mean square error of approximation is .050. Accepted then the strong invariance, the two evaluated models are equivalent toward the factorial coefficients and the intercepts.

The factors obtained in the confirmatory factorial analyzes reached, in most cases, values of internal consistency above .70 in both samples (men and women); Showing an adequate internal consistency for this type of subscales, particularly considering the reduced number of items (Table 4).

Contrasts of the means of the factors among women and men

Once proved the factorial invariance, the differences among the means of the factors from the two groups were estimated taking as a reference the women's sample, establishing 0 as the value of the means for this sample, considering freely the value of the means for the sample of men. Restrictions about regression coefficients and intercepts required for the contrast among the means were made automatically through the software AMOS 21 (Arbuckle, 2012). The results of the comparisons indicated that the means of motor competency and physical attractiveness factors were significantly higher .816, p <0.001 and .294, p <0.001 respectively) in men.

Discussion and conclusions

From the results shown, their analysis and discussion, and taking into account that the main objective of this study was to examine the factorial structure and measure the invariance of the structure in women and men Mexican university students, can be obtained the following conclusions:

1) The Confirmatory Factor Analysis, in both samples, indicated that the adjustment of the data to the theoretical model of 12 items grouped in two factors proposed by Blanco et al. (2015) is optimal. At the same time that the factors thus obtained present adequate standardized factorial saturations. On the other hand, in general, the factors correlate with each other positively and statistically significant, which shows that as physical self-concept increases in one of the factors, it also increases in the other.

2) The factors in both samples showed adequate internal consistency, particularly considering the reduced number of items in each of them.

3) Together with all of the above, the results of the factorial invariance analysis between men and women; Indicate a high congruence between pairs of factors. This suggests the existence of strong evidence of cross-validation of the measure and therefore of the stability of the structure, until it is proved otherwise.

4) Comparisons between groups showed significant differences, in favor to men, in the mean of the two factors. What seems to indicate that men are perceived themselves with better physical self-concept than women in relation to factors motor competence and physical attractiveness.

In summary, the analysis of psychometric properties has shown that a two-factor structure is feasible and appropriate according to the established psychometric requirements. The structure of two factors, according to statistical and substantive criteria, has shown adequate indicators of adjustment, reliability and validity. However, it is considered that more studies are necessary in order to corroborate or refute the data obtained in the present investigation.

At least two limitations are present in this work. The first is that participants are only Mexican university students, which threatens the possibility of generalizing these results. Expand the sample (for example adding young adults who are not students) is a work area for the future. The second limitation comes from the measuring instrument itself, which is based on self-inform and therefore may contain biases that result from social desirability.

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