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Examining the Validity, Reliability, and Measurement Invariance of the Social Support for Exercise Scale among Spanish- and English- language Hispanics

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Abstract

The Social Support for Exercise Subscales are commonly used among Hispanic populations. The aims of this study were to test the validity and reliability of the Spanish-language version of the Social Support for Exercise Subscales, and test the invariance of the Spanish- and English-language versions. Data were from a subsample of Hispanic adults in the Cameron County Hispanic Cohort (n=1,447). A series of confirmatory factor analysis (CFA) models were used to assess the validity and reliability of the Spanish-language version of the subscales. A multi group CFA approach was used to test measurement invariance. Results indicated the Spanish-language versions of family and friend support subscales had good validity and reliability (RMSEA<.07, CFI>0.95, TLI>0.94, and SRMR<0.05). There was also evidence of measurement invariance between the Spanish- and English-language versions. These findings indicate the Spanish-language family and friend support subscales are valid and can be compared between Spanish- and English-language Hispanic respondents.

Keywords

Social Support; Physical Activity; Invariance; Validity; Reliability

INTRODUCTION

Social support for physical activity refers to encouragement, modeling or another facilitation activity that is provided by individuals in a person's social network (Anderson, Wojcik,

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Winett, & Williams, 2006; Sarkar, Taylor, Lai, Shegog, & Paxton, 2016). Social support has been directly associated with physical activity levels in various populations (Scarapicchia, Amireault, Faulkner, & Sabiston, 2017), including different racial/ethnic groups (Eyler et al., 1999; Heredia, Ranjit, Warren, & Evans, 2016; Parks, Housemann, & Brownson, 2003). Given the significance of social support, it is commonly targeted by health behavior interventions to promote physical activity. Therefore, it is important for the research community to have valid and reliable measures of social support for physical activity that can be used with different populations. To address this need, Sallis and colleagues' developed the Social Support for Exercise Scale (Sallis, Grossman, Pinski, Patterson, & Nader, 1987).

The Social Support for Exercise Scale consists of three subscales: Family Participation, Family Punishment, and Friends Participation. The subscales have been widely used among English-language samples (Gell, Grover, Humble, Sexton, & Dittus, 2017; Gell & Wadsworth, 2014; Gorin, Powers, Koestner, Wing, & Raynor, 2014; Miller, Weinhold, Marrero, Nagaraja, & Focht, 2015; Pagoto, Schneider, Oleski, Smith, & Bauman, 2014; Scarapicchia et al., 2017; Schneider et al., 2016; Stolley, Sharp, Oh, & Schiffer, 2009). The subscales have also been adapted into other languages and made publicly available by the original authors (Sallis, n.d.). However, only a few of the versions adapted for other languages have had some form of psychometric testing published in the literature (Noroozi, Ghofranipour, Heydarnia, Nabipour, & Shokravi, 2011; Reis, Reis, & Hallal, 2011; STEVENS, Bakker-Van Dijk, De Greef, Lemmink, & Rispens, 2000; Theodoropoulou, Karteroliotis, & Stavrou, 2014).

The Spanish-language version has been used by researchers examining social support among Spanish-speaking samples (Craven, Keefer, Rademaker, Dykema-Engblade, & Sanchez-Johnsen, 2018; Hartman et al., 2011; Keller et al., 2014; Marcus et al., 2016; B. Marquez, Dunsiger, Pekmezi, Larsen, & Marcus, 2016; D. X. Marquez & McAuley, 2006). However, to our knowledge, there are no published studies testing psychometric properties of a Spanish-language version of the scale. In previous studies that used a Spanish-language version of the scale, authors cited the validity and reliability of the original English-language version. The psychometric properties of the English-language version may not necessarily generalize to a Spanish-language version, which could impact study results. Therefore, testing the validity of the Spanish-language version of the Social Support for Exercise scale can greatly support previous and future work.

Given that researchers who work with Hispanic populations often are working with a mix of Spanish- and English-speaking individuals, there is also a need to understand the potential differences in the psychometric properties and assess the equivalence/invariance between the Spanish- and English-language versions. Equivalent measures allow for valid comparisons of a construct between groups and help rule out the potential for measurement artifact to contribute to observed differences. Measure equivalence is also important to establish for researchers planning to use results from the two different versions of the scale in a pooled analysis. Therefore, the study aims are to 1) test the validity of the Spanish-language version of the Social Support for Exercise Scale and 2) test the invariance of the Spanish- and English-language versions of the scale in a sample of Hispanic respondents.

METHODS

Participants and Data Collection

This study used data from the Cameron County Hispanic Cohort (CCHC), which is an ongoing longitudinal study examining health conditions among Mexican Americans living along the US Mexico Border. More details about recruitment and data collection for the CCHC have been published elsewhere (S. Fisher-Hoch et al., 2012; S. P. Fisher-Hoch et al., 2010). Broadly, the CCHC study collected health-related data from participants including a self-reported survey about health behaviors such as physical activity. The Social Support for Exercise Scale was added to the CCHC survey as a measure of interest. In this study, we used the subset of CCHC participants who completed a survey that included the Social Support for Exercise Scale. The Institutional Review Board of the University of Texas Health Science Center at Houston approved this study.

Measures

The Social Support for Exercise Scale included in the CCHC study consisted of three subscales: family support (10 items), friend support (10 items), and family rewards and punishment (3 items) (Table 1). Participants are asked how often a family member (or friend, depending on the subscale) has said or done a behavior described in the statements. Participants respond to all statements using a 5-point scale, from 1 (none) to 5 (very often). For the Spanish version, the scale was translated from English to Spanish, and then back-translated. A research staff member read the survey to each participant in the language of his or her choice.

The Social Support for Exercise Scale used in this study includes some minor changes from the original published version. Originally, the friend support subscale included 5 items, the family support included 12 items, and the family rewards and punishments included 3 items (Sallis et al., 1987). In subsequent years, the developers recommended and have used (Sallis, Calfas, Alcaraz, Gehrman, & Johnson, 1999) updated versions of the scale consistent with what was used in this study (Sallis, n.d.). The updated version includes separate columns for responses for family and friends as this format was designed to make the scales easier to use than the originally validated version.

Additional variables from the survey were used to describe the sample. These variables include age, gender, marital status, employment, years of education, body mass index (BMI), waist circumference, and physical activity level. Waist circumference, height and weight (used to calculate BMI) were measured by research staff during a study visit. Physical activity was assessed using a modified version of the Godin Leisure-Time Exercise Questionnaire (Godin & Shephard, 1997). The modified version included questions about frequency and duration of both moderate and vigorous leisure-time physical activity, which were used to classify participants into meeting guidelines (or not).

Analysis

Descriptive statistics were used to assess characteristics of the study sample. Each item from the Social Support for Exercise Scale was screened for skewness, kurtosis, and missing

values. After data screening, a series of confirmatory factor analysis (CFA) models were evaluated for the Spanish-language versions of the social support subscales. The following models were assessed: 1) 10-item family support; 2) 2-factor model assessing family support and family rewards/punishment together (13-items); 3) 10-item friend support; and 4) 5-item friend support (from the original scale).

To assess model fit, the collective information from the following fit indicators were used: chi-square (non-significant=good fit), comparative fit index (CFI, >0.90 =adequate and >0.95 =good), Tucker-Lewis index (TLI, >0.90 =adequate and >0.95 =good), root mean square error of approximation (RMSEA, 0.05 – 0.08 =adequate, <0.05 =good), and standardized root mean square residual (SRMR, 0.05 – 0.08 =adequate, <0.05 =good) (Byrne, 2012). Models were also assessed by noting the magnitudes of factor loadings and identifying points of model strain by examining modification indices. Model adjustments were considered if modification indices were substantively meaningful and consistent with previous studies validating the Social Support for Exercise Scale (Noroozi et al., 2011; Theodoropoulou et al., 2014). Maximum likelihood estimation with robust standard errors was used for all models given the non-normal distribution of the scale items.

Scale reliabilities (proportion of true-score variance to total observed variance) were assessed using a CFA-based approach (Raykov, 2001, 2004). Using this approach, the scale's true score and error variance were calculated based on CFA estimates of factor loadings, error variances, and error covariances (Brown, 2015). Point estimates of reliability along with 95% confidence intervals are reported, where a score >0.65 was considered acceptable (Brown, White, Forsyth, & Barlow, 2004; Walker, Tullar, Diamond, Kohl III, & Amick III, 2016).

A multi group CFA approach was used to test measurement invariance of social support subscales between Spanish- and English-language respondents (Brown, 2015; van de Schoot, Lugtig, & Hox, 2012). Only subscales that demonstrated good validity and reliability were tested across three levels of invariance: configural, metric, and scalar. First, configural invariance was tested by fitting a multi group model with no equality constraints (equal forms model). This was to determine whether the pattern of item-factor loadings were the same between groups. Second, metric invariance was tested by constraining factor loadings to be equal between groups (equal loadings model). This was to determine whether the Spanish- and English-language respondents ascribed the same meaning to the respective social support constructs. Third, scalar invariance was tested by fitting a model where the factor loadings and intercepts were constrained to be equal between groups (equal intercepts model). This was to determine whether the meaning and levels of social support were equal between Spanish- and English-language respondents.

The equal forms model served as a baseline model where increasingly constrained models were compared sequentially. The Satorra-Bentler scaled chi-square difference test was used to assess differences in chi-square values between models (Satorra & Bentler, 2001). However, because chi-square tests are known to be sensitive to sample size and violations of the normality assumption (Chen, 2007), differences in other goodness of fit indices were also used to assess invariance. More specifically, a negative CFI -0.01 (e.g. CFI =

–0.02) was used as a primary indicator of lack of invariance (Chen, 2007; Cheung & Rensvold, 2002). In addition, RMSEA = 0.01, SRMR = 0.025 when comparing the equal forms model to the equal loadings model, and SRMR = 0.005 when comparing the equal loadings model to the equal intercepts model were used as secondary indicators of lack of invariance.

RESULTS

Factorial Validity

The total sample included 1,447 participants (Table 2). There were 20 participants who did not complete the friend support subscale leading to a sample of 1,427 people included in the friend support models. About 74% (1,078) of the total sample completed the Spanish-language version of the scale. The majority of the sample was female (66.3%) and married (66.3%) and the mean age was 45.4 years. When comparing between groups, Spanish-language participants tended to have a greater percentage of people who were unemployed and had lower levels of education (Table 2). Both groups had similar BMI levels whereas the English-language participants had slightly higher waist circumference despite a higher percentage of people reporting they were meeting physical activity guidelines (Table 2).

Results from the 1-factor, 10-item family support model indicated some evidence of weak model fit (RMSEA>0.08 and TLI<0.90) (Table 3). All standardized factor loadings were > 0.50 and statistically significant. However, modification indices indicated correlated errors between two item pairs (1 and 2, and 3 and 4), which were consistent with results from previous studies (Noroozi et al., 2011; Theodoropoulou et al., 2014). Including correlated errors resulted in a model with good fit across indices: χ^2 (df=33) = 162.1, $p<0.001$, RMSEA=0.06, CFI=0.959, TLI=0.944, SRMR=0.035 (Table 3). Results from testing the 2-factor model using 10-items for family support and 3-items for family rewards/punishment indicated evidence of weak model fit (CFI >0.90, TLI >0.90, and SRMR >0.08) (Table 3). When adding correlated errors (1 and 2, and 3 and 4), fit improved although there was still evidence of misfit (SRMR>0.08) (Table 3). All factor loadings were statistically significant; however, item 3 in the family rewards and punishment scale had a low standardized factor loading (0.20) indicating this was a weak item.

Similar to the family support subscale, results from the 10-item friend support model indicated some evidence of misfit (TLI<0.90). However, when including the same two pairs of correlated errors (1 and 2, and 3 and 4), model fit was good across fit indices: χ^2 (df=33) = 110.9, $p<0.001$, RMSEA=0.047, CFI=0.962, TLI=0.948, SRMR=0.035) (Table 3). In addition, all standardized factor loadings were >0.50 and statistically significant. When assessing the original 5-item friend support scale that was validated in previous studies (Noroozi et al., 2011; Theodoropoulou et al., 2014), results revealed evidence of poor model fit (RMSEA>0.08 and TLI<0.90). However, including correlated errors improved model fit: χ^2 (df=3) = 12.1, $p=0.007$, RMSEA=0.053, CFI=0.988, TLI=0.960, and SRMR=0.015 (Table 3).

Scale Reliability

The 10-item family support and friend support subscales demonstrated high levels of reliability (0.91; 95% CI = 0.90–0.92 and 0.90; 95% CI = 0.89–0.91, respectively). The 5-item friend support subscale demonstrated moderate reliability (0.79, 95% CI = 0.75–0.83) while the family rewards/punishment subscale had poor reliability (0.29; 95% CI = 0.21–0.38). Given the poor validity and reliability results, the family rewards/punishment subscale was not included in further invariance testing.

Measurement Invariance

The equal forms model for the 10-item family support subscale demonstrated good model fit: χ^2 (df=66) = 278.7, $p < 0.001$, RMSEA=0.067, CFI=0.954, TLI=0.937, and SRMR=0.036 (Table 4), supporting configural invariance between Spanish- and English-language respondents. The equal factor loadings model also demonstrated good fit: χ^2 (df=75) = 325.6, $p < 0.001$, RMSEA=0.068, CFI=0.946, TLI=0.935, and SRMR=0.050. When comparing models, the Satorra-Bentler scaled chi-square difference test was statistically significant (Table 4). However, there were minimal changes in other fit indices supporting metric invariance between the groups (Table 4). Results were similar when testing scalar invariance where the equal factor loadings and intercepts model demonstrated good fit with minimal changes in fit indices compared to the equal factor loadings model (Table 4). These results provide support for scalar invariance for the family support subscale between Spanish- and English-language respondents.

When testing invariance for the 10-item and 5-item friend support subscales, results were similar to the family support subscale. The equal forms models demonstrated good model fit supporting configural invariance (Table 4). The equal factor loadings and the equal intercepts models also demonstrated good model fit with minimal changes to fit indices supporting invariance between groups for these subscales (Table 4).

DISCUSSION

This study examined the validity and reliability of the Spanish-language version of the exercise social support scale and whether there was evidence for measurement invariance between scale versions. Our results indicate the Spanish-language versions of the family support and friend support subscales had good validity and reliability while the family rewards and punishment subscale had poor reliability and validity. In addition, there was evidence of measurement invariance between Spanish- and English-language versions suggesting the scales have the same meaning between these two groups. Overall, results indicate the subscales are reliable and valid measures of social support and that results from these scales can be compared between Spanish- and English-language Hispanic respondents.

Previous studies testing the validity of the exercise social support scale have revealed different factor structures for different populations (Noroozi et al., 2011; Sallis et al., 1987; Theodoropoulou et al., 2014). Original work conducted by the scale developers revealed there were two factors for family support: 1) participation and involvement and 2) rewards and punishment. However, the rewards and punishment factor was only made up of three

items and considered to be unstable as a subscale. Our results were consistent with these findings where there was evidence to support a participation and involvement subscale but the rewards and punishment subscale had poor reliability and validity among Spanish-language respondents.

More recent studies have tested adapted versions of the social support scale among women with diabetes from Iran, and, university students and adults from Greece. Both studies excluded the family support rewards and punishment items from their analyses. When testing the scales among Iranian women, researchers found a 3-factor solution for family support (using the participation and involvement items) and a 1-factor solution (using the original 5-items) for friend support (Noroozi et al., 2011). When testing the Greek version of the scale, researchers found a 2-factor solution for family support (using the participation and involvement items) and a 1-factor solution for friend support (using the original 5-items) (Theodoropoulou et al., 2014).

In our study (and consistent with Sallis et al.'s original work), we only tested a 1-factor solution using the participation and involvement items, which revealed good model fit. Different factor structures for different populations is not surprising given the cultural and demographic differences between the samples. Also, the previous studies used additional items that are not included in the most recent recommended version of the scale, which could also be contributing to the different number of factors found. Notably, the 5-item friend support subscale was valid across all four studies. This finding may be in part due to the same items used across all studies and the fact that this version of the subscale was limited to five items relevant to the respective study participants.

Our study extended on previous findings by testing a Spanish version of the Social Support for Exercise Scale, which includes a 10-item version of the friend support subscale. Our results indicated this 10-item version was also valid and reliable among Spanish and English-speaking respondents. In addition, we tested whether the subscales were invariant between Spanish- and English-language speakers. When comparing invariance models, chi square difference tests for respective subscales were statistically significant suggesting a lack of invariance. However, chi-square tests are sensitive to large samples and non-normal data, which could be contributing to the differences observed. Differences between other fit indices were minimal and within recommended ranges (Chen, 2007) providing evidence of measurement invariance between groups. This finding is important given that there is often a mix of Spanish- and English language speakers among Hispanic populations and thus it provides support that results using the Spanish and English versions are comparable and can be pooled for analyses.

There were some study limitations. Because our study focused on the factorial validity, reliability, and invariance testing, we did not include other validity or reliability tests in our analysis. Therefore, test-retest reliability and predictive validity (among others) could provide additional useful information about the subscales. In our study, there was also more Spanish-language respondents than English-language respondents. The unequal sample sizes between groups may impact the changes in goodness of fit indices contributing to a greater chance for Type II error (Chen, 2007). However, our study had a large sample size, which is

known to increase rejection rates for chi-square difference tests, and, to a lesser degree, fit indices (Chen, 2007). Last, our sample consisted of Spanish- and English-language Hispanic respondents living on the Texas-Mexico border. Thus, results may not be generalizable to other Hispanic populations.

Conclusions

This is the first known study to assess the validity and reliability of the Spanish-language version of the Social Support for Exercise Scale despite its common use in previous studies (Craven et al., 2018; Hartman et al., 2011; Keller et al., 2014; Marcus et al., 2016; B. Marquez et al., 2016; D. X. Marquez & McAuley, 2006). Our results indicate the subscales are valid and reliable and that they have the same meaning between Spanish- and English-language Hispanics. These results provide support for valid comparisons between these two group groups using this scale and for pooling their data in analyses. We also found support for the 5- and 10-item versions of the friend support subscale. The 10-item version mirrors the family support scale, which may ease administration and provide more coverage of the construct. However, the 5-item version would also be appropriate when survey length is an issue.

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Table 1.

Social Support for Exercise Scale items for English- and Spanish-language versions

Family Support / Friend Support Items			
English		Spanish	
1.	Did exercise with you *	1.	Hicieron ejercicio con usted *
2.	Offered to exercise with you *	2.	Ofrecieron hacer ejercicio con usted *
3.	Gave you helpful reminders to exercise ("Are you going to exercise tonight?") *	3.	Le recordaron de hacer ejercicio ("¿va a hacer ejercicio esta noche?") *
4.	Gave you encouragement to stick with your program *	4.	Lo(a) animaron a seguir con su plan de ejercicio *
5.	Changed their schedule so you could exercise together*	5.	Cambiaron su horario para que pudieran hacer ejercicio juntos *
6.	Discussed exercise with you	6.	Hablaron de ejercicio con usted
7.	Helped plan activities around your exercise	7.	Ayudaron a planear actividades en torno/alrededor a su ejercicio
8.	Asked you for ideas on how they can get more exercise	8.	Le pidieron sugerencias en cómo pueden ellos hacer más ejercicio
9.	Talked about how much they like to exercise	9.	Platicaron acerca de cuanto les gusta a ellos hacer ejercicio
10.	Planned to exercise on recreational outings	10.	Planearon hacer ejercicio en una excursión recreativa
Family Rewards and Punishment Items			
English		Spanish	
1.	Complained about the time you spend exercising	1.	Se quejaron acerca del tiempo que usted paso haciendo ejercicio
2.	Criticized or made fun of you for exercising	2.	Lo(a) criticaron o se burlaron de usted por hacer ejercicio
3.	Gave you rewards for exercising (bought you something or gave you something you like)	3.	Lo(a) recompensaron por hacer ejercicio (le compararon algo o le dieron algo que le gusta)

Response options: 1) None, 2) rarely, 3) a few times, 4) often, 5) very often;

*, indicates it was an item tested in the 5-item friend support subscale.

Table 2:

Characteristics of the Study Sample

Variable	Total (n=1,447)	Spanish-Language (n=1,078)	English-Language (n=369)
Female (n, %)	959 (66.3%)	750 (69.6%)	209 (56.6%)
Age (M, SD) *	45.4 (15.1)	47.3 (14.6)	40.2 (15.5)
Marital Status (n, %) *			
Not Married	490 (33.9%)	324 (30.1%)	166 (45.0%)
Married	955 (66.1%)	752 (69.9%)	203 (55.0%)
Employment (n, %) *			
Employed	729 (50.4%)	511 (47.4%)	218 (59.4%)
Unemployed	716 (49.6%)	567 (52.6%)	149 (40.6%)
Years Education (M, SD)	11.1 (5.4)	9.8 (5.1)	15.2 (4.2)
BMI (M, SD) *	31.2 (6.5)	31.1 (6.0)	31.7 (7.8)
Waist (M, SD) *	103.4 (15.4)	102.8 (13.9)	105.2 (19.0)
Meeting PA Guidelines (n, %) *	453 (32.0%)	289 (27.4%)	164 (45.4%)

*, indicates there were some missing data for these descriptive variables: n=1,133 with age data, n=1,446 with marital status and BMI data, n=1,445 with employment data, n=1,443 with Waist circumference data, and 1,414 with PA data

Table 3:**Measurement Model Results**

Model	χ^2	df	RMSEA	CFI	TLI	SRMR
Family Support	292.5 *	35	0.083	0.918	0.895	0.046
Family Support ^b	162.1 *	33	0.060	0.959	0.944	0.035
Family Support & Rewards/Punishment	497.3 *	64	0.079	0.883	0.858	0.101
Family Support & Rewards/Punishment ^b	348.5 *	62	0.065	0.923	0.903	0.099
Friend Support (10-items)	205.6 *	35	0.068	0.916	0.892	0.047
Friend Support (10-items) ^b	110.9 *	33	0.047	0.962	0.948	0.035
Friend Support (5-items)	65.2 *	5	0.106	0.919	0.839	0.045
Friend Support (5-items) ^b	12.1 **	3	0.053	0.988	0.960	0.015

^b, model includes correlated errors between items 1&2 and 3&4;

*, p<0.001

**, p=0.007

Table 4:

Measurement Invariance Result

Model	Overall Fit Indexes					Comparative Fit Indexes				
	χ^2 (df)	RMSEA	CFI	TLI	SRMR	Model Comparison	χ^2 (df)	RMSEA	CFI	SRMR
Family Support (10-items)										
1. Equal Forms	278.7 (66)	0.067	0.954	0.937	0.036					
2. Equal Loadings	325.6 (75)	0.068	0.946	0.935	0.050	1 vs. 2	46.9 (11)	0.001	-0.008	0.014
3. Equal Intercepts	369.1 (84)	0.068	0.938	0.934	0.049	2 vs. 3	43.5 (11)	0.000	-0.008	-0.001
Friend Support (10-items)										
4. Equal Forms	189.3 (66)	0.051	0.963	0.950	0.034					
5. Equal Loadings	235.9 (75)	0.055	0.952	0.943	0.056	4 vs. 5	46.6 (11)	0.004	-0.011	-0.007
6. Equal Intercepts	264.6 (84)	0.055	0.946	0.943	0.054	5 vs. 6	28.7(11)	0.000	-0.004	0.002
Friend Support (5-items)										
7. Equal Forms	36.3 (8)	0.070	0.978	0.946	0.025					
8. Equal Loadings	51.7 (12)	0.068	0.970	0.949	0.048	7 vs. 8	15.4 (4)	0.002	0.008	0.023
9. Equal Intercepts	62.0 (16)	0.064	0.965	0.956	0.045	8 vs. 9	10.3 (4)	0.004	0.005	0.003