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# Factor Replication of the Reduced Laffrey Health Conception Scale

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This study replicated the factor model for the Reduced Laffrey Health Conception Scale (RLHCS), which was originally developed by Laffrey (1986) and reduced by Lusk, Kerr, and Baer (1995). Two independent samples of construction workers ($n$ = 697 and $n$ = 510) were used. The samples were predominately Caucasian males (over 97%), with mean ages of 35 and 38 years, respectively. Principal components factor analysis with direct oblimin rotation and structural equation modeling were used to replicate factors and to test the equality of the three observed covariance matrices (factory workers and two groups of construction workers), respectively. Results replicated the two-factor structure (clinical health and overall wellness) found in the earlier study with factory workers (Lusk et al., 1995) and demonstrated factor invariance across different samples.

Health is a significant concept for nursing research, education and practice (Fawcett, 1995). Health conception refers to the meaning given to health by the individual. An individual's conception of health may affect health behaviors he or she chooses to practice (Laffrey, 1985). Knowing individuals' conceptions of health can assist health professionals, particularly nurses, to understand the health behavior choices of individuals and to formulate health goals that are acceptable, realistic, and consistent with the client's perspective (Laffrey, 1986). Therefore it is important to find out how individuals define health and to take this into account in providing effective nursing services.

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## THE LAFFREY HEALTH CONCEPTION SCALE (LHCS)

### Conceptual Basis

Health has been viewed as a multidimensional construct that must incorporate more than the absence of symptoms or disease (Laffrey & Crabtree, 1988; Smith, 1981, 1983). With a multidimensional view of health, an individual can continue to fulfill role expectations, adapt to environmental changes, or self-actualize, despite the presence of symptoms or disease.

Smith (1981, 1983) noted that large numbers of health definitions found in the literature could be categorized into four dimensions: (a) clinical health, defined as relief from the signs and symptoms of disease; (b) functional/role performance, in which health is defined as being able to function according to the expectations of the society in which one lives, including satisfactorily carrying out the individual's roles as husband, wife, father, mother, student, employee, and so forth; (c) adaptive health, defined as effective functioning in and adaptation to changing social and natural environments. In this conception, individuals consider themselves healthy if they are able to be flexible and still maintain stability in life; and (d) eudaimonistic health, defined as self-actualization or fulfillment of one's highest potential. Individuals with an eudaimonistic health conception consider health as the achievement of their self-realization and highest potentials (Laffrey, 1986). These four dimensions of health are not mutually exclusive, but all four need to be examined because an individual may weigh them differently in arriving at a personal conception of health. These four concepts are considered to be increasingly complex, with each including the concerns of the proceeding (Smith,1981, 1983).

### Development of the LHCS

While Smith (1981, 1983) provided useful conceptual frameworks for defining health, Laffrey (1986) operationalized them and developed the 28-item Health Conception Scale (HCS) to measure an individual's definitions of different aspects of health. Items selected for the Laffrey Health Conception Scale (LHCS) were based on congruency with the definitions of the four dimensions of health proposed by Smith (1981, 1983). Each dimension is measured by a 7-item subscale of the instrument and is scored on a Likert scale ranging from 1 (Strongly disagree) to 6 (Strongly agree). Each item is a short, descriptive statement about the nature of health. Content validity of the LHCS was evaluated by seven nurse experts, who independently categorized each item according to definitions of the four dimensions. Interrater agreement of 63-100% was achieved for all of the items. Construct validity was supported by a principal components factor analysis with an orthogonal (varimax) rotation; the four dimensions conceptualized for the instrument were confirmed. The LHCS demonstrated good internal consistency coefficients for the four health dimensions ranging from .85 to .88. A detailed description of the development and psychometric testing of the LHCS, along with a list of the original 28 items of LHCS, is provided in Laffrey (1986).

# DEVELOPMENT OF THE REDUCED LAFFREY HEALTH CONCEPTION SCALE (RLHCS)

Although Laffrey (1986) identified four dimensions in LHCS (clinical, functional/role performance, adaptive, and eudaimonistic), others have found strong intercorrelations among three of the subscales (functional/role performance, adaptive, and eudaimonistic dimensions of health) and have combined them to form a single indicator: 'overall wellness' (Lusk, Kerr, & Baer, 1995; Pender, Walker, Sechrist, & Frank-Stromborg, 1990). In particular, with the intention of creating a useful, yet less cumbersome version of the original 28-item LHCS, Lusk and colleagues (1995) reduced the LHCS to a 16-item instrument based on the results of factor analysis with a sample of chemical plant workers. The Reduced LHCS (RLHCS) is a bidimensional scale with the original clinical health subscale and a new overall wellness subscale.

In the Lusk and associates study (1995), the clinical health subscale was used in its original form. The overall wellness subscale was created by selecting the best three items from each of the 'Functional/role performance,' 'Adaptive,' and 'Eudaimonistic' health subscales. The items were selected based on three criteria: (a) items which had lower correlations with the other three subscales, but (b) had higher factor loadings on the factor analysis for that subscale, and (c) those items which were dissimilar in content. Further details of the reduction process and construction of the RLHCS are reported in Lusk and colleagues (1995).

Psychometric properties of the RLHCS were tested with a large sample ($N = 873$) of automobile manufacturing plant workers in the Midwest. Excellent construct validity and internal consistency reliability were reported (Lusk et al., 1995). Although initial factor analysis and psychometric testing results for the RLHCS appeared promising, replication and validation of the results are desirable before it can be used with confidence to measure individuals' definition of health. To date, no published reports on factor replication of the RLHCS have been found in the literature. The purpose of this study was to replicate the factor structure and examine the reliability of the RLHCS with two samples of construction workers.

# METHOD

## Sample

Data for the present study were obtained from a larger two-phase hearing protection intervention study with a regional sample of midwestern construction workers and a national sample of plumber/pipefitter trainers. For details about this sample and methodology, see Lusk and Associates (1999). A total of 1,501 workers were recruited at pretest and randomly assigned, usually by naturally occurring training groups, to four different conditions using a Solomon Four-Group Design (Michel & Haight, 1996) as follows:

Solomon Four-Group Design

| Pretest | Intervention | Posttest (10-12 months later) |
|---|---|---|
| O[a] | X | O |
| O[b] | | O |
| | X | O[c] |
| | | O[d] |

*Note.* a+b = Sample 1 (pretest group), c+d = Sample 2 (no-pretest group)

For the purpose of examining invariance of factor structure, the current study used two independent samples. As shown below, sample 1 (pretest group) included those who participated in the pretest survey in 1995 ($n = 697$). The majority of them (74%) also completed a posttest questionnaire approximately 1 year (10-12 months) later, but their posttest survey data were not subjected to factor analysis in this study. Sample 2 (no pretest group) consisted of workers who completed a posttest questionnaire in 1996 but did not participate in the 1995 pretest ($n = 510$). Some workers in both samples had received hearing protection training. Guadagnoli and Velicer (1988) suggested that a sample size of 300-400 observations is sufficient under any conditions of variable to component ratio and component saturation. Both sample sizes for the present study were sufficiently large for meeting this criterion for performing factor analysis.

Characteristics of the two samples are summarized in Table 1. The samples consisted of workers in three different construction trades (operating engineers, carpenters, and plumber/pipefitters) and a group of national plumber/pipefitter trainers. As shown in Table 1, the subjects were predominantely middle-aged Caucasian males. Significant differences were found between the two samples for age, $t(1{,}199) = -3.70, p < .001$; years in trade, $t(1{,}034) = -6.65$; and ethnicity, $\chi^2(1, N = 1{,}185) = 4.53, p < .05$. Subjects in the no-pretest group had a larger proportion of

**TABLE 1. Characteristics of Two Samples of Construction Workers**

| | Sample 1 Pretest group ($n = 697$) | | Sample 2 No-pretest group ($n = 510$) | |
|---|---|---|---|---|
| Trade Group | *n*(%) | | *n*(%) | |
| Operating engineers | 207(30) | | 174(34) | |
| Carpenters | 168(24) | | 111(22) | |
| Plumber/Pipefitters (PL/PFs) | 161(24) | | 100(20) | |
| National PL/PF trainers | 150(22) | | 125(24) | |
| Ethnicity—White* | 606(88) | | 464(92) | |
| Gender—Male | 672(97) | | 490(97) | |
| | *M* | *SD* | *M* | *SD* |
| Age* | 35.2 | 10.1 | 37.5 | 10.6 |
| Years in trade* | 9.9 | 9.4 | 14.0 | 10.3 |

* Significant ($p < .05$).

Caucasians (92% vs. 88%), were older (mean age: 38 years vs. 35 years), and had more experience in their trade (mean years of experience: 14 years vs. 10 years) than those in the pretest group. There was no significant difference between the two samples for gender and tradegroup (see Table 1).

## Measure (Instrument): RLHCS

Data were gathered by self-administered questionnaire. Subjects were asked to complete the 16-item RLHCS in conjunction with other measures included in the survey questionnaire to identify predictors of workers' use of hearing protection. The 16 items of the RLHCS are listed in Table 2, along with the results of the present and previous (1995) factor loadings. The instrument measures the extent of an individual's agreement with each statement on definition of health. The instrument employs a 6-point Likert response scale ranging from "Strongly disagree (1)" to "Strongly agree (6)." The RLHCS postulated an internal structure of two subscales, the clinical health and the overall wellness subscales, based on an exploratory factor analysis (principal components) with factory workers. The clinical and overall wellness subscales of the RLHCS consist of seven and nine items, respectively. The clinical health subscale includes items such as: "For me, health or being healthy means being free from symptoms of disease," and "For me, health or being healthy means not being sick." The overall wellness subscale has items such as "For me, health or being healthy means adequately carrying out my daily responsibilities," "For me, health or being healthy means adjusting to life's changes," and "For me, health or being healthy means feeling great—on top of the world" which comprise the dimensions of role performance, adaptive, and eudaimonistic health (Lusk et al., 1995).

Workers were asked to indicate the degree to which each item was consistent with the way they define health. Scores on the two subscales were computed as means. A higher mean overall wellness score indicated a greater degree of personal agreement that health is defined as overall wellness, while a higher clinical health mean score represented a higher perception of health as absence of disease, illness, or symptoms.

In the study of factory workers (Lusk et al., 1995), the RLHCS demonstrated good internal consistency (Cronbach alpha coefficicent = .85 for both subscales) and interitem correlations (.26 to .76 for the clinical subscale and .23 to .66 for the overall wellness subscale). Content validity was enhanced by using items from an established instrument, the original LHCS. Construct validity of the RLHCS was supported by factor analysis. Two distinct factors, the clinical health and overall wellness subscales, were obtained and explained 51% of the variance in definition of health.

## Statistical Analysis

Participants' responses obtained from the 16 items of the RLHCS were subjected to factor analysis by principal components analysis and the resulting matrix rotated, using oblique rotation (direct oblimin). Oblique rotation does not impose the restriction that factors be orthogonal, so results in terminal factors after oblique rotation are, in general, correlated with each other (Kim & Mueller, 1978a). For the purpose of replication of

**TABLE 2. Factor Loadings of Items in the RLHCS From the Factor Pattern Matrix***

| Item No. | Label | Factory workers in Lusk et al (1995) study ($n$ = 873) | | Construction workers Pretest group ($n$ = 697) | | Construction workers - No pretest group ($n$ = 510) | |
|---|---|---|---|---|---|---|---|
| For me health or being healthy means: | | F1[a] | F2[b] | F1 | F2 | F1 | F2 |
| HCS6 | Not being under a doctor's care for illness | .88 | | .87 | | .90 | |
| HCS5 | Not requiring pills for illness or disease | .88 | | .89 | | .90 | |
| HCS3 | Not requiring a doctor's services | .84 | | .81 | | .78 | |
| HCS11 | I do not require medications | .69 | | .74 | | .76 | |
| HCS8 | Not being sick | .55 | | .65 | | .66 | |
| HCS2 | Being free from symptoms of disease | .52 | | .67 | | .51 | |
| HCS15 | Having no physical or mental incapacities | .49 | | .54 | | .62 | |
| HCS13 | Coping with changes in my surroundings | | .89 | | .87 | | 81 |
| HCS14 | Fulfilling my responsibilities as a husband, wife, son, daughter, friend, worker, etc. | | .82 | | .81 | | .80 |
| HCS12 | Carrying on the normal functions of daily living | | .81 | | .69 | | .73 |
| HCS10 | Adequately carrying out my daily responsibilities | | .79 | | .85 | | .83 |
| HCS9 | Actualizing my highest and best aspirations | | .61 | | .74 | | .75 |
| HCS4 | Adjusting to life's changes | | .59 | | .65 | | .73 |
| HCS7 | Being able to change and adjust to demands made by the environment | | .55 | | .67 | | .64 |
| HCS1 | Feeling great—on top of the world | | .41 | | .41 | | .54 |
| HCS16 | My mind and body function at their highest level | .32 | .35 | .29** | .36 | .31 | .40 |
| % of variance explained | | 51 | | 54 | | 56 | |

*Note.* [a]Factor 1: Clinical health (7 items); [b]Factor 2: Overall wellness (9 items).

* Based on the results of principal components with direct oblimin rotation.

** Although loading of .29 was not met as a criterion for inclusion of .30 as an acceptable minimum loading, the values were listed to show the item loaded equally on both factors.

the factor model reported by Lusk and colleagues (1995), this study employed the same analysis method (oblique rotation) as used in the Lusk and associates study. In addition, Lusk and colleagues' finding of substantial correlations between RLHCS subscales ($r = .53$) supported that an oblique solution (direct oblim) was the most appropriate rotation of the factor matrix for the present study.

This study also used structural equation modeling to simultaneously test the equality of the three covariance matrices (factory workers and two replication samples, covariance matrices are available from the author). Structural equation modeling could be used to test other hypotheses about these data. In particular, confirmatory factor analyses could be used to assess the adequacy of a model based on the exploratory factor analyses. For the purpose of the present study, assessing the degree of replication, the hypothesis of equal covariance matrices is most relevant. The software used for structural equation analyses was AMOS 3.61 (Arbuckle, 1997); the estimation method was maximum likelihood estimation. An alpha level of .05 was used for all statistical tests.

## RESULTS

### Factor Replication and Scale Validity

A factor replication method was employed to see if the previously reported two-factor structure of the RLHCS in the Lusk and associates (1995) study could then be replicated. Simple bivariate correlations among the 16 items ranged from .27 to .66 for these samples. Consistent positive intercorrelations were found among the items. The appropriateness of the correlation matrix for factor analytic methods was determined by computing Bartlett's test of sphericity and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. Bartlett's test of sphericity can be used to test the hypothesis that the correlation matrix is an identity matrix. That is, all diagonal terms are 1 and all off-diagonal terms are 0 (Norusis, 1988). The values of the test statistic for sphericity were large (Sample 1 = 5023.75, Sample 2 = 4090.75) and the associated significance levels were small ($p = <.0001$) for the construction worker data. It appears unlikely that the population correlation matrix is an identity. The KMO measure of sampling adequacy is an index for comparing the observed correlation coefficients and the partial correlation coefficients. The index ranges between 0 and 1. A value of 1 implies that every variable can be predicted without error from other variables in the set (Kim & Mueller, 1978b). Reasonably large values for the KMO coefficient are needed for factor analysis of the variables (Norusis, 1988). The values of the KMO statistics for both of the samples were in the .90's, which was considered 'marvelous' by Kaiser (1974). These two measures confirmed that the items 'cohered psychometrically' (Dziuban & Shirkey, 1974) and the use of the factor model was appropriate for these data.

The two-factor solution was chosen for each sample in the present study in an attempt to replicate the two dimensions (clinical health, overall wellness) reported in the Lusk and colleagues study (1995), in which two factors were retained based on eigenvalues greater than 1.0. The eigenvalues for the two factors were 6.40 and 2.20

for sample 1 and 6.98 and 1.96 for sample 2 in the present study. Factor 1 is the factor with the larger loading for the clinical health variables. A criterion of .30 was used as an acceptable minimum loading (Tabachnick & Fidell, 1989). For those cases in which one loading was substantially (a difference of .15) higher than that of the other factor, the higher loading was considered salient (Gorsuch, 1983).

The present study examined the factor pattern matrix because the factor loadings and factor variable correlations are not identical when oblique rotation is used. The factor pattern matrix consists of standardized linear weights (path coefficients) and thus provides the composition of a variable in terms of hypothetical factors.

Table 2 provides the names of factors and items together with the pattern matrix of rotated factors, amount of variance, and their corresponding values from the previous (Lusk et al., 1995) study of factory workers for comparison. Items have been rearranged to present as clusters. As shown in Table 2, the two factors that emerged are exactly the same ones as in the Lusk and associates study (1995). With the exception of one item, the variables loaded strongly on only one of the two factors with loadings of .41 or greater. The item "For me, health or being healthy means my mind and body function at their highest level" loaded equally on both the clinical health and overall wellness subscales in all three different data sets (see Table 3). Using a criterion for inclusion of .30, the loadings of the items on the two factors were clearly distinct. Collectively, factor 1 (clinical health) and factor 2 (overall wellness) accounted for more than 54% of the overall variance in both construction worker samples (see Table 2). Compared to 51% in the Lusk and colleagues study (1995), the amount of variance explained by the two factors in this study was slightly greater.

Along with Cronbach alpha reliability coefficients, scale mean and standard deviation, bivariate interitem correlation, and intercorrelation for the two factors are reported in Table 3. The replication samples showed slightly greater inter-item correlations for both subscales and higher mean scores on clinical health compared to the Lusk and associates study (1995). As shown in Table 3, these summary statistics are strikingly parallel to those obtained from the Lusk and colleagues study (1995). Factor replication is also gained by examining the intercorrelations for the RLHCS factors. As shown in Table 3, when two factors were extracted and rotated, correlations between two factors were found to be relatively stable (ranging from .46 to .53) for both the construction worker and factory worker samples.

As a further and more general test of replication, structural equation modeling was used to test the equality of covariance matrices. This study hypothesized that the three observed covariance matrices are equal. In structural equation modeling the matrix or matrices estimated under the model, in this study a model of equal covariances can be used to evaluate the fit of observed data to the model. This analytic technique provides several statistical indices of how well the theoretically expected structure fits the data. One such index is chi-square ($\chi^2$) statistics. A nonsignificant chi-square is indicative of good model fit (Bentler, 1995). Because small difference between the covariance matrices in a large sample produce a significant chi-square (Maruyama, 1998), other goodness-of-fit indices that are less sensitive to sample size were used to evaluate the overall quality of model fit to the data. Along with the result of the chi-square test, this study provides three such goodness-of-fit indices: two incremental fit indices, the Tucker-Lewis Index (TLI) and the comparative fit index (CFI); and an absolute fit index, the Root Mean Square Error of Approximation (RMSEA). The TLI, also known as the Bentler-Bonett non-normed fit index (NNFI), compares the research model to a baseline model, is robust across sample sizes, and takes account of the model parsimony. The CFI also compares the target model to a baseline model, but with different assumptions such that it provides a population estimate of model fit (Arbuckle, 1997; Bentler, 1980; Bentler & Bonett, 1980). The RMSEA, which can be thought of as a kind of residual, is based on fitting the model to population moments: it is a measure of discrepancy per degree of freedom. These fit indices vary in size between zero and one. Values greater than .95 for TLI and CFI and a value of less than .06 for RMSEA were considered as indicative of a relatively good fit between the hypothesized model and the observed data (Hu & Bentler, 1999). This study also examined other goodness-of-fit indices to be sure that they were consistent with reported results.

The hypothesis that the three matrices, factory workers, construction workers pretest, and construction workers no-pretest, are equal was not rejected ($\chi^2 = 669.33$, $df = 272$, RMSEA = .027, TLI = .97, CFI = .97). The other fit indices reported by AMOS were consistent with the conclusion that there are no significant differences between the matrices. Thus there is no reason to suppose that a different factor structure underlies the generation of the covariance matrices.

## Reliability

Internal consistency of items within the factored subscales was assessed using Cronbach's alpha coefficient. The alpha coefficient estimates what proportion of variance in the measure is real versus measurement error. Alpha reliability

**TABLE 3. Statistics for Factors**

| | | Factory Workers in Lusk et al. Study ($n = 873$) | Construction Workers Sample 1 Pretest Group ($n = 697$) | Construction Workers Sample 2 No Pretest Group ($n = 510$) |
|---|---|---|---|---|
| *M* (*SD*) | F1[a] | 4.7 (1.1) | 5.0 (1.0) | 5.2 (1.1) |
| | F2[b] | 4.9 (.8) | 4.9 (.8) | 4.9 (1.0) |
| Inter-item correlation | F1 | 0.44 (.26-.76) | 0.48 (.32-.75) | 0.51 (.37-.76) |
| | F2 | 0.40 (.23-.66) | 0.43 (.25-.63) | 0.45 (.29-.67) |
| Cronbach's alpha | F1 | 0.85 | 0.87 | 0.88 |
| | F2 | 0.86 | 0.87 | 0.88 |
| Intercorrelation[c] between two factors | | 0.53 | 0.46 | 0.51 |

[a]Factor 1 (7 items): Clinical health. [b]Factor 2 (9 items): Overall wellness.
[c]Intercorrelations from an oblique solution (oblimin rotation).

coefficients for two subscales for each data set are provided in Table 3. Corresponding values from factory worker data in the Lusk and associates study (1995) are also included for comparison.

As can be seen in Table 3, across two construction worker samples, the RLHCS demonstrated excellent internal consistency, with alpha coefficients greater than .86 for the two subscales. Compared to alpha coefficients from the Lusk and colleagues study (1995), the replication samples in the present study showed slightly higher reliabilities. These reliability findings almost exactly match the corresponding summary statistics from the factory worker data presented in Lusk and associates (1995). This is strong evidence for the consistency of factor reliability across independent samples.

## DISCUSSION

The purpose of the present study, with two independent samples of construction workers, was to replicate the factor structure and reliability findings of the RLHCS from an earlier study (Lusk et al., 1995). Using principal components extraction with direct oblimin rotation, results replicated the two factors (clinical health and overall wellness) found in the Lusk and associates study (1995) with factory workers. The pattern of salient factor loadings matched almost perfectly across the three samples (factory workers and two groups of construction workers). The variance accounted for by two factors was modest; 54% and 56% for the two samples in the present study as compared to 51% in the Lusk and colleagues study (1995). These factor analyses support Lusk and associates' conceptualization of the two-factor structure of the RLHCS. Further, the equality of the three observed covariance matrices (factory workers and two groups of construction workers) was tested using structural equation modeling and fit indices indicated that the hypotheses that three matrices are equal could not be rejected.

With one exception, all of the items had significant loadings on only one factor. There was stability in factor pattern between the present analysis and the findings of Lusk and colleagues (1995) as indicated by consistent item loadings in relation to clinical and overall wellness health. However, item 16 ("For me, health and being healthy means my mind and body function at their highest level") had similar loadings on two factors in both samples in the present and Lusk and associates' studies. Examination of the item-total statistics revealed that the alpha reliability coefficient would slightly increase (.872 to.874) in sample 1 but decrease (.880 to .878) in sample 2 if item 16 was deleted from the overall wellness subscale. Both these changes are negligible. Although the present study retained item 16 for the purpose of replication, the investigators of this study recommend deletion of the item for parsimony because both Lusk and colleagues and the present studies showed that item 16 loaded on both factors consistently across three different samples.

Relative to internal consistency reliability, the RLHCS demonstrated excellent reliabilities with alpha coefficients of above .86 across two samples. These findings also corroborated earlier findings of high internal consistency for two subscales with factory workers (Lusk et al.,1995). The alpha coefficients for two subscales in the present and Lusk and associates' studies exceeded the criterion of .80 for basic research (Nunnally & Bernstein, 1994).

A replication of these results does not guarantee that the present findings will generalize across all conceivable subject groups. However, clearly, it would enhance the confidence of researchers wanting to use the RLHCS or attempting to replicate the current findings. The results of this study provide justification for broad use of the RLHCS as a promising instrument for measuring definition of health.

Subjects in both the Lusk and colleagues (1995) and present studies were generally healthy, predominantly Caucasian male workers, thereby limiting the generalizability of the results. Future research is also needed to examine the psychometric properties of the RLHCS with different populations, especially women, people of color, and with those who have various illnesses.

The two-factor, 16-item RLHCS demonstrated robust psychometric properties, with acceptable levels of internal consistency and invariance of the factor solution. Despite the fact that present findings corroborate results of the Lusk and associates study (1995), in terms of documenting validity and good internal consistency, additional measures of reliability and validity, such as test-retest reliability and concurrent, convergent, and discriminant validity, need to be assessed to augment the current findings. And the scale does need to be validated for use with diverse samples other than Caucasian males.

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