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Validation of the Social Interaction Anxiety Scale in scleroderma: a Scleroderma Patient-centered Intervention Network Cohort study

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ABSTRACT

Introduction: Individuals with visible differences due to medical conditions, such as systemic sclerosis (SSc; scleroderma), have reported difficulty navigating social situations because of issues such as staring, invasive questions, and rude comments. Fears or anxiety linked to situations in which a person interacts with others is known as social interaction anxiety. However, there exists no validated measurement tool to examine social interaction anxiety in rheumatologic conditions.
Methods: The present study examines the reliability (internal consistency) and validity (structural and convergent) of the Social Interaction Anxiety Scale-6 (SIAS-6) in a sample of 802 individuals with SSc, and compares these psychometric properties across limited and diffuse subtypes of the disease. Multi-group confirmatory factor analysis was used to examine the factor structure of the SIAS-6 in patients with both limited and diffuse SSc.
Results: A one-factor structure was found to fit well for individuals with SSc with both limited and diffuse disease. The measure demonstrated strong internal consistency reliability and convergent validity with relevant measures in expected magnitudes and directions.
Conclusions: The SIAS-6 is a psychometrically robust measure that can confidently be used in SSc populations to examine social interaction anxiety. Moreover, scores can meaningfully be compared between patients with limited and diffuse disease.

Keywords: Psychometric, Psychosocial, Scleroderma, Social anxiety, Systemic sclerosis

Introduction

The study of body image and associated constructs in a medical context has been called “one of the new frontiers” of body image research (p. 8) (1). Medical conditions that cause changes in appearance can adversely impact many aspects of health-related quality of life, including social interactions (2). Individuals with visible differences have reported difficulty navigating social situations because of issues such as staring, invasive questions, and rude comments (2-4). Such experiences may result in anxiety that is specifically related to fears about interacting and mingling with others; this has been termed social interaction anxiety (5).

The Social Interaction Anxiety Scale (SIAS) is a self-report measure specifically developed to measure social interaction anxiety (5). The SIAS is a unidimensional measure that has demonstrated excellent internal consistency reliability in both clinical (e.g., social anxiety, agoraphobia) and non-clinical (e.g., undergraduate) samples (α = 0.88-0.93) (5, 6) as well as sensitivity to change following interventions targeting social

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anxiety (5, 7). Peters and colleagues (8) developed a one-factor six-item short form of the SIAS, the SIAS-6. The SIAS-6 has demonstrated strong correlations with the original SIAS (ranging from $r = 0.88$ to $r = 0.92$) and related constructs (e.g., social appearance anxiety) in clinical and non-clinical samples (8). However, the factor structure and internal consistency reliability of the SIAS-6 have not been examined in the context of disfigurement from medical illness or injury.

Systemic sclerosis (SSc, or scleroderma) is a chronic and progressive autoimmune connective tissue disease with no known cure that is associated with marked appearance changes in visible and socially relevant areas of the body, including the hands and face (9-12). The disease's most common visible characteristic is skin thickening. Although SSc can have a heterogeneous presentation, it is typically divided into limited and diffuse subtypes, based on where skin thickening occurs. In limited disease, skin thickening is typically only present in the hands, arms, and face; in diffuse disease, skin involvement also includes the truncal region (13, 14). Appearance concerns are common in patients with both subtypes and can include a pinched appearance to the nose and eyes; contractures and amputations of the digits; loss of volume and flexibility of the lips; hypo- and hyper-pigmentation; and telangiectasias (11). Disease-related changes to appearance in SSc have been associated with appearance dissatisfaction and social discomfort (9, 15, 16). In a qualitative study, Joachim and Acorn (17) described SSc patients' concerns about calling attention to themselves in public and fears of stigmatization based on their appearance. For patients with SSc who struggle with unwanted appearance changes, there has been a call for increased research in order to inform assessments and interventions for body image distress and its social impacts (12, 18). To date, however, social interaction anxiety has not been studied in SSc.

The present study examines the reliability (internal consistency) and validity (structural and convergent) of the SIAS-6 in patients with SSc, and compares these psychometric properties across limited and diffuse subtypes of the disease. We hypothesized that a one-factor structure would provide the best fit for the data for both SSc disease subtypes and that internal consistency reliability would be high (Cronbach's alpha ≥0.80). In previous research with the SIAS-6, moderate-to-large relationships have been demonstrated with measures of social anxiety ($r = 0.54$), fear of negative evaluation ($r = 0.42$), and depression ($r = 0.48$) (8) and a moderate relationship between the full-length SIAS and a measure of appearance satisfaction ($r = -0.46$) (19). Effect sizes for correlations have been described as small ($|r| \leq 0.3$), moderate ($0.3 < |r| < 0.5$), or large ($|r| \geq 0.5$) (20). It was hypothesized that higher SIAS-6 scores would have moderate-to-large associations with measures of social appearance anxiety, social discomfort, and fear of negative evaluation, and smaller associations with measures of appearance dissatisfaction and symptoms of depression.

Patients and methods

Participants and procedures

The present study is a cross-sectional analysis of baseline data of patients enrolled in the Scleroderma Patient-centered Intervention Network (SPIN) Cohort who completed the SIAS-6. To be eligible for the SPIN Cohort, patients must have a confirmed diagnosis of SSc according to the 2013 American College of Rheumatology/European League Against Rheumatism classification criteria (21), be aged ≥18, be able to give informed consent, be fluent in English or French, and have the ability to respond to questionnaires via the Internet. The SPIN sample is a convenience sample. Eligible patients are invited by the attending physician or a supervised nurse coordinator to participate in the SPIN Cohort, and written informed consent is obtained. The local SPIN physician or supervised nurse coordinator then completes a medical data form that is submitted online to initiate patient registration in the SPIN Cohort. After completion of online registration, an automated welcoming email is sent to participants with instructions on how to activate their SPIN online account and how to complete the SPIN Cohort patient measures online. SPIN Cohort patients should complete outcome measures via the Internet upon enrollment and subsequently every three months. The SPIN Cohort study was approved by the Research Ethics Committee of the Jewish General Hospital, Montreal, Canada and by the Institutional Reviews Boards of each participating center. Patients included in the present study were enrolled at 27 SPIN centers in Canada, the USA, and the UK. Only data from the baseline assessments of English-speaking participants completed from April 2014 to February 2017 were analyzed.

Measures

SIAS-6 (8). The SIAS-6 is a six-item measure of anxiety associated with initiating and maintaining social interactions, which was developed from the 20-item SIAS (5). Response options range from 0 (*not at all characteristic or true of me*) to 4 (*extremely characteristic or true of me*). A total score is computed by summing all items, with scores ranging from 0 to 24. Higher scores correspond to greater social interaction anxiety.

Social Appearance Anxiety Scale (SAAS) (19). The SAAS is a 16-item measure of anxiety about being negatively evaluated by others because of one's appearance. Items are scored on a five-point scale ranging from 1 (*not at all*) to 5 (*extremely*). Total scores range from 16 to 80, with higher scores indicating greater anxiety. A psychometric analysis supported the structural validity, convergent validity, and internal consistency of the SAAS in SSc (16). Internal consistency reliability in the present sample was excellent ($\alpha = 0.96$).

Brief Fear of Negative Evaluation Scale – Revised (BFNE-II) (22). The BFNE-II assesses fears of being negatively evaluated by others. Items are scored on a five-point scale ranging from 1 (*not at all characteristic of me*) to 5 (*extremely characteristic of me*). Total scores range from 12 to 60, with higher scores indicating greater fear of negative evaluation. The BFNE-II has demonstrated strong internal consistency in non-SSc populations (22, 23). Internal consistency reliability in the present sample was excellent ($\alpha = 0.98$).

Brief Satisfaction with Appearance Scale (Brief-SWAP) (15). The Brief-SWAP is a six-item measure of body image dissatisfaction, adapted from the full SWAP (24) with the following two subscales: Dissatisfaction with Appearance and Social Discomfort. Respondents report appearance-related

concerns on a seven-point scale ranging from 0 (*strongly disagree*) to 6 (*strongly agree*). Subscale scores range from 0 to 18, with higher scores indicating greater appearance-related discomfort and dissatisfaction. The structural validity, convergent validity, and internal consistency of the measure have been supported with SSc patients (16, 25). Internal consistency reliability in the present sample for the Dissatisfaction with Appearance and Social Discomfort subscales was excellent ($\alpha = 0.83$ and $\alpha = 0.88$, respectively).

Patient Health Questionnaire (PHQ-8) (26). The PHQ-8 items measure depressive symptoms over the last two weeks on a four-point scale, ranging from 0 (*not at all*) to 3 (*nearly every day*). A total score is obtained by summing item scores, with higher scores indicating more depressive symptoms. The PHQ-8 performs equivalently to the PHQ-9 (27), which is a valid measure of depressive symptoms in patients with SSc (28). Internal consistency reliability in the present sample was excellent ($\alpha = 0.89$).

Sociodemographic and Medical Variables. Patients self-reported sociodemographic data. SPIN physicians reported medical information, including modified Rodnan skin scores (mRss) (29, 30) a measure of skin thickening with scores ranging from 0 to 51, with higher scores reflecting greater thickening and disease involvement, and disease subtype.

Data analysis

Descriptive statistics for sociodemographic and medical variables were calculated for the sample with SPSS, version 22.0. Confirmatory factor analysis (CFA) was conducted to confirm the single-factor structure of the SIAS-6 using Mplus version 7.12. MLR estimation, which provides maximum likelihood parameter estimates with standard errors and a chi-square statistic that is robust to non-normality, and non-independence of observations, was used in the present analysis. Modification indices were also requested to examine whether freeing parameters would improve model fit. After establishing structural validity, multiple group CFA was used, as described by Dimitrov (31), to evaluate the comparability of the factor structures, also referred to as measurement invariance, of the SIAS-6 for patients with limited and diffuse SSc via the following, iteratively restrictive models: (i) configural invariance; (ii) metric invariance; and (iii) scalar invariance. Briefly, this approach [recommended by Vandenberg and Lance (32)] first examines the baseline fit of the measurement model in both groups by constraining the number of factors and the items contributing to each factor to establish configural invariance, which demonstrates that the same factor structure exists for both groups. Next, a more restrictive model is run, such that the loading of each item onto the factor is constrained to equivalence between the groups to establish metric invariance, which suggests that the same factor loadings exist for both groups. If both the previous models demonstrate good fit, a third, even more restrictive, model is run to establish scalar invariance, to demonstrate that, in addition to factor loadings, the same item intercepts also exist for both groups.

Overall model fit was determined using the recommendations of Bentler (33). Three indicators of model fit were utilized, including: (a) the root-mean-square error of approximation (RMSEA) (34), with values <0.08 indicating acceptable fit and values <0.05 indicating good fit; (b) the standardized root-mean residual (SRMR) (35), an index of overall model fit with values <0.08 indicating acceptable fit and values <0.05 indicating good fit; and (c) the comparative fit index (CFI) (33), with values >0.95 indicating good model fit and values >0.90 indicating acceptable model fit. The Satorra and Bentler (36) scaling factors were used for the chi-square value, given statistically significant multivariate skewness and kurtosis in the present data (all $p<0.05$). Because the likelihood-ratio chi-square (χ^2) is influenced by sample size, it was not the sole indicator of model fit (37). Per previously established criteria (37, 38) the Satorra-Bentler Scaled chi-square (S-Bχ^2) (39) difference test and the CFI values were used to compare the increasingly restrictive multiple-group CFA models such that a non-statistically significant ($p>0.05$) change in S-Bχ^2 or a change in CFI of ≤0.01 indicated no difference between the nested models; in other words, adding more restrictions would not significantly compromise good model fit (40).

Internal consistency reliability for the SIAS-6 items was calculated using Cronbach's coefficient alpha. Convergent validity was examined via Spearman correlations of the SIAS-6 with the SAAS, BFNE-II, Brief-SWAP, and PHQ-8. The aforementioned hypotheses regarding the direction and magnitude of the relationships were established *a priori*, based on prior research with the SIAS-6. Scores between the two groups were compared using Independent Samples t-tests.

A minimum sample size estimation for a one-factor CFA with six items, assuming factor loadings between 0.50 and 0.80, is between 60 and 190 participants (41). Regarding minimum sample size for the proposed correlation analyses, a correlation that can be assessed with 95% confidence and precision of 0.10 would require a minimum sample size of 403 for a small correlation ($r = 0.30$) and at least 275 for a large correlation ($r = 0.50$) (42). Thus, the present sample size exceeded the minimum sample size requirements.

Results

Sample statistics are reported in Table I. Three participants who left the second item of the SIAS-6 blank were removed from the analysis. Participants (n = 802) were predominantly female (87%), married (74%), and had a mean age of 55.5 years (SD = 12.0).

Confirmatory factor analysis

CFA confirmed the one-factor model of the SIAS-6 [S-Bχ^2 (9) = 30.2, $p<0.01$; CFI = 0.99, RMSEA = 0.05, SRMR = 0.02]. Individual item factor loadings are provided in Table II. The modification indices were examined; however, no parameters were freed, given that the one-factor model fit well without modification.

Multiple-group confirmatory factor analysis models

The one-factor model fit the data well for limited and diffuse disease groups (see Tab. II). Additionally, the factor loadings were statistically significant for all items in both groups (see Tab. III). The metric invariance model fit the data well

TABLE I - Sociodemographic, disease, and psychosocial variables for sample (n = 802)

Sociodemographic variables	
Age (mean, SD)	55.55 (12.0)[a]
Female (n, %)	697 (86.9)
White (n, %)	686 (85.6)
Years of formal education (mean, SD)	15.40 (3.2)
Employed full or part-time (n, %)	326 (64.4)[b]
Married or living as married (n, %)	595 (74.2)
Disease variables	
Diffuse scleroderma (n, %)	350 (43.6)
Disease duration (time since first non-Raynaud's symptom) in years (mean, SD)	11.61 (8.8)[c]
Modified Rodnan skin score (mean, SD)	8.22 (9.0)[d]
Psychosocial measures (mean, SD)[e]	
SIAS-6	2.43 (3.8)
Limited	2.06 (3.1)
Diffuse	2.91 (4.5)
Brief-SWAP-dissatisfaction with Appearance	9.28 (5.21)[f]
Brief-SWAP-social discomfort	5.34 (5.22)[g]
PHQ-8	6.03 (5.4)[h]
SAAS	28.09 (13.0)[i]
BFNE-II	24.80 (12.2)[j]

Due to missing values: [a]n = 799; [b]n = 801; [c]n = 744; [d]n = 639; [e]SAAS = Social Appearance Anxiety Scale; SWAP = Satisfaction with Appearance Scale; PHQ-8 = Patient Health Questionnaire-8; SIAS-6 = Social Interaction Anxiety Scale; BFNE-II = Brief Fear of Negative Evaluation Scale-Revised.
Due to missing values; [f]n = 795; [g]n = 794; [h]n = 792; [i]n = 794; [j]n = 7.

descriptively (CFI = 1.00, RMSEA: 0.00, SRMR: 0.04; see Tab. II). Comparing the less restrictive configural invariance model to the more constrained metric invariance model, the results suggested that the metric model did not worsen fit statistically ($\Delta S\text{-}B\chi^2 = 5.84$ *df* = 5, p = 0.32) or descriptively ($\Delta CFI \leq 0.01$). The scalar model also demonstrated good fit (CFI = 1.00, RMSEA: 0.00, SRMR: 0.04; see Tab. II). When compared to the less restrictive metric invariance model, fit was not compromised ($\Delta S\text{-}B\chi^2 = 5.71$ *df* = 5, p = 0.33, $\Delta CFI \leq 0.01$).

Descriptive statistics for the SIAS-6

The total score for the SIAS-6 in the full sample was 2.43 (*SD* = 3.8; range: 0-24). The limited group mean was 2.06 (SD = 3.1; range 0-18), whereas the diffuse group mean was 2.91 (SD = 4.5; range 0-24). Internal consistency reliability was excellent for the total sample ($\alpha = 0.89$) as well as for limited ($\alpha = 0.86$) and diffuse subgroups ($\alpha = 0.90$). Comparing group means, the scores were significantly different between groups (p<0.01; 95% CI: -1.39, -0.29). Thus, patients with diffuse disease reported significantly greater social interaction anxiety than patients with limited disease.

Convergent validity

Consistent with the relationships hypothesized, SIAS-6 scores had positive, large correlations with measures of social appearance anxiety ($r_s = 0.50$, p<0.01) and fear of negative evaluation ($r_s = 0.60$, p<0.01), a moderate, positive correlation with a measure of social discomfort ($r_s = 0.43$, p<0.01), and a small, positive correlation with appearance dissatisfaction ($r_s = 0.23$, p<0.01). Contrary to the authors' expectations, there was a moderate rather than small correlation with symptoms of depression ($r_s = .41$, p<0.01; see Tab. IV).

Discussion

The results of the present study suggest that the SIAS-6 is a reliable and valid one-factor measure of social interaction anxiety for patients with SSc. Moreover, the multi-group confirmatory factor analysis provided support for the scalar invariance model, suggesting that scores can be meaningfully compared between limited and diffuse disease groups (40, 43). Internal consistency reliability was strong, and convergent validity was supported via significant correlations with relevant measures in the expected magnitudes and directions, except for the correlation with depressive symptomatology via the PHQ-8, which was larger than expected.

Given a possible range for total scores of 0 to 24, average scores for SSc patients in the range of 2 to 3 represent a low level of social interaction anxiety. In previous research, scores have been consistently higher among individuals receiving treatment for social anxiety [e.g., mean = 13.2; *SD* = 4.9 (8);

TABLE II - Fit statistics for configural invariance, metric invariance, and scalar invariance models of the Social Interaction Anxiety Scale-6 (SIAS-6)

Model	S-Bχ^2	p	CFI[a]	SRMR[b]	RMSEA[b]	Reference model #	ΔS-Bχ^2	Δdf	Δp	ΔCFI
1. Configural										
Limited	8.77	0.46	1.00	0.02	0.00					
Diffuse	7.34	0.60	1.00	0.02	0.09					
2. Metric	21.98	0.52	1.00	0.04	0.00	1	5.84	5	0.32	<0.01
3. Scalar	27.17	0.51	1.00	0.04	0.00	2	5.71	5	0.33	<0.01

[a] Plausible fit ≥0.90, good fit >0.95.
[b] Plausible fit ≤0.08, good fit ≤0.05.
CFI = robust comparative fit index; RMSEA = root-mean-square error of approximation; SRMR = standardized root-mean-square residual.

TABLE III - Standardized factor loadings from the confirmatory factor analysis (CFA) for the total sample and the multiple-group CFA baseline models for the Social Interaction Anxiety Scale-6 (SIAS-6)

SIAS-6 item		Factor loadings	
	Total sample (n = 802)	Limited (n = 452)	Diffuse (n = 350)
1. I have difficulty making eye contact with others	0.73	0.73	0.74
2. I find it difficult mixing comfortably with the people I work with	0.80	0.77	0.82
3. I tense up if I meet an acquaintance on the street	0.80	0.74	0.83
4. I feel tense if I am alone with just one person	0.81	0.72	0.86
5. I have difficulty talking with other people	0.84	0.80	0.86
6. I find it difficult to disagree with another's point of view	0.60	0.56	0.64

For all factor loadings $p<0.05$.

TABLE IV - Correlation of variables with the Social Interaction Anxiety Scale-6 (SIAS-6)

	Spearman's correlations[e]
Brief-SWAP – dissatisfaction with appearance[a]	0.22
PHQ-8[b]	0.41
Brief-SWAP – social discomfort	0.43
SAAS[c]	0.50
BFNE-II[d]	0.60

BFNE-II = Brief Fear of Negative Evaluation Scale-II; Brief-SWAP = Brief Satisfaction with Appearance Scale; PHQ-8 = 8-item Patient Health Questionnaire; SAAS = Social Appearance Anxiety Scale.
Due to missing values: [a]n = 794; [b]n = 792; [c]n = 789; [d]n = 787; [e]magnitude of correlations was defined as small = $|r|\leq 0.3$, moderate = $0.3<|r|<0.5$, and large = $|r|\geq 0.5$. All correlations were significant at $p<0.001$.

mean = 12.52; SD = 5.14 (44)] and among sexual minorities [e.g., mean = 4.7; *SD* = 4.8 (45)]. However, scores from community-dwelling adults without clinically significant anxiety symptoms have been lower [e.g., mean = 1.5; *SD* = 2.25 (44)], and similar to the scores found for SSc patients in the present study. To the authors' knowledge, the SIAS-6 has not been used previously in any samples with medical disfigurement, though a study using the full-length SIAS in a sample of patients with spasmodic torticollis (ST), a neurological condition causing involuntary neck contortions, found that ST patients had significantly higher SIAS scores as compared to non-affected controls (46). The SIAS-6 has not yet been used in other rheumatologic conditions, limiting comparisons to other diseases. Given the good psychometric properties of the SIAS-6 in SSc, researchers interested in interactional anxiety among patients with other conditions, may consider including the SIAS-6 as a measure of social interaction anxiety.

The results of the present study should be interpreted in the context of limitations. The SPIN Cohort is a convenience sample of patients receiving treatment at SPIN recruiting centers who complete study questionnaires online, potentially limiting generalizability. Additionally, the cross-sectional design of the present study precluded evaluations of sensitivity to change or test-retest reliability. A potential limitation of the measure is that all six items are positively worded. Most of the psychometric literature examining the role of negatively worded and reverse-scored items in minimizing response-bias has identified that negatively worded items can contribute to problems with internal consistency and factor structure (47). Barnette (47) examined the role of stem direction, item response direction, and Cronbach's alpha and identified that the best psychometric properties were achieved for measures with all directly worded stems and a mixture of directionality for response options. Future researchers who conduct psychometric work on this measure may consider testing the use of such alternative response options. Additionally, this study identified a disparity in scores such that patients with diffuse disease had higher scores than patients with limited disease. The present study was not powered to examine the role of various disease subtype-related variables (e.g., skin score, lung disease) or other medical characteristics (e.g., disease duration) in SIAS-6 scores. It may be interesting to identify the disease subtype-related variables associated with SIAS-6 scores in future research as the study sample grows. Additionally, exploring disease characteristics that can impact body image (e.g., facial involvement, location of telangiectasias, hand involvement) or participant characteristics (e.g., race/ethnicity, gender, marital status) may also be an interesting aim in future research that can inform interventions for social problems. Examining correlates of group membership in quartiles or identifying cut-off scores may be warranted in future research endeavors. Finally, it is conceivable that a disease-specific measure of social interaction anxiety that captures challenges of social interactions unique to SSc populations (e.g., fears about shaking hands) may better assess social interaction anxiety in individuals with SSc. Despite these limitations, the results of the present study provide important psychometric support for the use of the SIAS-6 to measure social interaction anxiety among patients with SSc.

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References

1. Cash TF, Smolak L. Understanding body images: historical and contemporary perspectives. In: Cash TF, Smolak L, eds. Body image: a handbook of science, practice, and prevention (2nd ed). New York (NY): Guilford Press 2011;3-12. Available from: https://www.guilford.com/excerpts/cash2.pdf. Accessed Sep 24, 2017.

2. Rumsey N, Harcourt D. Body image and disfigurement: issues and interventions. Body Image. 2004;1(1):83-97.
3. Rumsey N. Body image and congenital conditions with visible differences. In: Cash TF, Pruzinsky T, eds. Body image: a handbook of theory, research, and clinical practice. New York (NY): Guilford 2002;226-233.
4. Rumsey N. Optimizing body image in disfiguring congenital conditions. In: TF Cash TF, Pruzinsky T, eds. Body image: a handbook of theory, research, and clinical practice. New York (NY): Guilford 2002;431-439.
5. Mattick RP, Clarke JC. Development and validation of measures of social phobia scrutiny fear and social interaction anxiety. Behav Res Ther. 1998;36(4):455-470.
6. Heimberg RG, Mueller GP, Holt CS, Hope DA, Liebowitz MR. Assessment of anxiety in social interaction and being observed by others: The Social Interaction Anxiety Scale and the Social Phobia Scale. Behav Ther. 1992;23(1):53-73.
7. Safren SA, Turk CL, Heimberg RG. Factor structure of the social interaction anxiety scale and the social phobia scale. Behav Res Ther. 1998;36(4):443-453.
8. Peters L, Sunderland M, Andrews G, Rapee RM, Mattick RP. Development of a short form Social Interaction Anxiety (SIAS) and Social Phobia Scale (SPS) using nonparametric item response theory: the SIAS-6 and the SPS-6. Psychol Assess. 2012;24(1):66-76.
9. Benrud-Larson LM, Heinberg LJ, Boling C, et al. Body image dissatisfaction among women with scleroderma: extent and relationship to psychosocial function. Health Psychol. 2003;22(2):130-139.
10. Kwakkenbos L, Delisle VC, Fox RS, et al. Psychosocial aspects of scleroderma. Rheum Dis Clin North Am. 2015;41(3):519-528.
11. Malcarne VL, Handsdottir I, Greenbergs HL, Clements PJ, Weisman MH. Appearance self-esteem in systemic sclerosis. Cognit Ther Res. 1999;23(2):197-208.
12. Malcarne VL, Fox RS, Mills SD, Gholizadeh S. Psychosocial aspects of systemic sclerosis. Curr Opin Rheumatol. 2013; 25(6):707-713.
13. Gabrielli A, Avvedimento EV, Krieg T. Scleroderma. N Engl J Med. 2009;360(19):1989-2003.
14. Steen VD, Powell DL, Medsger TA Jr. Clinical correlations and prognosis based on serum autoantibodies in patients with systemic sclerosis. Arthritis Rheum. 1988;31(2):196-203.
15. Jewett LR, Hudson M, Malcarne VL, Baron M, Thombs BD; Canadian Scleroderma Research Group. Sociodemographic and disease correlates of body image distress among patients with systemic sclerosis. PLoS ONE. 2012;7(3):e33281.
16. Mills SD, Fox RS, Merz EL, et al. Evaluation of the satisfaction with appearance scale and its short form in systemic sclerosis: analysis from the UCLA scleroderma quality of life study. J Rheumatol. 2015;42(9):1624-1630.
17. Joachim G, Acorn S. Life with a rare chronic disease: the scleroderma experience. J Adv Nurs. 2003;42(6):598-606.
18. Thombs BD, van Lankveld W, Bassel M, et al. Psychological health and well-being in systemic sclerosis: State of the science and consensus research agenda. Arthritis Care Res (Hoboken). 2010;62(8):1181-1189.
19. Hart TA, Flora DB, Palyo SA, Fresco DM, Holle C, Heimberg RG. Development and examination of the social appearance anxiety scale. Assessment. 2008;15(1):48-59.
20. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale (NJ): Lawrence Erlbaum Associates; 1998.
21. van den Hoogen F, Khanna D, Fransen J, et al. 2013 classification criteria for systemic sclerosis: an American College of Rheumatology/European League against Rheumatism collaborative initiative. Arthritis Rheum. 2013;65(11):2737-2747.
22. Carleton RN, McCreary DR, Norton PJ, Asmundson GJ. Brief fear of negative evaluation scale-revised. Depress Anxiety. 2006;23(5):297-303.
23. Carleton RN, Collimore KC, Asmundson GJ. Social anxiety and fear of negative evaluation: construct validity of the BFNE-II. J Anxiety Disord. 2007;21(1):131-141.
24. Lawrence JW, Heinberg LJ, Roca R, Munster A, Spence R, Fauerbach JA. Development and validation of the Satisfaction with Appearance Scale: assessing body image among burn injured patients. Psychol Assess. 1998;10(1):64-70.
25. Jewett LR, Hudson M, Haythornthwaite JA, et al. Canadian Scleroderma Research Group. Development and validation of the brief-satisfaction with appearance scale for systemic sclerosis. Arthritis Care Res (Hoboken). 2010;62(12): 1779-1786.
26. Kroenke K, Spitzer RL. The PHQ-9: a new depression diagnostic and severity measure. Psychiatr Ann. 2002;32(9): 509-515.
27. Razykov I, Hudson M, Baron M, Thombs BD; Canadian Scleroderma Research Group. Utility of the Patient Health Questionnaire-9 to assess suicide risk in patients with systemic sclerosis. Arthritis Care Res (Hoboken). 2013;65(5):753-758.
28. Milette K, Hudson M, Baron M, Thombs BD; Canadian Scleroderma Research Group. Comparison of the PHQ-9 and CES-D depression scales in systemic sclerosis: internal consistency reliability, convergent validity and clinical correlates. Rheumatology (Oxford). 2010;49(4):789-796.
29. Clements PJ, Hurwitz EL, Wong WK, et al. Skin thickness score as a predictor and correlate of outcome in systemic sclerosis: high-dose versus low-dose penicillamine trial. Arthritis Rheum. 2000;43(11):2445-2454.
30. Clements PJ, Lachenbruch PA, Ng SC, Simmons M, Sterz M, Furst DE. Skin score. A semiquantitative measure of cutaneous involvement that improves prediction of prognosis in systemic sclerosis. Arthritis Rheum. 1990;33(8):1256-1263.
31. Dimitrov DM. Testing for factorial invariance in the context of construct validation. Meas Eval Couns Dev. 2010;43(2): 121-149.
32. Vandenberg RJ, Lance CE. A review and synthesis of the measurement invariance literature: Suggestions, practices, and recommendations for organizational research. Organ Res Methods. 2000;3(1):4-69.
33. Bentler PM. Comparative fit indexes in structural models. Psychol Bull. 1990;107(2):238-246.
34. Steiger JH. Structural model evaluation and modification: An interval estimation approach. Multivariate Behav Res. 1990;25(2):173-180.
35. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. Struct Equ Modeling. 1999;6(1):1-55.
36. Satorra A, Bentler PM. A scaled difference chi-square test statistic for moment structure analysis. Psychometrika. 2001; 66(4):507-514.
37. Gerbing DW, Anderson JC. Monte Carlo evaluations of goodness-of-fit indices for structural equation models. In: Bollen KA, Long JS, eds. Testing structural equation models. Newbury Park: Sage1993;40-65.
38. Chen FF. Sensitivity of goodness of fit indexes to lack of measurement invariance. Struct Equ Modeling. 2007;14(3): 464-504.
39. Satorra A. Scaled and adjusted restricted tests in multi-sample analysis of moment structures. In: Heijmans RDH, Pollcok DSG, Satorra A, eds. Innovations in multivariate statistical analysis: a festschrift for Heinz Neudecker. London, UK: Kluwer Academic Publishers. 2000;Ch 17:233-247.
40. Cheung GW, Rensvold RB. Evaluating goodness-of-fit indexes for testing measurement invariance. Struct Equ Modeling. 2002;9(2):233-255.

41. Wolf EJ, Harrington KM, Clark SL, Miller MW. Sample size requirements for structural equation models an evaluation of power, bias, and solution propriety. Educ Psychol Meas. 2013;76(6):913-934.
42. Schönbrodt FD, Perugini M. At what sample size do correlations stabilize? J Res Pers. 2013;47(5):609-612.
43. Bollen KA. Structural equations with latent variables. New York: Wiley; 1989.
44. Le Blanc AL, Bruce LC, Heimberg RG, et al. Evaluation of the psychometric properties of two short forms of the social interaction anxiety scale and the social phobia scale. Assessment. 2014;21(3):312-323.
45. Puckett JA, Levitt HM, Horne SG, Hayes-Skelton SA. Internalized heterosexism and psychological distress: the mediating roles of self-criticism and community connectedness. Psychol Sex Orientat Gend Divers. 2015;2(4):426-435.
46. Gündel H, Wolf A, Xidara V, Busch R, Ceballos-Baumann AO. Social phobia in spasmodic torticollis. J Neurol Neurosurg Psychiatry. 2001;71(4):499-504.
47. Barnette JJ. Effects of stem and Likert response option reversals on survey internal consistency: If you feel the need, there is a better alternative to using those negatively worded stems. Educ Psychol Meas. 2000;60(3):361-370.