Shadi Gholizadeh et al, Validation of the Social Interaction Anxiety Scale in scleroderma: a Scleroderma Patient-centered Intervention Network Cohort study, Journal of Scleroderma and Related Disorders (3, 1) pp. . Copyright © 2017. DOI: 10.5301/jsrd.50002

Validation of the Social Interaction Anxiety Scale in Scleroderma: A Scleroderma Patient-centered Intervention Network Cohort Study

Short Title: Validation of the Social Interaction Anxiety Scale in Scleroderma

Shadi Gholizadeh, MPH, MSc, MS[1], Linda Kwakkenbos, PhD[2,3,4], Marie-Eve Carrier, MSc[2], Sarah D. Mills, PhD, MPH[1], Rina S. Fox, PhD, MPH[1], Lisa R. Jewett, MSc[2,5], Karen Gottesman, BA[6], Scott Roesch, PhD[1,7], Brett D. Thombs, PhD[2,3,8-10], Vanessa L. Malcarne, PhD[1,7], and the SPIN Investigators[11]

[1]San Diego State University/University of California, San Diego Joint Doctoral Program in Clinical Psychology, San Diego, California, United States; [2]Lady Davis Institute for Medical Research, Jewish General Hospital, Montreal, Quebec, Canada; [3]Department of Psychiatry, McGill University, Montreal, Quebec, Canada; [4]Behavioural Science Institute, Clinical Psychology, Radboud University, Nijmegen, the Netherlands; [5]Department of Educational and Counselling Psychology, McGill University, Montreal, Quebec, Canada; [6]Scleroderma Foundation, United States; [7]Department of Psychology, San Diego State University, San Diego, California, United States; Departments of [8]Medicine, [9]Psychology, [10]Epidemiology, Biostatistics and Occupational Health, McGill University, Montreal, Quebec, Canada; [11]SPIN Investigators: Murray Baron, McGill University, Montréal, Québec, Canada; Susan J. Bartlett, McGill University, Montréal, Québec, Canada; Dan Furst, University of California, Los Angeles, California, USA; Frank van den Hoogen, Radboud University Medical Center and Sint Maartenskliniek, Nijmegen, The Netherlands; Maureen D. Mayes, University of Texas McGovern School of Medicine, Houston, Texas, USA; Luc Mouthon, Université Paris Descartes, Paris, France; Warren R. Nielson, St. Joseph's Health Care, London, Ontario, Canada; Serge Poiraudeau, Université Paris Descartes, Paris, France; Robert Riggs, Scleroderma Foundation, Danvers, Massachusetts, USA; Maureen Sauve, Scleroderma Society of Ontario, Hamilton, Ontario; Fredrick Wigley, Johns Hopkins University School of Medicine, Baltimore,

Maryland, USA; Shervin Assassi, University of Texas McGovern School of Medicine, Houston, Texas, USA; Isabelle Boutron, Université Paris Descartes, and Assistance Publique-Hôpitaux de Paris, Paris, France; Angela Costa Maia, University of Minho, Braga, Portugal; Ghassan El-Baalbaki, Université du Québec à Montréal, Montréal, Québec, Canada; Carolyn Ells, McGill University, Montréal, Québec, Canada; Cornelia van den Ende, Sint Maartenskliniek, Nijmegen, The Netherlands; Kim Fligelstone, Scleroderma Society, London, UK; Catherine Fortune, Scleroderma Society of Ontario, Hamilton, Ontario, Canada; Tracy Frech, University of Utah, Salt Lake City, Utah, USA; Dominique Godard, Association des Sclérodermiques de France, Sorel-Moussel, France; Daphna Harel, New York University, New York, New York, USA; Marie Hudson, McGill University, Montréal, Québec, Canada; Ann Impens, Midwestern University, Downers Grove, Illinois, USA; Yeona Jang, McGill University, Montréal, Québec, Canada; Sindhu R. Johnson, Toronto Scleroderma Program, Mount Sinai Hospital, Toronto Western Hospital, and University of Toronto, Toronto, Ontario, Canada; Ann Tyrell Kennedy, Federation of European Scleroderma Associations, Dublin, Ireland; Maggie Larche, McMaster University, Hamilton, Ontario, Canada; Catarina Leite, University of Minho, Braga, Portugal; Carlo Marra, Memorial University, St. John's, Newfoundland, Canada; Karen Nielsen, Scleroderma Society of Ontario, Hamilton, Ontario, Canada; Janet Pope, University of Western Ontario, London, Ontario, Canada; Alexandra Portales, Asociación Española de Esclerodermia, Madrid, Spain; Tatiana Sofia Rodriguez Reyna, Instituto Nacional de Ciencias Médicas y Nutrición Salvador Zubirán, Mexico City, Mexico; Anne A. Schouffoer, Leiden University Medical Center, Leiden, The Netherlands; Russell J. Steele, Jewish General Hospital and McGill University, Montréal, Québec, Canada; Maria E. Suarez-Almazor, University of Texas MD Anderson Cancer Center, Houston, Texas, USA; Joep Welling, NVLE Dutch patient

organization for systemic autoimmune diseases, Utrecht, The Netherlands; Durhane Wong-Rieger, Canadian Organization for Rare Disorders, Toronto, Ontario, Canada; Alexandra Albert, Université Laval, Québec, Québec, Canada; Guylaine Arsenault, Sherbrooke University, Sherbrooke, Québec, Canada; Lyne Bissonnette, Sherbrooke University, Sherbrooke, Québec, Canada; Gilles Boire, Sherbrooke University, Sherbrooke, Québec, Canada; Alessandra Bruns, Sherbrooke University, Sherbrooke, Québec, Canada; Patricia Carreira, Servicio de Reumatologia del Hospital 12 de Octubre, Madrid, Spain; Lorinda Chung, Stanford University, Stanford, California, USA; Pierre Dagenais, Sherbrooke University, Sherbrooke, Québec, Canada; Christopher Denton, Royal Free London Hospital, London, UK; Robyn Domsic, University of Pittsburgh, Pittsburgh, Pennsylvania, USA; James V. Dunne, St. Paul's Hospital and University of British Columbia, Vancouver, British Columbia, Canada; Paul Fortin, Université Laval, Québec, Québec, Canada; Anna Gill, Royal Free London Hospital, London, UK; Jessica Gordon, Hospital for Special Surgery, New York City, New York, USA; Genevieve Gyger, Jewish General Hospital and McGill University, Montréal, Québec, Canada; Ariane L Herrick, University of Manchester, Salford Royal NHS Foundation Trust, Manchester, UK; Monique Hinchcliff, Northwestern University, Chicago, Illinois, USA; Alena Ikic, Université Laval, Québec, Québec, Canada; Niall Jones, University of Alberta, Edmonton, Alberta, Canada; Artur Jose de B. Fernandes, Sherbrooke University, Sherbrooke, Québec, Canada; Suzanne Kafaja, University of California, Los Angeles, California, USA; Nader Khalidi, McMaster University, Hamilton, Ontario, Canada; Benjamin Korman, Northwestern University, Chicago, Illinois, USA; Patrick Liang, Sherbrooke University, Sherbrooke, Québec, Canada; Joanne Manning, Salford Royal NHS Foundation Trust, Salford, UK; Ariel Masetto, Sherbrooke University, Sherbrooke, Québec, Canada; David Robinson, University of Manitoba, Winnipeg,

Manitoba, Canada; Sophie Roux, Sherbrooke University, Sherbrooke, Québec, Canada; Doug Smith, University of Ottawa, Ottawa, Ontario, Canada; Robert Spiera, Hospital for Special Surgery, New York, New York, USA; Virginia Steen, Georgetown University, Washington, DC, USA; Evelyn Sutton, Dalhousie University, Halifax, Nova Scotia, Canada; Carter Thorne, Southlake Regional Health Centre, Newmarket, Ontario, Canada; John Varga, Northwestern University, Chicago, Illinois, USA; Pearce Wilcox, St. Paul's Hospital and University of British Columbia, Vancouver, British Columbia, Canada; Vanessa C. Delisle, Jewish General Hospital and McGill University, Montréal, Québec, Canada; Claire Fedoruk, Jewish General Hospital, Montréal, Québec, Canada; Brooke Levis, Jewish General Hospital and McGill University, Montréal, Québec, Canada; Mia R. Pepin, Jewish General Hospital, Montréal, Québec, Canada; Jennifer Persmann, Université du Québec à Montréal, Montréal, Québec, Canada.

Financial Support: The Scleroderma Patient-centered Intervention Network (SPIN) is funded by a Canadian Institutes of Health Research (CIHR) Emerging Team Grant for Rare Diseases (PI, Thombs; TR3-119192). In addition to CIHR funding, SPIN has received institutional contributions from the Lady Davis Institute for Medical Research of the Jewish General Hospital, Montréal, Canada and from McGill University, Montréal, Canada. SPIN has also received support from the Scleroderma Society of Ontario, Scleroderma Canada, and Sclérodermie Québec. Ms. Gholizadeh's work on this project was supported by a Rheumatology Research Foundation: Health Professional Research Preceptorship. Dr. Kwakkenbos was supported by a CIHR Banting Postdoctoral Fellowship. Ms. Jewett was supported by a CIHR Doctoral Research Award. Dr. Thombs was supported by an Investigator Salary Award from the Arthritis Society.

Word Count: 2804

Address for Correspondence: Vanessa L. Malcarne, PhD; Doctoral Training Facility; 6363 Alvarado Court Suite 103; San Diego, CA 92120-4913; Phone: (619) 594-8642; Fax: (619) 594-6780; Email: vmalcarne@mail.sdsu.edu.

ABSTRACT

Background: 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 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, and the measure demonstrated strong internal consistency reliability and convergent validity with relevant measures in expected magnitudes and directions.

Conclusion: 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.

KEY WORDS: scleroderma; systemic sclerosis; psychometric; social anxiety; psychosocial

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 ($\alpha = 0.88 – 0.93$) (5, 6) as well as sensitivity to change following interventions targeting social 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, whereas 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 ($r = .54$), fear of negative evaluation ($r = .42$), and depression ($r = .48$) (8) and a moderate relationship between the full-length SIAS and a measure of appearance satisfaction ($r = -.46$) (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, have the ability 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 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 United States, and the United Kingdom. Only data from the baseline assessments of English-speaking participants completed from April 2014 to February 2016 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: 1. configural invariance; 2. metric invariance; and 3. 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 less than .08 indicating acceptable fit and values less than .05 indicating good fit; (b) the Standardized Root Mean Residual (SRMR) (35), an index of overall model fit with values less than .08 indicating acceptable fit and values less than .05 indicating good fit; and (c) the Comparative Fit Index (CFI) (33), with values greater than .95 indicating good model fit and values greater than .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*s < .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-Bχ2) (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 >.05) change in S-Bχ2 or a change in CFI of ≤ .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 1. 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-Bχ2[9] = 30.2, p < .01; CFI = 0.99, RMSEA = 0.05, SRMR = 0.02). Individual item factor loadings are provided in Table 2.

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 Table 2). Additionally, the factor loadings were statistically significant for all items in both groups (see Table 3). The metric invariance model fit the data well descriptively (CFI = 1.00, RMSEA: 0.00, SRMR: 0.04; see Table 2). 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 (ΔS-Bχ2 = 5.84 df = 5, p = 0.32) or descriptively (ΔCFI $\leq$ 0.01). The scalar model also demonstrated good fit (CFI = 1.00, RMSEA: 0.00, SRMR: 0.04; see Table 2). When compared to the less restrictive metric invariance model, fit was not compromised (ΔS-Bχ2 = 5.71 df = 5, p = .33, ΔCFI $\leq$ 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 (α = .89) as well as for limited (α = .86) and diffuse subgroups (α = .90). Comparing group means, the scores were significantly different between groups (p < .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 = .50, p < .01) and fear of negative

evaluation (r_s = .60, p < .01), a moderate, positive correlation with a measure of social discomfort (r_s = .43, p < .01), and a small, positive correlation with appearance dissatisfaction (r_s = .23, p < .01). Contrary to the authors' expectations, there was a moderate rather than small correlation with symptoms of depression (r_s = .41, p < .01; see Table 4).

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]; mean = 12.52; SD = 5.14, Le Blanc et al., 2014) 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, Le Blanc et al. [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. The majority 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 related to 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 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.

REFERENCES

1. Cash TF, Smolak L. Understanding body images: Historical and contemporary perspectives. In: Cash TF, Smolak L, editors. Body image: A handbook of science, practice, and prevention (2nd ed.). New York (NY): Guilford Press 2011;3-12.
2. Rumsey N, Harcourt D. Body image and disfigurement: issues and interventions. *Body Image* 2004;*1*:83-97.
3. Rumsey N. Body image & congenital conditions with visible differences. In TF Cash & T Pruzinsky (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 & T Pruzinsky (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*: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;23:53-73.
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*: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;24:66-76.

9. Benrud-Larson LM, Heinberg LJ, Boling C, Reed J, White B, Wigley FM, et al. Body image dissatisfaction among women with scleroderma: Extent and relationship to psychosocial function. Health Psychol 2003; 22:130-9.
10. Kwakkenbos L, Delisle VC, Fox RS, Gholizadeh S, Jewett LR, Levis, B et al. Psychosocial aspects of scleroderma. Rheum Dis Clin North Am 2015;41:519-528.
11. Malcarne, V. L., Handsdottir, I., Greenbergs, H.L., Clements, P. J., & Weisman, M. H. Appearance self-esteem in systemic sclerosis. Cognit Ther Res 1999;23,197-208.
12. Malcarne VL, Fox RS, Mills SD, Gholizadeh S. Psychosocial aspects of systemic sclerosis. Curr Opin Rheumatol 2013;*25:*707-713.
13. Gabrielli A, Avvedimento EV, Krieg T. Scleroderma. N Engl J Med 2009;360:1989-2003.
14. Steen VD, Powell DL, Medsger TA. Clinical correlations and prognosis based on serum autoantibodies in patients with systemic sclerosis. Arthritis Rheum 1998;31:196-203.
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:e33281.
16. Mills SD, Fox RS, Merz EL, Clements PJ, Kafaja S, Malcarne, V. L 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*:1624-1630.
17. Joachim G, Acorn S. Life with a rare chronic disease: the scleroderma experience. Journal of Advanced Nursing 2003;42:598-606.

18. Thombs BD, van Lankveld W, Bassel M, Baron M, Buzza R, Haslam, S et al. Psychological health and well-being in systemic sclerosis: State of the science and consensus research agenda. Arthritis Care Res 2010;62:1181-1189.
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;48-59.
20. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale(NJ): Erlbaum; 1998.
21. van den Hoogen F, Khanna D, Fransen J, Johnson SR, Baron M, Tyndall A, et al. 2013 classification criteria for systemic sclerosis: An American College of Rheumatology/European League Against Rheumatism collaborative initiative. Arthritis Rheum 2013;65:2737-47.
22. Carleton RN, McCreary DR, Norton PJ, Asmundson GJ. Brief fear of negative evaluation scale—revised. Depress Anxiety 2006;*23*: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; 21:131-41.
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 Assessment 1998;10:64-70.
25. Jewett LR, Hudson M, Haythornthwaite JA, Heinberg L, Wigley FM, Baron M, et al. Development and validation of the Brief-Satisfaction with Appearance Scale for systemic sclerosis. Arthritis Care & Res 2010;62:1779-86.
26. Kroenke, K., & Spitzer, R. L. The PHQ-9: a new depression diagnostic and severity measure. Psychiatr Ann 2002;32:509-515.

27. Razykov I, Hudson M, Baron M, Thombs BD. Utility of the Patient Health Questionnaire-9 to Assess Suicide Risk in Patients with Systemic Sclerosis. Arthritis Care Res 2013;65:753-758.
28. Milette K, Hudson M, Baron M, Thombs BD, and the 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. Rheumatolo*gy* 2010;49:789-96.
29. Clements PJ, Hurwitz EL, Wong WK, Seibold JR, Mayes M, White B et al. Skin thickness scores as a predictor and correlate of outcome in systemic sclerosis: high-dose versus low-dose penicillamine trial. Arthritis Rheum 2000;43:2445-2454.
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;33:1256-1263.
31. Dimitrov, D. M. Testing for factorial invariance in the context of construct validation. Meas Eval Couns Dev 2010*;43:121*-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:*4-69.
33. Bentler PM. Comparative fit indexes in structural models. Psychol Bull 1990;107:238-46.
34. Steiger JH. Structural model evaluation and modification: An interval estimation approach. Multivariate Behav Res 1990*;25:*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;6:1-55.

36. Satorra A, Bentler PM. A scaled difference chi-square test statistic for moment structure analysis. Psychometrika 2001;66:507-514.
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: 40-65; 1993.
38. Chen FF. Sensitivity of goodness of fit indexes to lack of measurement invariance. Struc Equ Modeling 2007;14:464-504.
39. Satorra, A. (2000). Scaled and adjusted restricted tests in multi-sample analysis of moment structures. In: Heijmans RDH, Pollcok DSG, Satorra A, editors. Innovations in Multivariate Statistical Analysis: A Festschrift for Heinz Neudecker. Kluwer Academic Publishers; London, England: pp. 233–247.
40. Cheung GW, Rensvold RB. Evaluating goodness-of-fit indexes for testing measurement invariance. Struc Equ Modeling 2002;9:233-255.
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;73:913-934.
42. Schönbrodt FD, Perugini M. At what sample size do correlations stabilize?. J Res Pers 2013;47:609-612.
43. Bollen KA. Structural equations with latent variables. New York: Wiley; 1989.
44. Le Blanc AL, Bruce LC, Heimberg RG, Hope DA, Blanco C, Schneier FR et al. Evaluation of the psychometric properties of two short forms of the social interaction anxiety scale and the social phobia scale. Assessment 2014;21:312-323.

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;2:426-435.
46. Gündel H, Wolf A, Xidara V, Busch R, Ceballos-Baumann AO. Social phobia in spasmodic torticollis. J Neurol Neurosurg Psychiat 2001;71:499-504.
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):361-70.

Table 1.

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]

Note. 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

Table 2

Fit statistics for configural invariance, metric invariance, and scalar invariance models of the 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	.46	1.00	.02	.00					
Diffuse	7.34	.60	1.00	.02	.09					
2. Metric	21.98	.52	1.00	.04	.00	1	5.84	5	.32	< .01
3. Scalar	27.17	.51	1.00	.04	.00	2	5.71	5	.33	< .01

Note. CFI = robust comparative Fit Index; SRMR = standardized root mean square residual; RMSEA = root mean square error of approximation. [a] Plausible fit $\geq$ .90, Good fit >.95. [b] Plausible fit $\leq$ .08, Good fit $\leq$

Table 3.

Standardized factor loadings from the CFA for the total sample and the multiple-group CFA baseline models for the 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.	.73	.73	.74
2. I find it difficult mixing comfortably with the people I work with.	.80	.77	.82
3. I tense up if I meet an acquaintance on the street.	.80	.74	.83
4. I feel tense if I am alone with just one person.	.81	.72	.86
5. I have difficulty talking with other people.	.84	.80	.86
6. I find it difficult to disagree with another's point of view.	.60	.56	.64

Note. For all factor loadings $p < .05$.

Table 4

Correlation of Variables with the Social Interaction Anxiety Scale-6 (SIAS-6)

	Spearman's Correlations[e]
Brief-SWAP – Dissatisfaction with Appearance[a]	.22
PHQ-8[b]	.41
Brief-SWAP – Social Discomfort	.43
SAAS[c]	.50
BFNE-II[d]	.60

Abbreviations: Brief-SWAP = Brief Satisfaction with Appearance Scale; PHQ-8 = 8-item Patient Health Questionnaire; SAAS = Social Appearance Anxiety Scale; BFNE-II = Brief Fear of Negative Evaluation Scale-II. 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 = $|r| \geq 0.5$.; Note: all correlations were significant at $p < .001$