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Evaluation of Measurement Properties and Differential Item Functioning in the English and French Versions of the University of California, Los Angeles, Loneliness Scale-6: A Scleroderma Patient-Centered Intervention Network (SPIN) Study

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Objective. Loneliness has been associated with poorer health-related quality of life but has not been studied in patients with systemic sclerosis (SSc). The current study was undertaken to examine and compare the psychometric properties of the English and French versions of the University of California, Los Angeles, Loneliness Scale-6 (ULS-6) in patients with SSc during the COVID-19 pandemic.

Methods. This study used baseline cross-sectional data from 775 adults enrolled in the Scleroderma Patient-Centered Intervention Network (SPIN) COVID-19 Cohort. Reliability and validity of ULS-6 scores overall and between languages were evaluated using confirmatory factor analysis (CFA), differential item functioning (DIF) through the multiple-indicator multiple-cause (MIMIC) model, omega/alpha calculation, and correlations of hypothesized convergent relationships.

Results. CFA for the total sample supported the single-factor structure (comparative fit index [CFI] 0.96, standardized root mean residual [SRMR] 0.03), and all standardized factor loadings for items were large (0.60–0.86). The overall MIMIC model with language as a covariate fit well (CFI 0.94, SRMR 0.04, root mean square error of approximation 0.11). Statistically significant DIF was found for 3 items across language (β_{item2} = 0.14, $P < 0.001$; β_{item4} = –0.07, P = 0.01; β_{item6} = 0.13, $P < 0.001$), but these small differences were without practical measurement implications. Analyses demonstrated high internal consistency with no language-based convergent validity differences.

Conclusion. Analyses demonstrated evidence of acceptable reliability and validity of ULS-6 scores in English- and French-speaking adults with SSc. DIF analysis supported use of the ULS-6 to examine comparative experiences of loneliness without adjusting for language.

INTRODUCTION

Loneliness is a pervasive and distressing experience involving a person's perception that their social relationships do not fulfill their social needs (1). It is an especially important problem among individuals with chronic illnesses, as their symptoms may subject them to greater challenges integrating in social and work settings (2). Specifically, patients with autoimmune rheumatic

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SIGNIFICANCE & INNOVATIONS

- The COVID-19 pandemic has caused higher levels of loneliness globally, but this has not been explored in patients with autoimmune rheumatic diseases. Patients with systemic sclerosis (SSc) have increased risks of COVID-19–related pulmonary involvement, immunosuppressive medication use, and general frailty and may face higher rates of loneliness and its subsequent physical and mental health consequences.
- No studies have explored loneliness in patients with SSc, and no measures for loneliness had been validated prior to this study.
- There were not measurement differences that affected scores between the English and French versions of the University of California, Los Angeles, Loneliness Scale-6, supporting the combined use of English and French data for analysis and comparison in future research on loneliness in SSc.

diseases may experience high symptom burden, which can lead to disability and isolation from others (3).

The COVID-19 pandemic has caused unprecedented challenges for the global population due to social distancing and isolation, and a systematic review found small post-pandemic increases in loneliness compared to pre-pandemic (34 studies, n = 215,026; standardized mean difference 0.27 [95% confidence interval (95% CI) 0.14, 0.40]); however, only 1 study of patients with chronic health conditions was included (4). Systemic sclerosis (SSc) is a rare autoimmune disorder that damages the skin and connective tissue, and SSc-related symptoms, such as chronic fatigue and pain, reduce health-related quality of life (5). Patients with SSc in particular are at higher risk of poor COVID-19 outcomes given their general frailty and immunosuppressive medication use, and because interstitial lung disease is found in ∼40% of patients (6,7). There is scant research, however, on loneliness in autoimmune rheumatic diseases and none in SSc (2). No measures to assess loneliness have been evaluated in autoimmune rheumatic diseases.

The University of California, Los Angeles (UCLA), Loneliness Scale-6 (ULS-6) is a 6-item short form of the revised UCLA Loneliness Scale (R-ULS), a 20-item self-report measure that has been used in multiple populations, including patients with chronic illnesses (2,8). The 6 items for the ULS-6 were selected in a sample of 286 Portuguese adolescents based on an exploratory factor analysis of the R-ULS that found that they loaded onto an "isolation and withdrawal" factor, which was determined to capture the essence of the loneliness construct (9). A subsequent confirmatory factor analysis (CFA) of older Portuguese adults (n = 1,154) found that the ULS-6 showed acceptable fit with the predicted single-factor model (10). No studies have assessed the measurement properties of the ULS-6 in English or French or in individuals with chronic illnesses.

The aim of the present study was to assess the measurement properties of ULS-6 scores during the COVID-19 pandemic for patients with SSc overall and separately in English and French. The specific objectives were to evaluate structural validity and to determine whether there was differential item functioning (DIF) between English- and French-language responses, internal consistency, and convergent validity overall and within and between language samples.

PATIENTS AND METHODS

This was a cross-sectional study that analyzed data from participants enrolled in the Scleroderma Patient-Centered Intervention Network (SPIN) COVID-19 Cohort. The SPIN COVID-19 Cohort study was approved by the Research Ethics Committee of the CIUSSS du Centre-Ouest-de-l'Île-de-Montréal. This report was documented in accordance with COSMIN guidelines (11). See Appendix A for additional members of the SPIN COVID-19 Patient Advisory Team and the SPIN investigators and their affiliations.

Participants and procedure. Participants were recruited from the ongoing SPIN Cohort and additionally via social media and patient organization advertisements (12). The SPIN Cohort includes over 1,800 participants from 47 centers in Canada, the US, the UK, France, Spain, Mexico, and Australia who complete regular 3-month online assessments. SPIN Cohort participants must be age ≥18 years, fluent in English, French, or Spanish, and meet the 2013 American College of Rheumatology/EULAR criteria for SSc, verified by a SPIN physician (13). SPIN Cohort participants provide informed consent for participation and for future contact about additional SPIN studies. SPIN site personnel submit an online medical form post-consent to enroll participants, who then receive instructions via email to activate SPIN accounts and complete measures in English, French, or Spanish. Participants complete assessments every 3 months.

English and French-speaking SPIN Cohort participants were recruited from April 9 to April 27, 2020 via email and popups during SPIN Cohort online assessments to enroll in the SPIN COVID-19 Cohort. Potential participants were also invited through recruitment announcements on social media (e.g., SPIN's Facebook page and Twitter account) and patient organization advertisements in English and French in countries with large English and French-speaking populations, including Canada, the US, France, the UK, Australia, New Zealand, and the Philippines. SPIN COVID-19 Cohort participants completed measures using the Qualtrics online survey package.

Measures. Basic demographic and disease variables were self-reported at baseline, including age, gender, years of education, marital status, ethnicity, and current country. Loneliness was assessed via the ULS-6, a 6-item measure with responses

ranging from 1 (never) to 4 (often), with higher scores indicating greater loneliness (9). The SPIN researchers administered the English version of the ULS-6 and the French version of the ULS-6. The English ULS-6 was drawn from 6 items of the English R-ULS that aligned with Neto's selected ULS-6 items from the Portuguese R-ULS (9). The French version of those items from the R-ULS French translation was used for French-speaking participants (14).

Symptoms of depression were measured via the Patient Health Questionnaire 8 (PHQ-8), an 8-item measure evaluating depressive symptoms over the last 2 weeks. Responses range from 0 (not at all) to 3 (nearly every day), and total scores range from 0 to 24, with higher scores indicating greater depressive symptoms (15). The PHQ-8 is available in English and French and demonstrates an equivalent performance to the PHQ-9, which has been validated in patients with SSc (16,17). Social support was evaluated through the Oslo Social Support Scale 3 (OSSS-3), a 3-item self-report measure without a timeframe specification (18). The first response ranges from 1 to 4, and second and third responses range from 1 to 5; the total score ranges from 3 to 14, with higher scores indicating greater social support. The OSSS-3 has demonstrated sufficient internal reliability and structural validity, although it has not been validated in patients with SSc (18). The SPIN research team translated the OSSS-3 into French using the World Health Organization's well-accepted forward-backward translation method. Participants were also asked to self-report number of individuals currently living in their household and number of one-on-one and group interactions over the phone or through videoconferencing software in the past week.

Statistical analyses. Descriptive statistics, including means and SDs for each ULS-6 item and the total, were first calculated (SPSS software, version 27). Cohen's *d* standardized mean difference effect sizes between English and French ULS-6 total scores were compared with 95% CIs (19). The magnitude of effect size was interpreted as small ($0.20 \leq d < 0.50$), medium ($0.50 \leq d < 0.80$), and large ($d \geq 0.80$). CFA was used to evaluate the previously identified single-factor structure of the ULS-6, following the recommendations of Bentler (20). The following indicators of good model fit were used: 1) the chi-square test; 2) a comparative fit index (CFI) of >0.95; 3) a root mean square error of approximation (RMSEA) of <0.08; and 4) a standardized root mean residual (SRMR) of <0.08. The chi-square test was not used as a sole indicator of model fit, given its sensitivity to large sample sizes; therefore, the additional descriptive fit indices were employed, which do not depend on sample size (20).

The multiple-indicator multiple-cause (MIMIC) model was used to examine differential item functioning (DIF) for the English versus French versions of the ULS-6. The base MIMIC model is comprised of the CFA model and the direct effect of language group on the latent loneliness factor, which controls for group differences on the level of the latent factor (21). To assess for DIF, each item on the ULS-6 was regressed, one at a time, on language group. After items with statistically significant DIF were identified, MIMIC models that adjust and do not adjust for DIF were compared to evaluate the degree to which DIF may influence comparisons between groups.

Internal consistency reliability was calculated using Cronbach's alpha coefficient and McDonald's omega. Convergent validity was evaluated via Pearson's product-moment correlations of the ULS-6 with measures of depression (PHQ-8), social support (OSSS-3), number of people currently in the household, and frequency of social interactions. The magnitude of correlations was interpreted as small ($|r| \leq 0.30$), moderate ($0.30 < |r| < 0.50$), or large ($|r| \geq 0.50$) (22). Based on previous findings, for overall, English, and French samples, we predicted a large positive correlation between loneliness and depression and a large negative correlation between loneliness and social support (8,10,23). We anticipated a moderate negative correlation of loneliness to number of people currently in the household and frequency of social interactions (8,10,23). We predicted a small nonsignificant correlation with gender, given previous findings suggesting that loneliness levels do not depend on gender, and a moderate negative correlation with marital status, with married individuals scoring lower than nonmarried individuals (10,24). We also predicted a moderate positive correlation between age and ULS-6 scores (10,24). Correlation differences across language were calculated by transforming correlations to Fisher's Z values and using univariate generalized linear modeling. We predicted no correlation differences across language.

Regarding sample size for sufficiently powered analyses, a 1-factor CFA with 6 indicators would require a minimum sample size between 60 and 190 for factor loadings between 0.50 and 0.80 (25). For MIMIC models in the context of DIF, a total sample size of ≥600 allows for detection of even very small mediation effects and controlling the Type I error rate (21). A Pearson correlation of ≥0.30 with 95% confidence and a precision of 0.10 requires a sample size of ≥403 (25). There were no missing data for the CFA or MIMIC models. For the Pearson correlations, there was a range of 0 to 7 missing participant responses, accounting for ≤0.9% of the sample.

RESULTS

The initial sample had 800 participants, but 25 participants did not complete any ULS items and were therefore removed from analyses. Of the included 775 adults with SSc, 315 (42%, 16 missing) had diffuse SSc, 697 (90%, 4 missing) were women, and 512 completed measures in English (66%) (Table 1). For the total sample, the mean score on the ULS-6 was 7.00 (SD 4.76; range 0–18), with higher scores representing greater loneliness. English speakers (mean ± SD 7.29 ± 4.67) and French speakers

Table 1. Demographic characteristics of participants*

Characteristic	Overall (n = 775)	English (n = 512)	French (n = 263)
Age, mean ± SD years	55.6 ± 12.6 (n = 771)	56.4 ± 11.9 (n = 508)	54.0 ± 13.6 (n = 263)
Gender			
Women	697/771 (90.4)	461/508 (90.7)	236/263 (89.7)
Men	74/771 (9.6)	47/508 (9.3)	27/263 (10.3)
Marital status			
Not married	237/768 (30.9)	145/505 (28.7)	92/263 (35.0)
Married	531/768 (69.1)	360/505 (71.3)	171/263 (65.0)
Employment			
Not employed	449/769 (58.4)	300/507 (59.2)	149/262 (56.9)
Employed	320/769 (41.6)	207/507 (40.8)	113/262 (43.1)
Ethnicity			
White	638/765 (83.4)	426/506 (84.2)	212/259 (81.9)
Black	50/765 (6.5)	19/506 (3.8)	31/259 (12.0)
Other	77/765 (10.1)	61/506 (12.1)	16/259 (6.2)
Language			
English	512/775 (66.1)	506/506 (100)	0/263
French	263/775 (33.9)	0/506	263/263 (100)
Country			
US	244/773 (31.6)	244/510 (47.8)	0/263
Canada	192/773 (24.8)	129/510 (25.3)	63/263 (24.0)
France	198/773 (25.6)	4/510 (0.8)	194/263 (73.8)
UK	68/773 (8.8)	68/510 (13.3)	0/263
Australia	43/773 (5.6)	43/510 (8.4)	0/263
Other	28/773 (3.6)	22/510 (4.3)	6/263 (2.3)
Years since SSc diagnosis, mean ± SD years	11.6 ± 8.0 (n = 746)	12.1 ± 8.2 (n = 486)	10.7 ± 7.6 (n = 260)
Duration of education, mean ± SD years	15.8 ± 3.4 (n = 762)	15.9 ± 3.2 (n = 502)	15.6 ± 3.9 (n = 260)
SSc subtype			
Limited SSc	407/759 (52.5)	253/498 (50.8)	154/261 (59.0)
Diffuse SSc	315/759 (41.5)	219/498 (44.0)	96/261 (36.8)
Unknown per self-report	37/759 (4.9)	26/498 (5.2)	11/261 (4.2)

* Values are the no./total no. (%) unless indicated otherwise. SSc = systemic sclerosis.

(mean ± SD 6.45 ± 4.93) had a mean difference of 0.84 points (d = 0.18 [95% CI 0.03, 0.33]).

The CFA supported the expected single-factor structure (χ^2[9] = 85.56, P < 0.001; CFI 0.96, SRMR 0.03, RMSEA 0.11). All standardized factor loadings for items were large and statistically significant (0.60–0.86; all P < 0.001) (Table 2).

The overall MIMIC model fit well with language as a covariate (χ^2[14] = 147.36, P < 0.001; CFI 0.94, SRMR 0.04, RMSEA 0.11). Statistically significant DIF was found for 3 items across language, although standardized differences were small (β[item 2: "I feel part of a group of friends"] = 0.14, P < 0.001; β[item 4: "I feel isolated from others"] = –0.07, P = 0.01; β[item 6: "People are around me but not with me"] = 0.13, P < 0.001). The difference between English and French respondents in the latent factor score did not differ meaningfully when adjusting (SD –0.28 [95% CI –0.43, –0.12] or not adjusting for DIF (SD –0.29 [95% CI –0.46, –0.12]).

For the total sample, omega and alpha were both 0.87. For all study participants (Table 3), the ULS-6 total score correlated significantly and with expected directions and magnitudes with the total score for the PHQ-8 and the total score on the

Table 2. Item means and confirmatory factor analysis standardized factor loading results for the University of California, Los Angeles, Loneliness Scale-6 (ULS-6)*

Item†	Overall mean ± SD	English mean ± SD	French mean ± SD	Confirmatory factor analysis standardized factor loading
1. I lack companionship	1.04 ± 1.05	1.09 ± 1.05	0.92 ± 1.04	0.63
2. I feel part of a group of friends‡	0.84 ± 0.96	0.80 ± 0.90	0.91 ± 1.07	0.60
3. I feel left out	1.19 ± 1.02	1.29 ± 0.99	0.99 ± 1.05	0.82
4. I feel isolated from others	1.44 ± 1.07	1.58 ± 1.04	1.16 ± 1.08	0.86
5. I am unhappy being so withdrawn	1.15 ± 1.01	1.21 ± 0.99	1.05 ± 1.03	0.78
6. People are around me but not with me	1.35 ± 1.06	1.32 ± 1.04	1.41 ± 1.09	0.62
Total ULS-6 score mean	7.00 ± 4.78	7.29 ± 4.67	6.45 ± 4.93	NA

* NA = not applicable.
† On a 4-point scale, where 1 = never and 4 = often.
‡ Item 2 was reverse coded due to positive valence.

Table 3. Convergent validity of the University of California, Los Angeles, Loneliness Scale-6, per language through Pearson correlations*

Variable	Hypothesized range (direction)	Overall correlation (95% CI)	English correlation (95% CI)	French correlation (95% CI)	Hypothesis supported?	Correlation difference (95% CI)
PHQ-8 (n = 775)	Large + (|r| ≥ 0.50)	0.56 (0.58, 0.61)†	0.58 (0.52, 0.63)†	0.52 (0.43, 0.60)†	Yes	0.06 (–0.06, 0.15)
OSSS-3 (n = 775)	Large – (|r| ≥ 0.50)	–0.53 (–0.58, –0.47)†	–0.51 (–0.58, –0.45)†	–0.56 (–0.64, –0.47)†	Yes	0.05 (–0.08, 0.17)
No. of people in household (n = 774)	Moderate – (0.30 < |r| < 0.50)	–0.06 (–0.13, 0.01)	–0.04 (–0.13, 0.04)	–0.12 (–0.24, 0.001)	No; small and nonsignificant instead of moderate	0.08 (–0.07, 0.23)
No. of social interactions with 1 person (n = 769)	Moderate – (0.30 < |r| < 0.50)	–0.16 (–0.23, –0.09)†	–0.18 (0.26, –0.09)†	–0.13 (–0.25, –0.01)‡	No; small instead of moderate	0.05 (–0.19, 0.10)
No. of social interactions with multiple people (n = 769)	Moderate – (0.30 < |r| < 0.50)	–0.24 (–0.31, –0.17)†	–0.24 (–0.32, –0.15)†	–0.25 (–0.36, –0.13)†	No; small instead of moderate	0.01 (–0.14, 0.16)
Gender (n = 771)	Small, no direction predicted (|r| ≤ 0.30)	–0.06 (–0.13, 0.02)	–0.02 (–0.11, 0.06)	–0.11 (–0.23, 0.01)	Yes	0.09 (–0.06, 0.24)
Relationship status (n = 768)	Moderate – (0.30 < |r| < 0.50)	–0.17 (–0.24, –0.11)†	–0.21 (–0.29, –0.13)†	–0.13 (–0.25, –0.01)‡	No; small instead of moderate	0.08 (–0.23, 0.06)
Age (n = 771)	Moderate + (0.30 < |r| < 0.50)	–0.06 (–0.15, –0.01)‡	–0.12 (–0.20, –0.03)†	–0.03 (–0.15, 0.09)	No; small and negative instead of moderate and positive	0.09 (–0.24, 0.06)

* Values are the r value unless indicated otherwise. OSSS-3 = Oslo Social Support Scale 3; PHQ-8 = Patient Health Questionnaire 8.
† $P < 0.001$.
‡ $P < 0.05$.

OSSS-3. As expected, the ULS-6 total score had a small nonsignificant correlation with gender. Correlations with the frequency of social interactions with 1 person and multiple people were significant and negative, as expected, but small. The correlation with age was significant but small and negative, and the correlation with marital status was significant and small, with nonmarried individuals indicating higher loneliness than married individuals. Unexpectedly, the ULS-6 had a nonsignificant small negative correlation with number of people in the household. When testing the differences between correlations between English and French (Table 3), there were no significant language differences in the correlations between the ULS-6 and all hypothesized variables.

DISCUSSION

Analyses provided evidence for acceptable reliability and validity of the ULS-6 scores in English- and French-speaking adults with SSc. The CFA indicated the appropriateness of the single-factor structure, supporting use of a total score. Internal consistency calculations indicated high reliability. Although the overall MIMIC model fit well, MIMIC analyses also showed that 3 of the 6 items showed statistically significant DIF across linguistic groups. Despite these findings, differences between groups were not affected by adjusting or not adjusting for DIF. This evidence suggests that loneliness scores can be compared across languages.

Convergent validity findings did not significantly differ between the 2 groups, as expected. For both English and French speakers, the total score on the ULS-6 correlated significantly and in expected directions with total scores for depression and social support. Further, the ULS-6 was not significantly correlated with gender, as expected. For both languages, the ULS-6 had small correlations with frequencies of virtual social interactions and with nonmarried status (versus married status). Surprisingly, the ULS-6 had a small negative correlation with age. Previous literature using the ULS indicates that older age is consistently significantly associated with higher levels of loneliness in older adults and in patients with other chronic illnesses such as cancer (10,26,27). Our study finding, which differed from previous literature, could be attributed to a variety of justifications, including different patterns in patients with SSc than in older adults in the general population or patients with other chronic illnesses during the COVID-19 pandemic.

Additionally, the ULS-6 was not significantly inversely related to the number of people in the household (9). It is possible that COVID-19-related factors, such as needing to quarantine while ill with COVID, complicate this relationship and findings that would be expected to be significant. It is also possible that loneliness was more strongly rooted in the meaningfulness of interactions rather than the quantity of interactions. This interpretation aligns with the initially stated definition of loneliness as a pervasive and distressing experience involving a person's perception that their social relationships do not fulfill their social needs (1). Both English- and French-speaking patients with SSc might require more emotionally significant social interactions to reduce feelings of loneliness.

Loneliness as a latent construct has become especially relevant during the COVID-19 pandemic and may disproportionately impact chronically ill groups, especially those experiencing rare chronic illnesses such as SSc. A recent meta-analysis demonstrated that loneliness has increased since the start of the pandemic (4). Research has also demonstrated that sustained loneliness can have serious implications for mental and physical health outcomes (1,28). It is important to note, however, that in a recent SPIN study, depression levels in patients with SSc did not change from before the COVID-19 pandemic to during the COVID-19 pandemic; given our study findings that depression had a large correlation with loneliness, it is possible that loneliness levels may not have worsened for patients with SSc during the COVID-19 pandemic (29). SPIN researchers are in the process of analyzing findings regarding changes in loneliness levels during the COVID-19 pandemic, which will provide valuable information regarding the nature of loneliness in patients in the context of the COVID-19 pandemic, and whether their experiences compare to those of individuals in the general population (4).

Notably, the SPIN research team recently developed and tested an intervention, via a randomized controlled trial, targeting psychosocial outcomes including loneliness in patients with SSc during the COVID-19 pandemic (30). The COVID-19 Home-Isolation Activities Together (SPIN-CHAT) program was a 4-week telehealth group intervention providing education and mental health coping strategies, as well as social support, to reduce patient anxiety, depression, and loneliness. While developing this intervention, the SPIN patient advisory board emphasized the importance of prioritizing anxiety but believed that depression and loneliness should be less of a priority (31). They attributed this to the fact that patients with SSc already managed feelings of isolation before the COVID-19 pandemic and therefore demonstrated resiliency against depression and loneliness. Loneliness was still incorporated as an intervention target, given that patients with SSc are at increased risk of serious complications from COVID-19 and had been advised to self-isolate (31). While the intervention had small effects on anxiety, there were no intervention effects on loneliness (30). Beyond the SPIN-CHAT program, only 1 other study has specifically targeted loneliness since the start of the COVID-19 pandemic. The study's intervention was conducted for older adult clients of a Meals on Wheels program and involved 3–5 conversational phone calls per week for 4 weeks (32). The intervention successfully decreased loneliness levels on the R-ULS. Future studies should evaluate and continue to target the comparative experiences of loneliness in SSc and other chronically ill groups given the limited literature on this psychological construct.

This study had several strengths, including its large sample size, diverse group of participants, and rigorous psychometric

methods. However, the study also had notable limitations. The study sample was a convenience sample that had opted in to participating, posing a risk of selection bias. The context of the COVID-19 pandemic also created a unique environment for studying loneliness that may not be easily extrapolated to other circumstances. Further, this study did not investigate the discriminant validity of the ULS-6 or the extent to which the ULS-6 selectively captures loneliness, with the exclusion of associated yet distinct constructs such as depression. Additionally, given that the study was not designed to explicitly study loneliness, it did not incorporate specific variables of interest that would have further established convergent validity, such as strength of relationships. Additional collection of evidence is warranted to demonstrate further validity of the scale and to substantiate proposed theories for why certain findings may have differed from expectations.

In conclusion, the present study findings offer evidence of reliability and validity of the ULS-6 for use with and across English- and French-speaking patients with SSc, as demonstrated by CFA, MIMIC, and Pearson correlation findings. The limited literature on loneliness in patients with autoimmune rheumatic diseases shows that they are at higher risk of self-isolation generally and during the COVID-19 pandemic, demonstrating a need for further research (33). The ULS-6 can be used as a helpful tool in future studies evaluating and targeting loneliness through interventions for patients with SSc.

AUTHOR CONTRIBUTIONS

All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approved the final version to be submitted for publication. Dr. Malcarne had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study conception and design. Rapoport, Choi, Mouthon, Malcarne.
Acquisition of data. Kwakkenbos, Carrier, Henry, Thombs.
Analysis and interpretation of data. Rapoport, Roesch, Thombs, Malcarne.

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APPENDIX A: THE SPIN COVID-19 PATIENT ADVISORY TEAM AND SPIN INVESTIGATORS

In addition to the authors, the following primary investigators participated in the SPIN COVID-19 Patient Advisory Team: Catherine Fortuné (Ottawa Scleroderma Support Group, Ottawa, Ontario, Canada); Amy Gietzen (National Scleroderma Foundation, Tri-State Chapter, Binghamton, New York); Geneviève Guillot (Sclérodermie Québec, Longueuil, Quebec, Canada); Nancy Lewis (Toronto, Ontario, Canada); Karen Nielsen, Maureen Sauvé (Scleroderma Society of Ontario, Hamilton, Ontario, Canada); Michelle Richard (Scleroderma Atlantic, Halifax, Nova Scotia, Canada); Joep Welling (NVLE Dutch Patient Organization for Systemic Autoimmune Diseases, Utrecht, The Netherlands); and John Varga (University of Michigan, Ann Arbor).

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