Sexual activity and impairment among women with systemic sclerosis

Brooke Levis[1,5]; Marie Hudson, MD[3,5]; Ruby Knafo, MSc[1,5]; Murray Baron, MD[3,5]; Warren R. Nielson, PhD[6]; Marilyn Hill, PhD[6]; Brett D. Thombs, PhD[1-5]; Canadian Scleroderma Research Group (CSRG)[7]

Departments of [1]Psychiatry, [2]Epidemiology, Biostatistics, and Occupational Health, [3]Medicine (Division of Rheumatology), and [4]School of Nursing, McGill University, Montréal, Québec, Canada; [5]Lady Davis Institute for Medical Research, Jewish General Hospital, Montréal, Québec, Canada; [6]Beryl & Richard Ivey Rheumatology Day Programs, St. Joseph's Health Care, London Ontario; [7]**CSRG Recruiting Rheumatologists**: J. Pope, London, Ontario; M. Baron, Montreal, Quebec; J. Markland, Saskatoon, Saskatchewan; N. A. Khalidi, Hamilton, Ontario; A. Masetto, Sherbrooke, Quebec; E. Sutton, Halifax, Nova Scotia; N. Jones, Edmonton, Alberta; D. Robinson, Winnipeg, Manitoba; E. Kaminska, Hamilton, Ontario; P. Docherty, Moncton, New Brunswick; J.-P. Mathieu, Montreal, Quebec; S. LeClercq, Calgary, Alberta; M. Hudson, Montreal, Quebec; S. Ligier, Montreal, Quebec, T. Grodzicky, Montreal, Quebec; C. Thorne, Newmarket, Ontario; G. Gyger, Montreal, Quebec; & M. Fritzler, Advanced Diagnostics Laboratory, Calgary, Alberta.

Grant support: Ms. Levis' work was supported by a Canadian Institutes of Health Research, Institute of Musculoskeletal Health and Arthritis, Studentship in Mobility, Musculoskeletal, Oral, and Skin Health and Arthritis Across the Lifespan (# SMA 112834). Dr. Baron is the director of the Canadian Scleroderma Research Group, which receives grant funding from the Canadian Institutes of Health

Research, the Scleroderma Society of Canada and its provincial chapters, Scleroderma Society of Ontario, Sclérodermie Québec, the Ontario Arthritis Society, and educational grants from Actelion Pharmaceuticals and Pfizer Inc. Drs. Thombs and Hudson are supported by New Investigator Awards from the Canadian Institutes of Health Research and Établissement de Jeunes Chercheurs awards from the Fonds de la Recherche en Santé du Québec.

Word Count: 3,782

Address for Correspondence:

Brett D. Thombs, Ph.D.

Jewish General Hospital

4333 Cote Ste Catherine Road

Montreal, Quebec H3T 1E4

Telephone: (514) 340-8222 ext. 5112

Fax: (514) 340-8124

E-mail: brett.thombs@mcgill.ca

ABSTRACT

Objective: To assess (1) the rates of sexual activity and impairment, (2) clinical correlates of sexual activity/impairment, and (3) common sources of pain during and after sex in a large sample of female SSc patients.

Methods: Cross-sectional, multi-center study of female SSc patients from the Canadian Scleroderma Research Group Registry. Patients underwent medical examinations and clinical histories and were asked whether they had engaged in sexual activities with their partner in the past 4 weeks. Sexually active patients completed a 9-item version of the Female Sexual Function Index (FSFI) and items related to problems that may be linked to sexual dysfunction in SSc. Multivariate logistic regressions assessed independent predictors of activity/inactivity and sexual dysfunction.

Results: 238 of 547 patients (41%), including 226 of the 412 patients currently in relationships (55%), reported having engaged in sexual activities with a partner in the past 4 weeks. Among 165 sexually active patients with complete data for all variables, 102 (62%) had FSFI scores <22.5, indicating impaired function. 17% of patients were sexually active and not impaired. Independent predictors (P<0.05) of sexual activity were younger age, fewer gastrointestinal symptoms and less severe Raynaud's symptoms. Sexual impairment was independently associated with older age, higher skin scores and more severe breathing problems. Vaginal pain was 8 times more likely among women with impairment.

Conclusions: Research is needed to compare the extent of activity and impairment in SSc compared to women without SSc and to develop interventions to address impaired sexual function in women with SSc.

SIGNIFICANCE AND INNOVATION

- 41% of female SSc patients were sexually active, including 55% of those in a relationship, but only 17% overall were sexually active and not impaired.
- SSc symptoms independently associated with sexual inactivity or sexual impairment included gastrointestinal symptoms, Raynaud's symptoms, breathing problems and extent of skin involvement.
- Reports of pain were robustly associated with sexual impairment, and vaginal pain most prominently differentiated impaired from non-impaired women.

Systemic sclerosis (SSc), or scleroderma, is a chronic, multi-system, connective tissue disorder characterized by thickening and fibrosis of the skin and internal organ involvement [1]. Approximately 80% of SSc patients are women, with highest onset rates between 30 and 60 years of age [2]. Common psychosocial problems include pain, fatigue, pruritus, body image distress, depressive symptoms, and disability [3-8].

Impaired sexual function is common among women with chronic illnesses [9], including SSc [10-15]. Physical and psychological consequences of SSc that may affect sexual functioning include fatigue, depression, shrinking of the mouth and other appearance changes, Raynaud's phenomenon, skin tightening and discomfort, vaginal tightness and dryness, thickening of skin around the lips, painful finger ulcers and calcium deposits, gastrointestinal symptoms, joint pain and muscular weakness [10,16-19].

Existing studies of sexual functioning among women with SSc have concluded that sexual impairment is common, based on frequencies of reported problems [10,17], comparisons to the general population [11,12,15], and comparison to women with other chronic diseases [14]. Common problems reported include vaginal dryness and discomfort, painful intercourse, and reduced frequency and intensity of orgasms [10,15]. Impaired sexual function has been associated with disease duration, pain, body image dissatisfaction, and marital distress [11]. Existing studies, however, have been limited by the use of single, unvalidated items to assess impairment and problems [10,17]; not explicitly distinguishing between sexual inactivity and impairment [10-14,17]; and small sample sizes [10-12,17]. There is only one study of ≥100 patients that has analyzed sexual inactivity and impairment separately and used a validated measure of sexual function [15], but that study did not include any multivariate analyses of factors associated with sexual problems.

The objectives of this study were to assess: (1) the rate of sexual activity among female SSc patients and, specifically, patients in relationships; (2) the rate of sexual impairment among sexually active patients; (3) sociodemographic and clinical variables that differentiate sexually active patients from those inactive due to SSc; (4) sociodemographic and clinical variables associated with sexual impairment among active patients; and (5) sources of pain during and after sexual activity among active patients.

PATIENTS AND METHODS

Patient Sample

The study sample consisted of female patients recruited from 9 Canadian Scleroderma Research Group (CSRG) Registry sites. Eligible patients are ≥18 years old, have a diagnosis of SSc confirmed by a Registry rheumatologist, and are fluent in English or French. At annual Registry visits, patients undergo extensive clinical evaluations and complete a series of self-report questionnaires. All patients provided informed consent, and the research ethics board of each participating center approved the data collection protocol. Overall, approximately 80% of patients approached consent to Registry enrolment.

Measures

Sexual Activity

Patients were classified as sexually active/inactive based on the question, "*During the past 4 weeks, have you engaged in sexual activities with your partner?*" Patients who answered "no" identified reasons for non-activity, including: "Lack of interest in sex"; "My scleroderma

symptoms interfere with sexual activity"; and "I have some other health problem that interferes with sex."

Sexual Impairment

Many studies on female sexual function have been criticized for coding sexually inactive women as impaired [20]. Thus, sexual impairment was assessed only among sexually active women, using an abbreviated version [21] of the 19-item Female Sexual Function Index (FSFI), which assesses sexual functioning over the past 4 weeks [22]. The 9-item abbreviated version included items assessing 5 dimensions of sexual function from the original FSFI, including desire (2 items), arousal (1 item), lubrication (1 item), orgasm (3 items), and pain (2 items). FSFI items are scored on a 1-5 scale with the exception of 2 items related to pain during and following vaginal intercourse, which are scored 0 if vaginal intercourse was not attempted. In the original FSFI, the sum of item scores in each domain are multiplied by a domain factor, so that each domain is weighted equally to obtain a total FSFI score. In the 9-item FSFI used in this study, items were similarly weighted so that the total possible domain score for each domain was 6.0, with total scores ranging from 4.8 to 30. We included women who responded to items from all domains, $\leq$1 item from any domain and $\leq$3 items total.

The original FSFI has good reliability and validity and differentiates between women with and without sexual dysfunction diagnoses [22-25]. A 10-item abbreviated version correlated highly with the original 19-item version (r=0.98) in a sample of 568 women [21,25]. The only difference between the 10-item version and the 9-item version used in this study is that the 9-item version included 2 pain items, rather than 3. In previous studies, the 3 pain items produced substantively identical mean scores and very high estimates of internal consistency (3-item Cronbach's alpha =0.94 to 0.98) [22-25]. This suggests item redundancy and that weighted total

scores of the 9-item and 10-item versions would be comparable since the difference in the number of items is adjusted for by domain weighting. A cut-off score of 22.5 to classify impairment/non-impairment effectively differentiates women with and without sexual dysfunction based on DSM-IV criteria [21,25].

In addition to the FSFI items, sexually active women completed a checklist of possible scleroderma-specific pain sources during and following sexual activity, including: (1) finger or hand pain; (2) back pain; (3) vaginal pain; (4) muscle pain; (5) joint pain; (6) skin tightening; (7) skin pain/sensitivity; (8) skin ulcers; (9) Raynaud's symptoms; (10) other; (11) no discomfort or pain. This checklist was derived from sources of pain identified in the SSc literature and from clinicians with experience treating SSc patients.

Relationship status

Likely availability of a sexual partner was evaluated using the question, "Are you currently in a relationship with a partner?"

Sociodemographic, Lifestyle, and Disease Variables

Sociodemographic variables, including age, marital status, and race/ethnicity [21,25], were based on patient report. Alcohol consumption was defined as patient-reported average number of drinks per day and categorized as none, <1 drink per day, or 1+ drinks per day. Patients reported smoking status as never, former, or current. Body mass index (BMI) was calculated using data from the clinical examination and based on the Canadian Guidelines for Body Weight Classification in Adults [26] classified as <25 (normal or underweight), 25-29.9 (overweight) and ≥30 (obese).

The presence of Raynaud's phenomenon and disease duration (time from first non-Raynaud's disease manifestation) were recorded by study physicians. Skin involvement was

assessed using the modified Rodnan skin score [27], a widely used clinical assessment where the examining rheumatologist records the degree of skin thickening from 0 (no involvement) to 3 (severe thickening) in 17 body areas (total score range 0-51). Patients were classified into limited and diffuse cutaneous subsets based on Leroy's definition [28]. Finger contracture severity was assessed via fingertip-to-palm (FTP) distance recorded from the tip of the 3rd finger to the distal palmar crease using the more severely affected hand [29]. Finger ulcers were recorded by the study physician and defined as any active or healed digital ulcers, digital necrosis, loss of digital pulp, and auto- or surgical amputation of any digits. Severity of gastrointestinal symptoms, Raynaud's phenomenon and breathing problems in the past week were measured using 11-point numerical rating scales (NRS) (0=no disease, 10=very severe disease) derived from the visual analog scales (VAS) in the Scleroderma-Health Assessment Questionnaire [30]. NRS measures perform similarly to VAS measures, but are generally easier to score [31].

Hemoglobin levels were measured in g/L. Pulmonary hypertension was defined as systolic pulmonary artery pressure ≥45 on cardiac echocardiography [32]. The presence/absence of interstitial lung disease was defined according to the results of high resolution computed tomography scans of the lungs, when available, or by physician reports of the presence of typical basilar Velcro-like crackles on lung auscultation and/or chest x-ray reports of the presence of increased interstitial markings (not thought to be due to congestive heart failure) or lung fibrosis when lung scans were not available.

Data Analyses

The percentage of women who reported sexual activity was calculated for all women sampled and for women who reported currently being in a relationship with a partner. Of women

who reported being in relationships, those that reported being sexually active (defined in the FSFI as having engaged in sexual activities in the past 4 weeks) were compared to patients who reported being sexually inactive due to scleroderma symptoms on sociodemographic, lifestyle and disease factors using logistic regression models. Women who reported being inactive for other reasons were not included in this analysis since the purpose was to identify potentially modifiable disease factors linked to sexual activity/inactivity in SSc. Logistic regression analyses were also conducted to compare women with (FSFI total ≤22.5) and without sexual impairment (FSFI total >22.5) among those who reported sexual activity. For multivariate models, given sample size considerations related to the number of predictor variables per outcome (e.g. 8-10 patients in the smaller outcome group per predictor variable [33]), we selected *a priori* a core set of independent variables potentially related to sexual impairment in SSc (age, skin score, FTP distance, hemoglobin, severity of gastrointestinal symptoms, severity of Raynaud's, severity of breathing problems, presence/absence of interstitial lung disease). We conducted post-hoc analyses that included disease duration, alcohol consumption, BMI, and pulmonary hypertension as additional variables in the regression model, one at a time. We also reran the models with age as a continuous, rather than categorical, variable and substituting disease duration for age.

Discrimination and calibration of the logistic regression models were assessed with the c-index and Hosmer-Lemeshow goodness-of-fit (HL) statistic, respectively [34]. The c-index is the percentage of comparisons where sexually active (or sexually impaired) patients had a higher predicted probability of being sexually active (or sexually impaired) than inactive patients (or non-impaired patients), for all possible pairs of active and inactive patients (or impaired and non-impaired patients). The HL is a measure of the accuracy of the predicted number of cases of

active or impaired patients compared to the number of patients who actually reported sexual activity or impairment across the spectrum of probabilities.

In addition, for sexually active patients, sources of pain during and after sex were compared for patients with and without impaired sexual function using the χ^2 statistic or Fisher's Exact Test. Hochberg's sequential method was applied to adjust for multiple comparisons [35].

All analyses were conducted using PASW Statistics 18.0 (Chicago, IL) and statistical tests were 2-sided with a $P<0.05$ significance level.

RESULTS

There were 588 women who completed questionnaires between October 2008 and November 2010. Of these, 547 had complete sexual activity and impairment data (93.0%), including 226 (41.3%) who were sexually active, of whom 95 (42.0%) were not impaired (FSFI>22.5). Overall, 95 of 547 women (17.4%) were active without impairment (Table 1 by age and marital status). See Figure 1 for flow of patients through study analyses.

Analysis of Sexual Activity

Of the 547 patients, 412 (75.3%) were in a relationship, including 226 (54.9%) who were sexually active. Reasons for inactivity (n=186) included "lack of interest in sex" (n=150, 80.6%), "my scleroderma symptoms interfere with sexual activity" (n=81, 43.5%) and "I have some other health problem that interferes with sex" (n=60, 32.3%).

There were 307 patients in relationships who were sexually active (n=226, 73.6%) or inactive because scleroderma symptoms interfered (n=81, 26.4%). Of these, 237 (77.2%) had complete data for all variables in multivariate regression models, including 174 (73.4%) who

were sexually active and 63 (26.6%) who were not. As shown in Table 2, the majority of these patients were ≥50 years of age (n=178, 75.1%). Most patients were married (n=219, 92.7%), White (n=211, 92.5%), consumed <1 alcoholic drink per day (n=206, 87.3%), and had normal/underweight BMI (BMI <25; n=122, 51.5%). Only 10 patients with BMI <25 had BMI <18.5 (underweight). Most patients had limited SSc (n=148, 65.8%), with average disease duration of approximately 10 years.

As shown in Table 3, in bivariate analyses, patients 60 years or older, patients who were overweight (BMI 25–29.9) or obese (BMI ≥ 30), patients with pulmonary hypertension, patients with higher skin scores and patients with more severe gastrointestinal symptoms, Raynaud's symptoms, or breathing problems were significantly less likely to be sexually active. Patients who consumed alcohol, compared to patients who did not, were more likely to be sexually active. In the core multivariate logistic regression analysis, older patients (age 50-59 years: odds ratio [OR]=0.24, 95% confidence interval [CI]=0.08-0.73, P=0.012; age ≥60 years: OR=0.12, 95% CI=0.04-0.37, P<0.001), patients with more severe gastrointestinal symptoms (OR=0.80, 95% CI=0.69-0.94, P=0.005) and patients with more severe Raynaud's symptoms (OR=0.82, 95% CI=0.72-0.93, P=0.003) were less likely to be sexually active. The model had adequate discriminitive power (c-index=0.80) and calibration (P=0.219 for the HL statistic). In post-hoc sensitivity analyses, obese patients (BMI ≥30: OR=0.29, 95% CI=0.11-0.72, P=0.008) were less likely to be sexually active, and patients who consumed at least 1 alcoholic drink per day (OR=8.16, 95% CI=1.48-45.00, P=0.016) were more likely to be sexually active. Pulmonary hypertension and disease duration were not significantly related to likelihood of sexual activity. Inclusion of these variables in the model did not substantively influence the association of any of

the variables in the core model with sexual activity, nor did the use of age and BMI as continuous variables or the use of disease duration instead of age.

Analysis of Sexual Impairment

Of the 174 sexually active patients, 165 had FSFI total scores. Of these, 102 (61.8%) were classified as experiencing sexual impairment (see Table 4 for sociodemographic and clinical characteristics). As shown in Table 5, in bivariate analyses, patients 50 years or older, patients with higher skin scores, and patients with more severe breathing problems were more likely to be sexually impaired. In the core multivariate logistic regression analysis, older patients (age 50-59 years: OR=3.02, 95% CI=1.25-7.26, P=0.014; age ≥60 years: OR=3.28, 95% CI=1.26-8.53, P=0.015), patients with higher skin scores (OR=1.06, 95% CI=1.00-1.13, P=0.039) and patients with more severe breathing problems (OR=1.27, 95% CI=1.04-1.56, P=0.018) were more likely to be sexually impaired. The model had adequate discriminitive power (c-index=0.71) and calibration (P=0.384 for the HL statistic). In post-hoc sensitivity analyses, patients who consumed between 0 and 1 alcoholic drinks per day (OR=2.63, 95% CI=1.18-5.86, P=0.018) were more likely to be sexually impaired. BMI, disease duration, and pulmonary hypertension were not significantly related to sexual impairment. Inclusion of these variables in the model, one at a time, in addition to core model variables did not substantively influence the association of any of the variables in the core model with sexual impairment. Similarly, inserting disease duration into the model in place of age and using age and BMI as continuous variables rather than categorical variables did not affect results (not shown).

Sources of Pain

As shown in Table 6, among the 165 sexually active patients, 103 (62.4%) reported ≥1 pain source during sexual activity, and 62 (37.6%) after sexual activity with both substantially higher for women with impairment. Pain sources reported by at least 10% of women included vaginal, joint, muscle, finger or hand, and back pain during activity and vaginal and joint pain after activity. Of the 102 women classified as sexually impaired, 82 (79.6%) experienced pain during or after sexual activity, compared to 24 of 63 (38.1%) women who were not impaired. Controlling for multiple comparisons, only vaginal pain was significantly more common among impaired women ($P<0.001$). Impaired women reported an average of 1.8 and 0.6 sources of pain during and after sexual activity compared to 1.0 and 0.3 sources for non-impaired women (both $P<0.001$). Number of pain symptoms were not significantly associated with age or menopausal status.

DISCUSSION

The main finding of this study was that only 17% of female SSc patients were sexually active without sexual impairment. Overall, 41% of the women in the study reported being sexually active, including 55% of those in relationships. Among sexually active patients, 58% were classified as sexually impaired. In addition to older age, a number of SSc symptoms were associated with sexual inactivity or sexual impairment, including gastrointestinal symptoms, Raynaud's symptoms, breathing problems and extent of skin involvement. Sexual impairment was robustly associated with reports of pain, and women who were sexually impaired were more than twice as likely to report pain during or after sex as women who were not impaired. Most prominently, women with sexual impairment were more than 8 times as likely to report vaginal pain than women not classified as sexually impaired.

To date, one large study has used the FSFI to evaluate sexual function in the general population. That study sampled over 3,200 women aged 30-79 in the Boston metropolitan area and found that 51% of women in the general population were sexually active, and 38% of active women were sexually impaired, resulting in 31% who were active and not impaired [21]. It is not clear, however, how this compares to women with SSc in our study. This is because greater sexual activity and less impairment are highly associated with younger age and being in a relationship, but the Boston general population study did not provide information on activity and impairment by marital status and age. In the current study, 77% of women were ≥50 years of age compared to 42% in the Boston study. On the other hand, 69% in the SSc sample were married versus 45% in the Boston general population sample.

Our finding that higher skin scores are associated with increased likelihood of sexual impairment is similar to Bhadauria et al.'s finding that skin tightness is adversely related to sexual relations [10]. It is not surprising that pain was robustly linked to sexual impairment as many studies of patients with arthritis and other chronic pain conditions have found that pain is strongly associated with reduced sexual function [36-39]. Similarly, other studies of patients with SSc have identified specific sources of pain associated with sexual impairment in bivariate analyses, including vaginal pain, joint pain, skin pain, gastrointestinal pain and pain from Raynaud`s phenomenon [10,11,15]. We found that although many sources of pain may influence sexual function, vaginal pain most clearly distinguished women with and without impairment.

Several authors have suggested steps that women with SSc can take that may reduce their pain and discomfort during sexual activity [10,16,17]. For instance, the use of a water-based lubricant may be useful to reduce vaginal dryness and dyspareunia [10-12,15-17]. Remaining partly clothed, using extra blankets and adjusting room temperature may help to keep warm and

reduce the likelihood of a Raynaud's episode [14,16]. A warm bath before sexual activities, attempting alternative sexual positions, and using pillows may reduce the effects of painful joints [10,12,14,16]. In addition, anti-inflammatory drugs and muscle relaxants may help with muscle and joint pain [12,16]. Eating small meals and/or avoiding eating right before sexual activity may be helpful for patients with gastrointestinal problems [14,16]. Good communication during sexual activity has also been emphasized so that partners are aware of what is pleasurable and painful [16]. It is also possible that sexual function could be improved through range of motion exercises to reduce joint pain and stiffness prior to sexual activity, massage or exercises to lessen mouth tightening and improve mouth function, and massage or gentle manual stretching to lessen vaginal tightness. The degree to which these suggestions are effective in reducing barriers to sexual activity and enhancing the sexual experience of women with SSc, however, has not been tested.

There are a number of limitations that should be considered in interpreting the results of our study. First, it was cross-sectional and conducted with a convenience sample of patients enrolled in the CSRG Registry. Patients with very severe SSc who were too sick to participate, as well as those who may have died earlier in their disease course, are not enrolled in the Registry, which may result in an over-representation of healthier patients. Although approximately 80% of approached patients enroll in the Registry, data on patients who do not participate are not available.

We do not know to what degree having sexual problems may have influenced whether or not women in our sample were in relationships. In addition, 32% of sexually inactive patients indicated having other health problems, and most were taking medications. However, the questions in the survey did not provide us with any information to assess the relationship

between these variables and sexual activity and impairment. A limitation shared by this study and other studies that have used similar methodology [21] is that women may have been classified inactive due to the unavailability of a partner, for reasons such as absence during the specified time period or a medical condition. Furthermore, we did not assess sexual orientation in our study, although the questions that were asked would apply across sexual orientations.

Another limitation is that no previous studies have used the 9-item version of the FSFI, and no specific validation has been done with the 9-item version. Similarly, the checklist used to gather information on source of pain, including vaginal pain, was a self-report checklist designed for SSc that has not been specifically validated. It is possible that women without SSc of a similar age would also endorse a significant number of these symptoms, but the degree to which this is the case is not known. Measures of GI symptoms, Raynaud's phenomenon and severity of breathing problems were patient-reported; therefore it is possible that there was some misclassification within these measures.

In terms of comparison samples, although there is published literature on a general population sample [21], there are limitations in comparing these rates to our SSc sample. Marital status and age are the most prominent predictors of rates of activity and impairment; the weighted sampling from the population study did not allow direct comparisons by age and marital status with women from our study. Finally, we did not examine the effects of potential mediators, such as body image, fatigue, or relationship dissatisfaction, that may link disease symptoms with sexual activity and impairment in SSc. For instance, reduced sexual function has been associated with pain and body image dissatisfaction [13] as well as martial dissatisfaction [11]. Future research should build upon this study and examine potential mediators of sexual activity and impairment.

In summary, many female SSc patients in relationships are sexually active, although few are active without significant problems. GI symptoms and Raynaud's symptoms were independently associated with decreased sexual activity, while breathing problems and higher skin scores were independently associated with sexual impairment. Age was independently associated with both decreased sexual activity and increased sexual impairment. Rates of pain were high among SSc patients, and sexually impaired patients were significantly more likely to report any sources of pain, and, most prominently, vaginal pain. Research is needed to determine the extent of activity and impairment in SSc compared to women without SSc and to evaluate strategies that have been recommended to improve sexual functioning in women with SSc.

REFERENCES

1. Seibold J, Harris ED, Budd RC, Genovese MC, Sergent JS, Sledge CB. Kelley's textbook of rheumatology. Philadelphia, Elsevier, 2005.
2. Mayes MD, Lacey JV, Jr., Beebe-Dimmer J, *et al.* Prevalence, incidence, survival, and disease characteristics of systemic sclerosis in a large US population. Arthritis Rheum 2003; 48:2246-55.
3. Thombs BD, Taillefer SS, Hudson M, Baron M. Depression in patients with systemic sclerosis: A systematic review of the evidence. Arthritis Rheum 2007; 57:1089-97.
4. Schieir O, Thombs BD, Hudson M, *et al.* Prevalence, severity, and clinical correlates of pain in patients with systemic sclerosis. Arthritis Care Res 2010; 62:409-17.
5. Thombs BD, Hudson M, Bassel M, *et al*. Sociodemographic, disease, and symptom correlates of fatigue in systemic sclerosis: evidence from a sample of 659 Canadian Scleroderma Research Group Registry patients. Arthritis Rheum 2009; 61:966-73.
6. Jewett LR, Hudson M, Haythornthwaite JA, *et al.* Development and validation of the Brief-Satisfaction With Appearance scale for systemic sclerosis. Arthritis Care Res 2010; 62:1779-86.
7. Razykov I, Thombs BD, Hudson M, Bassel M, Baron M. Prevalence and clinical correlates of pruritus in patients with systemic sclerosis. Arthritis Rheum 2009; 61:1765-70.
8. 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 2010; 62:1181-9

9. Nusbaum MR, Hamilton C, Lenahan P. Chronic illness and sexual functioning. Am Fam Physician 2003; 67:347-54.

10. Bhadauria S, Moser DK, Clements PJ, *et al.* Genital tract abnormalities and female sexual function impairment in systemic sclerosis. Am J Obstet Gynecol 1995; 172:580-7.

11. Schouffoer AA, van der Marel J, Ter Kuile MM, *et al.* Impaired sexual function in women with systemic sclerosis: A cross-sectional study. Arthritis Rheum 2009; 61:1601-8.

12. Anderson E, Triplett LM, Nietert PJ, Brown AN. Sexual function among women with connective tissue disease. Curr Rheumatol Rev 2009; 5:126-32.

13. Knafo R, Haythornthwaite JA, Heinberg L, Wigley FM, Thombs BD. The association of body image dissatisfaction and pain with reduced sexual function in women with systemic sclerosis. Rheumatology 2011; 50:1125-30.

14. Knafo R, Thombs BD, Jewett L, Hudson M, Wigley F, Haythornthwaite JA. (Not) talking about sex: A systematic comparison of sexual impairment in women with systemic sclerosis and other chronic disease samples. Rheumatology 2009; 48:1300-3.

15. Impens AJ, Rothman J, Schiopu E, *et al.* Sexual activity and functioning in female scleroderma patients. Clin Exp Rheumatol 2009; 27:38-43.

16. Saad SC, Behrendt AE. Scleroderma and sexuality. J Sex Res 1996; 33:215-20.

17. Saad SC, Pietrzykowski JE, Lewis SS, *et al.* Vaginal lubrication in women with scleroderma and Sjogren's syndrome. Sex Disabil 1999; 17:103-13.

18. Sampaio-Barros PD, Samara AM, Marques Neto JF. Gynaecologic history in systemic sclerosis. Clin Rheumatol 2000; 19:184-7.

19. Schover LR, Jensen SR. Sexuality and chronic illness: A comprehensive approach. New York, Guilford, 1988.

20. Meyer-Bahlburg HF, Dolezal C. The Female Sexual Function Index: A methodological critique and suggestions for improvement. J Sex Marital Ther 2007; 33:217-24.

21. Lutfey KE, Link CL, Rosen RC, Wiegel M, McKinlay JB. Prevalence and correlates of sexual activity and function in women: Results from the Boston Area Community Health (BACH) survey. Arch Sex Behav 2009; 38:514-27.

22. Rosen R, Brown C, Heiman J, *et al.* The Female Sexual Function Index (FSFI): A multidimensional self-report instrument for the assessment of female sexual function. J Sex Marital Ther 2000; 26:191-208.

23. Meston CM, Derogatis LR. Validated instruments for assessing female sexual function. J Sex Marital Ther 2002; 28 Suppl 1:155-64.

24. Meston CM. Validation of the Female Sexual Function Index (FSFI) in women with female orgasmic disorder and in women with hypoactive sexual desire disorder. J Sex Marital Ther 2003; 29:39-46.

25. Wiegel M, Meston C, Rosen R. The Female Sexual Function Index (FSFI): Cross-validation and development of clinical cutoff scores. J Sex Marital Ther 2005; 31:1-20.

26. Health Canada. Canadian guidelines for body weight classification in adults. Ottawa, 2003

27. Clements P, Lachenbruch P, Siebold J, *et al.* Inter and intraobserver variability of total skin thickness score (modified Rodnan TSS) in systemic sclerosis. J Rheumatol 1995; 22:1281-5.

28. LeRoy EC, Black C, Fleischmajer R, *et al.* Scleroderma (systemic sclerosis): Classification, subsets and pathogenesis. J Rheumatol 1988; 15:202-5.

29. Medsger TA, Jr., Silman AJ, Steen VD, *et al.* A disease severity scale for systemic sclerosis: Development and testing. J Rheumatol 1999; 26:2159-67.

30. Steen VD, Medsger TA, Jr. The value of the Health Assessment Questionnaire and special patient-generated scales to demonstrate change in systemic sclerosis patients over time. Arthritis Rheum 1997; 40:1984-91.

31. Jensen MP, Karoly P, Braver S. The measurement of clinical pain intensity: A comparison of six methods. Pain 1986; 27:117-26.

32. Hsu VM, Moreyra AE, Wilson AC, *et al.* Assessment of pulmonary arterial hypertension in patients with systemic sclerosis: Comparison of noninvasive tests with results of right-heart catheterization. J Rheumatol 2008; 35:458-65.

33. Vittinghoff E, McCulloch CE. Relaxing the rule of ten events per variable in logistic and Cox regression. Am J Epidemiol 2007; 165:710-8.

34. Hosmer DW, Lemeshow S. Applied logistic regression, 2nd ed. New York John Wiley & Sons, 2000.

35. Hochberg Y. A sharper Bonferroni procedure for multiple tests of significance. Biometrika 1988; 75:800-3.

36. Hill J, Bird H, Thorpe R. Effects of rheumatoid arthritis on sexual activity and relationships. Rheumatology 2003; 42:280-6.

37. Ryan SJ, Dawes PT, Mayer B. Does inflammatory arthritis affect sexuality? Br J Rheumatol 1996; 35(Suppl. 2):19.

38. Kwan KS, Roberts LJ, Swalm DM. Sexual dysfunction and chronic pain: The role of psychological variables and impact on quality of life. Eur J Pain 2005; 9:643-52.

39. Ambler N, Williams AC, Hill P, Gunary R, Cratchley G. Sexual difficulties of chronic pain patients. Clin J Pain 2001; 17:138-45.

Table 1. Rates of sexual activity without impairment by age group and marital status

	N	N (%) Active	N (%) Not Impaired among Active	N (%) Active without Impairment
Age Group				
18-39	25	13 (52)	7 (54)	7 (28)
40-49	103	67 (65)	39 (58)	39 (38)
50-59	171	81 (47)	27 (33)	27 (16)
≥ 60	248	65 (26)	22 (34)	22 (9)
Marital Status[1]				
Married	373	189 (51)	75 (40)	75 (20)
Not Married	167	33 (20)	18 (55)	18 (11)
Total	547	226 (41)	95 (42)	95 (17)

[1] 7 patients did not report marital status.

Table 2. Descriptive statistics for women with systemic sclerosis in relationships who report sexual activity in last 4 weeks and who report being sexually inactive due to systemic sclerosis

Variable	Overall N=237	Active N=174(73%)	Inactive Due to Systemic Sclerosis N=63 (27%)
Age group			
18-39, *n (% in row)*	7	5 (71)	2 (29)
40-49, *n (% in row)*	52	45 (86)	7 (14)
50-59, *n (% in row)*	92	67 (73)	25 (27)
≥ 60, *n (% in row)*	86	57 (66)	29 (34)
Marital status (N=236)			
Married, *n (% in row)*	219	158 (72)	61 (28)
Not married, *n (% in row)*	17	15 (88)	2 (12)
Race/Ethnicity (N=228)			
White, *n (% in row)*	211	156 (74)	55 (26)
Non-White, *n (% in row)*	17	12 (71)	5 (29)
Alcohol consumption (N=236)			
None, *n (% in row)*	110	69 (63)	41 (37)
< 1 drink per day, *n (% in row)*	96	77 (80)	19 (20)
≥ 1 drinks per day, *n (% in row)*	30	28 (93)	2 (7)

Smoking status			
Never, *n (% in row)*	111	82 (74)	29 (26)
Former, *n (% in row)*	105	78 (74)	27 (26)
Current, *n (% in row)*	21	14 (67)	7 (33)
Body mass index			
< 25, *n (% in row)*	122	100 (82)	22 (18)
25-29.9, *n (% in row)*	71	49 (69)	22 (31)
≥ 30, *n (% in row)*	44	25 (57)	19 (43)
Disease classification (N=225)			
Limited, *n (% in row)*	149	107 (72)	42 (28)
Diffuse, *n (% in row)*	76	56 (74)	20 (26)
Skin scores, *mean (SD)*	8.43 (8.0)	7.80 (7.4)	10.19 (9.2)
Disease duration (years) (N=233), *mean (SD)*	9.86 (8.8)	9.93 (9.0)	9.64 (8.4)
Fingertip-to-palm distance, *mean (SD)*	0.98 (1.8)	0.89 (1.6)	1.23 (2.1)
Hemoglobin (g/L), *mean (SD)*	126.90 (12.9)	127.78 (11.9)	124.48 (15.2)
Severity of gastrointestinal symptoms, *mean (SD)*	1.71 (2.3)	1.24 (1.9)	3.00 (2.9)
Pulmonary hypertension (N=210)			
No, *n (% in row)*	190	151 (80)	39 (20)
Yes, *n (% in row)*	20	9 (45)	11 (55)
Interstitial lung disease			

No, *n (% in row)*	162	124 (76)	38 (24)
Yes, *n (% in row)*	75	50 (67)	25 (33)
Finger ulcers			
No, *n (% in row)*	108	82 (76)	26 (24)
Yes, *n (% in row)*	129	92 (71)	37 (29)
Severity of Raynaud's symptoms, *mean (SD)*	3.13 (2.9)	2.55 (2.6)	4.71 (3.3)
Severity of breathing problems, *mean (SD)*	1.89 (2.6)	1.47 (2.3)	3.03 (2.9)
Menopause status (N=231)			
No, *n (% in row)*	163	119 (73)	44 (27)
Yes, *n (% in row)*	68	52 (76)	16 (24)

Table 3. Unadjusted and adjusted odds ratios for reporting sexual relations with a partner in the last four weeks (N=237)

Variable	Unadjusted Odds Ratio	95% Confidence Interval	*P* Value	Adjusted Odds Ratio	95% Confidence Interval	*P* Value
Age group						
18-39	0.39	0.06-2.41	0.310	0.25	0.03-1.97	0.190
40-49	1.00	Reference	-------	1.00	Reference	-------
50-59	0.42	0.17-1.05	0.062	0.24	0.08-0.73	0.012
≥ 60	0.31	0.12-0.76	0.011	0.12	0.04-0.37	<0.001
Not married	2.90	0.64-13.04	0.166			
Non-White race/ethnicity	0.85	0.29-2.51	0.763			
Alcohol consumption						
None	1.00	Reference	-------			
< 1 drink per day	2.41	1.28-4.54	0.007			
≥ 1 drinks per day	8.32	1.88-36.75	0.005			
Smoking status						
Never	1.00	Reference	-------			
Former	1.02	0.56-1.88	0.945			
Current	0.71	0.26-1.93	0.498			
Body mass index						
< 25	1.00	Reference	-------			

25-29.9	0.49	0.25-0.97	0.041			
≥ 30	0.29	0.14-0.62	0.001			
Skin scores	0.97	0.93-1.00	0.045	0.98	0.94-1.03	0.382
Disease duration (years)	1.00	0.97-1.04	0.827			
Fingertip-to-palm distance	0.90	0.77-1.05	0.191	0.89	0.73-1.09	0.268
Hemoglobin (g/L)	1.02	1.00-1.04	0.083	1.01	0.99-1.04	0.336
Severity of gastrointestinal symptoms	0.74	0.65-0.84	<0.001	0.80	0.69-0.94	0.005
Pulmonary hypertension	0.21	0.08-0.55	0.001			
Interstitial lung disease	0.61	0.34-1.12	0.111	0.81	0.39-1.67	0.569
Finger ulcers	0.79	0.44-1.41	0.424			
Severity of Raynaud's symptoms	0.78	0.71-0.87	<0.001	0.82	0.72-0.93	0.003
Severity of breathing problems	0.81	0.72-0.90	<0.001	0.95	0.82-1.09	0.450
Menopause	1.20	0.62-2.32	0.584			

Table 4. Descriptive statistics for women with systemic sclerosis in relationships who are sexually active classified as sexually impaired (FSFI ≤ 22.5) versus not impaired (FSFI > 22.5)

Variable	Overall N=165	Not impaired N=63 (38%)	Sexually impaired N=102 (62%)
Age group			
18-39, *n (% in row)*	5	2 (40)	3 (60)
40-49, *n (% in row)*	45	24 (53)	21 (47)
50-59, *n (% in row)*	63	20 (32)	43 (68)
≥ 60, *n (% in row)*	52	17 (33)	35 (67)
Marital status (N=164)			
Married, *n (% in row)*	149	55 (37)	94 (63)
Not married, *n (% in row)*	15	8 (53)	7 (47)
Race/Ethnicity (N=159)			
White, *n (% in row)*	147	58 (40)	89 (60)
Non-White, *n (% in row)*	12	4 (33)	8 (67)
Alcohol consumption			
None, *n (% in row)*	65	27 (42)	38 (58)
< 1 drink per day, *n (% in row)*	73	22 (30)	51 (70)
≥ 1 drinks per day, *n (% in row)*	27	14 (52)	13 (48)
Smoking status			
Never, *n (% in row)*	79	29 (37)	50 (63)

Former, *n (% in row)*	74	30 (40)	44 (60)
Current, *n (% in row)*	12	4 (33)	8 (67)
Body mass index			
< 25, *n (% in row)*	95	35 (37)	60 (63)
25-29.9, *n (% in row)*	46	18 (39)	28 (61)
≥ 30, *n (% in row)*	24	10 (42)	14 (58)
Disease classification (N=155)			
Limited, *n (% in row)*	102	39 (38)	63 (62)
Diffuse, *n (% in row)*	53	17 (32)	36 (68)
Skin scores, *mean (SD)*	7.76 (7.4)	6.24 (5.5)	8.71 (8.3)
Disease duration (years) (N=163), *mean (SD)*	9.82 (8.7)	8.58 (7.7)	10.56 (9.2)
Fingertip-to-palm distance, *mean (SD)*	0.88 (1.6)	0.74 (1.7)	0.97 (1.6)
Hemoglobin (g/L), *mean (SD)*	127.87 (12.0)	127.86 (11.5)	127.88 (12.4)
Severity of gastrointestinal symptoms, *mean (SD)*	1.20 (1.9)	1.11 (1.8)	1.25 (2.0)
Pulmonary hypertension (N=153)			
No, *n (% in row)*	145	53 (37)	92 (63)
Yes, *n (% in row)*	8	5 (50)	4 (50)
Interstitial lung disease			
No, *n (% in row)*	117	44 (38)	73 (62)
Yes, *n (% in row)*	48	19 (40)	29 (60)
Finger ulcers			

No, *n (% in row)*	79	33 (42)	46 (58)
Yes , *n (% in row)*	86	30 (35)	56 (65)
Severity of Raynaud's symptoms, *mean (SD)*	2.41 (2.5)	2.33 (2.5)	2.46 (2.5)
Severity of breathing problems; mean (SD)	1.37 (2.2)	0.87 (2.1)	1.68 (2.3)
Menopause status (N=162)			
No, *n (% in row)*	112	45 (40)	67 (60)
Yes, *n (% in row)*	50	17 (34)	33 (66)

Table 5. Unadjusted and adjusted odds ratios for being sexually impaired (FSFI ≤ 22.5) (N=165)

Variable	Unadjusted Odds Ratio	95% Confidence Interval	*P Value*	Adjusted Odds Ratio	95% Confidence Interval	*P Value*
Age group						
18-39	1.71	0.26-11.26	0.575	1.86	0.24-14.22	0.550
40-49	1.00	Reference	-------	1.00	Reference	-------
50-59	2.46	1.12-5.42	0.026	3.02	1.25-7.26	0.014
60+	2.35	1.03-5.36	0.042	3.28	1.26-8.53	0.015
Not married	0.51	0.18-1.49	0.219			
Non-White race/Ethnicity	1.30	0.38-4.53	0.677			
Alcohol consumption						
None	1.00	Reference	-------			
<1 drink/day	1.64	0.82-3.33	0.164			
1+ drinks/day	0.66	0.27-1.63	0.366			
Smoking status						
Never	1.00	Reference	-------			
Former	0.85	0.44-1.63	0.627			
Current	1.16	0.32-4.19	0.821			
Body mass index						
<25	1.00	Reference	-------			
25-30	0.91	0.44-1.87	0.793			

≥30	0.82	0.33-2.03	0.663			
Skin scores	1.05	1.00-1.10	0.042	1.06	1.00-1.13	0.039
Disease duration (years)	1.03	0.99-1.07	0.160			
Fingertip-to-palm distance	1.10	0.89-1.34	0.384	1.10	0.87-1.40	0.434
Hemoglobin (g/L)	1.00	0.97-1.03	0.990	1.00	0.97-1.03	0.938
Severity of gastrointestinal symptoms	1.04	0.88-1.24	0.632	1.00	0.82-1.25	0.947
Pulmonary hypertension	0.576	0.14-2.40	0.449			
Interstitial lung disease	0.920	0.46-1.83	0.812	0.610	0.28-1.33	0.212
Finger ulcers	1.339	0.71-2.51	0.363			
Severity of Raynaud's symptoms	1.022	0.90-1.16	0.746	0.957	0.81-1.13	0.605
Severity of breathing problems	1.209	1.02-1.44	0.031	1.273	1.04-1.56	0.018
Menopause	1.304	0.65-2.62	0.455			

Table 6. Sources of pain reported by sexually active patients

Variable	Overall	Not Impaired	Sexually impaired	Significance *P* value
During Sex	**N=165**	**N=63**	**N=102**	
Finger or hand pain, *n (% in column)*	23	3 (5)	20 (20)	0.007[1]
Back pain, *n (% in column)*	18	4 (6)	14 (14)	0.140[1]
Vaginal pain, *n (% in column)*	65	7 (11)	58 (57)	<0.001[2]
Muscle pain, *n (% in column)*	27	5 (8)	22 (22)	0.021[1]
Joint pain, *n (% in column)*	35	11 (17)	24 (24)	0.354[1]
Skin tightening, *n (% in column)*	9	0 (0)	9 (9)	0.014[1]
Skin pain or sensitivity, *n (% in column)*	13	1 (2)	12 (12)	0.018[1]
Skin ulcers, *n (% in column)*	7	2 (3)	5 (5)	0.709[1]
Raynaud's symptoms, *n (% in column)*	10	1 (2)	9 (9)	0.091[1]
Other, *n (% in column)*	8	1 (2)	7 (7)	0.156[1]
Any pain, *n (% in column)*	103	24 (38)	79 (77)	<0.001[3]
After sex	**N=164**	**N=62**	**N=102**	
Finger or hand pain, *n (% in column)*	15	1 (2)	14 (14)	0.008[1]
Back pain, *n (% in column)*	14	3 (5)	11 (11)	0.172[1]
Vaginal pain, *n (% in column)*	27	1 (2)	26 (25)	<0.001[2]
Muscle pain, *n (% in column)*	16	4 (6)	12 (12)	0.246[1]
Joint pain, *n (% in column)*	20	4 (6)	16 (16)	0.071[1]
Skin tightening, *n (% in column)*	7	0 (0)	7 (7)	0.044[1]

Skin pain or sensitivity, *n (% in column)*	7	1 (2)	6 (6)	0.252[1]
Skin ulcers, *n (% in column)*	3	1 (2)	2 (2)	1.00[1]
Raynaud's symptoms, *n (% in column)*	7	1 (2)	6 (6)	0.252[1]
Other, *n (% in column)*	2	0 (0)	2 (2)	0.524[1]
Any pain, *n (% in column)*	62	11 (18)	51 (50)	<0.001[3]

[1] Not statistically significant, controlling for multiple comparisons using Hochberg's sequential method.
[2] Statistically significant, controlling for multiple comparisons using Hochberg's sequential method.
[3] Statistically significant, no adjustment for multiple comparisons.

Figure 1. Flow of patients through study