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Patterns of Hospital Admissions and Emergency Room Visits Among Patients with Scleroderma in South Carolina, USA

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ABSTRACT. ***Objective.*** Little research has examined patterns of hospitalization and use of emergency rooms (ER) among patients with systemic sclerosis (SSc). We compared the incidence of hospitalizations and ER visits across 3 race groups (non-Hispanic white, non-Hispanic black, other) and determined predictors of referral to the Medical University of South Carolina (MUSC), a major referral center for patients with SSc residing in the southeastern United States.

Methods. Data were obtained on all South Carolina hospitalizations (1996–2000) for patients who were ever hospitalized for a diagnosis of SSc during that time period. Hospitalization and ER incidence rates were determined in conjunction with corresponding population sizes obtained from the 2000 US Census, and rates were compared across race, sex, and age groups using Poisson regression models. Logistic regression was used to determine predictors of being treated at MUSC.

Results. The hospitalization incidence rate was significantly ($p < 0.05$) higher among blacks compared to whites (rate ratio 1.66; 95% confidence interval 1.41, 1.96), as was the ER incidence rate (rate ratio 1.78; 95% CI 1.50, 2.11). Even after adjusting for sex, age, median household income, primary insurance claim payor, county, and comorbidity, blacks were 60% less likely ($p < 0.05$) than whites to receive inpatient treatment at MUSC. Similar results were observed when comparing other non-whites to whites.

Conclusion. The increased hospitalizations and ER visits among non-whites provide additional evidence of greater disease burden among these population groups. Despite this increased burden, non-whites are less likely to receive care at a major SSc referral center. (J Rheumatol 2003;30:1238–43)

Key Indexing Terms:
SYSTEMIC SCLERODERMA HEALTH SERVICES RESEARCH HOSPITALIZATION
HOSPITAL EMERGENCY SERVICE SOCIOECONOMIC FACTORS

Systemic sclerosis (SSc, scleroderma) is a rare connective tissue disease most commonly characterized by skin thickening caused by an abnormal fibrosing process, affecting a wide variety of organ systems, including the lungs, esophagus and other portions of the gastrointestinal tract, kidneys, heart, and digital blood vessels. While some research has indicated greater disease burden and severity among blacks with SSc[1-5], little research has focused on healthcare utilization by patients with SSc, or whether there are disparities in health services between whites and non-whites with SSc.

Previously, we reported through an analysis of data from the 1995 Healthcare Cost and Utilization Project (HCUP) that several types of racial disparities exist on a national level among hospitalized patients with SSc, including significant differences in length of hospital stay, in age at admission, and in the rate at which hospitalizations occur in relation to the size of the population[6]. Admissions by patients with SSc were selected by searching the *International Classification of Diseases*, 9th edition, Clinical Management[7] (ICD9-CM) codes recorded in the dataset for each admission. As noted in that report, however, analyses of HCUP data may have certain inherent limitations, most importantly that no unique patient identification number is available. Because of this limitation, one cannot distinguish whether the hospital admissions of interest are repeat hospitalizations by the same patient. In addition, other admissions by the selected patients may be missed if an ICD9-CM code for SSc was not recorded. For example, a scleroderma patient hospitalized due to an injury sustained in an automobile accident may not have a diagnosis of scleroderma recorded in his/her medical record.

We build here on our previous work by examination of administrative hospitalization and emergency room data that are available in South Carolina (SC) for research purposes.

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The SC Office of Research and Statistics (ORS) compiles data from every hospital admission and each emergency room (ER) visit in SC (with the exception of federal and military hospitals), and these data are available to researchers that have proposals approved through the ORS data oversight committee. Using patient identifiers (e.g., name, social security number, date of birth, race, sex), ORS links multiple inpatient and/or ER encounters by the same patient by assigning a unique identification number to each patient and including this number on each inpatient and ER record in the datasets provided to researchers. To protect patients' identities, the personal information is not available to the researchers; however, the unique identification numbers are. Using the data provided by ORS, we investigated whether racial disparities exist among South Carolina patients with SSc with respect to the incidence of hospital admissions and ER visits.

An additional goal of the study was to examine referral patterns to our institution, the Medical University of South Carolina (MUSC). MUSC has a tradition of research and treatment of SSc, and many patients in SC and surrounding states are referred to MUSC for outpatient and inpatient treatment. Internal records within MUSC indicate that 367 patients with newly diagnosed SSc were evaluated from November 1997 through September 2002, with 103 of those patients seen in the last year. In addition, of the 355 inpatient admissions at MUSC studied in these analyses, 54.9% were by patients not residing in the 3 counties surrounding MUSC. There are several such institutions in the US that have gained recognition for treating SSc, and determining whether racial disparities exist in access to such referral centers might help explain the previously outlined disparities.

MATERIALS AND METHODS

After this study was approved by the MUSC Institutional Review Board and by the ORS data oversight committee, the ORS hospitalization and ER databases were searched for all encounters from 1996 to 2000 in which a diagnosis of SSc was documented, using the ICD9-CM code 710.1. ORS-assigned personal identification numbers were obtained for each of these encounters, and then the databases were searched again for all hospital and ER encounters by these patients, regardless of whether or not a diagnosis of SSc was listed. Thus, barring errors in diagnostic coding, any person with SSc who had had a hospital or ER encounter in SC during 1996 through 2000 was identified through this process, as were all hospitalizations and ER visits by those persons. Data obtained from the databases included demographics (age, sex, race), zip code, primary payor [private insurance; public insurance (Medicare, Medicaid, other government insurance); other], admission type (emergency, urgent, elective) and source (e.g., physician/clinic referral, transfer from another hospital), amount and type of charges, an indicator of in-hospital mortality, up to 3 physician specialty codes listed for treating physicians, total length of stay (LOS) and intensive care unit LOS (if applicable), procedure codes, a facility indicator of whether or not the treatment facility was MUSC, and injury code (if applicable). For each SC county, ORS also provided the percentage of hospitalizations for residents of that county that occurred outside the county of interest. Median household income, based upon 1990 US Census estimates and inflated to 2001 dollars using an employment cost index based on estimates provided by US Bureau of Labor Statistics, was linked to the patient data via the patient's zip code.

For each admission and ER visit, patients were classified using a modified version of Elixhauser's method[8] to indicate the presence of certain comorbid conditions, including congestive heart failure (CHF), cardiac arrhythmia (ARR), systemic hypertension (HTN), secondary pulmonary hypertension (SPH), pulmonary fibrosis (PF), and renal failure (RF). These conditions are common complications of SSc and are reflective of disease severity.

Demographic and clinical characteristics of the cohort of unique patients identified were compared across 3 race groups (non-Hispanic whites, non-Hispanic blacks, and other race classifications). The distribution of the characteristics was compared using chi-square tests and nonparametric tests, as appropriate. Since some patients had more than one admission and/or ER visit, the clinical characteristics used in the comparisons were obtained from the first admission or ER visit, depending on which type of characteristic was being examined.

Hospitalization and ER incidence rates were determined for each of 6 race/sex groups (non-Hispanic white males, non-Hispanic white females, non-Hispanic black males, and non-Hispanic black females, 'other' males, and 'other' females) stratified by 4 age groups (0–34 yrs, 35–49, 50–64, and $\geq$ 65, based upon age at admission). Other race categories made up only 8.9% of the entire population of SSc patients identified and were thus not addressed in some of the stratified analyses. These rates were defined as the number of hospitalizations (or ER visits) by unique patients divided by the 2000 US Census estimates of the total size of the population of interest. Poisson regression models were used to compare these rates across race (white and black only) and sex groups, while adjusting for age at admission.

Two logistic regression models were also developed to determine factors that are associated with receiving inpatient treatment at MUSC. For our purposes, patients receiving treatment at MUSC will be said to have been referred to MUSC. The unit of analysis was the patient's first hospital admission within the 5 year time period. Admissions by patients residing in the tri-county region surrounding MUSC were excluded from this analysis, as MUSC might have been the hospital of choice for these patients simply for proximity. Characteristics of the remaining patients were examined to determine the likelihood of receiving treatment at MUSC. In the first model, the variables included were patient race, sex, comorbid conditions, and county classification. The second model was identical to the first, with the exception of the addition of median household income and primary payor. These models were compared against one another to examine the extent to which any perceived differences across race could be explained by differences in socioeconomic factors. For these models, a patient's county of residence was classified into one of 4 categories, including counties outside SC, counties in SC in which over 10% of all hospitalizations occur in Georgia, counties in SC in which over 10% of all hospitalizations occur in North Carolina, and all other counties. Data on the percentage of hospitalizations occurring outside SC were obtained from one of the ORS web pages [http://www.drss.state.sc.us/hd/outmigration.html].

RESULTS

From January 1996 to December 2000, there were 2574 admissions to SC hospitals and 4402 ER visits by this cohort of 785 scleroderma patients. Table 1 lists several demographic and clinical characteristics of this cohort and compares these characteristics by race. Black patients were significantly younger and had significantly lower incomes, on average, than patients whose race was classified as white or other. Among patients with hospital admissions, whites and blacks averaged significantly fewer hospitalizations than those of other races. Blacks were significantly more

Table 1. Demographic and clinical characteristics* of patients with SSc with a hospitalization or emergency room visit in SC from 1996 to 2000.

Characteristics	All Patients, n = 785	Race Group White, n = 451	Black, n = 266	Other, n = 68	p
Sex, female, %	81.8	83.6	79.2	80.0	NS
Age group, yrs					
0–34	10.3	8.0	15.3	7.7	< 0.0001
35–49	23.3	17.1	34.9	21.5	
50–64	31.5	30.9	30.6	38.5	
≥ 65	34.9	44.0	19.2	32.3	
Household income †, median (interquartile range), $US	37, 759 (32,090–44,822)	40, 236 (33,274–46,638)	35, 123 (30,326–41,798)	33, 675 (30,895–44,149)	< 0.0001
Hospitalizations					
No. of unique patients with admission	727	427	235	65	NA
No. of admissions	2574	1441	792	341	NA
Admissions per unique patient	3.5	3.4	3.4	5.2	< 0.001
Admission type, %					
Emergency	52.1	48.5	59.2	50.8	< 0.05
Urgent	27.4	28.8	22.6	35.4	
Elective	20.5	22.7	18.3	13.9	
Primary payor, %					
Private	34.1	37.9	29.8	24.6	< 0.0001
Public					
Medicare	49.4	54.3	38.7	55.4	
Medicaid	10.0	3.5	22.6	7.7	
Other government sponsored	0.8	0.9	0.9	0.0	
Other	5.6	3.3	8.1	12.3	
Comorbidities present, %					
Congestive heart failure	12.0	10.5	13.2	16.9	NS
Cardiac arrhythmia	10.0	12.7	6.8	4.6	< 0.05
Systemic hypertension	28.3	26.2	32.3	27.7	NS
Secondary pulmonary hypertension	8.1	8.0	6.8	13.9	NS
Pulmonary fibrosis	12.0	11.5	10.6	20.0	NS
Renal failure	5.0	4.7	5.1	6.2	NS
ER visits					
No. of unique patients with ER visit	662	368	229	65	N/A
No. of ER visits	4402	2176	1531	695	N/A
ER visits per unique patient	6.6	5.9	6.7	10.7	< 0.001
Primary payor (%)					
Private	33.1	37.8	29.7	18.5	< 0.0001
Public					
Medicare	48.2	52.5	37.6	61.5	
Medicaid	10.1	2.5	23.6	6.2	
Other government sponsored	0.9	1.4	0.4	0.0	
Other	7.7	6.0	8.7	13.9	

* Clinical characteristics are based on patients' first hospitalization or ER visit, as appropriate. † Median household income was derived from zip code data obtained from the 1990 US Census and inflated to 2001 dollars using an employment cost index based on estimates obtained from the US Bureau of Labor Statistics.

likely than whites or other-race patients to have admissions classified as emergencies. Cardiac arrhythmia was significantly more likely to be listed as a diagnosis among whites. Of these patients, 13.6% were treated at MUSC, 1.5% were transfers from another hospital, and 3.2% died while in the hospital. Only 3.2% were treated by a rheumatologist. The median length of stay was 4 days, and the median charges were $8,300, with an interquartile range of $4,800 to $15,000. Of the 2501 admissions by patients residing within SC, 431 (17.2%) were by patients residing in the tri-county area surrounding Charleston.

Among patients with at least one ER visit, whites and blacks had significantly fewer ER visits, on average, than those of other races. Whites were significantly more likely to have a gastrointestinal-related ER procedure (15.8%) compared to blacks (7.4%) and other non-whites (7.7%), while whites and blacks were significantly less likely to have a musculoskeletal-related ER procedure (whites 4.9%; blacks 2.2%) than those whose race was classified as 'other' (13.9%). Of the overall group of patients who made an ER visit, 15.0% were treated at MUSC, and 6.3% of the ER patients had injuries reported. The percentage of ER patients

receiving procedures that were classified as cardiac (2.1%), gynecological (1.5%), neurological (1.5%), pulmonary (3.0%), renal (2.7%), surgical (3.5%), and vascular (5.0%) was not significantly different across the racial groups.

The hospitalization and ER incidence rates for patients residing in SC are summarized in Table 2. The most notable racial disparities occurred in the younger age groups. Results from the Poisson regression modeling indicated that after adjusting for age the hospitalization incidence rate was significantly ($p < 0.001$) higher for females compared to males (OR 3.84, 95% confidence interval 3.13, 4.72) and for blacks compared to whites (OR 1.66, 95% CI 1.41, 1.96). The modeling also indicated that ER visit incidence rate was significantly ($p < 0.001$) higher for females compared to males (OR 4.28, 95% CI 3.43, 5.35) and for blacks compared to whites (OR 1.78, 95% CI 1.50, 2.11).

The logistic regression models predicting being treated at MUSC are summarized in Table 3. In the first model, which excluded income and primary payor, significant predictors included race, sex, age group, county classification, having a diagnosis of congestive heart failure, and having a diagnosis of secondary pulmonary hypertension. Compared to white patients, the likelihood of being referred was 60% lower in blacks ($p < 0.05$) and 70% lower in other race classifications (although not statistically significant). The likelihood of referral was significantly ($p < 0.05$) greater among males compared with females, and significantly ($p < 0.05$) less likely in older patients compared to younger ones. Patients who resided outside SC who were hospitalized in SC were much more likely (OR 34.1, $p < 0.0001$) to be referred to MUSC than those residing in SC. Of all the comorbidities included in the model, the presence of secondary pulmonary hypertension was most significantly associated with being referred to MUSC (OR 8.6, $p < 0.0001$).

In the second logistic model, which incorporated the socioeconomic factors of median household income and primary payor, there was little change in the influence of any of the original variables. Median household income was a significant ($p = 0.018$) predictor of referral, with patients coming from higher income zip codes being less likely to be referred to MUSC. Primary payor was not significantly associated with referral, although those with private health insurance were, in fact, more likely to be referred to MUSC. Additional unadjusted analyses indicated that patients admitted to MUSC were significantly ($p < 0.01$) more likely than patients admitted to other hospitals to have commercial insurance (46.5% vs 32.2%), and less likely to be covered by Medicare (32.3% vs 52.1%).

DISCUSSION

This study confirms earlier reports that SSc disproportionately affects minorities. Blacks are younger, on average, than whites upon admission to South Carolina hospitals, seeming to indicate more severe disease among blacks. Other minorities admitted to SC hospitals and making ER visits tend to have more admissions and ER visits than whites and blacks across the same time frame. Given the known gender differences in the prevalence of SSc, it is not surprising that the rate at which hospitalizations and ER visits by SSc patients occur compared to the relative size of the underlying population is much higher among women compared to men. What has not yet been well documented is that these rates are also much higher in blacks when compared to whites. This racial difference in hospitalization and ER visit rates may be indicative of greater prevalence among blacks as well as more severe disease. Despite this apparent greater disease burden among blacks and other minorities, they are also much less likely than whites to receive treatment at MUSC, a major referral center for SSc, highlighting a potential disparity in access to optimal healthcare services.

To examine further whether the apparent greater disease

Table 2. Hospitalization and emergency room (ER) incidence rates for patients with SSc residing in SC.

	Race/Sex Group											
	White Males		Black Males		White Females		Black Females		Other Males		Other Females	
	N*	Rate**	N	Rate	N	Rate	N	Rate	N	Rate	N	Rate
Hospitalizations												
0–34 yrs	2	0.6	4	2.4	30	10.1	35	20.6	1	—	4	—
35–49	12	7.7	18	29.8	58	37.1	65	90.8	3	—	9	—
50–64	23	19.9	15	44.3	103	84.9	52	127.2	4	—	21	—
≥ 65	27	34.6	10	51.8	129	117.2	33	100.9	4	—	15	—
Total	64	9.7	47	16.9	320	46.7	185	58.7	12	34.3	49	159.7
ER visits												
O–34 yrs	5	1.6	6	3.7	32	10.7	42	24.7	2	—	4	—
35–49	10	6.4	16	26.5	54	34.6	66	92.2	3	—	12	—
50–64	17	14.7	8	23.6	91	75.0	48	117.4	5	—	22	—
≥ 65	24	30.7	8	41.5	108	98.1	32	97.9	3	—	14	—
Total	56	8.5	38	13.7	285	41.6	188	59.6	13	37.2	52	169.5

* N: number of unique patients in the age/race/sex group with admissions/ER visits in the time period 1996–2000. ** Rate: number of unique patients in the age/race/sex group per million population per year. Age strata-specific rates are not reported for 'Other' race patients due to small sample sizes.

Table 3. Summary of logistic regression models predicting likelihood of receiving treatment at the Medical University of South Carolina.

Variable	Model without income or primary payor		Model with income and primary payor	
	OR*	95% CI	OR*	95% CI
Race				
White	1.00	—	1.00	—
Black	0.41	0.18, 0.95	0.36	0.15, 0.89
Other	0.30	0.07, 1.37	0.40	0.09, 1.75
Sex				
Male	3.10	1.44, 6.65	2.88	1.27, 6.50
Female	1.00	—	1.00	—
Age group, yrs				
0–34	1.0	—	1.0	—
35–49	2.01	0.62, 6.51	1.79	0.54, 5.93
50–64	0.66	0.19, 2.31	0.60	0.17, 2.15
≥ 65	0.31	0.09, 1.13	0.28	0.07, 1.18
Median household income†	—	—	1.00	1.00, 1.00
Primary payor				
Private health insurance	—	—	1.00	—
Public health insurance	—	—	0.85	0.37, 1.96
Other	—	—	0.37	0.07, 2.07
County of residence**				
Reside in SC near GA	2.02	0.38, 10.74	1.84	0.33, 10.18
Reside in SC near NC	1.64	0.35, 7.73	1.50	0.31, 7.20
Reside outside SC	34.0	14.27, 81.07	42.8	16.0, 114.8
Reside in SC, not near GA or NC	1.00	—	1.00	—
Comorbid conditions present***				
Congestive heart failure	0.20	0.04, 0.94	0.08	0.01, 0.84
Cardiac arrhythmia	0.17	0.02, 1.39	0.17	0.02, 1.43
Systemic hypertension	1.11	0.5, 2.44	1.13	0.50, 2.55
Secondary pulmonary hypertension	8.55	3.11, 23.51	8.12	2.77, 23.81
Pulmonary fibrosis	1.04	0.39, 2.75	0.77	0.27, 2.23
Renal failure	0.34	0.04, 2.97	0.36	0.04, 3.43

* Odds ratios < 1 indicate a decreased likelihood of being referred compared to the referent category, while OR > 1 indicate an increased likelihood. ** "in SC near GA" and "in SC near NC" refer to those patients residing in SC counties in which at least 10% of all hospital admissions occur in Georgia (GA) and North Carolina (NC), respectively. *** Odds ratios associated with comorbid conditions reflect comparisons to patients without the comorbidity present. † Because median household income was treated as a continuous variable in the model, OR reflects the decrease in odds with every $1 increment in income. Income was, in fact, a significant (p = 0.018) independent predictor, with patients with higher income less likely to be referred to MUSC.

among blacks and other minorities could be explained by socioeconomic status, an analysis of covariance was performed on the 727 inpatient admissions examining predictors of age at hospital admission. Again, race was a highly significant ($p < 0.0001$) predictor, even after adjusting for income and insurance. The socioeconomic factors studied here clearly do not explain the disparate disease burden.

Reasons for these disparities are likely complex. It is unclear whether SSc is more prevalent and severe in blacks because of genetic or environmental/socioeconomic factors, or a combination of such factors. Evidence from our earlier study[6] suggests that systemic hypertension and diabetes mellitus may play an important role in the disease progression among black patients with SSc. The current study seems to indicate that a relative lack of access to a major scleroderma referral center exists among minorities and women living in SC. Interestingly, income and health insurance factors could not explain the observed racial and sex disparities. Given that this work relied upon income data obtained from the zip code level, it is possible that the models did not completely control for socioeconomic status, as problems have been found to occur when assigning zip code level data to individuals[9]. However, a subsequent analysis comparing referral rates between whites and blacks, stratified by income, suggests that the racial disparity in referral is more severe in the higher income groups rather than in the lower. An analysis of data from the 2000 US Census indicates that a larger proportion of blacks (25.1%) compared to whites (15.5%) live in counties classified as "Very Rural" (defined by whether or not the county's largest town has at least 10,000 residents), indicating that transportation may play a role in this disparity. We cannot address whether this disparity in access reflects a bias on the part of referring physicians, and whether improving this access would actually have a direct effect on the health of these patients with SSc also remains unknown.

This study has several strengths that separate it from earlier studies of scleroderma patients. With the exception of encounters at federal and military hospitals, the data sets

used in these analyses reveal SSc hospitalizations and ER visits during 1996 through 2000 in South Carolina. This strategy allowed us to study scleroderma in a relatively large sample and is likely the first study to examine access to care among patients with SSc.

This approach also brings some inherent limitations. Our analyses rely heavily on ICD9-CM coding of disease, a task largely accomplished by medical coders working in a variety of hospital settings. It is unclear how accurate such diagnoses are, but it is almost certain that errors in disease classification occur. Given that we searched the databases for any hospitalization and ER visit by patients who had ever had a diagnosis of SSc listed in these datasets, it is probably more likely that we have made the error of recording patients who do not truly have SSc than the error of not accounting for patients who do have SSc and have been hospitalized or had an ER visit. The low percentage of patients reportedly treated by a rheumatologist may be indicative of other misclassifications, as certain factors not directly associated with hospital billing may have a greater potential for not being reported in the administrative data files.

Because there is no standard way patients' race is obtained across the many hospitals and ER included in these data, there may be some patients whose race was misclassified in this study. However, this may not be as pertinent to this study as to others, as an earlier study indicated that self-reported blacks may be less likely than self-reported Asians and self-reported Native Americans to be mislabeled as whites[10]. In addition, we cannot really address racial disparities that may exist in other specific racial/ethnic groups, such as the Hispanic population of SC. Table 2 does appear to indicate, however, that disparities may indeed exist with respect to the hospitalization incidence rates for those SSc patients who are considered neither black nor white.

It is possible that the racial disparities in hospitalization and ER incidence rates reported here may be somewhat skewed by the lack of inclusion of healthcare encounters at federal and military hospitals in the analysis. However, an unpublished report of Department of Veterans Affairs (VA) hospitalization data indicates very few admissions among SSc patients (C. Maynard, personal communication). For the fiscal year 1999 and 2000, there were only 477 total inpatient admissions with SSc listed as the primary diagnosis in the entire VA hospital system, and only 8% of these took place within the service region that includes SC. Thus it is unlikely that there were many hospitalization visits to federal or military hospitals in SC from 1996 to 2000, and unlikely that the observed racial disparities were unduly influenced by such an omission.

Another limitation is that this study does not attempt to characterize the entire population of SSc patients in SC. People with scleroderma living in SC with no hospitalizations or ER visits during this time frame were not recorded in our datasets. An earlier population-based telephone survey and followup clinical examination estimated the point prevalence of scleroderma (males 1.2/100,000; females 3.6/100,000) and the annual incidence rate (males 1.9/million; females 12.8/million) for whites in SC[11]. Assuming these estimates are correct, we would expect roughly 16 white men and 49 white women with scleroderma to be living in SC at any one time, with 3 additional men and 18 additional women added each year. The identification of 64 white men and 320 white women who resided in and were hospitalized in SC over a 5-year time frame provides more evidence that we have included patients in the analyses who probably do not have scleroderma. A validation study of the hospitalization diagnosis of scleroderma could clarify this discrepancy.

While this type of study has certain inherent limitations, the strengths of the data and the observed results certainly suggest that blacks and other minorities are disproportionately affected by SSc, and yet they may not be receiving optimal care at a tertiary care SSc specialty center. Future work should focus on understanding why these disparities exist and whether changes to the health care system can be made to address them, with the goal to improve the health of all patients with scleroderma.

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