Correlates of Formal Work Disability in an Urban University Systemic Lupus Erythematosus Practice

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ABSTRACT. ***Objective.*** Work disability in systemic lupus erythematosus (SLE) has been sparsely studied. We sought to determine the demographic, disease-specific, and psychological features associated with work disability in patients with SLE at our medical center.

Methods. Ambulatory patients with SLE were enrolled in a cross-sectional study. Data collected by standardized interview, examination, questionnaire, and chart review were compared between formally work-disabled and never-disabled subjects. Multivariate logistic regression with outcome of formal work disability was then performed, using significant variables on univariate analysis.

Results. One hundred thirty-two of 143 subjects were working or students at time of SLE diagnosis. After a mean of 9.2 years' disease duration, 42.7% reported formal work disability due to SLE. On univariate analysis, lower education, African American ethnicity, marital status, and high disease activity and damage scores were associated with increased prevalence of work disability. Work type did not affect risk of work disability. Work-disabled subjects had more severe pain, fatigue, depression, and anxiety. On multivariate logistic regression, damage, African American ethnicity, and fatigue were associated with formal work disability, while global pain had a marginal association.

Conclusion. Formal work disability was highly prevalent in SLE, occurring in 42.7% of subjects. Disease damage, global pain, and fatigue were independently associated with formal work disability status on multivariate logistic regression. Premorbid work types did not strikingly influence rates of work disability. (First Release May 1 2008; J Rheumatol 2008;35:1046–52)

Key Indexing Terms:
WORK DISABILITY SYSTEMIC LUPUS ERYTHEMATOSUS DEMOGRAPHICS

Systemic lupus erythematosus (SLE) is a heterogenous systemic autoimmune disease that is associated with poor quality of life and impairment across mental, social, and physical domains of function[1-3]. SLE primarily affects young women[4], a demographic group that has increasingly sought employment outside the home over the last 30 years. Approximately 70% of US women ages 20–54 years are employed outside the home, and both husband and wife are employed in 57.5% of families[5]. Thus, medical work disability in women of child–rearing age has significant societal and personal consequences.

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Healthy People 2010 specifies as a national goal the reduction of work disability related to arthritis[6]. Yet work disability in SLE has only been sparsely studied. Cost analysis and social impact studies have mentioned work disability rates in the 20%–50% range[7-10]. Sutcliffe, *et al*[11] reported disability rates of 29.9% in a predominantly Caucasian study group. Work disability was associated with higher disease activity and lower education level, but not with age or disease duration. Partridge, *et al*[12] studied work disability in early SLE in a multi-ethnic population. Low education level, high physical demands at work, and high disease activity at time of SLE diagnosis were associated with work disability. However, sex, race, damage score, and occupational prestige were not associated with work disability. More recently, Yelin, *et al*[13] reported an employment rate of 54% among 748 SLE patients with an average of greater than 12 years' disease duration. Advanced age and disease duration, female sex, and a variety of job characteristics including high physical demands significantly increased risk of work loss. Bertoli, *et al*[14] examined the LUMINA cohort and found only a 19% work disability rate at 5 years' disease duration. Advanced age, male sex, poverty, disease duration, average disease activity, and damage accrual were significantly associated with work disability in that study. Previously, extensive investigation in rheumatoid arthritis (RA) has revealed similar work disability risk factors, including age, educa-

tion, pain, and disease severity, and also occupations with high physical demands[15-18].

We performed a cross-sectional study of outpatients with established SLE at a major urban medical center, the University of Chicago Medical Center, to determine the characteristics of work-disabled versus non-disabled patients with SLE. Based on previous data in SLE[11-14] and RA[15-18], we postulated that work disability would be common and that demographic characteristics such as education, premorbid work type, and age, as well as SLE-specific data including disease duration, activity and severity of SLE, and presence of common comorbidities would all be correlated with frequency of work disability. Because lupus nephritis is a relatively common severe SLE manifestation, we also postulated that lupus renal involvement could measurably increase risk of work disability.

MATERIALS AND METHODS

Patients fulfilling American College of Rheumatology (ACR) criteria for the classification of SLE[19] who received their usual lupus care in the University of Chicago Rheumatology Clinic by the authors were enrolled during clinic visits in a cross-sectional lupus clinical database from March 2004 through September 2005. Near total enrollment (> 95%) of patients with SLE receiving longitudinal lupus care by the authors (TOU, SC, SAB, JCL) was achieved during the study enrollment interval.

Because the population under study consisted predominantly of women of child-rearing age, 2 methods were used to ascertain disease-related work disability and differentiate this from voluntary choices of homemaker or retirement. Formal work disability status was determined with the questions, "Do you have formal work disability due to lupus currently? Have you had formal work disability due to lupus in the past?" and then was classified as (1) current formal work disability; (2) past formal disability, but not currently; or (3) never formal work disability. Self-reported work status was determined first by the following descriptors: (1) working fulltime; (2) working part-time, not due to lupus; (3) working part-time due to lupus; (4) previous fulltime worker, now fully work-disabled due to SLE; (5) previous part-time, now fully work-disabled by SLE; (6) previously employed, now unemployed; (7) previously employed, now at home by choice; and (8) never worked, not due to SLE. These categories were mutually exclusive. This was then collapsed into categories: (1) working, not limited/disabled by lupus, (2) work-disabled by SLE (not working, or working reduced hours, due to SLE); or (3) not working, but not due to SLE (unemployed, homemaker, retired) for statistical comparison with formal work disability status.

Work type at the time of disease onset and at the time of study enrollment was determined by subject review and selection of work categories, each of which had a list of specific occupations. These categories were (1) student, (2) managerial/professional work, (3) technical worker, (4) sales worker, (5) administrative support, (6) service work, (7) precision production/craft/repair, (8) operator/fabricator/labor, (9) other. These categories were modified from the 1990 US Census Bureau occupational classification categories[20], and the reproducibility of this modified system has been validated in a recent study of RA[21]. Student role was considered to be a working (nondisabled) category.

Variables. Demographic data were obtained from all patients by a standardized questionnaire, and included age, ethnicity, and marital status. Socioeconomic status was assessed by years of education and insurance type. ACR criteria for the classification of SLE and a detailed medical history of SLE including disease duration, manifestations, hospitalization due to SLE, and SLE-related medication history were collected by chart review and patient interview. Data were also collected on comorbidities of SLE by chart review: arterial or venous thrombosis, osteoporosis (bone densitometry T scores ≤ -2.5 at spine or hip), avascular necrosis of bone, hypertension, diabetes mellitus, obesity as body mass index (BMI), chronic renal insufficiency, and endstage renal disease (ESRD). Serological characteristics (ever-positive for anti-dsDNA, Sm, RNP, SSA, SSB, anticardiolipin antibody) and most recent laboratory values [hematocrit, leukocyte count, serum albumin, serum creatinine, and glomerular filtration rate (GFR)] were collected by chart review and review of computerized laboratory results. The definition of renal involvement utilized the ACR classification criteria description of proteinuria or active urinary sediment[15]. Lupus disease activity and chronic damage accrued in the setting of SLE at the time of study enrollment were determined by an SLE Disease Activity Index (SLEDAI)[22] and the Systemic Lupus International Collaborating Clinics/ACR Damage Index (SDI)[23], respectively. Patients also completed a Fatigue Severity Scale (FSS)[24], a measure of trait anxiety (State-Trait Anxiety Inventory; STAI)[25], and the Beck Depression Inventory (BDI)[26] at the time of enrollment. In addition, subjects completed a 10 cm visual analog global pain scale (range 0–100 mm) for the average pain in the preceding week, with 0 equaling no pain and 100 equaling the most severe pain. This is a widely used format for measuring pain levels in SLE and other diseases, and has been validated as a measure of chronic pain[22,23,27-29].

Statistical analysis. Data were entered into a Microsoft Access database. Statistical analysis was performed using Stata 8.0. Concordance between self-reported work status and presence of formal disability status was compared by chi-square analysis. Demographic and disease-specific characteristics were then compared between individuals with "current formal work disability" versus "never work disability," excluding 10 individuals with previous work disability who then returned to the workforce, a group too small to analyze. Fisher's exact test, Wilcoxon rank-sum tests, and chi-square analyses were used to assess association and odds ratios (OR) of demographic factors, disease-specific measures, and lupus medical history between formally work-disabled and never-disabled subjects. Wilcoxon rank-sum tests were used to assess fatigue score (FSS), anxiety trait (STAI), depressive symptoms (BDI), and global pain score in formally work-disabled and never-disabled subjects with SLE.

The relationship between work type at lupus diagnosis and subsequent prevalence of work disability was evaluated in a number of ways. Fisher's exact test was used to determine if subjects with specific premorbid work categories were disproportionately likely to be work-disabled at the time of the study. Because autonomy and job importance have been observed to be protective toward work disability in RA[15,18], we also looked specifically at the subjects in the professional/managerial group versus a combined variable of all the other groups by chi-square tests. Finally, we grouped together the 3 most physically demanding job categories (categories 6–8 above) due to small numbers in any single physical labor-oriented category and repeated a chi-square analysis comparing rates of subsequent work disability in SLE patients with initial physical labor versus a grouped variable of all other work categories.

Multivariate logistic regression was then performed with outcome of formal work disability. The model was selected using stepwise forward selection ($p > 0.20$) based on the variables of interest from the initial analyses. Independent association of significant variables with work disability was confirmed by bootstrapping the data and performing stepwise logistic regression for each bootstrap sample, in order to confirm that the final model was stable[30]. In this method, 1000 bootstrap samples were drawn from the original data, and each was used for forward stepwise selection. The inclusion probability among the 1000 bootstrap samples was calculated for each variable, with inclusion probabilities of > 0.4 considered adequate to allow for the inclusion of weak independent variables.

Our study was approved by the Institutional Review Board of the University of Chicago, and all subjects provided signed informed consent.

RESULTS

One hundred forty-three subjects were enrolled from March

2004 through September 2005 in the outpatient rheumatology clinic. Two subjects declined participation. Study group characteristics are summarized in Table 1. The mean age of subjects was 40.4 years. Women constituted 92% of the sample. African Americans were the largest ethnic group, at 60.8% of the study sample, followed by Caucasian at 26.6%, Hispanic at 7.0%, and Asian/Pacific Islander at 3.5%. The mean educational achievement was 14.0 years, and only 4 subjects did not complete high school education. Lupus duration averaged 9.2 years. The mean SLEDAI was 5.4 [standard deviation (SD) 4.6], indicating mild activity in this ambulatory population. The mean SDI score was 1.8 (SD 2.0). The most common comorbidity was hypertension (38.7%), followed by thromboses in 20% of the study group. Deep venous thrombosis was the most common thrombotic event (11.3%), followed by cerebrovascular accident (CVA; 9.2%), pulmonary embolism (5.6%), myocardial infarction (2.8%), transient ischemic attack (1.4%), digital gangrene (0.7%), and other thromboses (1.4%).

Of 143 subjects at SLE diagnosis, 10 (7.0%) were not working by choice, while 1 was unemployed and 15 were students. By the time of study enrollment, at a mean of 9.2 years of disease duration, 61 subjects (42.7%) had formal disability status, 10 (7.0%) subjects had received formal longterm disability in the past but no longer received such support, and 72 (50.3%) had never had formal work disability status (Table 2). Of the 15 who were students at SLE diagnosis, 10 were employed by study enrollment, 4 had current formal disability, and 1 had previous work disability. Self-reported work status (partially or completely disabled 46.9%) correlated highly with formal work disability status (current vs never) by chi-square analysis ($p < 0.001$). Of the self-reported disabled, most reported complete work disability (n = 60, 42.0%), while a few reported a decrease from full to part-time work due to lupus (n = 7, 4.9%).

Table 1. Characteristics of the SLE study population (n = 143). Mean (standard deviation) unless otherwise specified.

Characteristic	
Gender (female:male)	132:11
Age at SLE onset, yrs	31.3 (11.1)
Age at study enrollment, yrs	40.4 (11.6)
Disease duration, yrs	9.2 (8.3)
SLEDAI score	5.4 (4.6)
SDI score	1.8 (2.0)
Education, yrs	14.0 (2.3)
Race/ethnicity, %	
African American	60.8
Caucasian	26.6
Hispanic	7.0
Asian/Pacific Islander	3.5
Other	2.1

SLE: systemic lupus erythematosus; SLEDAI: SLE Disease Activity Index; SDI: Systemic Lupus International Collaborating Clinics/American College of Rheumatology Damage Index.

Table 2. Work disability status (due to SLE) of subjects at time of study enrollment (n = 143).

Disability Category	n (%)
Formal disability status	
Current formal work disability	61 (42.7)
Previous formal work disability	10 (7.0)
Never formally disabled	72 (50.3)
Self-reported current work status	
Complete/partial work disability	67 (46.9)
Work hours limited by SLE	7 (4.9)
Working, unlimited by SLE	55 (38.5)
Not working, not due to SLE	21 (14.7)

There appeared to be minimal misreporting of work types. Using the detailed self-reported work status, 2 nonworking subjects appeared to have misclassified themselves as having a current occupation. There were 5 subjects in the formal disability group who indicated a current work type; this may represent a small amount of classification error or reflect a minor amount of employment. Formally disabled individuals in Illinois are allowed to work a strictly limited monthly amount without threatening formal disability status.

The distribution of work types at disease diagnosis and at a mean of 9.2 years' disease duration are displayed in Table 3. At the time of lupus diagnosis, the most common work type categories were managerial/professional (27.3%), followed by administrative support (20.4%) and services work (20.4%). At study enrollment, managerial/professional work was somewhat more common among working subjects with SLE (39.4%), followed by services work (19.7%) and administrative support (18.2%). All work types registered a decreased number of subjects, except for the solitary subject in "other," who is an artist. Thus subjects developed work disability regardless of baseline work type. Chi-square of work types did not indicate that any specific work type had

Table 3. Work type of subjects with systemic lupus erythematosus (SLE) at lupus diagnosis and time of study (n = 143).

Work Category	At Time of SLE Onset N = 132, n (%)	At Study Enrollment N = 66*, n (%)
1. Student	15 (11.4)	2 (3.0)
2. Managerial/professional	36 (27.3)	26 (39.4)
3. Technical worker	5 (3.8)	2 (3.0)
4. Sales work	8 (6.1)	5 (7.6)
5. Administrative support	27 (20.4)	12 (18.2)
6. Services work	27 (20.4)	13 (19.7)
7. Precision production/craft/ repair	4 (3.0)	2 (3.0)
8. Operator/fabricator/labor	9 (6.8)	3 (4.5)
9. Other	1 (0.8)	1 (1.5)

* Five formally work-disabled subjects reported some employment despite disability status.

significantly more attrition than others (p = 0.4). While managerial/professional occupations became more common by study enrollment compared to other categories, increasing from 27.3% of the working subjects at diagnosis to 39.4% of working subjects at study enrollment, this was not statistically significant (p = 0.4). When the heaviest physical labor jobs (categories 6–8) were combined for statistical analysis, this did not change in frequency by study enrollment (30.2% at diagnosis vs 27.2% at enrollment; p = 0.5). Thus, we could not demonstrate a protective or high-risk effect of any job type.

Demographic variables were examined for correlation with formal work disability status (Table 4). Age, age at time of disease onset, and sex were not associated with formal work disability. Longer duration of disease was seen in the formally disabled subjects relative to working subjects, which approached significance (10.2 vs 8.1 yrs; p = 0.08). Ethnicity was associated with work disability status, with African American subjects having an increased prevalence of work disability (58.5%) relative to Caucasian (24.2%) and other groups (29.4%; p = 0.001). Education level was somewhat lower in individuals with formal work disability (13.5 vs 14.4 yrs; p < 0.001). A categorical variable of education greater than high school level (> 12 yrs) was not significantly protective against work disability, however (p = 0.10). Medicaid insurance status was not associated with formal work disability. Current marriage was protective toward work disability (OR 0.4, 95% confidence interval 0.2, 0.8; p = 0.007) relative to other marital statuses. Among the comorbidities, hypertension was more frequent in subjects with formal work disability (48.3% vs 27.8%; p = 0.012), as was avascular necrosis of bone (15% vs 0%; p = 0.001). BMI did not correlate with work disability status. Diabetes mellitus and osteoporosis, both of which were infrequent in this study group, were not significantly associated with work disability status (data not shown).

Table 4. Selected correlates of formal work disability in SLE on univariate analysis. Mean (standard deviation) unless otherwise specified.

Variable	Formal Work Disability, n = 61	Never Disabled, n = 72	p
Education	13.5 (2.1)	14.4 (2.4)	< 0.001
Ethnicity, %			
African American	58.5	41.5	0.001
Caucasian	24.2	75.8	
Other	29.4	70.6	
Married (currently), %	30.8	69.2	0.007
Male, %	4.9	11.1	0.726
SLE duration	10.2 (8.6)	8.1 (7.6)	0.078
SLEDAI score	6.4 (5.0)	4.7 (4.2)	0.035
SDI score	2.9 (2.1)	0.9 (1.3)	< 0.0001
Fatigue	5.0 (1.6)	3.8 (1.6)	0.0001
Depression	16.7 (10.6)	9.3 (9.0)	< 0.0001
Anxiety trait	47.1 (10.6)	37.2 (11.2)	< 0.0001
Global pain score	49.8 (31.1)	26.7 (23.2)	0.0001

SDI: Systemic Lupus International Collaborating Clinics/American College of Rheumatology Damage Index.

A variety of disease-specific variables correlated with formal work disability status (Table 4). The SLEDAI score was significantly higher in subjects with formal work disability (6.4, SD 5.0) versus nondisabled subjects (4.7, SD 4.2, p = 0.035). A SLEDAI score ≥ 6 at study enrollment increased odds of formal work disability by 2.2 (95% CI 1.1, 4.5). The summary damage instrument, SDI, correlated very strongly with formal work disability. Formally disabled subjects had higher SDI scores (2.9, SD 2.1) than never-disabled subjects (0.9, SD 1.3, p < 0.0001). Among the components of the SDI, cataracts (p = 0.047), CVA (p = 0.0002), ESRD (p = 0.0248), pulmonary hypertension (p = 0.019), muscular atrophy (p = 0.043), avascular necrosis of bone (p = 0.0038), tendon rupture (p = 0.042), and chronic scarring alopecia (p = 0.041) were significantly increased in the formal disability group. The association of seizure disorder and myocardial infarction with formal work disability approached statistical significance (p = 0.08 and p = 0.06, respectively).

Of specific disease manifestations in the medical history, proteinuria (> 500 mg/24 h, or dipstick ≥ 1+) was more frequent in work-disabled subjects (41.7%) than in nondisabled subjects (25.9%; p = 0.032). A history of thrombotic events (defined as CVA, transient ischemic attack, deep venous thrombosis, pulmonary embolism, or digital gangrene) was more common in the work-disabled (26.7% vs 11.1%; p = 0.025). Among serological and laboratory values, serum creatinine and GFR were associated with formal work disability (p = 0.05 and p = 0.01, respectively), but not hematocrit, white blood cell count, platelets, albumin, or serological markers (dsDNA, anticardiolipin antibody, Smith antibody, SSA, or SSB). At least 1 hospitalization for lupus was more frequent in the work-disabled group (78.3%) than in the nondisabled group (40.3%; p < 0.001). History of treatment with the major immunosuppressive drugs cyclophosphamide (n = 22 subjects), azathioprine (n = 60 subjects), or mycophenolate mofetil (n = 25 subjects) was significantly more common in the work-disabled group relative to the never-disabled group (all p < 0.05), but history of treatment with methotrexate (n = 25 subjects) or hydroxychloroquine (n = 119 subjects) was not associated with increased prevalence of work disability. While prednisone use (ever) was highly prevalent in both groups, it was significantly more common in work-disabled than in never-disabled subjects (98.3% vs 84.7%; p = 0.006).

Fatigue severity scores were significantly worse in the formal work disability subjects (5.0, SD 1.6) than in never-disabled subjects (3.8, SD 1.6, p = 0.0001; Table 4). Similarly, global pain score was higher in work-disabled (49.8, SD 31.1) than in never-disabled (26.7, SD 23.2; p = 0.0001). Trait anxiety scores were worse in formally work-disabled (47.1, SD 10.6) than in never-disabled (37.2, SD

11.2; $p < 0.0001$), and BDI depression scores were higher in the formally disabled (16.7, SD 10.6) than in the never-disabled subjects (9.3, SD 9.0; $p < 0.0001$).

Because numerous potentially interrelated factors were more prevalent in formally work-disabled subjects, a stepwise logistic regression by forward selection was performed, with the outcome of formal work disability. The initial demographic independent variables tested were marital status (married) and ethnicity due to their significance on univariate analysis. Education and Medicaid insurance status were used to adjust for socioeconomic status. Disease-specific independent variables, chosen because they were significant on univariate analysis and generalizable or relatively common in the study population, were SDI, SLEDAI > 6, hospitalization for lupus ≥ 1, CVA, global pain score, and FSS. STAI and BDI were included to adjust for psychiatric comorbidity, as both had significantly correlated with work disability on univariate analysis. Surprisingly, neither education as a continuous variable nor education as a categorical variable (≤ 12 yrs vs > 12 yrs) was significant in the multivariate model. Only SDI, African American ethnicity, and FSS were independently associated with increased prevalence of formal work disability on multivariate logistic regression, while global pain score was marginally significant when adjusted for these covariates ($p = 0.06$; Table 5). Adding back education and Medicaid insurance status to adjust for socioeconomic status did not significantly affect the outcome of the final model.

DISCUSSION

The prevalence of work disability is an obvious important functional outcome and severity measure that can be used to describe SLE populations, both cross-sectionally and longitudinally. Our study characterizes baseline, cross-sectional SLE work disability rates in the environment of an urban university practice. In contrast to other publications, this study carefully defines work disability status by 2 methods, and by demonstrating tight concordance between the methods suggests validity of these measures. Formal work disability status and self-reported work disability status appear to be similar outcome variables in this population. Another unique aspect of our study is the concurrent inclusion of work type analyses and detailed medical data on the same population. Finally, and perhaps most importantly, we have a robust population of ethnic minority lupus, allowing specific examination of the social influence of SLE in subjects of African American ethnicity.

Table 5. Multivariate logistic regression model of formal work disability in SLE.

Variable	OR	(95% CI)	p
SDI damage score	2.0	(1.4, 2.9)	< 0.001
Fatigue severity score	1.6	(1.1, 2.4)	0.010
African American ethnicity	7.3	(2.2, 24.0)	0.001
Global pain score (per 10 mm)	1.2	(1.0, 1.5)	0.06

After a mean 9.2 years of disease, 42.7% of subjects with SLE had obtained formal medical disability status. A similar number (46.9%) of subjects with SLE self-reported that they were partially or completely work-disabled due to lupus. The very high correlation between self-reported disability and formal disability status ($p < 0.001$) suggests that formal work disability status is surprisingly accurate in reflecting work disability in this population of young women. Significant loss of employment was seen across all premorbid employment types, although managerial/professional workers increased in relative frequency over time. It is possible that, with a larger group, a protective effect of this work category may have been demonstrated. Lower education status was associated with a higher rate of work disability, as was African American ethnicity. On multivariate logistic regression, education level fell out of significance, but African American ethnicity persisted. This correlation of African American ethnicity with an increased risk of medical work disability has been well recognized outside the field of rheumatology[31-34]. Minority workers with chronic illnesses experience greater employment loss. This is felt to be due to "dual discrimination," the dual effects of chronic illness and minority status on employment opportunities. Because we were not able to adjust for household income, it is very possible that a lower average socioeconomic status among African Americans contributes to this association. In addition, African American patients with SLE have been described as having greater disease severity relative to other SLE subsets[35-38]. In our study, mean SLEDAI scores were not significantly higher in African Americans (5.7 vs 4.7; $p = 0.4$). However, African American subjects had a higher rate of active SLE (i.e., SLEDAI ≥ 6) at study enrollment (49.4% vs 29.1%; $p = 0.02$). Thus the higher rate of work disability in African American subjects might be related to more severe disease. However, in our study SDI score did not differ between ethnic groups, and adjustment for disease activity (SLEDAI > 6) on logistic regression did not mitigate the association of African American ethnicity with increased risk for work disability. Thus, it seems more likely that the higher prevalence of work disability in African American patients with SLE is driven by socioeconomic barriers to employment. Because of the disproportionate effect of SLE on employment in African Americans, whatever the cause, SLE appears to have more severe economic consequences for African American patients.

The SDI score performed well in predicting formal work disability. SDI remained a highly significant association of work disability even after adjustment for other covariates, with an increase in odds of work disability of 2.0 for each 1-point increment in SDI score. Of interest, multiple types of damage within the SDI independently correlated with work

disability, and thus the association of SDI with work disability was not driven by one major category of damage.

On univariate analysis, disease activity at study enrollment also was associated with longterm work disability, and an enrollment SLEDAI score ≥ 6 increased odds of formal work disability by 2.2. However, SLEDAI failed to correlate with formal work disability on multivariate logistic regression. Although we have reported a very strong association of work disability with neurocognitive dysfunction[39] in a study where formal neurocognitive testing was performed on all participants, our study does not demonstrate an association between work disability and clinically evident neurocognitive impairment. This discrepancy may be due to lack of formal neurocognitive assessment in our study, resulting in underdiagnosis of neurocognitive dysfunction. Laboratory measures reflecting renal failure predicted work disability, but cytopenias, albumin levels, or serologies did not. History of hospitalization for SLE and treatment with major immunosuppressive drugs (azathioprine, cyclophosphamide, or mycophenolate) were likely associated with work disability by serving as disease severity measures.

Fatigue was independently associated with work disability on multivariate logistic regression (Table 5). For each 1-point increment in the 7-point FSS, the odds of work disability increased by 1.6. Excessive fatigue is one of the most common clinical manifestations of SLE[40], occurring in roughly 85% of patients. It has correlated with both poor physical and mental function in SLE[41], and thus the correlation seen with work disability in our study seems logical and has face validity. Fatigue has variably been associated with disease activity[40,41], higher pain levels[41], and depression[40,42]. While global pain score, depressive symptoms, and trait anxiety were each worse in work-disabled subjects in univariate analysis, only the pain score association persisted after multivariate regression, with marginal significance ($p = 0.06$).

Our study documents a higher formal work disability rate than found in most early studies of SLE work disability[7-10,12]. This may be due to strong socioeconomic factors influencing work disability rates in this urban setting. Our rates of work disability are similar to the 40% rate described in Partridge, *et al*[12], which sampled a group of Boston subjects with SLE who were 53% African American. Our work rates are quite similar to Yelin, *et al*[13], which features a multicenter long-duration lupus population. In the multi-ethnic LUMINA study[14], much lower disability rates were found, but disease duration was short. Differences in definition of work disability make direct comparison difficult across studies; our rates of partial/complete work disability are even higher based simply on self-reported work status (46.9%).

Our study confirmed the findings of LUMINA in some respects[14]. Education, disease activity, disease damage, disease duration, renal involvement, avascular necrosis, depression, and pain scores correlated with work disability, at least on univariate analysis. In contrast to our study, fatigue did not correlate with work disability in LUMINA. We did not find a correlate of male sex with work disability, but we had only 11 male subjects in our study. Contrasting findings between our studies are likely due to center-specific differences in our SLE populations and lupus duration.

Our study, by using work types, may be less prone to recall bias than studies that use questionnaires to ask disabled patients about the physical demands of their previous jobs. However, because we use work types rather than work descriptions, the severity of physical demands involved in the work is imputed by work type rather than being quantified in each case. Other limitations of our study include the relatively small group size, which may limit the precision of our work disability prevalence estimates, and the ethnic mixture and urban setting of our clinic, which may limit the generalizability of our findings relative to demographically divergent SLE populations. The number of subjects in physical-labor category job types was also quite small, and thus our ability to link high physical-labor jobs with higher rates of work disability was limited. This is inherent in studies of SLE, in which female preponderance makes heavy-labor employment less common. Yelin, *et al*[13] was able to demonstrate an effect of work type on work loss not seen in our study, perhaps due to the very large size of their sample. However, it is also true that the symptoms of SLE may result in work disability regardless of work type. Global disease symptoms such as pain and fatigue may impair work performance in all employment types. Finally, because of the cross-sectional design of this study, a causal relationship between these associated factors and work disability cannot be proven. Future studies will need to examine the longitudinal association of damage accrual, pain, fatigue, and sociodemographic variables with work disability to predict individual likelihood of work disability in lupus.

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