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## Socioeconomic Predictors of Incident Depression in Systemic Lupus Erythematosus

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### Abstract

**Objective**—To assess different measures of socioeconomic status (SES) as predictors of incident depression among women with systemic lupus erythematosus (SLE).

**Methods**—Data derive from the 2010–2015 waves of the Lupus Outcomes Study, where individuals with confirmed SLE were interviewed annually by telephone. Depression was assessed with the Center for Epidemiological Studies Depression Scale (CES-D), using a validated lupus-specific cutoff ( $\geq 23$ ) for major depressive disorder. Women interviewed in  $\geq 2$  consecutive waves, with scores  $< 23$  in the first wave (T1), were included. Level of financial strain was classified as high, moderate, or none based on responses to three questions. Generalized estimating equations assessed the impact of poverty status, income, education, and financial strain at T1 on risk of incident depression the next year (T2), while adjusting for sociodemographic and disease status measures. Individuals could contribute more than one two-year dyad to the analysis.

**Results**—682 women contributed 2,097 observations, with 19% having high financial strain, 47% moderate strain, and 34% no strain. 166 women had 184 episodes of incident depression (rate=8.8/100 person-years). In bivariate analysis, poverty, lower income and education, disease activity, and high financial strain were associated with onset of depression; race/ethnicity was not. Neither poverty, income, nor education remained significant in multivariate analyses, but disease activity and high financial strain did (OR=1.85, 1.06–3.23).

**Conclusion**—High financial strain was a significant predictor of new-onset depression in women with SLE, controlling for disease factors and other SES measures. Determining specific, modifiable sources of financial strain may help prevent development of depression.

Systemic lupus erythematosus (SLE) is an inflammatory autoimmune disease that predominantly affects women. Depression is common in SLE, affecting up to 50% of patients according to a recent systematic review(1), and is particularly common in women. In one study of females with SLE, 47% met the criteria for lifetime major depressive disorder(2), while in another study of males and females with SLE, depression rates and symptom levels were significantly higher among females(3). An undesirable outcome in itself, depression is also associated with greater disease activity(4), work disability(5,6), and markers of vascular disease(7) in SLE, and reduced health-related quality-of-life(8).

Low socioeconomic status (SES) in SLE has also been associated with poor outcomes, including increased disease activity(9–11), organ damage(12,13), and mortality(14), and decreased physical functioning(9) and quality of life(15). There is also evidence to suggest that lower SES is associated with prevalent depression(9,16) in SLE, but there are little data on the longitudinal relationship between these socioeconomic factors and the onset of depression.

SES is traditionally defined by one or more of educational attainment, or individual or neighborhood income level, but these measures do not always reflect one's current economic situation. For example, work disability is common in SLE(5,17–19), and although higher education may offer some protection(17,18), those unable to work may have limited income and resources regardless of their educational attainment. Additionally, such measures of SES may not fully capture financial strain, one's assessment of the current financial situation of themselves and their family(20). Financial strain has been associated with the incidence(21) and prevalence(22,23) of depression in general populations, and in cohorts of cancer survivors(24) and type II diabetes(25). However, its impact in SLE has not been assessed.

To address these research gaps, we evaluated the impact of financial strain, along with household income and educational attainment, on the development of depression amongst a community-based sample of women with SLE.

## PATIENTS AND METHODS

The sample was drawn from female participants in the University of California at San Francisco (UCSF) Lupus Outcomes Study (LOS). Participants in the LOS had initially participated in a study of genetic risk factors for SLE outcomes and were recruited from clinical and community-based sources. SLE diagnoses were verified by medical record review using the American College of Rheumatology (ACR) classification criteria. Standardized interviews were conducted each year, with annual retention rates of approximately 92%. Additional details about the LOS have been reported previously(26). Interviews began in 2002, but as questions on financial strain were only included in waves 8–12 of the LOS (collected over the years 2010–2015), only women who contributed data in those waves (n=890) were eligible for this analysis. This study was approved by the UCSF Committee on Human Research and all participants provided informed consent.

### Outcome: depressive symptom severity

The outcome of interest was new-onset of depression over a 12-month period. Depressive symptoms were assessed with the Center for Epidemiologic Studies Depression Scale (CES-D)(27), which asks about the frequency of experiencing each of 20 depressive symptoms over the past week. CES-D scores can range from 0 to 60. Based on an assessment of the utility of the CES-D to screen for depression in SLE(28), and as done previously by our group(29), a score of 23 was used as the cut-point for the outcome of depressive symptoms suggestive of major depression (depression).

## Independent variables

**Sociodemographic factors**—Sociodemographic information included age, race/ethnicity (White, Hispanic/Latino, African American, Asian/Pacific Islander, and Other), marital status (married or living with a partner vs. not), educational attainment (college graduate or not), household income (< \$40,000, \$40,000 to < \$80,000, or ≥ \$80,000), and poverty status (household income < or > 125% of the federal poverty level(30)).

**Health status**—Information on general health status included smoking status (current vs. former/never), obesity (body mass index (BMI) < or ≥ 30.0 kg/m<sup>2</sup>), and physical functioning, as assessed using the Short Form 36 (SF-36) Health Survey physical functioning subscale (range 0–100).

**SLE-specific disease factors**—Disease duration was the number of years since SLE diagnosis as obtained from medical record review. Disease activity over the past three months was measured using the Systemic Lupus Activity Questionnaire (SLAQ), a validated(31), self-reported measure of disease activity in SLE (score range 0–44) that includes items assessing constitutional symptoms, mucocutaneous symptoms, musculoskeletal symptoms, and other disease activity domains. A modified version of the SLAQ, one that excludes items (feeling depressed, fatigue, and forgetfulness) that could overlap with depressive symptoms, was also used. Disease damage was assessed using the Brief Index of Lupus Damage (BILD), a validated, self-reported measure of damage (score range 0–26) across several domains contained in the physician-assessed SLICC/ACR Damage Index (SDI), including renal, neuropsychiatric, pulmonary, and cardiovascular(32). Disease damage was assessed at only one time point (for most participants, during wave 5), but damage generally accumulates slowly over time and large year-to-year changes in damage would not be expected.

**Financial strain**—Waves 8–12 included three questions used to assess current and anticipated financial strain(33); specifically, participants rated their likelihood of experiencing actual hardships, or having to reduce their standard of living to the bare necessities, in the next two months, and their current difficulty living on their household income. From the responses to these questions, participants' level of financial strain was categorized as high (responding “Very Likely” or “Very or Extremely Difficult” to *any* of the three questions), none (responding “Not at all Likely” or “Not at all Difficult” to *all* three questions), or moderate (responses were a combination of “Somewhat” likely/difficult, “Not too likely”, and “Not at all” likely/difficult). In prior studies, this set of questions has had a reliability coefficient of 0.85(33), and has correlated negatively with past ( $r = -0.39$ ,  $p < 0.01$ ) and present ( $r = -0.40$ ,  $p < 0.01$ ) income levels(20). We had very few missing responses, and in our primary analysis, we took a conservative approach and classified those with missing responses, who answered at least one of the three financial strain questions, as Moderate (one observation with missing responses to all three questions was excluded).

We also conducted a sensitivity analysis that excluded observations with missing responses to one or more of the financial strain questions ( $n=16$ ) if the individual's overall level of financial strain was ambiguous. This meant that observations with missing responses were

retained if the individual responded “Very Likely” or “Very or Extremely Difficult” to another question, since only one of these ‘extreme’ responses was required to be classified as High Strain.

**Study sample**—In order to assess episodes of new-onset depression, eligible participants were required to have interview data from two consecutive waves, and to have been classified as non-depressed (CES-D < 23) in the first interview. Thus, the units of analysis were pairs of consecutive interviews, and we assessed the relationship between data collected during the first (T1), and the onset of depression in the second (T2). Interview-year pairs were excluded if the CES-D scores were missing in T1 or T2. As depressive symptoms can remit, participants who developed depression during one wave were included in later waves if their depressive symptoms (CES-D score) dropped below the threshold for depression. The final sample for analysis was 2,097 observations among 682 women (mean  $3.1 \pm 1.1$  observations each); of those excluded, 77 had prevalent depression at baseline, and 131 did not have data from two consecutive waves.

### Statistical analysis

Baseline characteristics for those who did and did not develop depression were compared using t-tests and chi-square tests. Bivariate generalized estimating equation models (used to account for multiple observations) were used to assess the association between each independent variable (as measured at time 1) and the odds of developing depression at time 2. We then constructed a series of multivariate models in order to identify independent predictors of new-onset depression. An indicator variable for missing income data was also included. The first four models evaluated the impact of: (a) poverty alone (without income, education, or financial strain); (b) categories of household income alone; (c) education alone, and (d) financial strain alone (without poverty, income, or education), on new-onset depression. Note that we did not include poverty status and income level in the same model because poverty was defined on the basis of household size and income. In the fifth model, we evaluated the impact of financial strain on new-onset depression while also adjusting for poverty and education. To account for the fact that baseline depressive symptom severity would be associated with meeting the criteria for depression over the following 12-month period, the CES-D score at time 1 (range 0–22) was also included in the model. Covariates in all models were age, marital status, race/ethnicity, obesity, current smoking, baseline CES-D score, SF-36 physical functioning, SLE disease duration, and SLAQ (in five-point increments) and BILD scores. Results of these models are presented using odds ratios (ORs) and 95% confidence intervals (95% CI).

In addition to the final models described above, we constructed several alternate models using different definitions of some of the covariates. These included defining obesity using the lupus-specific BMI cut-point of  $26.8 \text{ kg/m}^2$ (34), using four levels of educational attainment (post-graduate degree, college degree, some college/post-secondary education, and high school education or less) instead of two, replacing poverty status with the three household income categories, and, for those with multiple episodes of new-onset depression (n=18), restricting to the first episode.

## RESULTS

Baseline characteristics of the 682 participants are shown in Table 1. The mean age (SD) at the time of first interview was 51.0 (13.5) years, and the mean time since SLE diagnosis was 18.0 (8.9) years. Forty-five percent were college graduates, and 13% were living in poverty. We additionally identified 77 women who participated in at least two interviews, but were excluded from the analysis because they met the criteria for depression at the first interview. While these women had the same mean age and disease duration as those classified as non-depressed at T1 (Table 2), they had markedly higher levels of poverty (32% vs. 13%), disease activity (mean SLAQ score of 20.6 vs. 10.2), and disease damage (mean BILD score of 3.3 vs. 1.9).

Over the study period there were 184 episodes of new-onset depression experienced by 166 unique individuals (24% of the cohort, incidence rate of 8.8/100 person-years), with 18 individuals having two episodes. In Table 1 we compare the baseline (T1) characteristics of those who developed depression at T2, to the baseline characteristics (at the first-ever T1 interview) for those who never developed depression. A greater percentage of those who developed depression were living in poverty at T1 (19% vs. 11%), and fewer had graduated from college (36% vs. 48%), and these individuals had higher levels of disease activity and disease damage. Moreover, those who developed depression were also more likely to experience a clinically-meaningful increase in disease activity (5-point increase in SLAQ) between T1 and T2: 25%, versus 12% of those who never developed depression (Supplemental Table).

Baseline responses to the questions on financial strain are shown in Table 3. Nineteen percent of respondents (n=130) were considered to have a high level of financial strain, 47% moderate strain, and 34% as having none. Fifty-five percent of those with high financial strain gave a high-strain response to only one of the three questions, 24% did so for two questions, and 20% gave a high-strain response to all three. The question about difficulty living on one's current household income received the most high-strain responses. As shown in Table 4, there were notable differences in levels of financial strain when participants were stratified by poverty status, education, and race/ethnicity. For example, among those not in poverty, 12% had high financial strain and 37% had no strain, while 61% of those living in poverty had high financial strain and just 7% had none ( $p < 0.01$ ). High financial strain was reported most frequently by African-Americans (33%, with 18% having No Strain), and least frequently by Asian-Americans (14%, with 43% having No Strain).

New-onset depression occurred in 40% of those with high financial strain, 24% with moderate strain, and 16% of those with no strain. The first episode of depression occurred after a mean of 1.7 waves (median 1), while women who never developed depression averaged 3.4 (median 4) waves of follow-up. In the bivariate analysis, being married or living with a partner, completion of a college degree, and higher levels of physical functioning were all associated with decreased odds of developing depression. Poverty, more depressive symptoms at baseline, and higher levels of self-reported disease activity (as measured by the SLAQ) and damage (as measured by the BILD) were all associated with increased odds of developing depression, as was high financial strain (Table 5).

The first three multivariate models assessed the impact of poverty, categorical household income, and education, respectively, on the development of depression, but did not include financial strain (Table 5). After adjusting for covariates, none of these measures of SES remained significant. The only significant predictors of developing depression were baseline depressive symptoms and disease activity. In our fourth model, which included financial strain and covariates but not poverty or education, high financial strain was a significant predictor of developing depression (OR=1.85, 95% CI=1.09–3.16), and moderate financial strain was associated with an elevated, but non-significant risk of depression (OR=1.39, 0.91–2.13). When poverty and education were added to the model, high strain remained significant (OR=1.85, 1.06–3.23). Other independent predictors of depression in this final model were baseline CES-D score (OR=1.14, 1.11–1.18 per one-point increase in CES-D) and disease activity (OR=1.23, 1.05–1.43 per five-point increase in SLAQ).

Similar odds ratios for high financial strain were observed when using the lupus-specific obesity cut-point of BMI  $\geq 26.8$  kg/m<sup>2</sup> (OR=1.89, 1.08–3.28), using the modified SLAQ as a measure of disease activity (OR=1.89, 1.08–3.28), replacing poverty with categories of household income (OR=1.86, 1.08–3.20), using four levels of educational attainment instead of two (OR=1.85, 1.06–3.22), excluding observations (n=16) with missing responses to one or two of the financial strain questions (OR=1.93, 1.10–3.38), and restricting to the first episode of depression (OR=2.05, 1.13–3.75).

## DISCUSSION

Among this community-based sample of women with SLE, the annual incidence of depression was 8.8%. While none of household income, poverty status, and educational attainment were independent predictors of new-onset depression in this cohort, financial strain, a reflection of one's current financial situation, was one of the strongest predictors. In fact, having a high level of financial strain increased the risk of developing depression by nearly two-fold, even after adjusting for poverty, education, disease activity and damage, and other covariates. This finding was robust to a number of alternative model specifications, including the use of a modified SLAQ score that excluded "feeling depressed", and restricting to the first episode of depression for each person.

There are few reports on the predictors of incident depression in SLE available for comparison. A previous examination of cardiovascular and SLE-specific risk factors for new-onset depression in the LOS cohort(29) also found that poverty was a significant predictor in the bivariate analysis, but not the multivariate. Among members of the Hopkins Lupus Cohort(35), college education and higher family income were initially associated with a lower risk of incident depression, but neither were significant in the adjusted models. Our findings are also consistent with research on new-onset depression in the general population. Wang *et al* analyzed data from a longitudinal Canadian population health survey, and found financial strain was a risk factor for developing depression, even when adjusting for education, and individual and household income levels(21). Similar findings were observed in two longitudinal population studies conducted in the United Kingdom(36,37), and a longitudinal mental health survey from the Netherlands. In that study, both job loss, and

having a substantial reduction in income, but not low household income in itself, were predictors of incident mood disorder over a three-year period(38).

That we found poverty and education were not significantly associated with new-onset depression differs somewhat from findings of a prior LOS investigation in which education, and individual and neighborhood income levels, were significantly associated with prevalent depression. It is possible that education and poverty contribute differently to the outcomes of incident and prevalent depression, a supposition supported by our finding of a higher poverty rate in those who were excluded from analysis because of prevalent depression at T1. With stress, including chronic stress and stressful life events(39,40), associated with the onset of depression in general populations, high financial strain may be a trigger for incident depression in SLE, while poverty and education may play a larger role in the persistence of depression once it develops. Of note, persistent depression may itself contribute to poverty through lost productivity and work disability.

Although the questions we used to assess financial strain have been employed widely for this purpose, it is possible that when using them, we captured respondents' level of stress in general, rather than financial stress/strain specifically. However, while they did not overlap completely, we did observe that the distribution of financial strain differed considerably by household income and poverty status (Table 4), with 61% of those living in poverty reporting high financial strain compared to 12% of those not in poverty. As well, the percentage of LOS respondents who felt they were "not at all likely" to experience actual hardships such as inadequate housing, food, or medical attention within the next two months (64%), was similar to the percentages classified as "food secure" (74–76%) and "housing secure" (61–65%) in responses to two similar questions in the 2011–2014 Behavioral Risk Factor Surveillance System(41). Additional support for our capturing *financial* strain specifically is provided by the fact that the question with the most frequent 'high-strain' response was the one inquiring about difficulty living on one's current income. Financial strain can be assessed in a number of ways, ranging from a single question about financial status(22), to five-(42) and nine-item indices(43). Although these measures all cover the same topic areas, we acknowledge that another scale may have yielded different responses.

While the LOS cohort was recruited from a variety of clinical and community settings across the United States, its members have a relatively high level of education (45% college graduates, and only 16% with high school or less) compared to members of other US lupus cohorts(19,35,44,45), as well as the general US population (32.7% of females being college graduates(46)). Moreover, more than half are non-Hispanic whites. Thus, the relationship we observed between financial strain and new-onset depression should be assessed in other populations of SLE. If our findings are replicated, then moving forward, attention should focus on tangible ways of reducing financial strain in SLE patients. SLE is a chronic, relapsing-remitting disease associated with high levels of healthcare resource use and costs(26,47), and difficulties in paying for healthcare services, including prescription medications with high co-payments or not covered by insurance, have emerged in qualitative studies(48,49) as sources of financial strain for SLE patients. Thus, one way of reducing financial strain may be expanding access to health insurance. Support is provided by findings from the Oregon Medicaid experiment, wherein a sample of low-income adults

were randomized to either have the opportunity to apply for Medicaid or not. An analysis of clinical outcomes two years into the experiment found that Medicaid coverage was associated with a 9.15% absolute decrease (30% relative decrease) in the rates of prevalent depression(50), and was also associated with decreases in financial strain related to medical costs. Specifically, there were decreases in the percentage of participants with any out-of-pocket spending or medical debt, the amount of out-of-pocket spending, and the percent who had to borrow money to pay their medical bills or skipped payment on those bills(50).

Though nearly all participants in our study (97%) had some form of health insurance, those with coverage could still experience high financial strain if they had high deductibles or co-payments, or were close to exceeding (or had already exceeded) their annual or lifetime limits on benefits. Reductions in income as a result of absenteeism or work disability have also been documented as a source of financial strain in SLE(49); thus, where possible, workplace adaptations such as flexible hours and telecommuting may help maintain SLE patients' employment, and financial security and health status alongside.

We acknowledge some limitations in this analysis. As mentioned, although members of the LOS cohort were recruited from a variety of medical and community settings, this was a highly educated, predominantly White cohort, and these findings may not be generalizable to other populations of SLE. Moreover, those who were too ill to complete the interviews were not included. While participants' SLE diagnoses were clinically confirmed, the data on disease activity, disease damage, and other covariates were self-reported, and these measures, though obtained using validated instruments, may differ from those obtained using the SLEDAI, BILAG, or other physician assessments. The outcome of new-onset depression was based upon a CES-D score  $\geq 3$ , and was not clinically confirmed. However, in a prior validation study that used the Mini-International Neuropsychiatric Interview as the gold standard(28), this cut-point had a sensitivity of 88% for major depressive disorder, and a specificity of 89%.

Our analysis was based upon measurements of current financial strain, and current severity of depressive symptoms, taken one year apart. As it is unknown how levels of financial strain or depressive symptoms may have fluctuated over the intervening 12 months, our findings should be viewed with some caution. Still, the longitudinal nature of the LOS, where data on depressive symptom severity and other factors were collected annually, lent this study many strengths, including the ability to separate prevalent cases of depression each year from new or relapsing cases. Our prospective collection of this data adds support to the directionality of the relationships we observed (i.e. financial strain contributing to depression instead of depression causing financial strain), and minimizes the possibility of recall bias, wherein those who developed depression may be more likely to report past financial strain than those who did not.

In summary, we found that experiencing high levels of financial strain at one point in time was associated with an increased risk of developing depression the subsequent year. However, neither education nor living in poverty during that first year were independently associated with new-onset depression. As these findings suggest that high financial strain can increase the risk for depression regardless of education or income level, and depression



is a highly-treatable condition, we hope they will provide additional incentive for routine screening for depression in all SLE patients. Additionally, while the complexities of socioeconomic disparities make them difficult to fully address, this analysis has identified financial strain as a more specific driver of depression in SLE, one that is potentially more modifiable than other aspects of SES like educational attainment or total household income. Further work is needed to confirm these findings, and to explore policies that may help reduce financial strain, and in turn, potentially reduce the burden of depression in SLE.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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### SIGNIFICANCE AND INNOVATIONS

- Depression is common in women with systemic lupus erythematosus (SLE), and rates of prevalent depression are higher amongst those in lower socioeconomic groups.
- Financial strain has been shown to increase the risk of depression in the general population, but this is the first study to assess levels of current and anticipated financial strain as risk factors for new-onset depression in SLE.
- While neither race/ethnicity, poverty, income, nor education were independent predictors of new-onset depression, high financial strain was, and remained so in a number of sensitivity analyses.
- Prospective collection of the data minimized recall bias, and provides additional support for the directionality of this relationship between financial strain and incident depression in SLE.

**Table 1**

Baseline characteristics of systemic lupus erythematosus participants

	All participants, at time 1 (n=682)	Never developed depression (n=516)	Developed depression (n=166)	p-value
<b>Demographic</b>				
Age, mean (SD) years	51.0 (13.5)	50.8 (13.7)	52.4 (13.1)	0.20
Married or living with a partner	400 (59%)	309 (60%)	90 (54%)	0.19
<b>Race/ethnicity</b>				
White	414 (61%)	319 (62%)	95 (57%)	0.29
Hispanic	69 (10%)	49 (9%)	20 (12%)	0.34
African American	72 (11%)	49 (9%)	23 (14%)	0.11
Asian	81 (12%)	61 (12%)	20 (12%)	0.94
Other	46 (7%)	38 (7%)	8 (5%)	0.25
<b>Socioeconomic</b>				
Living below poverty <sup>a</sup>	88 (13%)	57 (11%)	31 (19%)	0.01*
<b>Household Income<sup>b</sup></b>				
< \$40,000	240 (35%)	164 (32%)	76 (46%)	< 0.01*
\$40,000 to < \$80,000	184 (27%)	141 (27%)	43 (26%)	0.72
\$80,000	220 (32%)	183 (35%)	37 (22%)	< 0.01*
<b>Educational Attainment</b>				
College degree (Bachelor's degree or higher)	306 (45%)	247 (48%)	60 (36%)	0.01*
<b>General Health</b>				
Current smoker	41 (6%)	25 (5%)	13 (8%)	0.14
Former smoker	215 (32%)	158 (31%)	60 (36%)	0.18
Body mass index 26.8 kg/m <sup>2</sup>	277 (41%)	206 (40%)	71 (43%)	0.52
Body mass index 30 kg/m <sup>2</sup>	174 (26%)	123 (24%)	51 (31%)	0.08
Depressive symptoms, mean (SD) CES-D score	9.3 (6.6)	7.8 (6.1)	14.2 (5.6)	< 0.01*
Physical functioning, mean (SD) SF-36-PF score	41.2 (12.1)	43.2 (11.5)	35.8 (11.7)	< 0.01*
<b>SLE Characteristics</b>				
Disease duration, mean (SD) years	18.0 (8.9)	18.2 (9.1)	18.4 (8.5)	0.72
Disease activity, mean (SD) SLAQ score	10.2 (6.7)	8.9 (6.3)	13.9 (6.7)	< 0.01*
Disease damage, mean (SD) BILD score	1.9 (2.0)	1.8 (2.0)	2.2 (2.1)	0.03*
BILD score=0	183 (27%)	146 (28%)	37 (22%)	0.13
BILD score=1	190 (28%)	139 (27%)	51 (31%)	0.34
BILD score=2	109 (16%)	92 (18%)	17 (10%)	0.02*
BILD score 3	199 (29%)	138 (27%)	61 (37%)	0.01*

\* significant at p < 0.05

<sup>a</sup>Missing for 15 individuals: 7 who never developed depression and 8 who did

<sup>b</sup>Missing for 38 individuals: 28 who never developed depression and 10 who did

CES-D=Center for Epidemiological Studies Depression Scale (0–60)

SF-36-PF=SF-36 Scale of Physical Functioning (0–100)

SLAQ=Systemic Lupus Activity Questionnaire (0–44)

BILD=Brief Index of Lupus Damage (0–26)

-Column 2 data pertains to the earliest observation in the dataset while Column 3 data pertains to the year before depression developed; therefore, the sums of the Column 2 and 3 values do not always equal the Column 1 value

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**Table 2**

Baseline characteristics of potential systemic lupus erythematosus participants with and without depression at time 1

	All included participants (not depressed at time 1) (n=682)	Excluded participants (depressed at time 1) (n=77)	p-value
<b>Demographic</b>			
Age, mean (SD) years	51.0 (13.5)	50.6 (9.5)	0.71
Married or living with a partner	400 (59%)	36 (47%)	0.05
<b>Race/ethnicity</b>			
White	414 (61%)	44 (57%)	0.54
Hispanic	69 (10%)	11 (14%)	0.26
African American	72 (11%)	11 (14%)	0.32
Asian	81 (12%)	3 (4%)	0.03 *
Other	46 (7%)	8 (10%)	0.24
<b>Socioeconomic</b>			
Living below poverty <sup>a</sup>	88 (13%)	25 (32%)	< 0.01 *
<b>Household Income<sup>b</sup></b>			
< \$40,000	240 (35%)	43 (56%)	< 0.01 *
\$40,000 to < \$80,000	184 (27%)	19 (25%)	0.60
\$80,000	220 (32%)	12 (16%)	< 0.01 *
<b>Education</b>			
College degree (Bachelor's degree or higher)	306 (45%)	17 (22%)	< 0.01 *
<b>General Health</b>			
Current smoker	41 (6%)	12 (16%)	< 0.01 *
Former smoker	215 (32%)	25 (32%)	0.87
Body mass index 26.8 kg/m <sup>2</sup>	277 (41%)	44 (57%)	< 0.01 *
Body mass index 30 kg/m <sup>2</sup>	174 (26%)	35 (45%)	< 0.01 *
Depressive symptoms, mean (SD) CES-D score	9.3 (6.6)	35.2 (9.2)	< 0.01 *
Physical functioning, mean (SD) SF-36-PF score	41.2 (12.1)	30.4 (10.4)	< 0.01 *
<b>SLE Characteristics</b>			
Disease duration, mean (SD) years	18.0 (8.9)	18.0 (8.6)	0.86
Disease activity, mean (SD) SLAQ score	10.2 (6.7)	20.6 (7.6)	< 0.01 *
Disease damage, mean (SD) BILD score	1.9 (2.0)	3.3 (3.0)	< 0.01 *
BILD score=0	183 (27%)	11 (14%)	0.02 *
BILD score=1	190 (28%)	18 (23%)	0.40
BILD score=2	109 (16%)	7 (9%)	0.11
BILD score 3	199 (29%)	40 (52%)	< 0.01 *
<b>Financial Strain</b>			
High	130 (19%)	41 (53%)	< 0.01 *

	All included participants (not depressed at time 1) (n=682)	Excluded participants (depressed at time 1) (n=77)	p-value
Moderate	320 (47%)	27 (35%)	0.05
None	232 (34%)	9 (12%)	< 0.01*

\* significant at  $p < 0.05$

<sup>a</sup>Missing for 16 individuals: 15 non-depressed at T1 and 1 depressed at T1

<sup>b</sup>Missing for 41 individuals: 38 non-depressed at T1 and 3 depressed at T1

CES-D=Center for Epidemiological Studies Depression Scale (0–60)

SF-36-PF=SF-36 Scale of Physical Functioning (0–100)

SLAQ=Systemic Lupus Activity Questionnaire (0–44)

BILD=Brief Index of Lupus Damage (0–26)

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**Table 3**

Responses to questions on current and anticipated financial strain

	All participants, at time 1 (n=682)	Never developed depression (n=516)	Developed depression(n=166)
<b>Responses to financial strain questions</b>			
<b>1. In the next two months, how likely is it that you and your family will experience actual hardships, such as inadequate housing, food, or medical attention?</b>			
Very Likely	42 (6%)	23 (4%)	18 (11%)
Somewhat Likely or Not Too Likely	196 (29%)	135 (26%)	61 (37%)
Not at all Likely	439 (64%)	356 (69%)	84 (51%)
No response	5 (0.7%)	2 (0.4%)	3 (2%)
<b>2. In the next two months, how likely is it that you and your family will have to reduce your standard of living to the bare necessities in life</b>			
Very Likely	76 (11%)	47 (9%)	31 (19%)
Somewhat Likely or Not Too Likely	229 (34%)	163 (32%)	68 (41%)
Not at all Likely	368 (54%)	300 (58%)	64 (39%)
No response	9 (1%)	6 (1%)	3 (2%)
<b>3. How difficult is it for you to live on your total household income right now</b>			
Very or Extremely Difficult	101 (15%)	56 (11%)	42 (25%)
Difficult or Somewhat Difficult	288 (42%)	217 (42%)	76 (46%)
Not at all Difficult	292 (43%)	242 (47%)	48 (29%)
No response	1 (0.1%)	1 (0.2%)	0
<b>Overall Level of Financial Strain</b>			
High <sup>a</sup>	130	78 (60%) <sup>d</sup>	52 (40%) <sup>e</sup>
Moderate <sup>b</sup>	320	242 (76%)	78 (24%)
None <sup>c</sup>	232	196 (84%)	36 (16%)

<sup>a</sup> Responded “Very Likely” or “Very or Extremely Difficult” to any of the three questions<sup>b</sup> Responses to the three questions were a combination of “Somewhat Likely or Not Too Likely”, “Not at all Likely”, “Difficult or Somewhat Difficult”, and “Not at all Difficult”<sup>c</sup> Responded “Not at all Likely” or “Not at all Difficult” to all three questions<sup>d</sup> Number (percent) of those with High financial strain at T1 who never developed depression<sup>e</sup> Number (percent) of those with High financial strain at T1 who developed depression at T2

**Table 4**

Levels of Financial Strain by Poverty Status, Household Income, Educational Attainment, and Race/Ethnicity

	High	Moderate	None	p-value
All Participants	130 (19%)	320 (47%)	232 (34%)	–
<b>Poverty Status<sup>a</sup></b>				
Poverty	54 (61%)	28 (32%)	6 (7%)	< 0.01 *
Not in Poverty	74 (12%)	287 (48%)	218 (37%)	
<b>Household Income<sup>b</sup></b>				
< \$40,000	106 (44%)	114 (48%)	20 (8%)	
\$40,000 to < \$80,000	15 (8%)	111 (60%)	58 (32%)	< 0.01 *
\$80,000	4 (2%)	82 (37%)	134 (61%)	
<b>Educational Attainment</b>				
No College Degree	92 (25%)	190 (51%)	93 (25%)	< 0.01 *
College Degree	38 (12%)	130 (42%)	139 (45%)	
<b>Race/Ethnicity</b>				
White	72 (17%)	192 (46%)	150 (36%)	
Hispanic	17 (25%)	34 (49%)	18 (26%)	
African American	24 (33%)	35 (49%)	13 (18%)	0.01 *
Asian American	11 (14%)	35 (43%)	35 (43%)	
Other	6 (13%)	24 (52%)	16 (35%)	

\* chi-square test significant at  $p < 0.05$ <sup>a</sup>Missing for 15 individuals: 2 high-strain, 5 moderate-strain, 8 no-strain<sup>b</sup>Missing for 38 individuals: 5 high-strain, 13 moderate-strain, 20 no-strain

**Table 5**

Predictors of the development of depression over 1 year

	<b>Bivariate analyses, OR (95% CI), p-value</b>	<b>Model #1: Covariates<sup>d</sup> + Poverty, OR (95% CI), p-value</b>	<b>Model #2: Covariates<sup>d</sup> + Education, OR (95% CI), p-value</b>	<b>Model #3: Covariates<sup>d</sup> + Income, OR (95% CI), p-value</b>	<b>Model #4: Covariates<sup>d</sup> + Financial Strain, OR (95% CI), p-value</b>	<b>Model #5: Covariates<sup>d</sup> + Poverty + Education + Financial Strain, OR (95% CI), p-value</b>
Age	1.00 (0.99–1.01), > 0.99	1.00 (0.98–1.01), 0.66	1.00 (0.98–1.01), 0.61	0.99 (0.97–1.01), 0.26	1.00 (0.98–1.01), 0.79	1.00 (0.98–1.02), 0.80
Married or living with a partner	0.69 (0.50–0.94) *, 0.02	0.80 (0.56–1.14), 0.22	0.77 (0.54–1.11), 0.16	0.80 (0.55–1.17), 0.25	0.87 (0.59–1.27), 0.46	0.87 (0.60–1.26), 0.46
Living below poverty	2.33 (1.53–3.54) *, < 0.01	1.16 (0.70–1.91), 0.56	n/a	n/a	n/a	1.01 (0.59–1.74), 0.96
<b>Household Income</b>						
< \$40,000	2.08 (1.40–3.10) *, < 0.01	n/a	n/a	1.06 (0.64–1.75), 0.82	n/a	n/a
\$40,000 to < \$80,000	0.92 (0.64–1.32), 0.64	n/a	n/a	1.15 (0.76–1.72), 0.52	n/a	n/a
\$80,000 (reference)	–	–	–	–	–	–
<b>Education</b>						
Did not graduate college	1.60 (1.13–2.26) *, 0.01	n/a	1.03 (0.69–1.54), 0.87	n/a	n/a	0.98 (0.65–1.48), 0.93
College graduate (reference)	–	–	–	–	–	–
<b>General Health</b>						
Baseline depression (CES-D score)	1.18 (1.15–1.21) *, < 0.01	1.14 (1.11–1.18) *, < 0.01	1.15 (1.11–1.18) *, < 0.01	1.15 (1.12–1.18) *, < 0.01	1.14 (1.11–1.18) *, < 0.01	1.14 (1.11–1.18) *, < 0.01
Physical functioning (SF-36 score)	0.96 (0.94–0.97) *, < 0.01	0.99 (0.97–1.01), 0.45	0.99 (0.97–1.01), 0.42	0.99 (0.97–1.01), 0.29	1.00 (0.97–1.02), 0.65	1.00 (0.97–1.02), 0.65
<b>SLE Disease Characteristics</b>						
Disease activity, SLAQ score (per five-point increment)	1.60 (1.44–1.77) *, < 0.01	1.24 (1.07–1.45) *, 0.01	1.24 (1.07–1.45) *, 0.01	1.25 (1.07–1.46) *, < 0.01	1.23 (1.05–1.43) *, 0.01	1.23 (1.05–1.43) *, 0.01
Disease damage, mean (SD) BILD score	1.09 (1.01–1.17) *, 0.03	0.97 (0.89–1.06), 0.54	0.97 (0.89–1.06), 0.54	0.96 (0.87–1.06), 0.43	0.96 (0.88–1.06), 0.42	0.96 (0.88–1.06), 0.42
<b>Financial Strain</b>						
High	2.53 (1.81–3.52) *, < 0.01	n/a	n/a	n/a	1.85 (1.09–3.16) *, 0.02	1.85 (1.06–3.23) *, 0.03
Moderate	1.16 (0.87–1.53), 0.31	n/a	n/a	n/a	1.39 (0.91–2.13), 0.13	1.39 (0.91–2.13), 0.13
None (reference)	–	–	–	–	–	–

\* significant at p < 0.05

Age, marital status, race/ethnicity, obesity, current smoking status, baseline CES-D score, SF-36 physical functioning score, SLE disease duration, disease activity (SLAQ score), disease damage (BILD score)

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