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Association of Poverty Income Ratio with Physical Functioning in a Cohort of Patients with Systemic Lupus Erythematosus

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Abstract

Objective: To examine the association of income relative to the poverty threshold [poverty income ratio (PIR)] with self-reported physical functioning in a cohort of systemic lupus erythematosus patients.

Methods: We used cross-sectional data on 744 participants from Georgians Organized Against Lupus (GOAL), and secondary analyses used data on 56 participants from a nested pilot study. Primary analyses utilized multivariable linear regression to estimate the association between PIR (categorized as <1.00, 1.00-1.99, 2.00-3.99, and ≥4.00; lower PIRs indicate higher poverty) and Physical Functioning (PF; scaled subscore from Short Form-12 survey; range, 0-100, higher scores indicate better functioning). Secondary analyses summarized complementary measures of physical functioning as means or percentages by PIR (categorized as <1.00, 1.00-1.99, and ≥2.00).

Results: Overall, the mean age of participants was 48.0 years; 6.7% were male; 80.9% were black; and 37.5%, 21.0%, 29.6% and 12.0% had PIRs of <1.00, 1.00-1.99, 2.00-3.99, and ≥4.00, respectively. The overall mean PF score was 45.8 (36.2, 40.7, 55.5, and 61.2 for PIRs of <1.00, 1.00-1.99, 2.00-3.99, and ≥4.00, respectively). With adjustment, higher PIRs remained associated (β (95% CI)) with higher PF scores (2.00-3.99 vs. 1.00-1.99: 10.9 (3.3 to 18.6); ≥4.00 vs. 1.00-1.99: 16.2 (6.4 to 26.0)). In secondary analyses, higher PIR was also associated with higher scores for objective physical performance.

Conclusion: Our results show that higher income relative to the poverty threshold is associated with better physical functioning across multiple domains, warranting further research into multi-component functional assessments to develop individual treatment plans and, potentially, improve socioeconomic disparities in outcomes.

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Keywords

Systemic lupus erythematosus; quality of life; epidemiology

Introduction

Low socioeconomic status (SES) is an established risk factor for worse outcomes in systemic lupus erythematosus (SLE) patients, such as greater disease damage and worse depressive symptomatology (1–7). Additionally, SLE patients often experience work loss (8, 9), activity limitations (10), and reduced health-related quality-of-life (HRQOL) (11–16), and low SES has been associated with lower HRQOL among SLE patients (5, 7, 17). Particularly, previous studies examining HRQOL and SES have shown that lower individual-level and neighborhood-level SES have been associated with poorer physical functioning among SLE patients (5, 7, 17). However, to our knowledge, none have used the income-to-poverty ratio, commonly known as the poverty income ratio (PIR), with more than two categories. The PIR, the official poverty measure of the U.S. Census (18), not only reflects individual SES relative to the poverty threshold but also accounts for household size, resulting in an estimate that provides a more accurate picture of an individual's poverty experience. For example, many SLE patients may have no income because they are dependents, or they may have household members who act as full-time caretakers; whether these SLE patients are "living in poverty" depends on the combined income of their entire household and number of household members depending on that income. Further, it may be important to utilize more than two PIR categories, since the experience of living just above the poverty threshold likely differs substantially from living far above the threshold.

Previous studies of HRQOL have targeted mostly white populations (5–7), despite black individuals having a greater burden of disease (*e.g.*, black women have >3 times greater incidence of SLE than white women) (19) and greater susceptibility for worse SLE-related outcomes (1, 3). We hypothesized that lower PIRs would be associated with worse functioning among SLE patients. Using cross-sectional data from the Georgians Organized Against Lupus (GOAL) cohort, an ongoing, population-based cohort predominantly comprised of black participants, we examined the association between multiple categories of PIR and self-reported physical functioning and whether the association differed by work status or race. In secondary analyses, using data from a nested ancillary pilot study, we also examined whether associations of PIR with functioning were consistent across a comprehensive set of measures related to physical functioning, including objective measures of physical performance.

Patients and Methods

Study Populations and Data Sources

For primary analyses, we used data from the ongoing GOAL cohort study, a population-based sample of patients with SLE from metropolitan Atlanta, Georgia. Recruitment and data collection methods have been previously published (20). Briefly, participants of GOAL were primarily recruited from the existing Georgia Lupus Registry, a population-based

registry funded by the Centers for Disease Control and Prevention, which estimated the incidence and prevalence of SLE in metropolitan Atlanta (19). Patients not included in the registry but who were receiving SLE treatment at Emory University, Grady Memorial Hospital (a large safety-net hospital in Atlanta), or from community rheumatologists in metropolitan Atlanta at the time of recruitment were recruited to enrich the cohort. Additionally, recruitment emphasized incident patients (≤ 2 years since diagnosis) to minimize survival bias. All participants were recruited by mail, by telephone, or in person, with subsequent assessments performed annually since Wave 1 (baseline; September 2011-September 2012). A total of 850 participants who were aged ≥18 years at the time of enrollment with a documented diagnosis of SLE (≥4 revised American College of Rheumatology (ACR) criteria (21) or 3 ACR criterion with a final diagnosis of SLE by a board-certified rheumatologist) were included in Wave 1. We used a cross-sectional design to describe the association of PIR with physical functioning, which were reported via questionnaire during a single wave of GOAL (Wave 5; June 2016 – July 2017). There was a total of 814 adult participants in Wave 5 of GOAL. For primary analyses, participants were excluded if they were missing either question comprising the physical functioning summary score (n=14), PIR (n=45), or any other covariates (n=70), leaving 744 participants in the final models.

For secondary analyses, a cross-sectional design was used to examine the association of PIR with additional complementary measures of physical functioning not captured in annual GOAL assessments (*i.e.*, objective physical performance, reported activities of daily living, and falls history), which were measured during study visits for a nested, GOAL-ancillary pilot study (October 2016 – April 2017). Recruitment and data collection methods for the pilot have been described previously (22). There were 60 participants in the pilot, and we excluded individuals missing information on PIR (n=4) from analyses, yielding a sample of 56 participants. The Emory University Institutional Review Board approved the main and ancillary study protocols (IRB00003656), and all participants provided informed consent.

Study Variables

Poverty Income Ratio (PIR)—Self-reported PIR was estimated as the ratio of a household income, as reported by the participant, to their appropriate poverty threshold for household size (23), as defined by the U.S. Census Bureau. PIR was grouped into categories of <1.00, 1.00-1.99, 2.00-3.99, and ≥4.00 for primary analyses. When examining the association of PIR with complementary measures of physical functioning among the n=56 included in these analyses, PIR was collapsed into categories of <1.00 (household income below the poverty threshold), 1.00-1.99, and ≥2.00 (household income more than twice the poverty threshold) to maximize study power.

Physical Functioning—Self-reported physical functioning, the primary outcome of interest, was ascertained from the self-administered Short Form-12 questionnaire (SF-12), which is a 12-item version of the SF-36 that is validated (24) and recommended for use in SLE (12). The scores for the Physical Functioning (PF) subscale was calculated from responses to two items of the SF-12: “Does your health now limit you in moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf?” and “Does

your health now limit you in climbing several flights of stairs?", with possible responses for both items of "yes, limited a lot," "yes, limited a little," and "no, not limited at all." The PF score was scaled 0-100, where higher scores represent better functioning (25). In sensitivity analyses, PF was dichotomized as "limited a lot" vs. "not limited a lot" for each question that comprised the scaled PF subscore.

Complementary Measures of Physical Functioning in Nested Pilot

Physical Performance: Physical performance was assessed using the Short Physical Performance Battery (SPPB) (26). The SPPB assessed balance (ability to hold standing poses in different foot positions), gait speed (fastest of two 4-meter walks at regular pace), and lower body strength (time taken to complete five chair stands without using arms), which were scored 0-4 (higher scores indicating better levels of physical performance). The physical performance score was the sum of these three individual scores (range 0-12) (26).

Activities of Daily Living: Instrumental activities of daily living (IADLs; *e.g.*, food preparation and housework) (27) and basic activities of daily living (BADLs; *e.g.*, bathing and dressing) (28) were self-reported, yielding scores that were dichotomized as the ability to perform the activity independently or with minimal assistance vs. inability to perform the activity without assistance.

Falls: Participants were asked if they had fallen in the past year and how many falls they had had in the past year.

Other Variables—All other variables were obtained via the Wave 5 GOAL questionnaires. SLE-related organ damage was assessed using the Self-Administered Brief Index of Lupus Damage (SA-BILD) score (range, 0-30), where higher scores indicate greater levels of damage (29, 30). Depressive symptomatology was assessed via the nine-item Patient Health Questionnaire (PHQ-9; range 0-27), where higher scores indicate more severe depression symptomatology (31). Current SLE activity was assessed using the Systemic Lupus Activity Questionnaire (SLAQ) (range, 0-44), with higher scores indicating greater SLE-related disease activity (32). Age at SLE onset, sex, race, ethnicity, years of education, work status, marital status, social support, and body mass index (BMI) were self-reported by participants. Disease duration was calculated as the difference in age at survey and age at SLE onset.

Statistical Analysis: Participant characteristics of GOAL were summarized overall and by PIR category using χ^2, Fisher's exact, analysis of variance, or non-parametric equality of medians tests, as appropriate. For the association between PIR and PF scores, slopes (βs) and 95% CIs were estimated with multivariable linear regression models. Adjustment for age, race, sex, education, marital status, and disease duration, which were considered a priori confounders, was performed. Because SLE-related organ damage (SA-BILD), depression (PHQ-9), SLE-related disease activity (SLAQ), and BMI were considered potential mediators as well as confounders, separate adjustment for each of these factors was performed using the fully-adjusted multivariable model. Interaction terms between PIR and race, current work status, and depression (PHQ-9 score ≥ 5 vs. ≤ 4) were included to assess potential effect modification by these variables. To address the robustness of results to the

scoring of PF, sensitivity analyses of the association between PIR and PF were performed using multivariable logistic regression models for each question comprising the PF subscore to estimate odds ratios (ORs) and 95% CIs. Logistic regression analyses utilized an identical modeling strategy for linear regression models, but did not address effect modification. Complementary measures of physical performance were summarized overall and by PIR category. Scores for physical performance and self-reported functioning were reported as means or percentages, as appropriate. Comparisons of scores across PIR categories were tested via Fisher's exact or non-parametric equality-of-means tests, as appropriate. All analyses were conducted using SAS v. 9.4 (Cary, NC), and the threshold for statistical significance was set at $\alpha=0.05$.

Results

Characteristics of the SLE Cohort

Overall, the mean age was 48.0 years, 6.7% were male, and 80.9% were black (Table 1). The prevalence of PIRs <1.00, 1.00-1.99, 2.00-3.99, and ≥4.00 among GOAL participants were 37.5%, 21.0%, 29.6%, and 12.0%, respectively. Participants with lower PIRs were younger, had lower educational attainment, were less likely to be married, and were more likely to be black. The mean age at the onset of SLE for PIRs of <1.00, 1.00-1.99, 2.00-3.99, and ≥4.00 were 30.1, 34.3, 32.6, and 35.1 years, respectively. The mean years of disease duration at the time of the survey differed by PIR category, where participants with a higher PIR were more likely to have longer disease duration. Both PHQ-9 and SLAQ scores significantly differed by PIR, in that participants with a lower PIR were more likely to have higher depressive symptoms and disease activity scores. SA-BILD scores did not significantly differ by PIR category.

Association of PIR with Self-Reported PF in GOAL

The overall mean scaled PF score for included GOAL participants was 45.8; and PF scores by PIR category, <1.00, 1.00-1.99, 2.00-3.99, and ≥4.00, were 36.2, 40.7, 55.5, and 61.2, respectively (Table 2). When adjusting for age, sex, and race, participants with a PIR <1.00 had PF score that was, on average, 7.0 points lower than participants with a PIR of 1.00-1.99, while participants with a PIR of 2.00-3.99 had a mean PF score that was 13.1 points higher and participants with a PIR ≥4.00 had a mean PF score that was 20.6 points higher than participants with a PIR of 1.00-1.99. Further adjustment for education, marital status, and disease duration did not substantially change these results. After multivariable adjustment and adjusting for SA-BILD, PHQ-9, and SLAQ scores individually, differences in PF scores by PIR were reduced; adjustment for SLAQ scores reduced differences in PF scores the most (Table 2). Interactions between PIR and work status, race, and depression were not statistically significant.

Sensitivity Analyses

Sensitivity analyses in which the two SF-12 questions comprising the scaled PF score were dichotomized (Table 3) revealed comparable results to primary analyses. In comparison to participants with a PIR of 1.00-1.99, participants with a PIR <1.00 had 26% increased likelihood of reporting that their health limited moderate activities, while participants with a

PIR of 2.00-3.99 had 51% reduced corresponding likelihood and participants with a PIR ≥4.00 had 64% reduced corresponding likelihood. Adjustment for age, sex, race, education, marital status, and disease duration did not considerably change these results. Likewise, individual adjustment of SA-BILD, PHQ-9, and SLAQ scores with multivariable adjustment did not substantially change the association. Participants with a PIR <1.00 were 30% more likely to report their health limiting their ability to climb several flights of stairs in comparison to those with a PIR of 1.00-1.99, whereas those with a PIR of 2.00-3.99 were 54% less likely and those with a PIR ≥4.00 were 61% less likely to report limited ability to climb stairs. Further multivariable adjustment did not substantially change the association of PIR with individuals' health limiting their ability to climb several flights of stairs. Additional adjustment for SA-BILD, PHQ-9, SLAQ, and BMI scores separately gave similar estimates, but adjusting for SLAQ reduced differences in estimates closer to the null.

Complementary Physical Functioning Measures

The mean PF score for the nested pilot participants included in our study was 38.0, where participants with the highest PIRs had the highest PF scores (Table 4). The overall mean balance score was 3.6, while the overall mean gait speed score was 3.4; however, neither balance nor gait speed scores statistically significantly differed by PIR category. The mean lower body strength scores for PIRs of <1.00, 1.00-1.99, and ≥2.00 were 1.6, 1.4, and 2.7, respectively. For PIRs of <1.00, 1.00-1.99, and ≥2.00, the mean overall physical performance scores were 8.4, 8.2, and 10.2, respectively. Overall, 35.7% of participants reported difficulty with food preparation, 14.3% reported difficulty with housework, 41.1% reported difficulty with shopping, and 12.5% reported difficulty with transportation; yet, the only IADL that statistically significantly differed by PIR was transportation, where 22.6% of participants with a PIR <1.00 reported difficulty with transportation and 0.0% of participants with PIRs of 1.00-1.99 and ≥2.00 reported difficulty with transportation. Overall, 19.6% of pilot participants included in our study reported difficulty with incontinence, which was the only BADL that statistically significantly differed by PIR: 25.8% of participants with a PIR <1.00 reported difficulty with incontinence, 30.0% of participants with a PIR of 1.00-1.99 reported difficulty with incontinence, and 0.0% of participants with a PIR ≥2.00 reported difficulty with incontinence. The mean number of falls that participants reported in the year previous to the study was 2.1, and falls were less frequently reported among those with a PIR >2.00 (26.7% vs. 48.4% and 70.0% for PIRs <1.00 and 1.00-1.99, respectively) (Table 4).

Discussion

In this study, self-reported physical functioning (PF) scores were fairly low in a predominantly black cohort of individuals with SLE (GOAL), regardless of poverty income ratio (PIR) category. The overall PF scores were below the mean of the healthy population in which the SF-12 was developed (50.0) (33,34), similar to previous studies investigating predictors of physical functioning that also show lower PF scores for individuals with SLE (35). On average, participants with higher PIRs had higher PF scores in this study. However, differences between PF scores by PIR category were greatest among participants with the highest income relative to poverty level, compared to those at or just above the poverty

threshold; whereas those with income below the poverty level had similar scores to those with income at the poverty level.

Participants of the nested pilot were demographically and clinically similar to the overall cohort (22), and while those in the nested pilot had lower PF scores than those in the overall cohort (38.0 vs. 45.8), associations of complementary measures of physical functioning with PIR in the pilot, on average, reflected similar associations observed in the overall GOAL cohort. Although PIRs of 2.00-3.99 and ≥4.00 were collapsed into a single category for the nested pilot, the lowest and highest PIR categories of the pilot had similar PF scores to the lowest and highest PIR categories of GOAL (36.2 and 61.2 vs. 32.3 and 60.0), indicating that levels of physical functioning are not substantially different from the overall cohort from which participants were selected. Differences in physical performance scores, on average, were larger with higher PIR. Of the instrumental activities of daily living (IADLs), a greater proportion of individuals with lower vs. higher PIRs reported difficulties with food preparation, housework, laundry, shopping, and transportation. Other IADL domains showed similar patterns, though they were not statistically significant. Statistically significant differences in the proportion of individuals reporting difficulties with basic activities of daily living (BADLs) between PIR categories were only observed for incontinence, which was only reported among those at (30%) or below (26%) the poverty threshold.

Previous studies have shown that SLE patients frequently have muscle weakness, high levels of fatigue, and low rates of physical activity (36–38), resulting in reduced physical functioning (39–41), an important aspect of health-related quality-of-life (HRQOL). While perceived physical functioning is important in addressing HRQOL, objective measures of physical functioning have not been as thoroughly studied in SLE populations (22). Additionally, studies examining physical functioning in SLE patients often do not employ multi-component assessments of functioning, such as those applied in populations of older adults. Measures of physical functioning in older adults, such as IADLs and BADLs, history of falls, gait speed, and chair stands (42), are predictors of worse mortality and health outcomes (26). Here, we found that multiple components of functioning may be associated with socioeconomic status (SES). Further, while lower individual-level and neighborhood-level SES have been shown to be associated with poorer physical functioning among SLE patients (5, 7, 17), to our knowledge, none have used multiple categories of the income-to-poverty ratio, commonly known as the poverty income ratio (PIR), which provides a more in-depth measurement of relative poverty.

Because our method of determining PF scores (25) is not validated across studies of HRQOL, it is unknown whether the estimated differences reflect clinically important differences in physical functioning. However, using the statistical definition of a minimally important difference in PF scores as half a standard deviation of the PF scores (43) from the overall GOAL cohort (=18.0 points), we found that the range of mean unadjusted physical functioning scores was 36.2-61.2, indicating a minimally important difference in PF scores across all PIR categories by this definition. However, pairwise differences in mean unadjusted PF scores between adjacent PIR categories were not meaningful.

In the ancillary pilot study, substantial levels of impairment in physical performance and self-reported functioning were found, irrespective of PIR category. For many domains, increasing PIR was associated with less impairment; however, we also found slightly greater impairment among participants with a PIR between 1.00-1.99 than those with a PIR of <1.00 for balance, lower body strength, and overall physical performance scores. Regardless of PIR, physical performance in this SLE cohort was comparable to, and sometimes lower than, that in the older (≥70 years) adult population, in which the test was developed (26). In a population-based sample of older adults born before 1947 in the United States, adults who had more sources of income had faster gait speed (44), which corresponds to the similar association of increased gait speed scores with higher PIRs found in our study.

Our study has limitations and strengths worth mentioning. First, this study is cross-sectional, which limits causal inference, and the lack of long-term follow-up data means that we do not know individual trajectories in PIR or physical functioning over time. Exclusions due to missing data, especially with regards to PIR, may have led to selection bias. Because PF scores were determined using two questions from the SF-12 survey, the measure may not adequately represent physical functioning and misclassification may have occurred. Functioning may fluctuate over time with SLE activity, so a single measure of physical functioning may not accurately portray participants' functioning. As with all observational studies, it is possible that we have not accounted for unknown confounders, and thus have residual confounding. Because our cohort was predominantly black, we were likely inadequately powered to examine effect modification by race. For the complementary outcomes measured only in our nested pilot study, the small sample size further decreased our power to examine factors that influence, confound, or modify functioning. Generalizability of the results beyond metropolitan Atlanta may be limited, because the cohort is a population-based sample reflecting the demographics of this specific area.

Despite these limitations, our study has several strengths, such as the large sample size of GOAL. A population-based sample of patients with SLE with adequate representation of black individuals yields an accurate portrayal of HRQOL in a diverse cohort. Sensitivity analyses showing that the association between PIR and PF remained after dichotomizing the outcome reduces concerns about whether the measurement of PF scores was too crude. Lastly, the use of multi-domain functional assessments is relatively novel in SLE populations, providing new insight that may allow for developing individual treatment plans and improving disparities in outcomes.

In conclusion, lower income, relative to poverty thresholds and household size, may be associated with worse functioning across multiple domains in SLE. Given these results, future directions could include in-depth assessment of SES, taking relative poverty into account, multidomain functioning assessments in a larger cohort, as well as investigation of trajectories in both relative poverty and functioning. Further research into multi-component functional assessments to develop individual treatment plans and potentially improve socioeconomic disparities in outcomes is warranted.

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Table 1.

Characteristics of SLE patients participating in the Georgians Organized Against Lupus cohort (June 2016 - July 2017) overall and categorized by poverty income ratio

		Poverty income ratio[a]				
Characteristic	**Overall (n=744)**	**<1.00 (n=279)**	**1.00-1.99 (n=156)**	**2.00-3.99 (n=220)**	**≥4.00 (n=89)**	**P Value[b]**
Sociodemographic						
Mean (SD) age at survey	48.0 (13.6)	44.3 (13.9)	50.4 (13.4)	48.9 (13.0)	53.1 (12.0)	<0.001
Sex, no. (%)						
Male	50 (6.7)	16 (5.7)	12 (7.7)	17 (7.7)	5 (5.6)	0.75
Female	694 (93.3)	263 (94.3)	144 (92.3)	203 (92.3)	84 (94.4)	
Race, no. (%)						
Black	602 (80.9)	257 (92.1)	138 (88.5)	154 (70.0)	53 (59.6)	<0.001
White	117 (15.7)	16 (5.7)	13 (8.3)	55 (25.0)	33 (37.1)	
Other	25 (3.4)	6 (2.2)	5 (3.2)	11 (5.0)	3 (3.4)	
Ethnicity, no. (%)[c]						
Hispanic	30 (4.1)	10 (3.6)	5 (3.2)	11 (5.0)	4 (4.5)	0.81
Non-Hispanic	709 (95.5)	266 (96.4)	150 (96.7)	208 (95.0)	85 (95.5)	
Mean (SD) years of education	14.6 (3.0)	13.1 (2.3)	13.8 (2.4)	16.1 (2.9)	17.4 (2.9)	<0.001
Currently employed, no. (%)						
No	449 (60.4)	212 (76.0)	103 (66.0)	104 (47.3)	30 (33.7)	<0.001
Yes	295 (39.7)	67 (24.0)	53 (34.0)	116 (52.7)	59 (66.3)	
Currently married/partner, no. (%)						
No	504 (67.7)	247 (88.5)	125 (80.1)	92 (41.8)	40 (44.9)	<0.001
Yes	240 (32.3)	32 (11.5)	31 (19.9)	128 (58.2)	49 (55.1)	
Currently receiving social support, no. (%)[d]						
No	410 (56.2)	117 (42.4)	71 (47.3)	148 (68.5)	74 (84.1)	<0.001
Yes	320 (43.8)	159 (57.6)	79 (52.7)	68 (31.5)	14 (15.9)	
Clinical						

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		Poverty income ratio[a]				
Characteristic	**Overall (n=744)**	**<1.00 (n=279)**	**1.00-1.99 (n=156)**	**2.00-3.99 (n=220)**	**≥4.00 (n=89)**	**P Value[b]**
Mean (SD) age at diagnosis, years	32.5 (12.0)	30.1 (11.3)	34.3 (12.4)	32.6 (12.0)	35.1 (12.3)	<0.01
Mean (SD) disease duration, years	15.4 (10.0)	13.7 (9.9)	16.1 (10.8)	16.2 (9.5)	18.0 (9.6)	<0.001
Median (IQR) SA-BILD score	3.0 (1.0-4.0)	3.0 (1.0-5.0)	3.0 (1.0-4.0)	2.0 (1.0-4.0)	2.0 (1.0-3.0)	0.17
Median (IQR) PHQ-9 score	6.0 (2.0-11.0)	8.0 (4.0-12.0)	7.0 (3.0-12.0)	5.0 (2.0-9.0)	3.0 (2.0-8.0)	<0.001
Median (IQR) SLAQ score	15.0 (9.0-22.0)	18.0 (12.0-24.0)	16.0 (9.5-22.0)	11.0 (7.0-18.0)	10.0 (7.0-15.0)	<0.001

[a] Ratio of household income to appropriate poverty threshold for household size, as defined by the United States Census Bureau (lower poverty income ratio indicates greater poverty)

[b] By χ^2, Fisher's exact, analysis of variance, or non-parametric equality-of-medians test, as appropriate

[c] Missing data, n=739

[d] Missing data, n=730

SA-BILD: Self-Administered Brief Index of Lupus Damage, PHQ-9: nine-item Patient Health Questionnaire, SLAQ: Systemic Lupus Activity Questionnaire: higher scores indicate more of the domain measured with these instruments; SLE: systemic lupus erythematosus

Table 2.

Association between poverty income ratio and self-reported physical functioning among participants with SLE in the Georgians Organized Against Lupus cohort[a]

	Poverty income ratio[b]			
Outcome	**<1.00**	**1.00 - 1.99**	**2.00 - 3.99**	**≥4 .00**
Mean (SD) physical functioning score[c]	36.20 (34.16)	40.71 (35.38)	55.45 (34.85)	61.24 (34.75)
Difference in physical functioning score[c] (95% CI)				
Unadjusted	−4.50 (−11.31, 2.30)	1.00 (ref.)	14.75 (7.62, 21.88)	20.53 (11.48, 29.58)
Age, sex, and race adjusted	−7.02 (−13.79, −0.25)	1.00 (ref.)	13.09 (6.00, 20.17)	20.62 (11.54, 29.69)
Multivariable-adjusted[d]	−6.02 (−12.81, 0.76)	1.00 (ref.)	10.90 (3.25, 18.55)	16.21 (6.39, 26.03)
Multivariable + SA-BILD score	−4.13 (−10.80, 2.55)	1.00 (ref.)	10.91 (3.42, 18.39)	13.47 (3.82, 23.13)
Multivariable + PHQ-9 score	−4.92 (−11.22, 1.38)	1.00 (ref.)	7.99 (0.87, 15.11)	12.34 (3.21, 21.48)
Multivariable + SLAQ score	−2.56 (−8.82, 3.69)	1.00 (ref.)	6.51 (−0.55, 13.57)	9.17 (0.08, 18.25)
Multivariable + BMI	−7.27 (−14.05, −0.49)	1.00 (ref.)	10.51 (2.88, 18.13)	16.02 (6.18, 25.87)

[a] Analysis of complete data (n=744)

[b] Ratio of household income to appropriate poverty threshold for household size, as defined by the United States Census Bureau (lower poverty income ratio indicates greater poverty)

[c] Scaled score of physical functioning (PF) subscore from twelve-item Short-Form Health Survey (SF-12), 0-100 (higher scores indicate better physical functioning)

[d] Adjusted for age, sex, race (black vs. not black), education, marital status (married vs. not married), and disease duration

SA-BILD: Self-Administered Brief Index of Lupus Damage, PHQ-9: nine-item Patient Health Questionnaire, SLAQ: Systemic Lupus Activity Questionnaire: higher scores indicate more of the domain measured with these instruments

BMI: body mass index, SLE: systemic lupus erythematosus

Table 3.

Association between poverty income ratio and low vs. high physical functioning among participants with SLE in the Georgians Organized Against Lupus cohort[a]: sensitivity analysis

	OR (95% CI) for physical functioning score[b] by poverty income ratio[c]			
Model	**<1.00**	**1.00 - 1.99**	**2.00 - 3.99**	**≥4 .00**
Health limits moderate activities				
Unadjusted	1.26 (0.84, 1.90)	1.00 (ref.)	0.49 (0.30, 0.78)	0.36 (0.19, 0.70)
Age, sex, and race adjusted	1.48 (0.97, 2.26)	1.00 (ref.)	0.51 (0.32, 0.83)	0.35 (0.18, 0.68)
Multivariable-adjusted[d]	1.46 (0.95, 2.25)	1.00 (ref.)	0.49 (0.29, 0.83)	0.36 (0.17, 0.75)
Multivariable + SA-BILD score	1.34 (0.87, 2.08)	1.00 (ref.)	0.48 (0.28, 0.82)	0.42 (0.20, 0.87)
Multivariable + PHQ-9 score	1.45 (0.92, 2.27)	1.00 (ref.)	0.54 (0.31, 0.94)	0.41 (0.20, 0.88)
Multivariable + SLAQ score	1.28 (0.82, 2.02)	1.00 (ref.)	0.58 (0.34, 1.01)	0.50 (0.23, 1.07)
Health limits climbing several flights of stairs				
Unadjusted	1.30 (0.87, 1.92)	1.00 (ref.)	0.46 (0.30, 0.71)	0.39 (0.22, 0.70)
Age, sex, and race adjusted	1.46 (0.98, 2.20)	1.00 (ref.)	0.48 (0.31, 0.75)	0.38 (0.21, 0.70)
Multivariable-adjusted[d]	1.38 (0.91, 2.08)	1.00 (ref.)	0.57 (0.36, 0.93)	0.51 (0.27, 0.96)
Multivariable + SA-BILD score	1.25 (0.82, 1.89)	1.00 (ref.)	0.57 (0.35, 0.92)	0.59 (0.31, 1.13)
Multivariable + PHQ-9 score	1.35 (0.88, 2.08)	1.00 (ref.)	0.64 (0.39, 1.06)	0.59 (0.30, 1.16)
Multivariable + SLAQ score	1.20 (0.78, 1.85)	1.00 (ref.)	0.67 (0.41, 1.11)	0.69 (0.35, 1.34)

[a] Analysis of complete data (n=744)

[b] Dichotomized two questions comprising physical functioning (PF) subscore from twelve-item Short-Form Health Survey (SF-12): limited a lot vs. not limited a lot

[c] Ratio of household income to appropriate poverty threshold for household size, as defined by the United States Census Bureau (lower poverty income ratio indicates greater poverty)

[d] Adjusted for age, sex, race (black vs. not black), education, marital status (married vs. not married), and disease duration

SA-BILD: Self-Administered Brief Index of Lupus Damage, PHQ-9: nine-item Patient Health Questionnaire, SLAQ: Systemic Lupus Activity Questionnaire: higher scores indicate more of the domain measured with these instruments

SLE: systemic lupus erythematosus

Table 4.

Physical performance and self-reported function overall and categorized by poverty income ratio of SLE participants in a Georgians Organized Against Lupus-ancillary pilot study (October 2016 - April 2017)

		Poverty income ratio[a]			
Measure	**Overall (n=56)**	**<1.00 (n=31)**	**1.00-1.99 (n=10)**	**≥2.00 (n=15)**	**p Value[b]**
Physical functioning					
Mean (SD) physical functioning score[c]	37.95 (34.37)	32.26 (33.04)	22.50 (21.89)	60.00 (35.10)	0.02
Physical performance[d]					
Mean (SD) balance score[e]	3.64 (0.86)	3.67 (0.94)	3.50 (0.85)	3.67 (0.72)	0.53
Mean (SD) gait speed score[e]	3.36 (1.07)	3.13 (1.26)	3.30 (0.95)	3.87 (0.35)	0.13
Mean (SD) lower body strength score[e]	1.84 (1.36)	1.58 (1.34)	1.40 (1.08)	2.67 (1.29)	0.02
Mean (SD) overall physical performance score[f]	8.84 (2.61)	8.39 (2.92)	8.20 (1.99)	10.20 (1.82)	0.04
Instrumental activities of daily living					
No. (%) reporting difficulty with:					
Food preparation	20 (35.7)	12 (38.7)	5 (50.0)	3 (20.0)	0.31
Housework	8 (14.3)	6 (19.4)	2 (20.0)	0 (0.0)	0.17
Laundry	2 (3.6)	2 (6.5)	0 (0.0)	0 (0.0)	0.11
Managing finances	2 (3.6)	1 (3.2)	1 (10.0)	0 (0.0)	0.21
Managing medications	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	-
Shopping	23 (41.1)	12 (38.7)	6 (60.0)	5 (33.3)	0.23
Transportation	7 (12.5)	7 (22.6)	0 (0.0)	0 (0.0)	0.04
Using telephone	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	-
Basic activities of daily living					
No. (%) reporting difficulty with:					
Bathing	8 (14.3)	5 (16.1)	2 (20.0)	1 (6.7)	0.67
Dressing	8 (14.3)	5 (16.1)	2 (20.0)	1 (6.7)	0.67
Feeding self	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	-

		Poverty income ratio[a]			
Measure	**Overall (n=56)**	**<1.00 (n=31)**	**1.00-1.99 (n=10)**	**≥2.00 (n=15)**	**p Value[b]**
Incontinence	11 (19.6)	8 (25.8)	3 (30.0)	0 (0.0)	<0.01
Toileting	1 (1.8)	1 (3.2)	0 (0.0)	0 (0.0)	1.00
Transferring	5 (8.9)	2 (6.5)	3 (30.0)	0 (0.0)	0.05
Falls					
No. (%) with falls in prior year	26 (46.4)	15 (48.4)	7 (70.0)	4 (26.7)	0.10
Mean (SD) number of falls in prior year	2.08 (0.84)	2.13 (0.74)	2.14 (1.07)	1.75 (0.96)	0.70

[a] Ratio of household income to appropriate poverty threshold for household size, as defined by the United States Census Bureau (lower poverty income ratio indicates greater poverty)

[b] By Fisher's exact or non-parametric equality-of-means test, as appropriate

[c] Scaled score of physical functioning (PF) subscore from twelve-item Short-Form Health Survey (SF-12), 0-100

[d] Assessed via the Short Physical Performance Battery (SPPB)

[e] Scaled, 0-4

[f] Scaled, 0-12

Higher scores reflect better functioning for all scales; SLE: systemic lupus erythematosus