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Physical Performance in a Diverse, Population-based Cohort of Individuals with Systemic Lupus Erythematosus

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Abstract

Objective: To report the burden and correlates of poor physical performance in a diverse cohort of individuals with SLE.

Methods: In this single-visit study of 446 individuals with SLE from a population-based metropolitan Atlanta cohort, we measured physical performance via the Short Physical Performance Battery [score range, 0–12; intermediate-low (<10) vs. high (≥10)]. We also collected demographic, clinical, and psychosocial variables and examined the associations [adjusted odds ratios (aORs)] of intermediate-low vs. high physical performance with these characteristics via multivariable logistic regression.

Results: We found that more than half (59.6%) of our participants had poorer (intermediate-low) overall physical performance. Only 7% of the cohort received the maximum score on the lower body strength task, vs. 90% and 76% receiving the maximum scores on balance and gait speed tasks. Current employment status (aOR=0.69; 95% CI, 0.45–1.05) and higher cognitive functioning (aOR= 0.57; 95% CI, 0.42–0.77) were strongly associated with lower odds of intermediate-low physical performance. Higher body mass index (aOR=1.25, 95% CI, 1.01–1.56), disease activity (aOR=1.59; 95% CI, 1.27–1.98), and disease burden (aOR=1.38; 95% CI, 1.08–1.77) were associated with poorer performance, as were higher depressive symptom and perceived stress scores and lower educational attainment (not statistically significant).

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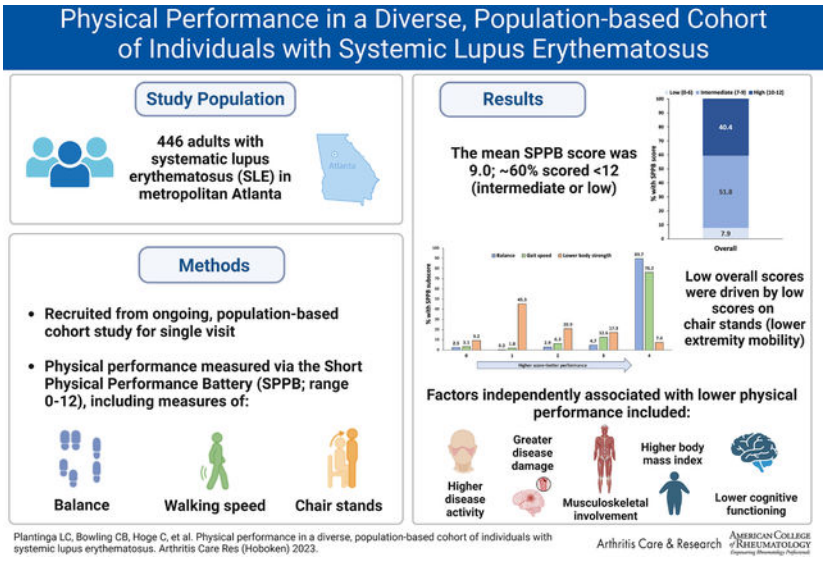
Conclusion: In our population-based, primarily Black cohort, we found that individuals with SLE commonly had poor physical performance. We identified both SLE- and non-SLE-specific factors that could help clinicians identify those most at risk for poor physical performance and intervene to improve, maintain, and support physical performance among those with SLE.

Graphical Abstract



Introduction

Physical performance is not commonly measured in clinical settings, despite its strong associations with higher risk of subsequent disability, loss of independence, and mortality (1, 2). While the Short Physical Performance Battery (SPPB) (1) was initially developed and validated among older adults, it has been explored as a predictor of mortality and disability among younger individuals with chronic, potentially debilitating conditions such as chronic obstructive pulmonary disease (3) and multiple sclerosis (4). Recent studies have also suggested that poor SPPB performance may serve as a proxy for muscle weakness and a predictor of subsequent declines in performance among individuals with systemic lupus erythematosus (SLE) (5, 6). Importantly for the disproportionately female and underserved SLE population, older adults who are female or are Black or Hispanic have, on average, lower physical performance than their counterparts, and this pattern is consistent across age groups (7).

Physical performance can be difficult to assess clinically by visual assessment (“eyeball test”) alone (8). Given this uncertainty and the often-limited time available in medical encounters, knowing the burden of and factors associated with poor physical performance in a diverse SLE population could provide clinicians important information for targeting individuals at risk for declining performance and subsequent disability and mortality. Results from our pilot study (9) suggested that physical performance overall was suboptimal in SLE, particularly for female and Black participants, with poor scores being driven primarily by poor lower body strength. However, a larger, population-based study was needed to

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confirm these findings. Here, we examined the prevalence and correlates of poor physical performance among primarily Black individuals with SLE who participated in an ancillary study [Approaches to Positive, Patient-centered Experiences of Aging in Lupus (APPEAL)] designed to assess prevalence of and risk factors for various aspects of functioning in this vulnerable population.

Methods

Study Population and Data Sources

For the APPEAL study, we recruited participants from the population-based Georgians Organized Against Lupus (GOAL) cohort of individuals with diagnosed SLE (10) in metropolitan Atlanta. GOAL recruitment and data collection details have been published previously (11, 12; also described in the Supplementary Methods). Additional inclusion criteria for the APPEAL study included: active participation in GOAL; ability to speak English; sufficient vision and hearing to undergo study testing; ability to consent; and living in Georgia at the time of recruitment. The Emory Institutional Review Board approved the APPEAL and GOAL study protocols (approval numbers IRB00110977 and IRB00003656, respectively). All APPEAL participants provided informed consent before completing study visits.

We approached *N*=618 GOAL participants by phone and email and in person in the lupus clinic. Of these, *N*=501 (81.1%) were eligible and interested in participating in APPEAL; of these, *N*=451 (90.0%) completed a single study visit (Figure S1). Study visits were conducted either in person at an Emory study site (*n*=206) or remotely via HIPAA-compliant Zoom software (San Jose, CA) (*n*=245). Data for participants who did not complete the Short Physical Performance Battery (n=1) or had potentially invalid questionnaire response patterns (*n*=4) were further excluded, leaving *N*=446 (Figure S1). Data reported here were obtained from a series of performance tests and questionnaires administered during study visits (10/8/2019–5/12/2022; Figure S2). Data on physical performance along with data on functioning and other domains obtained from self-administered surveys were entered via REDCap (13). Selected GOAL data from the closest survey to the APPEAL visit date were linked to the APPEAL data.

Variables

Physical performance.—The SPPB (1) includes assessments of balance, gait, and lower body strength. Details of remote administration and scoring of the SPPB in our study have been published elsewhere (14, 15) (see also Supplementary Methods). All individual SPPB subscores ranged from 0 to 4 (with higher scores indicating higher levels of physical performance), based on quartiles of performance of the original cohort of individuals aged ≥71 years (1). The overall SPPB score was the sum of the three individual scores (range, 0–12). Scores were categorized as ≥10 (high), 7–9 (intermediate), and 0–6 (low or very low); for analyses with SPPB as the outcome, scores were dichotomized ≥10 (high) vs. <10 (intermediate-low), as scores <10 are strongly associated with subsequent disability among older adults (2).

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Other variables.—Age, race, ethnicity, and education were self-reported from a fixed set of categories by the participant at the study visit, via the NIH Toolbox. Age was examined both as a continuous and categorical (18–34, 35–49, and ≥50 years) variable. Race was categorized as Black (as a single or multiple race), White, and other. Education was the highest level attained and categorized as high school graduate or lower, some college/associates degree, or college graduate or higher. Current employment was assessed using a single item from the Work Productivity and Activity Impairment Questionnaire: General Health v. 2.0 (16), which has been used previously in lupus and other rheumatologic conditions (17, 18). Current SLE activity was assessed via the Systematic Lupus Activity Questionnaire (SLAQ; range 0–44; higher scores indicating greater SLE-related disease activity) (19, 20). The Brief Index of Lupus Damage (BILD) score (range, 0–46; higher scores indicate greater cumulative SLE-related organ damage) (21, 22) closest to the APPEAL visit was obtained from linked GOAL data. Dichotomous measures of symptoms present vs. absent by system were also obtained from BILD items. Body mass index (BMI) was calculated as (weight in kg)/(height in m)^2 using measured (in-person visits) or self-reported (remote visits) values. Depression was assessed via the 8-item PROMIS Depression Short Form-8a, which has been validated in diverse populations (23) and in other rheumatologic conditions (24), and reported as T-scores (where 50=mean score and 10=1 SD). Participants' perceived stress was assessed using the 10-item Perceived Stress Scale (PSS-10) (25, 26), which measured the degree to which participants found life situations stressful over the past month. Scores range from 0 to 40; higher scores indicate greater perceived stress, with scores of ≥20 considered high levels of stress. Physical activity was assessed with the International Physical Activity Questionnaire – Short Form (27). Current steroid use was self-reported by the participant at the study visit. We assessed cognitive function with the Fluid Cognition battery (including five modules measuring overall capacity to reason and solve novel problems), administered via the NIH Toolbox application (28, 29). Individual assessment scores were incorporated into a composite T-score measuring fluid cognition, adjusted for age, sex, race/ethnicity, and education (in-person visits only). Gait speed was calculated using the 4-m walk time or number of steps in a 1-minute walk-in-place (30, 31) (see Supplementary Methods).

Statistical Analysis

Characteristics of participants were described and total SPPB score and individual SPPB subscores were summarized. Associations between characteristics and intermediate-low vs. high physical performance were assessed with adjusted odds ratios (aORs) from multivariable logistic regression, sequentially adjusting for potential confounders identified *a priori*. Complete case analysis was used for modeling (N=427, or 4.3% of the observations missing covariates). Several secondary and sensitivity analyses were conducted (see Supplementary Methods). The statistical significance threshold was set at 0.05. All analyses were conducted using Stata v. 17.0 (College Station, TX).

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Results

Characteristics of Study Participants

The 446 participants included in this analysis had a mean age of 46.2 years (41.0% aged ≥50 years) and were primarily female (91.7%), Black (82.5%), and non-Hispanic (94.4%) (Table 1). While 39.0% had a college degree or higher, fewer than half (47.0%) were employed at the time of enrollment. Participants had had SLE for a mean of 16.5 years. Participants' median SLAQ score was 11.0 and the mean BMI was 30.2 kg/m^2, and 57.3% reported currently taking steroids at enrollment.

Physical Performance among Individuals with SLE

The overall mean (SD) and median (25th-75th percentile) SPPB score were 9.0 (2.1) and 9 (8–10), respectively. Overall, 7.9%, 51.8%, and 40.4% had low, intermediate, and high scores (Figure 1). The percentages with high vs. intermediate and low SPPB scores were higher among younger (age <35 years), male, White, and Hispanic participants, relative to their counterparts, but none of these differences were statistically significant (Figure 1). However, differences in mean scores for each of these characteristics were statistically significant (Table S1).

Figure 2 shows the distributions of individual subscores. While balance and gait speed scores were skewed toward higher scores, with 89.7% and 76.2% receiving the maximum score of 4, chair stand scores were skewed toward lower scores, with only 7.4% receiving the maximum score. The lowest individual score was for the chair stands (mean, 1.7; median, 1.0); in general, the mean individual subscores did not statistically significantly differ by participant characteristics, although Black vs. White race was associated lower gait speed (3.5 vs. 3.9; P=0.02) (Table S1).

Association of Characteristics with Physical Performance

After adjustment, younger age was associated with lower odds of an intermediate-low vs. high SPPB score, but this association was not statistically significant for either continuous or categorized age; sex and Hispanic ethnicity were not associated with SPPB score (Table 2). White participants had 41% lower odds of having intermediate-low vs. high SPPB (aOR=0.59; 95% CI, 0.31–1.11) than Black participants, but the association was not statistically significant. Lower educational attainment was associated with higher odds of intermediate-low scores (aOR=1.71; 95% CI, 0.99–2.96 for high school graduate or lower vs. college graduate or higher), but this association was also not statistically significant. Each SD higher BMI, SLAQ score, and BILD score was associated with 25% (aOR=1.25; 95% CI, 1.01–1.56), 59% (aOR=1.59; 95% CI, 1.27–1.98), and 38% (aOR=1.38; 95% CI, 1.08–1.77) higher odds of intermediate-low vs. high SPPB scores, respectively, after adjustment. Within individual SLAQ domains, we found that having any symptoms within the pulmonary (aOR=1.74; 95% CI, 1.16–2.60), musculoskeletal (aOR=2.05; 95% CI, 1.28–3.30), or joint (aOR=1.91; 95% CI, 1.26–2.91) domains was statistically significantly associated with substantially higher scores. Symptoms within the weight loss, cognitive, and stroke syndrome domains were also associated with higher scores, but these associations were not statistically significant; fatigue symptoms were not associated with lower SPPB.

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Within BILD domains, musculoskeletal and skin damage were associated with 2.9-fold (aOR=2.93; 95% CI, 1.61–5.32) and 2.6-fold (aOR=2.55; 95% CI, 1.01–6.45) higher odds of lower SPPB scores (Table 2). Each SD higher fluid cognition T-score was associated with 43% lower odds (aOR=0.57; 95% CI, 0.42–0.77) of lower SPPB scores.

Secondary and Sensitivity Analyses

Comparison of characteristics of APPEAL vs. GOAL participants.—Compared to the overall GOAL cohort, APPEAL participants were younger (mean age 46.2 vs. 49.1 years), less likely to be White (11.5% vs. 17.5%), and more likely to report other race (6.0% vs. 2.5%) and to be employed (47.2% vs. 40.0%). APPEAL participants also reported lower current disease activity (median SLAQ score 11.0 vs. 13.0) and were more likely to report taking steroids (57.3% vs. 46.1%), compared to overall GOAL participants (Table S2). Otherwise, the characteristics of APPEAL and GOAL participants were similar. Additionally, comparing GOAL participants who were invited to participate in APPEAL vs. not (Figure S1), invited participants were younger (mean age 46.2 vs. 50.5 years, P<0.001) but similar in terms of sex (91.7% vs. 90.7% female), race (82.5% vs. 85.6% Black), ethnicity (5.6% vs. 5.0% Hispanic), and duration of disease (median duration, 14.8 vs. 15.0 years).

Comparison of characteristics and associations by study visit type.—Among all APPEAL participants (N=451), those completing remote vs. in-person visits were similar in age and ethnicity but were more likely to be White (15.1% vs. 7.3%; P=0.03) and female (95.1% vs. 87.9%; P=0.005) (Table S2). Those completing remote vs. in-person visits were more likely to be employed (50.2% vs. 43.4%), were less likely to be taking steroids (53.5% vs. 62.0%), and had a lower SLAQ score (10.0 vs. 11.5), but these differences were not statistically significant.

SPPB scores were similar by visit type (Table S1). Additionally, the patterns seen for younger age, White vs. Black race, and Hispanic vs. non-Hispanic ethnicity among all participants for SPPB scores were consistently repeated among participants who completed in-person visits but not among those who completed remote visits (Table S1).

Associations of older age and lower education with lower SPPB scores were stronger among in-person vs. remote visit participants (Table S3). Employment was protective (59% lower odds of intermediate-low vs. high scores; aOR=0.41; 95% CI, 0.22–0.80) only among in-person participants ($P_{interaction}$=0.02). Otherwise, the stratified associations were similar (if less statistically significant) to those seen in the overall results.

Associations using alternative models.—Using lasso selection (with all variables and age, sex, race, and SLAQ score fixed in the model), the model with the best fit was unchanged from our primary model. Results using the continuous SPPB score as the outcome were similar to the primary results (Table S4): older age (β=−0.21; 95% CI, −0.38,−0.05), ≤high school graduate vs. ≥college graduate (β=−0.56; 95% CI, −1.08,−0.05), BILD (β =−0.25; 95% CI, −0.45,−0.04), SLAQ (β=−0.47; 95% CI, −0.66,−0.27), and BMI (β=−0.21; 95% CI, −0.41,−0.01) were all associated with lower SPPB scores, while current working status (β=0.62; 95% CI, 0.21,1.03) was associated with higher SPPB scores. Unlike

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the primary analysis, however, male vs. female sex (−0.15; 95% CI, −0.87,−0.01) and White vs. Black race (β=0.77; 95% CI, 0.14,1.39) were statistically significantly associated with lower and higher SPPB scores, respectively.

Associations using gait speed as the outcome.—Overall mean (SD) gait speed was 1.02 (0.26) m/s (Figure S3A); although individuals completing remote vs. in-person visits had a higher mean gait speed (1.09 vs. 0.93 m/s, $P<0.001$), the distributions were similar with substantial overlap (Figure S3B; see also Table S1). Black vs. White participants had a slower overall mean gait speed (1.00 vs. 1.13 m/s, $P=0.001$), and this association was consistent by visit type, although not statistically significant for remote visits (Table S1).

Overall, associations of characteristics with slow vs. fast gait speed mirrored the associations of characteristics with lower SPPB score (Table S5). However, older age was associated with slow vs. fast gait speed, particularly among the in-person participants [each 10 years older age associated with 51% higher odds (aOR=1.51; 95% CI, 1.17–1.97) of slow gait speed, vs. no association among remote participants, $P_{interaction}=0.002$). As with SPPB score, employment was more protective [64% lower odds (aOR=0.36; 95% CI, 0.19–0.68) vs. 35% lower odds (aOR=0.65; 95% CI, 0.37–1.14) of slow gait speed)] among in-person vs. remote visits ($P_{interaction}=0.05$). Higher BMI was associated with higher odds of slow gait speed, but only among in-person visits ($P_{interaction}=0.02$). Otherwise, patterns did not differ by visit type.

Changes in physical performance over time.—The $n=49$ participants who also completed the pilot study were older (51.1 vs. 45.6 years, $P=0.002$) and had longer disease duration (18.8 vs. 14.5 years, $P=0.004$) than those who did not. Pilot participants were also less likely to be currently working (35.4% vs. 45.8%) but this difference was not statistically significant; otherwise, participants in the pilot did not differ from the other APPEAL participants (Table S6). Among these pilot participants, most had only small changes in their overall SPPB score [with the maximum increase and decrease being 1.4 and −1.4 points over a median (range) of 3.3 (2.6–5.3) years; Figures S2 and S4]. The median annualized rate change in score from pilot to main study was 0 (25^{th}-75^{th} percentile: −0.3,0.3). In general, rate changes were not associated with participant characteristics, although BMI was higher among those who experienced decreases vs. the same or increased SPPB score (32.3 vs. 26.7 kg/m^2; Table S7).

Discussion

In our population-based, primarily Black cohort, we found that individuals with SLE commonly had poor physical performance. Low scores were driven primarily by poor lower extremity mobility, as measured by chair stands, with only 7% of the cohort receiving the maximum score on this task, vs. 90% and 76% receiving the maximum scores on balance and gait speed tasks. Older, female, and Black participants were more likely to have intermediate-low physical performance than their counterparts, but these differences were smaller than those observed in the pilot and were not statistically significant when dichotomized, with or without adjustment for potential confounders. In contrast, higher educational attainment, current employment status, and higher cognitive functioning were all

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strongly protective against poorer physical performance, while higher disease activity and disease burden were strongly associated with poorer performance. Additionally, we found that, on average, physical performance scores for original pilot participants did not change over time.

To our knowledge, this is the largest study of physical performance in individuals with SLE to date. Our overall SPPB score (mean and median both = 9.0) was similar to what we found in our own pilot (9) (mean = 8.8) and to that reported by Andrews *et al.* (5) (mean = 8.8) in their U.S. cohort of 146 individuals with SLE recruited from the clinic and community; however, it was lower than the mean score of 10.1 among 30 SLE patients recruited from a single Italian clinic (6). These differences may reflect true differences in populations (*e.g.*, community- vs. clinic-based recruitment, differences in healthcare systems and access, different race/ethnicity distributions) or simply random chance. Our median score was also lower than the median score of 10 reported among populations with chronic obstructive pulmonary disease (3) and multiple sclerosis (4). Importantly, we found that nearly 60% of our cohort (mean age, 46 years) had intermediate-low scores (<10), compared to 53% of community-dwelling older adults aged >70 years (2). SPPB scores < 10 that have been associated with strongly increased risk of subsequent disability or mortality among older adults (2, 32), suggesting that a large proportion of individuals with SLE are at risk for these poor outcomes without intervention to improve physical performance.

We found that the strongest demographic predictors were higher educational attainment and working status. Both were associated with lower odds of poorer performance, independent of age, sex, and race, as well as disease activity. In contrast with our pilot (9) and as in the general older adult population (33), there was no evidence of a male sex advantage in physical performance in the setting of SLE. Similar to our pilot (9), we did find that mean scores were lower in older vs. younger age groups, but those aged 35–49 vs. ≥50 years had similar scores and age was not associated with performance after adjustment, suggesting that older age alone is not a good proxy for lower physical performance among those with SLE. Mean scores were substantially lower among Black vs. White participants, while Hispanic participants had substantially higher mean scores than non-Hispanic participants. With adjustment, neither race nor ethnicity was associated with poorer performance, suggesting these associations may be explained by racial and ethnic differences in age, sex, education, employment, and disease activity among subpopulations with SLE. As expected, higher concurrent lupus activity and cumulative disease burden were strongly associated with poorer physical performance. Depressive symptoms and stress were also associated with poorer performance, but these associations were partially explained by other variables. These results could help clinicians identify the patients most likely to be struggling with physical performance, prompting important examinations and discussions that could lead to interventions to maintain and potentially improve performance levels (*e.g.*, strength training, improved diet and/or sleep) as well as to support patients to ensure continued independence when needed (*e.g.*, provision of walkers, ramps/railings at home).

Interestingly, although we hypothesized that poor lower extremity mobility might be related to steroid-related reduced muscle mass, we found that current steroid use was unrelated to physical performance, similar to a previous study (6). This may be due to our crude

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measurement, which only captured whether participants were currently taking steroids at the time of the study visit and not the current or cumulative dose. Muscle strength has been associated with subsequent physical performance (5), suggesting a longitudinal design may have better captured whether steroid use might affect physical performance. Other factors that may have affected chair stand performance, especially considering that musculoskeletal and joint symptoms were associated with approximately twice the odds of poorer physical performance, include: arthritis in the hips or knees; leg or back pain; recent injuries; bone or muscle loss related to age, comorbid illness, or medications; reduced physical activity and conditioning; low mood or depression; or even cognitive dysfunction (34). Future studies should explore the reasons for this deficit among individuals with SLE, which is likely to lead to further decline and potential loss of independence without intervention.

Because gait speed predicts mortality and disability among older adults (29, 30), we also examined gait speed alone as an outcome. We found that about half of individuals in our cohort had a “slow” walking speed (<1 m/s), which has been associated with poor outcomes. Overall, associations of participant characteristics with slow vs. fast walking speed were quite similar to the associations we observed for intermediate-low vs. fast physical performance. The similarity of these results would suggest that gait speed alone could be used as a proxy to determine and track changes in physical performance over time in this population. However, gait speed can be challenging to measure in a clinic environment (35). Additionally, examining only gait speed in this population would miss the striking prevalence of poor performance on chair stands, which are perhaps the most easily implemented in the clinic. Thus, while members of the SLE care team can and should ask about changes in gait speed and observe patients’ movement before or after being seated for an examination whenever possible, a more comprehensive assessment (including a measurement of strength) would be important among these individuals. Where available, physical or occupational therapists or social workers might be best equipped to perform these assessments and create care plans to address any impairments.

In the small population of individuals who completed our initial pilot as well as the current study, we found that, on average, performance scores did not change over the up to 5.3-year period between study visits. We found that male vs, participants and participants with higher BMI and lower physical activity were more likely to have a decrease in score. These analyses are limited by the timing of the measurement and may reflect the effect of declines in physical performance on physical activity and BMI. However, it is possible that these associations identify potential targets for interventions to maintain or improve physical performance.

Our study has several limitations. Our study is cross-sectional, which limits our causal inference. For example, higher educational attainment or currently working status may be related to having higher physical performance, rather than vice versa. It is also possible that observed associations are due to additional unmeasured (*e.g.*, muscle mass) or unknown factors. Additionally, we do not yet have data on subsequent outcomes among this cohort, so we could not estimate the association between physical performance and outcomes such as mortality, institutionalization, or healthcare utilization. Despite our large sample, some aspects of our analyses are underpowered due to small subpopulations. Finally, because of

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changes to our protocol related to the COVID-19 pandemic, we had two different types of visits that resulted in slightly different scores. Our stratified sensitivity analyses suggested the effect of visit type on associations with participant characteristics was minimal, but we cannot discount the possibility of misclassification due to difficulties in remote measurement (14) or even changes in actual performance due to pandemic-related factors.

Our study also had several strengths. Our ancillary cohort was large, primarily Black, and population-based, increasing generalizability. Additionally, sensitivity analyses demonstrated the robustness of several of our assumptions. We found that our ancillary cohort had similar characteristics to the parent cohort, minimizing the potential for selection bias. Further, we found that associations in the overall cohort were generally similar to those in study visit-stratified analyses, suggesting that this potential misclassification did not affect our overall conclusions.

Among our diverse cohort of individuals with SLE, we found a high burden of low and intermediate physical performance levels. We also identified several participant characteristics, both SLE- and non-SLE-specific, that were associated with physical performance, which could help clinicians identify those most at risk as well as targets for interventions to improve, maintain, and/or support physical performance in these vulnerable individuals. Recognition of poor physical performance and related treatment planning could help prevent or delay disability, loss of independence, and mortality.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Significance and Innovations

- Physical performance is rarely measured among individuals with SLE, but poor performance may be predictive of disability, loss of independence, and mortality
- In our large, population-based, primarily Black cohort, we found that individuals with SLE commonly had poor physical performance, especially lower extremity mobility
- Factors independently associated with poorer performance were both SLE-specific (higher disease activity and burden) and non-SLE-specific (non-working status, lower education attainment, higher body mass index, and higher depressive symptom and perceived stress scores)
- Recognition of these factors could be used to identify individuals with SLE at high risk of poor physical performance as well as to intervene to improve, maintain, and support physical performance—which could delay or prevent associated poor outcomes among these individuals

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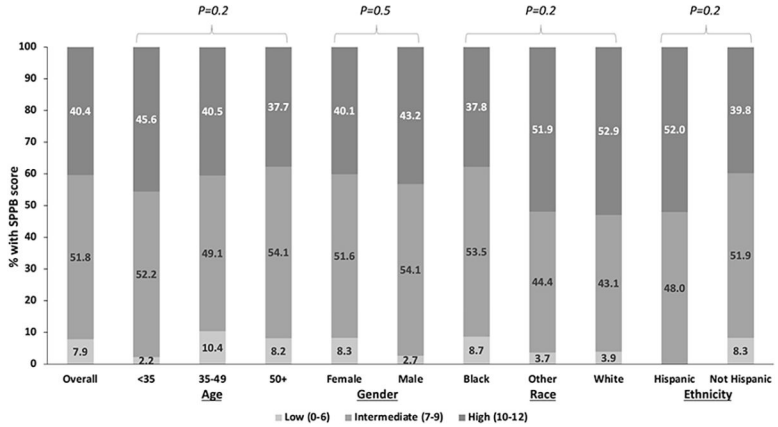

Figure 1.

Distribution of Short Physical Performance Battery scores among study participants, overall and by participant demographics. Scores ranged from 0 to 12 (with higher scores indicating higher levels of physical performance) and were categorized as: low (0–6), intermediate (7–9), and high (10–12) physical performance.

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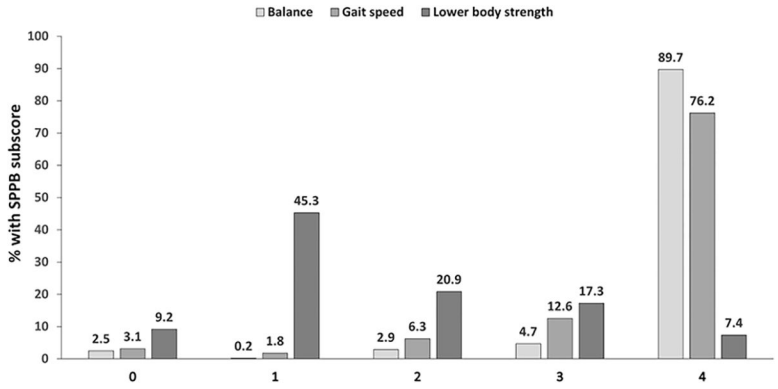

Figure 2.

Distribution of Short Physical Performance Battery subscores for balance, gait speed, and lower body strength (chair stands) among study participants. Subscores ranged from 0 to 4 (with 0 indicating inability to perform task and 4 indicating the highest level of performance).

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Table 1.

Characteristics of included study participants with systemic lupus erythematosus.

Characteristic	Value
N	*446*
Dates of visits/surveys	*10/8/19–5/12/22*
Sociodemographics	
Age in years	46.2 (11.8)
Age category	
18–34	90 (20.2%)
35–49	173 (38.8%)
≥50	183 (41.0%)
Sex[a]	
Female	409 (91.7%)
Male	37 (8.3%)
Race	
Black	368 (82.5%)
Other	27 (6.1%)
White	51 (11.4%)
Hispanic ethnicity, *n* (%)	25 (5.6%)
Highest level of education completed	
High school degree or lower	103 (23.1%)
Some college/associates degree	169 (37.9%)
College graduate or higher	174 (39.0%)
Currently working, *n* (%)	204 (47.0%)
Clinical	
Median (IQR) disease duration, years	14.8 (9.3–22.3)
Median (IQR) SLAQ score	11.0 (6.0–16.0)
Median (IQR) BILD score[b]	2.0 (1.0–4.0)
Organ system damage, *n* (%)	
Ocular	142 (31.8%)
Neuropsychiatric	76 (17.0%)
Renal	40 (9.0%)
Pulmonary	70 (15.7%)
Cardiovascular	108 (24.2%)
Peripheral vascular	76 (17.0%)
Gastrointestinal	103 (23.1%)
Musculoskeletal	87 (19.5%)
Skin	37 (8.3%)
Currently taking steroids	258 (57.3%)
Mean (SD) BMI, kg/m^2	30.2 (8.2)

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Characteristic	Value
Physical activity[c]	
Low	324 (73.8%)
Moderate	67 (15.3%)
High	48 (10.9%)
Mean (SD) depressive symptoms T-score[d]	48.2 (9.1)
Mean (SD) perceived stress score[e]	15.3 (7.2)
Mean (SD) fluid cognition T-score[f]	45.3 (11.2)

APPEAL, Approaches to Positive, Patient-Centered Experiences of Aging in Lupus; BILD, Brief Index of Lupus Damage (range, 0–46; 46 is maximum damage); BMI, body mass index; GOAL, Georgians Organized Against Lupus (parent study); IQR, interquartile (25^{th}-75^{th} percentile) range; SLAQ, Systemic Lupus Activity Questionnaire (range, 0–47; 47 is maximum activity). *N*=446, except for: ethnicity (*N*=445), work status (*N*=434), SLAQ score (*N*=427), BMI (*N*=435), physical activity (*N*=439), depressive symptoms score (*N*=412), perceived stress score (*N*=412), and medications (*N*=445).

[a] Represents sex at birth.

[b] From the closest GOAL assessment.

[c] From the International Physical Activity Questionnaire – Short Form.

[d] From the Patient Reported Outcomes Measurement Information System (PROMIS) Depression Short Form-8a.

[e] From Cohen's 10-item Perceived Stress Scale (range, 0–40; higher scores representing greater perceived stress).

[f] From the NIH Toolbox Fluid Cognition Battery (27, 28); in-person visits only, *N*=200.

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Table 2.

Associations of intermediate or low (<10) vs. high (10–12) physical performance scores with participant characteristics.

	OR for intermediate-low vs. high SPPB score (95% CI)		
Characteristic	**Unadjusted**	**Adjusted[a]**	**Adjusted[b]**
Age, per +10 years	1.12 (0.95–1.32)	1.12 (0.94–1.32)	1.10 (0.93–1.31)
Age category			
18–34 vs. ≥50	0.70 (0.41–1.18)	0.84 (0.24–3.02)	0.85 (0.23–3.14)
35–49 vs. ≥50	0.85 (0.55–1.31)	0.92 (0.43–1.94)	0.92 (0.43–1.98)
Male vs. female	0.95 (0.47–1.94)	0.89 (0.43–1.85)	0.98 (0.46–2.06)
Race			
Other vs. Black	0.52 (0.23–1.15)	0.55 (0.24–1.23)	0.62 (0.27–1.41)
White vs. Black	0.58 (0.31–1.06)	0.57 (0.31–1.06)	0.59 (0.31–1.11)
Hispanic vs. not Hispanic	0.72 (0.31–1.67)	1.12 (0.44–2.87)	0.95 (0.35–2.55)
Highest level of education completed			
≤High school graduate vs. ≥college graduate	1.89 (1.12–3.19)	1.78 (1.04–3.06)	1.71 (0.99–2.96)
Some college vs. ≥college graduate	1.46 (0.94–2.26)	1.40 (0.90–2.18)	1.17 (0.74–1.85)
Currently working vs. not	0.57 (0.38–0.84)	0.61 (0.41–0.92)	0.69 (0.45–1.05)
SLAQ score, per 1 SD	1.62 (1.30–2.01)	1.59 (1.27–1.98)	---
BILD score, per 1 SD	1.57 (1.25–1.98)	1.53 (1.21–1.94)	1.38 (1.08–1.77)
Organ system damage vs. not:			
Ocular	1.79 (1.16–2.74)	1.70 (1.08–2.67)	1.49 (0.94–2.38)
Neuropsychiatric	1.73 (1.00–2.97)	1.72 (1.00–2.98)	1.33 (0.75–2.36)
Renal	1.21 (0.61–2.41)	1.20 (0.60–2.42)	1.35 (0.66–2.77)
Pulmonary	1.80 (1.02–3.19)	1.72 (0.96–3.06)	1.39 (0.76–2.54)
Cardiovascular	1.67 (1.04–2.67)	1.64 (1.01–2.67)	1.43 (0.87–2.36)
Peripheral vascular	2.02 (1.16–3.51)	1.91 (1.09–3.34)	1.41 (0.78–2.55)
Gastrointestinal	1.22 (0.77–1.94)	1.15 (0.72–1.86)	1.00 (0.61–1.65)
Musculoskeletal	3.21 (1.18–5.70)	3.31 (1.84–5.95)	2.93 (1.61–5.32)
Skin	3.51 (1.43–8.66)	3.26 (1.32–8.07)	2.55 (1.01–6.45)
Currently taking steroids vs. not	1.00 (0.68–1.48)	1.02 (0.68–1.54)	0.95 (0.62–1.45)
BMI, per 1 SD	1.34 (1.09–1.65)	1.28 (1.04–1.58)	1.25 (1.01–1.56)
Depressive symptoms T-score, per 1 SD (10 points)	1.43 (1.14–1.78)	1.44 (1.15–1.80)	1.23 (0.96–1.58)
Perceived stress score, per 1 SD	1.37 (1.12–1.69)	1.38 (1.12–1.71)	1.15 (0.91–1.46)
Fluid cognition T-score, per 1 SD (10 points)[c]	0.58 (0.44–0.78)	0.56 (0.41–0.76)	0.57 (0.42–0.77)

N=427 for models. BILD, Brief Index of Lupus Damage; BMI, body mass index; SLAQ, Systemic Lupus Activity Questionnaire; SPPB, Short Physical Performance Battery.

[a] Adjusted for age in years, sex, race, and visit type (in-person vs. remote).

[b] Additionally adjusted for SLAQ score.

[c] For in-person visits only.