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Value of SLE-DAS in assessing disease activity in patients with systemic lupus erythematosus: a single-centre retrospective study

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ABSTRACT

Objectives This study aimed to evaluate the clinical value of the Systemic Lupus Erythematosus Disease Activity Score (SLE-DAS) for assessing disease activity in patients with SLE.

Methods Clinical data were collected from patients with SLE who were admitted at the Second Affiliated Hospital of Soochow University from January 2009 to December 2022. The glucocorticoid dose grading was used as the gold standard for disease activity assessment in SLE. The SLE-DAS value was calculated, and the SLE disease activity status was graded based on the SLE-DAS value. Another scoring criterion, the SLE Disease Activity Index 2000 (SLEDAI 2000), served as a control. Spearman correlation analysis was used to calculate the correlation between the scoring criteria and other variables.

Results The analysis included 396 patients with SLE. A strong correlation was found between SLE-DAS and SLEDAI 2000 (ρ=0.709, 95% CI 0.648 to 0.766, p<0.001), with median SLE-DAS and SLEDAI 2000 scores of 15.32 (7.90 to 24.45) and 13 (8 to 19), respectively. Compared with the SLEDAI 2000 value, the SLE-DAS value correlated better with glucocorticoid dose grading (ρ=0.434 vs 0.518), gammaglobulin use (ρ=0.170 vs 0.318) and immunosuppressant use (ρ=0.122 vs 0.221). A moderate correlation based on disease activity grading was found between SLE-DAS and glucocorticoid dose grading (ρ=0.441), whereas a mild correlation was observed between SLEDAI 2000 and glucocorticoid dose grading (ρ=0.325). Additionally, SLE-DAS revealed a positive correlation with severe thrombocytopenia, cardiac involvement and pulmonary involvement but not SLEDAI 2000.

Conclusion Compared with SLEDAI 2000, SLE-DAS may provide a more accurate disease activity assessment in patients with SLE, especially those with severe thrombocytopenia and cardiopulmonary involvement.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ The evaluation of disease activity has always been a great challenge in treating patients with systemic lupus erythematosus (SLE). Several tools were developed to assess disease activity in patients with SLE; however, each tool has its limitations.

WHAT THIS STUDY ADDS

⇒ The present study revealed that the SLE Disease Activity Score (SLE-DAS) may provide a more accurate disease activity assessment in patients with SLE, particularly in those with severe thrombocytopenia and cardiopulmonary involvement.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This study confirms the benefits of SLE-DAS in assessing SLE disease activity, paving the way for its use in clinical practice and drug trials.

INTRODUCTION

Systemic lupus erythematosus (SLE) is a chronic autoimmune disease that affects multiple organ systems, including the skin, kidneys, blood, joints and brain.[1] Differences in race/ethnicity, gender distribution, environmental exposures as well as reporting bias, study design and definition/classification criteria for SLE have resulted in inconsistent incidence of SLE reported in different studies, ranging from 1.4 to 15.13 cases per 100 000 person-years, with an global incidence of approximately 5.14, which has given rise to an estimated 400 000 new cases of SLE each year.[2 3] Improving early diagnosis, optimising treatment and enhancing SLE prognosis are crucial.

The importance of treat-to-target in SLE management is now well recognised, but assessing disease activity in SLE is a difficult task because of the heterogeneity of disease manifestations.[4–6] In recent decades, several tools have been developed to investigate disease activity in patients with SLE.[7–10] The SLE Disease Activity Index 2000 (SLEDAI 2000) is currently the most prominently used scoring criteria in clinical practice, which assesses the patient's condition within 10 days before consultation.[10] Touma *et al* found that the SLEDAI 2000 calculated using a timeframe of 30 days prior to a visit was similar to

the prescribed 10-day period.[11] However, SLEDAI 2000 does not reflect potentially serious SLE manifestations, such as haemolytic anaemia, interstitial pneumonitis and myocardial lesions. Another disadvantage of SLEDAI 2000 is that the scoring of all assessment criteria is binary (presence vs absence).

In 2019, Jesus *et al* developed a new scoring system for SLE, the SLE Disease Activity Score (SLE-DAS).[12] The analysis included data from the visit with the highest disease activity during the follow-up period of each patient. The final derived SLE-DAS was the sum of 17 weighted items, including haemolytic anaemia and cardiac/pulmonary involvement, when multiple linear regression with Physician Global Assessment (PGA) was applied as the dependent variable. The number of swollen joints, proteinuria levels and platelet and white blood cell counts are all quantified in the formula and, therefore, provide a good severity indication of the patient's symptoms. The study revealed that SLE-DAS demonstrated good construct validity, with similar specificity to SLEDAI 2000, higher sensitivity to detect clinically meaningful changes in SLE disease activity, and high performance in predicting damage accrual. Additionally, in 2021, the SLE disease activity status based on the SLE-DAS value was proposed.[13]

However, a study from a cohort of Latin American patients with Mexican Mestizo ethnicity revealed that the SLE-DAS was a useful tool to measure disease activity in SLE, but it had no additional advantage over the SLEDAI 2000 and appeared to perform poorly in only 60 patients with high disease activity.[14] Additionally, a study from India revealed that SLE-DAS has no advantage over the existing SLEDAI 2000 in patients with lupus nephritis.[15] This was a small convenience sampling study and was prone to sampling bias.[16] Therefore, as a brave and innovative attempt to quantify SLE disease activity, the performance of SLE-DAS in SLE remains unclear. The present study aimed to investigate the performance of SLE-DAS in assessing disease activity in patients with SLE from China.

METHODS

Study design and patients

This single-centre retrospective study was conducted at the Department of Rheumatology and Immunology at The Second Affiliated Hospital of Soochow University, China. We used inpatient medical records from June 2009 to December 2022 to consecutively enrol patients with SLE.

Patients with SLE fulfil at least one of the following classification criteria: the American College of Rheumatology (ACR) 1997 revised criteria,[17] the 2012 Systemic Lupus International Collaborating Clinics classification criteria,[18] or the 2019 European League Against Rheumatism/ACR classification criteria.[19] This study excluded patients with SLE if they had one or more of the following conditions: other autoimmune diseases (eg, rheumatoid arthritis, systemic sclerosis), pregnancy, severe infectious diseases, or drug-induced myelosuppression, and other clinical manifestations that could not be attributed to SLE, such as glomerulonephritis due to diabetes mellitus and haematopenia due to leukaemia.

Data collection

The electronic medical records of all study participants were used to extract data on demographics and clinical presentation, laboratory test results (blood cell counts, complement levels, autoantibody profiles, etc), imaging test results (chest CT and cardiac ultrasound) and renal pathology findings.

The SLE-DAS and SLEDAI 2000 were calculated based on clinical presentation and laboratory findings from the same hospitalisation.[10 12] The disease activity of patients with SLE was categorised into two grades based on the SLE-DAS and SLEDAI 2000 values: SLE-DAS of ≤7.64 was defined as remission-mild activity, SLE-DAS of >7.64 as moderate-severe activity,[13] SLEDAI 2000 of <7 as remission-mild activity and SLEDAI 2000 of ≥7 as moderate-severe activity.[20]

The patients' glucocorticoid dose grading based on the highest dose throughout the hospitalisation was used as a gold standard for SLE disease activity: glucocorticoid-free was defined as patients not currently receiving glucocorticoid therapy; low-dose glucocorticoid as a prednisone of ≤10 mg/day or equivalent; moderate-dose glucocorticoid as a prednisone of 0.5 mg/kg/day (>10 mg/day and ≤40 mg/day) or equivalent, high-dose glucocorticoid as a prednisone of 1–2 mg/kg/day (>40 mg/day and ≤100 mg/day) or equivalent, and intravenous pulse glucocorticoid as methylprednisolone of 250–500 mg/day.

Leucopenia was defined as a leucocyte count of $<3.0\times10^9$/L, neutropenia as a neutrophil count of $<1.5\times10^9$/L, lymphopenia as a lymphocyte count of $<0.8\times10^9$/L, anaemia as a haemoglobin level of <110 g/L or <120 g/L for women and men, respectively, thrombocytopenia as a platelet count of $<100\times10^9$/L, and severe thrombocytopenia as a platelet count of $\leq30\times10^9$/L.[21–23]

Statistical analysis

Statistical analyses were conducted using the IBM Statistical Package for the Social Sciences Statistics for Windows V.26.0 (IBM, Armonk, New York). Continuous variables were expressed as either mean±SD or median and 25th–75th percentile (P_{25}, P_{75}) based on the Shapiro–Wilk test. The Spearman correlation was used to analyse the correlation of the SLE-DAS value and the SLEDAI 2000 value. Furthermore, the Spearman correlation analysis was used to calculate the correlation between the scoring criteria and other variables. The absolute value of Spearman's rank correlation coefficient ρ of <0.2 was considered a very weak correlation, 0.21–0.4 as a weak correlation, 0.41–0.6 as a moderate correlation, 0.61–0.8 as a strong correlation, and 0.81–1 as a very strong correlation. The $P_{\text{False Discovery Rate (FDR)}}$ was calculated by correcting the p value of Spearman correlation analysis of SLE-DAS value, SLEDAI 2000 value, and their disease activity grading with glucocorticoid dose grading, gammaglobulin use,

immunosuppressant use, clinical presentation and serologic indices using the Benjamini- Hochberg method, respectively. Statistical significance was considered at a p value or P_{FDR} of <0.05.

RESULTS

Sample description

This study included 396 patients with SLE (table 1). Of these patients, 355 (89.6%) were women, with a median age of 35 (27–48) years and a median disease duration of 12 (2–72) months. Glucocorticoids were not administered in 6 (1.5%) patients and low, moderate, high and intravenous pulse doses were administered in 66 (16.7%), 108 (27.3%), 189 (47.7%) and 27 (6.8%) patients, respectively. Additionally, gammaglobulin and immunosuppressants were administered to 40 (10.2%) and 193 (48.7%) patients, respectively.

Correlation and consistency between the SLE-DAS and SLEDAI 2000

A strong correlation was found between the SLE-DAS and SLEDAI 2000 values (ρ=0.709, 95% CI 0.648 to 0.766, p<0.001) (figure 1), with median SLE-DAS and SLEDAI 2000 scored of 15.32 (7.90 to 24.45) and 13 (8 to 19), respectively.

The SLE-DAS value indicated 96 (24.2%) cases of remission-mild activity and 300 (75.8%) cases of moderate-severe activity, whereas the SLEDAI 2000 value denoted 72 (18.2%) cases of remission-mild activity and 324 (81.8%) cases of moderate-severe activity (figure 2). Of these, both SLE-DAS and SLEDAI 2000 rated 50 (12.6%) patients as remission-mild activity and 278 (70.2%) patients as moderate-severe activity, but in 68 (17.2%) patients, the assessment of disease activity was inconsistent between the two gradings. Overall, the correlation between the two gradings was moderate (ρ=0.497, 95% CI 0.396 to 0.606, p<0.001), with a kappa value of 0.489 (95% CI 0.386 to 0.588).

Correlation between SLE-DAS and glucocorticoid dose grading and gammaglobulin use

Glucocorticoid dose grading was used as the gold standard, and its correlation with SLE-DAS and SLEDAI 2000 was studied (table 2). The results revealed a moderate correlation between the SLE-DAS value and glucocorticoid dose grading (ρ=0.518, 95% CI 0.436 to 0.595, P_{FDR}<0.001) as well as a moderate correlation between the SLEDAI 2000 value and glucocorticoid dose grading (ρ=0.434, 95% CI 0.351 to 0.516, P_{FDR}<0.001). A moderate correlation based on disease activity grading was found between SLE-DAS and glucocorticoid dose grading (ρ=0.441, 95% CI 0.356 to 0.521, P_{FDR}<0.001), whereas a mild correlation was observed between SLEDAI 2000 and glucocorticoid dose grading (ρ=0.325, 95% CI 0.230 to 0.420, P_{FDR}<0.001).

Gammaglobulin is primarily used in patients with severe lupus, thus we further investigated its correlation with the two scoring criteria (table 2). The SLE-DAS value was weakly correlated with gammaglobulin use (ρ=0.318,

Table 1 Baseline characteristics of patients with SLE

Variable	n	N
Female, n (%)	355 (89.6)	396
Age	35 (27, 48)	396
Disease duration (months)	12 (2, 72)	396
Fever, n (%)	95 (24.0)	396
Rash, n (%)	173 (43.7)	396
Alopecia, n (%)	132 (33.3)	396
Mucosal ulcers, n (%)	50 (12.6)	396
Arthritis, n (%)	76 (19.2)	396
Myositis, n (%)	11 (2.8)	396
Vasculitis, n (%)	75 (18.9)	396
Pleuritis, n (%)	58 (14.6)	396
Pericarditis, n (%)	48 (12.1)	396
Proteinuria, n (%)	154 (38.9)	396
Urinary casts, n (%)	56 (14.1)	396
Haematuria, n (%)	173 (43.7)	396
Pyuria, n (%)	125 (31.6)	396
Cardiac involvement, n (%)	29 (7.3)	396
Pulmonary involvement, n (%)	21 (5.3)	396
Neuropsychiatric involvement, n (%)	27 (6.8)	396
ANA, n (%)	383 (97.7)	392
Anti-dsDNA, n (%)	237 (59.8)	396
Anti-Smith, n (%)	138 (35.0)	394
Anti-U1RNP, n (%)	166 (42.2)	393
Anti-ribosomal P protein, n (%)	93 (23.7)	393
Anti-Ro60, n (%)	240 (61.1)	393
Anti-Ro52, n (%)	205 (52.2)	393
Anti-SSB, n (%)	63 (16.0)	393
Anti-centromere protein B, n (%)	10 (2.5)	393
Anti-Scl70, n (%)	5 (1.3)	393
Anti-Jo1, n (%)	0 (0)	393
Antiphospholipid antibodies, n (%)	44 (19.1)	230
Direct Coombs' test, n (%)	30 (25.0)	120
Leucocyte count (10^9/L)	4.2 (3.1, 6.4)	396
Leucopenia, n (%)	87 (22.0)	396
Neutrophil count (10^9/L)	2.8 (1.9, 4.7)	396
Neutropenia, n (%)	37 (9.3)	396
Lymphocyte count (10^9/L)	1.0 (0.6, 1.4)	396
lymphopenia, n (%)	145 (36.6)	396
Haemoglobin (g/L)	110 (94, 124)	396
Anaemia, n (%)	199 (50.3)	396
Platelet count (10^9/L)	167.5 (96.3, 218.8)	396

Continued

Table 1 Continued

Variable	n	N
Thrombocytopenia, n (%)	105 (26.5)	396
Severe thrombocytopenia, n (%)	41 (10.3)	396
Erythrocyte sedimentation rate (mm/H)	32 (14, 52)	382
C reactive protein (mg/L)	5.9 (5.2, 9.2)	396
Complement 3 (g/L)	0.550 (0.380, 0.778)	396
Low complement 3, n (%)	304 (76.8)	396
Complement 4 (g/L)	0.099 (0.064, 0.150)	396
Low complement 4, n (%)	305 (77.0)	396
SLEDAI 2000 value	13 (8, 19)	396
SLEDAI 2000 disease activity grading, n (%)		396
SLEDAI 2000 score<7	72 (18.2)	
SLEDAI 2000 score≥7	324 (81.8)	
SLE-DAS value	15.32 (7.90, 24.45)	396
SLE-DAS disease activity grading, n (%)		396
SLE-DAS score≤7.64	96 (24.2)	
SLE-DAS score > 7.64	300 (75.8)	
Glucocorticoid dose grading, n (%)		396
Free	6 (1.5)	
Low	66 (16.7)	
Moderate	108 (27.3)	
High	189 (47.7)	
Intravenous pulse	27 (6.8)	
Gammaglobulin, n (%)	40 (10.1)	396
Hydroxychloroquine, n (%)	216 (54.5)	396
Immunosuppressants, n (%)	193 (48.7)	396
Biologics, n (%)	18 (4.5)	396

Except where indicated otherwise, values are median (P_{25}, P_{75}).
ANA, anti-nuclear antibody; Anti-SSB, anti-Sjögren's syndrome B; SLEDAI 2000, systemic lupus erythematosus disease activity index 2000; SLE-DAS, systemic lupus erythematosus disease activity score.

95% CI 0.228 to 0.401, P_{FDR}<0.001), whereas the SLEDAI 2000 value was very weakly correlated with gammaglobulin use (ρ=0.170, 95% CI 0.059 to 0.275, P_{FDR}=0.001). The results indicated a very weak correlation between SLE-DAS disease activity grading and gammaglobulin use (ρ=0.170, 95% CI 0.119 to 0.215, P_{FDR}=0.002). However, a correlation was not found between SLEDAI 2000 disease activity grading and gammaglobulin use (ρ=0.049, 95% CI −0.047–0.126, P_{FDR}=0.404).

There was also a weak correlation between SLE-DAS value and immunosuppressant use (ρ=0.221, 95% CI 0.131 to 0.319, P_{FDR}<0.001) and a very weak correlation

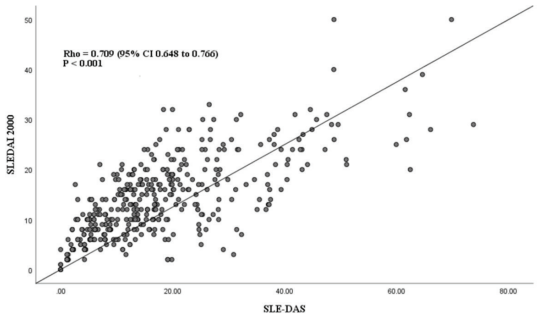

Figure 1 Scatter plot of SLE-DAS and SLEDAI 2000. SLEDAI 2000, systemic lupus erythematosus disease activity index 2000; SLE-DAS, systemic lupus erythematosus disease activity score.

between SLEDAI 2000 value and immunosuppressant use (ρ=0.122, 95% CI 0.023 to 0.220, P_{FDR}=0.024) (table 2). Furthermore, the SLE-DAS disease activity grading (ρ=0.151, 95% CI 0.056 to 0.254, P_{FDR}=0.005) was very weakly correlated with immunosuppressant use. However, the SLEDAI 2000 disease activity grading (ρ=0.106, 95% CI 0.014 to 0.214, P_{FDR}=0.051) was not found to be correlated with immunosuppressant use.

Correlation of SLE-DAS with clinical manifestations and laboratory indicators of SLE

We further investigated the correlation between disease activity scoring criteria and clinical manifestations and laboratory indicators. The SLEDAI 2000 value indicated a better correlation in terms of rash, vasculitis, urinary casts, haematuria, pyuria, anti-dsDNA positivity, leucocyte count, C3 and C4 than the SLE-DAS value. Moreover, a

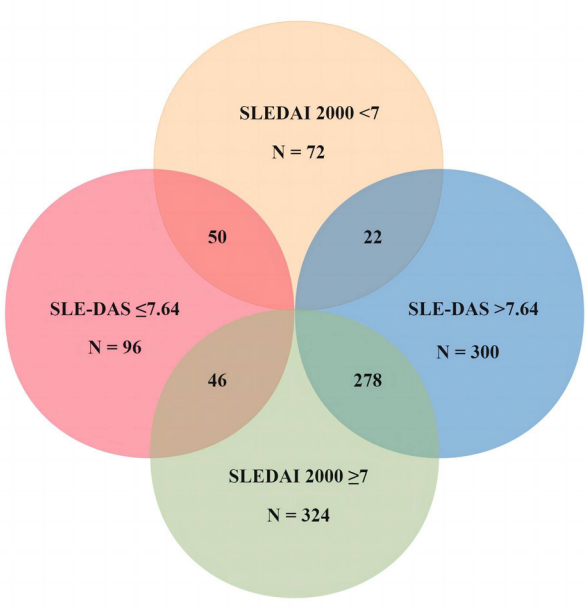

Figure 2 Distribution of SLE-DAS and SLEDAI 2000 disease activity grading. SLEDAI 2000, systemic lupus erythematosus disease activity index 2000; SLE-DAS, systemic lupus erythematosus disease activity score.

Table 2 Correlation of SLE-DAS and SLEDAI 2000 with glucocorticoid dose grading, gammaglobulin use and immunosuppressant use

	Glucocorticoid dose grading		Gammaglobulin		Immunosuppressants	
	Rho (95% CI)	P_{FDR}	Rho (95% CI)	P_{FDR}	Rho (95% CI)	P_{FDR}
SLE-DAS value	0.518 (0.436 to 0.595)	<0.001	0.318 (0.228 to 0.401)	<0.001	0.221 (0.131 to 0.319)	<0.001
SLEDAI 2000 value	0.434 (0.351 to 0.516)	<0.001	0.170 (0.059 to 0.275)	0.001	0.122 (0.023 to 0.220)	0.024
SLE-DAS disease activity grading	0.441 (0.356 to 0.521)	<0.001	0.170 (0.119 to 0.215)	0.002	0.151 (0.056 to 0.254)	0.005
SLEDAI 2000 disease activity grading	0.325 (0.230 to 0.420)	<0.001	0.049 (–0.047 to 0.126)	0.404	0.106 (0.014 to 0.214)	0.051

SLEDAI 2000, systemic lupus erythematosus disease activity index 2000; SLE-DAS, systemic lupus erythematosus disease activity score.

correlation was found between the SLEDAI 2000 value and alopecia, mucosal ulcers, myositis and neutrophil count, whereas the SLE-DAS value revealed no correlation with these variables. However, the SLE-DAS value, but not the SLEDAI 2000 value, was correlated with a positive direct Coombs' test and more predominantly with severe thrombocytopenia, cardiac involvement, pulmonary involvement (table 3). The correlation analysis that applies disease activity grading was similar to the above results (online supplemental file 1).

DISCUSSION

Accurate disease activity assessment is crucial for clinical practice, observational studies and clinical trials in patients with SLE.[24] The SLE-DAS provides an accurate, continuous and global measure of SLE disease activity, including items, such as haemolytic anaemia, cardiac involvement and pulmonary involvement, and assigns them different weights as well as considering values for continuous variables such as arthritis, proteinuria, leukocytes and platelets. This study investigated the clinical value of SLE-DAS in disease activity assessment in patients with SLE. We revealed that SLE-DAS may provide a more accurate disease activity assessment than SLEDAI 2000, especially in patients with severe thrombocytopenia and cardiopulmonary involvement.

Jesus *et al* revealed that the SLE-DAS demonstrated good construct validity and correlated highly with the validated instrument SLEDAI 2000 in both the derivation (r_s=0.94) and validation cohorts (r_s=0.943).[12] A retrospective study of 41 patients with lupus nephritis revealed that SLE-DAS was very strongly positively correlated with SLEDAI 2000 at 6-month follow-up (r=0.92), but only strongly positively correlated with SLEDAI 2000 at baseline (r=0.70), indicating that SLE-DAS correlates better with SLEDAI 2000 when disease activity is low, whereas SLE-DAS may correlate poorly with SLEDAI 2000 in patients with higher disease activity.[15] Another study confirmed this result in which the Spearman ρ coefficient was 0.90 when the correlation was analysed in patients with quiescence or low disease activity but dramatically dropped to 0.46 when analysing only patients with moderate to severe disease activity.[14] Therefore, the disease activity status of the included patients with SLE may influence the correlation between SLE-DAS and SLEDAI 2000.

The present study revealed that >70% of the patients with SLE had moderate-severe disease activity, which may be related to the fact that our study population was all inpatients; therefore, the correlation between SLE-DAS and SLEDAI 2000 was not very strong (rho=0.709) but acceptable, which was generally consistent with several recent studies.[25 26] A cross-sectional study conducted on 117 patients with SLE revealed a correlation coefficient of 0.743 between SLE-DAS and SLEDAI 2000.[25] Additionally, a prospective cohort study of 333 patients with SLE in Taiwan revealed a correlation coefficient of 0.78 between SLE-DAS and SLEDAI 2000.[26] However, the present study demonstrated that the correlation and agreement between the disease activity grading of the two scoring criteria was not satisfactory, and more studies are required to confirm this result in the future.

The determination of disease activity in patients with SLE in clinical practice is based on a combination of laboratory and clinical characteristics as well as on the physician's overall impression of the patient's status (PGA).[6] The SLE-DAS derivation was based on the PGA, and the validity of its constructs was demonstrated in an external cohort, which was scored on the PGA by a variety of clinical specialists.[12] This study did not record the PGA scores because of the limitations of the retrospective design. Treatment regimens tend to reflect patients' disease activity, especially glucocorticoid dose, thus glucocorticoid dose grading was used as a reference standard for disease activity in SLE. Both the SLE-DAS value (ρ=0.518) and the SLEDAI 2000 value (ρ=0.434) demonstrated a moderate correlation with glucocorticoid dose grading, but the SLE-DAS value demonstrated a greater correlation coefficient with glucocorticoid dose grading. In contrast, the SLE-DAS value correlated better with immunosuppressant use than the SLEDAI 2000 value (ρ=0.221 vs 0.122), though the correlation was still weak.

Fully considering rare but serious clinical manifestations, such as severe thrombocytopenia, cardiac involvement, and pulmonary involvement, is important when

Table 3 Correlation of SLE-DAS value and SLEDAI 2000 value with clinical manifestations and laboratory indicators of SLE

	SLE-DAS value		SLEDAI 2000 value	
	Rho (95% CI)	P_{FDR}	Rho (95% CI)	P_{FDR}
Fever	0.106 (0.007 to 0.200)	0.049	0.194 (0.092 to 0.285)	<0.001
Rash	0.151 (0.052 to 0.244)	0.004	0.234 (0.135 to 0.326)	<0.001
Alopecia	0.032 (–0.079 to 0.131)	0.569	0.191 (0.092 to 0.285)	<0.001
Mucosal ulcers	0.069 (–0.020 to 0.162)	0.202	0.150 (0.056 to 0.243)	0.004
Arthritis	0.156 (0.063 to 0.242)	0.003	0.170 (0.079 to 0.257)	0.001
Myositis	0.093 (0.017 to 0.165)	0.088	0.120 (0.031 to 0.200)	0.025
Vasculitis	0.249 (0.158 to 0.331)	<0.001	0.395 (0.324 to 0.465)	<0.001
Pleuritis	0.329 (0.238 to 0.411)	<0.001	0.307 (0.211 to 0.391)	<0.001
Pericarditis	0.323 (0.232 to 0.407)	<0.001	0.290 (0.193 to 0.376)	<0.001
Proteinuria	0.472 (0.397 to 0.543)	<0.001	0.490 (0.406 to 0.562)	<0.001
Urinary casts	0.270 (0.188 to 0.348)	<0.001	0.438 (0.363 to 0.503)	<0.001
Haematuria	0.318 (0.225 to 0.409)	<0.001	0.517 (0.436 to 0.587)	<0.001
Pyuria	0.266 (0.176 to 0.350)	<0.001	0.506 (0.430 to 0.573)	<0.001
Cardiac involvement	0.334 (0.263 to 0.400)	<0.001	0.048 (–0.107 to 0.150)	0.391
Pulmonary involvement	0.262 (0.184 to 0.328)	<0.001	–0.005 (–0.107 to 0.097)	0.923
Neuropsychiatric involvement	0.354 (0.277 to 0.421)	<0.001	0.341 (0.254 to 0.414)	<0.001
ANA, n (%)	0.040 (–0.062 to 0.141)	0.498	0.071 (–0.031 to 0.172)	0.202
Anti-dsDNA, n (%)	0.106 (0.010 to 0.201)	0.049	0.215 (0.123 to 0.308)	<0.001
Anti-Smith, n (%)	0.108 (0.012 to 0.204)	0.049	0.170 (0.073 to 0.267)	0.001
Anti-U1RNP, n (%)	0.084 (–0.007 to 0.175)	0.122	0.101 (0.003 to 0.190)	0.065
Anti-ribosomal P protein, n (%)	0.023 (–0.079 to 0.125)	0.663	0.071 (–0.031 to 0.171)	0.202
Anti-Ro60, n (%)	0.013 (–0.089 to 0.115)	0.795	0.027 (–0.075 to 0.129)	0.639
Anti-Ro52, n (%)	0.038 (–0.064 to 0.139)	0.512	0.008 (–0.094 to 0.110)	0.890
Anti-SSB, n (%)	0.083 (–0.019 to 0.183)	0.124	0.091 (–0.011 to 0.191)	0.097
Anti-centromere protein B, n (%)	0.033 (–0.069 to 0.134)	0.567	0.015 (–0.087 to 0.117)	0.801
Antiphospholipid antibodies, n (%)	0.040 (–0.093 to 0.173)	0.569	0.045 (–0.089 to 0.177)	0.551
Direct Coombs' test, n (%)	0.234 (0.072 to 0.380)	0.016	–0.101 (–0.281 to 0.078)	0.321
Leucocyte count (10^9/L)	–0.176 (–0.266 to 0.079)	0.001	–0.233 (–0.325 to 0.141)	<0.001
Leucopenia, n (%)	0.182 (0.097 to 0.272)	0.001	0.187 (0.098 to 0.281)	<0.001
Neutrophil count (10^9/L)	–0.092 (–0.188 to 0.007)	0.089	–0.155 (–0.247 to 0.053)	0.003
Neutropenia, n (%)	0.092 (–0.010 to 0.191)	0.089	0.090 (–0.012 to 0.189)	0.100
Lymphocyte count (10^9/L)	–0.305 (–0.397 to 0.211)	<0.001	–0.289 (–0.382 to 0.194)	<0.001
lymphopenia, n (%)	0.316 (0.228 to 0.401)	<0.001	0.265 (0.173 to 0.348)	<0.001
Haemoglobin (g/L)	–0.402 (–0.483 to 0.317)	<0.001	–0.355 (–0.443 to 0.263)	<0.001
Anaemia, n (%)	0.361 (0.272 to 0.444)	<0.001	0.324 (0.230 to 0.418)	<0.001
Platelet count (10^9/L)	–0.252 (–0.346 to 0.154)	<0.001	–0.176 (–0.262 to 0.080)	0.001
Thrombocytopenia, n (%)	0.297 (0.207 to 0.386)	<0.001	0.170 (0.077 to 0.260)	0.001
Severe thrombocytopenia, n (%)	0.226 (–0.003 to 0.043)	<0.001	0.062 (–0.045 to 0.161)	0.264
Erythrocyte sedimentation rate (mm/H)	0.175 (0.081 to 0.280)	0.001	0.171 (0.073 to 0.268)	0.001
C reactive protein (mg/L)	0.129 (0.026 to 0.229)	0.016	0.162 (0.065 to 0.254)	0.002
Complement 3 (g/L)	–0.355 (–0.434 to 0.256)	<0.001	–0.437 (–0.520 to 0.348)	<0.001
Low complement 3, n (%)	0.302 (0.207 to 0.391)	<0.001	0.350 (0.258 to 0.436)	<0.001
Complement 4 (g/L)	–0.270 (–0.361 to 0.171)	<0.001	–0.350 (–0.441 to 0.255)	<0.001
Low complement 4, n (%)	0.249 (0.152 to 0.339)	<0.001	0.336 (0.175 to 0.379)	<0.001

ANA, anti-nuclear antibody; Anti-SSB, anti-Sjögren's syndrome B; ESR, Erythrocyte sedimentation rate; SLEDAI 2000, systemic lupus erythematosus disease activity index 2000; SLE-DAS, systemic lupus erythematosus disease activity score.

assessing disease activity. Notably, the assessment of cardiopulmonary involvement in SLEDAI 2000 is limited to pericarditis and pleurisy, and thrombocytopenia is scored as a dichotomous variable without regard to the degree of reduction.[10] However, SLE-DAS includes not only serositis but also lesions of the heart and lungs themselves, such as interstitial pneumonia, diffuse alveolar haemorrhage, pulmonary hypertension and myocarditis; and the thrombocytopenia score is based on the exact value in addition to a dichotomous variable.[12] Our results revealed that the SLE-DAS value correlated poorly with rash, vasculitis, anti-dsDNA positivity, leucocyte count, C3 and C4 and did not correlate with alopecia, mucosal ulcers, myositis and neutrophil count, but it was positively associated with severe thrombocytopenia, cardiac involvement and pulmonary involvement, in contrast to the SLEDAI 2000 value. Moreover, the SLE-DAS value correlated better with gammaglobulin (ρ=0.318 vs 0.170), which can be used in select scenarios to treat patients with severe lupus, compared with the SLEDAI 2000 value. Therefore, SLE-DAS poorly correlates with serologic markers, cutaneous mucosal symptoms and musculoskeletal manifestations, but it improves the assessment of severe thrombocytopenia and cardiopulmonary involvement.

Lupus nephritis is a prevalent clinical manifestation of SLE.[27] The present study revealed that the SLEDAI 2000 value demonstrated better correlation with urinary casts, haematuria and pyuria than the SLE-DAS value, which was similar to the results of a study from India, where SLE-DAS performed poorly in patients without proteinuria but with active sediments.[15] However, isolated urinary casts, haematuria and pyuria are usually not clinical manifestations of severe lupus nephritis, whereas urinary abnormalities accompanied by proteinuria often attract the attention of clinicians and reflect the activity of lupus nephritis.[28] The correlation coefficients of the SLE-DAS value and the SLEDAI 2000 value were the same in terms of proteinuria (ρ=0.472 vs 0.490). The SLEDAI 2000 scored urinary casts, haematuria, pyuria and proteinuria similarly with weighted dichotomy, independent of the level. However, the SLE-DAS formula, despite not incorporating urinary casts, haematuria and pyuria, for proteinuria, includes not only the presence of proteinuria but also the level of proteinuria, which may be more reflective of the severity of lupus nephritis.

Moreover, this study compared the correlation of disease activity grading of the two scoring criteria with treatment, clinical manifestations and laboratory indicators. The results were essentially similar to those obtained using the values of both scoring criteria, indicating that the SLE-DAS disease activity grading is more accurate in assessing the disease activity status in patients with SLE.

This study has several limitations to be considered. First, this was a retrospective study, and data were inevitably missing. Second, the results may be biased because this was a single-centre study with a small sample size. Therefore, further multicentre and multiethnic studies are required to confirm these results. Third, glucocorticoid dose grading was used as a reference standard for disease activity in the present study, but given the complexity of routine clinical practice, glucocorticoid dose grading may not correctly reflect the true state of disease activity in some patients with SLE, which also affects the accuracy of the results of this study. Fourth, since more than 70% of the patients in this study had moderate-severe disease activity, the results of this study do not necessarily apply to patients with remission-mild disease activity. Additionally, the validation of prospective studies with consistent SLE-DAS and PGA scores, including damage accumulation prediction and health-related quality of life assessment, is an important direction for further research.

In conclusion, both the SLE-DAS and SLEDAI 2000 scoring systems can be used to evaluate disease activity in patients with SLE. However, the SLE-DAS may be preferable, especially in patients with more severe thrombocytopenia and cardiopulmonary involvement, and with further validation studies may provide a basis for developing and improving treatment programmes for patients with SLE.

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