EULAR Sjögren’s syndrome disease activity index (ESSDAI): a user guide

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ABSTRACT
The EULAR Sjögren’s syndrome (SS) disease activity index (ESSDAI) is a systemic disease activity index that was designed to measure disease activity in patients with primary SS. With the growing use of the ESSDAI, some domains appear to be more challenging to rate than others. The ESSDAI is now in use as a gold standard to measure disease activity in clinical studies, and as an outcome measure, even a primary outcome measure, in current randomised clinical trials. Therefore, ensuring an accurate and reproducible rating of each domain, by providing a more detailed definition of each domain, has emerged as an urgent need. The purpose of the present article is to provide a user guide for the ESSDAI. This guide provides definitions and precisions on the rating of each domain. It also includes some minor improvement of the score to integrate advance in knowledge of disease manifestations. This user guide may help clinicians to use the ESSDAI, and increase the reliability of rating and consequently of the ability to detect true changes over time. This better appraisal of ESSDAI items, along with the recent definition of disease activity levels and minimal clinically important change, will improve the assessment of patients with primary SS and facilitate the demonstration of effectiveness of treatment for patients with primary SS.

INTRODUCTION
With the growing interest in conducting clinical trials in primary Sjögren’s syndrome (SS), having specific and valid outcome measures became a necessity. For that purpose, an international collaboration was set up to develop and validate the EULAR Sjögren’s syndrome disease activity index (ESSDAI) and EULAR Sjögren’s syndrome patient reported index (ESSPRI).1

The ESSDAI is a systemic disease activity index that was generated in 2009. This score has been developed by consensus of a large group of worldwide experts from European and North American countries, supported by the EULAR (project code CLI 010).1 It includes 12 domains (ie, organ systems: cutaneous, respiratory, renal, articular, muscular, peripheral nervous system (PNS), central nervous system (CNS), haematological, glandular, constitutional, lymphadenopathic, biological). The ESSDAI includes organ-by-organ definitions that were agreed on by a large number of experts. Each domain is divided into 3–4 levels of activity. Definition of each activity level is provided by a detailed description of what should be considered in that item. The aim was to obtain a standardised instrument for the homogenous evaluation of systemic activity in order for the ESSDAI to be used as outcome criteria to evaluate primary SS in clinical trials as well as daily practice.

This tool has been validated in a large independent cohort and has been shown to have a high content validity, to be highly reproducible and to be able to detect change.3

In the past few years, the use of this tool has become more and more prevalent,3–7 particularly in the context of randomised controlled trials (RCTs)8–10 With the growing use of the ESSDAI, some domains appeared to be more challenging to rate than others. In the context of an RCT, ensuring a more accurate and reproducible rating of each domain, by providing a more detailed definition of each domain, emerged as an urgent need. The purpose of the present article is to provide a user guide for clinicians who use the ESSDAI to help them to measure disease activity and to ensure the best accuracy of this measure for its use in RCTs as well as in clinical practice. For
each of the ESSDAI domains, we will focus on the potentially difficult items.

**METHODS**

This glossary results from an initiative of the steering committee of the EULAR Sjögren’s task force collaborative group (project code CLI 010). This group of 10 physician experts in SS (HB, SJB, TD, J-EG, XM, MR-C, RS, ET, AT and CV) and a clinical epidemiologist (PR), has led the development of the ESSDAI. To develop the ESSDAI, we also contacted one collaborator of a member of the steering committee (SC) who has vast experience in the use of the ESSDAI in the clinical and research setting (PB-Z).

Based on their experience in the use of the ESSDAI, three members of the SC (SJB, XM and RS) identified difficulties in rating ESSDAI items. They prepared a draft for a glossary that aimed to clarify these difficult ratings. This proposal was submitted to other experts of the SC. They were asked to suggest any changes they wanted made. Their suggestions were submitted for the approval of all the SC members by email. The modifications were integrated until all members of the SC agreed on a final version.

**ESSDAI domains glossary**

First, two important points have been emphasised by the SC to be considered by physicians who use the ESSDAI: 1. The ESSDAI has been developed for patients with primary SS. Therefore, other differential diagnoses should be ruled out. When the ESSDAI is used, it should be with the assurance that the signs and symptoms are related to primary SS and not to an underlying and/or associated disease. Likewise, patients with primary SS may have concomitant illnesses that can mimic SS symptoms and organ involvement, which should be taken into account.

2. When assessing disease activity of an individual patient, the physician has to keep in mind that he/she has to exclude damage features that are irreversible. Therefore, for each single domain, the long-lasting fixed features (stable for at least 12 months) should be scored as 0.

**Constitutional domain**

<table>
<thead>
<tr>
<th>Domain</th>
<th>Activity level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constitutional symptoms</td>
<td>No=0</td>
<td>Absence of the following features</td>
</tr>
<tr>
<td>Exclusion of fever of infectious origin and voluntary weight loss</td>
<td>Low=3</td>
<td>Mild or intermittent fever (37.5–38.5°C)/night sweats and/or involuntary weight loss of 5–10% of body weight</td>
</tr>
<tr>
<td></td>
<td>Moderate=6</td>
<td>Severe fever (&gt;38.5°C)/night sweats and/or involuntary weight loss of &gt;10% of body weight</td>
</tr>
</tbody>
</table>

The rating of this domain should take into account the following comments:

Fever and night sweats: The presence of fever (measured by the patient or the physician using a thermometer) and night sweats is based on patient responses following direct questioning ‘Have you had fevers or night sweats in the past 4 weeks?’

If the fever is regularly (at least twice a week) >38.5°C or if the night sweats wet the nightclothes, score as moderate activity, else in presence of milder constitutional symptoms score as low activity.

Symptoms that are thought to be due to causes other than SS, for example, menopause, concomitant infection or neoplasia, should be scored as 0.

Weight loss: Weight loss should be recent to be taken into account (within the past 12 weeks). Where the weight loss is intentional or due to a concomitant illness, it should be scored as 0.

Constitutional symptoms related to lymphoma should be scored in the constitutional domain in addition to the scoring of lymphoma.

**Lymphadenopathy and lymphoma domain**

<table>
<thead>
<tr>
<th>Domain</th>
<th>Activity level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lymphadenopathy and lymphoma</td>
<td>No=0</td>
<td>Absence of the following features</td>
</tr>
<tr>
<td>Exclusion of infection</td>
<td>Low=4</td>
<td>Lymphadenopathy ≥1 cm in any nodal region or ≥2 cm in inguinal region</td>
</tr>
<tr>
<td></td>
<td>Moderate=8</td>
<td>Lymphadenopathy ≥2 cm in any nodal region or ≥3 cm in inguinal region, and/or splenomegaly (clinically palpable or assessed by imaging)</td>
</tr>
<tr>
<td></td>
<td>High=12</td>
<td>Current malignant B-cell proliferative disorder</td>
</tr>
</tbody>
</table>

To be clearer, we added ‘and lymphoma’ in the title of the domain.

The rating of this domain should take into account the following comments:

Lymphadenopathy or splenomegaly: If there is no significant lymph node or splenomegaly at the clinical examination, no other examination is requested. If there are some clinical abnormalities, and if an ultrasound or CT scan has been performed, these data will be used for scoring, else clinical abnormalities should be used for scoring.

Lymphadenopathies that are thought to be due to causes other than SS, for example, to a concomitant infection, should be scored as 0.
Current B-cell malignant proliferative disorder: B-cell proliferative disorders are based on the WHO classification criteria 2011, including under the item ‘Mature B-cell neoplasms’ of this classification.11

Any B-cell malignant disorder should be taken into account except if it is in complete remission for more than 6 months after the end of the treatment (including consolidation treatment).

Thus, recently diagnosed, currently treated, untreated smouldering low-grade lymphoma, or previously treated but not in remission B-cell proliferative disorders, should be taken into account.

The history of treated lymphoma considered in remission, monoclonal gammapathy of undetermined significance should not be scored.

Multiple myeloma is not to be taken into account.

Glandular domain

The rating of this domain should take into account the following comments.

The importance of parotid, submandibular or lacrymal gland swelling should be assessed by clinical examination and not by ultrasound. Ultrasound is a very interesting examination for assessing the structure of the gland and could be very useful for the diagnosis of SS, but until now it has not been shown to be reliable for assessing the size of the glands.

The swelling of submandibular is considered limited when it is <2 cm and important when it is >2 cm at its wider diameter.

The swelling of lacrymal glands is considered limited when it is <1 cm and important when it is >1 cm at its wider diameter.

In case of gland enlargement due only to lymphoma, lymphoma will be scored in the ‘Lymphadenopathy and lymphoma’ domain but not in the glandular domain. If the gland is enlarged independently from lymphoma, or if the contralateral gland or other salivary glands are enlarged, both domains should be scored.

Symptoms that are thought to be due to causes other than SS, for example, to sarcoidosis, IgG4-related disease, stones or a concomitant infection, should be scored as 0.

Articular domain

<table>
<thead>
<tr>
<th>Domain</th>
<th>Activity level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Articular Exclusion of osteoarthritis</td>
<td>No=0</td>
<td>Absence of currently active articular involvement</td>
</tr>
<tr>
<td></td>
<td>Low=2</td>
<td>Arthralgias in hands, wrists, ankles and feet accompanied by morning stiffness (&gt;30 min)</td>
</tr>
<tr>
<td></td>
<td>Moderate=4</td>
<td>1–5 (of 28 total count) synovitis</td>
</tr>
<tr>
<td></td>
<td>High=6</td>
<td>≥6 (of 28 total count) synovitis</td>
</tr>
</tbody>
</table>

The rating of this domain should take into account the following comments:

Arthralgia is a symptom characterised by joint pain without inflammatory signs in the joint/s involved. Only arthralgias of inflammatory origin should be scored.

This means a positive response to both the following questions is required: “Have you got pain in your hands/wrists/ankles and/or feet in the past 4 weeks? Are you stiff in the morning for at least 30 minutes?”

The synovitis count should be based on the 28 joint count used for the DAS28 evaluation in rheumatoid arthritis.12 It is based on clinical examination by a medical professional or, if clinical examination is not felt to be accurate (eg, a patient with generally swollen hands where a definitive joint count is not possible), on US examination.

Arthralgias or synovitis due to other causes, such as osteoarthritis, infectious, metabolic, rheumatoid arthritis or other autoimmune diseases should be excluded.

Cutaneous domain

<table>
<thead>
<tr>
<th>Domain</th>
<th>Activity level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutaneous Rate as ‘No activity’ stable long-lasting features related to damage</td>
<td>No=0</td>
<td>Absence of currently active cutaneous involvement</td>
</tr>
<tr>
<td></td>
<td>Low=3</td>
<td>Erythema multiforma</td>
</tr>
<tr>
<td></td>
<td>Moderate=6</td>
<td>Limited cutaneous vasculitis, including urticarial vasculitis, or purpura limited to feet and ankle, or subacute cutaneous lupus</td>
</tr>
<tr>
<td></td>
<td>High=9</td>
<td>Diffuse cutaneous vasculitis, including urticarial vasculitis, or diffuse purpura, or ulcers related to vasculitis</td>
</tr>
</tbody>
</table>

The rating of this domain should take into account the following comments:

Erythema multiforma are typical targets, or raised, oedematous papules distributed acrally; involvement of mucous membranes is possible.

Subacute cutaneous lupus erythematosus (SCLE) is characterised by two forms, including papulosquamous lesions and annular lesions that develop in sun-exposed areas, including the upper back, shoulders, extensor arms, neck and upper torso, while the face is usually spared.

Cutaneous vasculitis should include purpura, maculo-papular rash or urticarial rash. Lesions other than purpura and supposedly due to vasculitis such as isolated urticarial or macular rash of vasculitic origin should be confirmed (by histology and/or the presence of cryoglobulins) at least once in patient history.

Cutaneous vasculitic activity is classified according to the cutaneous extension as moderate activity (if limited to <18% of the body surface area) or high activity (if extended to ≥18% of the body surface area or if showing presence of ulcers). The body surface area involved is evaluated according to figure 1.

If a skin biopsy has been performed this should be used. Otherwise, scoring is based on clinical examination by a medical professional with suitable training and experience.

Cutaneous rash due to infections, drug reaction or neoplasia should be excluded. In case of SCLE, underlying SLE should be excluded.

### Pulmonary domain

<table>
<thead>
<tr>
<th>Domain</th>
<th>Activity level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary Rate as 'No activity' stable long-lasting features related to damage, or respiratory involvement not related to the disease (tobacco use, etc)</td>
<td>No=0</td>
<td>Absence of currently active pulmonary involvement</td>
</tr>
<tr>
<td></td>
<td>Low=5</td>
<td>Persistent cough due to bronchial involvement with no radiographic abnormalities on radiography Or radiological or HRCT evidence of interstitial lung disease with: no breathlessness and normal lung function test</td>
</tr>
<tr>
<td></td>
<td>Moderate=10</td>
<td>Moderately active pulmonary involvement, such as interstitial lung disease shown by HRCT with shortness of breath on exercise (NYHA II) or abnormal lung function tests restricted to: 70% &gt;DLCO ≥40% or 80% &gt;FVC≥60%</td>
</tr>
<tr>
<td></td>
<td>High=15</td>
<td>Highly active pulmonary involvement, such as interstitial lung disease shown by HRCT with shortness of breath at rest (NYHA III, IV) or with abnormal lung function tests: DLCO &lt;40% or FVC &lt;60%</td>
</tr>
</tbody>
</table>

FVC, forced vital capacity; HRCT, high-resolution CT; NYHA, New York Heart Association.

The rating of this domain should take into account the following comments:

A persistent cough is scored if linked to bronchial involvement ascertained by either HRCT (bronchial thickening or dilation) or pulmonary function tests (PFTs) (obstructive syndrome) and not due to active infection or tobacco use. Long-lasting (more than 12 months) persistent but stable cough more likely due to damage than activity should be scored as 0. Persistent cough only due to bronchial dryness should be scored as 0.

To be more precise and clear we modified the wording of the low disease activity level and changed ‘or’ by ‘due to’ bronchial involvement.

Interstitial lung disease, if suspected, should have been ascertained at least once in the patient history by HRCT by the presence of mainly ground glass aspect (rather than honeycombing aspects). HRCT should be repeated if symptoms, or radiological or lung function test worsening has occurred. For follow-up, classification is made either on lung function test and/or shortness of breath.

Shortness of breath resulting in slight limitation of physical activity: patient being comfortable at rest, but for whom ordinary physical activity results in fatigue, palpitation or dyspnoea, is classified as NYHA stage II and is scored as moderate activity. If limitation is more marked with symptoms present for ordinary activity and/or at rest (NYHA III or IV), activity is scored as high.

Shortness of breath due to another cause, such as tobacco-related chronic bronchitis, cardiac insufficiency, arterial pulmonary embolism or infection) should be scored as 0. Also, other autoimmune diseases associated with interstitial lung disease should have been excluded.

Non-evolving long-lasting (more than 12 months) interstitial lung disease thought to be due to damage rather than activity should be scored as 0.
### Renal domain

<table>
<thead>
<tr>
<th>Domain</th>
<th>Activity level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renal</td>
<td>High=15</td>
<td>Highly active renal involvement, such as glomerular involvement with proteinuria (&gt;1.5 g/day), or haematuria or renal failure (GFR ≥60 mL/min) or histological evidence of extra-membranous glomerulonephritis or important interstitial lymphoid infiltrate</td>
</tr>
<tr>
<td>Rate as ‘No activity’ stable</td>
<td>Low=5</td>
<td>Evidence of mild active renal involvement, limited to tubular acidosis without renal failure or glomerular involvement with proteinuria (between 0.5 and 1 g/day) and without haematuria or renal failure (GFR &gt;60 mL/min)</td>
</tr>
<tr>
<td>long-lasting features related to damage and renal involvement not related to the disease. If biopsy has been performed, please rate activity based on histological features first</td>
<td>Moderate=10</td>
<td>Moderately active renal involvement, such as tubular acidosis with renal failure (GFR &lt;60 mL/min) or glomerular involvement with proteinuria between 1 and 1.5 g/day and without haematuria or renal failure (GFR ≥60 mL/min) or histological evidence of extra-membranous glomerulonephritis or important interstitial lymphoid infiltrate</td>
</tr>
<tr>
<td></td>
<td>No=0</td>
<td>Absence of currently active renal involvement with proteinuria &lt;0.5 g/day, no haematuria, no leucocyturia, no acidosis or long-lasting stable proteinuria due to damage</td>
</tr>
</tbody>
</table>

GFR, glomerular filtration rate.

### Muscular domain

<table>
<thead>
<tr>
<th>Domain</th>
<th>Activity level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscular</td>
<td>High=18</td>
<td>Highly active myositis shown by abnormal EMG, MRI* or biopsy with weakness (deficit &lt;3/5) or elevated creatine kinase (&gt;4N)</td>
</tr>
<tr>
<td>Exclusion of weakness due to corticosteroids</td>
<td>Low=6</td>
<td>Mild active myositis shown by abnormal EMG, MRI* or biopsy with no weakness and creatine kinase (N &lt; CK ≤ 2N)</td>
</tr>
<tr>
<td></td>
<td>Moderate=12</td>
<td>Moderately active myositis proven by abnormal EMG, MRI* or biopsy with weakness (maximal deficit of 4/5), or elevated creatine kinase (2N &lt; CK ≤ 4N), or biopsy with weakness due to auto-immune disease should be scored as low activity; active myositis is proven either by abnormal EMG, MRI or biopsy.</td>
</tr>
</tbody>
</table>

*We decided to add this item not included in the initial version since the value of this examination for the diagnosis of myositis was not clear until recently. EMG, electromyogram.

The rating of this domain should take into account the following comments:

- Diagnosis of myositis should be made on the association of clinical symptoms (muscular pain or weakness) and/or CK elevation and either muscular involvement confirmed by needle detection on EMG, by diffuse inflammation on MRI and/or active myositis on biopsy. Therefore, having one positive examination among EMG, MRI or biopsy is mandatory, but all are not necessary.

- EMG should be performed by an accredited neurophysiologist. MRI evidence myositis with diffuse inflammation has been added to the definition of muscular domain, due to the recognised value of this examination for that purpose. Muscle biopsy is not mandatory in the definition of the activity levels of the domain, but advised in case of uncertainty on the diagnosis. A new biopsy is not mandatory in case of recurrence of the same symptoms with creatine kinase elevation and a previous biopsy showing inflammatory myositis.

- Patients having only muscular pain but no muscle weakness and normal creatine kinase level should be scored as low activity; active myositis is proven either by abnormal EMG, MRI or biopsy.

- Non-autoimmune causes (infection, statins and other drugs or toxics, etc) should be excluded. Muscle weakness or involvement that is thought to be due to causes other than SS, such as fibromyalgia, corticosteroids, statins or other classified auto-immune disease should be scored as 0.
The rating of this domain should take into account the following comments:

For all peripheral neuropathy (except cranial nerve neuropathy and small fibre neuropathy), peripheral neurological involvement should have been ascertained by NCS at least once. The diagnosis of patients with peripheral neuropathy requires exhaustive evaluation of signs and symptoms, followed by confirmation by electrophysiological studies, which are useful in establishing the type of neuropathy and whether it is primarily demyelinating or axonal.

Some types of neuropathy may require additional diagnostic tests:
- Proximal demyelinating neuropathy: elevated cerebrospinal fluid protein level and/or sensory evoked potentials.
- Small fibre neuropathy should have been ascertained by a cutaneous biopsy, and/or altered or absent laser-evoked potentials and/or abnormal quantitative sensory testing to thermal stimuli and/or abnormal sympathetic sensory testing.

For muscular testing, grade 3/5 means that the patient holds test position against gravity with no added pressure, but not against external pressure. If the motor deficit is grade 3 or less, activity should be scored as high.

Peripheral neuropathy that is thought to be due to causes other than SS, such as diabetes, or due to metabolic or toxic causes, or that are inherited, should be scored as 0.

Long-lasting (more than 12 months) non-evolving neurological involvement thought to be due to damage rather than activity should be scored as 0.
Biological domain

The rating of this domain should take into account the following comments:

- Cytopenias that are thought to be due to causes other than SS should be scored as 0.
- Cytopenias due to drug-induced toxicity, viral infections or haematological disorder other than autoimmune or lymphoma;
- Anaemia due to iron or vitamin deficiency;
- Neutropenia of ethnic origin or due to drug associated agranulocytosis;
- Thrombocytopenia linked to hypersplenism.
- Other causes of autoimmune cytopenia should have been discarded.

Biological domain

<table>
<thead>
<tr>
<th>Domain</th>
<th>Activity level</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological</td>
<td>No=0 Low=2</td>
<td>Absence of any of the following biological feature: clonal component and/or hypocomplementemia (low C4 or C3 or CH50) and/or hypergammaglobulinemia or high IgG level between 16 and 20 g/L.</td>
</tr>
<tr>
<td></td>
<td>Moderate=4</td>
<td>Cytopenias of autoimmune origin with neutropenia (1000 neutrophils&lt;1500/mm³), and/or anaemia (10 haemoglobin&lt;12 g/dl), and/or thrombocytopenia (100 000 platelets&lt;150 000/mm³) or lymphopenia (500 lymphocytes&lt;1000/mm³)</td>
</tr>
<tr>
<td></td>
<td>High=6</td>
<td>Cytopenias of autoimmune origin with neutropenia (500 neutrophils&lt;1000/mm³), and/or anaemia (8 haemoglobin&lt;10 g/dl), and/or thrombocytopenia (50 000 platelets&lt;100 000/mm³) or lymphopenia (&lt;500/mm³)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cytopenias of autoimmune origin with neutropenia (neutrophils&lt;500/mm³), and/or anaemia (haemoglobin&lt;8 g/dl) and/or thrombocytopenia (platelets&lt;50 000/mm³)</td>
</tr>
</tbody>
</table>

The biological presence of cryoglobulinemia should be taken into account even if there is no clinical sign, even in the case of low cryocrit levels (<1%). Clinical signs related to cryoglobulinemia should be additionally scored in each domain.

CONCLUSION

Since its development, the ESSDAI has been frequently used in primary SS clinical studies. The ESSDAI is now in use as a gold standard, as the SLEDAS or BILAG is in lupus, to measure systemic disease activity in clinical and biological studies in SS that aim at evaluating new biomarkers of activity. It has been shown to correlate with B-cell biomarkers such as β2 microglobulin, serum free light chains of immunoglobulins, the cytokine BAFF and to be associated with the risk of lymphoma.

In addition, ESSDAI has started to be used as an outcome measure in RCTs in SS, and even as the primary outcome measure in currently ongoing RCTs. Recently, the definition of disease activity levels and thresholds of minimal clinically important improvement (MCII) have been recently proposed for that tool: a moderately active disease being defined as an ESSDAI ≥5 and an MCII as a decrease of at least 3 points. These cut-offs have started to be used, respectively, as entry criteria and primary end points for RCTs (testing tocilizumab [NCT01782235] or abatacept [NCT02067910]). In this setting, enhancing the accuracy and the reliability of disease activity scoring to correctly classify patients at study entry but also at final evaluation is a crucial point to determine the efficacy of the drug under investigation.

Finally, the detailed definitions given in this paper on the way to rate each of the ESSDAI domains may be useful in future RCTs as well as in clinical practice. We hope it will improve the accuracy of clinical trials data and help to demonstrate the effectiveness of future treatment in patients with primary SS.

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Collaborators

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