Psychometric testing of the British English Workplace Activity Limitations Scale in four rheumatic and musculoskeletal conditions

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Abstract

Objectives: The aims were to validate a British English version of the Workplace Activity Limitations Scale (WALS) linguistically, then test this psychometrically in RA, axial spondyloarthritis (axSpA), OA and FM.

Methods: The WALS was forward translated, reviewed by an expert panel, and cognitive debriefing interviews were conducted. Participants completed a postal questionnaire booklet. Construct (structural) validity was examined by fit to the Rasch measurement model. Concurrent validity included testing between the WALS and the Work Limitations Questionnaire-25 (WLQ-25). Two weeks later, participants were mailed a second questionnaire booklet for test–retest reliability.

Results: Minor wording changes were made to the WALS, then 831 employed participants completed questionnaires: 267 men and 564 women; 53.5 (s.d. 8.9) years of age; with condition duration 7.7 (s.d. 8.0) years. The WALS satisfied Rasch model requirements, and a WALS Rasch transformation table was created. Concurrent validity was strong with the WLQ-25 (RA $r_s = 0.78$; axSpA $r_s = 0.83$; OA $r_s = 0.63$; FM $r_s = 0.64$). Internal consistency was consistent with group use ($s = 0.80–0.87$). Test–retest reliability was excellent, with intraclass correlation coefficient (2,1) at $r = 0.90$.

Conclusion: A reliable, valid British English version of the WALS is now available for use in the UK.

Lay Summary

What does this mean for patients?

Working people with arthritis can have difficulties doing work activities. If not identified and addressed, people can struggle to keep working and even give up work. The Workplace Activity Limitations Scale (WALS), developed in Canada, measures work difficulties. With help from 48 people with rheumatoid arthritis (RA), osteoarthritis (OA), axial spondyloarthritis (axSpA) or fibromyalgia (FM), we adapted the WALS into British English. They considered that the 12 questions of the WALS reflected their work problems well. We sent a questionnaire booklet, including the WALS and other work and health questionnaires (e.g. pain, fatigue, daily activity ability), to >800 people with RA, OA, axSpA or FM. Several weeks later, we again sent them the WALS to complete. We found a good relationship between WALS scores and other questionnaires; that is, the WALS is a valid, or realistic, measure of work difficulties. It is also reliable; people gave very similar answers second time round. The WALS could be used in clinics quickly (<5 min) to identify people with problems at work attributable to their arthritis. A score of seven or more indicates need for referral for work advice/rehabilitation to help resolve work problems, which could then help people to keep working.

Keywords: patient-reported outcomes, work, work rehabilitation, arthritis, musculoskeletal, rehabilitation

Key messages

- WALS content is considered highly relevant by working people with RA, OA, axSpA and FM.
- WALS has good reliability and construct (structural), concurrent and discriminant validity.
- WALS can be used to evaluate work difficulties, need for work rehabilitation and treatment outcomes.

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Introduction

Work participation (i.e. paid work) is important for the health and well-being of people with rheumatic and musculoskeletal disorders (RMDs). Yet they have a shorter healthy working life expectancy [1] and are less likely to be employed compared with those without long-term health conditions [2]. Working people with RMDs can struggle to manage work, leading to presenteeism (i.e. reduced at-work productivity owing to health problems [3]). This is an important target for improvement in medical, rehabilitation and vocational interventions, and from the perspectives of people with RMDs [4]. Outcome measures assessing at-work productivity, tested across a range of RMDs, can help to direct and evaluate such interventions.

The OMERACT Work Productivity Group identified two patient-reported outcome measures of at-work productivity suitable for use in RMD [5, 6]. The Work Limitations Questionnaire-25 (WLQ-25) measures duration of difficulty with work activities (work productivity) [7]; and the Workplace Activity Limitations Scale (WALS) measures the amount of difficulty with work activities (work ability) [4, 8]. People with RA and OA preferred the WALS over the WLQ-25 as an outcome measure [9].

The WALS was developed and tested psychometrically in Canada and has been used there in studies in inflammatory arthritis [i.e. RA, PsA and axial spondyloarthritis (axSpA)], OA, lupus and scleroderma [10–13]. In RA and OA, it has the following characteristics: good content validity, comprehensibility and content relevance [9]; low respondent burden [16]; and concurrent validity with other work measures [6, 17]; although there is only limited evidence for its test–retest reliability [6]. It has potential for clinical and research use in the UK. The WALS was developed in Canadian English. Before use in the UK, it should be validated linguistically (i.e. translated and culturally adapted) into British English (a different form of the same language), then tested psychometrically [18]. Although most Canadian English is understandable in the UK, some words used in the WALS have different meanings, e.g. ‘subway’ means a rapid transport system in North America but an underpass for crossing roads in the UK. The aims of the present study were therefore as follows: to validate linguistically, investigate content validity, and evaluate the psychometrics of a British English WALS among employed people with RA, axSpA, lower limb OA and FM in the UK. Testing should include both classical testing and item response theory (e.g. Rasch analysis) to establish psychometric properties (e.g. reliability and validity) [19].

Methods

The study design used cross-cultural adaptation, followed by cross-sectional surveys to establish psychometric properties of the WALS. The COmensus-based Standards for the selection of health Measurement Instruments (COSMIN) checklists were followed [19, 20]. Ethical approval was obtained from the National Research Ethics Service Committee East Midlands, Leicester South (17/EM/0409). All participants provided written, informed consent.

Participants and recruitment

Patients were recruited from 41 secondary care and six community National Health Service Trusts’ Rheumatology, Orthopaedic or Therapy outpatient clinics, with some participants from our research group’s Arthritis Volunteer Register, in the UK. Participants were eligible if they were: ≥18 years of age, in paid employment ≥1 day per week, currently working or on <4 weeks sick leave, with participation delayed until at work, and had a primary diagnosis of RA or undifferentiated inflammatory arthritis (UIA), axSpA, OA (knee and/or hip) or FM. Diagnoses were confirmed by a rheumatologist for RA, UIA and axSpA or by a rheumatologist, orthopaedic surgeon, general practitioner or extended scope physiotherapist for OA and FM. Participants needed to be able to read, write and understand British English and were ineligible if on long-term sick leave, because they were unable to complete the work measures. Patients were identified by research facilitators or therapists using these criteria and given a short study explanation and information pack. The latter included a reply form, including diagnosis, employment and sick leave status, to check eligibility criteria.

Data collection

In phase 1, linguistic validation and cross-cultural adaptation were conducted to ensure that the wording in the WALS was considered comprehensible by participants. Content validity (i.e. the degree to which the content of a patient-reported outcome measure is considered an adequate reflection of what is being measured) was also tested [18, 21] (see Supplementary Data S1, available at Rheumatology Advances in Practice online).

In phase 2, for psychometric testing, participants were mailed a paper questionnaire booklet to complete at home [test 1 (T1)]. Two weeks after return of the questionnaire, they were mailed a second questionnaire [test 2 (T2)], to assess test–retest reliability. Participants were sent a reminder letter after 2 weeks, followed at 4 weeks by another reminder and questionnaire booklet, if needed.

The T1 booklet included demographic data: age, sex, living arrangements, education status, condition duration, medication regimen, employment status and job title, to allow coding to job skill level {1 = elementary occupations; 2 = requiring compulsory education/work-related training; 3 = post-compulsory education (sub-degree) or longer work experience; 4 = degree education or equivalent experience [22]}. The T1 booklet also included the British English WALS, consisting of 12 items, measured on a scale of 0–3 for difficulty in performing work activities (0 = no difficulty; 3 = unable to do; Supplementary Data S2, available at Rheumatology Advances in Practice online). The WALS includes: eight physical activity items; three about managing work and concentration at work [12]. The instructions state that respondents should answer about their work performance without help from others or using special gadgets or equipment, in order that their answers are not confounded by the use of workplace behavioural coping strategies [10].

The recall period is not specified. Those items answered as ‘not applicable to my job’ are scored 0. Scoring allows up to three missing items, which can be imputed using the individual’s mean or median scores (depending on the data distribution). A summed score is calculated (0–36), with scores ≥9 being associated with greater absenteeism, job disruptions and need for work accommodations, compared with those scoring <5 [13].

To test concurrent validity, several work and health measures were included in the T1 questionnaire booklet. Some of these were condition-specific measures, and therefore four

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separate condition-specific T1 questionnaire booklets were
used, with participants completing the booklet relevant for
their condition. For all measures, a higher score indicates
worse status. Three work measures were included. The WLQ-
25 consists of 25 items in four subscales (1–5 scale), indicat-
ing the percentage time in the past 2 weeks that physical
work, time, mental–interpersonal and output demands were
limited [7]. From these, the WLQ Percentage Productivity
Loss [7] and Summed scores [23] are created. Two forms of
the Work Instability Scale (WIS) were used: the RA-WIS was
included in those questionnaires for people with RA, OA or
the degree of mismatch between the respondent’s work abili-
ties and their job demands. The RA-WIS includes 23 true/false
items and the AS-WIS 20 items. Both have cut-points indicat-
ing low, moderate and high work instability (RA-WIS <10
and >17; AS-WIS <11 and >18). The third work measure
was the Work Productivity and Activity Impairment (WPAI)
(Genral Health) scale, which includes six items, from which
a percentage overall work impairment due to health (in the
past 7 days) score is calculated [27].

For RA, the condition-specific health measures included in
the T1 booklet were: the Rheumatoid Arthritis Impact of
Disease (RAID) scale, consisting of seven 0–10 numerical rat-
ing scales (NRS; e.g. pain, fatigue, function) scored by sum-
ming weighted NRS scores [28]; and the HAQ, consisting of
20 daily activities rated 0–3 (0 = not at all difficult; 3 = unable
to do) [29]. The HAQ was scored by summing all items
(0–20 = mild; 21–40 = moderate; 41–60 = severe disability
without adjustment for using aids and devices [30]. For
axSpA, the health measures were: the BASDAI, in which the
average score (0–10) is calculated from six 10 cm visual ana-
xing scales (VAS) of symptom severity (e.g. fatigue, spinal
pain [31]); and the BASFI, in which an average score (0–10) is
calculated from ten 10 cm VAS of physical function [32]. For
OA, two subscales of the WOMAC were included [pain (five
items) and physical function (17 items); both scored from
0 = none to 4 = extreme], with total scores for each subscale
calculated [33]. Finally, for FM, the Revised Fibromyalgia
Impact Questionnaire (FIQR) was included. This consists of
three subscales rated on 0–10 NRS (overall impact (two
items); symptoms (10 items); and function (nine items). Subscale
and overall total scores were then calculated [34].

For all four conditions, an additional health question was
about perceived health status: ‘Considering all the ways that
your condition affects you, how have you been over the past
month?’ (scored from 1 = very good to 5 = very poor).

At test 2, participants completed the WALS, perceived
health status and also an item on perceived change in health
status: ‘Overall, how much is your arthritis/condition trou-
bling you now compared with when you last completed this
questionnaire?’ (1 = much less; 3 = about the same; 5 = much
more).

Sample size

A test–retest reliability correlation of 0.7 is considered a mini-
mum acceptable level [36].

Statistical analyses

Demographic, work and health measures were summarized
descriptively, as appropriate. RUMM 2030+ software was
used for Rasch analysis [37]. Given that all work and health
measures either consisted of ordinal data or were not
normally distributed, non-parametric statistical tests were
conducted using the Statistical Package for the Social Sciences
(SPSS) v.26 [38]. The following psychometric properties were
assessed.

Compliance

Compliance (i.e. the amount of missing data) was assessed by
identifying the number (percentage) of missing data items and
also WALS which could not be scored.

Validity

Construct (structural) validity measures the degree to which
the scores of a patient-reported outcome measure adequately
reflect the dimensionality of the construct being measured
(e.g. do all scale items measure the same construct, and are
items independent of one another?). The first analytical strat-
gy was testing the fit of the WALS for each condition to the
Rasch measurement model [39]. The approach also tested
cross-diagnostic validity to test for invariance (i.e. whether
the scale can be used to assess group differences because items
are being interpreted similarly across groups; e.g. across con-
ditions, age groups and sex). For interested readers, full
details of the analysis are given in Supplementary Data S3
and Table S1, available at Rheumatology Advances in
Practice online, and described in detail elsewhere [40].

Concurrent validity (i.e. the degree to which scores are con-
sistent with hypotheses, e.g. that scores on other relevant
measures are correlated with the WALS) was assessed using
Spearman’s correlations with work and health measures. We
hypothesized that there would be moderate to strong corre-
lations between scores for the WALS and the three work
measures and moderate correlations with perceived health status
and condition-specific symptoms and physical function scales.
Correlations of 0.4–0.59 are considered moderate and ≥0.6
are strong [41].

Discriminant validity (i.e. hypothesis testing that there
would be significant WALS score differences between those
reporting they had very poor/poor, fair or good/very good
perceived health status). This was assessed using Kruskal–
Wallis tests, with P ≤ 0.05 considered significant.

Reliability

Internal consistency (i.e. the degree of interrelatedness be-
tween items within a scale) was assessed using Cronbach’s α.
Results ≥0.8 were deemed good to excellent; ≥0.9 is consis-
tent with individual use; and ≥0.7 with group-level use [41].

Test–retest reliability is the extent to which scores for par-
ticipants who report that their health has not changed are the
same for repeated measurements over time. This was assessed
in those reporting perceived health as ‘the same’ at T2, using
Spearman’s correlations and intraclass correlation coefficient
(ICC) (2,1); two-way random consistency, average measures
model. An ICC of ≥0.75 is considered excellent and 0.5–0.74
moderate [42]. Reliability of individual WALS items was

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calculated using linear weighted \( \kappa \), with levels of agreement considered as: 0.41–0.60 = moderate; ≥0.61 = good [41].

Responsiveness
Sensitivity to change was assessed by calculating the standard error of measurement (SEM) and the minimal detectable change (MDC95) scores. The SEM represents the s.d. of repeated measures of one individual. The MDC95 is a statistical estimate of the smallest detectable change corresponding to change in ability rather than a measurement error [43, 44].

Floor and ceiling effects were considered present if >15% of participants achieved either the lowest or highest scores in the WALS [45]. If present, these can have a negative effect on the quality of the measure, because responsiveness (i.e. the ability to detect change over time) will be limited.

Results
Phase 1
Linguistic validation, cross-cultural adaptation and content validity results are given in Supplementary Data S1, Tables S2 and S3, available at Rheumatology Advances in Practice online. In cognitive debriefing interviews (n = 48; participant characteristics are in Table 1), all items were considered very relevant and, following expert panel review, only minor changes in wording were needed.

Phase 2
Overall, 1359 people were referred to the study; 831 returned T1 and 622 T2 questionnaire booklets (Supplementary Fig. S1, available at Rheumatology Advances in Practice online). The response rates were as follows: secondary care, 62% (696/1117); community hospitals, 53% (119/224); and volunteers, 89% (16/18). Participant characteristics are shown in Table 1 and work and health measures in Table 2. The median time between tests was 36 (IQR 28–47) days.

Compliance
There were 0.01% missing data. WALS scores could not be calculated for three participants (with 5–12 missing items each) in each of the RA, axSpA and OA groups. These participants were not included in analyses (i.e. the sample size was reduced to 822). All FM scores could be calculated. The frequency of ‘not applicable’ (re-scored as 0) and ‘missing’ data are shown in Supplementary Table S4, available at Rheumatology Advances in Practice online.

Validity
Construct (structural) validity
Table 3 displays the detailed analysis of fit to the Rasch model. The scale is unidimensional. The items most easily affirmed (i.e. the transition from no to some difficulty) were: ‘Lifting, carrying or moving objects’ (RA); ‘Crouching, bending or kneeling’ (axSpA and OA); and ‘Concentrating’ (FM). The items most difficult to affirm (i.e. the transition from a lot of difficulty to unable to do) was: ‘Working with your hands’ (RA, axSpA, OA and FM). Invariance was confirmed for age, sex, condition, disease duration, educational and work status. Full details of the results are given in Supplementary Data S3, available at Rheumatology Advances in Practice online. A transformation table was created to convert WALS raw scores to interval level scores, if required (Supplementary Table S5, available at Rheumatology Advances in Practice online). A reference metric was also created to allow test equating of raw WALS scores with raw RA- and AS-WIS scores (Supplementary Table S6, available at Rheumatology Advances in Practice online). Both the latter have clinically derived cut-points. Direct comparison with these cut-points suggests that WALS scores of 7 and 14 would indicate thresholds for moderate and high work instability, respectively, in these four RMDs.

Concurrent validity
As hypothesized, the WALS exhibited a moderate to strong positive correlation with work measures (total scores: \( r_s = 0.51–0.84 \), perceived health status \( r_s = 0.42–0.71 \) and diagnosis-specific symptoms \( r_s = 0.54–0.68 \) and physical function measures \( r_s = 0.55–0.77 \) (Table 4).

Discriminant validity
As hypothesized, there were significant differences between the three levels of perceived disease severity for the WALS across all four conditions, with higher perceived disease severity subgroups scoring worse (Supplementary Table S7, available at Rheumatology Advances in Practice online).

Reliability
Internal consistency
Cronbach’s \( \alpha \) values across the four conditions were good to excellent, ranging from 0.80 (FM) to 0.87 (RA). All were consistent with group-level use (Table 3).

Test–retest reliability
At T2, 356 of 622 (57%) participants reported that their condition was ‘the same’ as at T1 and included in analyses. For all four conditions, correlations between T1 and T2 scores were strong to very strong \( r_s = 0.80 \) and above. The ICCs (2,1) were excellent, at 0.90 and above (Table 5). Item reliability was moderate to good (Supplementary Table S8, available at Rheumatology Advances in Practice online).

Responsiveness
Sensitivity to change
The MDC95 scores ranged from 3.17 (RA) to 5.08 (OA) in those stating that their health was ‘the same’ at T2 (Table 5).

Floor and ceiling effects
Fewer than 15% scored 0 for the WALS, indicating there was no floor effect: RA = 6 of 294 (2%); axSpA = 21 of 199 (10.40%); OA = 3 of 176 (1.70%); and FM = 1 of 156 (0.60%). There were no ceiling effects (i.e. score of 36) in the four conditions.

Discussion
A linguistically validated British English version of the WALS is now freely available for use in the UK (Supplementary Data S2, available at Rheumatology Advances in Practice online and www.mskhub.com). This study provides new evidence that the British English WALS has good psychometric properties in RA, OA, axSpA and FM and can be used in the UK.

We ensured linguistic and cross-cultural validity of the WALS by using a standard translation process [21], with the approval of the WALS developer. Example activities were updated in three items: to reflect active travel options (in item 1); and in items 2 and 6 to increase relevancy to manual jobs.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>RA Phase 1</th>
<th>RA Phase 2</th>
<th>axSpA Phase 1</th>
<th>axSpA Phase 2</th>
<th>OA Phase 1</th>
<th>OA Phase 2</th>
<th>FM Phase 1</th>
<th>FM Phase 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>12</td>
<td>294</td>
<td>10</td>
<td>199</td>
<td>13</td>
<td>173</td>
<td>13</td>
<td>156</td>
</tr>
<tr>
<td>Sex, n (%), male:female</td>
<td>5.7</td>
<td>76 (26.00):218 (74.00)</td>
<td>4.6</td>
<td>124 (62.30):75 (37.70)</td>
<td>4.9</td>
<td>54 (31.00):119 (69.00)</td>
<td>2.11</td>
<td>10 (6.00):146 (94.00)</td>
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<td>Age, mean (S.D.), years</td>
<td>57.33 (6.77)</td>
<td>53.47 (8.97)</td>
<td>33.00 (14.62)</td>
<td>46.96 (10.24)</td>
<td>55.92 (6.70)</td>
<td>56.49 (7.21)</td>
<td>39.69 (9.11)</td>
<td>45.71 (10.05)</td>
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<td>Job skill level, n (%)</td>
<td>1 and 2</td>
<td>3</td>
<td>149 (51.00)</td>
<td>5</td>
<td>66 (33.10)</td>
<td>8</td>
<td>84 (48.60)</td>
<td>7</td>
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<td></td>
<td>3</td>
<td>142 (48.00)</td>
<td>5</td>
<td>133 (66.90)</td>
<td>5</td>
<td>88 (50.80)</td>
<td>6</td>
<td>61 (39.00)</td>
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<tr>
<td></td>
<td>Missing</td>
<td>–</td>
<td>3 (1.00)</td>
<td>–</td>
<td>–</td>
<td>1 (0.70)</td>
<td>–</td>
<td>–</td>
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<tr>
<td>Disease duration, mean (S.D.), years</td>
<td>18.08 (11.93)</td>
<td>7.66 (7.97)</td>
<td>12.70 (9.78)</td>
<td>12.33 (10.40)</td>
<td>12.35 (10.60)</td>
<td>4.97 (6.83)</td>
<td>5.38 (3.55)</td>
<td>2.99 (4.17)</td>
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<td>Phase 2 only</td>
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<tr>
<td>Symptom duration, mean (S.D.), years</td>
<td>9.33 (8.52)</td>
<td>18.97 (11.75)</td>
<td>7.89 (8.50)</td>
<td>8.36 (7.16)</td>
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<td>Living conditions, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17 (10.00)</td>
<td>7 (4.00)</td>
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<tr>
<td>With spouse/family/significant other</td>
<td></td>
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<td></td>
<td>14 (7.00)</td>
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<tr>
<td>Children &lt;18 years old living at home, n (%)</td>
<td>241 (82.00)</td>
<td>179 (89.90)</td>
<td>143 (83.00)</td>
<td>139 (89.00)</td>
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<td>Educational level, n (%), ISCED</td>
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<td></td>
<td>68 (34.20)</td>
<td>31 (18.00)</td>
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<tr>
<td>No formal qualifications</td>
<td>27 (9.20)</td>
<td>14 (7.00)</td>
<td>17 (10.00)</td>
<td>7 (4.00)</td>
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<tr>
<td>Secondary/post-secondary non-tertiary</td>
<td>148 (50.30)</td>
<td>100 (50.30)</td>
<td>91 (53.00)</td>
<td>76 (49.00)</td>
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<tr>
<td>Tertiary</td>
<td>117 (39.80)</td>
<td>84 (42.20)</td>
<td>61 (35.00)</td>
<td>73 (47.00)</td>
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<tr>
<td>Missing</td>
<td>2 (0.70)</td>
<td>1 (0.50)</td>
<td>4 (2.00)</td>
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<tr>
<td>Full-time/part-time work, n (%)</td>
<td>160 (54.40):134 (45.60)</td>
<td>150 (75.40):49 (24.60)</td>
<td>106 (61.30):67 (38.70)</td>
<td>70 (45.00):86 (55.00)</td>
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<tr>
<td>Hours worked, mean (S.D.)</td>
<td>33.24 (12.47)</td>
<td>37.77 (10.44)</td>
<td>34.16 (11.66)</td>
<td>31.50 (10.56)</td>
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<tr>
<td>Self-employed, n (%)</td>
<td>63 (21.40)</td>
<td>34 (17.10)</td>
<td>21 (12.10)</td>
<td>18 (11.50)</td>
<td></td>
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<tr>
<td>Physical demands of job, n (%)</td>
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<td></td>
<td></td>
<td></td>
<td>53 (30.70)</td>
<td>61 (39.10)</td>
<td></td>
<td></td>
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<tr>
<td>None/a little</td>
<td>101 (34.40)</td>
<td>83 (41.70)</td>
<td>53 (30.70)</td>
<td>61 (39.10)</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Noticeable</td>
<td>37 (12.60)</td>
<td>175 (8.90)</td>
<td>22 (12.70)</td>
<td>14 (9.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A lot/great deal</td>
<td>156 (53.00)</td>
<td>99 (49.80)</td>
<td>98 (56.60)</td>
<td>81 (51.90)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medication regimen, n (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2 (0.70)</td>
<td>19 (9.50)</td>
<td>33 (19.00)</td>
<td>23 (15.00)</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NSAIDs ± analgesics</td>
<td>11 (3.70)</td>
<td>4 (2.00)</td>
<td>118 (69.00)</td>
<td>14 (9.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS ± NSAIDs</td>
<td>6 (2.00)</td>
<td>51 (25.60)</td>
<td>10 (6.00)</td>
<td>6 (4.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single DMARD</td>
<td>103 (35.00)</td>
<td>10 (5.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combination DMARD</td>
<td>97 (33.00)</td>
<td>2 (1.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Biologic/biosimilar (e.g. gabapentin/pregabalin)</td>
<td>66 (22.40)</td>
<td>112 (56.30)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuropathic analgesics</td>
<td></td>
<td></td>
<td>12 (7.00)</td>
<td>99 (64.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FM, opiate medication</td>
<td></td>
<td></td>
<td></td>
<td>12 (8.00)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

axSpA: axial spondyloarthritis; ISCED: International Standard Classification of Education.
Participants considered the WALS comprehensive, comprehensible and easy to complete, indicating good content validity from the perspective of the patients in these four RMDs (i.e. comparable to findings in RA and OA in Canada [9]).

To our knowledge, this is the first study examining construct (structural) validity of the WALS in RA, axSpA, OA and FM, demonstrating fit to the Rasch model and making available a Rasch transformation table from WALS raw to interval scores. Given that the WALS is unidimensional, either summed or (Rasch) standardized scores can be used. As hypothesized, the WALS demonstrated good concurrent validity with other work measures, except the WLQ-25 physical demands subscale in FM. Some participants can have difficulty completing this subscale, because instructions are reversed compared with the other three subscales [6]. Potentially, more participants with FM experience such difficulty, because >50% of people with FM report cognitive deficits, which is higher than that experienced by people with RA.

### Table 2. Phase 2: participants’ work and health measures

<table>
<thead>
<tr>
<th>Parameter</th>
<th>RA ((n = 294))</th>
<th>axSpA ((n = 199))</th>
<th>OA ((n = 173))</th>
<th>FM ((n = 156))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Work measures</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WALS, 0–36, median (IQR)</td>
<td>9.00 (5.00–14.00)</td>
<td>6.00 (3.00–11.00)</td>
<td>10.00 (6.00–14.00)</td>
<td>16.00 (12.00–19.00)</td>
</tr>
<tr>
<td>WLQ-25, 0–100, median (IQR)</td>
<td>30.00 (10.00–55.00)</td>
<td>25.00 (5.00–50.00)</td>
<td>30.00 (10.00–50.00)</td>
<td>60.00 (40.00–80.00)</td>
</tr>
<tr>
<td>Time management demands</td>
<td>37.50 (20.00–58.33)</td>
<td>37.50 (12.50–55.31)</td>
<td>41.67 (25.00–58.33)</td>
<td>58.33 (43.75–73.96)</td>
</tr>
<tr>
<td>Physical demands</td>
<td>16.67 (5.33–36.11)</td>
<td>13.89 (2.78–30.56)</td>
<td>16.67 (5.56–36.11)</td>
<td>44.44 (27.78–61.11)</td>
</tr>
<tr>
<td>Mental interpersonal demands</td>
<td>20.00 (5.00–44.06)</td>
<td>10.00 (0–30.00)</td>
<td>20.00 (5.00–43.75)</td>
<td>45.00 (25.00–65.00)</td>
</tr>
<tr>
<td>WLQ-25 percentage productivity loss</td>
<td>29.38 (14.17–43.70)</td>
<td>22.74 (7.08–40.03)</td>
<td>28.61 (15.21–45.36)</td>
<td>51.69 (37.30–64.62)</td>
</tr>
<tr>
<td>WLQ-25 summed score</td>
<td>13.00 (7.75–18.00)</td>
<td>11.00 (4.00–15.00)</td>
<td>13.00 (8.00–17.00)</td>
<td>18.00 (15.00–20.00)</td>
</tr>
</tbody>
</table>

| **Health measures** | | | | |
| Perceived severity health last month (1–5, median (IQR), n (%)) | 3.00 (2.00–3.00) | 2.00 (2.00–3.00) | 3.00 (3.00–3.00) | 4.00 (3.00–4.00) |
| Poor/very poor | 45 (15.30) | 21 (10.60) | 37 (21.40) | 83 (53.00) |
| Fair | 133 (45.20) | 78 (39.20) | 95 (54.90) | 63 (41.00) |
| Good/very good | 116 (39.50) | 100 (50.30) | 10 (21.40) | 10 (6.00) |
| RA | | | | |
| RAID (0–10), median (IQR) | 4.84 (3.15–6.42) | – | – | – |
| HAQ20 (0–60), median (IQR) | 9.00 (5.00–18.00) | – | – | – |
| axSpA | | | | |
| BASDAI (0–10), median (IQR) | – | 3.93 (1.95–5.87) | – | – |
| BASFI (0–10), median (IQR) | – | 2.97 (1.40–5.35) | – | – |
| OA | | | | |
| WOMAC, median (IQR) | – | – | – | – |
| Pain (0–20) | – | – | 10.00 (7.00–13.00) | – |
| Physical function (0–68) | – | – | 31.00 (21.00–41.50) | – |
| FM | | | | |
| FIQR, normalized scores, median (IQR) | – | – | – | – |
| Overall impact (0–20) | – | – | 10.00 (10.00–17.00) | – |
| Symptoms (0–50) | – | – | 34.50 (28.13–39.00) | – |
| Function (0–30) | – | – | 19.33 (14.67–22.67) | – |
| FIQR total (0–100) | – | – | 68.33 (54.20–77.50) | – |
| T1 to T2 | n = 219 | n = 156 | n = 131 | n = 116 |
| Time between T1 and T2, median (IQR), days | 40.00 (34.00–48.00) | 38.00 (29.00–49.25) | 30.00 (23.75–37.00) | 33.00 (26.50–45.00) |


For test–retest reliability analysis.

Table 3. Fit of the Workplace Activity Limitations Scale to the Rasch model: construct (structural) validity

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Residuals (S.D.)</th>
<th>( \chi^2 )</th>
<th>Reliability</th>
<th>Dimensionality</th>
<th>DIF</th>
<th>ECV</th>
<th>Latent correlation*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Item Person Value (d.f.)</td>
<td>P-value</td>
<td>PSI</td>
<td>z</td>
<td>% t-tests (LCI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RA</td>
<td>0.01 0.84</td>
<td>28.10 (20)</td>
<td>0.11</td>
<td>0.83</td>
<td>0.87</td>
<td>2.70</td>
<td>None</td>
</tr>
<tr>
<td>axSpA</td>
<td>0.43 0.73</td>
<td>18.70 (15)</td>
<td>0.24</td>
<td>0.77</td>
<td>0.85</td>
<td>3.52</td>
<td>None</td>
</tr>
<tr>
<td>OA</td>
<td>0.17 0.92</td>
<td>22.80 (19)</td>
<td>0.24</td>
<td>0.80</td>
<td>0.83</td>
<td>1.80</td>
<td>None</td>
</tr>
<tr>
<td>FM</td>
<td>0.19 0.81</td>
<td>13.40 (18)</td>
<td>0.77</td>
<td>0.80</td>
<td>0.80</td>
<td>3.21</td>
<td>None</td>
</tr>
<tr>
<td>Across all four conditions</td>
<td>0.41 0.97</td>
<td>24.10 (23)</td>
<td>0.40</td>
<td>0.84</td>
<td>0.87</td>
<td>2.80</td>
<td>None</td>
</tr>
</tbody>
</table>

Ideal values: 1.0 1.0

Bold text indicates ideal values.

* Between parallel forms.

\( \chi^2 \): residual sum of squares; PSI: Person separation index.

Table 4. Concurrent validity of the Workplace Activity Limitations Scale with work and health measures

<table>
<thead>
<tr>
<th>WALS (0–36)</th>
<th>RA (n = 294)</th>
<th>axSpA (n = 199)</th>
<th>OA (n = 173)</th>
<th>FM (n = 156)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( r_s )</td>
<td>( r_s )</td>
<td>( r_s )</td>
<td>( r_s )</td>
</tr>
<tr>
<td>Work measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WLQ-25 (0–100)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time management demands</td>
<td>0.70**</td>
<td>0.75**</td>
<td>0.65**</td>
<td>0.57**</td>
</tr>
<tr>
<td>Physical demands</td>
<td>0.62**</td>
<td>0.73**</td>
<td>0.50**</td>
<td>0.39**</td>
</tr>
<tr>
<td>Mental interpersonal demands</td>
<td>0.68**</td>
<td>0.71**</td>
<td>0.62**</td>
<td>0.58**</td>
</tr>
<tr>
<td>Output demands</td>
<td>0.71**</td>
<td>0.71**</td>
<td>0.52**</td>
<td>0.56**</td>
</tr>
<tr>
<td>WLQ-25 percentage productivity loss</td>
<td>0.78**</td>
<td>0.83**</td>
<td>0.63**</td>
<td>0.64**</td>
</tr>
<tr>
<td>WLQ-25 summed score</td>
<td>0.79**</td>
<td>0.84**</td>
<td>0.67**</td>
<td>0.66**</td>
</tr>
<tr>
<td>WIS (0–23 RA, OA, FM; 0–20 axSpA)</td>
<td>0.77**</td>
<td>0.84**</td>
<td>0.73**</td>
<td>0.60**</td>
</tr>
<tr>
<td>Overall work impairment owing to health</td>
<td>0.66**</td>
<td>0.80**</td>
<td>0.68**</td>
<td>0.51**</td>
</tr>
<tr>
<td>Health measures</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-reported health in last month (1–5)</td>
<td>0.61**</td>
<td>0.71**</td>
<td>0.53**</td>
<td>0.42**</td>
</tr>
<tr>
<td>RA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RAID (0–10), median (IQR)</td>
<td>0.68**</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>HAQ20 (0–60), median (IQR)</td>
<td>0.73**</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>axSpA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASDAI (0–10), mean (S.D.)</td>
<td>–</td>
<td>0.68**</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>BASFI (0–10), mean (S.D.)</td>
<td>–</td>
<td>0.77**</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>OA</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WOMAC, median (IQR)</td>
<td>–</td>
<td>–</td>
<td>0.56**</td>
<td>–</td>
</tr>
<tr>
<td>Pain (0–20)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Physical function (0–68)</td>
<td>–</td>
<td>–</td>
<td>0.55**</td>
<td>–</td>
</tr>
<tr>
<td>FM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FIQR, normalized scores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall impact (0–20)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.43**</td>
</tr>
<tr>
<td>Symptoms (0–50)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.54**</td>
</tr>
<tr>
<td>Function (0–30)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.55**</td>
</tr>
<tr>
<td>FIQR total (0–100)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0.61**</td>
</tr>
</tbody>
</table>

** Correlation significant at 0.01 level.


Table 5. Test–retest reliability and sensitivity to change of the Workplace Activity Limitations Scale

<table>
<thead>
<tr>
<th>Condition</th>
<th>Number for test–retest*</th>
<th>Test 1 scorea [median (IQR)]</th>
<th>Test 2 scorea [median (IQR)]</th>
<th>Spearman’s correlation*, ( r_s )</th>
<th>ICC (2,1)* (95% CI)</th>
<th>SEM*</th>
<th>MDC95</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA</td>
<td>136</td>
<td>8.00 (4.00–12.75)</td>
<td>7.00 (4.00–11.00)</td>
<td>0.83**</td>
<td>0.92 (0.90, 0.94)</td>
<td>1.15</td>
<td>3.17</td>
</tr>
<tr>
<td>axSpA</td>
<td>98</td>
<td>5.00 (2.00–9.00)</td>
<td>5.00 (1.75–7.25)</td>
<td>0.80**</td>
<td>0.90 (0.84, 0.93)</td>
<td>1.67</td>
<td>4.82</td>
</tr>
<tr>
<td>OA</td>
<td>78</td>
<td>8.00 (5.75–12.25)</td>
<td>7.00 (4.00–12.25)</td>
<td>0.81**</td>
<td>0.90 (0.84, 0.93)</td>
<td>1.83</td>
<td>5.08</td>
</tr>
<tr>
<td>FM</td>
<td>54</td>
<td>15.00 (10.00–19.25)</td>
<td>14.00 (11.00–19.00)</td>
<td>0.82**</td>
<td>0.90 (0.83, 0.94)</td>
<td>1.57</td>
<td>4.36</td>
</tr>
</tbody>
</table>

a Participants indicating perceived health ‘about the same’ at T1 and T2, who had WALS scores available at both time points.

** Correlation significant at 0.01 level.

axSpA: axial spondyloarthritides; ICC: intraclass correlation coefficient; IQR: interquartile range; MDC95: minimum detectable change; SEM: standard error of measurement.
for example [46, 47]. As hypothesized, correlations with physical function, symptom and health scales were moderate in OA and FM, but generally strong (i.e. higher than expected) in RA and axSpA. These findings are comparable to those in RA and OA in Canada [17]. We also demonstrated the WALS has good discriminant validity in the four RMDs, which had not been tested previously.

Internal consistency was good, and comparable to findings in RA and OA in Canada [6], meaning that the WALS can be used for group measurement in the four RMDs. Identifying that WALS scores of 7 and 14 equate to RA- and AS-WIS cut-points for moderate and high work instability indicates that the WALS could help not only to identify patients’ work limitations but also who could benefit from work rehabilitation. The evidence for test–retest reliability is extended, and specific values of MDC95 for each of the four RMDs are provided. These had previously been tested in only a small sample of ‘workers with arthritis’ [5, 6].

It is worth noting that across all four RMDs, the phase 2 results showed that those reporting they had ‘fair’ health status had average WALS scores exceeding the cut-off score for moderate work instability (i.e. 7) and also (apart from axSpA) those with poor/very poor health status had scores exceeding the cut-off for high work instability (i.e. 14). The FM group also had higher average WALS scores than the other three RMDs, despite being younger, with many experiencing high work instability. Health professionals working with employed people with RMDs reporting fair or poor health status, and especially those with FM, are recommended to screen for work problems and provide work advice and support, as relevant.

The WALS tests intrinsic work activity impairment (i.e. capacity in International Classification of Functioning, Disability and Health terms), because the instructions specify reporting difficulty without help from another person or use of gadgets or equipment. It might not therefore reflect the person’s real ability to work (performance in International Classification of Functioning, Disability and Health terms; i.e. with ergonomic modifications, help and/or job accommodations). Under the UK Equality Act 2010, it is the duty of an employer to provide these (termed as ‘reasonable adjustments’) to employees with disabilities. Clinically, and in work rehabilitation studies, using a WALS omitting the instructions to answer ‘without help or gadgets/equipment’ could better identify whether improvement occurs following work rehabilitation and putting reasonable adjustments in place. Modified instructions could focus on how people usually do these activities. Additionally, there is no time frame in the instructions. Some work measures (e.g. the WLQ-25), ask about the last 2 weeks. A disadvantage of a short time frame is, firstly, that the measure can be completed only by people working for ≥1 day during that time. Those on sick, annual or other extended leave for >2 weeks cannot complete it. Second, people with RMDs can experience episodic flares or worse health. A limited time frame means that completion might coincide with a period of unusual ill-health or good health. Avoiding a time scale overcomes this problem, because participants might either reflect on their difficulties when last at work or estimate difficulties. This could, however, be problematic in those on long-term sick leave if they estimate difficulties incorrectly. Particularly in intervention studies, it might be better to specify a time (e.g. 3 months). Future research could psychometrically test a WALS with modified instructions.

A strength of this study was that we had relatively large samples of people with RA, axSpA, OA and FM recruited from a wide variety of NHS outpatient clinics, meaning that the results are representative for people accessing secondary or community care. Limitations were that fewer people with FM had stable self-reported health between T1 and T2, compared with the other conditions, resulting in a smaller sample for test–retest reliability than required. Responsiveness (i.e. longitudinal validity) still needs testing, and minimal clinically important differences need to be established in the UK. Further testing in other RMDs is required.

Conclusions

Overall, psychometric testing of the British English WALS demonstrated good validity and reliability in employed people with RA, axSpA, OA and FM in the UK. The WALS meets most recommendations of the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN) checklists for methodological quality and reporting [19, 20]. Accordingly, the British English WALS can be used in the UK for these four RMDs.

Supplementary material

Supplementary material is available at Rheumatology Advances in Practice online.

Data availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request, following completion of associated studies. The British English WALS is available in the Supplementary Materials.

Contribution statement

A.H., A.T. and Y.P. contributed to the study conception and design. Phase 1: A.H. and Y.P. conducted data collection and analysis. A.H., A.T., M.G., Y.P., S.V. and R.O’B. were members of the Expert Panel. Phase 2: material preparation and data collection were performed by A.H., A.C., and J.P. Analyses were performed by A.T. (Rasch analysis) and A.H. (classical testing). The first draft of the manuscript was prepared by A.H., with A.T. drafting the construct (structural) validity/Rasch analysis sections. All authors contributed to and revised previous versions of the manuscript. All authors read and approved the final manuscript.

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Scotland: Janet Harkess (LC), NHS Fife; Justine Griffin (LC), NHS Greater Glasgow and Clyde.

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Jyseleca is indicated for the treatment of moderate to severe active rheumatoid arthritis in adult patients who have responded inadequately to, or who are intolerant to one or more disease modifying anti-rheumatic drugs. It may be used as monotherapy or in combination with methotrexate.

*From biochemical assays, the clinical relevance of which is uncertain.

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