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THE VISA-A (SEDENTARY) SHOULD BE USED FOR SEDENTARY PATIENTS WITH ACHILLES TENDINOPATHY: A MODIFIED VERSION OF THE VISA-A DEVELOPED AND EVALUATED IN ACCORDANCE WITH THE COSMIN CHECKLIST.

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ABSTRACT

Objective: To develop and evaluate a modified version of the Victorian Institute of Sport Assessment - Achilles (VISA-A) questionnaire, for use in sedentary patients with Achilles tendinopathy, using the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN) recommendations.

Methods: Twenty-two sedentary patients with Achilles tendinopathy completed the VISA-A and provided feedback regarding the relevance, comprehensiveness and comprehensibility of each item, response options and instructions. Patient and professional feedback was used to develop the VISA-A (sedentary) questionnaire. Reliability, validity, and responsiveness of the VISA-A (sedentary) was evaluated in 51 sedentary patients with Achilles tendinopathy: 47.1% women, mean age 64.8 (SD 11.24).

Results: Factor analysis identified two dimensions (symptoms and activity) for the VISA-A (sedentary). Test-retest reliability was excellent for symptoms (ICC = 0.991) and activity (ICC = 0.999). Repeatability was 1.647 for symptoms and 0.549 for activity. There was a significant difference between the VISA-A and VISA-A (sedentary) scores both pre- and post-treatment. There was stronger correlation between the pre- to post-treatment change in the VISA-A (sedentary) scores (r=0.420 for symptoms, r=0.407 for activity) and the global rating of change than the VISA-A scores (r=0.253 for symptoms, r=0.186 for activity).

Conclusion: The VISA-A (sedentary) demonstrates adequate reliability, validity, and responsiveness in sedentary patients with Achilles tendinopathy. The VISA-A (sedentary) is a more appropriate measure than the VISA-A for this cohort and is recommended for clinical and research purposes.

What is already known on this topic?

The VISA-A is the most widely used patient reported outcome measure (PROM) for Achilles tendinopathy (AT) but the psychometric properties of the questionnaire in sedentary individuals are unknown.

What this study adds.

The VISA-A (sedentary) demonstrated adequate reliability, validity, and responsiveness in sedentary patients with AT, whereas the VISA-A lacked structural validity, was less responsive and demonstrated a floor effect in this cohort.

How this study might affect research, practice, or policy.

The VISA-A (sedentary) represents a more appropriate PROM for sedentary patients and will better enable clinicians and researchers to assess the impact of AT and efficacy of specific interventions.

INTRODUCTION

Achilles tendinopathy (AT) is the preferred term for persistent Achilles tendon pain and loss of function related to mechanical loading(1). Achilles tendinopathy is frequently seen in runners(2) but only 35% of patients presenting to general practice describe symptoms related to sporting activity(3). Athletic and sedentary patients may therefore represent subgroups of AT, with differing aetiologies(4) and varying degrees of impact on physical activity, function, and quality of life(5, 6).

Patient reported outcome measures (PROMs) quantify an individual's perception of the impact of a pathology that cannot be captured with clinical tests or diagnostic imaging(7). The Victorian Institute of Sport Assessment - Achilles (VISA-A) questionnaire is one of the most widely used PROMs for patients with AT(8), covering the domains of symptoms, function and physical activity(9). However, the VISA-A was developed with an athletic population and the psychometric properties of the questionnaire in sedentary individuals are unknown(10). Athletic and sedentary patients are likely to value different outcomes and PROMs must therefore reflect the issues that are important to these specific populations(6). Without appropriate measurement properties, it is difficult to determine the impact of a pathology or efficacy of specific interventions using a PROM(5).

The aim of this study was to develop and evaluate a modified version of the VISA-A that can be used in sedentary patients with AT. This questionnaire: the VISA-A (sedentary), was developed to measure the severity of AT using the Consensus-based Standards for the selection of health Measurement Instruments (COSMIN) recommendations(11, 12). We hypothesised that there would be a significantly larger change in pre- to post-treatment scores for the VISA-A (sedentary), and a stronger correlation between the change in VISA-A (sedentary) and global rating of change (GROC) scores.

METHODS

This was a prospective study involving patients referred to two National Health Service (NHS) Foundation Trusts. The study was approved by the University and NHS ethics committees and conducted in accordance with the ethical standards of the World Medical Association Declaration of Helsinki (2002).

Equity, diversity, and inclusion statement:

Patients were included if they were aged 18 years or older with a clinical diagnosis of AT but did not participate in Achilles tendon loading sports, inclusive of all genders, race/ethnicities, socioeconomic levels, and occurrence in a marginalised community. Patients were excluded if they were unable to understand the English language or complete the questionnaires, thus findings may not be generalisable to these cohorts. Our author team consisted of two women and four men, with junior, mid-career and senior physiotherapy clinician/researchers, four from the United Kingdom and two from Australia.

Development of the VISA-A (sedentary)

Consecutive patients presenting to an outpatient's physiotherapy department for non-surgical management of AT were used as the study population for the development of the VISA-A (sedentary) questionnaire. All patients were referred with clinically and MRI-confirmed AT by four lower-limb orthopaedic surgeons working in a secondary care musculoskeletal outpatient's clinic. The clinical criteria used to diagnose AT was localised Achilles tendon pain during loading (e.g., calf raise) and palpation. This patient sample was representative of the target population in which the PROM was to be administered and evaluated (table 1), with regards to the referral pathway to physiotherapy.

Patient and public involvement:

Eligible patients completed a paper copy of the VISA-A at their initial physiotherapy assessment and were asked to write comments regarding the relevance, comprehensiveness and comprehensibility of

each item, response options and instructions. Patients were then encouraged to offer alternative suggestions (item generation) based on their perception of their condition during a one-to-one, informal interview conducted by one of the authors (RN). Patient feedback was discussed with the referring orthopods and expert panel (RN, JC, JG, SO) to determine whether this was representative of other sedentary AT patients. The expert panel consisted of four physiotherapists, all of whom have a special interest in tendinopathy and multiple publications on the topic in peer reviewed journals. These professionals were also asked to provide input regarding item relevance and comprehensiveness of the VISA-A for this patient cohort based on clinical experience and the existing literature. A provisional version of the VISA-A (sedentary) was created, evaluated, and adapted until no further changes were recommended by patients or professionals (figure 1). In total, 30 individuals (22 patients and eight professionals) were consulted during the development process; points raised are listed in supplementary table 1.

INSERT FIGURE 1 HERE

The VISA-A (sedentary) was developed using a reflective model where all items of the PROM are intended to be a manifestation of the same underlying construct. The construct to be measured by the VISA-A (sedentary) was the severity of AT in sedentary patients, with eight questions covering symptoms and their impact on activity (appendix A). The structure and item weighting remained consistent with the VISA-A with lower scores indicating greater severity of AT(9). Based on feedback during the development phase, the scoring scale was reversed so 'no pain' was positioned to the left of the scale; the VISA-A scale was also reversed for the evaluation phase to ensure any differences in VISA scores could not be attributed to scale reversal (appendix B). Scale reversal has been utilised in previous studies to avoid patient misinterpretation and support self-administration of the VISA-A(13). The intended application of the PROM is for clinical and research purposes, with the PROM administered on paper.

Evaluation of psychometric properties

For factor analysis to be considered 'adequate', the COSMIN checklist recommends a sample size of at least five times the number of items and >100 patients, or at least six times the number of items but <100 patients. The VISA questionnaires contain eight items, therefore a minimum sample size of 48 is recommended but for other elements on the COSMIN checklist to be deemed 'adequate', a minimum sample size of 50 was required. To account for potential dropouts, a sample size of 55 was chosen to adequately evaluate the psychometric properties of the VISA-A (sedentary).

Patients were recruited, assessed, and treated by three of the authors (JR, SO and RN) with each patient completing paper copies of the VISA-A and VISA-A (sedentary) questionnaires at their initial face-to-face appointment (table 1). The VISA-A (sedentary) was repeated 3-days later via telephone call, by the treating physiotherapist who was blinded to the initial results, before commencing treatment. This timeframe was considered suitable as the interval between measures should be long enough to prevent recall, but short enough to ensure the patient's presentation remains stable. The median duration of symptoms prior to treatment was 24 weeks, with a maximum of 520 weeks. Thirty-seven patients presented with first-episode AT, with the remaining 14 reporting recurrent symptoms. No modification to the treatment/intervention was made as part of this study.

Patient demographics	VISA-A (sedentary) development	VISA-A (sedentary) evaluation
Gender, n (%)		
Female	14 (63.6)	24 (47.1)
Age (years)		
Mean (SD)	60 (7.35)	64.8 (11.24)
Range	48-73	40-85

Table 1: patient demographics for development and evaluation of the VISA-A (sedentary). SD: standard deviation.

The VISA-A and VISA-A (sedentary) were administered in paper format at discharge to determine the pre- to post-treatment change in scores. The GROC questionnaire (appendix C), which is a valid,

reliable, and clinically relevant measure that is not condition specific(14), was also administered at discharge to determine the patient's overall perception of change following treatment. Patients were instructed to complete the GROC with specific reference to their Achilles tendon to ensure responses were relevant(14). The median time to discharge was 12.0 weeks (IQR 6.0 [10-16]). Patients with incomplete data sets were removed from the study.

Statistical analysis:

Data analysis was performed by two of the authors (TM and RN). All statistical analyses were performed using SPSS 25.0 (SPSS Inc, Chicago, Illinois, USA) and R (R version 3.2.0, The R Foundation for Statistical Computing). Continuous variables were assessed for their distributions using graphical analysis (construction of histograms and normal Q-Q plots) and through the Kolmogorov-Smirnov and Shapiro-Wilk tests. Statistical analysis and presentation are consistent with the CHecklist for statistical Assessment of Medical Papers (CHAMP)(15).

Internal consistency:

Internal consistency of the VISA-A (sedentary) was determined by calculating Cronbach's alpha (α), including the change to α when items were deleted. Internal consistency was considered acceptable for Cronbach's α coefficients between 0.70 and 0.95(16). Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity (BTS) were calculated and considered acceptable if KMO values were above 0.5 and BTS $p<0.05$. Exploratory factor analysis (EFA), using principal component analysis based on the correlation matrix with varimax rotation, was performed to assess the structural validity of the VISA-A (sedentary). Eigenvalues were used to identify underlying factors; if more than one factor with an eigenvalue >1 was identified, the questionnaire was reviewed and split into subscales that only loaded onto one factor with an eigenvalue >1.

Test-retest reliability:

Three-day test-retest reliability was assessed through calculation of the intraclass correlation coefficient (ICC) with 95% confidence intervals (CI), using a two-way mixed-effect model (with raters considered fixed and participants random) for absolute agreement based on single ratings (ICC 3,1)(17), and Bland-Altman plots. Proportional bias was assessed through linear regression of the difference in scores on the mean of scores, with the null hypothesis that the slope of this line equals zero.

Measurement error:

Measurement error was expressed as within-subject standard deviation (s_w) and calculated as $s_w^2 = \frac{1}{2n} \Sigma d_i^2$ where n is the number of subjects and d_i is the difference between an individual's pre-treatment and 3-day retest VISA-A (sedentary) scores(18). Repeatability was calculated as $s_w \times 1.96 \times \sqrt{2}$(18). The minimal clinically important difference (MCID) was determined using distribution (0.5 x SD of the mean difference in the pre-post treatment scores) and anchor-based analyses (difference between the change in scores of responders and non-responders on the GROC)(19).

Construct validity and responsiveness:

The difference between VISA-A and VISA-A (sedentary) scores, both pre- and post-treatment, was evaluated using the Wilcoxon Signed Rank test. Agreement between the VISA-A and VISA-A (sedentary) scores, both pre- and post-treatment, was assessed with Bland-Altman analysis and through calculation of the ICC using a two-way random-effect model (with raters and participants considered random) for absolute agreement based on single ratings (ICC (2,1)).

The correlation between the pre- to post-treatment change in VISA-A and VISA-A (sedentary) scores and the GROC was calculated using Spearman's Rank correlation coefficient. Effect size and standardised response means were calculated based on responders (4 to 7 on GROC) and non-responders (-7 to 3 on GROC). Where relevant, a p value <0.05 was considered significant for all analyses.

Floor and ceiling effects were determined by calculating the percentage of patients recording the highest or lowest possible scores at baseline or discharge. If more than 15% of patients achieved these scores, floor or ceiling effects were considered present(20).

RESULTS:

Fifty-five patients were recruited to evaluate the psychometric properties of the VISA-A (sedentary). Four patients were excluded due to incomplete data, therefore full data sets were available for 51 patients (figure 2), which meets the COSMIN requirements for adequate evaluation(11).

INSERT FIGURE 2 HERE

The mean pre- to post-treatment change in scores were 14.24 for the VISA-A and 31.04 for the VISA-A (sedentary) (table 2). The mean GROC at discharge was 4.75 (SD 2.11).

		Symptoms					Activity			Scores		
	PROM	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q1-5	Q6-8	Q1-8
Pre-Rx	VISA-A	6.04 (1.90)	5.16 (2.24)	5.96 (1.93)	5.59 (1.76)	2.92 (2.20)	1.49 (1.68)	0.00 (0.00)	0.00 (0.00)	25.67 (6.94)	1.49 (1.68)	27.16 (7.76)
	VISA-A (sedentary)	5.92 (1.85)	5.45 (1.96)	5.57 (1.62)	5.43 (1.91)	5.04 (2.45)	2.76 (2.18)	3.57 (2.02)	6.90 (5.09)	27.41 (6.45)	13.24 (7.35)	40.65 (12.17)
3-day re-test	VISA-A (sedentary)	5.90 (1.91)	5.53 (1.95)	5.53 (1.57)	5.47 (1.97)	4.98 (2.51)	2.80 (2.23)	3.57 (2.02)	6.90 (5.09)	27.41 (6.40)	13.27 (7.39)	40.69 (12.15)
Post-Rx	VISA-A	7.98 (1.78)	7.57 (2.14)	7.84 (1.94)	7.78 (2.06)	6.84 (2.97)	3.37 (2.86)	0.00 (0.00)	0.00 (0.00)	38.02 (9.46)	3.37 (2.86)	41.39 (10.70)
	VISA-A (sedentary)	7.71 (1.95)	7.43 (2.30)	7.90 (1.72)	7.73 (1.65)	8.31 (2.09)	6.53 (3.04)	7.18 (2.28)	18.90 (8.12)	39.08 (8.41)	32.61 (11.92)	71.69 (19.31)
Pre- to post-Rx change	VISA-A	1.94 (1.36)	2.41 (1.92)	1.88 (1.48)	2.20 (1.89)	3.92 (3.38)	1.88 (2.34)	0.00 (0.00)	0.00 (0.00)	12.35 (6.76)	1.88 (2.34)	14.24 (7.99)
	VISA-A (sedentary)	1.78 (1.33)	1.98 (1.52)	2.33 (1.75)	2.29 (1.72)	3.27 (2.88)	3.76 (3.09)	3.61 (2.50)	12.00 (6.72)	11.67 (6.62)	19.37 (10.07)	31.04 (15.74)

Table 2: mean pre- and post-treatment scores for the VISA-A and VISA-A (sedentary) questionnaires. Data are presented as mean values with standard deviations in parentheses. Rx: treatment.

Internal consistency:

The overall Cronbach's α for the VISA-A (sedentary) was 0.724 (table 4). All inter-item correlations for the questions were <0.70, with all items having at least one inter-item correlation >0.3. The

questionnaire's corrected item-total correlations ranged from 0.27 to 0.65, with Cronbach's α decreasing to 0.719 or less with the removal of any item, indicating all items should be retained.

Exploratory factor analysis indicated that the VISA-A (sedentary) has a multidimensional structure with two factors demonstrating an eigenvalue >1. The questionnaire was split with items 1-5 (symptoms) loading onto one factor and items 6-8 (activity) loading onto the other (table 3 and supplementary figure 1). For Q1-5 and Q6-8, KMO values were 0.627 and 0.652 respectively. For Q1-5 and Q6-8, BTS values were both p<0.001.

		Initial Eigenvalues		
	Component	Total	% of variance	Cumulative %
Symptoms	1	2.165	43.294	43.294
	2	0.999	19.972	62.266
	3	0.916	18.327	81.593
	4	0.544	10.875	92.468
	5	0.377	7.532	100
Activity	1	1.743	58.090	58.090
	2	0.644	21.467	79.557
	3	0.613	20.443	100

Table 3: Eigenvalue factor loading for each component.

Cronbach's α for symptoms and activity was 0.663 and 0.563 respectively (table 4); the α value did not increase with removal of any item. For both subscales, the inter-item correlations were <0.70, with all items having at least one inter-item correlation >0.3. Corrected item-total correlations ranged from 0.31 to 0.58 for symptoms and 0.42 to 0.46 for activity.

	Cronbach's α [95% CI]	ICC (95% CI)	S_w	Repeatability
Q1-8	0.724 [0.593-0.825]	0.994 (0.989-0.997)	0.642	1.779
Q1-5 (symptoms)	0.663 [0.491-0.790]	0.991 (0.985-0.995)	0.594	1.647
Q6-8 (activity)	0.563 [0.261-0.720]	0.999 (0.999-1.000)	0.198	0.549

Table 4: internal consistency and reliability values for the VISA-A (sedentary). S_w: within-participant standard deviation.

The overall Cronbach's α for the VISA-A (Q1-8) was 0.705, with α values increasing to 0.720 when items seven or eight were removed, indicating these items should not be retained. Factor analysis was

not possible for the VISA-A, therefore subsequent analyses were performed using the same dimensions as the VISA-A (sedentary). Cronbach's α for Q1-5 was 0.724, increasing to 0.800 with the removal of item five, indicating this item should not be retained. Cronbach's α was not calculable for Q6-8 as all patients scored zero for Q7 and Q8.

Test-retest reliability:

The ICC for agreement between the 3-day retest and pre-treatment VISA-A (sedentary) scores was excellent for symptoms and activity (table 4). There was no significant difference between the repeated measures for symptoms (p=0.99) or activity (p=0.32). Bland-Altman analysis (supplementary figure 2) showed no bias of 0.0 (95% CI -0.24 - 0.24) for symptoms, with narrow limits of agreement from -1.66 to 1.66 and no significant evidence of proportional bias (P=0.66). There was a very small mean bias of 0.039 (95% CI -0.040 - 0.117) for activity with the confidence interval crossing zero, narrow limits of agreement from -0.51 to 0.59 and no significant evidence of proportional bias (P=0.33).

Measurement error

The s_w for symptoms and activity was 0.594 and 0.198 respectively. Repeatability was 1.647 for symptoms and 0.549 for activity (table 4). The MCID using a distribution-based analysis was 3.31 for symptoms and 5.03 for activity; using an anchor-based analysis the MCID was 4.33 and 4.88.

Construct validity and responsiveness:

There was a significant difference between the VISA-A and VISA-A (sedentary) scores, with the VISA-A scores being significantly lower both pre- (P<0.001 for symptoms and activity) and post-treatment (P=0.022 for symptoms, P<0.001 for activity). Bland-Altman analysis (supplementary figures 3 and 4) showed proportional bias between the questionnaires at both timepoints, with greater differences observed for higher scores both pre- and post-treatment. The ICC for agreement between scores was moderate to excellent for symptoms but poor for activity at both time points (table 5).

There was stronger correlation between the pre- to post-treatment change in the VISA-A (sedentary) scores (r=0.420 [95% CI 0.163 - 0.623] for symptoms, r=0.407 [95% CI 0.148 - 0.614] for activity) and the GROC than the VISA-A scores (r=0.253 [95% CI -0.02 - 0.494] for symptoms, r=0.186 for activity [95% CI -0.09 - 0.431). Effect size and standardised response means for symptoms and activity are presented in supplementary table 2.

	Q1-5 (symptoms) ICC [95% CI]	Q6-8 (activity) ICC [95% CI]
Pre-treatment	0.834 [0.673-0.911]	0.073 [-0.620-0.256]
Post-treatment	0.894 [0.820-0.938]	0.029 [-0.033-0.127]

Table 5: Intraclass correlation coefficient (ICC) for agreement between the VISA-A and VISA-A (sedentary).

Floor and ceiling effects:

One patient (1.96%) achieved a maximum score for VISA-A (sedentary) symptoms post-treatment, while three patients (5.88%) obtained maximum scores for activity, therefore the VISA-A (sedentary) demonstrated no floor or ceiling effect. Twenty patients (39.22%) recorded minimum scores for VISA-A activity pre-treatment and ten (19.61%) post-treatment, indicating a floor effect for activity (Q6-8).

DISCUSSION

The VISA-A (sedentary) demonstrated excellent test-retest reliability with very high ICC values and narrow 95% confidence intervals. There was stronger correlation between the VISA-A (sedentary) and the GROC than the VISA-A, although the correlations were moderate. The VISA-A (sedentary) demonstrates no floor or ceiling effect, adequate reliability, validity, and responsiveness and is recommended for use in this cohort.

Since PROMs measure constructs that can only be reported by patients themselves, no gold standard exists for these measures(21). The VISA-A is one of the most widely used PROMs in AT studies, but recent publications have questioned its validity and responsiveness(22, 23). It is felt that internal validity of the VISA-A was not adequately investigated in the original study(9), likely due to the fact that it was developed before the COSMIN guidelines were published. However, recent systematic reviews conclude that whilst the VISA-A demonstrates insufficient evidence for measurement error there is sufficient evidence for reliability, construct validity and responsiveness (24, 25).

In accordance with the COSMIN checklist(11), the VISA-A (sedentary) was developed using an adequate number of symptomatic patients and professionals from relevant disciplines, indicating that the questionnaire has content validity. Patient feedback and measures of internal consistency indicate that items 6-8 of the VISA-A are not relevant to sedentary individuals, with patients unable to score higher than 60/100 on this PROM. Measures of construct validity and responsiveness also demonstrate statistically significant differences between questionnaires for the activity dimension (Q6-8), which is not unexpected as the VISA-A was developed using an active population and is recommended for use in homogeneous groups(9, 10).

Clinical implications:

Exploratory factor analysis identified the VISA-A (sedentary) as a two-dimensional PROM; therefore, each dimension should be scored out of 50 points (Appendix D). The MCID values were similar using distribution and anchor-based analyses, indicating that a change of 5 points for symptoms and 5 points for activity is clinically relevant for sedentary individuals with AT. Only 27/51 patients (52.9%) achieved the MCID of 14 points on the VISA-A(26), despite 49/51 (96.1%) patients recording a perceived improvement on the GROC.

Limitations:

It was not possible to perform an EFA for the VISA-A, indicating a lack of structural validity in this cohort, therefore the VISA-A was split into the same dimensions as the VISA-A (sedentary) to allow

adequate analyses, as recommended by Comins et al(23). Although Cronbach's α was acceptable (>0.70) for the VISA-A (sedentary) overall, the lower limit of the 95% CI was 0.593, and the α value was 0.563 for the activity dimension with wide confidence intervals. This may reflect the different scoring format and weighting of response options for items 7-8. Future studies should investigate whether a more consistent and evenly weighted scoring system is warranted or improves the internal consistency of the VISA-A (sedentary).

The test-retest reliability of the VISA-A (sedentary) was excellent. Baseline questionnaires were administered face-to-face in paper format, with follow up scores obtained 3-days later via phone call. Although the environment (hospital versus home) and administration (paper versus telephone call) of the two questionnaires were different, this method was employed to minimise patient inconvenience and represents a pragmatic approach given the inherent difficulties in conducting research of this nature amid the COVID-19 pandemic.

To promote methodological quality of the study, recommendations from the COSMIN checklist were adhered to where possible. Data from 51 patients were available for this study, indicating adequate sample size. To be categorised as 'very good', at least 100 patients are required, therefore it is recommended that the VISA-A (sedentary) is further investigated in studies with larger sample sizes. The study sample contained a comparable number of male and female patients, but all individuals were over the age of 40, which limits the generalisability of findings to younger sedentary patients.

Several recent publications have identified an association between psychosocial variables and outcomes in tendinopathy(27, 28). Although limited evidence exists for AT, and specific psychosocial variables (e.g., kinesiophobia) were not voluntarily reported by patients in this study, the importance of including a psychosocial domain may become more evident as our understanding of AT evolves.

CONCLUSION:

The VISA-A (sedentary) demonstrates adequate reliability, validity, and responsiveness in sedentary patients with AT. The VISA-A (sedentary) represents a more appropriate measure than the VISA-A for this cohort and is recommended for clinical and research purposes, with each dimension scored out of 50 points.

Legends for figures and tables

Figure 1: development of the VISA-A (sedentary).

Figure 2: flow of patients for the evaluation of the VISA-A sedentary: Rx: treatment.

Competing interests: None.

Contributorship: RN and SO contributed to the study design, development of the VISA-A (sedentary), data collection, data analysis and writing up of the study. JC and JG contributed to the study design and development of the VISA-A (sedentary). JR contributed to data collection. TW contributed to data analysis and writing up of the study.

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Ethical approval information: This study was approved by the University research committee and the NHS Research Ethics Committee.

Data sharing statement: Full data sets of anonymised VISA-A, VISA-A (sedentary) and GROC scores are available, upon reasonable request, via email from the corresponding author.

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VISA-A (Sedentary)

Name: Date:

For each question please mark the box that most accurately describes your usual Achilles tendon symptoms.

1. **For how many minutes do you have <u>STIFFNESS</u> in the Achilles region following a period of prolonged inactivity (e.g. when first getting out of bed)?**

0	10	20	30	40	50	60	70	80	90	100
10										0

2. **Once you have warmed up for the day how much <u>PAIN</u> do you have when stretching your Achilles tendon?**

no pain

0	1	2	3	4	5	6	7	8	9	10
10										0

strong severe pain

3. **How much <u>PAIN</u> do you have when using stairs?**

no pain

0	1	2	3	4	5	6	7	8	9	10
10										0

strong severe pain

4. **For how many minutes does your Achilles <u>PAIN</u> last once you have stopped a painful activity?**

0	10	20	30	40	50	60	70	80	90	100
10										0

5. **How much <u>PAIN</u> do you have doing 10 double-legged heel raises? If you are unable to do 10, please mark your pain level for the number you can do.**

no pain

0	1	2	3	4	5	6	7	8	9	10
10										0

strong severe pain

6. **How many single-legged heel raises can you do on your affected side without <u>PAIN</u>?**

0	1	2	3	4	5	6	7	8	9	10
0										10

VISA-A (Sedentary)

7. At what level are you undertaking your normal activities due to your Achilles symptoms (e.g. walking, gardening or housework)?

- ☐ Normal level or higher than when symptoms began (10)
- ☐ Participating in full activities but not at the same level (7)
- ☐ Modified activities (4)
- ☐ Unable to participate (0)

8. Please answer question **A, B or C only,** depending on which section best describes your **PAIN** when walking. Do not complete all sections.

A. If you have **no pain when walking** on flat ground, for how long can you walk?

0-5 mins	6-10 mins	11-20 mins	21-30 mins	>30 mins
☐	☐	☐	☐	☐
0	7	14	21	30

B. If you have **some pain when walking** on flat ground **but it does not stop you,** for how long can you walk?

0-5 mins	6-10 mins	11-20 mins	21-30 mins	>30 mins
☐	☐	☐	☐	☐
0	4	10	14	20

C. If you have **pain that stops you walking** on flat ground**,** for how long can you walk?

0-5 mins	6-10 mins	11-20 mins	21-30 mins	>30 mins
☐	☐	☐	☐	☐
0	2	5	7	10

Total score (/100) ☐ %

The VISA-A questionnaire: An index of the severity of Achilles tendinopathy

IN THIS QUESTIONNAIRE, THE TERM PAIN REFERS SPECIFICALLY TO PAIN IN THE ACHILLES TENDON REGION

1. **For how many minutes do you have stiffness in the Achilles region on first getting up?**

0	10	20	30	40	50	60	70	80	90	100
10										0

2. **Once you are warmed up for the day, do you have pain when stretching the Achilles tendon fully over the edge of a step? (keeping knee straight)**

no pain

0	1	2	3	4	5	6	7	8	9	10
10										0

strong severe pain

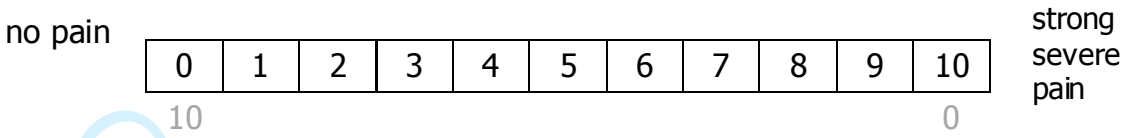
3. **After walking on flat ground for 30 minutes, do you have pain within the next 2 hours? (If unable to walk on flat ground for 30 minutes because of pain, mark box 10 for this question).**

no pain

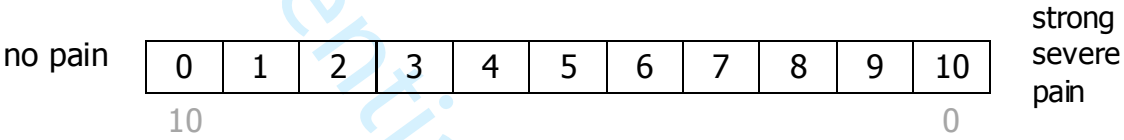
0	1	2	3	4	5	6	7	8	9	10
10										0

strong severe pain

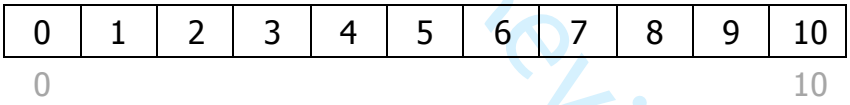
4. Do you have pain walking downstairs with a normal gait cycle?



5. Do you have pain during or immediately after doing 10 (single leg) heel raises from a flat surface?



6. How many single leg hops can you do without pain?



7. Are you currently undertaking sport or other physical activity?

- ☐ Not at all (0)
- ☐ Modified training ± modified competition (4)
- ☐ Full training ± competition but not at same level as when symptoms began (7)
- ☐ Competing at the same or higher level as when symptoms began (10)

8. Please complete **EITHER A, B or C** in this question.

- If you have **no pain while undertaking Achilles tendon loading sports** please complete **Q8a only**.
- If you have **pain while undertaking Achilles tendon loading sports but it does not stop you from completing the activity**, please complete **Q8b only.**
- If you have **pain that stops you from completing Achilles tendon loading sports**, please complete **Q8c only.**

A. If you have **no pain** while undertaking **Achilles tendon loading sports,** for how long can you train/practice?

NIL	1-10 mins	11-20 mins	21-30 mins	>30 mins
☐	☐	☐	☐	☐
0	7	14	21	30

OR

B. If you have some pain while undertaking **Achilles tendon loading sport,** but it does not stop you from completing your training/practice for how long can you train/practice?

NIL	1-10 mins	11-20 mins	21-30 mins	>30 mins
☐	☐	☐	☐	☐
0	4	10	14	20

OR

C. If you have **pain that stops you** from completing your training/practice in **Achilles tendon loading sport**, for how long can you train/practice?

0-5 mins	6-10 mins	11-20 mins	21-30 mins	>30 mins
☐	☐	☐	☐	☐
0	2	5	7	10

Total score (/100) ☐ %

GLOBAL RATING OF CHANGE SCALE (GROC)

Please rate the overall change in your Achilles tendon symptoms from the time that you began treatment until now (tick one box only).

- ☐ A very great deal worse (-7)
- ☐ A great deal worse (-6)
- ☐ Quite a bit worse (-5)
- ☐ Moderately worse (-4)
- ☐ Somewhat worse (-3)
- ☐ A little bit worse (-2)
- ☐ A tiny bit worse (-1)
- ☐ About the same (0)
- ☐ A very great deal better (7)
- ☐ A great deal better (6)
- ☐ Quite a bit better (5)
- ☐ Moderately better (4)
- ☐ Somewhat better (3)
- ☐ A little bit better (2)
- ☐ A tiny bit better (1)

The VISA-A (sedentary) questionnaire

Name: Date:

For each question, please mark the box that most accurately describes your usual Achilles tendon symptoms.

1. For how many minutes do you have <u>STIFFNESS</u> in the Achilles region following a period of prolonged inactivity (e.g. when first getting out of bed)?

0	10	20	30	40	50	60	70	80	90	100
10										0

2. Once you have warmed up for the day, how much <u>PAIN</u> do you have when stretching your Achilles tendon?

no pain

0	1	2	3	4	5	6	7	8	9	10
10										0

strong severe pain

3. How much <u>PAIN</u> do you have when using stairs?

no pain

0	1	2	3	4	5	6	7	8	9	10
10										0

strong severe pain

4. For how many minutes does your Achilles <u>PAIN</u> last once you have stopped a painful activity?

0	10	20	30	40	50	60	70	80	90	100
10										0

5. How much <u>PAIN</u> do you have doing 10 double-legged heel raises? If you are unable to do 10, please mark your pain level for the number you can do.

no pain

0	1	2	3	4	5	6	7	8	9	10
10										0

strong severe pain

<u>Symptoms total: /50</u>

The VISA-A (sedentary) questionnaire

6. How many single-legged heel raises can you do on your affected side without PAIN?

0	1	2	3	4	5	6	7	8	9	10
0										10

7. At what level are you undertaking your normal activities due to your Achilles symptoms (e.g., walking, gardening, or housework)?

- ☐ Normal level or higher than when symptoms began (10)
- ☐ Participating in full activities but not at the same level (7)
- ☐ Modified activities (4)
- ☐ Unable to participate (0)

8. Please answer question **A, B or C only,** depending on which section best describes your **PAIN** when walking. Do not complete all sections.

A. If you have **no pain when walking** on flat ground, for how long can you walk?

0-5 mins	6-10 mins	11-20 mins	21-30 mins	>30 mins
☐	☐	☐	☐	☐
0	7	14	21	30

B. If you have **some pain when walking** on flat ground **but it does not stop you,** for how long can you walk?

0-5 mins	6-10 mins	11-20 mins	21-30 mins	>30 mins
☐	☐	☐	☐	☐
0	2	5	7	10

C. If you have **pain that stops you walking** on flat ground**,** for how long can you walk?

0-5 mins	6-10 mins	11-20 mins	21-30 mins	>30 mins
☐	☐	☐	☐	☐
0	2	5	7	10

Activity total: /50

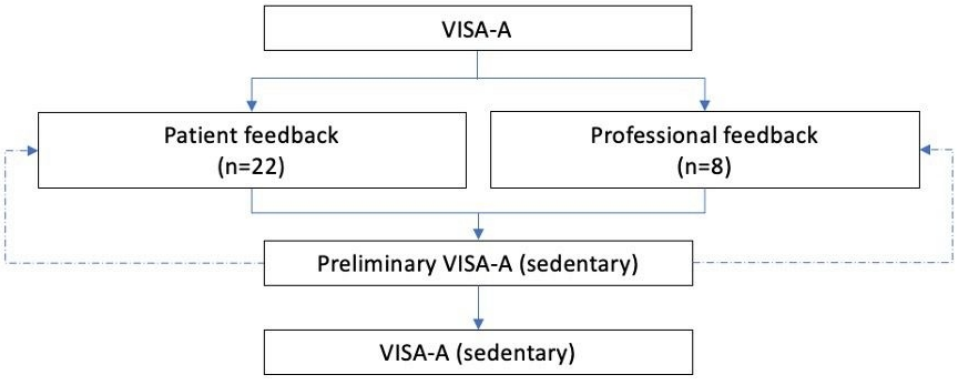


Figure 1: development of the VISA-A (sedentary).

76x33mm (300 x 300 DPI)

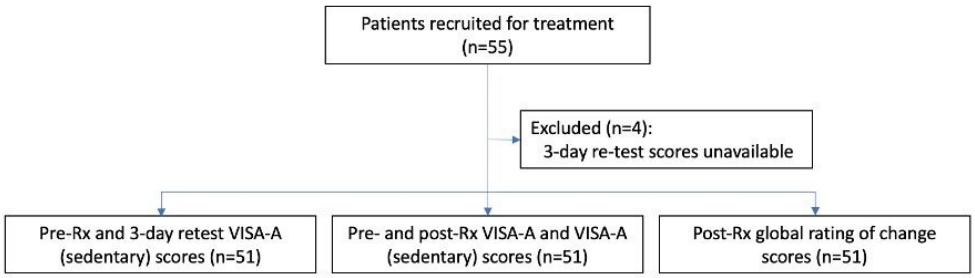


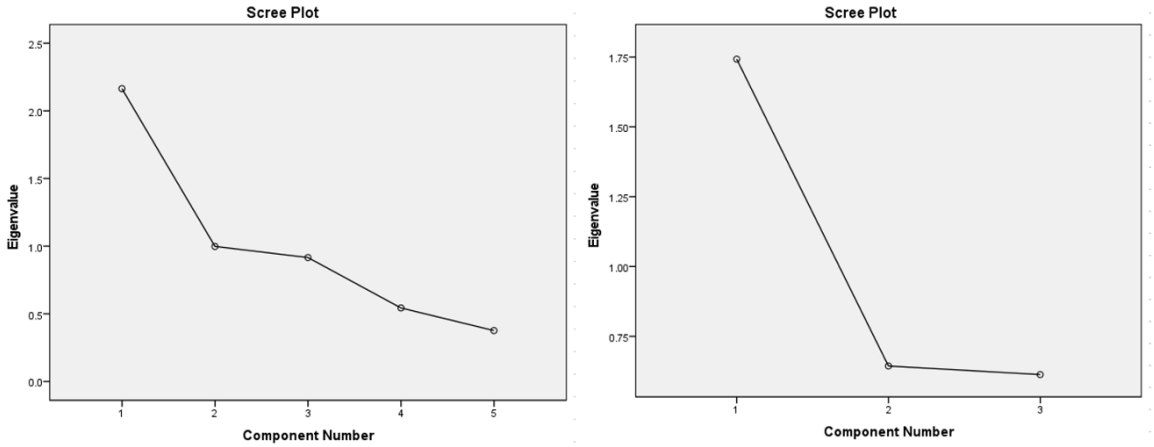
Figure 2: flow of patients for the evaluation of the VISA-A sedentary: Rx: treatment.

76x23mm (300 x 300 DPI)

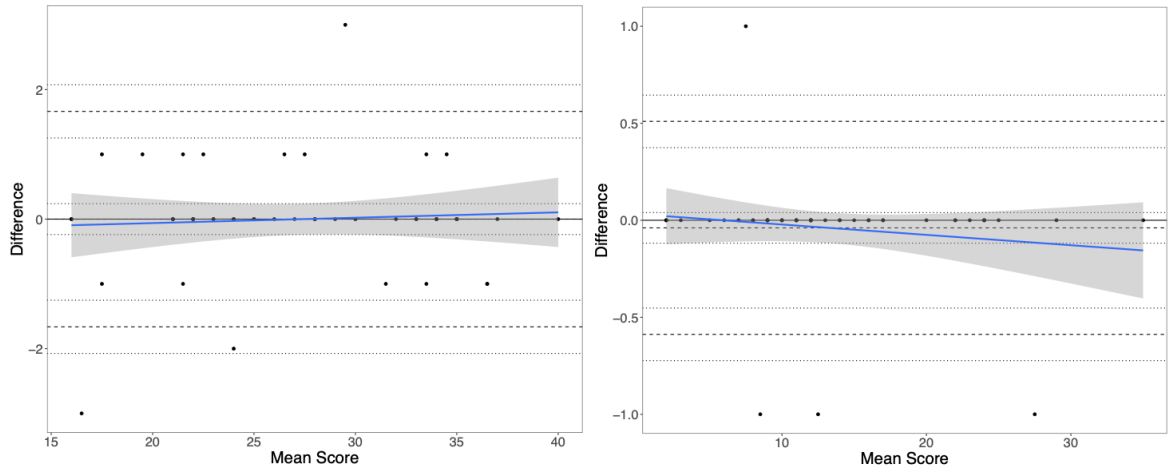
SUPPLEMENTARY MATERIAL:

	Summary of patient and professional comments/feedback for the VISA-A	Issues
Q1	**For how many minutes do you have stiffness in the Achilles region on first getting up?** Patients agreed that stiffness in the Achilles region is a symptom of Achilles tendinopathy. Patients were unsure whether 'first getting up' referred to the first steps after getting out of bed or after other periods of inactivity (e.g., prolonged sitting). Some patients only reported stiffness after other periods of inactivity, not when getting out of bed.	Comprehensibility Response options
Q2	**Once you have warmed up for the day, do you have pain when stretching the Achilles tendon fully over the edge of a step? (keeping knee straight)** Patients agreed that stretching the Achilles can aggravate pain. Some patients did not feel safe performing the test over the edge of a step.	Relevance
Q3	**After walking on flat ground for 30 minutes, do you have pain within the next 2 hours? (If unable to walk on flat ground for 30 minutes because of pain, mark box 10 for this question).** Patients agreed that walking can aggravate Achilles pain. Patients found it difficult to provide an accurate score due to the complexity of the question.	Comprehensibility
Q4	**Do you have pain walking downstairs with a normal gait cycle?** Patients agreed that stairs can aggravate pain. Pain on stairs was often worse, or only present, when ascending stairs.	Comprehensiveness Response options
Q5	**Do you have pain during or immediately after doing 10 (single leg) heel raises from a flat surface?** Patients agreed that single leg heel raises can aggravate pain. Several patients were unable to perform 10 single leg heel raises due to fatigue/weakness.	Relevance Response options
Q6	**How many single leg hops can you do without pain?** Patients felt hopping on one leg was neither possible, nor a functional task, and all patients reported this as not relevant.	Relevance
Q7	**Are you currently undertaking sport or other physical activity?** No patients were participating in 'training' or 'competition'. Other physical activities were impacted including walking, housework, and gardening.	Relevance Response options
Q8	**Pain during Achilles tendon loading sport.** No patients were participating in tendon loading sports (training or games). Patients answered more than one part of the question and, although the question states that they should complete EITHER A, B or C, they felt this needed to be emphasised.	Relevance Comprehensibility Instructions Response options
Other	Duration of pain after a provocative exercise is not included in the questionnaire The scale should be reversed so that "no pain" is positioned to the left of the scale and "strong severe pain" to the right. The relevant symptom or instruction for each question should be emphasised, especially question eight.	Comprehensiveness Comprehensibility Instructions

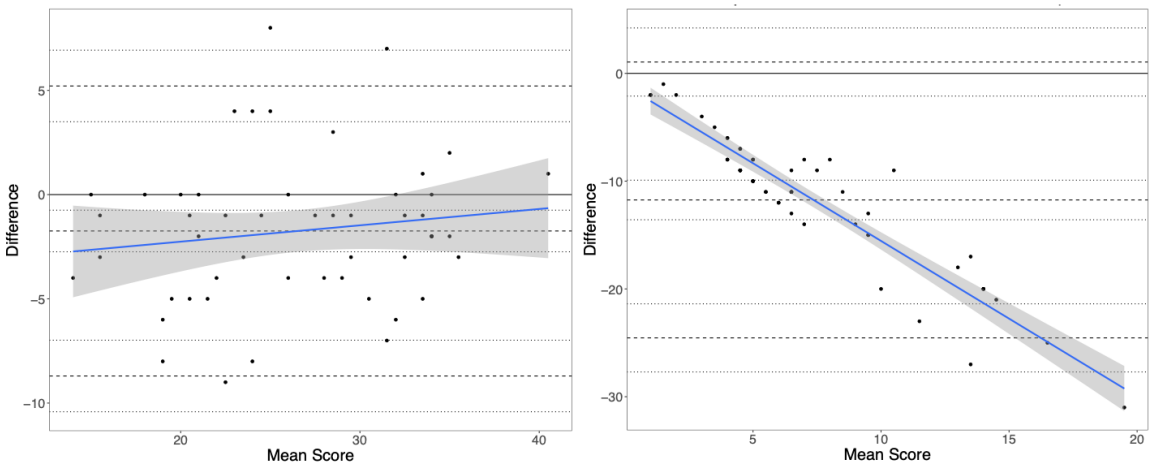
Supplementary table 1: Patient and professional feedback regarding the VISA-A.



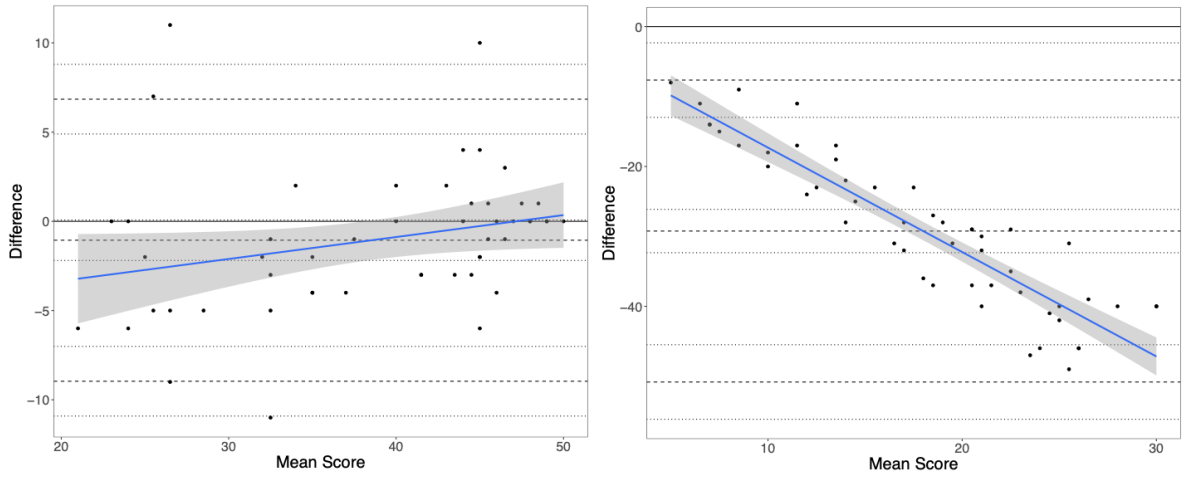
Supplementary figure 1: Scree plots for symptoms (left) and activity (right).



Supplementary figure 2: Bland-Altman plots for VISA-A (sedentary) pre-treatment versus 3-day retest symptoms (left) and activity (right).



Supplementary figure 3: Bland-Altman plots for pre-treatment VISA-A (sedentary) versus VISA-A symptoms (left) and activity (right).



Supplementary figure 4: Bland-Altman plots for post-treatment VISA-A (sedentary) versus VISA-A symptoms (left) and activity (right).

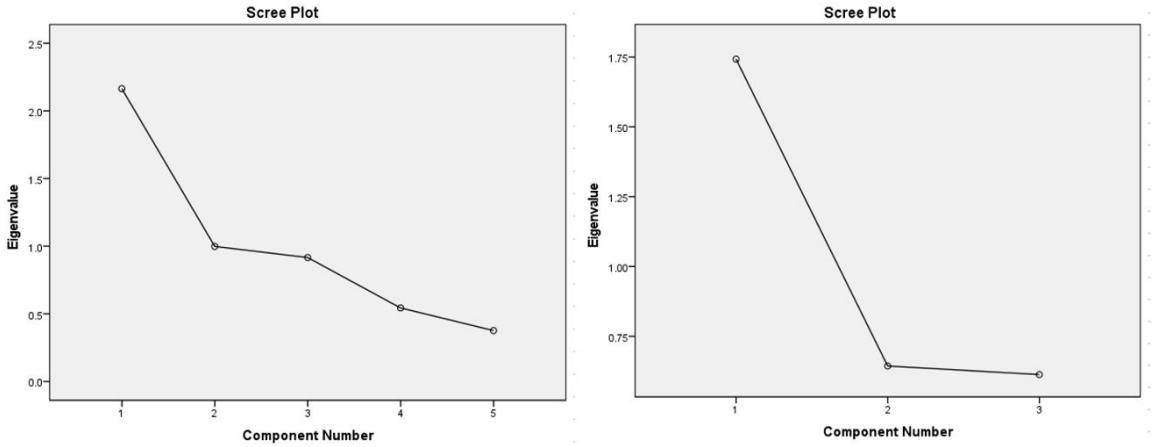
	Mean change	SD of change	SD of pre-Rx scores	SD of post-Rx scores	SD of scores pooled	ES (Cohen)	SRM
VISA-A (sedentary) symptoms - no change	8.27	4.10	7.635	10.147	8.98	0.92	2.02
VISA-A (sedentary) symptoms - change	12.60	6.91	6.013	8.001	7.08	1.78	1.82
VISA-A (sedentary) activity - no change	15.55	10.40	7.737	13.494	11.00	1.41	1.50
VISA-A (sedentary) activity - change	20.43	9.85	7.342	11.432	9.61	2.13	2.07

Supplementary table 2: effect size (ES) and standardised response means (SRM). SD: standard deviation, Rx: treatment.

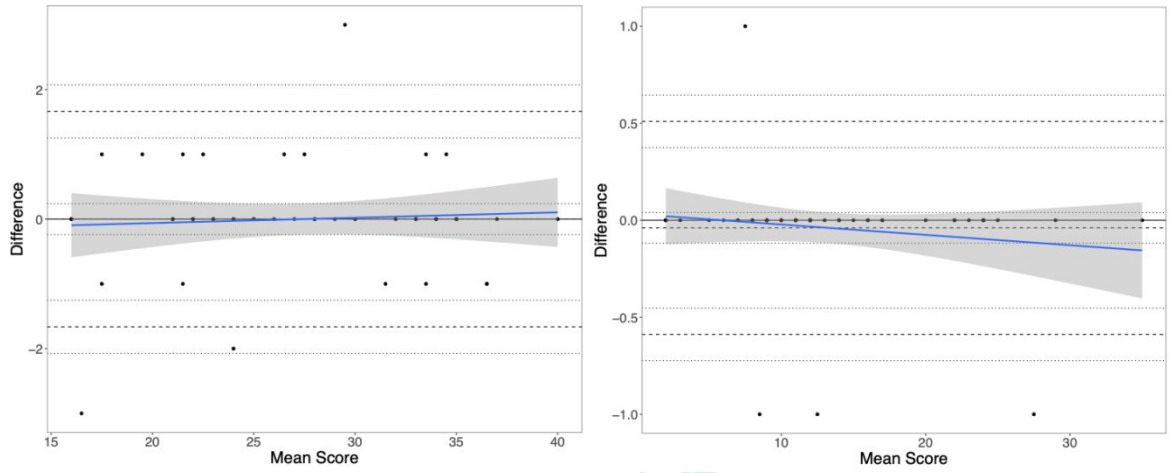
SUPPLEMENTARY MATERIAL:

	Summary of patient and professional comments/feedback for the VISA-A	Issues
Q1	**For how many minutes do you have stiffness in the Achilles region on first getting up?** Patients agreed that stiffness in the Achilles region is a symptom of Achilles tendinopathy. Patients were unsure whether 'first getting up' referred to the first steps after getting out of bed or after other periods of inactivity (e.g., prolonged sitting). Some patients only reported stiffness after other periods of inactivity, not when getting out of bed.	Comprehensibility Response options
Q2	**Once you have warmed up for the day, do you have pain when stretching the Achilles tendon fully over the edge of a step? (keeping knee straight)** Patients agreed that stretching the Achilles can aggravate pain. Some patients did not feel safe performing the test over the edge of a step.	Relevance
Q3	**After walking on flat ground for 30 minutes, do you have pain within the next 2 hours? (If unable to walk on flat ground for 30 minutes because of pain, mark box 10 for this question).** Patients agreed that walking can aggravate Achilles pain. Patients found it difficult to provide an accurate score due to the complexity of the question.	Comprehensibility
Q4	**Do you have pain walking downstairs with a normal gait cycle?** Patients agreed that stairs can aggravate pain. Pain on stairs was often worse, or only present, when ascending stairs.	Comprehensiveness Response options
Q5	**Do you have pain during or immediately after doing 10 (single leg) heel raises from a flat surface?** Patients agreed that single leg heel raises can aggravate pain. Several patients were unable to perform 10 single leg heel raises due to fatigue/weakness.	Relevance Response options
Q6	**How many single leg hops can you do without pain?** Patients felt hopping on one leg was neither possible, nor a functional task, and all patients reported this as not relevant.	Relevance
Q7	**Are you currently undertaking sport or other physical activity?** No patients were participating in 'training' or 'competition'. Other physical activities were impacted including walking, housework, and gardening.	Relevance Response options
Q8	**Pain during Achilles tendon loading sport.** No patients were participating in tendon loading sports (training or games). Patients answered more than one part of the question and, although the question states that they should complete EITHER A, B or C, they felt this needed to be emphasised.	Relevance Comprehensibility Instructions Response options
Other	Duration of pain after a provocative exercise is not included in the questionnaire The scale should be reversed so that "no pain" is positioned to the left of the scale and "strong severe pain" to the right. The relevant symptom or instruction for each question should be emphasised, especially question eight.	Comprehensiveness Comprehensibility Instructions

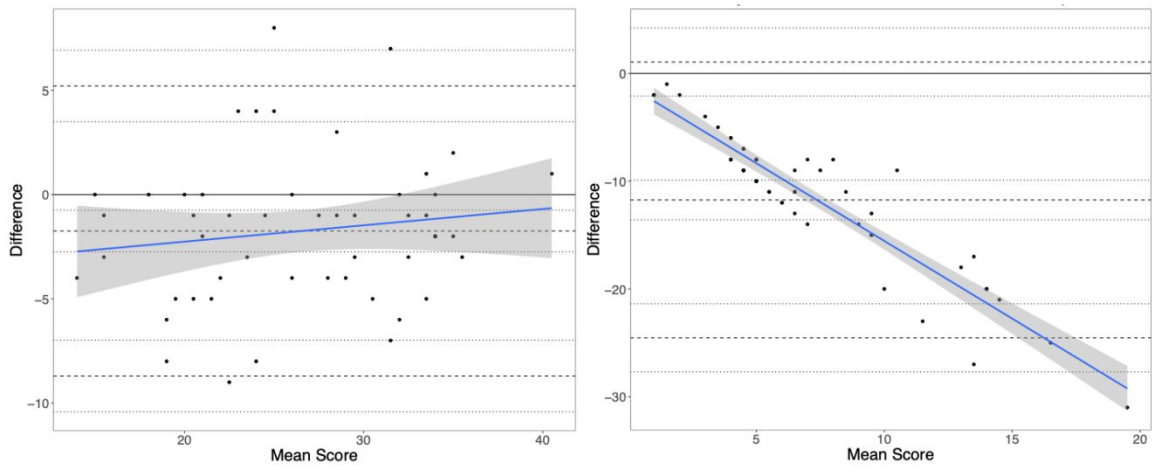
Supplementary table 1: Patient and professional feedback regarding the VISA-A.



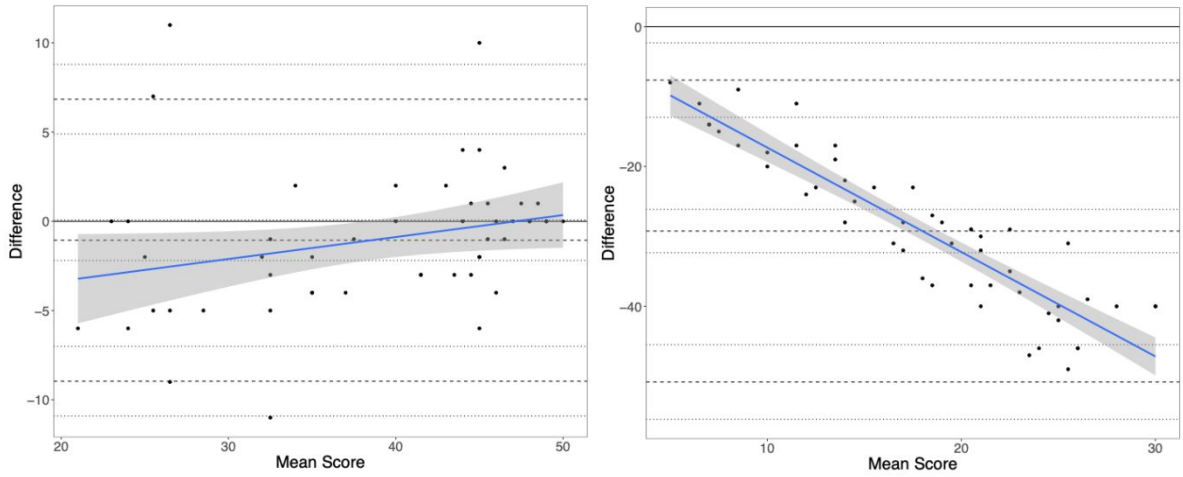
Supplementary figure 1: Scree plots for symptoms (left) and activity (right).



Supplementary figure 2: Bland-Altman plots for VISA-A (sedentary) pre-treatment versus 3-day retest symptoms (left) and activity (right).



Supplementary figure 3: Bland-Altman plots for pre-treatment VISA-A (sedentary) versus VISA-A symptoms (left) and activity (right).



Supplementary figure 4: Bland-Altman plots for post-treatment VISA-A (sedentary) versus VISA-A symptoms (left) and activity (right).

	Mean change	SD of change	SD of pre-Rx scores	SD of post-Rx scores	SD of scores pooled	ES (Cohen)	SRM
VISA-A (sedentary) symptoms - no change	8.27	4.10	7.635	10.147	8.98	0.92	2.02
VISA-A (sedentary) symptoms - change	12.60	6.91	6.013	8.001	7.08	1.78	1.82
VISA-A (sedentary) activity - no change	15.55	10.40	7.737	13.494	11.00	1.41	1.50
VISA-A (sedentary) activity - change	20.43	9.85	7.342	11.432	9.61	2.13	2.07

Responsiveness	ES (Cohen)	SRM
VISA-AS(pain) no resp	0.92	2.02
VISA-AS(pain) resp	1.78	1.82
VISA-AS(function) no resp	1.41	1.50
VISA-AS(function) resp	2.13	2.07

Supplementary table 2: effect size (ES) and standardised response means (SRM). SD: standard deviation, Rx: treatment.