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Fibromyalgia Assessment Screening Tools (FAST) Based on Only Multidimensional Health Assessment Questionnaire (MDHAQ) Scores as Clues to Fibromyalgia

Juan Schmukler, Shakeel Jamal, Isabel Castrejon, Joel A Block, and Theodore Pincus

Objective. The study was designed to develop fibromyalgia assessment screening tool (FAST) indices based only on multidimensional health assessment questionnaire (MDHAQ) scores as clues to fibromyalgia (FM), analyzed for possible agreement with the 2011 FM criteria.

Methods. All patients with all diagnoses complete an MDHAQ at each visit in routine care. The MDHAQ includes scores for physical function, pain, global assessment, fatigue, self-report painful joint count, and a 60-symptom checklist. MDHAQ items similar or identical to the 2011 FM criteria symptom severity scale (SSS) and widespread pain index (WPI) components of a polysymptomatic distress scale (PSD) were compiled into continuous MDHAQ-FM-SSS, MDHAQ-FM-WPI, and MDHAQ-FM-PSD indices. Ten candidate MDHAQ scores were analyzed against the 2011 FM criteria using descriptive statistics, Spearman correlations, kappa statistics, and receiver operating characteristic curves for the area under the curve (AUC). MDHAQ candidate variables with the highest AUC were compiled into cumulative MDHAQ-FAST indices of three (FAST3) or four (FAST4) scores.

Results. The highest AUCs among MDHAQ scores were seen for symptom checklist, painful joint count, fatigue, and pain, which are included in FAST4; FAST3-F excludes pain, and FAST3-P excludes fatigue. AUCs for FAST3-P, FAST3-F, and FAST4, as well as continuous MDHAQ-FM scores, all were greater than 0.92, indicating excellent criterion validity. Kappa statistics versus the 2011 criteria were 0.63-0.68, higher than 0.41-0.47 versus physician ICD-10 diagnoses.

Conclusion. Pragmatic FAST3, FAST4, and MDHAQ-FM indices are similar to FM criteria to screen for FM in routine care. It is more feasible to collect the same MDHAQ, which is informative in all rheumatic diseases studied, from each patient than to ask different patients with different diagnoses to complete different questionnaires.

INTRODUCTION

Fibromyalgia (FM) is common in the general population (1,2) and is even more common in people with rheumatic conditions (3–5). FM often is easily recognized but may be difficult to identify in some patients, particularly those with other diagnoses such as rheumatoid arthritis (RA), osteoarthritis (OA), systemic lupus erythematosus (SLE), and others. FM classification criteria were reported in 1990 (6), revised in 2010 (7), and endorsed by the American College of Rheumatology (ACR). Further revised criteria were reported in 2011 (8) and 2016 (9), based only on patient self-report questionnaires, were termed "diagnostic criteria," and were not endorsed by the ACR (10).

FM criteria are used in clinical trials and other clinical research but generally not in routine care. It is not feasible for office staff to ask patients with different diagnoses to complete different self-report questionnaires in busy clinical settings (11). Patients with FM may have high scores on indices designed to assess disease activity in RA and other diseases, which may not reflect disease activity. For example, a patient with no swollen joints and an erythrocyte sedimentation rate (ESR) of 10 mm/hr (suggesting no inflammatory activity), but a tender joint count of 18/28, a pain visual analog scale (VAS) of 8, and a patient global assessment (PATGL) of 8 would have a disease activity score (DAS28) (12) of 5.1, a clinical disease activity index (CDAI) (13) of 36, and a routine assessment of patient index data (RAPID3) score (14) of 20. While

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Dr. Pincus holds a copyright and trademark on the multidimensional health assessment questionnaire (MDHAQ) and the routine assessment of patient index data (RAPID3), for which he receives royalties and license fees, all of which are used to support further development of quantitative questionnaire measurements for patients and doctors in clinical rheumatology care. No other disclosures relevant to this article were reported.

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SIGNIFICANCE & INNOVATIONS

- The multidimensional health assessment questionnaire (MDHAQ), which is informative in all rheumatic diseases studied, can be useful to screen for fibromyalgia (FM) in busy clinical settings.
- Several scales and indices derived from the MDHAQ are comparable to 2011 FM criteria in screening for FM, regardless of primary rheumatic disease diagnosis.
- The more pragmatic cumulative indices perform similarly to continuous indices and are far less cumbersome to calculate.

these index scores would suggest high activity (13–16), the patient would not be a candidate for initiation or intensification of therapy with biological agents. Such patients may present apparent anomalies for the treat-to-target approach (17), which may be explained, however, when the basis for nonintensification is recognized (18).

A more feasible approach than the FM criteria questionnaire to screen for FM in routine care might be available from a multidimensional health assessment questionnaire (MDHAQ) (19,20), which has been reported previously to provide clues to FM (21,22). The MDHAQ/RAPID3 has been documented to be sensitive to changes in clinical status in all rheumatic diseases studied (23,24), including OA (25), SLE (25,26), ankylosing spondylitis (25,27–30), psoriatic arthritis (31), gout (25), vasculitis (32), and polymyalgia rheumatica (33). The MDHAQ also includes a fatigue VAS; queries concerning sleep quality, anxiety, and depression; a self-report painful joint count (34) similar to the FM criteria widespread pain index (WPI); and a symptom checklist which includes items found on the FM criteria symptom severity scale (SSS). In this report, we analyze the capacity of various MDHAQ-derived indices, compared with the 2011 FM criteria as the reference standard, to screen for FM (10).

PATIENTS AND METHODS

Patients. All consecutive patients (with all diagnoses) seen for rheumatology care at Rush University are asked to complete an MDHAQ (19,20) at each rheumatology visit in routine care. In April 2017, the 2011 revised FM criteria questionnaire (8) was added to the MDHAQ for completion by all unselected patients with any condition who were not new to the clinic (new patients complete a long MDHAQ version that queries past history) and could complete English-language questionnaires (the FM questionnaire was available only in English).

The RAPID3 index on the MDHAQ is composed of three 0-10 scores for physical function, pain, and patient global assessment (14,16,35,36). At our institution, questionnaires are routinely distributed to all patients but are reviewed and scored variably by different physicians and even by the same physician. Although they had access to the patients' FM criteria questionnaire responses, the 13 faculty clinicians stated explicitly that they did not review the FM criteria questionnaire when assigning specific primary and secondary diagnoses according to *International Classification of Diseases, 10th Revision* (ICD-10) codes. In analyses of proposed FM indices based on MDHAQ scales (termed "MDHAQ-FM" indices), patients were identified as having FM according to three methods: 1) physician-entered FM ICD-10 code in the medical record as a primary or secondary diagnosis, 2) the 2011 modified FM criteria, the primary reference criteria, and 3) the 2016 modified FM criteria.

Institutional approval. The Rush University Institutional Review Board (IRB) waived a requirement for patient consent in completion of patient questionnaires because the questionnaire is a component of routine care, analogous to a laboratory test, for quantitative data to guide clinical decisions (37). The Rush University IRB approved the addition of the FM criteria questionnaire to the MDHAQ for routine care. The IRB approved a retrospective review of routine care questionnaires, provided the data were de-identified of protected information concerning patient name, medical record number, and date of birth. The study was conducted in accordance with the Helsinki Declaration.

Patient questionnaires. *FM criteria questionnaire*. The FM criteria questionnaire is composed of two scales: the symptom severity scale (SSS) and the widespread pain index (WPI) (8). The SSS queries for six symptoms; three, fatigue, waking unrefreshed, and cognitive symptoms, are scored from 0 to 3 (total: 0-9); three others, headaches, pain or cramps in the lower abdomen, and depression, are scored 0 or 1 (total: 0-3) (total SSS scores = 0-12). The WPI queries for 19 painful joints or other body regions, each scored as 0 or 1 (total: 0-19). The sum of the SSS (0-12) and the WPI (0-19) scores is termed a polysymptomatic distress scale (PSD) (total: 0-31) (38). A patient meets 2011 FM criteria if the WPI score is greater than or equal to 7 and the SSS score is greater than or equal to 5 or if the WPI score is 3-6 and the SSS score is greater than or equal to 9 (8).

The 2016 modification of the 2011 FM criteria introduced two changes: a requirement for pain in 4 of 5 bodily regions, introduced because patients with regional pain syndromes may be misclassified as having FM according to 2011 criteria (9), and a statement that the same criteria are applied to "primary" and "secondary" FM. The 2011 criteria appear more informative in rheumatology settings (9,10) and were chosen as the reference standard (10), although some descriptive analyses involving the 2016 criteria are presented.

MDHAQ. The MDHAQ (19,20) is a two-page single-sheet questionnaire developed from the Stanford health assessment questionnaire (HAQ) (39) in clinical care as a continuous quality improvement program (40). The MDHAQ includes a 0-10 score for physical function, pain, and patient global assessment, com-

piled into a 0-30 RAPID3 score, as well as scales for fatigue, rheumatoid arthritis disease activity index (RADAI) self-report painful joint count (34), and a 60-symptom checklist. Although developed initially in studies of patients with RA, MDHAQ/RAPID3 has been found to be informative in OA, SLE, FM, ankylosing spondylitis, psoriatic arthritis, and polymyalgia rheumatica, in addition to RA and other rheumatic diseases (24,25).

The MDHAQ physical function scale includes 10 activities: 8 from the original standard HAQ (39) and 2 complex activities (19,20) scored 0-3, as in the HAQ (39) a total of 0-30 recalculated to 0-10. The MDHAQ physical function section also includes queries concerning sleep quality, anxiety, and depression in the patient-friendly HAQ format. Pain and PATGL VASs are in 21 circles at 0.5 intervals (41). Three 0-10 scores for function, pain, and PATGL are compiled into a 0-30 RAPID3 score using a template on the MDHAQ (42).

The two-page MDHAQ also includes a 0-10 fatigue VAS and a self-report painful joint count termed the rheumatoid arthritis disease activity index (RADAI) (34). The eight symmetrical joint groups (fingers, wrists, elbows, shoulders, hips, knees, ankles, and toes) are scored for pain as a graded scale, 0 = none, 1 = mild, 2 = moderate, and 3 = severe for a total score of 0-48, or as a binary sacle, 0 = none, 1 = pain present for a total score of 0-16. The MDHAQ version of the RADAI self-report painful joint count adds the neck and back, which are scored in a graded or binary format for a total score of 0-54 or 0-18. The MDHAQ contains a 60-symptom checklist, which includes items similar to the SSS: fatigue, problems with sleeping, problems with thinking, problems with memory, depression, and stomach pain. Demographic data on the MDHAQ include date of birth, sex, ethnicity, and years of formal education.

MDHAQ-FM derived indices. Two approaches were used to develop four MDHAQ-derived FM indices, which were then compared with the 2011 FM criteria as the external standard. The first approach was to construct a continuous index composed of the MDHAQ items that were similar to the FM criteria items, termed the "MDHAQ-FM-PSD." For this approach, the MDHAQ self-report painful joint count was regarded as analogous to the FM-WPI and was termed the "MDHAQ-FM-WPI," and items on the symptom checklist and other scales that queried for the same symptoms as the SSS were compiled into an "MDHAQ-FM-SSS" index. The arithmetic sum of the MDHAQ-FM-SSS and MDHAQ-FM-WPI was termed the MDHAQ-FM-PSD.

The second approach involved a compilation of MDHAQ scores into a cumulative index, as more-easily calculated and feasible in busy clinical settings than a continuous MDHAQ-FM-PSD. Initially, 10 MDHAQ candidate scores were evaluated for their area under the curve (AUC) in receiver operating characteristic (ROC) curve analyses using the 2011 criteria as the external standard: physical function (0-10), pain VAS (0-10), PATGL VAS (0-10), RAPID3 (0-30), fatigue VAS (0-10), sleep quality (0-3.3), anxiety (0-3.3), depression (0-3.3), RADAI self-report painful joint count (0-48, 0-54, 0-16, or 0-18, as noted above), and symptom checklist (0-60). The four scores with the highest AUCs were compiled into indices of three or four individual scores, termed fibromyalgia assessment screening tools, FAST3 or FAST4, respectively. RAPID3 and PATGL were not included in FAST indices because clinical observations had suggested that they were more likely to reflect somatic symptoms such as fever or dyspnea.

Statistical analyses. All analyses were performed in Stata version 12.0 for Macintosh (StataCorp LP). The proportion of patients with FM (primary or secondary) defined as physician-entered ICD-10 code and the proportion of patients with FM who met the 2011 and 2016 criteria for FM were computed. Demographic and clinical characteristics were compared in patients who met or did not meet the 2011 FM criteria. Means and SDs were compared using *t* tests, and percentages were compared using χ^2 tests.

Spearman rank-order correlation coefficients were calculated between the individual items on the MDHAQ and FM criteria questionnaire counterparts to evaluate construct validity. Correlations between the SSS, WPI, and total PSD from the FM questionnaire (the sum of the WPI and SSS scores) and a composite total MDHAQ-FM-SSS, MDHAQ-FM-WPI, and MDHAQ-FM-PSD were computed.

To develop cumulative FAST indices,10 MDHAQ scores were analyzed using ROC curves versus the 2011 FM criteria as the external standard to identify measures with highest AUC. FAST3 and FAST4 indices were constructed from the three or four scores with the highest AUCs for individual MDHAQ items. Cumulative indices include a 0 or 1 score for each of three or four variables with the highest AUC, based on the optimal "trade-off" between sensitivity and specificity. Agreement of the MDHAQ-derived continuous and cumulative indices withthe 2011 FM criteria and clinical diagnosis was assessed by kappa statistics (43). Indices were also analyzed using Spearman correlations with the 2011 FM criteria for the SSS, WPI, and PSD.

RESULTS

Patient diagnoses from medical record. Among 502 patients with complete data, 106 (21%) were identified by ICD-10 codes as having primary or secondary FM, 131 (26%) met the 2011 FM criteria, and 112 (22%) met the 2016 FM criteria (Table 1). Primary ICD-10 diagnoses included FM in 49 patients, OA in 74 patients, RA in 78 patients, SLE in 88 patients, and other rheumatic diseases in 213 patients (Table 1).

Table 1. Diagnoses as charted by physicians compared to FM status by 2011 and 2016 modified criteria

Primary Diagnosis According to Physician	Total, N (%)	Median RAPID3 Score, (Interquartile Range)	Diagnosed With FM by the Physician, n (%)	2011 FM Criteria Positive, n (%)	2016 FM Criteria Positive, n (%)
FM	49 (10)	18.7 (15.2-22.7)	49 (100)	33 (67)	29 (59)
OA	74 (15)	15.0 (11.5-19.8)	15 (20)	24 (32)	20 (27)
RA	78 (15.5)	13.3 (5.3-17.7)	8 (10)	14 (18)	12 (15)
SLE	88 (17.5)	10.0 (3.5-16.3)	9 (10)	17 (19)	15 (17)
Other	213 (42)	9.8 (5-16.7)	25 (12)	43 (20)	36 (15)
Total	502 (100)	12.7 (5.8-17.7)	106 (21)	131 (26)	112 (22)

Abbreviation: FM, fibromyalgia; OA, osteoarthritis; RA, rheumatoid arthritis; SLE, systemic lupus erythematosus.

Median RAPID3 scores were 18.7 in patients with FM, 15.0 in patients with OA, 13.3 in patients with RA, 10.0 in patients with SLE, and 9.8 in the remaining patients (Table 1).

Among the 49 patients with primary FM per ICD-10, 33 (67%) met the 2011 FM criteria and 29 (59%) met the 2016 FM criteria. Among patients assigned a primary diagnosis of RA, OA, and SLE, 10%, 20%, and 10%, respectively, also were assigned a diagnosis of FM (secondary) per ICD-10, whereas 11%, 32%, and 19%, respectively, met the 2011 FM criteria, and 15%, 27%, and 17%, respectively, met the 2016 FM criteria. More patients were assigned a primary diagnosis of FM per ICD-10 than those who met 2011 or 2016 FM criteria, whereas a reciprocal pattern was seen for patients with other primary diagnoses and comorbid or secondary FM (Table 1).

MDHAQ measures according to 2011 FM criteria. MDHAQ measures were compared in 131 patients with FM per

Table 2. Demographic and clinical measures on the MDHAQ versus the 2011 FM criteria[a]

		FM 2011 Criteria		
	Total (N = 502)	Positive (n = 131)	Negative (n = 371)	*P*
Demographic measures				
Age, years	52.6 (16.3)	50.2 (15.8)	53.5 (16.4)	0.05
Female sex	415 (83%)	119 (90%)	296 (80%)	0.004
Race and/or ethnicity				
White	195 (46%)	47 (46%)	148 (47%)	0.05
Black	140 (33%)	30 (29%)	110 (35%)	...
Hispanic	69 (16%)	23 (22%)	46 (15%)	...
Asian	15 (4%)	2 (2%)	13 (4%)	...
Formal education, years	14.6 (3.1)	13.8 (3.4)	14.8 (3.0)	0.001
Clinical measures				
Physical function (0-10)	2.4 (2.1)	4.1 (1.9)	1.8 (1.8)	<0.001
Pain VAS (0-10)	5.1 (3.1)	7.7 (1.8)	4.2 (2.9)	<0.001
Global VAS (0-10)	4.7 (2.9)	7.1 (1.9)	3.9 (2.7)	<0.001
Fatigue VAS (0-10)	4.8 (3.3)	7.8 (1.9)	3.7 (3.0)	<0.001
RAPID3 (0-30)	12.3 (7.3)	18.8 (4.6)	10.1 (6.7)	<0.001
RADAI self-report painful joint count (0-54)	11.1 (10.8)	21.9 (11.0)	7.3 (7.6)	<0.001
Symptom checklist (0-60)	11.9 (9.4)	22.0 (9.3)	8.3 (6.2)	<0.001
Sleep quality (0-3.3)	1.2 (1.0)	2.0 (0.9)	0.9 (0.9)	<0.001
Anxiety (0-3.3)	0.7 (0.8)	1.2 (0.9)	0.5 (0.7)	<0.001
Depression (0-3.3)	0.6 (0.8)	1.2 (0.9)	0.4 (0.7)	<0.001

Abbreviation: FM, fibromyalgia; MDHAQ, multidimensional health assessment questionnaire; RADAI, rheumatoid arthritis disease activity index; RAPID3, routine assessment of patient index data; VAS, visual analog scale.
[a]Ordinal variables are presented as absolute number (percentage), and continuous variables are presented as mean (SD).

the 2011 FM criteria versus the other 371 patients (Table 2). Differences in age and ethnicity were marginally significant but not clinically important ($P = 0.05$). Differences in sex were significant ($P = 0.004$), reflecting that women generally score higher on all self-report questionnaire scales (44). Differences in formal education, 13.8 vs 14.8 years in patients who met FM criteria versus those who did not ($P= 0.001$), were significant, consistent with evidence that most clinical measures differ more by education level than by age (45). All clinical MDHAQ scores studied were clinically and statistically significantly higher in patients who met 2011 FM criteria than in patients who did not meet these criteria, including scores for physical function, pain VAS, PATGL VAS, RAPID3 (by definition based on individual component scores), sleep quality, anxiety, depression, fatigue VAS, RADAI self-report painful joint count, and symptom checklist (Table 2).

MDHAQ scales compared with FM criteria. Table 3 includes MDHAQ items that query similar constructs in different scales (eg, depression on a 0-3.3 scale in the HAQ format and as 0-1 symptom among 60 in the symptom checklist). Correlation coefficients of the six individual components of the SSS and their MDHAQ counterparts were highly significant (Table 3) and were consistently higher between the identical or nearly identical pairs than between the other five items, with the exception of fatigue and waking up unrefreshed on the FM criteria SSS and fatigue and sleep quality in two measures each on the MDHAQ (Table 3). For the final continuous indices, the individual items with the highest correlation were chosen. The correlation coefficient between the SSS from the FM criteria and a summary index derived from the six corresponding MDHAQ items, termed MDHAQ-FM-SSS, was rho = 0.869 (Table 3).

Correlations between the WPI from the FM criteria and each of the four versions of the RADAI self-report painful joint count ranged from rho = 0.652 to rho= 0.753 (Table 3), highest for the version with 0-3 scoring and the back and neck added to the original scale (Table 3). The summary correlation between the PSD (the sum of SSS and WPI scores in the ACR criteria) and the MDHAQ equivalent composed of the sum of the MDHAQ-FM-SSS and MDHAQ-FM-WPI scores, termed the MDHAQ-FM-PSD, was rho = 0.864 (Table 3).

The optimal cut point for the MDHAQ-FM-WPI and MDHAQ-FM-SSS, based on ROC analyses (Figure 1A), was 5 for each scale, resulting in an AUC versus the 2011 FM criteria of 0.881 for the MDHAQ-WPI and of 0.916 for the MDHAQ-SSS (Table 4). An MDHAQ-PSD score greater than or equal to 10 had an AUC of 0.929 (Table 4), which correctly classified 85.1% of patients (data not shown).

Table 3. Spearman correlations between individual components of the 2011 revised FM criteria and MDHAQ items[a]

	MDHAQ Items								
Between SSS and MDHAQ[b]									
	Fatigue (0-3)	Fatigue (0-1)	Problems With Thinking/ Memory (0-2)	Good Night's Sleep (0-3.3)	Sleep (0-1)	Headaches (0-1)	Stomach Pain/ Cramps (0-1)	Depression (0-1)	Depression (0-3.3)
SSS items									
Fatigue (0-3)	0.779	0.556	0.431	0.571	0.422	0.303	0.300	0.377	0.449
Trouble thinking or remembering (0-3)	0.497	0.373	0.737	0.446	0.432	0.315	0.385	0.449	0.542
Waking up unrefreshed (0-3)	0.676	0.421	0.432	0.641	0.512	0.330	0.343	0.356	0.444
Headaches (0-1)	0.349	0.268	0.288	0.252	0.243	0.718	0.259	0.247	0.265
Pain/cramps in lower abdomen (0-1)	0.309	0.236	0.307	0.272	0.221	0.308	0.507	0.267	0.295
Depression (0-1)	0.411	0.258	0.432	0.321	0.412	0.326	0.265	0.704	0.655
Between WPI and RADAI[c]									
	RADAI (0-48)		Dichotomized RADAI (0-16)			RADAI Including Back and Neck (0-54)		Dichotomized RADAI Including Back and Neck (0-18)	
WPI scale	0.733		0.652			0.753		0.703	

Data are rho values

Abbreviation: FM, fibromyalgia; MDHAQ, multidimensional health assessment questionnaire; PSD, polysymptomatic distress scale (the sum of SSS and WPI scores); RADAI, rheumatoid arthritis disease activity index; SSS, symptom severity scale; WPI, widespread pain index.

[a]The MDHAQ-SSS is sum of fatigue (0-3), problems with thinking/memory (0-2), good night's sleep (0-3.3), headaches (0-1), stomach pain/cramps (0-1), and depression (0-1) scores; The MDHAQ-WPI is the self-report joint count, including the back and neck (0-54), divided by 3 (0-18); The MDHAQ-PSD is the sum of MDHAQ-SSS and MDHAQ-WPI scores.

[b]The correlation between composites of 6 MDHAQ somatic symptoms (MDHAQ-FM-SSS) and SSS = 0.869.

[c]The correlation between MDHAQ-FM-PSD (MDHAQ-FM-WPI + MDHAQ-FM-SSS) and PSD = 0.864.

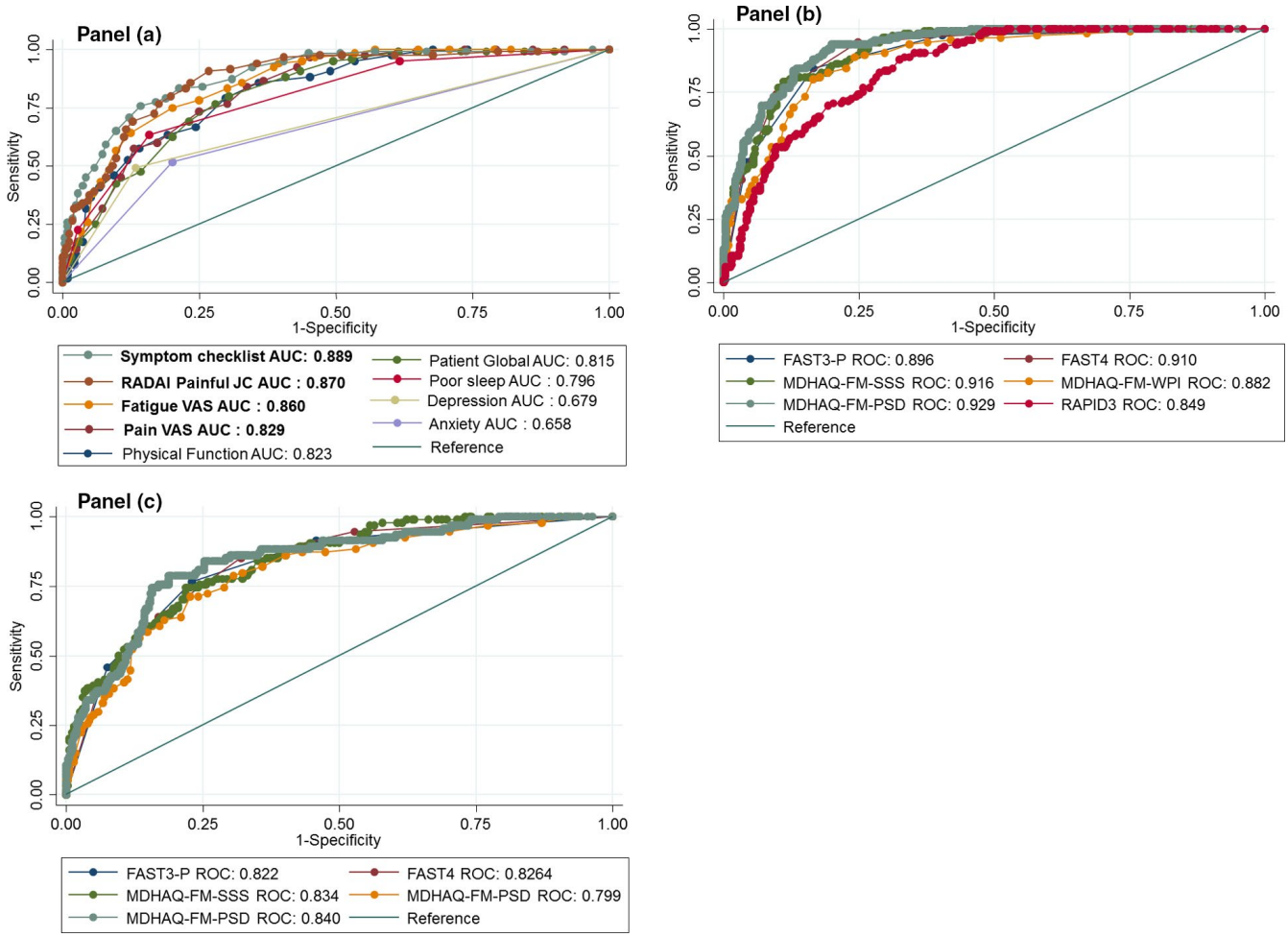

Figure 1. **a**, Receiver operating characteristic (ROC) curves for the multidimensional health assessment questionnaire (MDHAQ) single items to screen for fibromyalgia (FM) according to the 2011 FM criteria as a reference standard. The four single items showing a higher area under the curve (AUC) are in bold: symptom checklist, rheumatoid arthritis disease activity index (RADAI) self-report painful joint count (JC), fatigue visual analog scale (VAS), and pain VAS. ROC curves to compare the capacity of all MDHAQ-based composite indices and routine assessment of patient index data (RAPID3) to discriminate between patients with or without FM according to the 2011 revised criteria (**b**) and according to the physicians' diagnosis of FM (**c**) as a reference standard. The MDHAQ-FM-SSS is the sum of fatigue, problems with thinking/memory, good night sleep, headaches, stomach pain/cramps, and depression scores. The MDHAQ-FM-WPI is the self-report painful joint count, which includes the back and neck (0-54), divided by 3. The MDHAQ-FM-PS is the sum of the MDHAQ-SSS and the MDHAQ-WPI. FAST3-P, (fibromyalgia assessment screening tool cumulative index) includes pain, self-report painful joint count, and symptom checklist; FAST4 (fibromyalgia assessment screening tool cumulative index) includes pain, fatigue, self-report painful joint count, and symptom checklist; SSS, symptom severity scale.

Analyses of nine individual MDHAQ scores and RAPID3 versus 2011 FM criteria. Each of nine candidate single MDHAQ scores and RAPID3 were compared to the 2011 FM criteria according to ROC curves (Figure 1b), to develop more feasibly-scored indices based on the MDHAQ for busy clinical settings. The five MDHAQ scores with the highest AUC were the symptom checklist (AUC = 0.891), self-report RADAI painful joint count (AUC = 0.877), fatigue VAS (AUC = 0.861), RAPID3 (AUC = 0.849), and pain VAS (AUC = 0.828) (Figure 1a). RAPID3 (and PATGL) was not included in the FAST indices, as noted in the Methods. The optimal trade-offs of sensitivity and specificity based on the ROC analyses (Figures 1a and b) were pain VAS (0-10) greater than or equal to 6, fatigue VAS (0-10) greater than or equal to 6, self-report painful joint count (0-54) greater than or equal to 16, and a symptom checklist (0-60) greater than or equal to 16. In cumulative composite measures, each component is awarded 0-1 point based on meeting the prespecified cut point.

A similar approach was used to develop cutoff points for the MDHAQ-SSS, the MDHAQ-WPI, and the MDHAQ-PSD, which is the sum of the MDHAQ-SSS and MDHAQ-WPI scores. The optimal trade-offs of sensitivity and specificity that were selected based on the ROC analyses were an MDHAQ-FM-SSS score (0-11.3) greater than or equal to 5, an MDHAQ-FM-WPI score (0-18) greater than or equal to 5, and an MDHAQ-FM-PSD score (0-29.3) greater than or equal to 10 (Table 4).

Table 4. Performance characteristics of MDHAQ individual scores (MDHAQ-FM indices versus 2011 FM criteria as reference standard)[a]

	Cut Point	Sensitivity, %	Specificity, %	LR+	AUC of ROC Curves	Correlation vs PSD as a Continuous Variable
Pain VAS (0-10)	≥6	85.5	65.0	2.44	0.829	0.639
Fatigue VAS (0-10)	≥6	84.0	69.6	2.76	0.860	0.692
RADAI self-report painful joint count (0-54)	≥16	68.7	87.3	5.42	0.877	0.742
Symptom checklist (0-60)	≥16	77.1	86.3	5.61	0.889	0.785
MDHAQ-FM indices						
MDHAQ-FM-SSS (0-11.3)	≥5	79.8	83.3	4.79	0.916	0.808
MDHAQ-FM-WPI (0-18)	≥5	81.6	81.2	4.34	0.881	0.765
MDHAQ-FM-PSD (0-29.3)	≥10	85.6	84.9	5.68	0.929	0.863
FAST3-P (0-3)					0.924	0.832
Pain VAS	≥1	97.7	59.0	2.38	...	...
Painful joint count	≥2	85.5	83.8	5.29	...	...
Symptom checklist	3	48.1	95.7	11.15	...	...
FAST3-F (0-3)					0.937	0.854
Fatigue VAS	≥1	97.6	63.1	2.64	...	...
Painful joint count	≥2	83.2	87.9	6.88	...	...
Symptom checklist	3	42.4	96.8	13.1	...	...
FAST4 (0-4)					0.927	0.852
Fatigue VAS	≥1	98.4	51.6	2.03	...	...
Pain VAS	≥2	95.2	75.2	3.84	...	...
Painful joint count	≥3	74.4	90.3	7.64	...	...
Symptom checklist	4	40.0	96.8	12.33	...	...

Abbreviation: AUC, area under the curve; FAST3-F, fibromyalgia assessment screening tool cumulative index (includes fatigue, self-report painful joint count, and symptom checklist); FAST3-P, fibromyalgia assessment screening tool cumulative index (includes pain, self-report painful joint count, and symptom checklist); FAST4, fibromyalgia assessment screening tool cumulative index (includes pain, fatigue, self-report painful joint count, and symptom checklist); FM, fibromyalgia; LR+, positive likelihood ratio; MDHAQ, multidimensional health assessment questionnaire; PSD, polysymptomatic distress scale; RADAI, rheumatoid arthritis disease activity index; ROC, receiver operating characteristic; SSS, symptom severity scale; VAS, visual analog scale; WPI, widespread pain index.

[a]MDHAQ-FM-SSS is the sum of fatigue (0-3), problems with thinking/memory (0-2), good night's sleep (0-3.3), headaches (0-1), stomach pain/cramps (0-1), and depression (0-1) scores. MDHAQ-FM-WPI is the RADAI score, which includes the back and neck (0-54) score, divided by 3. MDHAQ-FM-PSD is the sum of the MDHAQ-FM-SSS and MDHAQ-FM-WPI scores.

Three FAST cumulative indices were developed from these MDHAQ scales (Table 4). All include the symptom checklist and self-report painful joint count. FAST3-P adds a pain VAS, FAST3-F adds a fatigue VAS, and FAST4 includes both a pain VAS and fatigue VAS. All 3 FAST indices agreed with the 2011 FM criteria, with a ROC AUC higher than 0.924 ($P = 0.21$, comparing the three indices) (Table 4, Figure 1a).

Correlations of the FAST measures and indices as continuous variables versus the PSD as a continuous variable all were statistically significant and greater than $r = 0.639$ (Table 4). Correlations of MDHAQ-FM indices with PSD were higher than those of individual MDHAQ measures with PSD (Table 4). Correlations of MDHAQ-FAST3-P, MDHAQ-FAST3-F, and MDHAQ-FAST4 of $r = 0.832$-0.854 were almost as high as that of the MDHAQ-PSD with PSD ($r = 0.863$) (Table 4).

Kappa values for these indices were 0.63-0.68 versus the FM 2011 FM criteria, 0.56-0.60 versus the 2016 FM criteria, and 0.41-0.45 versus the ICD-10 diagnosis (Table 5). Agreement with the 2011 FM criteria of greater than 82% was seen (Table 5), indicating similar and robust capacity to screen for FM.

DISCUSSION

The present study extends previous reports that earlier MDHAQ versions provided clues to FM (21,22,46). The continuous MDHAQ-FM-PSD of similar or identical MDHAQ and 2011 FM criteria PSD items identifies FM comparably to the FM criteria, with a ROC AUC of 0.929. The cumulative indices FAST3-P, FAST3-F, and FAST4, which are based on the MDHAQ pain VAS, fatigue VAS, painful joint count, and/or symptom checklist, are more easily scored and associated with ROC AUCs greater than 0.924, virtually identical to the MDHAQ-FM-PSD. FAST3-P and FAST3-F scores of greater than or equal to 2 and FAST4 score greater than or equal to 3 appear to provide the optimal trade-off of sensitivity and specific-

Table 5. Proportions and agreement between the studied indices and three reference standards: the 2011 FM criteria, the 2016 FM criteria, and the physician's diagnosis

	FM 2011 Criteria		FM 2016 Criteria		Physicians' Diagnosis	
FM Criteria Status	Positive	Negative	Positive	Negative	Positive	Negative
MDHAQ-FM-PSD (n = 450)						
Screening positive for FM	101 (66.9%)	50 (33.1%)	87 (57.6%)	64 (42.4%)	74 (49%)	77 (60.1%)
Screening negative for FM	17 (5.7%)	282 (94.3%)	14 (4.7%)	285 (95.3%)	20 (6.7%)	279 (93.3%)
Correctly classified	85.1%		82.7%		78.4%	
Kappa (95% CI)	0.65 (0.57-0.72)		0.58 (0.49-0.66)		0.47 (0.38-0.55)	
FAST3-P (n = 502)						
Screening positive for FM	112 (85.5%)	60 (16.2%)	96 (55.8%)	16 (4.8%)	82 (47.7%)	90 (52.3%)
Screening negative for FM	19 (14.5%)	311 (83.8%)	76 (44.2%)	314 (95.1%)	24 (7.3%)	306 (92.7%)
Correctly classified	84.3%		81.7%		77.3%	
Kappa (95% CI)	0.63 (0.56-0.70)		0.56 (0.48-0.63)		0.45 (0.36-053)	
FAST3-F (n = 464)						
Screening positive for FM	104 (83.2%)	41 (12.1%)	89 (82.4%)	56 (15.7%)	68 (68.7%)	77 (21.1%)
Screening negative for FM	21 (16.8%)	298 (87.9%)	19 (17.6%)	300 (84.3%)	31 (31.3%)	288 (78.9%)
Correctly classified	86.6%		83.8%		76.7%	
Kappa (95% CI)	0.68 (0.60-0.75)		0.60 (0.51-0.68)		0.41 (0.32-0.50)	
FAST4 (n = 464)						
Screening positive for FM	93 (73.8%)	32 (9.5%)	81 (64.3%)	27 (7.9%)	63 (50%)	63 (50%)
Screening negative for FM	33 (26.2%)	306 (90.5%)	45 (35.7%)	311 (92.0%)	36 (10.7%)	302 (89.4%)
Correctly classisfied	85.9%		84.5%		78.7%	
Kappa (95% CI)	0.64 (0.57-0.72)		0.59 (0.50-0.67)		0.42 (0.33-0.52)	

Abbreviation: CI, confidence interval; FAST3-F, fibromyalgia assessment screening tool cumulative index (includes fatigue, self-report painful joint count, and symptom checklist); FAST3-P, fibromyalgia assessment screening tool cumulative index (includes pain, self-report painful joint count, and symptom checklist); FAST4, fibromyalgia assessment screening tool cumulative index (includes pain, fatigue, self-report painful joint count, and symptom checklist); FM, fibromyalgia; MDHAQ, multidimensional health assessment questionnaire; PSD, polysymptomatic distress scale; SSS, symptom severity scale; WPI, widespread pain index.
[a]MDHAQ-FM-PSD is the sum of the MDHAQ-FM-SSS and MDHAQ-FM-WPI scores.

ity for identifying FM in routine clinical practice. Ultimately, interpretation of questionnaire data depends on the clinician's judgment, as it is also true for laboratory and radiographic data.

A FAST on a MDHAQ to screen for FM status can be an advantage in the busy clinical setting, in which distribution of different questionnaires to patients with different diagnoses generally is not feasible. The most successful strategy involves all patients completing the same questionnaire (11). The MDHAQ/RAPID3 is informative in all rheumatic diseases in which it has been studied (23–25). The four-page MDHAQ provides a useful intake questionnaire that includes questions on past illnesses, surgeries, family history, allergies, medications, and demographic data as well as all scales on the two-page version (47). The four-page "new patient" MDHAQ collects RAPID3 and a symptom checklist in new patients prior to a definitive diagnosis and/or in patients who do not have a definitive diagnosis, when they may be useful and when a disease-specific questionnaire cannot be applied (47).

Most quantitative clinical rheumatology measures are designed to address inflammatory activity, with a raison d'être to control inflammation to prevent organ damage. Indices such as the DAS28, CDAI, and RAPID3 function well in selected patients in clinical trials and other clinical research but may be sensitive to organ damage and/or patient distress in routine care. For example, DAS28 = 5.1, CDAI = 26, and RAPID3 = 16, suggests high activity in a patient with no swollen joints (score of 0) and ESR of 10, but a tender joint count of 18, a pain VAS of 8, and a PATGL of 8. One report indicated that nonintensification of therapy according to "treat-to-target" in many patients with a moderate or high DAS28 was explained by recognition of high levels of damage or FM (18).

Many sites have abbreviated the MDHAQ to include only RAPID3 (48), although all reports from the authors of this report concerning RAPID3 have not suggested use without other MDHAQ scales (49). One reason seen in this and earlier reports is that patients with FM have higher RAPID3 scores than patients with other rheumatic diagnoses (23), but other MDHAQ scores may be clues to FM (22). The presence of secondary FM may explain persistently high indices and apparently poor responses to a treat-to-target strategy in RA (17,18).

A full MDHAQ, which includes fatigue, painful joint count, a symptom checklist, recent medical history, etc, is completed

by patients in 5-10 minutes versus 2-5 minutes for RAPID3. The time is the patient's; the process helps the patient prepare for the visit and ultimately saves time for both doctor and patient while improving documentation considerably (11,49).

Several limitations are seen in our study. Only about 30% of questionnaires with complete data were entered into the database because of limited personnel to enter paper questionnaires. However, no selection was applied according to diagnosis or other characteristics. The data came from only one center, which does not specialize in FM, but FM is widespread in all rheumatology care. Similar observations have been made at another site in Australia (46).

The observations appear to be relevant, extending previous reports concerning MDHAQ clues to FM (21,22). Neither the 2011/2016 FM criteria nor any FAST index invariably indicates FM, which is recognized as a spectrum of symptoms (50), because all quantitative data, whether from patient self-report questionnaires, laboratory tests, or any other sources, require interpretation by a knowledgeable physician. A feasible clue to identify FM in routine care appears helpful, particularly in patients with other rheumatic diagnoses, but the ultimate diagnosis depends on the physician's judgment.

In summary, several FAST indices give similar results using 2011 FM criteria as external reference. The FAST3-F may present an advantage of not including a pain VAS, so the three measures in RAPID3 are distinct from the three measures in the FAST3. Further research in larger numbers of patients, including longitudinal analyses, may identify whether a particular FAST index may be more informative than others for providing clues to FM in routine rheumatology care.

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All authors were involved in drafting the article or revising it critically for important intellectual content, and all authors approve the final version to be published. Drs. Schmukler and Castrejon had full access to all of the data and take responsibility for the integrity of the data and the accuracy of the data analysis.

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REFERENCES

1. Wolfe F, Cathey MA. Prevalence of primary and secondary fibrositis. J Rheumatol 1983;10:965–8.
2. Croft P, Rigby AS, Boswell R, Schollum J, Silman A. The prevalence of chronic widespread pain in the general population. J Rheumatol 1993;20:710–3.
3. Wolfe F, Cathey MA, Kleinheksel SM. Fibrositis (fibromyalgia) in rheumatoid arthritis. J Rheumatol 1984;11:814–8.
4. Clauw DJ, Katz P. The overlap between fibromyalgia and inflammatory rheumatic disease: when and why does it occur? [Editorial] J Clin Rheumatol 1995;1:335–42.
5. Yunus MB. The prevalence of fibromyalgia in other chronic pain conditions. Pain Res Treat 2012;2012:584573.
6. Wolfe F, Smythe HA, Yunus MB, Bennett RM, Bombardier C, Goldenberg DL, et al. The American College of Rheumatology 1990 criteria for the classification of fibromyalgia. Report of the Multicenter Criteria Committee. Arthritis Rheum 1990;33:160–72.
7. Wolfe F, Clauw DJ, Fitzcharles MA, Goldenberg DL, Katz RS, Mease P, et al. The American College of Rheumatology preliminary diagnostic criteria for fibromyalgia and measurement of symptom severity. Arthritis Care Res 2010;62:600–10.
8. Wolfe F, Clauw DJ, Fitzcharles MA, Goldenberg DL, Hauser W, Katz RS, et al. Fibromyalgia criteria and severity scales for clinical and epidemiological studies: a modification of the ACR preliminary diagnostic criteria for fibromyalgia. J Rheumatol 2011;38:1113–22.
9. Wolfe F, Clauw DJ, Fitzcharles MA, Goldenberg DL, Hauser W, Katz RL, et al. 2016 Revisions to the 2010/2011 fibromyalgia diagnostic criteria. Seminars Arthritis Rheum 2016;46:319–29.
10. Ablin JN, Wolfe F. A comparative evaluation of the 2011 and 2016 criteria for fibromyalgia. J Rheumatol 2017;44:1271–6.
11. Pincus T, Oliver AM, Bergman MJ. How to collect an MDHAQ to provide rheumatology vital signs (function, pain, global status, and RAPID3 scores) in the infrastructure of rheumatology care, including some misconceptions regarding the MDHAQ. Rheum Dis Clin North Am 2009;35:799–812.
12. Prevoo ML, van 't Hof MA, Kuper HH, van Leeuwen MA, van de Putte LB, van Riel PL. Modified disease activity scores that include twenty-eight-joint counts. Development and validation in a prospective longitudinal study of patients with rheumatoid arthritis. Arthritis Rheum 1995;38:44–8.
13. Aletaha D, Smolen JS. The Simplified Disease Activity Index and Clinical Disease Activity Index to monitor patients in standard clinical care. Rheum Dis Clin North Am 2009;35:759–72.
14. Pincus T, Yazici Y, Bergman MJ. RAPID3, an index to assess and monitor patients with rheumatoid arthritis, without formal joint counts: similar results to DAS28 and CDAI in clinical trials and clinical care. Rheum Dis Clin North Am 2009;35:773–8.
15. Fransen J, van Riel PL. The disease activity score and the EULAR response criteria. Rheum Dis Clin North Am 2009;35:745–57.
16. Pincus T. Can RAPID3, an index without formal joint counts or laboratory tests, serve to guide rheumatologists in tight control of rheumatoid arthritis in usual clinical care? [Review] Bull NYU Hosp Jt Dis 2009;67:254–66.
17. Smolen JS, Aletaha D, Bijlsma JW, Breedveld FC, Boumpas D, Burmester G, et al. Treating rheumatoid arthritis to target: recommendations of an international task force [published errata appear in Ann Rheum Dis 2011;70:1349 and Ann Rheum Dis 2011;70:1519]. Ann Rheum Dis 2010;69:631–7.
18. Tymms K, Zochling J, Scott J, Bird P, Burnet S, de Jager J, et al. Barriers to optimal disease control for rheumatoid arthritis patients with moderate and high disease activity. Arthritis Care Res 2014;66:190–6.
19. Pincus T, Swearingen C, Wolfe F. Toward a multidimensional Health Assessment Questionnaire (MDHAQ): assessment of advanced activities of daily living and psychological status in the patient-friendly health assessment questionnaire format. Arthritis Rheum 1999;42:2220–30.
20. Pincus T, Sokka T, Kautiainen H. Further development of a physical function scale on a MDHAQ [corrected] for standard care of patients with rheumatic diseases [published erratum appears in J Rheumatol 2005;32:2280]. J Rheumatol 2005;32:1432–9.

21. Callahan LF, Pincus T. A clue from a self-report questionnaire to distinguish rheumatoid arthritis from noninflammatory diffuse musculoskeletal pain. The P-VAS:D-ADL ratio. Arthritis Rheum 1990;33:1317–22.
22. DeWalt DA, Reed GW, Pincus T. Further clues to recognition of patients with fibromyalgia from a simple 2-page patient multidimensional health assessment questionnaire (MDHAQ). Clin Exp Rheumatol 2004;22:453–61.
23. Pincus T, Askanase AD, Swearingen CJ. A multi-dimensional health assessment questionnaire (MDHAQ) and routine assessment of patient index data (RAPID3) scores are informative in patients with all rheumatic diseases. Rheum Dis Clin North Am 2009;35:819–27.
24. Castrejon I. The Use of MDHAQ/RAPID3 in different rheumatic diseases a review of the literature. Bull Hosp Jt Dis (2013) 2017;75:93–100.
25. Castrejon I, Bergman MJ, Pincus T. MDHAQ/RAPID3 to recognize improvement over 2 months in usual care of patients with osteoarthritis, systemic lupus erythematosus, spondyloarthropathy, and gout, as well as rheumatoid arthritis. J Clin Rheumatol 2013;19:169–74.
26. Askanase AD, Castrejon I, Pincus T. Quantitative data for care of patients with systemic lupus erythematosus in usual clinical settings: a patient Multidimensional Health Assessment Questionnaire and physician estimate of noninflammatory symptoms. J Rheumatol 2011;38:1309–16.
27. Castrejon I, Pincus T, Wendling D, Dougados M. Responsiveness of a simple RAPID-3-like index compared to disease-specific BASDAI and ASDAS indices in patients with axial spondyloarthritis. RMD Open 2016;2:e000235.
28. Danve A, Reddy A, Vakil-Gilani K, Garg N, Dinno A, Deodhar A. Routine Assessment of Patient Index Data 3 score (RAPID3) correlates well with Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) in the assessment of disease activity and monitoring progression of axial spondyloarthritis. Clinical Rheumatol 2015;34:117–24.
29. Cinar M, Yilmaz S, Cinar FI, Koca SS, Erdem H, Pay S, et al. A patient-reported outcome measures-based composite index (RAPID3) for the assessment of disease activity in ankylosing spondylitis. Rheumatol Int 2015;35:1575–80.
30. Park SH, Choe JY, Kim SK, Lee H, Castrejon I, Pincus T. Routine Assessment of Patient Index Data (RAPID3) and Bath Ankylosing Spondylitis Disease Activity Index (BASDAI) scores yield similar information in 85 Korean patients with ankylosing spondylitis seen in usual clinical care. J Clin Rheumatol 2015;21:300–4.
31. Coates LC, Tillett W, Shaddick G, Pincus T, Kavanaugh A, Helliwell PS. Value of the routine assessment of patient index data 3 in patients with psoriatic arthritis: results from a tight-control clinical trial and an observational cohort. Arthritis Care Res (Hoboken) 2018;70:1198–205.
32. Annapureddy N, Elsallabi O, Baker J, Sreih AG. Patient-reported outcomes in ANCA-associated vasculitis. A comparison between Birmingham Vasculitis Activity Score and routine assessment of patient index data 3. Clinical Rheumatol 2015;35:395–400.
33. Castrejon I, Huang A, Everakes SL, Nika A, Sequeira W. Clinical improvement according to RAPID3 in patients with polymyalgia rheumatica: a longitudinal analysis from routine care. J Clin Rheumatol 2018;24:390–2.
34. Stucki G, Liang MH, Stucki S, Bruhlmann P, Michel BA. A self-administered rheumatoid arthritis disease activity index (RADAI) for epidemiologic research. Psychometric properties and correlation with parameters of disease activity. Arthritis Rheum 1995;38:795–8.
35. Pincus T. Is a self-report RAPID3 score a reasonable alternative to a DAS28 in usual clinical care? [Editorial]. J Clin Rheumatol 2009;15:215–7.
36. el-Haddad C, Castrejon I, Gibson KA, Yazici Y, Bergman M, Pincus T. MDHAQ/RAPID3 scores in patients with osteoarthritis are similar to or higher than in patients with rheumatoid arthritis: a cross-sectional study from current routine rheumatology care at four sites. RMD Open 2017;3:e000391.
37. Pincus T, Castrejon I. Are patient self-report questionnaires as "scientific" as biomarkers in "treat-to-target" and prognosis in rheumatoid arthritis? [Review] Curr Pharm Des 2015;21:241–56.
38. Wolfe F, Walitt BT, Rasker JJ, Katz RS, Hauser W. The use of polysymptomatic distress categories in the evaluation of fibromyalgia (FM) and FM severity. J Rheumatol 2015;42:1494–501.
39. Fries JF, Spitz P, Kraines RG, Holman HR. Measurement of patient outcome in arthritis. Arthritis Rheum 1980;23:137–45.
40. Pincus T, Maclean R, Yazici Y, Harrington JT. Quantitative measurement of patient status in the regular care of patients with rheumatic diseases over 25 years as a continuous quality improvement activity, rather than traditional research. Clin Exp Rheumatol 2007;25 Suppl 47:69–81.
41. Pincus T, Swearingen CJ, Bergman MJ, Colglazier CL, Kaell AT, Kunath AM, et al. RAPID3 (Routine Assessment of Patient Index Data) on an MDHAQ (Multidimensional Health Assessment Questionnaire): agreement with DAS28 (Disease Activity Score) and CDAI (Clinical Disease Activity Index) activity categories, scored in five versus more than ninety seconds. Arthritis Care Res (Hoboken) 2010;62:181–9.
42. Pincus T, Bergman MJ, Yazici Y. RAPID3-an index of physical function, pain, and global status as "vital signs" to improve care for people with chronic rheumatic diseases. Bull NYU Hosp Jt Dis 2009;67:211–25.
43. Landis JR, Koch GG. The measurement of observer agreement for categorical data. Biometrics 1977;33:159–74.
44. Sokka T, Toloza S, Cutolo M, Kautiainen H, Makinen H, Gogus F, et al. Women, men, and rheumatoid arthritis: analyses of disease activity, disease characteristics, and treatments in the QUEST-RA study. Arthritis Res Ther 2009;11:R7.
45. McCollum L, Pincus T. A biopsychosocial model to complement a biomedical model: patient questionnaire data and socioeconomic status usually are more significant than laboratory tests and imaging studies in prognosis of rheumatoid arthritis. Rheum Dis Clin North Am 2009;35:699–712.
46. Gibson K, Castrejon I, Pincus T, Bryant KJ. Recognition of secondary fibromyalgia using an index of 3 components of the multidimensional health assessment questionnaire: 90% agreement with ACR criteria for fibromyalgia. Arthritis Rheumatol 2016;68(suppl 10).
47. Pincus T, Swearingen CJ. The HAQ compared with the MDHAQ: "keep it simple, stupid" (KISS), with feasibility and clinical value as primary criteria for patient questionnaires in usual clinical care. Rheum Dis Clin North Am 2009;35: 787–798.
48. Curtis JR, Chen L, Danila MI, Saag KG, Parham KL, Cush JJ. Routine use of quantitative disease activity measurements among US rheumatologists: implications for treat-to-target management strategies in rheumatoid arthritis. J Rheumatol 2018;45:40–4.
49. Pincus T, Skummer PT, Grisanti MT, Castrejon I, Yazici Y. MDHAQ/RAPID3 can provide a roadmap or agenda for all rheumatology visits when the entire MDHAQ is completed at all patient visits and reviewed by the doctor before the encounter. Bull NYU Hosp Jt Dis 2012;70:177–86.
50. Wolfe F, Walitt BT, Hauser W. What is fibromyalgia, how is it diagnosed, and what does it really mean? [Editorial]. Arthritis Care Res 2014;66:969–71.