



Development and evaluation of a
crosswalk between Health Assessment Questionnaire
Disability index and SF-36 physical functioning scale in
rheumatoid arthritis

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Introduction

- Multitude of measures for a single domain
 - 26 physical function questionnaires in RA*

- Barrier to the interpretation of study results

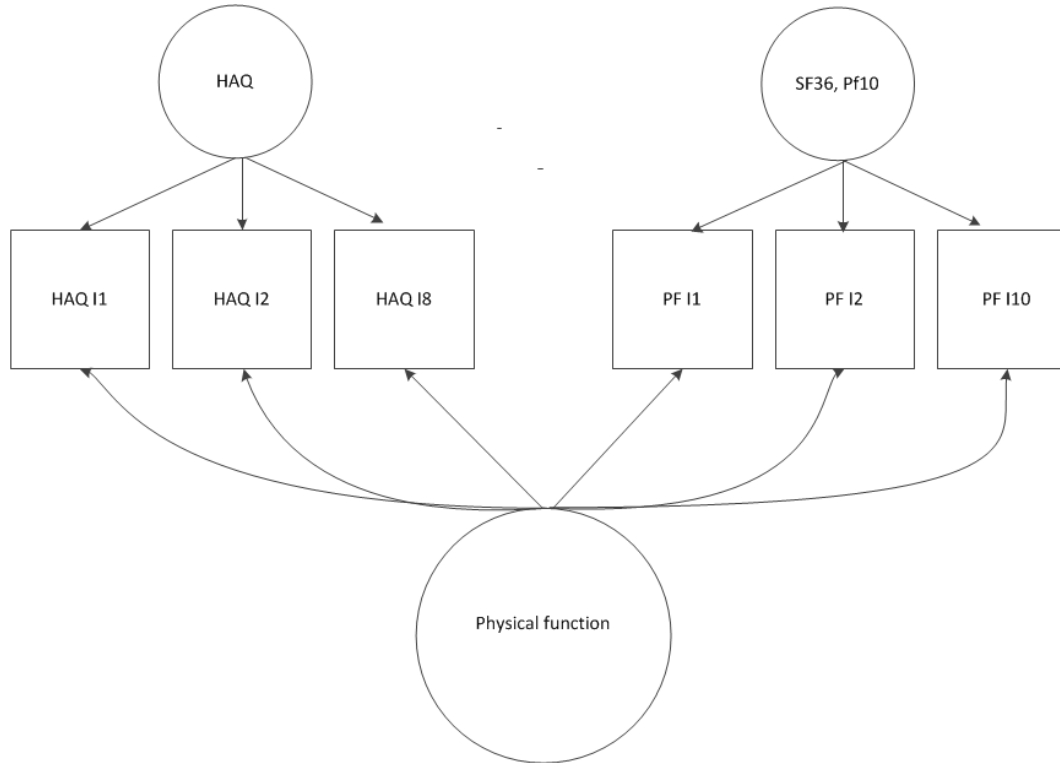
- Health Assessment Questionnaire Disability Index
 - 20 items
 - 0 (without any difficulty) – 3 (Unable to do)
 - Total score: 0-3; Higher scores indicate more disability

- SF-36 Physical functioning scale
 - 10 items
 - 1 (Yes, limited a lot) – (3 No, not limited at all)
 - Total score: 0-100, Higher scores indicate better functioning

*Oude Voshaar MA, Ten Klooster PM, Taal E, van de Laar MA. Measurement properties of physical function scales validated for use in patients with rheumatoid arthritis: A systematic review of the literature. Health Qual Life Outcomes. 2011;9:99.



Basic process of developing an IRT-based crosswalk



'Concurrent item calibration'



Basic process of developing an IRT-based crosswalk

PF-10 score	N	Rasch model	HAQ score	N	Rasch model
		EAP			EAP
100	50	-4.36	0.000	236	-3.48
95	89	-3.42	0.125	109	-2.46
90	107	-2.70	0.250	109	-1.78
85	87	-2.24	0.375	124	-1.16
80	87	-1.82	0.500	108	-0.80
75	94	-1.27	0.625	105	-0.52
70	109	-0.88	0.750	117	-0.05
65	113	-0.68	0.875	116	0.44
60	85	-0.39	1.000	122	0.67
55	84	0.11	1.125	113	0.78
50	127	0.53	1.250	85	0.99
45	86	0.72	1.375	97	1.44
40	102	0.89	1.500	67	1.92
35	86	1.26	1.625	71	2.13
30	92	1.79	1.750	46	2.20
25	82	2.13	1.875	35	2.27
20	81	2.36	2.000	37	2.44
15	54	2.80	2.125	36	2.89
10	36	3.40	2.250	34	3.38
5	39	3.90	2.375	14	3.63
0	26	4.80	2.500	14	3.77
			2.625	12	4.05
			2.750	11	4.61
			2.875	6	5.24
			3.000	1	6.00

'Concurrent item calibration'

Instrument specific test characteristic curves/score tables





Basic process of developing an IRT-based crosswalk

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Summed score linking*

*Orlando M, Sherbourne CD, Thissen D. Summed-score linking using item response theory: Application to depression measurement. Psychological Assessment. 2000;12(3):354.





Cross-walking within the framework of IRT: Equating

Rasch model: Summed score is a sufficient statistic for the trait level

Therefore: Scores can be converted directly via the latent metric

Statistical equating error is a function of the reliability of the two instruments (i.e. the reliability with which trait levels can be estimated using either instrument)





Cross-walking within the framework of IRT: Linking

Two parameter models: discrimination parameter differentially weighs relationship of individual items with latent trait

Therefore: Trait levels associated with observed sum scores vary to some degree (depending on the specific response pattern)

Second source of equating error: variability of trait levels given observed score

Trait levels associated with total score levels now have to be estimated





Cross-walking within the framework of IRT: Further generalization of the linking approach

Two instruments measure different yet highly correlated constructs

Two-dimensional IRT model where the responses pertain to instrument specific latent dimensions

Third source of equating error related to the correlation between the latent variables



Methods

- Baseline data DREAM registry
- HAQ-ADI & SF-36 Pf-10 data jointly calibrated
- 3 crosswalks developed and evaluated
 - Model fit (item level LM statistics*)
 - Precision (ICC, two-way mixed effects model with absolute agreement for single measurements (type A,1))
- Cross-validation in US NDB data
 - Rheumatoid arthritis
 - Systemic lupus erythematosus
 - Fibromyalgia

*Glas CA. Modification indices for the 2-PL and the nominal response model. Psychometrika. 1999;64(3):273-94.

Patient characteristics of the calibration sample

	Calibration sample (n=1791)
Sex, % female	69.2
Age in years, mean (SD)	56.54 (13.31)
HAQ-SDI (0-3), mean (SD)*	1.08 (0.71)
PF-10 (0-100), mean (SD)	53.89 (26.35)
DAS28, mean (SD)*	4.28 (1.51)
VAS Pain (0-100), mean (SD)*	43.38 (26.23)
VAS General Health (0-100), mean (SD)*	44.49 (26.48)



Model fit: Rasch model

	β_1 (SD)	β_2 (SD)	β_3 (SD)	L.M.	p	E.S.
Dressing	-0.25 (0.05)	1.54 (0.06)	4.26 (0.12)	7.03	0.03	0.03
Rising	-0.06 (0.05)	1.94 (0.06)	6.68 (0.28)	9.02	0.01	0.03
Eating	-1.13 (0.06)	1.29 (0.05)	3.27 (0.08)	7.86	0.02	0.03
Walking	0.00 (0.05)	1.62 (0.06)	4.01 (0.11)	7.58	0.02	0.05
Hygiene	-0.48 (0.06)	-0.50 (0.05)	2.53 (0.06)	11.84	0.00	0.06
Reaching	-0.73 (0.06)	0.97 (0.05)	3.33 (0.08)	3.40	0.18	0.02
Grasping	-0.74 (0.06)	-0.89 (0.05)	3.72 (0.08)	11.41	0.00	0.05
Activities	-1.55 (0.06)	0.13 (0.05)	2.84 (0.08)	3.12	0.21	0.03
Vigorous activities	-3.94 (0.09)	-1.23 (0.05)		24.69	0.00	0.04
Moderate activities	-2.20 (0.07)	1.68 (0.05)		7.01	0.03	0.02
Lifting or carrying groceries	-2.17 (0.07)	1.44 (0.05)		5.54	0.06	0.02
Climbing several flights of stairs	-1.06 (0.06)	1.55 (0.06)		8.92	0.01	0.03
Climbing one flight of stairs	-0.17 (0.06)	2.85 (0.07)		18.63	0.00	0.03
Bending, kneeling or stooping	-2.02 (0.06)	1.18 (0.05)		5.15	0.08	0.03
Walking more than a mile	-0.97 (0.05)	0.94 (0.06)		3.26	0.20	0.03
Walking several blocks	0.13 (0.07)	2.36 (0.08)		100.71	0.00	0.07
Walking one block	0.71 (0.06)	3.12 (0.09)		24.39	0.00	0.03
Bathing and dressing self	0.28 (0.05)	3.94 (0.09)		1.26	0.53	0.01

Relative precision: Intraclass correlation coefficient (95% ci)

	Rasch model	Two-parameter model	Multi-dimensional model
Precision of predicted HAQ-ADI scores	0.737 (0.714 to 0.758)	0.739 (0.716 to 0.760)	0.737 (0.715 to 0.759)
Precision of predicted PF-10 scores	0.738 (0.716 to 0.759)	0.736 (0.714 to 0.758)	0.744 (0.721 to 0.764)





Crosswalk

HAQ alternative disability index (ADI)			
Observed HAQ-ADI score	Predicted PF-10 score	Observed PF-10 score	Predicted HAQ-ADI score
0.000	95	100	0.000
0.125	90	95	0.000
0.250	80	90	0.125
0.375	75	85	0.125
0.500	70	80	0.250
0.625	65	75	0.375
0.750	60	70	0.500
0.875	50	65	0.625
1.000	45	60	0.625
1.125	45	55	0.875
1.250	40	50	0.875
1.375	35	45	1.000
1.500	30	40	1.250
1.625	25	35	1.375
1.750	20	30	1.500
1.875	20	25	1.625
2.000	20	20	1.875
2.125	15	15	2.125
2.250	10	10	2.250
2.375	10	5	2.625
2.500	5	0	2.750
2.625	5		
2.750	0		
2.875	0		
3.000	0		





Patient characteristics National Data bank rheumatic diseases

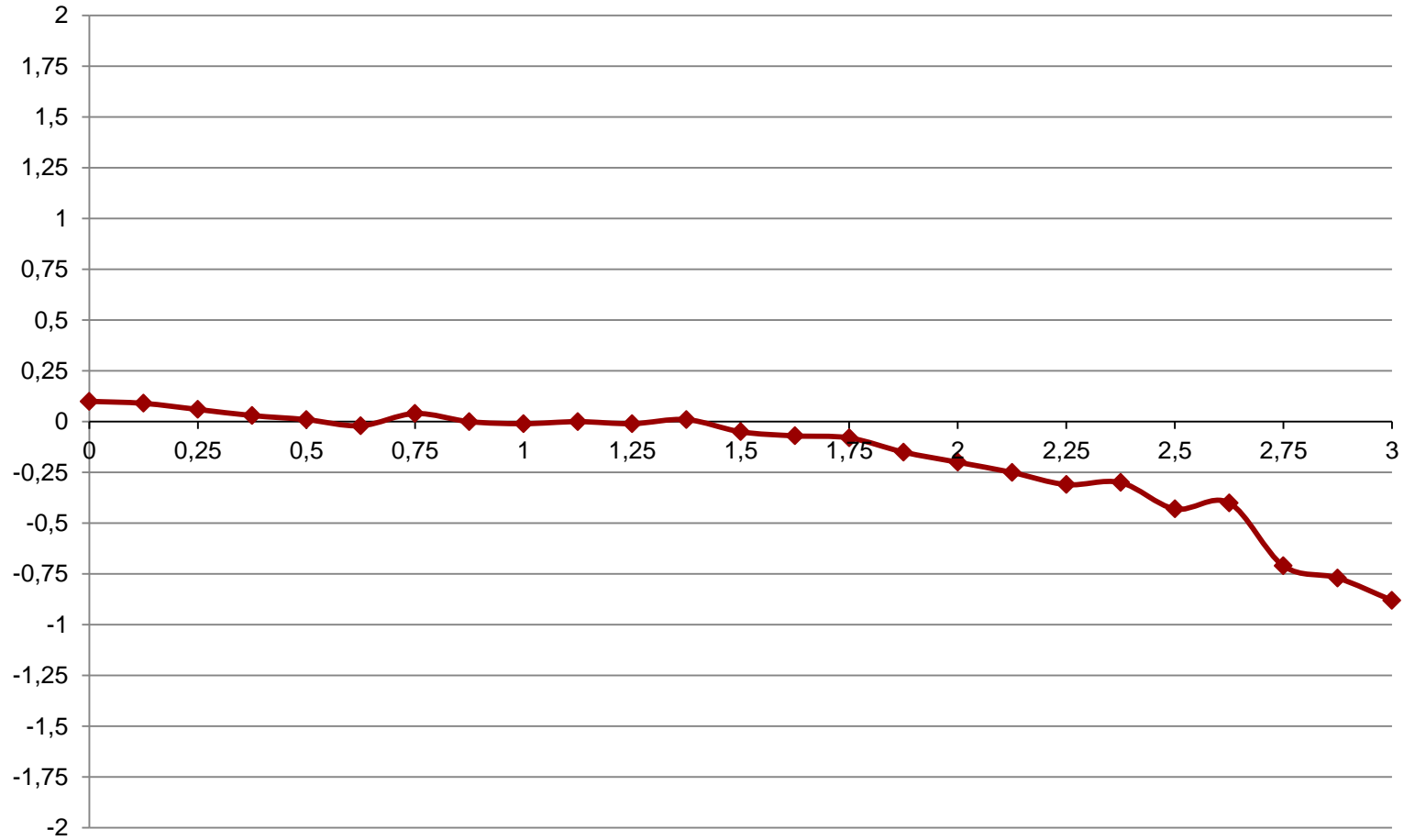
	FM (n= 3776)	SLE (n=1609)	RA (n=29020)
Age (SD)	53.44 (12.25)	47.55 (13.23)	58.15 (13.65)
Disease duration, years (SD)	13.20 (10.38)	13.45 (10.33)	12.28 (10.91)
Sex, % female	94.2%	88%	77%
PCS (SD)	31.69 (8.96)	37.20 (11.35)	36.06 (10.79)
MCS (SD)	41.29 (12.31)	44.31 (11.66)	48.15 (11.65)
HAQ-ADI (SD)	0.95 (0.62)	0.58 (0.59)	0.84 (0.69)
PF-10 (SD)	50.56 (26.86)	65.25 9(29.28)	59.20 (28.81)

Precision Rasch Crosswalk in NDB data

	ICC (95% CI)	Mean difference (SD)	LOA (SD)
RA			
HAQ-ADI	0.77 (0.76 to 0.77)	0.01 (0.49)	-0.95 to 0.97
PF-10	0.78 (0.77 to 0.78)	1.03 (18.54)	-35.30 to 37.37
FM			
HAQ-ADI	0.72 (0.69 to 0.74)	-0.09 (0.51)	-1.00 to 0.91
PF-10	0.73 (0.71 to 0.75)	-2.53 (18.64)	-39.06 to 34.00
SLE			
HAQ-ADI	0.76 (0.73 to 0.79)	-0.11 (0.46)	-1.01 to 0.79
PF-10	0.78 (0.75 to 0.80)	-3.28 (17.92)	-38.40 to 31.84



Precision across total HAQ-ADI score levels





Thank you for your attention

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The logo graphic for Reumafonds, consisting of a dark red curved line that forms a partial circle around the text.
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