Identification of similarities and differences in functioning in persons with rheumatoid arthritis and ankylosing spondylitis using the International Classification of Functioning, Disability and Health (ICF)

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ABSTRACT

Objective. *The objective of this study is to identify similarities and differences in functioning in AS and RA using the ICF as the framework for the description of functioning.*

Methods. *The Comprehensive ICF Core Sets for RA and AS were compared qualitatively regarding their content. A comparison study of common second-level ICF categories from both ICF Core Sets collected in two different cross-sectional studies in the Netherlands was performed. Significant differences regarding the level of impairments, limitations or restrictions were analyzed within the Mann-Whitney U-Test. To study whether the common ICF categories have different meaning for the two populations the Rasch model for dichotomous response option was used.*

Results. *The Comprehensive ICF Core Set for AS includes 74 ICF categories in 19 chapters and the Comprehensive ICF Core Set for RA includes 96 ICF categories in 22 chapters. Interviews among 87 patients with AS and 143 patients with RA on 24 of the common ICF categories revealed significant differences regarding the extent of problems. DIF analyses reflect that the meaning of some ICF categories, such as 'd410 Changing basic body positions' is different in relation to functioning depending on the health condition.*

Conclusion. *This study was the first to compare functioning in AS and RA based on the ICF. The results confirmed to a large extend the experiences well known from other studies and thereby showed that the ICF is useful to describe and compare functioning. Some aspects could be identified which are not easy to understand with existing evidence and need to be explained in the future.*

Introduction

Ankylosing spondylitis (AS) and rheumatoid arthritis (RA) are two of the major types of inflammatory rheumatic diseases that primarily cause impairments in the joints. Whereas the axial skeleton is predominantly affected in AS (1), the peripheral joints are most frequently impaired in RA (2). In addition, inflammation of other organs add burden and increase the risk for secondary conditions (3, 4).

Aspects of health related quality of life (HR-QoL) in both diseases that are mainly impaired when compared to the general population relate to pain, decreased physical functioning and role limitation (5, 6).

The functioning status of patients is one significant prognostic measure for long-term outcomes, including mortality (7). Both diseases result in increased mortality rates in comparison with the normal population (8, 9). More important than the shorter life expectancy, the usually long duration of disease processes in AS and RA contributes to limitations in functioning across all areas from impairments in body functions and body structures, to limitations and restrictions in activities and participation (10, 11).

Although both diseases share the impact on the same large areas of functioning, there are important differences in the more specific type and level of impact. For this reason, disease specific measures such as the Bath Ankylosing Spondylitis Functional Index (BASFI) (12), the Dougados Functional Index (DFI) (13), the Health Assessment Questionnaire modified for spondylarthropathies (HAQ-S) (14), the Revised Leeds Disability Questionnaire (RDLQ) (15) and the ASQoL (16) for AS, and the Health Assessment Questionnaire (HAQ) (17),

the Arthritis Impact Measurement Scales (AIMS) (18), and the McMaster Toronto Arthritis Patient Preference Disability Questionnaire (MACTAR) (19, 20) and the RAQoL (21) for RA are available to assess functioning and health. Importantly, none of these instruments allow comparisons across diseases. Eventually for this reason differences between the level of functioning in persons with AS and RA have not been investigated extensively in a quantitative (or systematic) manner. Some studies address specific differences in the *level of functioning* between AS and RA such as activities of daily living (25), employment (26) or quality of life (5, 27) using generic measures. However, generic measures which allow comparison across diseases have proven useful (22-24), but they do not address functioning comprehensively and are not based on a theoretical framework to assess functioning.

Followed by the approval of the International Classification of Functioning, Disability and Health (ICF) (29) by the World Health Assembly in 2001 ICF Core Sets for AS (30) and RA (31) have been developed. These disease oriented Brief and Comprehensive ICF Core Sets list ICF categories from the components of body functions, body structures, activities and participation and environmental factors (32). While Brief ICF Core Sets serve as practical tools for single encounters, minimum data sets for the reporting of clinical and epidemiological studies and health statistics, the Comprehensive ICF Core Sets are intended for use in multidisciplinary settings (33).

In rehabilitation management, but also in research, ICF Core Sets serve as a guide to comprehensively assess and describe functioning and, hence, they contribute to the total understanding of functioning and health. Considering the large number of ICF categories included in a Comprehensive ICF Core Set, the responsibility for the description of functioning in specific ICF categories will be distributed to different team members (34).

Furthermore, the ICF provides a standardized language and classification of functioning which can be used for comparison of functioning across health conditions (35). The extent of problems in single ICF categories can be rated within the ICF Qualifiers. Hence, comparison of the content of ICF Core Sets and the extent of problems in ICF categories may facilitate the identification of similarities and differences in functioning between health conditions (36, 37).

Objective

The objective of this study is to identify similarities and differences in functioning in AS and RA using the specific ICF Core Sets for each health condition. The specific aims are (1) to compare *aspects* of functioning impaired in both diseases by relating the content of the Comprehensive ICF Core Sets for AS and RA, (2) to analyze whether significant differences exist regarding the *level* of impairment, limitation or restriction in the ICF categories that are common in both ICF Core Sets, and (3) to study whether the common ICF categories have *different meaning* for the two different populations.

Material and methods

To compare aspects of functioning relevant for patients, the Comprehensive Core Sets of AS and RA were used. ICF Core Sets include chapters and ICF categories listed in a hierarchical order, shown in the following example:

Chapter level	b2 Sensory functions and pain
Second-level category	b280 Sensation of pain
Third-level category	b2801 Pain in body part
Fourth-level category	b28010 Pain in head and neck
	b28011 Pain in chest
	b28013 Pain in back

To compare the level of impairments across categories and the importance of the category for the total level of functioning, data collected from populations in two different cross-sectional studies with convenience samples of persons with AS and RA, respectively were analysed. In both studies, the data were collected at the University Hospital Maastricht, the Netherlands. Specific details of both studies have been published previously (38).

In AS, the *extended* ICF checklist for AS (38) was used to assess functioning. The extended ICF checklist for AS includes ICF categories from the ICF checklist (39) and additional ICF categories specific to this health condition, which were identified after the content comparison between AS-specific instruments and the ICF. The extended ICF checklist for AS includes a total of 165 ICF categories, but does not include all ICF categories from the Comprehensive ICF Core Set for AS and contains several categories not selected in the final Comprehensive ICF Core Set. In RA, the data collection was performed within the Comprehensive ICF Core Set for RA, which includes a total of 96 ICF categories (31).

The assessment of functioning based on the ICF in both studies involved the rating of ICF categories with the ICF qualifiers that describe the extent of a problem. ICF Qualifiers range from '0=no impairment, limitation or restriction' to '4=complete impairment, limitation or restriction'. In environmental factors, ICF Qualifiers range from '+4=complete facilitator' to '-4=complete barrier'. ICF Qualifier '8=not specified' is being used if the available information is not sufficient to quantify the extent of the problem. If an ICF category is not applicable to the specific patient, the ICF Qualifier '9=not applicable' is assigned.

The common second-level ICF categories from both ICF Core Sets have been selected for this study.

Data analysis

Descriptive statistics were used to define the study population. The content of the Comprehensive ICF Core Sets for AS and RA is compared qualitatively using the hierarchical structure of the ICF and using descriptive statistics.

To identify significant differences regarding the level of impairments, limitations or restrictions the Mann-Whitney U-Test was performed for each ICF category. In the environmental factors the ICF Qualifiers 1 to 4 and -1 to -4 were collapsed to 1 and -1 to present facilitators or barriers only in general. For the analysis SPSS was used.

To study whether the common ICF categories have different meaning for the

two populations the Rasch model for dichotomous response options was used. The analysis was performed in ICF categories from body functions, body structures, and activity and participation, building one latent construct named 'functioning'. The response categories of the items (ICF categories for this investigation) were dichotomized into 0 (no impairment, limitation or restriction) or 1 (having an impairment, limitation or restriction). The estimate and the corresponding quotient of the differential item functioning (DIF) for each of the ICF categories were calculated. A quotient >2 is considered as DIF. DIF occurs when persons from different groups (heath conditions) with the same level of functioning have a different probability of giving a certain response on an ICF category. For example, persons with AS and low levels of functioning, and persons with RA and high level of functioning, report similar impairment in a determined ICF Category. This indicates that the meaning of this category differs between the both groups, irrespectively of differences in their level of functioning. For the Rasch analysis the Conquest software was used (40).

Results

Comparison of aspects typical and relevant for functioning

Table Ia, b and c show the comparison of ICF categories included in the Comprehensive ICF Core Sets for RA and AS. While the Comprehensive ICF Core Set for AS includes 74 ICF categories presented in 19 chapters the Comprehensive ICF Core Set for RA includes 96 ICF categories represented in 22 chapters. The ICF Core Set for AS includes two chapters, namely '*e3 Support and relationships'* and '*e4 Attitudes'*, which include all second-level ICF categories from these chapters. The ICF Core Set for RA includes an assortment of the more specific second-level ICF categories from these chapters. In the comparison these second-level ICF categories were judged as common ICF categories in both ICF Core Sets.

Eighteen chapters are common in both ICF Core Sets. Fifty-three second-level, one third-level and six fourth-level categories are the same (50%). In

Table Ia. Content comparison of Comprehensive and Brief ICF Core Sets for AS and RA: Body functions and body structures.

BODY FUNCTIONS						59%
1st level	2nd level	3rd level		AS	RA	Agreement on 2nd level
b1 Mental functions						75%
b130			**Energy and drive functions**	**X***	**X**	
	b1300°		Energy level	X		
	b1301°		Motivation	X		
b134			**Sleep functions**	**X***	**X***	
b152			**Emotional functions**	**X***	**X**	
b180			Experience of self and time functions		X	
	b1801		Body image		X	
b2 Sensory functions and Pain						50%
b210			Seeing functions	X		
	b2108		Seeing functions, other specified	X		
b280			**Sensation of pain**	**X***	**X***	
	b2800°		Generalized pain		X	
	b2801°		Pain in body part		X	
		b28010	**Pain in head and neck**	**X**	**X**	
		b28011°	Pain in chest	X		
		b28013	**Pain in back**	**X**	**X**	
		b28014	**Pain in upper limb**	**X**	**X**	
		b28015	**Pain in lower limb**	**X**	**X**	
		b28016	**Pain in joints**	**X**	**X**	
b4 Functions of the Cardiovascular, Haematological, Immunological and Respiratory Systems						0.33%
b430			Haematological system functions		X	
b440			Respiration functions	X		
	b4402		Depth of respiration	X		
b455			**Exercise tolerance functions**	**X***	**X***	
b5 Functions of the Digestive, Metabolic and Endocrine System						0%
b510			Ingestion functions		X	
b6 Genitourinary and reproductive functions						100%
b640			**Sexual functions**	**X**	**X**	
b7 Neuromusculoskeletal and movement related functions						67%
b710			**Mobility of joint functions**	**X***	**X***	
	b7102°		Mobility of joints generalized		X	
b715			Stability of joint functions		X	
b730			Muscle power functions		X*	
b740			**Muscle endurance functions**	**X**	**X***	
b770			**Gait pattern functions**	**X**	**X***	
b780			**Sensations related to muscles and movement functions**	**X***	**X***	
	b7800°		Sensation of muscle stiffness		X	
BODY STRUCTURES						36%
s2 The eye, ear and related structures						0%
s220			Structure of eyeball	X		
	s2202		Iris	X		
s299			Eye, ear and related structures, unspecified		X*	
s4 Structures of the cardiovascular, immunological and respiratory system						0%
s430			Structure of respiratory system	X		
	s4302		Thoracic cage	X		
s7 Structures related to movement						57%
s710			Structure of head and neck region		X*	
s720			**Structure of shoulder region**	**X**	**X***	
s730			Structure of upper extremity		X*	
		s73001	Elbow joint		X	
		s73011	Wrist joint		X	
	s7302		Structure of hand		X	
		s73021	Joints of hand and fingers		X	
		s73022	Muscles of hand		X	
s740			Structure of pelvic region	X*		
s750			**Structure of lower extremity**	**X***	**X***	
		s75001°	Hip joint		X	
		s75011°	Knee joint		X	
	s7502°		Structure of ankle and foot		X	
		s75021°	Ankle joint and joints of foot and toes	X		
s760			**Structure of trunk**	**X***	**X***	
	s7600		**Structure of vertebral column**	**X**	**X**	
		s76000	**Cervical vertebral column**	**X**	**X**	
s770			**Additional musculoskeletal structures** related to movement	**X***	**X**	
	s7700°		Bones	X		
	s7702°		Muscles	X		
	s7703°		Extra-articular ligaments, fasciae, extramuscular aponeuroses, retinacula, septa, bursae, unspecified	X		
s8 Skin and related structures						0%
s810			Structure of areas of skin		X*	

Bold letters: Common ICF chapters/categories in AS and RA; * ICF categories included in the Brief ICF Core Set; ° Disease specific ICF category covered by a common second-level category.

Table Ib. Content comparison of Comprehensive and Brief ICF Core Sets for AS and RA: activity and participation.

ACTIVITY AND PARTICIPATION				60%
2nd level		AS	RA	Agreement on 2nd level
d1 Learning and applying knowledge				0%
d170	Writing		X	
d2 Gerenal tasks and demands				50%
d230	**Carrying out daily routine**	**X***	**X***	
d240	Handling stress and other psychological demands	X		
d3 Communication				0%
d360	Using communication devices and techniques		X	
d4 Mobility				58%
d410	**Changing basic body position**	**X***	**X***	
d415	**Maintaining a body position**	**X**	**X**	
d430	**Lifting and carrying objects**	**X**	**X***	
d440	Fine hand use		X*	
d445	Hand and arm use		X*	
d449	Carrying, moving and handling objects, other specified and unspecified		X	
d450	**Walking**	**X***	**X***	
d455	**Moving around**	**X**	**X**	
d460	Moving around in different locations		X	
d465	Moving around using equipment		X	
d470	**Using transportation**	**X**	**X***	
d475	**Driving**	**X***	**X**	
d5 Self-care				71%
d510	**Washing oneself**	**X**	**X***	
d520	**Caring for body parts**	**X**	**X**	
d530	**Toileting**	**X**	**X**	
d540	**Dressing**	**X**	**X***	
d550	Eating		X*	
d560	Drinking		X	
d570	**Looking after one's health**	**X**	**X**	
d6 Domestic life				75%
d620	**Acquisition of goods and services**	**X**	**X**	
d630	Preparing meals		X	
d640	**Doing housework**	**X**	**X**	
d660	**Assisting others**	**X**	**X**	
d7 Interpersonal interactions and relationships				100%
d760	**Family relationships**	**X***	**X**	
d770	**Intimate relationships**	**X**	**X***	
d8 Major life areas				25%
d845	Acquiring, keeping and terminating a job	X*		
d850	**Remunerative employment**	**X***	**X***	
d859	Work and employment, other specified and unspecified		X*	
d870	Economic self-sufficiency	X		
d9 Community, social and civic life				100%
d910	**Community life**	**X**	**X**	
d920	**Recreation and leisure**	**X***	**X***	

Bold letters: Common ICF chapters/categories in AS and RA; * ICF categories included in the Brief ICF Core Set; ° disease specific ICF category covered by a common second-level category.

addition, in AS eight and in RA seven disease-specific third and fourth-level categories are covered by a common second-level category.

Body functions and body structures (Table Ia)

Five of six chapters and ten of 17 second-level categories (59%) in body functions are common in AS and RA. In body structures, only one chapter but four of 11 second-level categories (36%) are common in AS and RA. Fifty percent or more of the ICF categories of chapter '*b1 Mental functions'*, '*b2 Sensory functions and pain'*, '*b6 Genitourinary and reproductive functions*', '*b7 Neuromusculoskeletal and movement related functions*', and '*s7 Structures related to movement'* are common. Differences related to disease-specific problems in body functions and body structures are presented in AS within the ICF categories '*b210 Seeing functions*', '*b440 Respiration functions'*, '*s220 Structure of the eyeball'* and '*s430 Structure of the respiratory system'* and in RA within the ICF categories '*b180 Experience of self and time functions*', '*b430 Haematological system functions'*, '*b510 Ingestion functions'*, '*s710 Structure of head and neck region'*, '*s730 Structure of upper extremity'*, '*s740 Structure of pelvic region'*, and '*s810 Structure of areas of skin'*.

Activity and participation (Table Ib)

Seven of nine chapters, and 21 of 35 second-level categories (60%) are common in both ICF Core Sets. Fifty percent or more of the ICF categories of chapter '*d2 General tasks and demands'*, '*d4 Mobility'*, '*d5 Self-care'*, '*d7 Interpersonal interactions and relationships*', and '*d9 Community, social and civic life'* are common. Differences related to disease-specific problems in activity and participation are presented mainly in RA within ICF categories related to hand and arm function, such as '*d170 Writing'*, '*d360 Using communication devices and techniques'*, '*d440 Fine hand use'*, '*d445 Hand and arm use'*, '*d550 Eating'*, '*d560 Drinking'*, and '*d630 Preparing meals'*. In AS, the disease-specific ICF categories are related to work, such as '*d845 Acquiring, keeping and terminating a job'* and '*d870 Economic self-sufficiency'*.

Environmental factors (Table Ic)

Four of five chapters and 18 of 25 second-level categories (72%) in environmental factors are common in AS and RA. Fifty percent or more of ICF categories are common in all of the common chapters. Differences related to disease-specific problems in the environmental factors are presented in AS within ICF categories related to services and systems, such as '*e575 General social support services, systems and policies'* and '*e590 Labour and employment services, systems and policies*'. The disease-specific ICF categories in RA are related to products and technology such as *'e125 Products and technology for communication*' and '*e155 Design, constructions and building products and technology of buildings for private use'*.

Table Ic. Content comparison of Comprehensive and Brief ICF Core Sets for AS and RA: environmental factors.

ENVIRONMENTAL FACTORS					72%
1st level	2nd level	3rd level	AS	RA	Agreement on 2nd level
e1 *Products and technology*					71%
e110		**Products or substances for personal consumption**	**X***	**X***	
	e1101°	Drugs	X		
e115		**Products and technology for personal use in daily living**	**X**	**X***	
e120		**Products and technology for personal indoor and outdoor mobility and transportation**	**X**	**X***	
e125		Products and technology for communication		X	
e135		**Products and technology for employment**	**X**	**X**	
e150		**Design, construction and building products and technology of buildings for public use**	**X**	**X***	
e155		Design, construction and building products and technology of buildings for private use		X*	
e2 *Natural environment and human made changes to environment*					0%
e225		Climate	X		
e3 *Support and relationship*					83%
e3		Support and relationships	X*		
e310		**Immediate family**		**X***	
e320		**Friends**	**X**		
e340		**Personal care providers and personal assistants**		**X**	
e355		**Health professionals**		**X**	
e360		**Other professionals**		X	
e4 *Attitudes*					
e4		Attitudes	X		83%
e410		**Individual attitudes of immediate family members**		**X**	
e420		**Individual attitudes of friends**		**X**	
e425		**Individual attitudes of acquaintances, peers, colleagues, neighbours and community members**		**X**	
e450		**Individual attitudes of health professionals**		**X**	
e460		**Societal attitudes**		**X**	
e5 *Services, systems and policies*					60%
e540		**Transportation services, systems and policies**	**X**	**X***	
e570		**Social security services, systems and policies**	**X**	**X***	
e575		General social support services, systems and policies	X		
e580		**Health services, systems and policies**	**X**	**X***	
e590		Labour and employment services, systems and policies	X		

Bold letters: Common ICF categories in AS and RA; * ICF categories included in the Brief ICF Core Set; ° Disease specific ICF category covered by a common second-level category.

Level of impairment, limitation and restrictions

Demographic and health condition-specific characteristics of the study samples are shown in Table II. The mean age in AS was 48 years, in RA 60.8 years. 27.6% of patients with AS and 70.6% with RA were female. The mean disease duration in AS was 16.3 years, and in RA 13.7 years. Mean years of formal education in AS was 13.5, in RA 11.3 years. The rate of paid employment in AS was 54% compared to 15% in RA, but the rate of unemployment due to disease was 24% in AS compared to 19% in RA.

The description of the patient's functioning status in RA and AS at the fifty-three common second-level ICF categories of both ICF Core Sets is shown in Table IIIa (body functions, body structures, activity and participation) and IIIb (environmental factors). For five of the common second-level ICF categories, no comparison was possible since data from AS were not available. In chapters 3 and 4 of the environmental factors, data comparison was not possible since data were collected at different levels (chapter-level in AS, and second-level categories in RA).

The areas in which patients with AS and RA showed limitations in functioning or not were predominantly similar. In both AS and RA, more than 90% of the patients showed no problems in '*d570 Looking after one's health*', '*d660 Assisting others*', and '*d770 Intimate relationships*'. In addition, nearly no patient with AS showed problems in '*d760 Family relationships*' and nearly no patient with RA in '*s760 Structure of the trunk*'. In both samples, '*d455 Moving around*' was the most frequently severe or complete problem. In addition, the majority of the patients in AS showed severe to complete problems in '*d410 Changing basic body position*' and '*d415 Maintaining a body position*'.

In environmental factors, no ICF category was considered a barrier in the majority of patients with AS and RA. In both diseases '*e110 Products or substances for personal consumption*' and '*e115 Products and technology for personal use in daily living*' were rated as facilitators.

Clear differences in having a problem or not having it were identified only in the ICF categories '*s760 Structure of the trunk*' and '*d910 Community life*' in which the majority of patients with AS had at least moderate problems, in contrast to patients with RA, who did not have a problem.

Significant differences in the extent of problems could be identified in 24 ICF categories. Patients with AS presented a higher extent of problems in functioning in all ICF categories except in '*d620 Acquisition of goods and services*'. Remarkable high significant differences in the median (MD) (ΔMD=2) could be identified in '*s760 Structure of the trunk*', '*d410 Changing basic body positions*', '*d415 Maintaining a body position*', and '*d910 Community life*'.

Importance of the category for total functioning

Table IIIa presents the differential item functioning (DIF) of ICF categories of the components body functions, body structures, activities and participation. In total, thirty ICF categories were analysed. All of them fitted the Rasch model (details not shown), meaning the categories belong to the unidimensional trait called 'functioning'. The comparison of the two groups shows that these RA patients scored 1.272 log odd units (logits) lower than AS patients (error= .034) indicating that the RA patients had fewer problems in functioning than AS patients.

Twenty-two ICF categories display DIF indicating that they have different meaning for persons with AS and RA. ICF categories with a negative estimate for DIF represent aspects of functioning in which persons with AS have

Table II. Sociodemographics.

	AS	RA
Total no.	87	143
Age Mean (SD)	48 (12.3)	60.8 (12.3)
Sex (female) % (no.)	27.6 (24)	70.6 (101)
Years of formal education Mean (SD)	13.5 (4.1)	11.3 (4.8)
Disease duration Mean (SD)	16.3 (10.7)	13.7 (10.8)
Disease specific characteristics		
Rheumatic factor-positive % (no.)		56.6 (81)
Erosion (Yes) % (no.)		53.1 (76)
Presence of extraarticular involvement % (no.)		28.0 (40)
HAQ Mean (SD)		0.986 (0.72)
HLA-positive % (no.)	55.2 (48)	
Peripheral arthritis % (no.)	32.2 (28)	
Uveitis % (no.)	35.6 (31)	
Psoriasis % (no.)	6.9 (6)	
Inflammatory bowel disease % (no.)	19.5 (17)	
BASFI (0-10), mean (SD)	5.3 (2.5)	
Current working status % (no.)		
Home maker	2.3 (2)	24.5 (35)
Paid employment	54 (47)	15.4 (22)
Retired	14.9 (13)	37.8 (54)
Unemployed due to AS/RA	24.1 (21)	18.9 (27)
Unemployed, other reason	4.5 (4)	2.1 (3)

more easily problems than RA patients. For example, the item '*s760 Structure of the trunk'* is easier for persons with AS than for persons with RA. I.e. even persons with AS with low problems in functioning will have more frequently problems in this ICF category than persons with RA that have the same level of problems in functioning.

Discussion

The fact that 50% of the ICF categories are included in both, the ICF Core Sets for AS and for RA confirms that similarities and differences in functioning in patients with AS and RA exist.

High concordance in ICF categories was found in chapters that represent well-known limitations in functioning in both AS and RA, including the experience of pain, movement-related body functions and body structures, the execution of tasks in relation to daily routine and employment (1, 26, 27, 41-43). Furthermore, chapters describing functioning according to relationships and community life, which are closely related to social role behaviour, are also common. However, information about social roles have been infrequently investigated in AS and RA to date (44), although these are important aspects from the patient's perspective (45).

At the same time, differences could be identified in aspects of functioning that are specific to either AS or RA. For example, many ICF categories included in the ICF Core Set for RA are related to impaired hand function, and hence, differ from patients with AS who have primary difficulties in relation to the back (4). Instead, the ICF Core Set for AS includes ICF categories such as respiration functions and exercise tolerance functions. Impairments in respiratory function in AS result from restrictions in chest wall mobility or more rarely pulmonary emphysema while impairments in exercise tolerance is likely multifactorial and a consequence of the respiratory problems, but also limitations in joint mobility, muscle cachexia, and energy level (46). In activity and participation, the problems of patients with AS are more often described in aspects related to employment, likely reflecting the higher importance of work for younger patients and for males, while the problems of patients with RA are more often described in aspects related to movement and self-care, which are closely related to impairments in hand function.

Hence, the ICF Core Sets help to analyze differences in the extent of problems in common ICF categories, but also to describe limitations in aspects of functioning that are specific for AS and RA.

Based on the ICF interviews, differences could also be identified with respect to the extent of problems in functioning. Patients with AS showed more severe problems in functioning even though they were younger. While both patient groups were identified from the out-patient register from the same hospital, it should be realised that this centre is a tertiary referral center for AS, hence likely attracting patients with severe disease. This is reflected by the high percentage of patients with TNF inhibitors in the AS sample. The combination of severity of disease and the longer disease duration may eventually have more impact on the level of functioning than the effect of the difference in age alone. Beyond that, an earlier study found a comparable level of functioning in AS and RA, when the samples were matched for sex. However, men with AS showed lower levels in functioning than men with RA (25). In our study, 72.4% of the patients with AS were men, what could contribute to the explanation of the findings. For the purpose of the analyses presented in this paper, the results from two separate studies were joined. Samples were too small to match cases for age, gender and disease duration. Unmatched comparisons might also be informative given they represent the samples seen in real life.

While the clear difference in '*s720 Structure of trunk'* is explicable by the characteristics of the diseases, the difference in '*d910 Community life'* needs further consideration. The result may be influenced by preferences of the two study samples regarding participation in the community. For instance, to experience restrictions in community life patients have to participate. It could be assumed that the RA sample, which was older, had less interest in community life and consequently experienced fewer problems. Participation in the community has mainly been investigated regarding work and employment. However, in AS and RA the specific aspect of community life lacks evidence.

The Rasch analysis shows that many ICF categories have a different meaning for persons with AS than for persons with RA. For example, it is not surprising that the ICF category '*d410 Changing basic body position'* has different meaning in relation to functioning, taking into account the different nature of mobility problems in AS and RA. However, as

Table IIIa. Distribution of ICF Qualifiers across 2nd level ICF categories for RA (n=143) and AS (n=87) in Body functions (b), Body structures (s), Activity and Participation (d) and the estimate and quotient for the differential item functioning (DIF). For DIF analysis persons with AS represent the reference population.

ICF Category		Distribution of ICF Qualifier (bold letters = Modal value)											DIF	
			% of n 0-4 (n)[1]					MD	% of total population (n)[2]					
		n (0-4)	0	1	2	3	4	(0-4)	8	9	M	*p*	estimate	quotient
Body functions														
b130	Energy and drive functions	**RA (142)**	17.6 (25)	31.0 (44)	**35.2 (50)**	16.2 (23)	0	2.00			0.7 (1)			
		AS (87)	4.6 (4)	28.7 (25)	**35.6 (31)**	31.0 (27)	0	2.00					**-2.825**	**-17.99**
												0.001		
b134	Sleep functions	**RA (142)**	**43.0 (61)**	26.8 (38)	16.8 (24)	11.2 (16)	2.1 (3)	1.00			0.7 (1)			
		AS (87)	19.5 (17)	28.7 (25)	**34.5 (30)**	17.2 (15)	0	2.00					-0.048	-0.41
												0.000		
b152	Emotional functions	**RA (142)**	**55.2 (79)**	31.5 (45)	11.2 (16)	1.4 (2)	0	0.00						
		AS (87)	**50.6 (44)**	27.6(24)	17.2(15)	4.6(4)	0	0.00					**0.493**	**4.40**
											0.7(1)	0.218		
b280	Sensation of pain	**RA (138)**	12.3 (17)	**42.8 (59)**	33.3 (46)	11.6 (16)	0	1.00			3.5 (5)			
		AS (87)	0	19.5 (17)	**51.7 (45)**	28.7 (25)	0	2.00					**-1.328**	**-9.10**
												0.000		
b455	Exercise tolerance functions	**RA (141)**	**31.9 (45)**	24.8 (35)	29.8 (42)	10.6 (15)	2.8 (4)	1.00			1.4 (2)			
		AS (-)	no data available											
b640	Sexual functions	**RA (89)**	**66.3 (59)**	9.0 (8)	16.9 (15)	4.5 (4)	3.4 (3)	0.00	11.7 (16)	23.4 (32)	4.2 (6)			
		AS (84)	**63.1 (53)**	19.0 (16)	16.7 (14)	1.2 (1)	0	0.00	3.4 (3)				**0.638**	**5.19**
												0.746		
b710	Mobility of joint functions	**RA (142)**	21.8 (31)	**38.7 (55)**	27.5 (39)	12.0 (17)	0	1.00			0.7 (1)			
		AS (87)	1.1 (1)	26.4 (23)	**47.1 (41)**	16.1 (14)	9.2 (8)	2.00					**-1.046**	**-7.75**
												0.000		
b740	Muscle endurance functions	**RA (140)**	27.1 (38)	**32.9 (46)**	27.1 (38)	12.1 (17)	0.7 (1)	1.00	1.4 (2)		0.7 (1)			
		AS (-)	no data available											
b770	Gait pattern functions	**RA (142)**	26.1 (37)	**36.6 (52)**	25.4 (36)	9.9 (14)	2.1 (3)	1.00			0.7 (1)			
		AS	no data available											
b780	Sensations related to muscles and movement functions	**RA (141)**	**68.8 (97)**	18.4 (26)	9.2 (13)	3.5 (5)	0	0.00			1.4 (2)			
		AS (77)	16.9 (13)	35.1 (27)	**40.3 (31)**	7.8 (6)	0	1.00			111.5 (10)		**-0.84**	**-6.94**
												0.000		
Body structures														
s720	Structure of shoulder region	**RA (142)**	**54.9 (78)**	17.6 (25)	19.0 (27)	8.5 (12)	0	0.00			0.7 (1)			
		AS (87)	**51.7 (45)**	27.6 (24)	17.2 (15)	3.4 (3)	0	0.00					**0.54**	**4.82**
												0.831		
s750	Structure of lower extremity	**RA (120)**	25.0 (30)	28 (23.3)	**35.8 (43)**	14.2 (17)	1.7 (2)	2.00	0.7 (1)		15.4 (22)			
		AS (87)	**33.3 (29)**	26.4 (23)	27.6 (24)	11.5 (10)	1.1 (1)	1.00					**0.925**	**7.64**
												0.092		
s760	Structure of trunk	**RA (142)**	**95.1 (135)**	2.1 (3)	2.1 (3)	0.7 (1)	0	0.00			0.7 (1)			
		AS (87)	0	6.9 (6)	**51.7 (45)**	35.6 (31)	5.7 (5)	2.00					**-0.782**	**-4.98**
												0.000		
s770	Additional musculoskeletal structures related to movement	**RA (139)**	**84.2 (117)**	9.4 (13)	5.0 (7)	1.4 (2)	0	0.00		1.4 (2)	1.4 (2)			
		AS (-)	no data available											
Activities and Participation														
d230	Carrying out daily routine	**RA (142)**	**59.2 (84)**	26.8 (38)	11.3 (16)	2.1 (3)	0.7 (1)	0.00			0.7 (1)			
		AS (-)	no data available											
d410	Changing basic body position	**RA (142)**	31.0 (44)	**40.8 (58)**	19.0 (27)	9.2 (13)	0	1.00			0.7 (1)			
		AS (84)	1.2 (1)	10.7 (9)	26.2 (22)	**50.0 (42)**	11.5 (10)	3.00			3.4 (3)		**-1.327**	**-10.21**
												0.000		
d415	Maintaining a body position	**RA (142)**	31.7 (45)	**37.1 (52)**	22.5 (32)	8.5 (12)	0	1.00			0.7 (1)			
		AS (86)	3.5 (3)	14.0 (12)	30.2 (26)	**45.3 (39)**	7.0 (6)	3.00			1.1 (1)		**-0.781**	**-6.10**
												0.000		
d430	Lifting and carrying objects	**RA (141)**	22.4 (32)	**30.8 (44)**	33.3 (47)	7.1 (10)	5.7 (8)	1.00			1.4 (2)			
		AS (87)	18.4 (16)	29.9 (26)	**35.6 (31)**	16.1 (14)	0	2.00					**0.505**	**4.07**
												0.385		
d450	Walking	**RA (142)**	33.1 (47)	**33.8 (48)**	21.1 (30)	11.3 (16)	0.7 (1)	1.00			0.7 (1)			
		AS (87)	**36.8 (32)**	26.4 (23)	20.7 (18)	14.9 (13)	1.1 (1)	1.00					**0.741**	**6.44**
												0.900		
d455	Moving around	**RA (116)**	21.6 (25)	18.1 (21)	13.8 (16)	12.1 (14)	**34.5 (40)**	2.00	1.4 (2)	16.3 (23)	1.4 (2)			
		AS (87)	5.7 (5)	10.3 (9)	12.6 (11)	27.6 (24)	**43.7 (38)**	3.00					**-0.16**	**-1.18**
												0.002		
d470	Using transportation	**RA (115)**	**60.0 (69)**	24.3 (28)	6.1 (7)	6.1 (7)	3.5 (4)	0.00	1.4 (2)	17.6 (25)	0.7 (1)			
		AS (82)	**70.7 (58)**	18.3 (15)	8.5 (7)	1.2 (1)	1.2 (1)	0.00		5.7 (5)			**0.907**	**7.56**
												0.431		
d475	Driving	**RA (123)**	**41.5 (51)**	37.4 (46)	8.9 (11)	3.3 (4)	8.9 (11)	1.00		0.7 (1)	12.7 (18)			
		AS (85)	14.1 (12)	**42.4 (36)**	32.9 (28)	8.2 (7)	2.4 (2)	1.00			2.3 (2)		-0.203	-1.66
												0.000		
d510	Washing oneself	**RA (142)**	**73.9 (105)**	14.1 (20)	7.7 (11)	3.5 (5)	0.7 (1)	0.00			0.7 (1)			
		AS (87)	**60.9 (60)**	18.4 (16)	5.7 (5)	5.7 (5)	1.1 (1)	0.00					**0.462**	**3.92**
												0.435		
d520	Caring for body parts	**RA (142)**	**59.2 (84)**	23.9 (34)	12.7 (18)	4.2 (6)	0	0.00			0.7 (1)			
		AS (87)	**28.7 (25)**	21.8 (19)	19.5 (17)	21.8 (19)	8.0 (7)	1.00					-0.17	-1.48
												0.000		

***Table IIIa** continues on next page*

Table IIIa.

	ICF Category	Distribution of ICF Qualifier (bold letters = Modal value)										DIF	
			% of n 0-4 (n)[1]					MD	% of total population (n)[2]				
		n (0-4)	0	1	2	3	4	(0-4)	8	9	M	*p*	estimate	quotient
d530	Toileting	**RA (142)**	**72.5 (103)**	17.6 (25)	7.0 (10)	2.8 (4)	0	0.00			0.7 (1)			
		AS (87)	**60.9 (53)**	25.3 (22)	13.8 (12)	0	0	0.00					**0.285**	**2.46**
												0.084		
d540	Dressing	**RA (142)**	**57.7 (82)**	31.0 (44)	8.5 (12)	2.1 (3)	0.7 (1)	0.00			0.7 (1)			
		AS (87)	**40.2 (35)**	35.6 (31)	20.7 (18)	3.4 (3)	0	1.00					0.179	1.58
												0.004		
d570	Looking after one's health	**RA (141)**	**91.5 (129)**	8.5 (12)	0	0	0	0.00			0.7 (1)			
		AS (87)	**98.9 (86)**	1.1 (1)	0	0	0	0.00					**1.799**	**12.07**
												0.020		
d620	Acquisition of goods and services	**RA (139)**	35.3 (49)	**42.4 (59)**	14.4 (20)	5.8 (8)	2.2 (3)	1.00	1.4 (2)	0.7 (1)	0.7 (1)			
		AS (87)	**51.7 (45)**	32.2 (28)	13.8 (12)	2.3 (2)	0	0.00					**1.072**	**9.40**
												0.017		
d640	Doing housework	**RA (130)**	28.5 (37)	**31.5 (41)**	27.7 (36)	6.9 (9)	5.4 (7)	1.00	0.7 (1)	7.7 (11)	0.7 (1)			
		AS (87)	6.9 (6)	21.8 (19)	**47.1 (41)**	24.1 (21)	0	2.00					**-0.277**	**-2.16**
												0.000		
d660	Assisting others	**RA (130)**	**94.6 (123)**	3.1 (4)	0.8 (1)	1.5 (2)	0	0.00		8.5 (12)	0.7 (1)			
		AS (87)	**100.0 (87)**	0	0	0	0	0.00					**-2.825**	**-17.99**
												0.028		
d760	Family relationships	**RA (140)**	**83.6 (117)**	10.0 (14)	4.3 (6)	2.1 (3)	0	0.00			1.4 (2)			
		AS (87)	**94.3 (82)**	4.6 (4)	1.1 (1)	0	0	0.00					**1.294**	**9.59**
												0.016		
d770	Intimate relationships	**RA (120)**	**90.8 (109)**	5.8 (7)	2.5 (3)	0.8 (1)	0	0.00	2.1 (3)	13.4 (19)	0.7 (1)			
		AS (86)	**90.7 (78)**	7.0 (6)	2.3 (2)	0	0	0.00		1.1 (1)			**0.635**	**4.47**
												0.780		
d850	Remunerative employment	**RA (43)**	**44.2 (19)**	18.6 (8)	16.3 (7)	11.6 (5)	9.3 (4)	1.00	11.3 (16)	58.5 (83)	0.7 (1)			
		AS (68)	14.7 (10)	**30.9 (21)**	25.9 (17)	5.9 (4)	23.5 (16)	2.00		21.8 (19)			-0.078	-0.55
												0.000		
d910	Community life	**RA (104)**	**64.4 (67)**	21.2 (22)	12.5 (13)	1.0 (1)	1.0 (1)	0.00	0.7 (1)	26.1 (37)	0.7 (1)			
		AS (87)	29.9 (26)	19.5 (17)	**40.2 (35)**	10.3 (9)	0	2.00					**-0.265**	**-2.19**
												0.000		
d920	Recreation and leisure	**RA (141)**	**37.6 (53)**	36.2 (51)	21.3 (30)	5.0 (7)	0	1.00		0.7 (1)	0.7 (1)			
		AS (87)	12.6 (11)	25.3 (22)	**46.0 (40)**	14.9 (13)	1.1 (1)	2.00					-0.204	-0.29
												0.000		

ICF Qualifier: 0: no problem; 1: mild problem; 2: moderate problem; 3: severe problem; 4: complete problem; 8: not specified; 9: not applicable.
[1]Percentage distribution across ICF Qualifier 0 to 4 is analyzed for numbers of patients rated with an ICF Qualifier 0 to 4; [2]Percentage distribution across Qualifier 8, 9 and Missing were analyzed for the according total population.
MD: Median, M = Missing value, p = p-value: significance level: 0.05; DIF: Differential item functioning: A quotient bigger than 2 indicates DIF (bold letters)

Table IIIb. Distribution of ICF Qualifiers across 2nd level ICF categories for RA (n=143) and AS (n=87) in Environmental factors (e).

	ICF Category	Distribution of ICF Qualifier (**bold letters** = Modal value)							
		% of n 0-4 (n)					% of total population (n)		
		n 0-4	facilitator (1)	0	barrier (-1)	MD (0-4)	8	9	M	*p*
Environmental factors										
e110	Products or substances for personal consumption	**RA (141)**	**71.6 (101)**	19.1 (27)	9.2 (13)	1.00	0.7 (1)		0.7 (1)	
		AS (87)	**80.5 (70)**	9.2 (8)	10.3 (9)	1.00				
										0.198
e115	Products and technology for personal use in daily living	**RA (139)**	**52.5 (73)**	41.0 (57)	6.5 (9)	1.00		2.1 (3)	0.7 (1)	
		AS (87)	**75.9 (66)**	24.1 (21)	0	1.00				
										0.000
e120	Products and technology for personal indoor and outdoor mobility and transportation	**RA (140)**	**67.1 (94)**	30.0 (42)	2.9 (4)	1.00	0.7 (1)	0.7 (1)	0.7 (1)	
		AS (87)	49.4 (43)	49.4 (43)	1.1 (1)	0.00				
										0.013
e135	Products and technology for employment	**RA (116)**	**55.6 (15)**	40.7 (11)	3.7 (1)	1.00	11.3 (16)	69.7 (99)	0.7 (1)	
		AS (62)	38.7 (24)	**51.6 (32)**	9.7 (6)	0.00		28.7 (25)		
										0.116
e150	Design, construction and building products and technology of buildings for public use	**RA (138)**	21.0 (29)	**48.6 (67)**	30.4 (42)	0.00	2.1 (3)	0.7 (1)	0.7 (1)	
		AS (86)	1.2 (1)	**53.5 (46)**	45.3 (39)	0.00		1.1 (1)		
										0.000
e540	Transportation services, systems and policies	**RA (86)**	**37.4 (49)**	32.1 (42)	30.5 (40)	0.00	4.2 (6)	35.2 (50)	0.7 (1)	
		AS (87)	9.2 (8)	**89.7 (78)**	1.1 (1)	0.00				
										0.596
e570	Social security services, systems and policies	**RA (131)**	**37.4 (49)**	32.1 (42)	30.5 (40)	0.00	7.7 (11)		0.7 (1)	
		AS (87)	34.5 (30)	**40.2 (35)**	25.3 (22)	0.00				
										0.868
e580	Health services, systems and policies	**RA (140)**	**39.3 (55)**	32.9 (46)	27.9 (39)	0.00				
		AS (87)	**64.4 (56)**	17.2 (15)	18.4 (16)	1.00				
										0.001

ICF Qualifier: 0: no problem; 1: mild problem; 2: moderate problem; 3: severe problem; 4: complete problem; 8: not specified; 9: not applicable.
[1]Percentage distribution across ICF Qualifier 0 to 4 is analyzed for numbers of patients rated with an ICF Qualifier 0 to 4; [2]Percentage distribution across Qualifier 8, 9 and Missing were analyzed for the according total population.
MD: Median; M: Missing value; *p*: *p*-value: significance level: 0.05.

mentioned before, this should also be interpreted in the light of possible sampling bias and difference in gender and disease duration. As such, this finding supports the result from the comparison based on single ICF categories. The DIF analysis takes this general difference between the groups into account.

Some results of the Rasch analysis are not so intuitive. For example, it is difficult to explain why an ICF category such as '*d760 Family relationships*' also presented DIF reflecting that it has a different meaning for the functioning of the persons with AS and RA, respectively.

We expected that an ICF category such as '*d475 Driving'* would present a DIF since it is well known that patients with AS have limitations in driving a car due to limited mobility of the thoracic and cervical spine (47, 48). However, to our surprise this was not the case, indicating that this category contributes to differentiate between person with different levels of functioning independently from the condition. This result should be further investigated in the future when comparing both populations.

This study had some limitations that should be taken into account in interpreting the results. Data analysis was not matched for age, sex and disease duration and sampling bias might have resulted in inclusion of the more sever spectrum of AS patients. Hence, their impact on functioning could not be identified. In addition, some categories showing DIF might be influenced by the factors we did not take into account. Also, the comparison was based on already existing data which were not complete for AS. Hence, the results lack completeness.

Conclusion

AS and RA are chronic diseases that impair functioning of patients. This study was the first to compare functioning in AS and RA based on the ICF. The results confirmed to a large extent, observations well-known from previous studies, and thereby showed that the ICF is useful to describe and compare functioning.

Furthermore, some aspects were identified that are not easy to understand with existing evidence and need to be explained in the future, notably, common ICF categories of the ICF Core Sets related to community participation, which are less represented in frequently used disease-specific measures. Hence, using the ICF in the future may broaden the assessment of functioning and will help to understand functioning in AS and RA more comprehensively.

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