Factors explaining limitations in activities and restrictions in participation in rheumatoid arthritis

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Aim. The objectives of this study were to examine which factors, according to the International Classification of Functioning, Disability and Health (ICF) framework contribute to the explanation of activity limitations measured by the Health Assessment Questionnaire (HAQ - model I) and which factors contribute to the explanation of participation restrictions measured by the Social Function Scale of SF-36 (model II) in patients with rheumatoid arthritis (RA).

Methods. Cross-sectional data collection of variables concerning the health status of 239 consecutively included patients with RA at the outpatient Departments of Physical Medicine and Rehabilitation of the University Hospital of Zurich and of the University Hospital of Munich was conducted. Measures included: disease activity score (DAS-28), Rheumatoid Arthritis Disease Activity Index (RADAI), HAQ, Short-form-36 (SF-36), Sociodemography Questionnaire, Comorbidity Questionnaire (SCQ), Muscle Strength Index (MSI), range of motion (EPM-ROM), grip strength, Sequentional Occupational and Dexterity Assessment (SODA), radiologic score (Ratingen Score). Multivariate regression analyses were conducted building models of explanation.

Results. Model I included vitality, RADAI, DAS, SODA PAIN Score, MSI and EPM-ROM as explaining variables with a globally explained variance of 53%. Model II included vitality, RADAI, DAS, SODA PAIN Score, MSI and EPM-ROM as explaining variables with a globally explained variance of 42.4%.

Conclusion. Activity limitations in RA were mainly explained by vitality and disease activity factors. Restrictions in participation in RA were mainly explained by vitality and mental health.

KEY WORDS: Arthritis, rheumatoid - Activities of daily living - Rehabilitation centers.

Rheumatoid Arthritis (RA) is a chronic, systemic, inflammatory autoimmune disease of unknown aetiology with an incidence of 54 per 100'000 in women and 24.5 per 100'000 in men. The prevalence of RA in Germany amounts to 1-2% and worldwide to 0.5-1% of the population.

This disease that predominately involves joints leads often to impairments in body functions (e.g., pain, joint stiffness) and structures (e.g., joint destruction), limitations in several activities (e.g., walking) and further restrictions in participation in social life as well as in maintaining professional status. Those disabilities
were now described by the International Classification of Functioning, Disability and Health (ICF). The disability caused by RA results in a major economic loss also because it affects patients and also to slow productive years.

The current drug therapy aims to reduce pain and disease activity and also to slow the disease progress. Specific surgical therapy is directed to enhance joint mobility and function. However, today at least patients with longer lasting RA must accept more or less major limitations in activities and restrictions in participation. Identifying variables that influence the impact of the disease on functioning is important for planning essential therapy of which rehabilitation aims at restoring impaired function, delaying progression of loss of function and regaining normal levels of activities and participation in daily living and social life. Knowing these variables determines the selection of quality and quantity of therapy and of adequate rehabilitation strategies.

The ICF is a common language and classification to describe functioning and its loss due to health conditions or diseases. In the ICF functioning is seen in relation to health condition, as well as to personal and environmental factors. The ICF provides a useful reference to identify the concepts contained in outcome assessments used in clinical trials.

Multiple variables of disease status may cause and explain activity limitations and participation restrictions in RA. In recent years in cross sectional studies the association of activity limitations and variables that determine the impact in RA was examined: disease activity variables (like articular signs), joint deformities, pain, joint destruction, disease duration, sex, age, depression and other psychological factors were often found to be associated with disability. Muscle strength was also evaluated in a few recent studies, alike range of motion was rarely examined in this context.

Regression analyses showing the amount of association of variables and activity limitations in RA were recently published: Hand function in RA patients was found to be explained by pinch strength, stiffness of the hand and the presence of certain deformities. In other studies physical function was found to be explained by sex, age, disease activity, disease duration, depression and other psychological impairments, demographic variables, self efficacy, pain, joint damage, grip strength, and range of motion. Variables that influence restrictions in participation in RA are poorly examined so far, solely the association of social function (measured by the SF-36 subscale) and physical function was evaluated, but up to now, to our knowledge, there exists no regression analyses in this context.

Some informative basis provides a study using bivariate correlations. The results showed in a cross sectional study that in RA measures of impairments were associated with measures representing activity limitations and measures of activity limitations were associated with measures representing participation restrictions.

There is evidence that multiple variables of different components according to the ICF affect activity limitations. There is little knowledge about variables influencing participation restrictions in RA. Moreover, we do not know much about the influence of a potential explaining variables like psychosocial variables, global health representing variables, social variables (like working status, living situation) and other variables of interest in rehabilitation therapy.

We conducted a data collection and regression analyses covering a comprehensive set of variables. In addition our data collection included some rarely examined variables in rehabilitation therapy (muscle strength, joint mobility, hand dexterity).

The goal of our study was to explain activity limitations and participation restrictions in RA and to quantify the amount of influence of explaining variables.

**Materials and methods**

**Objectives**

The objectives of this evaluation were to identify explaining factors in the following models:

- in model I we aimed to discover which factors contribute to the explanation of activity limitations measured by physical function questionnaire (Health Assessment Questionnaire, HAQ) as an indicator for relevant activities in RA and how much;
- in model II we aimed to discover which factors contribute to the explanation of participation restrictions measured by Social Function Scale of SF-36 which covers a typical field of participation and how much.

A subsample of data including the Ratingen Score (radiologic score for joint destruction) was available to analyse the explaining potency of the Ratingen Score.
Study design

This is a cross sectional study. The data were collected on consecutive patients with RA in two study centres.

Patients

Inclusion criteria

Patients were included if they fulfilled the ACR-Criteria 24 for the diagnosis of RA and if they agreed to participate by written, informed consent. The disease duration and the age at disease onset were not restricted.

Exclusion criteria

Patients were excluded if they were younger than 18 years and if they were not able to read, understand and fill in German written questionnaires.

Recruitment

Patients have been recruited at the outpatient Department of Physical Medicine and Rehabilitation of the University Hospital of Zurich, Switzerland, and of the University Hospital of Munich, Germany, from January 1999 to July 2004. The physicians asked patients with the established diagnosis of RA consecutively to take part in the study.

Data collection

The patients were recruited in two different study centres using a similar data collection procedure and using the same measures.

At the assessment a trained physician completed the inclusion and exclusion criteria form, checked informed consent and collected data for the Disease Activity Index (DAS) and the disease characteristics. The included patients were instructed in completion of questionnaires as there were the Rheumatoid Arthritis Disease Activity Index (RADAI), HAQ, SF-36, Sociodemography Questionnaire and Comorbidity Questionnaire (SCQ).

All physicians participating in the study were trained to perform the DAS and to handle the questionnaires. Well-trained therapists performed the tests for manual dexterity (Sequentional Occupational Dexterity Assessment, SODA), muscle strength (Muscle Strength Index, MSI) and range of motion (EPM-ROM). Plain radiographs of hands and feet at the assessment date were taken and scored by a trained physician (Ratingen Score).

Measures

HAQ

The HAQ is a standardized, valid and frequently used patient-centred instrument. It assesses the disease-specific physical disability of patients with rheumatic disease.25 The HAQ has been translated and validated into numerous languages including the German language version.26 It consists of 20 items covering eight groups of functional limitations of the lower and upper extremities. Scores range from 0-3 with higher scores indicating worse function.

DAS

The Disease Activity Score (DAS28) 27, 28 is a standardized and valid disease activity index. Physicians calculate the DAS28 using the number of swollen joints, the number of tender joints of 28 given joints, and the erythrocyte sedimentation rate (Westergren method). The DAS28 has a continuous score from 0-10 with higher scores indicating higher disease activity.

RADAI

The RADAI 29, 30 is a standardized, valid patient-centred disease activity index with questions concerning the estimation of his disease activity, general pain, morning stiffness and local joint pain in different joints. The RADAI is ordinal scaled from 0-10, whereas 0 represents no and 10 maximal disease activity.

SF-36

The SF-36 31 is a multi-purpose, 36-item instrument derived from Medical Outcome Study for the following eight health concepts (subscales) in global health: limitation in physical activities (physical function), usual role activities because of physical function (physical role), bodily pain (body pain), general health perception (general health), vitality (vitality), social activities (social function), usual role activities because of emotional problems (emotional role) and mental health including psychological distress and well-being (mental health). The scores of the eight subscales range from 0 to 100. Higher scores denote less limi-
tations or distress in the different dimensions. We used the validated German version.32

SOCIODEMOGRAPHY

The Sociodemography Questionnaire contains socioeconomic data of patients with the following categories: living situation, education and profession, life habits and sports activities.

SCQ

The SCQ is a standardized patient-centred validated questionnaire for assessment of comorbidities, their treatment and their consequences of disabilities in the daily life 33 with the following 14 diseases categories in a for the patient understandable verbalizations: hypertension, cardiac disease, vascular disease, psychological affection/depression, Diabetes mellitus, overweight/hyperlipidemia, malignancy, alcoholic/drug excess, lung disease, kidney disease, liver disease, gastrointestinal disease, blood disorders, back pain. Each category can be scored up to 3 points, the global score is up to 42 points.

SODA

The SODA is a valid test designed especially for RA patients that quantifies physical function of the upper extremity in form of bimanual dexterity in a test situation (capacity).34,35 The SODA includes 12 task items. The range of the total SODA score is 0 to 108. A higher score indicates a higher functioning.

EPM-ROM

The ROM is a standardised measure of the joint mobility. It is measured at different joints of the upper and lower extremity at both sides. The mean of all values is taken. EPM-ROM means Escola Paulista de Medicina Range of Motion according to its initiators.36

Grip strength

Grip strength is measured with a vigorimeter at both hands three times and then taken the mean respectively. Evaluation of the vigorimeter to measure grip strength in healthy subjects and RA patients was conducted by Jones et al.37
MSI

The MSI is a valid test of the strength of the muscles of the upper and lower extremity.\textsuperscript{21, 38} The MSI is calculated as the mean score of standardised isometric extension and flexion strength of the knee and elbow joints.

RATINGEN SCORE

The Ratingen Score\textsuperscript{39, 40} is used for evaluation of the joint destruction of RA patients assessing radiographs of hands and feet. The amount of joint surface (wrist, metacarpophalangeal joints, metatarsalia I-V and interphalangeal joints at both sides) destroyed by erosions is assessed in percent.

DISEASE CHARACTERISTICS

The disease characteristic questionnaire is a not yet standardized instrument for assessment of disease history data of RA patients that are relevant for characterisation of the disease.\textsuperscript{41} The questionnaire consists of five categories of questions: 1) family history; 2) prognostic factors; 3) health economic questions; 4) questions about the previous medication; 5) previous surgical treatments as a result of RA.

The assessments in this study were chosen to cover the domains as described in the ICF model (Figure 1).

Statistical analysis

Statistical analysis was conducted using SPSS, Version 12.0 (SPSS Inc.\textsuperscript{16}). Descriptive statistics were done to characterize the study population. The two subgroups (Munich/Zurich) were compared using $\chi^2$ and Mann-Whitney-U-Test. For the multivariate regression analysis of the two models we applied a standardized variable selection procedure.

SELECTION OF VARIABLES FOR MULTIVARIATE REGRESSION ANALYSES

After mapping all available variables to ICF components according to the ICF (Figure 1) the first step consisted in building chunks (chunks=sets of variables that are logically related and of equal context within a chunk and that are candidate explaining variables) for each component — these are body functions and structures, activities, participation, environmental factors, personal factors and health condition — as well as building subchunks within the component body functions and structures, namely disease activity, pain, joint structure, muscle strength/joint mobility. For the model I the components body functions and structures, personal factors, environmental factors, health condition were considered as relevant chunks regarding the objectives of the study, for the model II these were the components body functions and structures, activities, personal factors, environmental factors, health condition. In the next step within each chunk the most relevant variables corresponding to the dependent variable were selected for the two models by calculating correlations (Spearman) of the variables to the dependent variable HAQ and Social Function Scale, respectively. The variables remained in their chunks if the correlation coefficient got greater than the cut off value ($P<0.1$).

Next step was to check for co-linearity among the variables within chunks. Therefore, we set an inter-correlation of $R>0.6$ aiming to avoid redundancy of included variables. This threshold was presumed to fit a stringent variable selection for the multivariate regression analyses.

In summary, we included all variables indicating significant univariate correlation to the dependent variable with $P<0.1$ and inter-correlation to all other included variables with $R>0.6$ into the final models respectively.

MULTIVARIATE REGRESSION ANALYSES

Multivariate stepwise backward regression analyses for explaining activity limitations and participation restrictions were conducted using the chunks as blocks consecutively entered. We started with the body functions and structures subchunks, then the activity chunk (in the participation model), personal factors chunk, environmental factors chunk and health condition chunk (order of addition).

Results

Patients

Data have been acquired from 113 RA patients assessed in Zurich, and 126 patients assessed in Munich.

Altogether there were 239 patients of whom 79% were females and 21% males. Their age ranged from 19 to 87 with a mean ± SD age of 56±13. RA disease
duration ranged from 1 to 55 years with a mean ± SD years of 10±11. The age at disease onset ranged from 5 to 76 years with a mean ± SD years of 45±15. The DAS28 ranged from 0.8 to 7.8 with a mean ± SD DAS of 4.2±1.5, the RADAI ranged from 0.3 to 9.6 with a mean ± SD RADAI of 4.6±2.1, the HAQ ranged from 0 to 3.0 with a mean ± SD HAQ of 1.3±0.7. Other patients’ characteristics show Table I.

Seventeen percent (N.=38/215) of the patients had anaemia (Hb<12.0 g/dL), hemoglobin Hb and vitality were weakly correlated (R=0.21, P<0.003).

The subgroups (Munich/Zurich) were comparable regarding basic characteristics like age, gender; disease duration. The DAS28 (P=0.000) and RADAI (P=0.002) indicated higher scores in the Zurich subsample.

Multivariate linear regression analysis

**MODEL I (ACTIVITY MODEL)**

For the first model 17 variables were available and included in the regression analysis with the result that vitality, DAS, RADAI, SODA Pain Score, MSI, EPM-ROM and disease duration added in this order were independent explaining variables of activity limitations measured by the HAQ in RA (Table II). Vitality

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**Table I.**— Patient characteristics.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of patients N.</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Living alone</td>
<td>55</td>
<td>23.0%</td>
</tr>
<tr>
<td>Smoker</td>
<td>57</td>
<td>23.8%</td>
</tr>
<tr>
<td>Regularly alcohol drinking</td>
<td>119</td>
<td>49.8%</td>
</tr>
<tr>
<td>High school degree and higher education level</td>
<td>58</td>
<td>24.2%</td>
</tr>
<tr>
<td>Unable to work</td>
<td>57</td>
<td>23.8%</td>
</tr>
<tr>
<td>Unemployed</td>
<td>5</td>
<td>2.1%</td>
</tr>
<tr>
<td>Employed</td>
<td>55</td>
<td>23.0%</td>
</tr>
<tr>
<td>Retired</td>
<td>104</td>
<td>43.5%</td>
</tr>
<tr>
<td>Housewife</td>
<td>52</td>
<td>21.8%</td>
</tr>
<tr>
<td>Others</td>
<td>14</td>
<td>5.8%</td>
</tr>
</tbody>
</table>

**Table II.**— Model I - winner chunks and variables in regression analysis.

<table>
<thead>
<tr>
<th>ICF Component chunks</th>
<th>Variables</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body functions and structures</td>
<td>Vitality</td>
<td>Vitality</td>
</tr>
<tr>
<td></td>
<td>Mental Health</td>
<td>DAS</td>
</tr>
<tr>
<td></td>
<td>DAS</td>
<td>RADAI</td>
</tr>
<tr>
<td></td>
<td>Body pain</td>
<td>SODA pain</td>
</tr>
<tr>
<td></td>
<td>EPM-ROM</td>
<td>MSI</td>
</tr>
<tr>
<td>Health condition</td>
<td>Disease duration</td>
<td>Disease duration</td>
</tr>
<tr>
<td></td>
<td>ANA (Disease characteristic)</td>
<td></td>
</tr>
<tr>
<td>Personal factors</td>
<td>Sex</td>
<td>Comorbidity</td>
</tr>
<tr>
<td></td>
<td>Unable to work</td>
<td>Jobless</td>
</tr>
<tr>
<td></td>
<td>Employed</td>
<td>Education: technical school</td>
</tr>
<tr>
<td>Environmental factors</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

The subgroups (Munich/Zurich) were comparable regarding basic characteristics like age, gender; disease duration. The DAS28 (P=0.000) and RADAI (P=0.002) indicated higher scores in the Zurich subsample.

**Table III.**— Multivariate stepwise backward regression analysis with HAQ as dependent variable, final model I.

<table>
<thead>
<tr>
<th>Incl. variables</th>
<th>R²</th>
<th>Adjusted R²</th>
<th>β</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitality</td>
<td>0.555</td>
<td>0.530</td>
<td>-0.313</td>
<td>0.000</td>
</tr>
<tr>
<td>DAS28</td>
<td>0.170</td>
<td>0.017</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RADAI</td>
<td>0.211</td>
<td>0.006</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SODA pain</td>
<td>0.130</td>
<td>0.058</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSI</td>
<td>-0.164</td>
<td>0.016</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EPM-ROM</td>
<td>0.090</td>
<td>0.199</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disease duration</td>
<td>0.168</td>
<td>0.012</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table IV.**— Model II - winner chunks and variables in regression analysis.

<table>
<thead>
<tr>
<th>ICF Component chunks</th>
<th>Variables</th>
<th>Variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body functions and structures</td>
<td>Vitality</td>
<td>Mental health</td>
</tr>
<tr>
<td></td>
<td>DAS</td>
<td>RADAI</td>
</tr>
<tr>
<td></td>
<td>Body pain</td>
<td>SODA pain</td>
</tr>
<tr>
<td></td>
<td>MSI</td>
<td></td>
</tr>
<tr>
<td>Activities</td>
<td>HAQ</td>
<td>SODA</td>
</tr>
<tr>
<td></td>
<td>Physical role</td>
<td></td>
</tr>
<tr>
<td>Personal factors</td>
<td>Comorbidity</td>
<td>Unable to work</td>
</tr>
<tr>
<td></td>
<td>Jobless</td>
<td>Education: technical school</td>
</tr>
<tr>
<td>Environmental factors</td>
<td>—</td>
<td>Living alone</td>
</tr>
<tr>
<td>Health condition</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>
as the strongest variable explained 28.7%, the DAS 9.8%, the SODA PAIN Score 4.1%, the RADAI 3.6%, the MSI 3.2%, disease duration 2% and the EPM-ROM 1.6% of the total variance (Table III).

**MODELL II (PARTICIPATING MODEL)**

Fifteen variables were selected in the second model. The result of the regression analysis indicated that vitality, mental health, HAQ and living alone added in this order were independent explaining variables of participation restrictions measured by the Social Function Scale in RA (Table IV). Thirty-three point six percent of the total variance were explained by vitality, 4.2% by mental health, 2.6% by living alone and 2% by the HAQ (Table V).

**ALTERNATIVE MODELL II**

Substituting the HAQ by the next best associated variable Physical Function Scale of the SF-36 in the participation model the result of the regression analysis indicated no relevant difference explaining 3% of the total variance. Further 33.6% were explained by vitality, 4.2% by mental health and only 1.9% by living alone.

**SUBSAMPLE MODELL (RATINGEN SCORE INCLUSIVE)**

We got a subsample of patients (N.=85) for which the Ratingen Score was available and conducted multivariate regression analyses corresponding to the variable selection procedure for both models showed above. For the activity model 17 variables were available (N.=85) after the variables selection process. That did not fit with the standard guideline of performing multivariate regression analyses (including at the most 1 variable per 10 subjects into the model). We therefore chose an alternative variable selection procedure running the following strategy: the only one variable of each relevant chunk/subchunk with the highest correlation to the dependent variable was selected. After checking for co-linearity, the remaining variables were: Vitality, RADAI, SODA Pain Score, MSI, inability to work, disease duration. Ratingen Score must be added separately, because it did not present the highest correlation to the HAQ in the subchunk. Finally stepwise regression was conducted. In this subsample model the Ratingen Score explained 7.8%, vitality 30.6% and the RADAI 6.5% of the total variance.

No appropriate subsample model for explaining participation restrictions could be performed because there was no significant correlation of Ratingen Score to the dependent variable Social Function Scale (R= 0.034, P=0.760).

**Discussion**

The main results are that 53% of the variance variables in activity limitations could be explained by vitality, RADAI, DAS, pain, MSI, EPM-ROM and disease duration. In the second model explaining variables of participation restrictions in RA were vitality, mental health, HAQ and living alone with 42.4% of variance explained.

In model I vitality was the strongest explaining variable of activity limitations. This is a new aspect in RA modelling disease impact. Vitality is a scale that includes four different items namely fatigue, pep, motivation and energy. It is well established that fatigue is a frequent and major problem for RA patients and for it relevant in the clinical management of RA. A recent examination indicated a strong association of vitality to fatigue. High fatigue levels characterize RA and are mainly linked to pain and depression. The items fatigue, energy and pep may be strongly influenced by anemia being a frequent comorbidity in RA. Treatment of anemia in RA patients with erythropoietin was evaluated to be effective in correction of anemia, in improving muscle strength and vitality and in reducing fatigue and disease activity. It is, however, questionable that anemia in our RA patients is outmost responsible for low vitality and consequently according to our model for activity limitations in RA patients. In our patient sample there were fewer patients with anemia compared to general estimates of prevalence of anemia. This may not explain the high association of vitality in this sample. Moreover, different psychological factors like depression or anxiety could influence vitality. Depression is also known

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**Table V.**— Multivariate stepwise backward regression analysis with Social Function Scale of SF-36 as dependent variable, final model II.

<table>
<thead>
<tr>
<th>Incl. variables</th>
<th>R²</th>
<th>Adjusted R²</th>
<th>β</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitality</td>
<td>0.441</td>
<td>0.424</td>
<td>0.330</td>
<td>0.000</td>
</tr>
<tr>
<td>Mental Health</td>
<td>-0.262</td>
<td>0.001</td>
<td>-0.330</td>
<td>0.019</td>
</tr>
<tr>
<td>HAQ</td>
<td>-0.188</td>
<td>0.019</td>
<td>-0.188</td>
<td>0.010</td>
</tr>
<tr>
<td>Living alone</td>
<td>-0.173</td>
<td>0.010</td>
<td>-0.173</td>
<td>0.010</td>
</tr>
</tbody>
</table>
as a physical function and quality of life influencing issue in RA. Anxiety as well was described to influence physical function. Therefore, there are different aspects in the scale that may explain the broad influence of vitality on activity limitations in RA patients.

MSI and EPM-ROM as measures of muscle strength and joint mobility are scarcely evaluated variables explaining activity limitations in RA. Thereby in the past the association of MSI and of joint mobility to physical function was demonstrated and leg muscle strength was detected to be associated with walking ability. The association of EPM-ROM to activity limitations was not evaluated before in a regression analysis to our knowledge. We found both MSI and EPM-ROM showing a considerable amount of activity limitations explaining variance of together 4.8% confirming our presumption that both rehabilitation parameters are relevant for clinical practice.

The other explaining variables (RADAI, DAS, pain, disease duration) of the model I confirm the findings of the past. In model II vitality and mental health explained a great part of the variance of participation restrictions (together 37.8%) indicating that comprehensive scales of health like vitality and mental health covering psychological aspects like depression, well being and mood have an extensive influence on participation in daily living in RA. To our knowledge the association of vitality and participation in RA is not especially described in any publication. In one study depression in RA was found to be explained by social inactivity next to poor physical function and comorbidities.

Living alone is an item of living situation that could restrict patients in participation on social life because of missing motivation and enjoyment feeling lonesome. A partner could have a major motivating and organising influence for participation in leisure activities, culture events etc. despite of disability caused by RA.

The HAQ may represent also impairments besides activity limitations in RA caused by disease activity. Hence the association of participation and factors of the component body functions and structures seemed to be covered by the HAQ taking into account variables of disease activity (e.g., joint destruction or pain) expressed by loss of function.

Our findings in model II especially for the variables vitality and mental health are new aspects in this context, for to our knowledge there exist no comparable study.

In the subsample model (incl. Ratingen Score) explaining variables of activity limitations were Vitality, RADAI-Score and Ratingen Score. The Ratingen Score had a relevant association as expected and already shown in recent relevant studies.

Generally speaking, there is evidence that multiple variables show relevant associations to the health status in RA and hence are important for planning adequate therapy in terms of multidisciplinary treatment strategies. Regarding the ICF, these multiple variables explaining activity limitations are representatives of the components Body Functions and Structures and Health Condition. The variables explaining participation restrictions are representatives of the components Body Functions, Activities and Environmental Factors. In our cross sectional data we could confirm the recent findings concerning the association between impairments and activity limitations (model I) as well as between impairments, activity limitations and participation restrictions (model II) in regression analyses, respectively. It has to be mentioned that environmental factors are even important variables as shown in our model II.

Differences to recent modelling examinations were that in our sample the item depression was not shown as activity limitations explaining variable probably because of being covered by the vitality scale. Further no sociodemographic variables (e.g., unemployed, jobless) came in one of the models. The well known associations of these variables in this context could not be confirmed in our regression models.

The study holds some limitations. We conducted a multivariate analysis with a cross-sectional data set. Longitudinal analyses may have presented in addition predictive information in the sense of causality. Our sample size was limited. Moreover only a small subsample analysis could be run with complete data of joint destruction. Other aspects which could have an explaining effect in this context like further psychological factors (e.g., anxiety), income, coping strategies, self-efficacy and illness perception were not included in the data set. Other not covered aspects concerning physical function are muscle endurance and coordination. In practice they were classified as relevant for rehabilitative treatment strategies and therefore have to be evaluated in a regression analysis.

The study population based on university setting. It is evident that more urbanites were recruited than
rural living patients because of burden of travel. Environmental influences of the different living situations of the patients may have had an influence on activities and participation of the patients and may have biased the models; e.g., the capacity of walking may be less important for participation in urban setting as in a rural setting. A recruitment of patients with different attributes or qualities is likely. Hence, the generalization of our findings is limited.

We used the ICF Model to examine relations between activities and participation and potentially explaining variables. We built models which in future may help designing studies, planning therapy strategies, monitoring treatment outcomes and learning about the impact of a chronic disabling disease like RA. It may be an advantage for multidisciplinary patient care if modelling and systematic assessment of disease consequences identify data sets on the basis of the ICF.

Conclusions

Variables explaining activity limitations in RA in a cross sectional setting are vitality, DAS, RADAI, pain, Ratingen Score, MSI, EPM-ROM and disease duration; variables explaining participation restrictions are vitality, mental health, HAQ and living alone. In a wide spectrum there were found variables out of all components of the ICF showing the broad correlations of these factors to the health status of RA patients. The common opinion that comprehensive multidisciplinary treatment in RA is relevant for outcome is supported. In conclusion, these findings are relevant for clinical aspects and rehabilitation strategies, for teaching and for research in RA.

References