Factors Associated With Activity Limitations in People With Rheumatoid Arthritis

Júnia A. Andrade, Marina B. Brandão, Maria Raquel C. Pinto, Cristina C. D. Lanna

OBJECTIVE. We evaluated factors contributing to activity limitations in people with rheumatoid arthritis (RA) according to the International Classification of Functioning, Disability and Health model.

METHOD. In a cross-sectional study, we measured five activity constructs in 81 people with RA.

RESULTS. Multiple regression analysis revealed the following results for the five constructs: (1) RA Activities ($R^2 = .512$) included handgrip strength, range of motion deficit, deformity, and mental health; (2) Upper-Limb Activities ($R^2 = .473$) included time since diagnosis, dexterity, handgrip strength, and range of motion deficit; (3) Timed Activities ($R^2 = .320$) included dexterity and work activities; (4) Physical Autonomy Activities ($R^2 = .562$) included range of motion deficit, vitality, pain, and functional classification; and (5) Physical Conditions for Activities ($R^2 = .416$) included functional classification and vitality.

CONCLUSION. Factors most associated with activity limitations were handgrip strength and hand range of motion deficits. Activity limitations in people with RA are multifactorial.


Compared with other tools, the International Classification of Functioning, Disability and Health (ICF; World Health Organization, 2001) provides a broader conceptual understanding and interpretation of the functioning and disabilities of people with rheumatoid arthritis (RA; Chung et al., 2011). The ICF model defines activity as the execution of tasks at home, at work, and during leisure (Cieza et al., 2002).

Kuhlow et al. (2010) observed that factors such as individual vitality and disease progression are related to activity limitations. Chung et al. (2011) correlated results from functional tools and variables with the components included in the ICF using methodologies described by Cieza et al. (2002) and Sigl, Cieza, van der Heijde, and Stucki (2005). We developed representative constructs based on the SF–36 (Ware, Snow, Kosinski, & Gandek, 1993) and the Arthritis Impact Measurement Scale (AIMS2; Meenan, Mason, Anderson, Guccione, & Kazis, 1992), as described by Kuhlow et al. (2010) and Chung et al. (2011), as well as on specific tools developed to assess activities affected by arthritis and effects on the upper limbs.

We used the ICF model and joint factor analysis to examine factors reported to be associated with functioning and disability in people with RA, including dexterity (van Lankveld, van’t Pad Bosch, & van de Putte, 1998), fatigue (Pollard, Choy, Gonzalez, Khoshaba, & Scott, 2006), stiffness (Kalyoncu, Dougados, Daurès, & Gossec, 2009), pinch (Vliet Vlieland, Zwinderman, Breedveld, & Hazes, 1997), handgrip (Goodson, McGregor, Douglas, & Taylor, 2007), strength, range of motion (ROM) deficit (Dellhag & Burckhardt, 1995), deformities (Toussirot, 2010), mental health, vitality, and...
pain (Kuhlow et al., 2010). The results of this study can inform early intervention rehabilitation programs to prevent activity limitations in people with RA.

Method

Participants

For this cross-sectional study, we used convenience sampling to recruit 81 patients treated between June 2009 and August 2010 in the Clinics Hospital at the Universidade Federal de Minas Gerais (UFMG) in Brazil. Inclusion criteria included age over 18 yr, RA diagnosis by a rheumatologist according to American College of Rheumatology (ACR) criteria (Hochberg et al., 1992), and mental competence as determined by the Mini-Mental State Examination (Folstein, Folstein, & McHugh, 1975). Patients who had undergone upper-limb surgery or who had an uncorrected visual deficit that could compromise functionality were excluded.

Procedures

The study was approved by the UFMG Ethics Committee (ETIC 024/09), and all participants signed informed consent forms. A required sample size of 79 participants was calculated on the basis of a pilot study using a convenience sample of 10 patients. Dominant upper-limb total ROM deficit and palmar and pulp-to-pulp hand pinch strength were evaluated during the pilot study to assess interexaminer and test–retest reliability. Measurements performed by the first author and another examiner, both of whom were occupational therapists, were used to determine interexaminer reliability.

We used video footage to calculate the reliability of the Minnesota Rate of Manipulation Test (MMRT; American Guidance Service, 1969), Upper Extremity Function Test for the Elderly (TEMA; Desrosiers, Hébert, Dutil, & Bravo, 1993), and Sequential Occupational Dexterity Assessment (SODA; van Lankveld et al., 1996). Two therapists evaluated the video footage separately and without exchanging information. Video footage was also used to collect data after the pilot study, although only one score from one observer was collected. Because they are relatively time-consuming and tiring, the SF–36 and AIMS2 were administered only once. Interexaminer intraclass correlation coefficients (ICCs) from the pilot study were satisfactory, varying from .857 to .979. Test–retest reliability was also satisfactory, ranging from .949 to .989.

For the full study, all measurements were conducted on the same day. One occupational therapist gathered demographic, clinical, and anthropometric data on the participants, including gender, age, time of diagnosis, work situation, dominant side, presence and intensity of fatigue and stiffness, hand deformities, movement limitations, handgrip strength, and pulp-to-pulp pinch grip strength, and administered the AIMS2. The other therapist administered the SODA, TEMPA, SF–36, and MMRT.

Study Variables and Constructs

We selected as study variables the following ICF components identified in the literature:

- General state of health, time since diagnosis, mental health, vitality, physical condition for activities, RA activities, work situation, work activity (Kuhlow et al., 2010)
- Hand deformity, physical autonomy activities (Chung et al., 2011)
- Hand ROM deficit, handgrip strength, age, gender (Chung et al., 2011; Kuhlow et al., 2010)

Functional classification, fatigue intensity, stiffness intensity, hand pinch strength, upper-limb total ROM deficit, pain, upper-limb activities, and timed activities were examined in relation to the study variables (Tables 1 and 2).

We grouped the variables into constructs representing the ICF activity component because of the many functional instruments that appear in the literature and to enable analysis of uniformity among the factors associated with limitations in activity according to the ICF model. The five constructs are as follows:

1. **RA Activities** include coordination capability, pinch and handgrip, activities of daily living, and upper-limb strength specific for RA alterations and were measured using the SODA.
2. **Upper-Limb Activities** include object manipulation, manual strength, and upper-limb ROM and were measured using the TEMPA task items.
3. **Timed Activities** include performance times for upper-limb activities and were measured using the TEMPA times.
4. **Physical Autonomy Activities** include mobility, walking and bending, upper-limb function, self-care, and housework and were measured using the AIMS2 Physical Activity scale (Chung et al., 2011).
5. **Physical Conditions for Activities** include number and difficulty of limitations compared with activities performed previously and were measured using the SF–36 Physical Functioning scale (Kuhlow et al., 2010).

Comparison of the results for the constructs indicates which measures contribute to the representation of the ICF activity component for people with RA.
Measures

**TEMPA.** The Brazilian version of the TEMPA assesses performance of the upper extremities and consists of eight standardized tasks. Scoring of the task analysis dimension ranges from 0 to 150 (0 indicates no disability). The TEMPA is scored according to the time required (in seconds) to complete each task; the higher the score, the greater the disability. The TEMPA has demonstrated high levels of reliability in people with stroke for both unilateral tasks (test–retest ICC $\geq .89$) and the functional component (ICC $>.97$; Richards, Stoker-Yates, Pohl, Wallace, & Duncan, 2001).

**SODA.** SODA scores range from 0 to 108 across the 12 tasks; the SODA has been validated for people with RA, with test–retest reliability of .93 and internal consistency of .91 (Cronbach’s $\alpha$). The pain score ranges from 0 to 12. Spearman’s correlations between task difficulty and reported pain for ordinal data ranged from .40 to .72 (van Lankveld et al., 1996).

**AIMS2.** The AIMS2 scores range from 0 to 10 (10 indicates the worst state of health). Test–retest reliability of the Portuguese version of the AIMS2 ranged from .94 to .97 and interrater reliability from .91 to .98 (Brandão, Ferraz, & Zerbini, 1997).

**SF–36.** The SF–36 has eight scales and a final score ranging from 0 to 100 (100 represents the best state of health). The Brazilian Portuguese version of the SF–36 was tested in people with RA, with Pearson’s test–retest reliability of .44 to .85 and interrater reliability of .55 to .81 (Ciconelli, Ferraz, Santos, Meinaõ, & Quaresma, 1999).

**Work Situation.** Work situation was recorded as able to work—that is, working, retired, homemaker, or unemployed—or unable to work—that is, retired because of disability or temporarily not working because of RA.

**Classification of Functional Status.** ACR classes range from Class I, which includes people with complete functional capacity who are able to perform all the usual tasks without hindrance, to Class IV, which represents people who are extremely or completely disabled, bedridden, or confined to a wheelchair and unable to perform minimal personal care (Hochberg et al., 1992).

**Range of Motion.** ROM was categorized as follows: $0 = \text{no or limited movement}; 1 = 1–4 \text{ limited movements};$ and $2 = 5–8 \text{ limited movements}$.

**Handgrip and Pinch Strength.** To measure handgrip and pulp-to-pulp pinch strength, we used a Jamar dynamometer, which measures forces of 0–91 kg, and a pinch
gauge, which measures forces of 0–27 kg. The Jamar dynamometer has a test–retest reliability of $r \geq .97$ and an interrater reliability of $r \geq .80$ and has been validated in evaluating hand muscle strength with an error of 3% compared with other similar instruments (Kalyoncu et al., 2009). The pinch gauge has an interrater reliability ICC of .83 and a test–retest reliability of .98. It has been validated as a tool for evaluating the muscle strength of three types of pinch, with 1% error compared with other similar instruments (Mathiowetz, Weber, Volland, & Kashman, 1984).

**Symptom Intensity.** Morning stiffness (Vliet Vlieland et al., 1997) and fatigue (Pollard et al., 2006) can be assessed by means of a visual analog scale (VAS). A VAS ranging from 0 to 10 points was used (10 represents the most severe symptoms).

**Dexterity.** Dexterity was evaluated using the MMRT (Johnson, 1995), a standardized task that involves turning the disks in a tray. An estimate of the test’s reliability in the healthy population calculated over two attempts yielded an index of .91 (Lafayette Instrument, 1998).

**Data Analysis**

The demographic characteristics of the sample were calculated as numbers and percentages. Median and interquartile range were used for age and time since diagnosis, because these data were nonnormally distributed.

A linear regression model was used to analyze the effect of the variables used in this study on the ICF activity component. The independent variables were entered into the model, and Spearman’s correlations were calculated to determine whether any variable was highly correlated with the response variable and to avoid multicollinearity. The construction of the multivariate model began with the selection of all component variables that had $p$ values $\leq .20$. Step by step, the least significant variables were removed until only variables with a significance level of $p < .05$ remained in the model. Finally, the full model was fit with all the variables with a significance level of $p < .05$ for all components for the final multivariate model. A residual analysis was then performed to validate the assumptions of the linear regression model.

**Results**

Sample characteristics are presented in Table 3. The linear regression multivariate analysis yielded variables associated with each of the models, as follows (Table 4):

- **Model 1**, RA Activities, included dominant handgrip strength, dominant hand ROM deficit, dominant hand deformity, mental health, general state of health, and functional classification ($R^2 = .512$). Variables with a significance level of .05 were dominant handgrip strength, dominant hand ROM deficit, dominant hand deformity, and mental health.

- **Model 2**, Upper-Limb Activities, included dexterity, dominant handgrip strength, dominant hand ROM deficit, time since diagnosis, classification, general state of health, and age ($R^2 = .473$). Variables with a significance level of .05 were time since diagnosis, dexterity, dominant handgrip strength, and dominant hand ROM deficit.

- **Model 3**, Timed Activity, included dexterity, dominant handgrip strength, work activities, time since diagnosis, and general state of health ($R^2 = .320$). Variables with a significance level of .05 were dexterity and work activities.

- **Model 4**, Physical Autonomy Activities, included dominant handgrip strength, dominant hand ROM deficit, dominant upper-limb total ROM deficit, vitality, pain, functional classification, work activities, and general state of health ($R^2 = .562$). The variables with a significance level of .05 were dominant hand ROM deficit, dominant upper-limb total ROM deficit, vitality, pain, and functional classification.

- **Model 5**, Physical Conditions for Activities, included dexterity, vitality, functional classification, work activities, and general state of health ($R^2 = .416$). Variables with a significance level of .05 were functional classification and vitality.

**Discussion**

In this study, decreased handgrip strength and hand ROM most frequently resulted in activity limitations, followed by decreased dexterity and impaired vitality. The great variability in associated factors suggests that activity limitations in this sample were complex and multifactorial.
Decreased muscle strength in the dominant hand resulted in reduced values for the Upper-Limb Activities and RA Activities constructs, which represent upper-extremity function and self-care. These results are consistent with those of several studies that analyzed hand function in people with RA (Dellhag & Burckhardt, 1995; Goodson et al., 2007).

Decreased finger ROM of the dominant hand also resulted in reduced activities in the Upper-Limb Activities, RA Activities, and Physical Autonomy Activities constructs. The latter two constructs specifically target people with RA, who typically have diminished ROM in their hands (Dellhag & Burckhardt, 1995). The general consensus is that decreased hand ROM causes functional changes in people with RA (Goodson et al., 2007).

The effect of vitality on activity in this study was similar to that reported by Kuhlow et al. (2010). The vitality factor includes fatigue, which is often related to pain and depression symptoms in people with RA (Pollard et al., 2006). Fatigue is associated with decreased quality of life in people with RA and also contributes to sleep disorders and inability to work (Rupp, Boshuizen, Jacobi, Dinant, & van den Bos, 2004).

Clinical dexterity and coordination appeared to affect activities for which a timer was used to measure performance. In a similar study, Kuhlow et al. (2010) noted that no studies have yet investigated the effect of dexterity on activity limitations in people with RA.

The factors that affected the performance and functionality of participants in this study have also been reported in other studies conducted using different methods and evaluation tools. Plant et al. (2005) and Toussirot (2010) reported that the factors affecting functionality are diverse and clearly indicative of a multifactorial phenomenon. Stamm, Cieza, Machold, Smolen, and Stucki (2004) reported that different instruments place different emphases in their measurements and that instruments used for rehabilitation of people with RA are insufficient. As reported by Chung et al. (2011), the multifactorial characteristics of chronic diseases such as RA must be taken into consideration.

Constructs in the ICF activity component also appeared to be influenced by other factors, as reported in the literature. The following factors also affected our results: time since diagnosis, work activities, hand deformities, mental health, fatigue intensity, ACR functional classification, and pain. Therefore, we propose that analysis of activity limitations in people with RA must be complex and multifactorial; focusing only on performance attributes to represent activity limitations may prevent accurate analysis.

### Limitations and Future Research

The current study emphasized the body functions and structures and activity components to the detriment of other components in the ICF model. However, Stamm et al. (2004) argued that the relationship between changes in musculoskeletal function and limitations in activity performance according to the ICF model has not been sufficiently explored in people with rheumatic diseases. Another limitation of this study was the larger proportion

### Table 4. Results of Linear Regression Multivariate Analysis

<table>
<thead>
<tr>
<th>Model</th>
<th>Variable</th>
<th>Beta (95% CI)</th>
<th>p</th>
<th>Adj R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>RA Activities</td>
<td>Dominant handgrip strength</td>
<td>0.46 (0.09, 0.82)</td>
<td>.016</td>
<td>.51</td>
</tr>
<tr>
<td></td>
<td>Dominant hand ROM deficit</td>
<td>-4.23 (-7.72, -0.73)</td>
<td>.018</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dominant hand deformity</td>
<td>-1.47 (-2.07, -0.87)</td>
<td>&lt;.0001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mental health</td>
<td>0.20 (0.09, 0.31)</td>
<td>&lt;.0001</td>
<td></td>
</tr>
<tr>
<td>Upper-Limb Activities</td>
<td>Time since diagnosis</td>
<td>0.30 (0.003, 0.59)</td>
<td>.048</td>
<td>.47</td>
</tr>
<tr>
<td></td>
<td>Dexterity</td>
<td>0.26 (0.13, 0.40)</td>
<td>&lt;.0001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dominant handgrip strength</td>
<td>-0.85 (-1.19, -0.51)</td>
<td>&lt;.0001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dominant hand ROM deficit</td>
<td>3.54 (0.04, 7.03)</td>
<td>.48</td>
<td></td>
</tr>
<tr>
<td>Timed Activities</td>
<td>Dexterity</td>
<td>1.51 (0.34, 2.68)</td>
<td>.013</td>
<td>.32</td>
</tr>
<tr>
<td></td>
<td>Work activities</td>
<td>9.06 (0.02, 18.10)</td>
<td>.049</td>
<td></td>
</tr>
<tr>
<td>Physical Autonomy Activities</td>
<td>Dominant hand ROM deficit</td>
<td>0.42 (0.13, 0.71)</td>
<td>.006</td>
<td>.56</td>
</tr>
<tr>
<td></td>
<td>Total dominant UL ROM deficit</td>
<td>0.13 (0.04, 0.22)</td>
<td>.004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vitality</td>
<td>-0.02 (-0.03, -0.006)</td>
<td>.004</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pain</td>
<td>0.12 (0.02, 0.21)</td>
<td>.020</td>
<td></td>
</tr>
<tr>
<td>Physical Conditions for Activities</td>
<td>ACR functional classification</td>
<td>0.96 (0.47, 1.46)</td>
<td>&lt;.0001</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vitality</td>
<td>-34.16 (-49.81, 18.50)</td>
<td>.002</td>
<td>.42</td>
</tr>
<tr>
<td>Physical Conditions for Activities</td>
<td>ACR functional classification</td>
<td>0.69 (0.53, 1.21)</td>
<td>&lt;.0001</td>
<td></td>
</tr>
</tbody>
</table>

*Note. ACR = American College of Rheumatology; Adj R² = adjusted coefficient of determination; CI = confidence interval; RA = rheumatoid arthritis; ROM = range of motion; UL = upper limb.*
of people categorized at ACR Classes I and II (less severe impairments); people in Classes III and IV are more dependent and less likely to seek outpatient care because of the difficulty of attending specialized centers. Finally, it is important to note that the cross-sectional design of this study prevents inference of cause-and-effect relationships even though significant associations between variables were found.

Future studies should propose evaluations and interventions that consider the context of the ICF model to address both environmental and personal factors. Such studies could clarify the results of different and multifactorial assessments for chronic diseases such as RA. In addition, disability interventions should be considered in individual contexts.

Implications for Occupational Therapy Practice

The results of this study have the following implications for occupational therapy practice:

- Factors associated with activity limitations in people with RA are complex and varied.
- Decreased hand grip strength and hand ROM were most strongly related to activity limitations, followed by decreased dexterity and impaired vitality.
- Occupational therapy evaluation of people with RA should take into consideration all the factors discussed in this article; a sole focus on activity limitations should be avoided.

Conclusion

Selection of the best construct to represent the ICF activity component for people with RA should be based on thorough clinical and individual evaluation to identify the concept that best quantifies individual performance. Interventions based on analysis of functionality using the ICF model may inform future rehabilitation programs for people with RA and prevent potential losses in the related constructs to avoid activity limitations.

Acknowledgments

We acknowledge support from the dean of research at Universidade Federal de Minas Gerais. The study’s ClinicalTrials.gov identifier is NCT02730286.

References


