# SHOULDER ROTATIONAL STRENGTH, MOVEMENT, PAIN AND JOINT TENDERNESS AS INDICATORS OF UPPER-EXTREMITY ACTIVITY LIMITATION IN MODERATE RHEUMATOID ARTHRITIS

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**In this study 32 women were investigated in order to elucidate how shoulder rotational muscular strength and upper-extremity impairments are associated with activity limitation in moderate rheumatoid arthritis. A regression analysis was carried out to determine whether these variables could indicate the outcomes of a shoulder–arm disability questionnaire (SDQ) comprising three parts, plus parts of the Health Assessment Questionnaire, the Functional Status Questionnaire and the Sickness Impact Profile. Shoulder–arm and wrist movements were moderate-to-good ($r = 0.53$, $p < 0.01$ and $r = 0.58$, $p < 0.01$, respectively) in relation to isometric internal rotational strength. The relationship between isokinetic concentric and eccentric internal rotational strength was moderate-to-good ($r = 0.59$, $p < 0.01$). Isokinetic eccentric internal rotation strength, shoulder–arm movement, joint tenderness and pain variables together indicated 25–61% (adjusted $R^2$) of the variation in SDQ. Eccentric strength had the highest adjusted $R^2$ (41%) in relation to SDQ 1, covering mainly personal hygiene. Shoulder rotational strength did not indicate the more general instruments. Thus, hand and elbow impairments also are probably important in explaining activity limitations.**

*Key words:* human activities, arm, arthritis, rheumatoid, disability evaluation, health status indicators, movement, muscle, skeletal, pain measurement.

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## INTRODUCTION

Compared with healthy subjects, patients with rheumatoid arthritis (RA) have reduced isometric (1–7) and isokinetic muscular strength (1, 3, 4, 8). Several studies have shown increased muscular function after exercise (9). Van den Ende et al. (10) concluded that dynamic muscular exercises in patients with RA entail increased muscular strength, although this review article concerns mainly evaluation of lower-extremity strength. Studies comprising specific exercises and strength evaluation of the upper extremities are less common than exercises and evaluation of the lower extremities.

Few studies have been undertaken on the relationship between muscular strength and self-reported activity limitation in RA. Grip strength, however, has been associated with activity (e.g. 11–13). Recently, it has also been shown that elbow and knee isometric muscular strength are indicators of activity limitation (14).

Problems of the upper extremities are frequent in RA, and shoulder problems are common. Although weakness of upper-extremity muscles in RA has often been reported (2, 5, 7, 8), this has been seldom investigated. Shoulder rotational muscular strength is of particular interest, as the muscles involved are the weakest (isokinetically) in the shoulder joint (e.g. 15). Since these muscles also stabilize the shoulder joint (e.g. 16) it seems important to measure and exercise them in patients with RA.

The International Classification of Impairment, Activity and Participation (ICIDH-2) (17) is important for rehabilitation personnel as a guide level for examining, setting goals, treating and evaluating a health problem. Physiotherapy embraces at least two perspectives on impairment and activity. One is focused on impairment level, with the assumption that an activity limitation will be influenced by treatment and intervention. The other perspective is focused on activity level with the ensuing analysis of reasons for activity limitations. If the relationships between impairment levels and activity levels are strong, then one can examine, set goals, treat and evaluate at either level. If the relationships are weak, focus on impairment level may be questioned, unless it is goal-related.

In an earlier study by the present authors (18) with the focus on movement impairment, the relationships between disease activity, pain, shoulder, elbow and wrist movement and activity limitation were studied in female RA patients. Although these variables—and especially movement impairment—might be seen as predictors of activity, the relationships were rather weak, and it might be that inclusion of the muscular strength variable could strengthen the relationships, which was the aim of this study.

## METHODS

### *Subjects*

The criteria for participation in the study included RA according to the American Rheumatism Association (ARA) (19); female; aged 20 or

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older; pain- and/or problems caused by movement impairment in the shoulder–arm region and willingness to participate later in a training study of shoulder joint rotational muscular exercises. Owing to a long period of data collection, technical problems with the isokinetic muscular strength measuring devices and the requirement that the patients should be able to perform a range of motion (ROM) arc of 60° in shoulder rotation, complete data sets were obtained for only 32 of the 63 subjects described in detail earlier (18). Despite the small sample size, we suggest possible relationships between the shoulder rotational muscular strength and other upper-extremity impairment variables and activity limitation, which might be of clinical importance. Median age of the subjects was 65.5 years (lower quartile 55.5 years; upper quartile 69.3 years) and median disease duration was 8.5 years (lower quartile 4 years; upper quartile 19.3 years). All the subjects were in Steinbrocker et al. (20) functional classes I–II, with the exception of one subject, who was in functional class III. Their activity limitations according to parts of the Health Assessment Questionnaire (HAQ) (12), the Functional Status Questionnaire (FSQ) (21) and the Sickness Impact Profile (SIP) (22) are presented in Table I. The 32 subjects were clinically somewhat better in activity and somewhat older than the group mentioned above (18). Twenty-five of the subjects were old-age- or disability pensioners, 5 were working or studying, one subject was sick-listed and one was unemployed. The subjects were on daily NSAIDs and/or disease-modifying drugs, corticosteroids, irregular analgesics, or occasional intra-articular corticosteroid injections.

Table I. *Medians (calculated from means of right and left shoulder and wrist for each patient) for shoulder–upper arm pain at rest, isometric shoulder internal and external rotational muscular strength, isokinetic concentric and eccentric shoulder internal rotational muscular strength and wrist volar flexion. In addition, medians for the other instruments, lower and upper quartiles (%) and ranges for different instruments (SDQ; Shoulder–arm Disability Questionnaire, HAQ; Health Assessment Questionnaire, FSQ; Functional Status Questionnaire and SIP; Sickness Impact Profile),* (n = *32)*

| Instrument | Median | 25; 75% | Ranges |
|---|---|---|---|
| Joint tenderness (0–42) | 8 | 5; 10.8 | 1–19 |
| Pain at rest (0–10) | 0.75 | 0; 2 | 0–3.5 |
| Pain during movement (0–50) | 12.8 | 7.9; 16.4 | 1.1–20 |
| Number of tendalgias (0–8) | 0 | 0; 1 | 0–4 |
| Shoulder–arm movement (5–30) | 26 | 21.1; 28.5 | 13.5–30 |
| Wrist volar flexion (°) | 42.5 | 33.1; 61.9 | 22.5–90 |
| Isometric internal rotation (Nm) | 8.6 | 5.4; 11.7 | 1.6–17.7 |
| Isometric external rotation (Nm) | 6.3 | 4.3; 8.4 | 1.1–16.5 |
| Isokinetic concentric (Nm) | 7.5 | 5.5; 10.3 | 3.5–18 |
| Isokinetic eccentric (Nm) | 13.3 | 10.3; 20.8 | 6.5–24 |
| SDQ 1[a] (0–100) | 80.9 | 64.2; 90.4 | 9.5–99.9 |
| SDQ 2[a] (0–100) | 83.3 | 66.6; 91.6 | 16.7–99.9 |
| SDQ 3[a] (0–100) | 62.4 | 43.7; 81.9 | 0–99.9 |
| HAQ[b] (0–3) | 1.13 | 0.89; 1.38 | 0.13–2.50 |
| FSQ[a] (0–100) | 76.3 | 55.2; 82 | 14.3–97.3 |
| SIP, physical[b] (0–100) | 11.9 | 3.9; 17.8 | 0–59.2 |
| SIP, overall[b] (0–100) | 11.4 | 6.3; 15.8 | 0–48.4 |

[a] The higher the score, the better the ability.
[b] The higher the score, the poorer the ability.

*Measurements and recordings*

Ratings of impairments and activities followed the revised ICIDH (17). The reliability for recording the Ritchie index (23), pain intensity (24), shoulder tendinitis (25), shoulder-arm functional movement (26), active wrist range of motion (23), isometric muscular strength (27) and isokinetic muscular strength (28) is satisfactory. The HAQ, FSQ and SIP also show satisfactory reliability (12, 22, 29).

*Impairments in upper extremities*

*Disease activity.* As a sign of disease activity, the upper-body half of the Ritchie articular index (30) was recorded. This index scores joint tenderness on a four-grade scale (0–3). The jaw, neck and upper-extremity joints (described earlier, 18) were included (possible score 0–42). The higher the score, the more tender the joints are and/or the more tender joints there are.

*Pain.* Pain intensity in the shoulder–upper arm at rest and during tests of shoulder–arm movements was assessed using Borg's category ratio scale (CR-10) (31). This scale ranges from 0 to 10, where 0 equals "no pain" and 10 "extremely severe pain". The presence of shoulder tendalgia was used as another pain variable. Isometric muscular contraction, extension and palpation of the tendon and its insertion (32) were performed. If pain was provoked by all three actions, the patient was considered to have tendalgia. The muscles tested were the long tendon of the biceps brachi (resistance to elbow flexion), supraspinatus (resistance to abduction), infraspinatus (resistance to external rotation) and the subscapularis (resistance to internal rotation).

*Movement.* Functional active movement was assessed in five shoulder–arm movements (hand-raising, hand-to-opposite-shoulder, hand-to-neck, hand-behind-back and hand-to-seat) (possible score 1–6 per movement): the higher the score, the greater the ability (33). Range of motion of active wrist volar flexion was recorded according to the procedure of the American Academy of Orthopaedics Surgeons (34), with the patient seated.

*Isometric muscular strength.* Maximum isometric voluntary muscular moment, i.e. muscular strength of the shoulder internal and external rotators, was tested in a seated position using a special apparatus (Rodby, Enhörna, Sweden) and an electromechanical force transducer (Bofors, Sweden). The measurement procedure has been described in detail earlier (35).

During maximum strength testing, the contraction was gradually increased and verbal feedback was given until the values stabilized at a peak level. The highest value of three reproducible recordings was used in the analysis. For each subject, the moment arm was measured from the joint axis to the point of application of the force transducer. The movement centre of the shoulder joint axis was projected to the longitudinal axis of the humerus at the centre of the lateral epicondyle of the humerus.

*Isokinetic muscular strength.* Maximum isokinetic muscular strength of shoulder internal rotators was tested using a Kinetic-Communicator (KIN-COM) dynamometer with a special software program. Two different devices with the same testing system were used; version 3.0 and version 3.21 (Chattex Corporation, Chattanooga, Tennessee). The reliability of the KIN-COM operating systems (lever arm position, lever arm velocity and force measuring systems), i.e. the ability to reproduce measurements of weight, has been reported as accurate (36). In our study the angles and gravity corrections were recorded before measurements.

The subjects sat with the trunk stabilized and the feet on a foot rest (Fig. 1). The part of KIN-COM where the mechanical joint axis is situated was tilted maximally backwards to align with the anatomic joint axis for shoulder rotation. The elbow was placed in a V-shaped support aligned with the KIN-COM mechanical joint axis, keeping the shoulder joint at approximately 30° of abduction, slightly flexed (5–10°), and approximately 90° of elbow flexion, and the forearm in between supination and pronation. To minimize the efforts of the wrist flexors and extensors, the forearm was fixed distally to a pad including a force transducer. The subjects were asked not to move the forearm in elbow flexion and extension during the measurements. The moment arm was measured in the same way as in isometric muscular testing.

Concentric$_{(con)}$ and eccentric$_{(ecc)}$ muscular strength at 60°/s were measured. The minimal force required to start the contractions was set at 5 N. Concentric contraction was measured first, then eccentric and then concentric again, and so on. The subjects rested for about 30 seconds between each contraction. Three contractions per type were performed and the average was used in the analysis. Measurements at 30°/s and external rotation at both 30°/s and 60°/s were also carried out but were more difficult to perform and pain and/or weakness resulted in some of the subjects breaking off the trial. For concentric contractions, the reason for this at 30°/s might be that lower speeds require more strength than movements at higher speeds (e.g. 16). In addition, the external rotators of

*Fig. 1.* Positioning during isokinetic measurements.

the shoulder joint are weaker (isokinetically) than their corresponding internal rotators (16, 37). These measurements were not included in the results.

In the analysis, 60° ROM and torque average were used because these could better represent a functional movement than the commonly used peak torque does. Several authors (e.g. 37) have also shown that the range of angles at which peak torque in shoulder rotation is attained varies widely. The majority of the measurements were taken at between approximately 30° external rotation and approximately 30° internal rotation, being 0° when the forearm was in the sagittal plane. Measurements that exceeded 60° ROM were cut off at the end of the ROM arc.

Three physiotherapists, not otherwise involved in the study, recorded the impairments. To increase reliability, the physiotherapists received both verbal and written information before the start of the study. They also observed another physiotherapist, who was familiar with the different measurements, before making their own assessments and measurements. Training assessment techniques among physiotherapists show good reliability (38). The recordings of isokinetic muscular strength were carried out by one person (C.B).

*Activities*

*Activity questionnaire for the upper extremities.* A shoulder–arm disability questionnaire (SDQ) (33) was used, comprising three parts: SDQ 1—reflecting mainly personal hygiene (washing one's face, armpits, back, buttocks, combing one's hair, doing one's hair, putting on/taking off a coat); SDQ 2—dressing-related items (putting on/taking off socks, trousers, shoes, a sweater); and SDQ 3—lifting, carrying, pouring and tying knots (possible score 0–100/part). The SDQ is described elsewhere (33).

*General activity questionnaires.* The part of the HAQ (possible score 0–3) measuring mainly physical activity limitation and the parts of the FSQ (possible score 0–100) measuring mainly physical and social activity limitation were also used, as well as the physical and overall (including physical and psychosocial dimensions and independent categories) dimensions of the SIP (possible score 0–100/dimension), which measure mainly physical and overall activity limitation.

*Statistics and analysis*

The mean pain intensities for the right and the left shoulder during each of the five single shoulder-arm movements were summed to a total "pain-during-movement" score (possible score 0–50). The shoulder–arm movements were scored similarly (possible score 5–30). Means of right and left shoulder–upper arm pain at rest, wrist volar flexion, isometric shoulder rotational strength and isokinetic shoulder internal rotational strength were also used in the analysis.

Correlations were calculated with Pearson's product moment correlation coefficient and the *p*-values were adjusted according to the Bonferroni procedure. Correlations from 0 to 0.25 indicate little or no relationship, those from 0.25 to 0.50 a fair degree of relationship, those from 0.50–0.75 a moderate to good relationship and those above 0.75 a very good to excellent relationship (39).

A forward, stepwise multiple linear regression analysis was used to evaluate how far the variation in different activity instruments could be explained by the variables measuring muscular strength, movement, pain and disease activity together. The significance level was set to 0.05.

From an earlier study (18), the significant predicting variables (with the exception of passive shoulder adduction and active elbow supination) that described activity limitation were included as possible indicating variables in the present study. Together with isometric shoulder rotational strength and isokinetic shoulder internal rotational strength, there were 10 indicating variables. Owing to the small sample size only three dependent variables could be analysed at the same time in the regression model.

In the regression analysis, shoulder–upper arm pain at rest and the number of shoulder tendalgias were dichotomized, these conditions being treated as present or absent. The reason for this was that several patients had no pain at rest and no tendalgia (the lower quartiles (25%) were 0). For the following variables the distribution was positively skewed; isometric shoulder external rotational strength and the physical and overall dimensions of SIP. These data were log-transformed to reduce positive skew. Shoulder–arm movement, SDQ 1, SDQ 2 and FSQ were squared, owing to negative skew. In this study we computed factor-based scores (40) for the factors SDQ 1, SDQ 2 and SDQ 3 in the SDQ questionnaire.

## RESULTS

The medians, lower and upper quartiles and ranges from the different measurements and instruments are listed in Table I.

*Correlations between shoulder rotational muscular strength variables*

The correlation between isometric internal and isometric external strength was very good to excellent ($r = 0.78$, $p < 0.01$), and that between concentric and eccentric isokinetic internal rotational strength was moderate to good ($r = 0.59$, $p < 0.01$). The other relationships between muscular strength variables were fair ($r = 0.36$–$0.42$).

*Correlations between muscular strength variables and the other dependent variables*

The correlation between wrist volar flexion and isometric internal ($r = 0.58$, $p < 0.01$) and external ($r = 0.52$, $p < 0.05$) rotator strength was moderate to good, as was that between shoulder–arm movement and isometric internal rotator strength ($r = 0.53$, $p < 0.01$). The correlation between shoulder–arm movement and isometric external rotational strength was fair ($r = 0.48$, $p < 0.05$). The other relationships were weak or none-to-fair.

*Correlations between shoulder muscular strength variables and SDQ, HAQ, FSQ and SIP*

The relationships between shoulder rotational muscular strength variables and SDQ, HAQ, FSQ and SIP are presented in Table II. The relationships between isometric and isokinetic strength and SDQ 1 were fair-to-moderate to good. All the other relationships between strength and activity were weak or

Table II. *Correlations (Pearson's) between shoulder rotator muscular strength variables (isometric internal and external rotation and isokinetic concentric and eccentric internal rotation) (int. rot. = internal rotation, ext. rot. = external rotation, (conc) = concentric, (ecc) = eccentric) and SDQ (Shoulder–arm Disability Questionnaire) 1, SDQ 2, SDQ 3, HAQ (Health Assessment Questionnaire), FSQ (Functional Status Questionnaire) and the physical and overall parts of SIP (Sickness Impact Profile)* (r-*values, and* p-*values in parentheses) (n.s = non-significant)* (n = 32)

| | Isometric int. rot. | Isometric ext. rot. | $\text{Isokinetic}_{(conc)}$ | $\text{Isokinetic}_{(ecc)}$ |
|---|---|---|---|---|
| SDQ 1 | 0.43 (n.s) | 0.42 (n.s) | 0.34 (n.s) | 0.65 ($p < 0.01$) |
| SDQ 2 | 0.24 (n.s) | 0.35 (n.s) | 0.11 (n.s) | 0.39 (n.s) |
| SDQ 3 | 0.21 (n.s) | −0.004 (n.s) | 0.35 (n.s) | 0.39 (n.s) |
| HAQ | −0.34 (n.s) | −0.38 (n.s) | −0.09 (n.s) | −0.34 (n.s) |
| FSQ | 0.27 (n.s) | 0.14 (n.s) | 0.09 (n.s) | 0.29 (n.s) |
| SIP, physical | −0.46 ($p < 0.05$) | −0.26 (n.s) | −0.05 (n.s) | −0.18 (n.s) |
| SIP, overall | −0.26 (n.s) | −0.13 (n.s) | 0.04 (n.s) | −0.008 (n.s) |

none-to-fair. The relationships between the $\text{isokinetic}_{(ecc)}$ strength and SDQ 1, 2, 3 were fair-to-moderate to good. Between the latter strength variable and HAQ, FSQ and SIP the relationships were weak or none-to-fair.

*Regression analysis*

Muscular strength variables were indicators only for SDQ not for HAQ, FSQ or SIP. Therefore only SDQ is included in the regression analysis.

About 61% (adjusted $R^2$) of the variation among the results within SDQ 1 was explained by $\text{isokinetic}_{(ecc)}$ shoulder internal rotational strength (adjusted $R^2 = 0.41$), shoulder–arm movement and pain during shoulder–arm movements. About 25% (adjusted $R^2$) of the variation within SDQ 2 was explained by $\text{isokinetic}_{(ecc)}$ shoulder internal rotational strength (adjusted $R^2 = 12.5$), shoulder-arm movement and the occurrence of shoulder–upper arm pain at rest. For SDQ 3, the indicator variables were $\text{isokinetic}_{(ecc)}$ shoulder internal rotational strength (adjusted $R^2 = 12.2$), joint tenderness and the occurrence of shoulder tendalgia, together explaining about 42% (adjusted $R^2$). The results are presented in Table III.

## DISCUSSION

Although there were rather few subjects in this study, the results indicate that maximum $\text{isokinetic}_{(ecc)}$ muscular strength of shoulder internal rotation is an indicator of upper-extremity activity limitation, mainly in personal hygiene. Together with joint tenderness, pain variables and shoulder–arm movement variables, this $\text{isokinetic}_{(ecc)}$ strength explains a fairly large part of the variance in upper-extremity activity, but also leaves much to be explained, especially in SDQ 2 and 3.

The variation in activity limitation that was not explained in SDQ can probably be explained by impairments in hand and elbow and in SDQ 2 also by lower-extremity impairments. Measurement of hand function and grip strength may strengthen the explanation of the variation in activity limitation, but the focus of the present study was on shoulder-arm impairments.

As about 80% of RA patients can function independently (41), our results refer to the majority of patients. Still, the result might have been different with a larger sample, with more variation in functional capacity and disease activity. With a larger sample, movement and also isometric muscular strength may have been

Table III. *Indicator variables (joint tenderness, occurrence of pain at rest, pain during movement, occurrence of tendalgia, shoulder–arm movement and isokinetic eccentric strength) for SDQ (Shoulder–arm Disability Questionnaire) 1, 2, 3. Values presented are regression coefficient (b), standard error of b (SE (b)), adjusted $R^2$ ($R^2$), constant and total adjusted $R^2$ ($R^2$)* (n = 32)

| | SDQ 1[a] b (SE (b)) **$R^2$** | SDQ 2[a] b (SE (b)) **$R^2$** | SDQ 3 b (SE (b)) **$R^2$** |
|---|---|---|---|
| Joint tenderness | | | −2.5 (0.96) **0.217** |
| Occurrence of pain at rest | | −2123.2 (1031.6) **0.063** | |
| Pain during movement | −151 (62) **0.168** | | |
| Occurrence of tendalgia | | | −18.4 (8.4) **0.076** |
| Shoulder-arm movement[a] | 3.2 (1.6) **0.038** | 4.5 (2.3) **0.063** | |
| Isokinetic eccentric strength | 320 (65) **0.408** | 223 (98.9) **0.125** | 2.1 (0.76) **0.122** |
| Constant | 1225 (1336.8) | 1498 (1673.4) | 54 (13.2) |
| Total adjusted **$R^2$** | **0.614** | **0.251** | **0.415** |

[a] The variables are squared-transformed.

more important in explaining the variation in activity limitation. For the latter, the relationships may depend on threshold levels in muscular strength, as suggested by some authors (42, 43). Another reason why isometric strength did not contribute to the explanation of activity is that daily activities are usually performed at a number of angles and not at one single joint angle. Threshold levels might also explain the low correlation between isokinetic$_{(con)}$ strength and activity limitation, except that eccentric contractions probably also stress the tendon and its insertion more than concentric contractions.

One reason why isometric strength correlated poorly with isokinetic strength might be that isometric torque was measured only at one single joint angle. To plan optimal exercises, isometric strength should be measured at different angles, as suggested by others (e.g. 44).

Isokinetic muscular strength measurements might reflect pain in patients with RA, as such measurements involve dynamic movements. In our study, pain was allowed during the measurements. However, pain intensity levels were not measured, the patients themselves judging how much effort to exert. Muscular strength is possibly influenced by reflex inhibition (45). Arvidsson et al. (46) have shown that pain relief plays a significant role in the ability to activate quadriceps normally, after open-knee surgery. For these reasons pain during strength measurements might contribute to our finding that isokinetic$_{(ecc)}$ strength is an indicator of upper-extremity activity.

The fact that shoulder–upper arm pain at rest and during shoulder–arm movements are indicating variables for SDQ 1 and 2 in the present study but not in our earlier study (18) might be because we used different regression models and because of the way different dependent variables correlate to each other and to the independent variables.

One reason why shoulder rotational muscular strength did not indicate HAQ, FSQ and SIP could be that these general activity instruments cover activities where other muscles in the upper- and lower extremities are probably important. Stucki et al. (14) also found that when measured as one index, isometric strength in both the upper- and lower extremities is related to HAQ. Furthermore, the general activity instruments also reflect other impairments in both the upper and lower extremities. The sum scores, particularly in FSQ and overall SIP, also include factors where shoulder rotational strength is probably not as important as in instruments reflecting upper-extremity activity. It seems that further studies are needed to find out which muscular groups can best explain the variation in activity instruments in patients with RA and whether there are any threshold levels.

Comparison of our isokinetic muscular strength results with those of other studies is difficult because of the variety of sitting positions, different measuring velocities, whether gravitational forces are included, different ROM and the fact that peak torque has usually been used as the outcome of strength. We have been unable to find any study measuring isokinetic shoulder rotational strength in RA.

Nor have we found any study concerning eccentric muscular strength training in the shoulder joint in RA, probably because the training devices are expensive and eccentric contractions involve a risk of rotator cuff injury or shoulder subluxation (28) and muscle soreness (47). Few authors have studied isokinetic$_{(ecc)}$ exercises in RA, and only in the lower extremities (e.g. 48). Although isokinetic muscular exercises in the shoulder joint produce the greatest increase in concentric strength (47), the question is whether the shoulder joint and muscle mechanisms will hold in patients with RA. However, weakness of isokinetic$_{(ecc)}$ internal rotational strength might reflect isokinetic strength of the shoulder muscles in general, in which muscles are easier to exercise and also might be beneficial.

Although the results of this study explain the variation in activity to a fairly high degree, indicating that impairment is related to activity, there is still much that remains unexplained. Physiotherapists dealing with RA patients should probably study several more impairment variables in relation to each other and to activity, but perhaps also, as recommended in the literature of, for example, movement science (49), they should analyse, set goals, treat and evaluate at activity level.

In summary, the study indicates that isokinetic$_{(ecc)}$ shoulder internal rotational muscular strength is related to activities in the upper extremities but is not reflected by general activity instruments. However, there is still much that needs explanation, even when using activity questionnaires that focus specifically on the upper extremities. Thus, hand and elbow impairments are probably also of importance in explaining activity. We are aware that these results alone cannot form a basis for further conclusions, but they do indicate that further study might be fruitful.

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