Work Limitations Among Working Persons with Rheumatoid Arthritis: Results, Reliability, and Validity of the Work Limitations Questionnaire in 836 Patients

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ABSTRACT. ***Objective.*** To describe workplace limitations and the validity and reliability of the Work Limitations Questionnaire (WLQ) in persons with rheumatoid arthritis (RA).

Methods. A total of 836 employed persons with RA reported clinical and work related measures and completed the WLQ, a 25 item questionnaire that assesses the impact of chronic health conditions on job performance and productivity. Limitations are categorized into 4 domains: physical demands (PDS), mental demands (MDS), time management demands (TMS), and output demands (ODS), which are then used to calculate the WLQ index.

Results. Of the 836 completed WLQ, about 10% (85) could not be scored, as more than half the items in each domain were not applicable to the patient's job. Demographic and clinical variables were associated with missing WLQ scores including older age (OR 1.7, 95% CI 1.3–2.1), male sex (OR 1.9, 95% CI 1.2–3.0), and Health Assessment Questionnaire (HAQ) scores (OR 1.4, 95% CI 1.0–2.0). Work limitations were present in all work domains: PDS (27.5%), MDS (15.7%), ODS (19.4%), and TMS (28.6%), resulting in a mean WLQ index of 5.9 (SD 5.6), which corresponds to a 4.9% decrease in productivity and a 5.1% increase in work hours to compensate for productivity loss. The WLQ index was inversely associated with Medical Outcomes Study Short Form 36 (SF-36) Mental Component Score (MCS; r = –0.60) and Physical Component Score (PCS; r = –0.49). Fatigue (0.5), pain (0.46), and HAQ (0.56) were also significantly associated with the WLQ index. Weaker associations were seen with days unable to perform (0.29), days activities cut down (0.38), and annual income (–0.10).

Conclusion. The WLQ is a reliable tool for assessing work productivity. However, persons with RA tend to select jobs that they can do with their RA limitations, with the result that the WLQ does not detect functional limitations as well as the HAQ and SF-36. The WLQ provides special information that is not available using conventional measures of assessment, and can provide helpful knowledge about individual patient problems in the workplace. Whether this information will have greater predictive ability and clinical relevance compared with surrogate measures such as the HAQ and SF-36 has not been determined, but should be the subject of future studies. (J Rheumatol 2005;32:1006–12)

Key Indexing Terms:
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Diminished work capacity is a central outcome of rheumatoid arthritis (RA). Work capacity is usually measured by (1) the ability to be employed — the work disability rate; (2) by the number of days lost from work or the number of days unable to fully perform job tasks because of illness; and (3) the actual ability to perform work tasks, and the patient's functional ability. Work disability is a robust measure, but is strongly related to demographics, social support systems, and economic conditions. In addition, it is a dichotomous measure and is insensitive to diminished work ability among the working, or what has been called "presenteeism." Days lost from work or the number of days unable to fully perform work tasks is a crude but often-used measure that suffers from recall and ascertainment bias at the patient-care level[1]. A number of health related lost workplace productivity instruments exist and have been recently reviewed[2]. The measurement of functional ability, although it may offer strong insights into work ability, is a surrogate measure that may not relate to actual work tasks.

In 2001, Lerner and colleagues developed the Work Limitations Questionnaire (WLQ) to measure the extent to which health related problems interfere with a person's work capacity in the workplace[3]. This questionnaire was

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studied in a number of settings and illnesses, including osteoarthritis, and data relating to validity and reliability were developed[3-6]. Subsequently, the authors provided weights for the questionnaire's scores so that the extent of loss of work ability and productivity could be estimated as percentage of expected capacity[6]. The WLQ measures presenteeism. As such it may be useful to employers; it may be predictive of future work disability and alert patients, physicians, and employers to problems that can be ameliorated.

The WLQ offers an opportunity to study and provide insights into work related disability among patients with RA. Psychometric testing of the WLQ in this population has not been performed to date. Our aim was to (1) describe the limitations experienced at work in a group of employed patients with RA; (2) examine the reliability or internal consistency of the WLQ; (3) using correlation analysis, to determine the construct validity of the WLQ as a measure of employment related disability in relation to a number of clinical, demographic, and work status variables that are known to be associated with work ability and functional status; and (4) to describe the clinical relevance of the WLQ in RA compared to other available tools.

MATERIALS AND METHODS

Patient sample. Patients in this study were participants in the National Data Bank for Rheumatic Diseases (NDB) longitudinal study of RA outcomes. Patients were recruited from the practices of 915 United States rheumatologists, and are followed with semiannual questionnaires[7-10]. The NDB represents an open cohort in which patients are added continuously. About 8% of patients decline to participate per year. This report concerns the status of 836 employed RA patients who completed at least one WLQ during the 18 month period from July 2001 through December 2002. In the event more than one questionnaire was completed, the most recent questionnaire was chosen for analysis. Of working patients, approximately 98% completed the WLQ.

Demographic and disease status variables. NDB participants were asked to complete semiannual, detailed 28 page questionnaires about all aspects of their illness. At each assessment, demographic variables were recorded including sex, age, ethnic origin, education level, current marital status, and medical history. Disease status and activity variables collected included the Stanford Health Assessment Questionnaire functional disability index (HAQ disability)[11,12]; visual analog scales (VAS) for pain, global disease severity, and fatigue[13]; the Arthritis Impact Measurement Scales (AIMS) anxiety and depression scales[14,15]; and the RA Disease Activity Index (RADAI)[16-18]. Patients also completed the Medical Outcomes Study Short Form 36 (SF-36), from which the Physical Component Score (PCS) and the Mental Component Score were calculated[19,20]. HAQ-II is a shortened, modified version of the HAQ with similar scaling, but superior psychometric properties[21].

Work related variables. Patients who were employed report annual earnings and the number of hours worked per week. The earnings questions was: "How much did you yourself earn from all of your job in the last year (January-December 2002) BEFORE TAXES?" Check boxes were provided and ranged from "Under $10,000" in $10,000 steps until "$100,000 or more." Patients also report the number of days in the last 6 months lost from work and the days unable to perform fully in the last 30 days. The ability to perform specific work tasks was assessed with the WLQ[3,5]. The WLQ is a self-administered questionnaire that was designed for assessing individuals ("respondents") who are currently employed. It includes 25 items covering 4 dimensions: physical demands (PDS), mental demands (MDS), time management demands (TMS), and output demands (ODS), over a 2 week reporting period. In psychometric studies the WLQ has demonstrated high reliability and construct validity[3,5]. When evaluated in a group of patients with osteoarthritis (OA), the WLQ correctly detected OA versus healthy, employed control group differences and correlated significantly with arthritis pain, stiffness, functional limitations, and self-reported work productivity. The PCS of the SF-36 was related to the WLQ physical demands score ($F = 23.98$, $p = 0.0001$). In addition, the amount of work limitation reported by OA patients was related to their self-reported arthritis severity[4]. The WLQ indicates the degree to which health problems interfere with specific aspects of job performance (called on-the-job disability or presenteeism) and the productivity impact of these work limitations. The WLQ index is calculated from 4 subscales and weighted based on an analysis of the relationship between WLQ scale scores and actual employee productivity[4]. Scores may be interpreted as the percentage loss in productivity compared to a healthy (not limited) employee or the percentage increase in work hours required to compensate for productivity loss, with reference to a conversion table.

Statistical methods. Scoring of the individual items, subscales, and WLQ index followed the methods of the WLQ manual[6]. However, the method of scoring suggested by the manual led to loss of data in 10.1% of patients because of a "not applicable" category. Therefore, we also scored the WLQ by imputing missing index values using an approximate Bayesian bootstrap hot-decking method, stratified on sex and HAQ score. Except as described, data reported here are not imputed and use the scoring method suggested by the WLQ manual.

To model the relationship between HAQ, WLQ, and earnings, we used age, sex, education level, marital status, and ethnicity as covariates. Because the relationship between earnings and age was not linear, age was modeled using linear splines with cutpoints at 40 and 65 years of age. As earnings are recorded in categories that are censored at < $10,000 and $100,000, censored interval regression was used to model the relationship between these variables and predictor variables. The model-dependent variable was earnings. In addition to the covariates specified above, HAQ and WLQ were right-hand side variables in separate regression analyses.

Correlation analyses used Pearson correlations. Correlation analysis was chosen for display of construct validity data as it was the simplest, most readable way to display the associations across multiple columns. Data were analyzed using Stata v. 8.0[22].

RESULTS

Demographic and severity characteristics. The mean age of the 836 employed RA patients was 53.3 years (SD 10.5; Table 1). Seventy-seven percent of the employed patients were women and 39.4% were college graduates. Non-Hispanic whites made up 92% of the employed study population. Median annual earnings were $25,000. The mean and median hours worked were 36.9 (SD 13.9) and 40.0, respectively. Six percent (6.0%) of patients worked 10 hours or less. Patients reported that health kept them from performing their work 3.9 days (SD 7.4) in the last 30 days and that the number of limited days in the last 6 months was 20.7 (SD 40.7). The effects of RA were seen in the mean HAQ scores of 0.8 and the SF-36 physical component score of 35.9, suggesting mild to moderate impairment.

Measuring productivity with the WLQ. The WLQ scales are linked to observed productivity such that the WLQ score can be translated into a decrease in productivity compared to healthy persons. The distribution of WLQ index scores was skewed (Figure 1). Roughly 24% of individuals had a WLQ

Table 1. Characteristics of 836 employed patients with RA.

Variable	Mean	SD
Age, yrs	53.3	10.5
Sex, % male	23.9	
Non-Hispanic white, %	92.2	
High school graduate, %	97.0	
College graduate, %	39.4	
Disease duration, yrs	13.9	10.1
Annual earnings, US dollars	33,845	24,719
HAQ (0–3)	0.8	0.6
HAQ2 (0–3)	0.8	0.5
Pain (0–10)	3.3	2.6
Global severity (0–10)	2.8	2.3
Physical component score, SF-36	35.9	9.6
Mental component score, SF-36	46.4	12.9
RADAI	3.09	1.96

RADAI: Rheumatoid Arthritis Disease Activity Index.

index of zero, suggesting no limitations, while < 1% had scores of 30. The mean WLQ score was 5.9 (SD 5.6) and the median score was 4.6 (Table 2). This translates to a 4.9% decrease in productivity and a 5.1% increase in work hours required to compensate for productivity loss[6] and suggests that most persons with RA experienced little disability at work. Of the WLQ subscales, the mental demands (MDS) and time management scales (TMS) were least affected by RA (Table 2). In linear (p = 0.330) and nonlinear regression (p = 0.333) analyses, WLQ index was not related to duration of RA.

However, of the 836 persons who completed the WLQ, only 751 observations (89.9%) could be used in calculating the WLQ index because of exclusions of data due to "Does not apply to my job" responses. As shown in Table 2, individual items had varying rates of nonapplicable responses. As nonapplicable items are not scored and are treated as "missing" in scoring the domains (PDS, MDS, ODS, and TMS), missing data are generated for the domains and for the WLQ index by the recommended scoring system. The items that were most often "missing" were lifting (21.8%), repetitive activities (15.2%), difficulty thinking clearly (14.8%), difficulty helping people (12.1%), and difficulty bending (10.2%).

We used logistic regression to explore the relationship between missingness for the WLQ index and demographic and severity characteristics (Table 3). Missingness was associated with HAQ [OR 1.4 (0.99 to 2.0)] and HAQ-II [OR 1.7 (1.1 to 2.5)] scores, 10 year age differences [OR 1.7 (1.3 to 2.1)], and being male [1.9 (1.9 to 3.0)], but not with education, anxiety, depression, or fatigue. In multivariable analyses, these variables remained significant (except for HAQ; p = 0.066). In addition, rates of missingness for the various domains differed according to sex. For males versus females, these rates were TMS (10.0% vs 4.2%), PDS (8.0% vs 3.0%), MDS (4.5% vs 2.7%), and ODS (4.5% vs 5.3%). These differences may be explained in part by the older age of men with missing data: 64.6 years (SD 8.0) versus 54.8 years (SD 13.0). The HAQ and HAQ-II scores for those with and without missing data were HAQ 0.9 (SD 0.7) versus 0.8 (SD 0.6) and HAQ-II 0.9 (SD 0.6) versus 0.7 (SD 0.5). The HAQ results indicate that missingness is associated with RA severity.

Measuring construct validity of WLQ in patients with RA. The degree to which the WLQ agreed with theoretical constructs of disability as quantified by similar tests of disability is presented in Table 4. The WLQ index was inversely associated with SF-36 MCS (r = –0.60) and SF-36 PCS (–0.49). Fatigue (0.50), pain (0.46), and HAQ (0.56) and HAQ-II (0.54) were also significantly associated with the

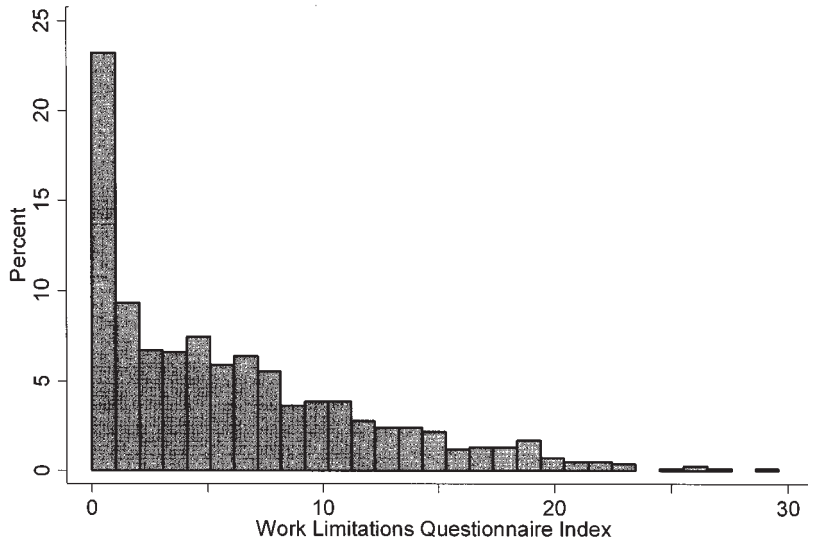

Figure 1. Distribution of WLQ scores among 836 persons with RA.

Table 2. Analysis of items, categories, and WLQ scale according to items scored as not applicable.

Difficulty Category	Scale	Not Applicable, n	Not Applicable, %	Item Mean (SD)
Items				
Lifting or carrying	PDS	182	21.8	2.2
Repetitive physical tasks	PDS	127	15.2	2.2
Thinking clearly	MDS	124	14.8	1.7
Helping others	MDS	102	12.2	1.5
Bending or reaching	PDS	85	10.2	2.2
Walking or moving around	PDS	76	9.1	1.8
Working without a break	TMS	74	8.9	2.2
Sticking to a routine or schedule	TMS	70	8.4	1.7
Finishing work on time	ODS	68	8.1	2.2
Working required number of hours	TMS	67	8.0	1.9
Starting on job on arrival	TMS	66	7.9	2.0
Use hand tools	PDS	63	7.5	2.1
Working fast enough	ODS	59	7.1	1.8
Speaking with people or in meetings	MDS	49	5.9	1.3
Sit or stand for more than 15 minutes	PDS	48	5.7	2.2
Controlling temper	MDS	46	5.5	1.4
Handling workload	ODS	45	5.4	1.8
Getting going at beginning of work day	TMS	44	5.3	2.4
Working without mistakes	ODS	39	4.7	1.6
Feeling you have done all you are capable of	ODS	36	4.3	2.0
Keeping mind on work	MDS	32	3.8	1.8
Reading or using eyes	MDS	29	3.5	1.8
Concentrating	MDS	28	3.3	1.8
Working carefully	MDS	28	3.3	1.6
Losing train of thought	MDS	26	3.1	1.8
	ODS	36	4.3	2.0
Scales				
Time management scale	TMS	47	5.6	28.6 (26.8)
Physical demands scale	PDS	35	4.2	27.5 (25.1)
Mental demands scale	MDS	26	3.1	15.7 (18.9)
Output demands scale	ODS	43	5.1	19.4 (23.8)
Index				
WLQ index		85	10.2	5.9 (5.6)

Table 3. Association of non-applicable items and demographic and clinical status variables.

Variable	OR	p	95% CI
Age (per 10 years)	1.7	0.000	1.3–2.1
Sex (1 = male)	1.9	0.010	1.2–3.0
HAQ-II (0–3)	1.6	0.010	1.1–2.5
HAQ (0–3)	1.4	0.057	1.0–2.0
Patient global (0–10)	1.1	0.122	0.9–1.2
PCS (7–60)	0.9	0.139	0.9–1.0
Anxiety (0–10)	0.9	0.218	0.8–1.0
Depression (0–10)	1.1	0.291	0.9–1.2
Education (years)	1.0	0.777	0.9–1.1
Pain (0–10)	1.0	0.822	0.9–1.1
Fatigue (0–10)	1.0	0.918	0.9–1.1
Depression (0–10)	1.1	0.291	0.9–1.2
Multivariate Analyses			
Age (per 10 years)	1.5	0.000	1.2–1.9
Sex (1 = male)	1.7	0.039	1.0–3.0
HAQ-II (0–3)	1.7	0.010	1.1–2.7

PCS: Physical component score of SF-36.

Table 4. Correlation of work limitation scores and subscale scores with clinical and demographic variables.

Variable	WLQ	PDS	MDS	ODS	TMS
WLQ Index	1.00				
PDS	0.83	1.00			
MDS	0.89	0.70	1.00		
ODS	0.91	0.67	0.73	1.00	
TMS	0.76	0.67	0.58	0.54	1.00
MCS	–0.60	–0.56	–0.58	–0.50	–0.44
HAQ	0.56	0.66	0.48	0.44	0.46
HAQ-II	0.54	0.65	0.45	0.42	0.46
Fatigue	0.50	0.49	0.46	0.42	0.37
PCS	–0.49	–0.60	–0.39	–0.39	–0.42
Depression	0.46	0.43	0.48	0.38	0.31
Pain	0.46	0.56	0.39	0.35	0.38
Anxiety	0.41	0.38	0.45	0.31	0.29
Days with limited activities	0.38	0.43	0.31	0.33	0.30
Days unable to work	0.29	0.30	0.25	0.27	0.19
Education level	–0.13	–0.14	–0.12	–0.08	–0.16
Annual Earnings	–0.10	–0.15	–0.08	–0.06	–0.09
Sex	–0.06	–0.10	–0.04	–0.05	–0.07
Age	0.02	0.04	–0.03	0.03	0.05

PDS: Physical Demands Scale; MDS: Mental Demands Scale; ODS: Output Demands Scale; TMS: Time Management Scale.

WLQ index. Weaker associations were seen with days unable to perform (0.29), days activities cut down (0.38), education level (–0.13), and annual earnings (–0.10). For comparison, the correlations of these variables with the HAQ were as follows: days unable to perform (0.30), days activities cut down (0.37), education level (–0.15), and annual earnings (–0.20). As age, sex, education, marital status, and ethnicity are associated with earnings, we adjusted for these factors and estimated the association of WLQ and HAQ with annual earnings in 2 separate regression analyses. A one unit difference in HAQ score was associated with a change in earnings of $4840 (95% CI 1781 to 7900, p = 0.002). For WLQ, a one unit change was associated with a change in income of $243 (95% CI 83 to 570, p = 0.144).

We also analyzed the association between the WLQ index and RA duration by linear regression. No association was found: coefficient = 0.02 (95% CI –0.01 to 0.6, p = 0.176).

Factor analysis. Factor analysis of the individual WLQ domains using varimax rotation indicated that one predominant factor explained 77% of variance, with the second and third factors explaining 9% and 7%, respectively. All items had loadings on the first factor of 0.53 or above. The second factor (loading of 0.41–0.45) appeared to identify a mental domain, including working carefully, concentration, thinking, and losing train of thought. The third factor (loadings between 0.40 and 0.44) identified finishing work and working without mistakes. Factor analysis indicated a single

Table 5. Alpha reliability of Work Limitations Questionnaire (WLQ).

Variable	N	Item-Test Correlation	Item-Rest Correlation	Average Inter-item Correlation	Alpha
Without imputation					
TMS	789	0.81	0.65	0.69	0.87
PDS	801	0.88	0.77	0.61	0.83
MDS	810	0.87	0.74	0.62	0.83
ODS	793	0.87	0.74	0.63	0.84
WLQ Scale				0.64	0.88
With imputation					
TMS	836	0.88	0.78	0.62	0.83
PDS	836	0.88	0.77	0.63	0.83
MDS	836	0.86	0.74	0.65	0.85
ODS	836	0.81	0.67	0.70	0.87
WLQ Scale				0.65	0.88

TMS: Time Management Scale; PDS: Physical Demands Scale; MDS: Mental Demands Scale; ODS: Output Demands Scale.

domain when applied to the PDS, MDS, ODS, and TMS scores.

Measuring alpha reliability of WLQ in patients with RA. The alpha reliability was high for the separate WLQ components, TMS ($\alpha = 0.87$), PDS (0.83), MDS (0.83), and ODS (0.84; Table 5). The WLQ index also demonstrated high internal consistency (0.88). Results were the same regardless of whether the 751 or 836 sample was used.

Alternative scoring. Using data imputation so as not to lose 10.1% of the observations, differences in the WLQ scales (scale with imputed vs nonimputed) were WLQ index (6.0 vs 5.9), PDS (27.7 vs 27.5), MDS (16.2 vs 15.7), ODS (20.1 vs 19.4), and TMS (28.6 vs 28.6). Alpha reliability (Table 5), correlation with other work and function variables, and factor analyses results were almost indistinguishable using the imputed versus nonimputed methods.

DISCUSSION

In agreement with previous work of the WLQ authors[3-6], we found that the WLQ had acceptable construct validity and alpha reliability in an RA patient population. However, some differences were noted compared with results of their study in OA[5]. As expected, RA patients had more limitations compared to those with OA: physical demands 33 versus 23, time management 47 versus 29, mental-interpersonal demands 26 versus 20, and output demands 43 versus 22. In addition, Cronbach's alpha for the individual scales was lower in the RA population (83–87) compared with the OA sample (93–97). However, one major problem was identified in the current study, the inability to score the WLQ or some of its subsections when a large number of items (> 50%) in a domain were scored as "Does not apply to my job" (Table 2). Over 10% of the WLQ index scores and from 16% to 29% of the domain (subscale) scores had this problem. This was much higher than the 1% noted in a previous study evaluating the WLQ in a population of patients with OA[5], perhaps reflecting the severity of RA illness compared with OA.

In our study, missingness was associated with age, sex, and disease severity, and seemed to reflect the selection of RA patients who are older and have more functional difficulties for jobs that are less demanding. The relationship with male sex is less clear, but may reflect the older age of working men. The missing problem is complex, as persons with missing data have more severe impairments, as measured by the HAQ, but have jobs that do not as often require activities that would be limited by the impairments.

An alternative scoring method may provide one possible solution to this problem of missingness: scoring those items that "do not apply to my job" as having "no limitations," as in fact that is the case. This would be helpful in understanding how persons perform at their particular job. However, this solution distorts the overall work ability of the patients. We solved this problem in the current study by data imputation of the WLQ index using an approximate Bayesian hot decking method. However, such methods are not practical for individual patients. Another method of scoring that is possible would relax the requirement that 50% of items in a domain be present. More work on this issue is required.

Persons with RA tend to select jobs that they can do with their RA limitations. Mancuso, *et al*, in an interview study, observed that 36% of respondents changed their jobs or altered career paths as primary adaptations to keep working. This included seeking more administrative positions, declining promotions, working part-time, and being purposely overqualified for a job to make the work easier[23]. In our population of employed RA patients the average duration of illness was 14 years, suggesting that modifications to stay employed may already have been made. Multiple studies have documented that significant impairments occur early in the course of RA, and that physical requirements of the job are important cognates of work status[24-31].

What is or should be the role of the WLQ in RA? To a large extent this depends on who is the user of the WLQ. For employers or work counselors, the WLQ may be useful in identifying workers with work limitations. Clinicians are generally interested in overall functional ability and consequences of illness. In this respect, instruments such as the HAQ or SF-36, which are more correlated with clinical status and earnings, would seem to be more clinically relevant. In the instance where the clinician might be interested in work limitations on the job, the WLQ could be a helpful additional questionnaire. Whether the WLQ will provide more predictive information regarding future work disability, compared with the HAQ and SF-36, is not known. In addition, the WLQ does not address limitations among home workers, students, and retired persons. Other potential roles for the WLQ include measurement of changes in work limitations in a treatment study, identifying workers who are producing less, perhaps with the goal of rearranging work responsibilities to less demanding tasks, and identifying persons who are at risk for work disability.

One limitation of this study is its cross-sectional design. Longitudinal studies where repeated WLQ measures are obtained are needed to establish the WLQ's sensitivity to change as well as defining a threshold that represents an adequate clinical response. Evaluation of the WLQ in patients with early arthritis might also yield different results. Finally, studies are required to determine whether the WLQ can predict future work disability better than currently available functional status questionnaires.

In summary, with alternative scoring, the WLQ is a reliable questionnaire for assessing work productivity. However, persons with RA tend to select jobs that they can do with their RA limitations, so the WLQ does not detect functional limitations as well as the HAQ and SF-36. The WLQ provides special information that is not available using conventional measures of assessment, and might pro-

vide helpful knowledge about individual patient problems in the workplace. Whether this information will have greater predictive ability and clinical relevance compared with surrogate measures such as the HAQ and SF-36 has not been determined, but should be the subject of future studies.

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