

The Importance of Patient Expectations in Predicting Functional Outcomes After Total Joint Arthroplasty

NIZAR N. MAHOMED, MATTHEW H. LIANG, EARL F. COOK, LAWREN H. DALTRY, PAUL R. FORTIN, ANNE H. FOSSEL, and JEFFREY N. KATZ

ABSTRACT. *Objective.* To evaluate the relationship between patient expectations of total joint arthroplasty (TJA) and health related quality of life plus satisfaction 6 months after surgery.

Methods. This prospective cohort study included patients undergoing primary total hip (THA) and knee arthroplasty (TKA). Patients were evaluated with self-report questionnaires prior to surgery and 6 months post-surgery. Medical Outcomes Study Short Form 36 (SF-36), the Western Ontario McMaster Universities Osteoarthritis Index (WOMAC), and a satisfaction scale were used to evaluate outcomes at final followup. Multivariate regression models were used to evaluate the impact of expectations on outcomes.

Results. There were 102 patients with THA and 89 with TKA. Mean age was 66 years. All patients achieved significant improvements in their WOMAC and SF-36 scores following surgery. Patient expectations regarding surgery were not associated with their age, gender, index joint of surgery, marital status, or race. Expectations were not correlated with pre-operative functional health status. Expectation of complete pain relief after surgery was an independent predictor of better physical function and improvement in level of pain at 6 months post-surgery. Expectation of low risk of complications from TJA was an independent predictor of greater satisfaction.

Conclusions. Patient expectations were important predictors of improved functional outcomes and satisfaction following TJA. Greater understanding of the relationship between expectations and outcomes may improve the process of care and outcomes of TJA. (J Rheumatol 2002;29:1273-9)

Key Indexing Terms:

HIP KNEE EXPECTATION OUTCOMES ARTHROPLASTY

Arthritis is the number one cause of disability in the population¹. The prevalence of arthritis is known to increase with age²⁻⁵. Current estimates indicate that the number of people with arthritis disability will double by the year 2020^{5,6}. Total

joint arthroplasty (TJA) for the management of end stage arthritis has been shown to be effective in improving physical function and reducing pain in over 90% of patients⁷⁻⁹. The direct medical costs of TJA in the United States exceed \$15,000 per case for inpatient care alone, amounting to more than 1.2 billion dollars annually¹⁰.

The results of TJA have traditionally been evaluated using measures focusing on joint impairment including range of motion, joint stiffness, radiographs, and physician rating of pain relief and function. Recently, the technology of evaluating the outcomes of various medical conditions including TJA has evolved to include patient based measures emphasizing functional ability rather than joint impairment. Examples include the Medical Outcomes Study Short Form 36 (SF-36) and the Western Ontario McMaster Universities Osteoarthritis Index (WOMAC), which evaluates functional ability as it relates to the hip and knee.

Patient expectation has been defined as anticipation that given events are likely to occur during or as a result of medical care. This is in contrast to patient desires, which reflect the patient's wishes that a given event occur¹¹. Expectations of a better result of treatment have been associated with improved outcomes in various groups including college students, heart surgery patients, recovering alcoholics, and women undergoing abdominal hysterectomy^{12,13}. Positive expectations have also been linked with greater compliance

From the Division of Orthopaedic Surgery, Toronto Western Hospital, University Health Network, the Department of Health Administration, University of Toronto, Toronto, ON, Canada; and the Division of Rheumatology and Immunology, and Robert B. Brigham Multipurpose Arthritis and Musculoskeletal Diseases Center, Brigham and Women's Hospital, Boston, MA, USA.

Supported in part by NIH Grant no. AR36308, an Arthritis Foundation Investigator Award (to Dr. Katz) and a Hip Hip Hooray Grant of the Canadian Orthopaedic Foundation. Dr. Mahomed is a recipient of the Canadian Arthritis Society Research Fellowship No. 95035, and Health Services Research Fellowship from the American Academy of Orthopaedic Surgeons and the Orthopaedic Research and Education Foundation. Dr. Fortin is a Junior Research Scholar of the Canadian Arthritis Society.

N.N. Mahomed, MD, ScD, FRCSC, Division of Orthopaedic Surgery, Toronto Western Hospital and Department of Health Administration, University of Toronto; M.H. Liang, MD, MPH, Division of Rheumatology and Immunology; E.F. Cook, MD; L.H. Daltroy, DRPH, Robert B. Brigham Multipurpose Arthritis and Musculoskeletal Diseases Center, Brigham and Women's Hospital; P.R. Fortin, MD, MPH, Division of Rheumatology, Toronto Western Hospital; A.H. Fossel; J.N. Katz, MD, MSc, Division of Rheumatology and Immunology, and Robert B. Brigham Multipurpose Arthritis and Musculoskeletal Diseases Center, Brigham and Women's Hospital.

Address reprint requests to Dr. N.N. Mahomed, Toronto Western Hospital, 399 Bathurst Street, ECW 1-002, Toronto, ON, Canada M5T 2S8.

Submitted November 2, 2000; revision accepted November 11, 2001.

with the medical regimen following cardiac transplantation¹². Patients whose expectations have been met are more satisfied with the outcomes following total joint replacement surgery¹⁴.

A large number of studies in the literature have attempted to evaluate the determinants of the outcomes of TJA based on radiographic and clinical failure rates. These have generally focused on the technical aspects of the procedure, such as bio-materials, implant design, methods of fixation, etc^{7,8}. Few studies have evaluated the determinants of patient based outcomes following TJA. Furthermore, little attention has been given to the role of patient expectations in influencing the outcomes of TJA. The goal of this study was to evaluate the relationship between patient expectations of TJA and patient-based functional outcomes 6 months after surgery.

MATERIALS AND METHODS

Patient selection. This study was based on a prospective cohort of patients undergoing primary total hip and knee arthroplasties at 2 tertiary referral centers (Boston and Montreal). Patients were enrolled into the study between August 1, 1994 and April 1, 1996. Eligible patients were at least 50 years of age with a diagnosis of primary or secondary osteoarthritis. Patients were excluded if they had a diagnosis other than osteoarthritis, had prior arthroplasty of the index joint or were unable to complete questionnaires in either English or French. Patients undergoing total hip (THA) or total knee arthroplasty (TKA) were pooled as the indications for surgery, process of care, and outcomes are similar and standardized^{7,8}. The ethics review committee of each institution approved the study protocol.

Questionnaires. Patients consenting to participate were asked to complete a set of self-report questionnaires prior to surgery, and at 6 months post-surgery. The questionnaires prior to surgery (baseline) consisted of the SF-36, WOMAC, demographic questions, and 4 questions on patient expectations (see below). Education was defined as a continuous variable with each incremental unit representing an additional year of schooling. Followup questionnaires included SF-36 and WOMAC. The SF-36 consists of 8 domains including physical function, bodily pain, role physical, general health, vitality, role emotional, social function, and mental health¹⁵⁻¹⁷. There are 2 summary scores: physical component summary (PCS) and mental component summary (MCS). The WOMAC evaluates functional ability as it relates to the hip and knee^{18,19}. It consists of 3 sub-scales; pain, stiffness, and physical function. All WOMAC scores were re-scaled to 0-100 with higher scores representing better functional health. Hawker, *et al* and others have shown the need to include both general (SF-36) and disease specific (WOMAC) instruments to adequately evaluate the outcomes of TJA²⁰⁻²². The psychometric properties of the WOMAC and SF-36 with respect to reliability, validity, and responsiveness have been well established in the literature^{15-18,20,22}.

Questions regarding patient expectations of TJA included expectations of pain relief, limitations in activities of daily living, overall success of the surgery, and likelihood of joint related complications. Responses for pain relief and activities of daily living were graded on a 4 point Likert scale ranging from no pain/limitation to very painful/limited (see Table 3). Given the skewed distribution of the response patterns these were dichotomized into high versus low expectations (response distribution for expectation of pain: 76% no pain/20% slight pain/4% moderate pain; response distribution for expectation of functional limitation: 40% no limitation/48% slight limitation/11% moderate or severe limitation). Expectations regarding overall success and likelihood of complications were recorded on a visual analog scale ranging from 0 (no success/no complication) to 100 (certain success/certain of complication). These responses were also dichotomized into high versus low expectations by defining those expecting > 90% likelihood of success or < 10% likelihood of complications as having high expectations.

Trained nurses or physicians at each center conducted a standardized chart review. The data abstracted included details of the surgical procedure

(including type of prosthesis and method of fixation: cement versus uncemented), comorbidity as measured by the Cumulative Illness Rating Scale (CIRS)²³⁻²⁶, length of stay in hospital, discharge status, and complications. The CIRS is a measure of medical comorbidity in 14 major organ systems of the body; it evaluates both the presence and severity of disease processes.

Statistical analysis. The primary dependent variables were the 3 scale scores of the WOMAC (pain, stiffness, and physical function), and 2 scale scores from the SF-36 (physical function and bodily pain). Univariate analyses (Spearman correlations, Chi-square tests, and Student's t test as appropriate) were used to explore the relationships between each of the expectation questions and pre-surgery (baseline) variables. All 4 expectation variables and available pre-operative variables [including age, gender, level of education, medical comorbidity (CIRS score), index joint of surgery, and center of surgery] were entered into multivariable linear regression models with backwards elimination (stay criteria $p < 0.05$) to evaluate the predictive role of expectations for each outcome. Additional models were developed using within patient change scores for the respective outcome variable rather than pre-operative baseline and final followup scores. The results of these analyses were equivalent to those using pre-operative baseline and final followup scores. Therefore only results using pre-operative baseline and final followup data are presented. The residuals from the regression models were evaluated to assess their distribution and effects of significant outliers. Statistical analysis was performed using PC-SAS version 6.11 (SAS Institute, Cary, NC). All p values are 2-tailed with a critical threshold of $p < 0.05$.

RESULTS

Three hundred and eighty-seven patients met the eligibility criteria, of whom 222 completed the pre-operative baseline questionnaire. Of these, 192 completed the followup questionnaire at 6 months, and form the cohort for this study. There was no significant difference between respondents and non-respondents with respect to measured pre-operative baseline variables. There were 106 women and 86 men with a mean age of 67 years who underwent 103 THA and 89 TKA (Table 1). The cohort was predominantly Caucasian, with an average 13 years of schooling, and two-thirds were married. There were no statistically significant differences between the THA and TKA groups with respect to age, gender, level of education, race, marital status, comorbidity, or center of surgery. Both the THA and TKA groups showed significant improvement in WOMAC pain and function scores at final followup compared to pre-operative baseline status (Table 2). Similar effects were noted with the SF-36 physical function, bodily pain, and PCS scores.

Patient expectations were dichotomized into high (positive) versus low (negative). The specific thresholds and distri-

Table 1. Demographics.

	THA n = 103	TKA n = 89	Total n = 192
Age in years (mean, SD)	66 (9)	68 (9)	67 (9)
Gender: Female (n, %)	57, 55%	49, 55%	106, 55%
Education in years (mean, SD)	14 (4)	13 (4)	13 (4)
Race: Caucasian (n, %)	101, 98%	88, 99%	188, 98%
Marital status: married (n, %)	75, 73%	52, 59%	129, 67%
CIRS comorbidity score (mean, SD)	2.9 (1.7)	3.4 (1.9)	3.1 (1.8)
Center: Boston (n, %)	61, 59%	54, 61%	115, 60%

Table 2. Functional health status: pre-operative (baseline) and 6 months post surgery.

	THA Baseline Mean (SD)	THA 6 Mo. Post-Op Mean (SD)	TKA Baseline Mean (SD)	TKA 6 Mo. Post-Op Mean (SD)
WOMAC				
Pain	50 (20)	86 (16)	50 (19)	81 (21)
Stiffness	44 (23)	70 (20)	46 (25)	68 (21)
Physical function	46 (19)	79 (16)	51 (19)	77 (21)
Global WOMAC	47 (17)	80 (15)	50 (18)	77 (18)
SF-36				
Physical function	27 (23)	60 (26)	28 (22)	56 (27)
Bodily pain	40 (19)	70 (22)	42 (24)	61 (25)
PCS	28 (7)	40 (9)	30 (8)	40 (9)
MCS	56 (11)	57 (9)	56 (11)	56 (11)

All comparisons were significant at $p < 0.05$. All WOMAC scores re-scaled to 0–100 with higher scores representing better functional status. PCS: physical component summary score; MCS: mental component summary score.

bution of responses are outlined in Table 3. Seventy-six percent of individuals expected to have no pain after recovery from surgery. In contrast, only 40% of individuals expected to have no limitations in their usual activities. Eighty-four percent of individuals expected to have a 90% or greater chance of complete success with regards to their surgery. Seventy-five percent expected the overall risk of a joint specific complication to be under 10%. The mean age, gender distribution, and index joint of surgery were not different between patients with high versus low expectations. There was a trend towards higher level of education among those with more positive expectations, and this was statistically significant for expectations regarding complications ($p < 0.05$). Individuals with expectations of greater pain relief and overall success had lower CIRS comorbidity scores ($p < 0.05$). There was a similar trend for the other 2 questions. Although not detailed in Table 3, patients' marital status and race were not different among those with high versus low expectations.

Univariate relationships between expectations and pre-operative baseline functional health status are summarized in Table 4. Individuals with positive expectations regarding pain relief, functional improvement, and overall surgical success did not significantly differ from those with lower expectations in terms of their WOMAC scores or SF-36 scores. Those expecting a less than 10% chance of joint specific complications had less pain as measured by the WOMAC pain scale ($p < 0.05$). Overall, severity of pre-operative functional disability did not correlate with patient expectations of surgery.

The relationship between expectations and post-operative functional health status is detailed in Table 5. Individuals expecting complete pain relief from their TJA had better functional health as measured by WOMAC function and pain scores, and SF-36 physical function, and bodily pain scores ($p < 0.05$). Positive expectations of functional improvement or overall success of surgery did not correlate with post-operative functional health status. In addition, those expecting a

Table 3. Relationship between patient expectations and pre-operative baseline factors.

Expectations	Response Distribution (%)	Age (years)	Gender Female (%)	Education (years)	CIRS	Joint: Hip (%)	Center: Boston (%)
How painful do you expect your hip/knee to be:							
Not at all	76	67	55	14	2.9*	58	62
Slightly/moderately/very painful	24	67	52	13	3.7*	42	53
How limited do you expect to be in your usual activities:							
Not at all limited	40	68	57	13	3.0	47	64
Slightly/moderately/very limited	60	67	52	14	3.2	59	58
How likely will your surgery be a complete success:							
≥ 90%	84	68	53	14	3.0*	54	63
< 90%	16	66	62	13	3.8*	53	47
How likely will you have a hip or knee joint complication:							
≤ 10%	75	68	51	14*	3.1	54	63
> 10%	25	67	58	12*	3.4	51	56

* Comparisons significant at $p < 0.05$.

Table 4. Relationship between pre-operative functional health status and patient expectations.

Expectations	WOMAC Function	WOMAC Stiffness	WOMAC Pain	SF-36 Function	SF-36 Pain
How painful do you expect your hip/knee to be:					
Not at all	48	45	50	28	41
Slightly/moderately/very painful	50	44	52	25	41
How limited do you expect to be in your usual activities:					
Not at all limited	49	44	51	30	43
Slightly/moderately/very limited	48	46	48	25	40
How likely will your surgery be a complete success:					
≥ 90%	49	45	50	28	42
< 90%	44	41	48	22	39
How likely will you have a hip or knee joint complication:					
≤ 10%	50	45	51*	29	42
> 10%	45	44	45*	22	39

* Comparisons significant at $p < 0.05$.

lower risk of joint specific complications had significantly better WOMAC function scores ($p < 0.05$).

Multivariable linear regression was used to evaluate the role of patient expectations in predicting outcomes after adjusting for other significant pre-operative baseline variables. Separate models were developed for each of the 3 scale scores of the WOMAC (pain, stiffness, and physical function) and 2 scores of the SF-36 (physical function and bodily pain). Each model included the candidate variables age, gender, education level, joint (hip versus knee), center (Boston versus Montreal), comorbidity (measured by CIRS), the respective pre-operative baseline functional health scale score, and the 4 expectations questions.

Patient expectations predicted outcomes for WOMAC pain, WOMAC physical function, and SF-36 physical function (Table 6). Expectations did not predict outcomes based on WOMAC stiffness and SF-36 bodily pain (data not presented). For WOMAC scale scores of pain and physical function the most statistically significant predictor of the post-operative score was the respective pre-operative baseline WOMAC

score. Level of education was also predictive of outcome, with individuals having higher education attaining better outcomes. The only other variable that was predictive of WOMAC scores was patient expectation of pain relief after surgery. Individuals expecting no pain after surgery averaged 8.1 points higher on WOMAC physical function and 7.8 points higher on WOMAC pain ($p < 0.05$). These are clinically significant differences as defined by Bellamy^{27,28}.

Pre-operative SF-36 scores were the most statistically significant predictors of final scores for SF-36 physical function models. Greater medical comorbidity was associated with lower physical function scores. Similar to WOMAC, individuals with expectations of no pain after surgery averaged 8.5 points higher for SF-36 physical function ($p < 0.05$).

DISCUSSION

Patients had high expectations regarding the outcomes of TJA. Over 75% expected to be completely pain free and 40% expected to be unlimited in their usual activities. Expectations were not associated with pre-operative functional health sta-

Table 5. Relationship between patient expectations and post-operative functional health status/satisfaction.

Expectations	WOMAC Function	WOMAC Stiffness	WOMAC Pain	SF-36 Function	SF-36 Pain
How painful do you expect your hip/knee to be:					
Not at all	80*	70	85*	61*	68*
Slightly/moderately/very painful	72*	65	79*	51*	59*
How limited do you expect to be in your usual activities:					
Not at all limited	80	69	83	62	68
Slightly/moderately/very limited	78	69	84	56	64
How likely will your surgery be a complete success:					
≥ 90%	79	69	84	59	66
< 90%	76	73	81	53	65
How likely will you have a hip or knee joint complication:					
≤ 10%	80*	69	85	61	68
> 10%	74*	70	79	52	61

* Comparisons significant at $p < 0.05$.

Table 6a. Linear regression model for predictors of WOMAC pain scale.

Variable	β Parameter Estimate	Standard Error	F Value	p Value
Pre-op WOMAC Pain Score	1.55	0.34	21.07	0.0001
Level of education (in years)	0.95	0.35	7.36	0.007
How painful do you expect your hip/knee to be: Not at all vs. slightly/moderately/very painful	7.80	2.99	6.70	0.01

Model $R^2 = 0.21$ (all significant variables reported).

Table 6b. Linear regression model for predictors of WOMAC function scale.

Variable	β Parameter Estimate	Standard Error	F Value	p Value
Pre-op WOMAC Function Score	0.62	0.10	41.48	0.0001
Level of education (in years)	0.73	0.34	4.51	0.04
How painful do you expect your hip/knee to be: Not at all vs. slightly/moderately/very painful	8.10	2.85	8.03	0.005

Model $R^2 = 0.29$ (all significant variables reported).

Table 6c. Linear regression model for predictors of SF-36 physical function.

Variable	β Parameter Estimate	Standard Error	F Value	p Value
Pre-op SF 36 Function Score	0.44	0.08	31.74	0.0001
CIRS Co-morbidity score	-2.68	0.97	7.53	0.007
How painful do you expect your hip/knee to be: Not at all vs. slightly/moderately/very painful	8.51	4.21	4.07	0.04

Model $R^2 = 0.23$ (all significant variables reported).

tus, age, gender, index joint undergoing surgery, or center where surgery was performed. Patients with fewer medical comorbidities and higher level of education tended to expect better outcomes. Both THA and TKA cohorts had significant improvements in functional ability. Expectation of complete pain relief was an independent predictor of greater improvement in pain and function, based upon WOMAC (physical function and pain scores) and SF-36 (physical function score).

Review of the published literature revealed only 3 studies evaluating the association between patient expectations regarding TJA outcomes. All 3 focused on hip replacement. We were unable to find any reports on the role of patient expectations in knee replacement surgery. Burton, *et al* reported a retrospective case series of patients having undergone primary THA²⁹. All subjects were contacted after surgery and asked to recall their preoperative expectations. This design can introduce significant recall bias. Nevertheless, they found that expectations were generally high but only 55% felt that these were fulfilled. Similar to our study, the quality of life was better in the group whose expectations were met.

In a prospective study of expectations and outcome of THA, Haworth, *et al* evaluated 145 patients who underwent a primary THA³⁰. Similar to the present study, they found that

patients had high expectations of surgery, with 28% reporting that their expectations were not met. Patients were most satisfied with improvement in pain relief and less with respect to functional improvements. The study did not use standardized outcome measures and failed to adjust for pre-operative baseline factors in the analysis.

Most recently, Mancuso, *et al* reported on a retrospective series of 180 primary THA patients who were surveyed 2 to 3 years after surgery¹⁴. Patients were asked to recall their pre-operative expectations of surgery and these were correlated with outcomes based on the Hip Rating Questionnaire and the SF-36. Pre-operative baseline functional health status was obtained by chart review. The authors found that patients with worse pre-operative function had greater expectations of improvement. This is in contrast to the present study, where no correlation was noted between pre-operative functional health and expectations. The differences may be related to bias introduced by recalled expectations and/or inaccuracy in the assessment of function based upon medical records. The authors focused their analysis strictly on satisfaction and did not evaluate the relationship between expectations and functional health.

In our study, patients had higher expectations of pain relief

compared to improvements in functional ability. This is similar to previous reports that pain relief is the primary indication for TJA^{7,8}. Patient expectations regarding TJA were not related to their level of functional disability prior to surgery. Thus, patients with greater functional disability had equally high expectations of recovery after surgery as those with lesser disability. This reflects the clinical paradigm that regardless of the level of pre-operative disability patients will achieve equally positive outcomes³¹.

Expectations were not associated with age, gender, race, marital status, index joint undergoing surgery, or center where surgery was performed. This suggests that expectations are a separate construct from these sociodemographic variables and consequently cannot be reliably controlled in analytical studies by these standard variables. Similarly, expectation of complete pain relief was an independent predictor of functional outcomes after adjusting for sociodemographic factors and pre-operative baseline functional health. In fact after pre-operative functional health status, patient expectation was the second most important determinant of outcome.

Patients with expectations of greater pain relief may have perceived less pain after surgery (or interpreted it more optimistically) and hence participated more vigorously in rehabilitation after surgery, thereby achieving a higher level of physical functioning. Alternatively, expectations may be determined by patient level of self-efficacy in managing their disease or its antecedents. Self-efficacy (confidence in the ability to perform specific behaviors) has been shown to be a modifiable determinant of improved functional outcomes in other disease states³². This hypothesis needs to be evaluated in future studies focusing on the determinants of expectations.

This study has some limitations: we did not evaluate patients' knowledge of TJA or self-efficacy as potential predictors of functional outcome or determinants of expectations. Patient extent of participation in rehabilitation was not measured, which prevents us from exploring the potential pathways through which expectations influence outcomes. In addition, our study reflects the experience of 2 tertiary referral centers and may not be representative of the community setting where the majority of TJA are performed. Finally, the demographics of this cohort, predominantly white and highly educated, may limit the generalizability of the findings to other populations.

In conclusion, this prospective study showed that patient expectation of complete pain relief following TJA is an independent predictor of functional outcomes. Health care providers need to set out clear expectations of potential benefits for each individual patient. Inappropriate expectations may be a possible explanation for sub-optimal outcomes following technically successful surgery. Future studies need to evaluate the determinants of patient expectations and the pathways through which they influence outcomes including the role of self efficacy.

REFERENCES

1. Badley E, Rasooly I, Webster G. Relative importance of musculoskeletal disorders as cause of chronic health problems, disability and health care utilization: Findings from the 1990 Ontario Health Survey. *J Rheumatol* 1994;21:505-14.
2. Badley EM, Webster GK, Rasooly I. The impact of musculoskeletal disorders in the population: are they just aches and pains? Findings from the 1990 Ontario Health Survey. *J Rheumatol* 1995;22:733-9.
3. Reynolds D, Chambers L, Badley E, et al. Physical disability among Canadians reporting musculoskeletal diseases. *J Rheumatol* 1992;19:1020-30.
4. Cunningham L, Kelsey J. Epidemiology of musculoskeletal impairments and associated disability. *Am J Public Health* 1984;74:574-9.
5. Badley E. Population projections and the effect on rheumatology. *Ann Rheum Dis* 1991;50:3-6.
6. Badley EM, Crotty M. An international comparison of the estimated effect of the aging of the population on the major cause of disablement, musculoskeletal disorders. *J Rheumatol* 1995;22:1934-40.
7. Harris WH, Sledge CB. Total hip and total knee replacement (2). *N Engl J Med* 1990;323:801-7.
8. Harris WH, Sledge CB. Total hip and total knee replacement (1). *N Engl J Med*. 1990;323:725-31.
9. Hawker G, Wright J, Coyte P, et al. Health-related quality of life after knee replacement. *J Bone Joint Surg Am* 1998;80:163-73.
10. Baron JA, Barrett J, Katz JN, Liang MH. Total hip arthroplasty: use and select complications in the US Medicare population. *Am J Public Health* 1996;86:70-2.
11. Uhlmann RF, Inui TS, Carter WB. Patient requests and expectations. Definitions and clinical applications. *Med Care* 1984;22:681-5.
12. Leedham B, Meyerowitz BE, Muirhead J, Frist WH. Positive expectations predict health after heart transplantation. *Health Psychol* 1995;14:74-9.
13. Mondloch MV, Cole DC, Frank JW. Does how you do depend on how you think you'll do? A systematic review of the evidence for a relation between patients' recovery expectations and health outcomes. *CMAJ* 2001;165:174-9.
14. Mancuso CA, Salvati EA, Johanson NA, Peterson MGE, Charlson ME. Patients' expectations and satisfaction with total hip arthroplasty. *J Arthroplasty* 1997;12:387-96.
15. Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. *Med Care* 1992;30:473-83.
16. McHorney CA, Ware JE Jr, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. *Med Care* 1993;31:247-63.
17. McHorney CA, Ware JE Jr, Lu JF, Sherbourne CD. The MOS 36-item Short-Form Health Survey (SF-36): III. Tests of data quality, scaling assumptions, and reliability across diverse patient groups. *Med Care* 1994;32:40-66.
18. Bellamy N, Buchanan WW, Goldsmith CH, Campbell J, Stitt LW. Validation study of WOMAC: a health status instrument for measuring clinically important patient relevant outcomes to antirheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol* 1988;15:1833-40.
19. Bellamy N. Pain assessment in osteoarthritis: experience with the WOMAC osteoarthritis index. *Semin Arthritis Rheum* 1989; 18:14-7.
20. Bombardier C, Melfi CA, Paul J, et al. Comparison of a generic and a disease-specific measure of pain and physical function after knee replacement surgery. *Med Care* 1995;33:AS131-44.
21. Buchbinder R, Bombardier C, Yeung M, Tugwell P. Which outcome

- measures should be used in rheumatoid arthritis clinical trials? Clinical and quality-of-life measures' responsiveness to treatment in a randomized controlled trial. *Arthritis Rheum* 1995;38:1568-80.
22. Hawker G, Melfi C, Paul J, Green R, Bombardier C. Comparison of a generic (SF-36) and a disease specific (WOMAC) (Western Ontario and McMaster Universities Osteoarthritis Index) instrument in the measurement of outcomes after knee replacement surgery. *J Rheumatol* 1995;22:1193-6.
23. Parmelee PA, Thuras PD, Katz IR, Lawton MP. Validation of the Cumulative Illness Rating Scale in a geriatric residential population [see comments]. *J Am Geriatr Soc* 1995;43:130-7.
24. Conwell Y, Forbes NT, Cox C, Caine ED. Validation of a measure of physical illness burden at autopsy: the Cumulative Illness Rating Scale. *J Am Geriatr Soc* 1993;41:38-41.
25. Waldman E, Potter JF. A prospective evaluation of the cumulative illness rating scale. *Aging* 1992;4:171-8.
26. Miller MD, Paradis CF, Houck PR, et al. Rating chronic medical illness burden in geropsychiatric practice and research: application of the Cumulative Illness Rating Scale. *Psychiatry Res* 1992;41:237-48.
27. Bellamy N, Carette S, Ford PM, et al. Osteoarthritis antirheumatic drug trials. II. Tables for calculating sample size for clinical trials. *J Rheumatol* 1992;19:444-50.
28. Bellamy N, Kean WF, Buchanan WW, Gerecz-Simon E, Campbell J. Double blind randomized controlled trial of sodium meclofenamate (Meclomen) and diclofenac sodium (Voltaren): post validation reapplication of the WOMAC Osteoarthritis Index. *J Rheumatol* 1992;19:153-9.
29. Burton KE, Wright V, Richards J. Patients' expectations in relation to outcome of total hip replacement surgery. *Ann Rheum Dis* 1979;38:471-4.
30. Haworth RJ, Hopkins J, Eells P, Ackroyd CE, Mowat AG. Expectations and outcome of total hip replacement. *Rheumatol Rehab* 1981;20:65-70.
31. Fortin PR, Clarke AE, Joseph L, et al. Outcomes of total hip and knee replacement: preoperative functional status predicts outcomes at six months after surgery. *Arthritis Rheum* 1999;42:1722-8.
32. Carroll DL. The importance of self-efficacy expectations in elderly patients, recovering from coronary artery bypass surgery. *Heart Lung* 1995;24:50-9.