

# Translation and Validation of the Turkish Version of the Arthritis Impact Measurement Scales 2 in Patients with Knee Osteoarthritis

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**ABSTRACT. Objective.** To translate and evaluate the validity, reliability, and acceptability of Arthritis Impact Measurement Scales 2 (AIMS2) in patients with knee osteoarthritis (OA).

**Methods.** Turkish AIMS2 was developed using the “translation-backward translation” method and administered to 141 patients with symptomatic knee OA. Reliability was assessed by test-retest and internal consistency analyses. Construct validity was assessed by correlating the AIMS2 scales with Western Ontario and McMaster University Osteoarthritis Index (WOMAC), 100 mm visual analog scale (VAS) for pain, patient’s and physician’s global assessment, range of motion (ROM), and Kellgren-Lawrence grading system.

**Results.** Test-retest reliability coefficients ranged from 0.75-0.98, and Cronbach’s alpha coefficients from 0.72-0.90. Significant moderate to high correlations were obtained between AIMS2 scales (except social activities and support from family and friends scales) and most of the other clinical measurements.

**Conclusion.** Turkish AIMS2 is a valid, reliable, and acceptable instrument in patients with symptomatic knee OA. (J Rheumatol 2005;32:1331-5)

## Key Indexing Terms:

AIMS2 OSTEOARTHRITIS VALIDATION HEALTH STATUS QUALITY OF LIFE

Osteoarthritis (OA) is a common, progressive joint disease characterized by destruction of articular cartilage that may affect several joints, especially weight-bearing joints such as the knee<sup>1</sup>. It affects people in all geographic locations and has been identified as the most common cause of disability in middle aged and older people. More than half the population older than 45 years is affected by knee OA<sup>2,3</sup>. The effects of knee OA are quite visible because mobility is related to its clinical features including pain, stiffness, loss of function, and joint deformities<sup>3-5</sup>. Knee OA has a direct impact on quality of life.

Therefore, specific health status measurement instruments have gained importance for assessment of health related quality of life in OA. In addition, these instruments, which measure outcome over a wide range of functions, including physical, social, and psychological variables, were strongly recommended for OA at the 1996 Conference on Outcome Measures in Arthritis Clinical Trials (OMER-ACT III)<sup>6</sup>.

The self-administered Arthritis Impact Measurement

Scales 2 (AIMS2) is one of the most widely used and accepted health status measurement instruments worldwide in rheumatic disorders. Initially it was validated by Meenan, *et al*<sup>7</sup> as a tool that assesses mobility, pain level, and global functional impairment. In 1992 its revised form, which was used in clinical trials, was developed by addition of measurements of arthritis relevant to health status such as arm function, work, and support from family and friends<sup>8</sup>. Subsequent research has validated its translated versions for various populations with rheumatic disease<sup>9-12</sup>.

Our aim was to translate AIMS2 into Turkish and assess its reliability, validity, and acceptability in patients with symptomatic knee OA.

## MATERIALS AND METHODS

**Patients.** One hundred and forty-one patients, ranging in age from 40 to 80 years, with clinically symptomatic OA of the knee (fulfilling American College of Rheumatology criteria) for at least 6 months’ duration were included in the study.

Patients were excluded from the study if they (1) had inflammatory arthritis or soft-tissue rheumatism; (2) had a specific condition (neoplasm, diabetes mellitus, vascular disease, paresis, osteonecrosis, recent trauma, etc.) or poor general health that would affect functional status; (3) had mental problems; and/or (4) were unreliable.

All patients gave informed consent for the study.

**Turkish AIMS2.** AIMS2 is a self-administered 78-item questionnaire<sup>8</sup>. It was translated into Turkish in 3 steps by the forward and backward translation procedure. First, 3 bilingual Turkish volunteers fluent in English translated the original questionnaire and met to review their translations and make cultural and vocabulary adaptations. In the second step, 3 independent, bilingual volunteers translated the reviewed version of the questionnaire back into English. After language discrepancies between the

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backward-translated AIMS2 and the original AIMS2 had been discussed by all translators, 15 healthy individuals and 10 patients with OA of the knee participated in a pilot study involving completion of the Turkish version of AIMS2 to determine the need for final adaptations. The following items were altered because of structural differences between Turkish and English and cultural diversity: (1) in item 1, the word “physically” has no equivalent in Turkish, so it was omitted from the question; (2) for clarity of meaning, we used the word “spend” in our scale, and item 5 was translated as “How often did you spend time in bed or in a chair for most or all of the day?”; (3) we replaced the word “block” with “street” in items 7 and 9 to be more colloquial; (4) because of social differences, points in item 33 were changed to “How often did you go to a group meeting such as a religion-related or friend-related meeting?”; (5) for the level of tension scale, instead of the phrase “free of tension” in item 51, we used “away from tension”; and (6) in Turkish, there is a phrase about death: “When I die, others will be more relaxed”, so we replaced “to be better off” with “to be relaxed” in item 56.

**Testing the Turkish AIMS2 and statistical analysis.** All subgroups of AIMS2 were given as quantitative data. For acceptability of the scale, each item was individually evaluated concerning missing responses and multiple responses. All answers were checked before statistical analysis. Time needed for completing the scale was noted.

Reliability studies were performed by test-retest reliability and internal consistency. Test-retest reliability was assessed by having patients complete the scale twice at a 1-3 day interval and comparing scores. Test-retest values were assessed by determining the intraclass correlation coefficient (ICC) between 2 measurement points<sup>13</sup>. Internal consistency expressed by the coefficient alpha ( $\alpha$ ) or Cronbach’s coefficient was used for each subscale, and if Cronbach’s coefficient value was greater than 0.7, it was considered as an acceptable internal consistency<sup>14</sup>.

Validation studies were assessed by construct validity, which refers to the scale’s behavior in relation to other assessment tools. For construct validity, correlation studies were used between Turkish AIMS2 scores and clinical measures that might be expected to have a converging relationship. These clinical assessment measures were (1) Western Ontario and McMaster University Osteoarthritis Index (WOMAC)<sup>15</sup>; (2) a 100 mm visual analog scale (VAS) for pain; (3) patient’s global assessment measured on a 100 mm VAS; (4) physician’s global assessment disease activity measured on a VAS; (5) range of motion (ROM) with goniometry (flexion measurement only because no patients had restriction of extension); and (6) Kellgren-Lawrence grading<sup>16</sup>.

For definition of effects of education and age on the scales, correlation analyses were performed between scales and these demographic variables. All correlation analyses were performed using Pearson’s rank correlation coefficient.

Student’s t test was used for comparison of subgroups by gender.

SPSS for Windows software was used for data management and statistical analysis. All the results were expressed as mean  $\pm$  standard deviation (SD).

## RESULTS

One hundred and forty-one patients with knee OA were enrolled in the study. Table 1 shows demographic and clinical characteristics of the patients. The mean age was  $58.9 \pm 8.2$  (45-76) years. Mean disease duration was  $6.5 \pm 3.9$  (1-20) years. Most patients were women (76.6%), were married (69.5%), and had low education level (40.4%). Radiological severity of OA with Kellgren-Lawrence was mostly grade II and III (58.2% and 25.5%, respectively).

The questionnaire was filled out completely by all patients. Only 10 illiterate patients needed assistance to complete the questionnaire. The questions were well under-

**Table 1.** Demographic and clinical characteristics of patients with knee OA. Results are expressed as mean  $\pm$  standard deviation (SD).

Variables	Mean $\pm$ SD
Age, yrs	58.9 $\pm$ 8.2
Gender	
Female, n (%)	108 (76.6)
Male, n (%)	33 (23.4)
Disease duration, yrs	6.5 $\pm$ 3.9
WOMAC	
Pain	12.3 $\pm$ 4.3
Stiffness	4.2 $\pm$ 1.7
Function	46.4 $\pm$ 12.1
VAS	
Pain (mean $\pm$ SD)	54.7 $\pm$ 18.7
Physician’s assessment	48.3 $\pm$ 16.5
Patient’s assessment (mean $\pm$ SD)	56.8 $\pm$ 20.4
Kellgren-Lawrence grading system (%)	
Grade I	11 (7.8)
Grade II	82 (58.2)
Grade III	36 (25.5)
Grade IV	12 (8.5)
Range of motion	107 $\pm$ 8.9

stood by patients. Few items were omitted (5.6%) and there were few multiple answers (1.8%). Mean time needed for completion was  $30.2 \pm 8.2$  (18-55) min.

Results of reliability analyses and mean scores of subscales are presented in Table 2. Test-retest correlation coefficients ranged from 0.75 for hand and finger function to 0.98 for work. Cronbach’s coefficient ranged from 0.72 for social activities to 0.90 for self-care (Table 2).

Table 3 shows the results of validity analysis. There was a significant correlation between most of the Turkish AIMS2 scales and other clinical measures. Mobility level, walking and bending, and health perceptions were highly to moderately correlated with all clinical measures ( $r = -0.44$ – $0.47$ ). Similarly, arthritis pain and work scales were also highly to moderately correlated with all measures ( $r = -0.31$ – $0.50$ ), with the exception of the Kellgren-Lawrence grade. Hand-finger functions, arm functions, household tasks, satisfaction, and arthritis impact scores were moderately correlated with most measures ( $r = -0.34$ – $0.35$ ), while scores of social activities and support from family and friends were not correlated with other measures.

When correlation analysis was performed between education level and scales, education level was highly negatively correlated with the scores of mobility ( $r = -0.42$ ), walking and bending ( $r = -0.37$ ), arthritis pain ( $r = -0.35$ ), work ( $r = -0.38$ ), tension ( $r = -0.24$ ), mood ( $r = -0.18$ ), and health perception scales ( $r = -0.36$ ) (Table 4). There was also a significant relationship between age and all scales ( $r = 0.18$ – $0.58$ ), except scales of self-care tasks and support from family and friends. An increase in age corresponded to a general increase on the scores of these scales (Table 4).

When subjects were compared by gender, the scores for

Table 2. Internal consistency and test-retest reliability of Turkish AIMS2 scales. Results are expressed as mean  $\pm$  standard deviation.

AIMS2 Scales	Visit 1 (n = 141)	Visit 2 (n = 141)	ICC*	Cronbach's $\alpha$ **
Mobility level	3.7 $\pm$ 2.1	3.7 $\pm$ 2.1	0.97	0.80
Walking and bending	4.6 $\pm$ 2.3	4.6 $\pm$ 2.5	0.91	0.78
Hand/finger function	1.5 $\pm$ 2.1	2.0 $\pm$ 4.4	0.75	0.84
Arm function	1.5 $\pm$ 2.0	1.7 $\pm$ 2.1	0.95	0.81
Selfcare tasks	1.7 $\pm$ 2.4	1.4 $\pm$ 2.4	0.94	0.90
Household tasks	1.6 $\pm$ 2.3	1.6 $\pm$ 2.2	0.94	0.86
Social activity	5.3 $\pm$ 1.5	5.3 $\pm$ 1.4	0.91	0.72
Support from family/friends	2.3 $\pm$ 2.1	2.5 $\pm$ 2.1	0.91	0.85
Arthritis pain	5.8 $\pm$ 2.3	5.8 $\pm$ 2.3	0.94	0.81
Work	3.0 $\pm$ 2.0	3.1 $\pm$ 2.0	0.98	0.77
Level of tension	4.8 $\pm$ 1.1	4.9 $\pm$ 1.0	0.91	0.73
Mood	4.2 $\pm$ 1.3	4.2 $\pm$ 1.4	0.94	0.80
Satisfaction with health	4.0 $\pm$ 1.6	4.1 $\pm$ 1.5	0.89	0.82
Health perception	6.2 $\pm$ 2.2	6.1 $\pm$ 2.2	0.91	–
Arthritis impact	4.1 $\pm$ 2.3	4.0 $\pm$ 2.3	0.94	–

\* Intraclass correlation coefficient between scores of visit 1 and visit 2. \*\* Internal consistency.

mobility level, walking and bending, hand and finger functions, arm functions, self-care tasks, arthritis pain, health perceptions, and arthritis impact scales in women were significantly higher than in men (Student's t test,  $p < 0.05$ ) (Table 5).

## DISCUSSION

Our study showed that Turkish AIMS2 has acceptable validity and reliability for Turkish-speaking patients with knee OA. This is also the first report that studies validity and reliability of the Turkish AIMS2.

As recommended, we adapted the scale to the Turkish population to reduce misunderstanding and minimize missing data<sup>17</sup>. After adaptations were made in a few items,

acceptability of scales was good, as shown by the low number of missing and multiple responses. In our study, only illiterate patients needed assistance to complete the questionnaire. This indicated that Turkish AIMS2 can be successfully self-administered by patients with knee OA.

Results of reliability analysis were satisfactory because Cronbach's coefficient value was greater than 0.7 for each subscale. Test-retest reliability was also high for each subscale. This is probably due to the fact that the time interval between the 2 tests was very short. There is no evidence available to aid in the selection of the time interval between questionnaire administrations, although most studies have used an interval of 7 to 14 days for test-retest. Moreover, Marx, *et al*<sup>18</sup> showed that there was no significant difference

Table 3. Correlation analyses between Turkish AIMS2 scales and other disease measures.

AIMS2 Scales	WOMAC			VAS		Kellgren-Lawrence	ROM	
	Pain	Stiffness	Function	Pain	Physician			
Mobility level	0.41**	0.17*	0.41**	0.17*	0.21**	0.24**	0.30**	-0.41**
Walking and bending	0.40**	0.16*	0.40**	0.47**	0.34**	0.34**	0.38**	-0.44**
Hand/finger function	0.18*	0.11	0.21*	0.13	0.23**	0.21*	0.17*	-0.27**
Arm function	0.26**	0.06	0.29**	0.32**	0.35**	0.42**	0.26**	-0.23**
Selfcare tasks	0.14	0.01	0.16	0.06	0.22**	0.21**	0.12	-0.16
Household tasks	0.21*	0.02	0.27**	0.19*	0.22**	0.26**	0.14	-0.34**
Social activity	0.03	-0.00	0.10	-0.10	-0.08	-0.02	-0.01	-0.05
Support family/friends	-0.02	0.00	-0.02	0.05	0.00	0.00	0.00	-0.05
Arthritis pain	0.39**	0.21**	0.38**	0.38**	0.23**	0.20*	0.11	-0.31**
Work	0.35**	0.22**	0.36**	0.42**	0.46**	0.50**	0.10	-0.30**
Level of tension	0.13	0.08	0.16*	0.03	0.20*	0.20*	0.04	-0.23**
Mood	0.23**	0.07	0.16*	0.07	0.13	0.15	0.10	-0.18*
Satisfaction	0.35**	0.18*	0.33**	0.19*	0.09	0.13	0.13	-0.17*
Health perception	0.29**	0.22**	0.30**	0.36**	0.24**	0.26**	0.26**	-0.27**
Arthritis impact	0.25**	0.11	0.28**	0.29**	0.17*	0.17*	0.12	-0.32**

VAS: visual analog scale; physician: physician's global assessment; patient: patient's global assessment; ROM: range of motion. \*  $p < 0.05$ . \*\*  $p < 0.01$ .

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Table 4. Correlation analyses between Turkish AIMS2 scales and demographic variables (education level and age).

AIMS2 Scales	Education Level	Age
Mobility level	-0.42**	0.38**
Walking and bending	-0.37**	0.40**
Hand/finger function	-0.29**	0.23**
Arm function	-0.16	0.25**
Selfcare tasks	-0.08	0.11
Household tasks	-0.12	0.32**
Social activity	0.02	0.23**
Support family/friends	0.08	0.02
Arthritis pain	-0.35**	0.39**
Work	-0.38**	0.58**
Level of tension	-0.12	0.31**
Mood	-0.24**	0.21*
Satisfaction with health	-0.18*	0.38**
Health perception	-0.36**	0.30**
Arthritis impact	-0.11	0.18*

\* p < 0.05, \*\* p < 0.01.

between 2 days and 2 weeks as time interval in the reliability analyses. We chose an interval of 1-3 days to be appropriate because this time interval avoids differences in answers due to changes in clinical status of patients.

Results of correlation studies support the contention that the Turkish AIMS2 has evidence of construct validity. We found a significant correlation between AIMS2 pain subscale and other functional measures assessed by WOMAC. The same strong relationship was seen between AIMS2 subscales concerning lower limb function and pain severity measures such as VAS and WOMAC-pain subscale. These results are in accord with previous data that showed severity of knee pain contributes to disability<sup>19-21</sup>. Furthermore, ROM was significantly negatively correlated with most scales. Although high scores of physiological scales (walking and bending) that depend on lower limb function may

directly result in reduction of knee movement, it is of interest that upper limb functions were also related to ROM of the knee. It may be that restriction of knee movement is associated with more severe OA and reflects a loss in most functions. The radiological severity of OA by Kellgren-Lawrence grading system was significantly related to mobility level and walking and bending scales; however no significant correlation between radiological severity and arthritis pain was found in our study. This is in accordance with community studies that have shown a relationship between radiological severity and disability, although pain may not be related to radiological severity<sup>20,22-24</sup>. For this reason, Turkish AIMS2 is a potentially useful tool to detect the consequences of knee OA.

We did not find significant correlation between either social activities or support from family and friends and other measures. This result suggests that the validity of these subscales needs further analysis, as reported<sup>25</sup>.

We examined possible influences of demographic variables on the Turkish AIMS2 because it is important to understand factors that contribute to pain sensitivity and disability. Lower education level, aging, and female sex have been found to be related to functional loss and pain in patients with knee OA in previous studies<sup>26-28</sup>. Also in our study, lower education level and aging were positively correlated with most Turkish AIMS2 subscales scores. There was also significant difference between genders for most of the scales. In other words, female sex, aging, and lower education level were related to general worsening in scores of scales. The most likely explanation for this is that these demographic variables influence self-controlling mechanisms and pain-reducing modalities in knee OA.

In conclusion, the AIMS2 questionnaire translated into Turkish is a reliable and valid instrument for the assessment of patients with knee OA. Our results have to be confirmed

Table 5. Mean scores of Turkish AIMS2 scales for women and men. Comparisons were performed using the Student's t test.

AIMS2 Scales	Female	Male	p
Mobility level	3.9 ± 2.1	2.7 ± 2.0	*
Walking and bending	4.8 ± 2.3	3.6 ± 2.2	*
Hand and finger function	1.7 ± 2.2	0.8 ± 1.5	*
Arm function	1.7 ± 2.2	0.6 ± 1.1	*
Selfcare tasks	1.9 ± 2.6	0.8 ± 1.3	*
Household tasks	1.3 ± 2.4	0.9 ± 2.9	-
Social activity	5.2 ± 1.4	5.6 ± 1.6	-
Support family/friends	2.2 ± 2.0	2.5 ± 2.5	-
Arthritis pain	6.1 ± 2.3	5.1 ± 2.3	*
Work	3.2 ± 2.0	2.0 ± 1.7	-
Level of tension	2.9 ± 1.1	4.7 ± 0.7	-
Mood	4.4 ± 1.4	3.7 ± 1.1	-
Satisfaction with health	4.1 ± 1.7	3.6 ± 1.4	-
Health perception	6.6 ± 1.9	4.9 ± 2.3	*
Arthritis impact	4.4 ± 2.3	3.1 ± 2.0	*

\* p < 0.05.

by sensitivity to change analysis<sup>29,30</sup>, and further studies of the Turkish AIMS2 completed by patients with different diagnoses are required to establish its definitive validity.

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## REFERENCES

1. Dieppe P. Osteoarthritis, clinical features and diagnostic problems. In: Klippel JH, Dieppe P, editors. *Rheumatology*. Mosby; 1994: 7.4.1.
2. Felson DT, Naimark A, Anderson J, Kazis L, Castelli W, Meenan RF. The prevalence of knee osteoarthritis in the elderly. The Framingham Osteoarthritis Study. *Arthritis Rheum* 1987;30:914-8.
3. Cicuttini F, Spector T. Osteoarthritis in the aged. *Epidemiological issues and optimal management*. *Drug Aging* 1995;6:409-20.
4. Hadier NM. Osteoarthritis as a public health problem. *Clin Rheum Dis* 1985;11:175-85.
5. Guccione AA, Felson DT, Anderson JJ, Anthony JM, Zhang Y, Wilson PW. The effects of specific medical conditions on functional limitations of elders in the Framingham Study. *Am J Public Health* 1994;84:351-8.
6. Bellamy N, Kirwan J, Boers M, et al. Recommendations for a core set of outcome measures for future phase III clinical trials in knee, hip, and hand osteoarthritis. Consensus development at OMERACT III. *J Rheumatol* 1997;24:799-802.
7. Meenan RF, Gertman PM, Mason JH, Dunaif R. The Arthritis Impact Measurement Scales. Further investigations of a health status measure. *Arthritis Rheum* 1982;9:1048-53.
8. Meenan RF, Mason JH, Anderson JJ, Guccione AA, Kazis LE. AIMS2: the content and properties of a revised and expanded Arthritis Impact Measurement Scales health status questionnaire. *Arthritis Rheum* 1992;35:1-10.
9. Riemsma RP, Taal E, Rasker JJ, Houtman PM, Van Paassen HC, Wiegman O. Evaluation of the Dutch version of the AIMS2 for individuals with rheumatoid arthritis. *Br J Rheumatol* 1996;35:755-60.
10. Sampalis JS, Pouchot J, Beaudet F, et al. Arthritis Impact Measurement Scales: Reliability of a French version and validity in adult Still's disease. *J Rheumatol* 1990;17:1657-61.
11. Neumann L, Dudnik Y, Bolotin A, Buskila D. Evaluation of a Hebrew version of the revised and expanded Arthritis Impact Measurement Scales (AIMS2) in patients with fibromyalgia. *J Rheumatol* 1999;26:1816-21.
12. Salaffi F, Piva S, Barreca C, et al. Validation of an Italian version of the Arthritis impact measurement scales 2 (Italian-AIMS2) for patients with osteoarthritis of the knee. *Rheumatology* 2000; 39:720-7.
13. Shout PE, Fleiss JL. The effects of measurement errors on some multivariable procedures. *Am J Public Health* 1977;67:1188-91.
14. DeVellis RF. *Scale Development: theory and applications*. Newbury Park, CA: Sage; 1991.
15. 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 anti-rheumatic drug therapy in patients with osteoarthritis of the hip or knee. *J Rheumatol* 1988;15:1833-40.
16. Kellgren JH, Lawrence JS. Radiologic assessment of osteoarthritis. *Ann Rheum Dis* 1987;16:494-501.
17. Guillemin F, Bombardier C, Beaton D. Cross-cultural adaptation of health-related quality of life measures: literature review and proposed guidelines. *J Clin Epidemiol* 1993;46:1417-32.
18. Marx RG, Menezes A, Horovitz L, Jones EC, Warren RF. A comparison of two time intervals for test-retest reliability of health status instruments. *J Clin Epidemiol* 2003;56:730-5.
19. Van Baar ME, Dekker J, Lemmens JA, Oostendorp RA, Bijlsma JW. Pain and disability in patients with osteoarthritis of hip or knee: the relationship with articular, kinesiological, and psychological characteristics. *J Rheumatol* 1998;25:125-33.
20. Creamer P, Lethbridge-Cejku M, Hochberg MC. Factors associated with functional impairment in symptomatic knee osteoarthritis. *Rheumatology* 2000;39:490-6.
21. Salaffi F, Cavalieri F, Nolli M, Ferraccioli G. Analysis of disability in knee osteoarthritis. Relationship with age and psychological variables but not with radiographic score. *J Rheumatol* 1991;18:1581-6.
22. Jordan JM, Luta G, Renner JB, et al. Self-reported functional status in osteoarthritis of the knee in a rural southern community: the role of sociodemographic factors, obesity, and knee pain. *Arthritis Care Res* 1996;9:273-8.
23. McAlindon TE, Cooper C, Kirwan JR, Dieppe PA. Determinants of disability in osteoarthritis of the knee. *Ann Rheum Dis* 1993;52:258-62.
24. Jordan J, Luta G, Renner J, Dragomir A, Hochberg M, Fryer J. Knee pain and knee osteoarthritis severity in self-reported task specific disability: the Johnston County Osteoarthritis Project. *J Rheumatol* 1997;24:1344-9.
25. Koh ET, Seow A, Pong LY, et al. Cross cultural adaptation and validation of the Chinese Health Assessment Questionnaire for use in rheumatoid arthritis. *J Rheumatol* 1998;25:1705-8.
26. Felson DT, Zhang Y, Hannan MT, et al. The incidence and natural history of knee osteoarthritis in the elderly. The Framingham Osteoarthritis Study. *Arthritis Rheum* 1995;38:1500-5.
27. Cooper C, Snow S, McAlindon TE, et al. Risk factors for the incidence and progression of radiographic knee osteoarthritis. *Arthritis Rheum* 2000;43:995-1000.
28. Thumboo J, Chew LH, Lewin-Koh SC. Socioeconomic and psychosocial factors influence pain or physical function in Asian patients with knee or hip osteoarthritis. *Ann Rheum Dis* 2002;61:1017-20.
29. Andresen EM. Criteria for assessing the tools of disability outcomes research. *Arch Phys Med Rehabil* 2000;81 Suppl 2:S15-20.
30. Deyo RA, Centor RM. Assessing the responsiveness of functional scales to clinical changes: an analogy to diagnostic test performance. *J Chronic Dis* 1986;39:897-906.