Impact of Psychological Distress on Pain and Function Following Knee Arthroplasty

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Impact of Psychological Distress on Pain and Function Following Knee Arthroplasty

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Background: Preoperative psychological distress has been reported to be an important risk factor for poor outcome following lower-extremity arthroplasty. We determined the independent impact of preoperative psychological distress on three, twelve, and twenty-four-month WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) pain and function scores and on change scores over those time periods.

Methods: Data were obtained from an international group of 952 patients in thirteen centers participating in the Kinemax Outcomes Study. Patients completed the WOMAC and Short Form-36 (SF-36) questionnaires. The mental health (MH) scale of the SF-36 was used to quantify the impact of psychological distress on WOMAC pain and function scores. We also dichotomized patients into groups with and without psychological distress on the basis of evidence-based cut-points. Repeated-measures models were used to derive mean preoperative and three, twelve, and twenty-four-month WOMAC pain and function scores and general linear models were used to derive change scores for patients with and without psychological distress after adjustment for covariates.

Results: Psychological distress, when examined on a continuous scale, was found to predict pain and function at all time-points. WOMAC pain scores for psychologically distressed patients were 3 to 5 points lower, depending on the time-frame, than the scores for the non-distressed patients, after adjustment for covariates. WOMAC function scores did not differ significantly between the two groups following surgery. The changes in the WOMAC pain and function scores for the psychologically distressed patients were not significantly different from those for the non-distressed patients.

Conclusions: Many patients with psychological distress demonstrate a substantial decrease in that distress following surgery. Patients who are distressed have slightly worse pain preoperatively and for up to two years following knee arthroplasty as compared with patients with no psychological distress. With the exception of preoperative scores, these differences are not likely to be measurable at the individual patient level. WOMAC pain and function change scores do not differ between patients with and without distress after adjustment for covariates.

Level of Evidence: Prognostic Level I. See Instructions to Authors for a complete description of levels of evidence.

The influence of psychological distress on outcomes of procedures in patients with musculoskeletal disorders has received increased attention in recent years\textsuperscript{3,4}. Psychological distress is a term used to describe a broad array of psychological symptoms including depression, poor coping, anxiety, and somatization\textsuperscript{5,6}.

Authors of recently published studies have examined the impact of psychological distress on patients undergoing either total hip or total knee arthroplasty\textsuperscript{7,8}. Generally, studies have demonstrated that approximately 25% of patients undergoing hip or knee arthroplasty have preoperative distress that negatively impacts preoperative and postoperative physical function and pain. Given that joint replacement surgery is a common procedure (approximately 780,000 hip and knee re-
placements were performed in the United States in 2003\textsuperscript{3}), the role and impact of psychological distress appear to warrant additional study. Ethgen et al., in a seminal review of arthroplasty outcome studies, argued for more studies designed to determine the extent to which psychological profiles of patients influence the outcomes of joint replacement surgery\textsuperscript{18}.

A variety of methods have been used to identify patients who are psychologically distressed before a planned hip or knee replacement. To quantify psychological distress, most investigators have used a surrogate measure of general distress, either the mental health (MH) score\textsuperscript{20} or the mental component summary (MCS) score of the Short Form-36 (SF-36)\textsuperscript{21}, a commonly used generic health status measure.

We found only two studies in which the investigators identified patients who were psychologically distressed prior to knee arthroplasty and then determined the impact of that distress on physical function after surgery\textsuperscript{22,23}. Patients with an SF-36 MCS score of \textless{}50 points (the mean derived from a large sample of the United States population\textsuperscript{24}) were considered to have psychological distress, whereas a score of \textgeq{}50 points indicated no distress. Patients with an MCS score of \textless{}50 points had poorer six and twelve-month outcomes than did patients with an MCS score of \textgeq{}50 points. Generalizability was limited because Ayers et al. examined relatively small samples of fifty-two\textsuperscript{1} and 165\textsuperscript{2} patients, and the impact of distress, in WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) units, was not quantified with use of a multivariate approach.

The purpose of our study was to quantify the independent impact of preoperative psychological distress on WOMAC pain and function scores three, twelve, and twenty-four months following surgery. We employed two strategies to accomplish our purpose. First, we used a continuous measure of distress, the MH score of the SF-36. Second, we dichotomized the MH score, to place patients into distressed and non-distressed groups, using an evidence-based approach. We compared the change scores for each time interval and the final scores at each time interval between the distressed and non-distressed groups. Change scores for the outcome of interest most commonly reflect improvements following surgery, and we were interested in comparing functional improvement and pain relief between patients with distress and those without distress. We hypothesized that change scores for patients with distress would be less than those for patients without distress after adjustment for covariates, including baseline pain and function.

Final scores reflect the status of patients at a particular point in time following an intervention, and we were interested in knowing whether the MH scores predicted outcomes at the different time-points in the study. Patients with better final outcome scores are more satisfied with their outcome than are patients with lower final outcome scores\textsuperscript{24,25}. We hypothesized that the MH score of the SF-36 would negatively impact the follow-up scores at various time-points, after adjustment for covariates. Patients with lower baseline functional status have been shown to have worse outcomes at three, six, and twenty-four months following surgery (in spite of having greater change scores)\textsuperscript{26-29}.

### Materials and Methods

Data for these analyses were obtained as part of the Kinemax Outcomes Study, a prospective cohort study of primary total knee arthroplasty for the treatment of osteoarthritis conducted in thirteen centers: four in the United States, six in the United Kingdom, two in Australia, and one in Canada\textsuperscript{1}. Other papers on the original cohort study have been published\textsuperscript{20,26}.

The appropriate institutional review board or ethical committee approved the study at each of the participating centers, and all patients signed an approved consent form. Patients were recruited from September 1997 to December 1998 in the United Kingdom, the United States, and Australia. In Canada, recruitment extended to the end of 1999.

#### Patients

All patients undergoing primary total knee arthroplasty with the Kinemax prosthesis (Stryker Howmedica, Mahwah, New Jersey) for the treatment of osteoarthritis were included in the study. A diagnosis of osteoarthritis was made by the operating surgeon after clinical and radiographic examination. Patients were excluded if they had a history of knee joint infection or previous implant surgery on the index knee or if they were unable to complete the questionnaires because of cognitive or language difficulties. Patients who had had bilateral total knee arthroplasty with the procedures performed within twelve months of each other were also excluded from these analyses to ensure that the follow-up results reflected the outcome of the index operation and not a subsequent surgical procedure.

#### Data Collection Procedures

Independent research assistants obtained consent and collected data using a standardized protocol. Preoperative data were collected within six weeks prior to the total knee arthroplasty, and follow-up data were collected at three, twelve, and twenty-four months following the surgery. One author (E.A.L.) trained all of the research assistants to standardize data collection, and data were entered into a single database at the coordinating center.

#### Data Elements

Preoperatively, the patients filled out the Self-Administered Comorbidity Questionnaire, which has been validated\textsuperscript{7} and includes queries regarding demographic details, socioeconomic data (education, income, working status, and living arrangements), height, weight, and history of comorbid conditions. At each evaluation, two health-status scales were administered: the WOMAC\textsuperscript{20,26}, a disease-specific measure of pain, stiffness, and function, and the SF-36\textsuperscript{30,31}, a generic health-status measure. With the usual method of scoring the WOMAC, pain is assigned a score out of 20 points and function is assigned a score out of 68 points, with a low score indicating better health\textsuperscript{32}. For ease of interpretation, we transformed WOMAC pain and func-
tion scores to a 0 to 100-point scale for each domain, with a higher score being better and 100 points being the best. The MH scale of the SF-36 also ranged from 0 to 100 points, with 100 points being the best.

For this study, we used the MH scale of the SF-36 as a measure of general psychological distress (Fig. 1). We chose the MH scale of the SF-36 because it consists entirely of mental health questions relating to a variety of mental health dimensions and it has been validated as a general measure of distress. We did not choose the MCS of the SF-36 because it is composed of multiple dimensions of health and can be influenced by a patient's physical health.

Research conducted across multiple countries has suggested that SF-36 scores are reasonably equivalent across Australia, the United Kingdom, and the United States. For example, normative data for Australian women were found to be very similar to data for women in the United States. Clarke et al. found no clinically relevant differences between the MH scores for Australian men between the ages of eighteen and sixty-five years old and the scores for men between those ages in the United Kingdom, suggesting reasonable equivalence for/across the two countries.

**Statistical Methods**

Using the preoperative MH score as a continuous variable, we generated parameter estimates and p values from general linear models for WOMAC pain and function scores at each assessment time. Models were adjusted for age, gender, number of comorbid medical conditions, country, center within country, and preoperative score.

Using the age and gender-based MH scores that Ware et al. derived from a study of 1374 patients who were seeing mental health clinicians (see Appendix), we dichotomized our data into two groups: those with psychological distress (patients with a score at or below the age and gender-based median for the patients in the mental health dataset) and those who were not psychologically distressed (those with a score above the median). We reasoned that if a patient in our dataset had an MH score at or below the age and gender-based median of those seeing mental health clinicians, it was likely that the patient had psychological distress.

In addition, because statistical information can be lost when continuous data are converted to dichotomous data, we tested the sensitivity of these estimates by using MH score cut-points of 50 and 60 points. We also dichotomized the MCS score of the SF-36 using a cut-point of 50 points, a score that has been used in the joint replacement literature to dichotomize patients into distressed and non-distressed groups. The stability of our estimates would be demonstrated to the extent that the estimates of effect derived with use of these various cut-points were similar to those derived with use of our original cut-point.

Demographic, socioeconomic, and preoperative health-status data were compared between the distressed and non-distressed groups (as categorized with our original cut-point) with use of Wilcoxon two-sample tests and chi-square analyses where appropriate. We used repeated-measures analysis to report preoperative and three, twelve, and twenty-four-month WOMAC pain and function scores for the distressed and non-distressed groups. As the WOMAC scores represent multiple assessments of the same patient over time, we used repeated-measures analysis to adjust for the within-patient factors and interactions between those factors and the between-patient factors such as distress group.

A total of 181 patients had missing data at twenty-four months for the following reasons: thirty-five (19%) had died, nineteen (11%) had been unable to continue with the study because of other medical conditions (such as stroke), seventeen (9%) had had revision surgery on the index knee, forty-six (25%) had asked that they be withdrawn from future follow-
up, twelve (7%) had moved and could no longer be followed, forty (22%) had been lost to follow-up for unknown reasons, and twelve (7%) were unable to return for the twenty-four-month examination but were willing to stay in the study. When follow-up data were missing at twenty-four months, we used the last-observation-carried-forward method to substitute the missing data with the twelve-month score, if that was available, for patients who to our knowledge had not died, had not had other medical conditions that made them unable to continue with the study, or had not undergone revision surgery. Scores were adjusted for preoperative status, age, gender, number of comorbid medical conditions, country, and center within the country. Differences in WOMAC scores of 7 to 12 points on a 100-point scale have been shown to be perceptible to individual patients and clinically meaningful. For groups of patients, changes in WOMAC scores of 3 to 6 points on a 100-point scale are considered clinically important.

We also analyzed the changes in the WOMAC pain and function scores at each follow-up time compared with the preoperative scores. We used general linear models to report adjusted mean change scores for the distressed and non-distressed groups to determine whether there was a significant difference between the groups. Scores also were adjusted for age, gender, number of comorbid medical conditions, country, and center within the country. For a sensitivity analysis, the various cut-points described earlier were also examined. Because our method of substitution of missing data may affect the results, we also report the results for all analyses without substitution of missing data.

Statistical analyses were performed with use of SAS version-8.1 statistical software.

Results

Preoperative Description of the Sample

A total of 1249 (78.7%) of all eligible patients were recruited. Of the eligible patients who were not recruited, 128 (8.1%) refused to consent, 197 (12.4%) were missed preoperatively because of the absence of the research assistant due to sickness or vacation or were not admitted because of insufficient time to obtain consent and to inform and/or evaluate the patient prior to surgery, and fourteen (0.9%) were already enrolled in another study and the institutional review board protocol at that site did not allow patients to be recruited into more than one study. During the recruitment period, only 6% of all patients treated with primary total knee arthroplasty by the participating surgeons did not receive a Kinemax-Plus prosthesis, frequently because a more constrained prosthesis was required. After exclusion of 275 patients who had had bilateral total knee arthroplasty with the two procedures per-

### TABLE I Comparison of Sociodemographic Characteristics and SF-36 MH Scores Between the Psychologically Distressed and Non-Distressed Groups*

<table>
<thead>
<tr>
<th></th>
<th>Distressed (N = 172)</th>
<th>Non-Distressed (N = 780)</th>
<th>P Value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age† (yr)</td>
<td>70 (61, 70)</td>
<td>71 (65, 76)</td>
<td>0.033</td>
</tr>
<tr>
<td>Female gender§</td>
<td>113/172 (66)</td>
<td>461/780 (59)</td>
<td>0.11</td>
</tr>
<tr>
<td>Income lowest category§</td>
<td>45/150 (30)</td>
<td>153/667 (23)</td>
<td>0.07</td>
</tr>
<tr>
<td>Education &lt; high school§</td>
<td>94/164 (57)</td>
<td>407/777 (52)</td>
<td>0.19</td>
</tr>
<tr>
<td>Working§</td>
<td>21/171 (12)</td>
<td>110/667 (16)</td>
<td>0.52</td>
</tr>
<tr>
<td>Marital status separated or divorced§</td>
<td>26/171 (15)</td>
<td>43/779 (6)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Lives alone§</td>
<td>64/170 (38)</td>
<td>228/772 (30)</td>
<td>0.038</td>
</tr>
<tr>
<td>Smokes§</td>
<td>22/168 (13)</td>
<td>52/755 (7)</td>
<td>0.006</td>
</tr>
<tr>
<td>Drinks alcohol§</td>
<td>18/169 (11)</td>
<td>63/766 (8)</td>
<td>0.31</td>
</tr>
<tr>
<td>Body mass index†</td>
<td>29.5 (26.8, 34.4)</td>
<td>28.4 (25.3, 32.0)</td>
<td>0.0038</td>
</tr>
<tr>
<td>No. of comorbidities†</td>
<td>2 (1, 3)</td>
<td>1 (1, 2)</td>
<td>0.0039</td>
</tr>
<tr>
<td>Self-reported depression§</td>
<td>41/167 (25)</td>
<td>38/765 (5)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>SF-36 mental health score† (points)</td>
<td>44 (36, 52)</td>
<td>80 (68, 88)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Preop.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-mo</td>
<td>60 (48, 76)</td>
<td>80 (68, 92)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>12-mo</td>
<td>60 (48, 72)</td>
<td>84 (72, 92)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>24-mo</td>
<td>60 (44, 76)</td>
<td>84 (70, 92)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

*The psychologically distressed and non-distressed groups were determined on the basis of age and gender-based cut-points reported by Ware et al. †The p values were derived with the Wilcoxon two-sample test for the continuous data and with the chi-square test for the categorical data. ‡The values are given as the median with the 25th and 75th quartiles in parentheses. §The values are given as the number with the characteristic/total number in the group for which the information was known (percentage of the group).
formed within twelve months of each other, 974 patients met the inclusion criteria. Twenty-two of those patients did not have complete preoperative MH-score data and were excluded from further analyses. Of the remaining 952 patients, 172 (18%) had a preoperative MH score at or below the age and gender-based median of those seeing mental health clinicians\(^1\) and were included in the distressed group and 780 (82%) had a score above the median and were included in the non-distressed group. Differences between the distressed and non-distressed groups with regard to sociodemographic factors are shown in Table I. The distressed group was significantly younger and more likely to be separated or divorced, to be living alone, and to report current smoking than the non-distressed group. The distressed group also reported a greater number of comorbid medical conditions and had a higher body mass index than the non-distressed group.

There was no significant difference in the overall proportion of distressed patients among the four countries, but there was considerable variation among the centers. Proportions ranged from 13% to 32%, excluding one clinic in which the proportion of distressed patients was only 3%. For this reason, in all of our multivariate models we adjusted for country and center nested within country.

**Longitudinal Analyses**

A total of 682 patients (72%) had complete data over the two-year period of the study. Patients with missing data were more likely to have lower preoperative MH scores and lower WOMAC function scores (p < 0.05). No other significant differences were found between those with and those without missing data.

When the preoperative MH score was examined as a continuous variable, it was found to have a significant impact on WOMAC pain and function scores at all time periods (see Appendix) after adjustment for covariates. For the preoperative WOMAC pain score, the parameter estimate for the MH score was 0.136, indicating that for each point increase in the MH score, the WOMAC pain score increases by 0.136 point—that is, patients with higher MH scores (indicating better mental health) report significantly higher WOMAC pain scores (indicating less pain). The R\(^2\) values ranged from 0.13 to 0.29 for the models reported, indicating that the included variables explained 13% to 19% of the variation in WOMAC pain scores and 19% to 29% of the variation in WOMAC function scores.

After the preoperative MH score was dichotomized, the unadjusted WOMAC pain and function scores were found to be consistently higher for the non-distressed group, indicating less pain and functional limitation at each assessment time. Seven (4.1%) of the 169 patients with distress had a WOMAC pain score of >75 points, indicating only mild to no pain, compared with twenty-two (2.8%) of the 777 non-distressed patients. Conversely, almost a quarter (187; 24.1%) of the 777 non-distressed patients reported a WOMAC pain score of <25 points, indicating severe-to-extreme pain, compared with almost half (seventy-nine; 46.7%) of the 169 distressed patients.

Despite the distressed group having much lower preoperative WOMAC scores, they had a dramatic improvement in these scores in the first three months and this improvement was

<table>
<thead>
<tr>
<th>Analysis with Substitution of Missing Data†</th>
<th>Distressed§</th>
<th>Non-Distressed§</th>
<th>P Value#</th>
</tr>
</thead>
<tbody>
<tr>
<td>WOMAC pain score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop.</td>
<td>N = 125</td>
<td>N = 618</td>
<td>0.0002</td>
</tr>
<tr>
<td>3-mo</td>
<td>36.7 (29.7, 43.7)</td>
<td>44.3 (37.6, 50.9)</td>
<td>0.16</td>
</tr>
<tr>
<td>12-mo</td>
<td>72.9 (66.2, 79.6)</td>
<td>77.6 (71.2, 84.0)</td>
<td>0.016</td>
</tr>
<tr>
<td>24-mo</td>
<td>75.4 (68.7, 82.0)</td>
<td>79.5 (73.2, 85.8)</td>
<td>0.029</td>
</tr>
<tr>
<td>WOMAC function score</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop.</td>
<td>N = 129</td>
<td>N = 620</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>3-mo</td>
<td>36.9 (30.4, 43.3)</td>
<td>46.4 (40.3, 52.6)</td>
<td>0.08</td>
</tr>
<tr>
<td>12-mo</td>
<td>64.1 (57.2, 71.0)</td>
<td>67.0 (60.4, 73.5)</td>
<td>0.15</td>
</tr>
<tr>
<td>24-mo</td>
<td>67.3 (60.4, 74.1)</td>
<td>68.9 (62.4, 75.5)</td>
<td>0.4</td>
</tr>
</tbody>
</table>

The psychologically distressed and non-distressed groups were determined on the basis of age and gender-based cut-points reported by Ware et al.\(^1\). †When follow-up data at twenty-four months were missing, the last-observation-carried-forward method was used to substitute the missing data with the twelve-month score, if available, for patients who to our knowledge had not died, had no other medical conditions that prevented them from continuing with the study, or had not undergone revision surgery. ‡Because of the possibility that underlying assumptions of the last-observation-carried-forward method of substitution may have affected the results, the results without substitution are also reported. §The values are given as the least square means (adjusted for preoperative score, age, gender, number of comorbid medical conditions, country, and center within country), in points, with 95% confidence intervals in parentheses. #P value for the significance of the difference between the least square means.
Patients with psychological distress have noticeably worse preoperative pain and function as compared with patients who are not distressed. The mental health of patients with psychological distress also demonstrated substantial improvements in their MH scores, but these scores were approximately 20 points lower than those in the non-distressed group at all follow-up time-points. There was little change in the MH scores in the non-distressed group throughout all assessment times (Table I).

The preoperative and three, twelve, and twenty-four-month outcomes according to the dichotomized MH score are presented in Table II. The least square means for WOMAC pain and function scores based on multivariate models were adjusted for preoperative score, age, gender, number of comorbid medical conditions, country, and center within country. Table II includes the analyses of the complete data as well as the data with substitution of missing values as outlined in the Statistical Methods section. Preoperatively, both WOMAC pain and WOMAC function scores for the distressed group were significantly worse than those for the non-distressed group (p < 0.0003). Both groups had significantly better scores at each follow-up visit compared with the baseline values (p < 0.0001). At the twelve-month and twenty-four-month assessment times, the WOMAC pain scores in the distressed group were significantly lower (p < 0.05) than those in the non-distressed group. Differences in the WOMAC pain scores between the two groups were on the order of 3 to 5 points, with the distressed group having worse pain. Differences in the WOMAC function scores were on the order of 1 to 3 points and were not significant at any time period. These findings remained consistent with and without substitution of missing data. In the three sensitivity analyses, approximately 85% of the mean differences between the two groups were within 2 points of the estimates reported with use of the original cut-point (see Appendix for data derived with use of an MH-score cut-point of 60 points; data for other analyses not shown).

The least square means for changes in WOMAC pain and function scores from the preoperative time-point to the three, twelve, and twenty-four-month time-points are summarized in Table III. There were no significant differences between groups with regard to the amounts of change between the preoperative and any of the follow-up assessments analyzed. This finding was consistent between the analyses performed with and those performed without substitution of missing values. Sensitivity analyses indicated that mean difference estimates derived with use of the three additional cut-points (MH scores of 50 and 60 points and an MCS score of 50 points) were not significant (see Appendix for data derived with use of an MH-score cut-point of 60 points; data for other analyses not shown).

Discussion

Patients with psychological distress have noticeably worse preoperative pain and function as compared with patients who are not distressed. The mental health of patients with pre-
operative distress markedly improves following surgery, but the mental health of patients classified preoperatively as non-distrressed stays essentially the same. These data suggest that preoperative distress is reversible, at least to some extent, and that this reversal is probably related to the surgical intervention.

Our analytic strategy was designed to determine if preoperative distress predicted poor outcome and, if so, to quantify the extent of this impact in a clinically meaningful way. The MH scale, when examined as a continuous variable, was a highly significant predictor of pain and function scores at all time periods. However, this analysis does not provide a description or context for judging the clinical importance of the prediction. Our approach to dichotomizing the MH scale allowed us to judge the clinical impact, in WOMAC scale points, and the sensitivity analysis indicated that our estimates were reasonably stable.

Our study appears to be the first in which multivariate approaches were used to quantify the independent impact of preoperative psychological distress on the change in status following knee replacement surgery and on the outcomes at various time-points. Distinguishing between change (representing improvement or worsening) and outcome (representing the final status) appears to be clinically important because change and outcome are conceptually different phenomena. Patients who are on the higher-functioning end of the WOMAC function scale preoperatively, for example, can have only a small amount of change because of the ceiling effect. The score can only get so high. Alternatively, patients who score very poorly on the WOMAC function scale prior to surgery can have a dramatic change in their score but still not be near the ceiling of the scale. We therefore believe that it is clinically important to examine outcomes from both the perspective of score changes and the perspective of final scores at various time-points. Reports of health-care quality (the so-called report cards) related to knee replacement should, in our opinion, address both changes in functional status and pain as well as final status.

Our data indicate that psychological distress adversely affects outcome but only when considered at the group level and only in terms of pain. Preoperative psychological distress does not appear to have a deleterious effect on function, as measured by the WOMAC, in terms of either change scores or outcomes at various time-points. Differences in WOMAC pain scores were on the order of 3 to 5 points during the two-year study, which is below literature-based estimates of minimal clinically important differences for individual patients. Clinically important differences between groups of patients are estimated to be on the order of 3 to 6 WOMAC points. Change scores appear to be less affected by psychological distress than are follow-up scores because we found no significant differences between the change scores for the two groups during the three follow-up periods (Table III).
Psychological distress is reversible, as shown in our study, and interventions designed to reduce distress have been shown to be effective for elderly patients with arthritis. However, interventions would be of value for improving the results of knee replacement only if distress were convincingly shown to have a deleterious effect on such results. More research is clearly needed before large-scale trials are conducted because the magnitude of the effect of distress on pain and function appears to be very small.

Our study was conducted in thirteen centers from four countries, which may have reduced the generalizability of the results to any one country. Also, the loss to follow-up was on the order of 28%, which may have influenced our estimates of effects attributable to psychological distress. We suspect that this influence is likely given that a higher proportion of patients with distress and lower WOMAC function scores were lost to follow-up. This loss of data may have resulted in an underestimation of the effect of distress since a greater proportion of patients with distress had missing data. In addition, the great majority (92%) of our patients were white, so the results are not generalizable to patients of other races.

Finally, and potentially most importantly, we used a general measure of psychological distress rather than more specific distress measures, so we cannot determine the potential impact of more specific types of distress. The distress scores did not tell us if the distress was related to an acute event or patient state or was a chronic condition more related to a patient trait. As a result, we cannot make inferences about what may have caused the distress. Additional research is needed to clarify the potential effect of more specific forms of psychological distress on outcome.

In summary, patients with preoperative psychological distress have twelve to twenty-four-month pain outcomes that are slightly worse than those for patients who are not distressed. Postoperative changes in pain scores do not differ between patients with and those without distress. Physical function outcome and change scores also do not differ significantly between distressed and non-distressed patients.

Appendix

Tables showing a summary of the median scores for the MH scale from the study by Ware et al., the parameter estimates from the logistic regression analyses, the sensitivity analysis for outcome with use of a cut-point of 60 points for the MH score, and the sensitivity analysis for change scores with use of a cut-point of 60 points for the MH score are available with the electronic versions of this article, on our web site at jbjs.org (go to the article citation and click on “Supplemental Material”) and on our quarterly CD-ROM (call our subscription department, at 781-449-9780, to order the CD-ROM). [1]

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