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Pessimistic explanatory style

A PSYCHOLOGICAL RISK FACTOR FOR POOR PAIN AND FUNCTIONAL OUTCOMES TWO YEARS AFTER KNEE REPLACEMENT

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Seligman's theory of causal attribution predicts that patients with a pessimistic explanatory style will have less favourable health outcomes. We identified 702 patients who had undergone 894 primary total knee replacements between 1993 and 2005, who responded to follow-up surveys at two (n = 783 knee replacements) and/or five years (n = 443 knee replacements) and had also completed the Minnesota Multiphasic Personality Inventory long before the joint replacement (median = 16.6 and 14.5 years for two- and five-year cohorts, respectively). Scores from the Minnesota Multiphasic Personality Inventory Optimism-Pessimism scale were used to categorise patients as pessimistic (t-score > 60) or non-pessimistic (t-score ≤ 60). Multivariate logistic regression models assessing the effect of pessimistic explanatory style on pain or improvement in knee function were adjusted for gender, age, distance from the place of treatment and depression score. Pessimists reported (a) significantly more moderate or severe pain at two years with odds ratio 2.21 (95% confidence interval (CI) 1.12 to 4.35; p = 0.02), but not at five years when the odds ratio was 1.21 (95% CI 0.51 to 2.83; p = 0.67); and (b) less improvement in knee function at two years when the odds ratio was 0.53 (95% CI 0.30 to 0.96; p = 0.04), but not at five years when the odds ratio was 1.26 (95% CI 0.57 to 2.77; p = 0.57).

No significant associations with moderate or severe limitation of activity were seen at two or five years. We conclude that a pessimistic explanatory style is associated with worse pain and functional outcomes two years after total knee replacement.

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A distressed psychological state around the time of surgery, including depression and anxiety, has been associated with poorer pain and functional outcomes at short- and medium-term follow-up in patients who have undergone total knee replacement (TKR).[1-5] Although the psychological state may change over time, psychological traits tend to remain stable. It is not known whether certain pre-existing, psychological characteristics of these patients, such as optimism or pessimism, affect the outcome after TKR.

In order to investigate this question conceptually, we used Seligman's theory[6-8] of causal attribution, that is, an explanatory or attributional style. The theory postulates that the manner in which people explain to themselves the reasons for the occurrence of specific, important, good or bad events in their lives, by asking questions such as "Why did this happen to me?", has important ramifications. More specifically, according to this theory, people who 1) attribute the causes of adverse events in their lives to themselves. with an internal explanation, 'It's me....', 2) carry the expectation that the condition will persist, applying a stable explanation, '.....happened again, as usual....' and 3) believe that it will affect other aspects of their life, with a global explanation, '.....and now....I'll never get to....', can be described as having a pessimistic attributional style. The converse characterises an optimistic explanatory style.[6-8] It has been shown over the past 35 years that a pessimistic explanatory style is a significant risk factor for future episodes of depression, reduced occupational or academic accomplishments, and an increased risk of poorer physical health.[9]

The score from the optimism-pessimism scale of the Minnesota Multiphasic Personality Inventory (MMPI)[10] preceding the TKR, either primary or revision, was used to classify our patients.[11,12] Two longitudinal studies have validated Seligman's theory among general medical outpatients.[13,14] These 30-year follow-up projects found that a pessimistic explanatory style, derived from scores on a bidirectional scale of optimism-pessimism using the MMPI item pool, was significantly associated with increased mortality[13] and poorer self-reported quality of life.[14]

The original MMPI consisted of 550 unique true/false items pertaining to thoughts, feelings, attitudes, physical symptoms, emotional symptoms and previous life experiences. Empirical approaches were used to create a profile of scales characterising common psychological and psychiatric conditions.[15] The MMPI and its current revision, the MMPI-2,[16] have been the most widely used and thoroughly researched of the self-reporting measures of personality functioning yet developed.[17]

Typically, TKR is a successful surgical procedure associated with a significant reduction in pain, improved knee function and better overall quality of life.[18,19] However, to our knowledge there are no studies that have determined whether the explanatory style is associated with a better or a poorer outcome. In this study our objectives were to assess whether an explanatory style is independently associated with self-reported (1) pain, (2) limitations in activities after follow-up at two and five years post-primary or post-revision TKR and (3) time to revision or re-operation in patients with primary TKR.

Patients and Methods

We identified a cohort of 812 patients (322 men and 490 women) who had undergone primary or revision TKR between 1993 and 2005, had completed the two- or five-year pain, function and activity limitation questionnaire between 1993 and 2007, and also completed a MMPI at any time prior to their index TKR. For this group the median interval from the time of completion of the MMPI to TKR was 16.5 years (0 to 42). This included 702 patients (275 men, 427 women) with 894 primary TKRs and 143 (61 men, 82 women) with 164 revision TKRs. Some patients had bilateral TKRs and some qualified for inclusion in both primary and revision TKR cohorts during this 12-year period. Outcomes were derived from a validated pain/function questionnaire[20] which was sent to the patients for completion and return, or administered in the clinic as part of the regular follow-up. For those who did not respond to the survey and were not attending clinical follow-up, it was administered by telephone interview by trained staff. The study was approved by the Institutional Review Board at the Mayo Clinic.

Predictor of interest. The score from the optimism-pessimism scale of the MMPI, preceding the TKR (either primary or revision) was used to classify our patients. Following Maruta et al,[13,14] we classified patients into two categories: pessimists (T-score > 60) and non-pessimists (T-score ≤ 60).

Outcomes of interest. Self-reporting of joint pain, improvement in knee function compared to the pre-operative status and overall limitation of activity were obtained from the follow-up questionnaire for both primary and revision TKR patients. We also calculated implant survival in patients with primary TKR.

Knee pain was assessed by a single question: 'How much pain do you have in your knee that was operated upon'?, to which the seven potential responses comprised; no pain, mild occasional pain, pain only when negotiating stairs, pain while walking and climbing stairs, moderate (occasional), moderate (continuous), and severe. Patients were categorised into two groups derived from their response: 'moderate' and 'severe' were combined; the other categories were combined as the reference group.

Self-reported knee function required comparison to pre-operative status. It was also assessed with a single question: 'Compared to your condition before your knee surgery, how would you rate your knee function'? There were four possible responses; much better, somewhat better/better, same, worse. Patients were categorised into two groups, based on their response to this item. We compared patients in the category of 'much better' with those in the reference category comprising 'somewhat better, same, worse', based on the fact that, typically, TKR is an extremely successful procedure and most patients aim to achieve much better knee function than pre-operatively.

The self-reported current status of functional activity for walking, stair-climbing and rising from a chair was obtained by asking about limitations in these three activities and classifying the patients into two groups, using a four-point categorical scale for each activity: (1) Distance walked: unlimited or > ten blocks = none; five to ten blocks = mild; < five blocks = moderate; housebound, indoors only or unable = severe; (2) Climbing stairs: normal up and down = none; Normal up, down with hand rail = mild; up and down with hand rail = moderate; up with rail, down unable or unable = severe; and (3) rise from chair: able, no arms = none; able with arms = mild, able with difficulty = moderate; unable = severe.

The classification into the two groups of functional limitations was based on the extent of the limitation. Those patients who reported moderate or severe limitation in two or more of these three activities were grouped as having moderate-severe limitations overall,[21,22] and the remainder were classified as having none or only mild limitations, and served as the reference group.

Finally, implant survival was defined as the time from the primary TKR to that of the first revision or re-operation.

Covariates/confounders. Given the creation of these subsets, yielding small numbers of patients with events of interest in some cells, we limited the multivariable analyses to the following, already acknowledged, potential confounders: gender, age in three categories (≤ 60, 61 to 70, > 70 years),[23,24] depression score (MMPI),[25,26] and distance travelled from the patient's residence to the place of treatment (Mayo Clinic, Rochester, Minnesota) in three categories (0 to 100, > 100 to 500, > 500 miles).

Statistical analyses. Summary statistics are presented for the clinical characteristics of the primary and revision TKR two- and five-year cohorts. Multivariable logistic regression analyses were used to examine the associations between explanatory style, with each patient classified as having a pessimistic or non-pessimistic style, with each

binary outcome of interest, in the two- and five-year primary TKR cohorts and after adjusting for potential confounders. Similar analyses were performed for revision TKR cohorts, except that small numbers precluded multivariate analyses for the five-year revision TKR cohort.

The explanatory variables in the multivariate logistic models were gender, age, distance from the place of treatment, MMPI depression score and the binary variable categorised as pessimistic or non-pessimistic. All analyses used a generalised estimating equations approach, adjusting the standard errors for the correlation between knees (right and left) within the same patient due to replacement of both knees and/or multiple operations on the same knee. Time to revision was assessed by using the time from TKR to the first revision/re-operation on the same knee.

A Cox's proportional-hazards regression model was used to compare the time to revision in pessimists and non-pessimists after adjusting for age, gender, distance from the place of treatment and depression score. The Cox survival analysis was performed using a robust estimate of variance to account for correlated joints within the same patient.

The characteristics of survey responders and non-responders were compared using logistic regression analyses on whether or not the patient had or did not have an MMPI. The odds ratio or hazard ratio with 95% confidence intervals (CI) are reported from these regression analyses, and p-values < 0.05 were considered significant. A 95% CI for the odds or hazard ratio that includes unity represents a non-significant association. Analyses were performed using SAS 9.1.3 (SAS Institute Inc., Cary, North Carolina) and Stata 10.0 (StataCorp LP, College Station, Texas).

Results

We studied 702 patients with 894 primary TKRs and completed MMPIs who had responded to follow-up pain and functional activity questionnaires; there were 783 knees with completed surveys at two years and 443 at five years after surgery. The number of completed surveys exceeded 894, as some patients responded to both two- and five-year pain and functional activity surveys. Other characteristics of the cohorts are described in Table I. Similarly, there were 164 revision TKR patients with completed MMPIs who had responded to follow-up pain and functional activity questionnaires; 144 had completed surveys at two years and 79 had completed pain and function surveys at five years post-operatively. Mean T-scores for patients from 1962 to 1965 were 56 for women and 57 for men similar in age to our cohort.[27,28]

For the primary TKR two-year follow-up cohort, the mean age at operation was 68.8 years (29 to 93), 300 (38%) were men, 96 (12%) had a normal BMI of < 25, the underlying diagnosis was osteoarthritis in 732 (93%), and a cemented implant was used in 769 (98%). The MMPI was administered a mean of 17 years before the primary TKR (Table I). Characteristics of other cohorts are summarised in Table I.

Patients in the primary two-year follow-up group with an MMPI were significantly less likely than those without an MMPI to be male ($p < 0.01$, $p < 0.01$, $p = 0.04$, $p < 0.01$, $p < 0.01$), odds ratio, 0.76 (95% CI 0.63 to 0.91), to live > 100 to 500 miles or > 500 miles from the place of treatment (relative to < 100 miles), odds ratio 0.72 (95% CI 0.60 to 0.87) and odds ratio 0.68 (95% CI 0.47 to 0.98), respectively. In addition, they were more likely to have higher comorbidity, odds ratio 1.88 (95% CI 1.59 to 2.22) for five-point increase in Deyo-Charlson index[29] which is a validated measure of comorbidity that consists of a weighted scale of 17 comorbidities expressed as a summative score, and American Society of Anaesthesiology (ASA)[30] scores of 3 to 4 (relative to 1 to 2), odds ratio 1.38 (95% CI 1.17 to 1.63). There were no significant ($p > 0.40$) effects of age, operative diagnosis or BMI.

Pessimistic explanatory style and outcomes two years after primary TKR. In all, 35 of 222 (16%) of pessimists compared to 52 of 533 (10%) of non-pessimists had moderate-severe pain two years after primary TKR. Furthermore, the odds of moderate-severe pain were 2.21 times greater in pessimists than in non-pessimists in the multivariate-adjusted logistic model, which is statistically significant ($p = 0.02$) (Table II).

A total of 173 of 222 (78%) of pessimists, compared to 457 of 532 (86%) of non-pessimists, reported significant improvement in their knee function, that is, they considered they were much better at the two-year follow-up. Multivariate-adjusted odds of improvement at two years were significantly lower in pessimists for pain at two years in primary TKR, $p = 0.04$, odds ratio 0.53 (95% CI 0.30 to 0.96).

It was found that 72 of 220 (33%) of pessimists, compared to 136 of 523 (26%) of non-pessimists, reported moderate or severe limitation of activity two years after primary TKR which was not significantly different, odds ratio 1.01 (95% CI, 0.62 to 1.66; $p = 0.97$) (Table II).

Pessimistic explanatory style and outcomes five years after primary TKR. There were no significant differences between pessimists and non-pessimists with regard to moderate or severe knee pain, odds ratio 1.21 (95% CI 0.51 to 2.83) ($p = 0.67$) (Table II), and improvements in knee function were not significantly different between pessimists and non-pessimists, odds ratio 1.26 (95% CI 0.57 to 2.77) ($p = 0.57$). Although the association of pessimism with limitation of activity at five years was not statistically significant (odds ratio 1.84 (95% CI 0.98, 3.43) ($p = 0.06$)), the upper limit of the CI indicated that the odds of limitation of activity could be more than three times greater in pessimists.

Pessimistic explanatory style and revision rates after primary TKR. There was a lowered, albeit non-significant, association of pessimism and the risk of revision, hazard ratio 0.8 (95% CI 0.39 to 1.64) ($p = 0.55$). More specifically, the revision rates at five-year follow-up were 2% for pessimists and 3% for non-pessimists, and 8% and 7% at ten-year follow-up, respectively.

Table I. Demographic and clinical characteristics of the study cohort

	Primary total knee replacement		Revision total knee replacement	
	2-year (n = 783)	5-year (n = 443)	2-year (n = 144)	5-year (n = 79)
Mean age at surgery, years (SD)	68.8 (9.7)	68.9 (9.3)	67.2 (9.6)	67.2 (9.7)
Men/women (%)	300/483 (*38.3*/*61.7*)	183/260 (*41.3*/*58.7*)	62/82 (*43.1*/*56.9*)	33/46 (*41.8*/*58.2*)
Years from MMPI* to surgery, mean (SD)	17.4 (9.4)	16.2 (9.7)	17.2 (8.9)	16.7 (9.0)
T-score for pessimism, mean (SD)†	54.2 (10.5)	54.5 (10.5)	55.1 (10.4)	55.0 (10.0)
T-score for depression, mean (SD)	57.7 (11.0)	57.9 (11.3)	58.7 (11.7)	58.4 (11.3)
Age groups in years (%)				
≤ 60	144 (*18.4*)	72 (*16.3*)	36 (*25.0*)	19 (*24.1*)
> 60 to 70	257 (*32.8*)	162 (*36.6*)	44 (*30.6*)	26 (*32.9*)
> 70	382 (*48.8*)	209 (*47.2*)	64 (*44.4*)	34 (*43.0*)
Body mass index (kg/m^2) (%)				
≤ 25	96 (*12.3*)	57 (*13.0*)	15 (*10.4*)	4 (*5.1*)
> 25 to 29.9	289 (*37.1*)	165 (*37.6*)	53 (*36.8*)	36 (*45.6*)
30 to 34.9	215 (*27.6*)	118 (*26.9*)	50 (*34.7*)	21 (*26.6*)
35 to 39.9	111 (*14.3*)	60 (*13.7*)	20 (*13.9*)	15 (*19.0*)
≥ 40	67 (*8.6*)	39 (*8.9*)	6 (*4.2*)	3 (*3.8*)
Missing information	5	4		
ASA‡ score (%)				
Class I and II	396 (*50.6*)	217 (*49.0*)	73 (*50.7*)	45 (*57.0*)
Class III and IV	386 (*49.4*)	226 (*51.0*)	71 (*49.3*)	34 (*43.0*)
Missing information	1			
Charlson index, mean (SD)	1.8 (2.3)	1.7 (2.2)	1.5 (2.3)	1.0 (1.7)
Cemented (%)			Not applicable	
Yes	769 (*98.3*)	442 (*99.8*)		
Hybrid	13 (*1.7*)	1 (*0.2*)		
Missing information	1			
Operative diagnoses (%)				
Rheumatoid arthrits or other inflammatory arthritic conditions	28 (*3.6*)	22 (*5.0*)		
Loosening/wear or osteolysis			88 (*61.1*)	45 (*57.0*)
Osteoarthritis	732 (*93.5*)	409 (*92.3*)		
Dislocation, bone or prosthesis, fracture, instability, nonunion			25 (*17.4*)	18 (*22.8*)
Other	23 (*2.9*)	12 (*2.7*)		
Failed prior replacement with components removed or infection			31 (*21.5*)	16 (*20.3*)

* MMPI, Minnesota Multiphasic Personality Inventory

† mean T-scores for patients from 1962 to 1965 were 56 for women and 57 for men similar in age to our cohort[27,28]

‡ ASA, American Society of Anaesthesiologists

Pessimistic explanatory style and outcomes two and five years after revision TKR. There were no significant differences with regard to moderate or severe pain between pessimists and non-pessimists at the two-year follow-up of revision TKR (Table III). Pessimists were significantly less likely to report improvement in knee function two years post revision TKR, odds ratio 0.3 (95% CI 0.11 to 0.85) (p = 0.02). In multivariate-adjusted logistic regression analysis there was no significant association between pessimist/non-pessimist and moderate or severe functional limitation at two-years.

The small number of patients at five-year follow-up following revision TKR (79), precluded multivariate analyses.

Discussion

This is the first study to examine the association between the pre-existing psychological trait of a pessimistic explanatory style identified on the optimism-pessimism scale of the MMPI years before surgery, and long-term outcomes of self-reported pain and joint function following TKR.

We found that 'pessimistic' patients undergoing TKR were twice as likely as non-pessimists to report moderate or severe pain at the two-year follow-up, and, conversely, almost half as likely to report improvement in knee function. It is important to note that scores on the optimism-pessimism scale used to classify our patients were obtained from MMPIs that had been completed a median of 15 to 17 years before their primary TKR. This has important implications.

First, our data identify a pessimistic explanatory style as a psychological risk factor of significance for poor outcomes at two-year follow-up after primary TKR. Knowledge of the patient's explanatory style can inform the surgeon and patient, allowing both to have realistic expec-

Table II. Association* of pessimism and outcomes after primary total knee replacement

	Two-year			Five-year		
	n/N† (%)	Odds ratio (95% CI‡)	p-value	n/N† (%)	Odds ratio (95% CI)	p-value
Moderate-severe pain						
Pessimist						
No	52/533 (*10*)	1.0		34/306 (*11*)	1.0	
Yes	35/222 (*16*)	2.21 (1.12 to 4.35)	0.02	18/126 (*14*)	1.21 (0.51 to 2.83)	0.67
Best improvement in knee function						
Pessimist						
No	457/532 (*86*)	1.0		255/305 (*84*)	1.0	
Yes	173/222 (*78*)	0.53 (0.30 to 0.96)	0.04	100/123 (*81*)	1.26 (0.57 to 2.77)	0.57
Moderate-severe functional limitation						
Pessimist						
No	136/523 (*26*)	1.0		95/298 (*32*)	1.0	
Yes	72/220 (*32.7*)	1.01 (0.62 to 1.66)	0.97	53/123 (*43*)	1.84 (0.98 to 3.43)	0.06

* multivariate logistic regression models adjusted for gender, age, distance from medical centre and depression scores

† totals do not add up to 783 at two years and 443 at five years owing to missing responses

‡ CI, confidence interval

Table III. Association* of pessimism and outcomes after revision total knee replacement

	Two-year		
	n/N† (%)	Odds ratio (95% CI‡)	p-value
Moderate-severe pain			
Pessimist			
No	32/97 (*33*)		
Yes	11/41 (*27*)	1.16 (0.34 to 3.98)	0.82
Best improvement in knee function			
Pessimist			
No	66/98 (*67*)		
Yes	18/39 (*46*)	0.30 (0.11 to 0.85)	0.02
Moderate-severe functional limitation			
Pessimist			
No	48/99 (*48*)		
Yes	22/38 (*58*)	0.91 (0.34 to 2.47)	0.85

* multivariate logistic regression models adjusted for gender, age, distance from medical centre, depression scores and pessimism. Numbers were too small to perform multivariable models for five-year follow-up

† totals do not add up to 144 at two-years and 79 at five-years owing to missing responses to each of the variables

‡ CI, confidence interval

tations of outcome following primary TKR. Furthermore, these data identify a pessimistic explanatory style as a significant risk even after adjusting statistically for the important already-known mediators of age, gender and self-reported depression. Finally, the twofold magnitude of association is impressive, particularly after adjusting for these demographic and emotional variables.

Our five-year follow-up was completed with smaller sample sizes (< 80 events). Lack of differences in outcomes between pessimists and non-pessimists at five years may be due to increased potential for recall bias at five years for pain and change of knee function and/or small sample size. *A priori* sample size calculations were not possible owing to the lack of previously published data for pessimism scales in TKR patients. However, it may also be due to unknown mediators or moderators, or even a frank lack of an association, all requiring further follow-up at longer intervals and with larger samples.

Our study was limited in several ways. First, there are likely to be unknown biases among the physicians who asked patients to complete an MMPI. However, explanatory style is unlikely to have biased completion and return rates for the MMPIs among the medical outpatients included in our study.[31] Similar biases among patients may pertain to completion of the self-report pain and functional activity questionnaires. Also, for most of our patients

several years had elapsed between the completion of the MMPI and the TKR and an additional two to five years for the self-report checklists of pain, functional and activity limitations. Thus, other, unknown, stressors and comorbidities may have affected the follow-up report. Nevertheless, Seligman's theory postulates pessimism to be an enduring trait among medical outpatients, and validated here over a 30-year follow-up. Additional follow-up visits between two and five years would have been informative to allow us to discern when the relationship between pessimism and outcome was no longer statistically significant. In addition, our study was completed entirely with retrospective data and the original version of the MMPI. For clinicians or researchers interested in replicating or disputing our findings, a revised version of the optimism-pessimism scale, the optimum-pessimism-R[12], has been developed for the MMPI-2, the current version of the original MMPI. Finally, we asked our patients to provide reports on themselves pre- and post-operatively, and did not make comparisons with general population norms.

There was no statistically significant association between the patient's pessimism status and the moderate-severe functional limitations, such as stair-climbing, at two-year follow-up, although the lower limit of the odds ratio was very close to 1 and the upper limit indicated that the odds could be more than three times greater in pessimists. It is important to differentiate this result from self-reported improvement of the knee from the pre-operative status, which was significantly higher in non-pessimists at the two-year follow-up.

The self-reported variable for limitation of activity, including stair-climbing, pain while walking and similar activities, assesses the current state, whereas the variable of self-reported change in improvement (Tables II and III) captures the change the patient perceives from their pre-operative condition, which may help explain the differences in results for these two variables. Additionally, limitation of activity after TKR is already known to be affected by comorbid conditions,[32-34] which, along with increasing age, may partially or completely negate the benefit derived from the TKR over time. In contrast, the improvement in knee function is joint specific and is more likely to be influenced by TKR than any comorbidity.

Two recent studies have shown that a pessimistic explanatory style, as characterised by elevated scores on the optimism-pessimism scale of the MMPI, is associated with higher mortality over time among general medical outpatients[13] and in a college sample.[35] Pessimism was also associated with poorer self-reported health in all domains of the Short Form 36 (SF-36)[36] in general medical outpatients,[14] among survivors of head/neck cancer[37] and breast cancer,[38] in patients with temporal lobe epilepsy,[39] and contributed to successful cessation of smoking among medical patients.[40] Our study adds a post-operative orthopaedic sample to the medical literature on associations between explanatory style and self-reported outcomes.

This is of considerable importance as the main reason for undergoing TKR is pain relief, improvement in function and a better overall quality of life. A pessimistic explanatory style has an adverse impact on these outcomes.

It should be noted that patients who completed an MMPI as part of their evaluation may speculatively be considered to be among the most complex of medical referrals. The MMPI was widely used here as a screening and evaluative measure. Thus, if the examining physician believed there were psychological elements related to the presenting medical symptoms, an MMPI was likely to be obtained as an aid in clarifying such issues.

Apart fom Seligman's theory of explanatory style, studies examining the outcome expectations of patients prior to an intervention suggest that positive expectations are associated with better results and higher patient satisfaction.[37-41] It is conceivable that explanatory style may have exerted an influence on the expectation of outcome of these patients in these reports. Further study is needed to clarify the association between pre-operative expectation, which is typically termed dispositional optimism,[41,42] and explanatory style as theorised by Seligman.

How might these findings affect patient care. We speculate that the difference in pain and functional outcomes between pessimists and non-pessimists may be related to lower pre-operative expectations, as described above, unhealthy lifestyles that might interfere with rehabilitation after TKR, less rigorous involvement at two-year follow-up leading to sub-optimal outcomes, or different perceptions of what constitutes a good outcome. Screening for explanatory style or broad outcome expectations should be considered in patients already known to be at high risk for undergoing TKR, as our data clearly indicate that a pessimistic explanatory style adds to the risk of a poorer outcome. This can inform patients of the expected outcomes and provide support for implementing cognitive-behavioural intervention.

How does this tie in with other literature regarding psychological correlates such as depression or anxiety? In a multinational prospective cohort of 682 patients who completed two-year assessments after primary TKR, pre-operative psychological distress, defined as a SF-36 mental health subscale score < 50, was associated with significant differences in multivariate-adjusted Western Ontario McMaster Universities Arthritis Index (WOMAC)[43] pain scores at one- and two-year follow-up after primary TKR (3 to 5 points).[3] No associations were noted with the WOMAC function scale. In another study of 8000 TKRs at a single centre in the United States, lower pre-operative mental component summary score predicted the greatest variation in the Short-Form-12 (SF-12)[44] physical component summary score 12 months after TKR, meaning that the pre-operative mental component summary was strongly associated with and predictive of the post-operative physical component summary score.[45] Ayers et al[5] found that the former pre-operative score significantly predicted the latter score at the six-month follow-up after TKR.

Our study identifies another psychosocial characteristic associated with poorer outcomes from TKR. Because

patients with psychosocial stressors such as depression and anxiety have poor social support and coping strategies,[5] further studies also need to examine these in patients with a pessimistic explanatory style compared to the non-pessimists, and determine the mechanisms through which they affect outcomes following TKR.

Our findings have implications for developing mental health interventions specific to the issues faced by patients following TKR, suggesting that individuals who have a pessimistic explanatory style may be less resilient in adapting to the challenges of surgery. Whether it is possible to provide cognitive-behavioural interventions specifically for such patients to improve outcomes in terms of pain, function, quality of life and overall satisfaction, needs to be investigated.

Among our patients of both genders who underwent TKR, a pessimistic explanatory style, measured many years before surgery, was associated with significantly higher self-reported pain and less favourable functional outcomes at follow-up, compared to patients classified as having an optimistic, or non-pessimistic, explanatory style. Given the cognitive nature of a pessimistic explanatory style as presented in Seligman's theory, potential interventions for such patients might include psycho-educational and cognitive-behavioural strategies. Pre-operative identification of explanatory style can assist patients and their surgeons in setting a realistic goal after primary TKR.

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