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Belford, K., Gallagher, N., Dempster, M., Wolfenden, M., Hill, J., Blaney, J., O'Brien, S., Smit, A. M., Botha, P., Molloy, D., & Beverland, D. (2020). Psychosocial predictors of outcomes up to one year following total knee arthroplasty. *Knee*. <https://doi.org/10.1016/j.knee.2020.03.006>

Published in:
Knee

Document Version:
Peer reviewed version

Queen's University Belfast - Research Portal:
[Link to publication record in Queen's University Belfast Research Portal](#)

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Psychosocial Predictors of Outcomes up to 1 Year Following Total Knee Arthroplasty

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Acknowledgements

We would like to thank Mrs Beverley Leckey and Belfast Arthroplasty Research Trust for their assistance with the study.

This study has been supported by the Belfast Arthroplasty Research Trust (www.bartni.org).

This study was approved by the Office for Research Ethics Northern Ireland.

This research study was conducted at the Primary Joint Unit, Musgrave Park Hospital, Belfast, Northern Ireland.

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Abstract

Background

Total knee arthroplasty (TKA) aims to relieve pain and improve physical functioning of the knee, however, some patients continue to experience pain and impaired function following TKA which cannot be explained by surgical and implant factors. Psychological factors may influence the outcomes of TKA. The aim of this prospective study was to examine the psychosocial factors that predicted pain, stiffness and physical functioning up to 1 year following TKA.

Methods

102 patients completed pre-operative and 1-year questionnaires which assessed a wide range of psychosocial and sociodemographic factors prior to surgery. The Oxford Knee Score (OKS) and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) Pain, Stiffness and Physical Functioning subscales were used as outcome measures. Pearson correlation analysis and multiple linear regression were conducted to examine relationships between predictor and outcome variables.

Results

Regression analysis showed that regarding variance in WOMAC outcome measures post TKA, our model predicted 31% for physical functioning, 25% for pain and 29% for stiffness

at 1 year. Regarding variance in OKS post TKA, the model predicted 36% at 1 year. Greater levels of depressive symptoms and neuroticism and worse pre-operative scores significantly predicted poorer outcomes.

Conclusion

The findings indicate that pre-operative psychosocial factors are important in understanding outcomes of TKA. Psychosocial factors could be considered during pre-operative assessment and further research conducted on psychological interventions within this population to determine whether early and 1-year outcomes can be improved.

Keywords: Total Knee Arthroplasty; Psychosocial Factors; Outcomes

1. Introduction

Total knee arthroplasty (TKA) aims to relieve pain and improve physical functioning of the knee.¹ Whilst most people experience reduced pain and improved functioning, up to 20% experience chronic pain, impaired functioning and are dissatisfied following TKA.²

Moreover, these findings cannot be completely explained by surgical and implant factors.¹ A number of studies have shown that psychological factors influence outcomes of surgical procedures.³ Whilst research on the influence of psychosocial factors on outcomes of TKA is growing, research in this area remains at an early stage and it is important to develop a greater understanding of the relationship between psychological factors and outcomes following TKA. A considerable proportion of studies in this area have used global measures of health status, such as the 36-item Short Form Survey (SF-36).⁴ However, such measures lack specificity and provide limited information regarding the type of distress experienced.⁵ The use of specific measures has been recommended to identify specific psychosocial factors which predict TKA outcomes.⁶

Several systematic reviews have investigated psychosocial factors and outcomes in TKA.^{4,7-9,11,13,14,16} Depression,⁷⁻¹⁰ anxiety,^{7,8,10} pain catastrophising,^{4,7,9,11,12} and poorer mental health^{4,7} have been found to be associated with worse outcomes following TKA. However, conflicting evidence has been found regarding the roles of psychosocial factors such as depression⁴ and anxiety,^{4,13,14} in TKA outcome, therefore, the role of psychosocial factors in recovery following TKA remains unclear.

There are a limited number of studies examining the role of specific psychological factors, such as coping, pain self-efficacy or kinesiophobia, on outcomes following TKA. Greater pain catastrophising has been associated with worse pain following TKA.¹² Magklara et al. (2014) did not find conclusive evidence to determine the influence of self-efficacy on functional recovery outcomes after total hip or knee arthroplasty.¹⁶ Kinesiophobia, the fear of movement and physical activity due to beliefs that movement will cause pain or injury,¹⁷ has been shown to be an independent risk factor for worse functional outcome after TKA.^{18,19} Despite several studies investigating the aforementioned specific psychological factors in recovery from TKA, contrasting findings have been reported.

Furthermore, the contribution of each of the above specific psychological factors on TKA outcomes should be examined simultaneously, as this is important to discern the relative strength of relationships between predictors and outcomes. Therefore, the primary aim of this prospective study was to examine any associations between the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) physical function subscale and a range of psychosocial factors following TKA. The secondary outcomes were WOMAC pain, WOMAC stiffness and Oxford Knee Score (OKS). These outcomes were assessed pre-operatively and at 1 year post TKA.

2.1 Patients and Methods

All patients aged 18 years or older who attended for TKA between June 2016 and October 2017 under the care of two consultant orthopaedic surgeons in a single centre were invited to participate. All patients received a cementless LCS® Rotating Platform TKA (DePuy Orthopaedics Inc, Warsaw, Indiana) via a medial Insall approach without patellar resurfacing. Ethical approval was obtained (reference number: 16/NI/0042) and all participants provided written informed consent.

This study used a longitudinal design. Participants were posted a questionnaire pack to complete on two occasions: prior to surgery and 1 year following TKA. Outcomes were assessed via postal questionnaires which are known to have lower response rates, however, due to limited resources and hospital staff already under time pressures, this method was deemed most suitable for this study. The pre-operative questionnaire pack, sent on average 54 days before surgery, contained the following questionnaires: Depression Anxiety and Stress Scale (DASS-21),²⁰ Big Five Inventory (BFI),²¹ Brief Coping Orientations to Problems Experienced (Brief COPE),²² Pain Catastrophising Scale (PCS),²³ Pain Self-Efficacy Questionnaire (PSEQ-2),¹⁵ Tampa Scale of Kinesiophobia (TSK),²⁴ WOMAC²⁵ and OKS.²⁶

The following information was collected using a sociodemographic questionnaire: gender, age, relationship status, level of education, employment status, social support, financial stress, expectations regarding pain reduction following TKA and the likelihood of returning to usual level of activity following TKA (measured using a 10 point Likert scale from 0 ‘not at all likely’ to 10 ‘extremely likely’).

Of the 361 patients assessed for eligibility, 128 (35.5%) patients consented and returned a pre-operative questionnaire. Patients included in the study sample needed to have completed questionnaires at pre-operation and 1-year, leaving 102 patients (28.3%) who were included

in statistical analysis (Figure 1). Sociodemographic information for the sample at baseline are shown in Table 1.

2.2 Statistical analysis

Descriptive statistics were used to report sociodemographic data, WOMAC scores and OKS pre- and post-surgery. A paired t-test was used to examine change over time on each of these outcome measures. Pearson correlation analysis examined the relationships between predictor and outcome variables. Time between completion of the questionnaire and surgery and any variables with a correlation of $r \geq 0.2$ with an outcome variable (WOMAC and OKS) were included in the regression models. After ensuring assumptions were met, multiple regression analyses were conducted to examine the extent to which the predictors explained outcomes of the WOMAC and OKS at at 1 year. The regression models reported were the most parsimonious models. This was achieved by conducting backward elimination, where predictor variables with the lowest beta value were removed on an iterative basis and the final model was the one with the highest adjusted R^2 value. Baseline scores on the outcome measure were retained in the regression models, so that the variance in the outcome that was explained by the baseline scores was always accounted for. Statistical analysis was conducted using SPSS for Windows (IBM, Version 22.0, Armonk, USA).

3. Results

A total of 102 participants provided complete data at both time points (pre-operation and 1 year). A sample size of 102 is sufficient to detect an R^2 value of at least 0.2 with 90% power in a regression model with 12 predictors, using an alpha value of 0.05 (calculated using GPower²⁷). None of the initial regression models had more than 12 predictors and all had an

initial R-squared value greater than 0.2. The regression models indicated that depression, anxiety and stress displayed a high degree of multicollinearity (based on the tolerance statistic). Therefore, anxiety and stress were removed from any further analyses and depression was retained. The mean scores for pain, physical function, stiffness and OKS all improved between pre-operation and 1 year (Table 2). A recent retrospective study found the minimum clinically important difference (MCID) for the WOMAC pain, function and stiffness subscales to be 11, 9 and 8, respectively, meaning that the change in WOMAC physical function between pre-operation and 1 year reached the MCID.²⁸ The MCID for the OKS has been reported to be 5,²⁹ meaning the difference in OKS between pre-operation and 1 year reached the MCID.

A paired t-test found a statistically significant improvement across time for each outcome measure (Table 2). There were no statistically significant differences between the study sample and all other patients who had a TKA within the time period of the study in terms of OKS, age, sex or side of operation (Table 3).

3.1 Physical functioning

Bivariate correlations found that worse physical functioning was associated with younger age, depression, neuroticism, pain catastrophising, worse pre-operative physical functioning, active coping, venting and self-blame as coping strategies, whilst pain self-efficacy, extraversion and conscientiousness were associated with better physical functioning at 1 year. All of these variables were included as covariates in the initial regression model. The final regression model explained 31% of the variance in physical functioning at 1 year ($F(4, 95)=12.23, p<0.001$; Table 4). Pre-operative physical functioning scores and age contributed

19% of the variance in physical functioning at 1 year, with the psychological variables contributing the remaining 12%.

3.2 Pain

Bivariate correlations showed that younger age, depression, neuroticism, pain catastrophising, worse pre-operative pain, and self-blame as a coping strategy were correlated with worse pain at 1 year, whilst extraversion, pain self-efficacy, social support and conscientiousness were associated with less pain at 1 year. All of these variables were included as covariates in the initial regression model. The final regression model explained 25% of the variance in pain at 1 year ($F(5, 94)=7.70, p<0.001$; Table 4). Pre-operative pain scores and age contributed 12% of the variance in pain at 1 year, with the psychological variables contributing the remaining 13%.

3.3 Stiffness

Bivariate correlations indicated that worse stiffness was associated with depression, neuroticism, worse pre-operative stiffness, self-blame as a coping strategy and pain catastrophising, whilst conscientiousness, pain self-efficacy, agreeableness and extraversion were associated with less stiffness at 1 year. All of these variables were included as covariates in the initial regression model. The final regression model explained 29% of the variance in stiffness at 1 year ($F(3, 97)=14.82, p<0.001$; Table 4). Pre-operative stiffness scores contributed 3% of the variance in stiffness at 1 year, with the psychological variables contributing the remaining 26%.

3.4 OKS

Bivariate correlations suggested that worse OKS was associated with depression, neuroticism, pain catastrophising, active coping and self-blame, whilst pain self-efficacy,

social support, expectations regarding post-operative physical functioning, extraversion, conscientiousness and better pre-operative OKS were associated with better OKS at 1 year. All of these variables were included as covariates in the initial regression model. The final regression model explained 36% of the variance in OKS at 1 year ($F(6, 97)=10.78, p<0.001$; Table 4). Pre-operative OKS scores contributed 20% of the variance in OKS at 1 year, with the psychological variables contributing the remaining 16%.

4. Discussion

This study has shown that pre-operative psychosocial factors are significantly associated with physical functioning, pain and stiffness at 1 year following TKA. In particular, pre-operative depressive symptoms, neuroticism and worse pre-operative functioning are associated with poorer outcomes at 1 year.

Depressive symptoms were significantly associated with worse pain, stiffness and physical functioning at 1 year following TKA. Several systematic reviews have found depression to be associated with poorer outcomes following TKA.⁷⁻¹⁰ However, Vissers et al. (2012) found strong evidence that pre-operative depression had no influence on post-operative functioning after TKA.⁴ These conflicting findings may be due to heterogeneity in study design, statistical analysis and variation in outcome measures used.

The current study did not examine the mechanisms of how depression impacts on outcomes following TKA. Psychological distress has been shown to delay wound healing.³⁰ Walburn et al. (2009) reported that 17 of 22 studies included in their systematic review found psychological stress to be associated with impaired wound healing or dysregulation of a

biomarker related to wound healing.³⁰ Negative cognitions may also influence the effect of depressive symptoms on TKA outcomes, since patients with depressive symptoms may interpret their outcomes and recovery following TKA more negatively. Specific symptoms of depression, including low motivation, sleep disturbance and fatigue, may also impact on rehabilitation and recovery following TKA.³¹ However, additional studies are necessary to clarify the mechanisms of depressive symptoms on recovery following TKA.

It is also important to note that there was strong overlap between the measures of depression, anxiety and stress used in this study. Consequently, the preceding discussion might equally refer to anxiety or stress or, at least, we cannot rule out anxiety or stress as important covariates of the outcomes examined in this study.

The personality trait of neuroticism (assessed pre-operatively), was also significantly related to greater stiffness and worse physical functioning at 1 year. Neuroticism has previously been found to be associated with worse outcomes following TKA.⁴⁰

Worse pre-operative physical functioning was significantly related to worse physical functioning at 1 year (as assessed by the WOMAC and OKS). A previous systematic review by Alattas et al. (2016) similarly reported that poorer pre-operative function and pre-operative anxiety were the most significant factors to predict a poorer outcome following TKA.¹⁰

Previous studies have found that younger patients tend to have worse pre-operative and post-operative patient reported outcomes scores than older patients.^{38,39} Younger patients generally have higher physical activity levels than older patients, therefore, TKA may not meet their expectations for physical functioning and pain levels following TKA.³⁸

Coping styles, such as self-blame have previously been found to predict poorer psychological and physical health outcomes.^{32,33} and less effective coping styles have been associated with worse pain and physical functioning at six months following TKA.³⁴ Previous research has also shown that expectations about the likelihood of returning to usual level of activity are related to TKA outcomes up to 1 year post TKA.^{35,36} In our study, all of these variables were found to be significantly related to TKA outcomes when examined using only bivariate correlations. However, the added value of our regression analysis demonstrates that emotional and personality factors are likely to play a more important role in outcomes at 1 year post TKA.

There are several limitations to the current study. Even though sex, age and both pre- and post-operative OKS were comparable between patients who participated in the study and patients who had TKA in the same time period, only 128 (35.5%) of the 361 patients who were assessed for eligibility and invited to take part in the study participated and fully completed the pre-operative questionnaire. However, 20.5% of the 361 patients were not eligible for the study and a further 9.4% were unable to be contacted. Another 25.8% declined to participate for various reasons and the remaining 8.8% had agreed to take part in the study but did not return their pre-operative questionnaire or had a large amount of missing data. This response rate is typical of and consistent with postal questionnaire studies⁴¹ however, this method was chosen to avoid extra burden on hospital staff administering the questionnaire, and this way, the patient could take their time at home to complete the questionnaire. The questionnaires were piloted within the hospital Patient Liaison Group who felt that many patients would be deterred from taking part due to the questionnaires being too long, therefore, to minimize the demands on patients, the shorter versions of the DASS, COPE and PSEQ were used. Patients may also have been discouraged from participating since the questionnaires were of a personal nature. Also, the use of self-reported outcomes of

TKA has been criticised as overestimating outcomes and the use of objective outcome measures has been encouraged.⁴² Furthermore, this was a single centre study; therefore, multi-centre studies would help to increase the generalisability of the findings. Despite these limitations, this study adds to the evidence base on predictors of recovery from TKA up to 1 year post surgery beyond biomedical factors and global measures of distress.

Whilst this study examined a range of psychological factors, the influence of psychosocial factors on recovery from TKA remains a complex process and may involve additional psychosocial variables than were measured in this study. It is also possible that psychological variables could change over time (although measures of personality tend to be relatively stable) and we only measured the psychological variables at baseline in this study.

Nevertheless, identifying and targeting the key psychosocial factors pre-operatively which predict outcomes following TKA may improve patient care and enhance post-operative outcomes. Screening questionnaires prior to surgery could identify individuals at risk of poor outcomes. To save time and cost in a busy clinical environment, the patient could complete the questionnaire online at home. For patients found to be at risk of poor outcomes following TKA, increasing personal staff attention and increasing physiotherapy post-operatively may aid recovery.^{43,44} Psychological intervention to promote recovery and optimise outcomes following TKA could also be offered to patients found to be at risk of poor outcomes.

Examples of psychological interventions which have been used in TKA or total hip arthroplasty patients include cognitive behaviour therapy, psycho-education, motivational interviewing, relaxation therapy and guided imagery.⁴⁵ In a systematic review by Bay et al. (2018),⁴⁵ two of the seven interventions investigated were effective in improving at least one patient reported joint outcome. One study used a combination of cognitive behaviour therapy and relaxation therapy, one to two mornings a week over 6 weeks at least 6 months before surgery. This was found to significantly improve hip function at the 1-year follow-up.⁴⁶ The

other study used guided imagery, which involved listening to a CD every day for 2 weeks before and 3 weeks after surgery. This was found to significantly decrease knee pain 3 weeks after surgery.⁴⁷

The efficacy of cognitive behavioural therapy for persistent pain and depression has also been demonstrated.^{48,49} A recent feasibility randomised controlled trial found support for a brief pre-operative psychological intervention in improving pain and physical functioning following TKA.⁵⁰ Participants in the intervention arm received 1-hour long sessions of psychological intervention, once or twice weekly, based on general principles of cognitive behavioural therapy for anxiety, depression, and pain management, tailored to the needs of each participant.⁵⁰ The most suitable method of delivering effective psychological interventions to TKA patients and the timing of these interventions should be investigated further taking into consideration cost, availability and capacity.

5. Conclusion

In conclusion, this study found that psychosocial factors, including depressive symptoms and neuroticism, significantly predicted outcomes following TKA. These findings are consistent with a biopsychosocial model which proposes that biological, psychological and social factors influence the development and outcomes of illness and disease.⁵¹ Future work should determine whether pre-operative recognition and targeted intervention with regards to these factors could improve both short- and long-term outcomes.

Declarations of interest: none.

References

1. **Wylde V, Dieppe P, Hewlett S, Learmonth ID.** Total knee replacement: Is it really an effective procedure for all? *The Knee*. 2007;14:417-423.

2. Pinedo-Villanueva R, Khalid S, Wylde V, Gooberman-Hill R, Soni A, Judge A.

Identifying individuals with chronic pain after knee replacement: a population-cohort, cluster-analysis of Oxford knee scores in 128,145 patients from the English National Health Service. *BMC Musculoskelet Disord.* 2018;19:354.

3. Montgomery GH, Schnur JB, Erbllich J, Diefenbach MA, Bovbjerg DH.

Presurgery psychological factors predict pain, nausea, and fatigue one week after breast cancer surgery. *J Pain Symptom Manage.* 2010;39:1043-1052.

4. Vissers MM, Bussmann JB, Verhaar JA, Busschbach JJ, Bierma-Zeinstra SM,

Reijman M. Psychological factors affecting the outcome of total hip and knee arthroplasty: A systematic review. *Semin Arthritis Rheum.* 2012;41:576-588.

5. Riddle DL, Wade JB, Jiranek WA, Kong X.

Preoperative pain catastrophizing predicts pain outcome after knee arthroplasty. *Clin Orthop Relat Res.* 2010;468:798-806.

6. Paulsen MG, Dowsey MM, Castle D, Choong PF.

Preoperative psychological distress and functional outcome after knee replacement. *ANZ J Surg.* 2011;81:681-687.

7. Sorel JC, Veltman ES, Honig A, Poolman RW.

The influence of preoperative psychological distress on pain and function after total knee arthroplasty: a systematic review and meta-analysis. *Bone Joint J.* 2019;101-B:7-14.

8. Hernández C, Díaz-Heredia J, Berraquero ML, Crespo P, Loza E, Ruiz Ibán MÁ.

Pre-operative Predictive Factors of Post-operative Pain in Patients With Hip or Knee Arthroplasty: A Systematic Review. *Reumatol Clin.* 2015;11:361-380.

9. Lewis GN, Rice DA, McNair PJ, Kluger M.

Predictors of persistent pain after total knee arthroplasty: a systematic review and meta-analysis. *Br J Anaesth.* 2015;114:551-561.

- 10. Alattas SA, Smith T, Bhatti M, Wilson-Nunn D, Donell S.** Greater pre-operative anxiety, pain and poorer function predict a worse outcome of a total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc.* 2017;25:3403-3410.
- 11. Burns LC, Ritvo SE, Ferguson MK, Clarke H, Seltzer Z, Katz J.** Pain catastrophizing as a risk factor for chronic pain after total knee arthroplasty: a systematic review. *J Pain Res.* 2015;8:21-32.
- 12. Riddle DL, Jensen MP, Ang D, Slover J, Perera R, Dumenci L.** Do Pain Coping and Pain Beliefs Associate With Outcome Measures Before Knee Arthroplasty in Patients Who Catastrophize About Pain? A Cross-sectional Analysis From a Randomized Clinical Trial. *Clin Orthop Relat Res.* 2018;476:778-786.
- 13. Blettermann AN, de Geest-Vrolijk ME, Vriezekolk JE, Nijhuis-van der Sanden MW, van Meeteren NL, Hoozeboom TJ.** Preoperative psychosocial factors predicting patient's functional recovery after total knee or total hip arthroplasty: a systematic review. *Clin Rehabil.* 2018;32:512-525.
- 14. Khatib Y, Madan A, Naylor JM, Harris IA.** Do Psychological Factors Predict Poor Outcome in Patients Undergoing TKA? A Systematic Review. *Clin Orthop Relat Res.* 2015;473:2630-8.
- 15. Nicholas M, McGuire B, Asghari A.** A 2-item short form of the pain self-efficacy questionnaire: Development and psychometric evaluation of PSEQ-2. *The Journal of Pain.* 2015;16:153-163.
- 16. Magklara E, Burton CR, Morrison V.** Does self-efficacy influence recovery and well-being in osteoarthritis patients undergoing joint replacement? A systematic review. *Clin Rehabil.* 2014;28:835-46.

- 17. Vlaeyen JW, Kole-Snijders AM, Rotteveel AM, Ruesink R, Heuts PH.** The role of fear of movement/(re)injury in pain disability. *J Occup Rehabil.* 1995;5:235-252.
- 18. Güney-Deniz H, Irem Kınıklı G, Çağlar Ö, Atilla B, Yüksel İ.** Does kinesiophobia affect the early functional outcomes following total knee arthroplasty? *Physiother Theory Pract.* 2017;33:448-453.
- 19. Filardo G, Merli G, Roffi A, Marcacci T, Berti Ceroni F, Raboni D et al.** Kinesiophobia and depression affect total knee arthroplasty outcome in a multivariate analysis of psychological and physical factors on 200 patients. *Knee Surg Sports Traumatol Arthrosc.* 2017;25:3417-3423.
- 20. Lovibond SH, Lovibond PF.** *Manual for the Depression Anxiety Stress Scale.* 2nd ed. Sydney: Psychological foundation; 1995.
- 21. John OP, Donahue EM, Kentle RL.** *The Big Five Inventory—versions 4a and 54.* Berkeley: University of California, Berkeley, Institute of Personality and Social Research; 1991.
- 22. Carver CS.** You want to measure coping but your protocol's too long: Consider the brief cope. *Int J Behav Med.* 1997;4:92-100.
- 23. Sullivan M, Bishop S, Pivik J.** The pain catastrophizing scale: Development and validation. *Psychol Assess.* 1995;7:524-532.
- 24. Miller RP, Kori SH, Todd DD.** The Tampa Scale: A Measure of Kinesisophobia. *Clin J Pain.* 1991;7:51-52.

- 25. 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;15:1833-1840.
- 26. Murray DW, Fitzpatrick R, Rogers K, Pandit H, Beard DJ, Carr AJ et al.** The use of the Oxford hip and knee scores. *J Bone Joint Surg Br.* 2007;89:1010-1014.
- 27. Faul F, Erdfelder E, Buchner A, Lang AG.** Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behav Res Methods.* 2009;41:1149-1160.
- 28. Clement ND, Bardgett M, Weir D, Holland J, Gerrand C, Deehan DJ.** What is the Minimum Clinically Important Difference for the WOMAC Index After TKA? *Clin Orthop Relat Res.* 2018 Oct;476(10):2005-2014.
- 29. Clement ND, MacDonald D, Simpson AH.** The minimal clinically important difference in the Oxford knee score and Short Form 12 score after total knee arthroplasty. *Knee Surg Sports Traumatol Arthrosc.* 2014 Aug;22(8):1933-9.
- 30. Walburn J, Vedhara K, Hankins M, Rixon L, Weinman J.** Psychological stress and wound healing in humans: a systematic review and meta-analysis. *J Psychosom Res.* 2009;67:253-71.
- 31. Aasvang EK, Luna IE, Kehlet H.** Challenges in postdischarge function and recovery: the case of fast-track hip and knee arthroplasty. *Br J Anaesth.* 2015;115:861-6.
- 32. Austenfeld JL, Stanton AL.** Coping through emotional approach: A new look at emotion, coping, and health-related outcomes. *J Pers.* 2004;72:1335-1363.

- 33. Smith CA, Wallston KA.** An analysis of coping profiles and adjustment in persons with rheumatoid arthritis. *Anxiety, Stress, & Coping*. 1996;9:107-122.
- 34. Lopez-Olivo MA, Landon GC, Siff SJ, Edelstein D, Pak C, Kallen MA et al.** Psychosocial determinants of outcomes in knee replacement. *Ann Rheum Dis*. 2011;70:1775-1781.
- 35. Engel C, Hamilton NA, Potter PT, Zautra AJ.** Impact of two types of expectancy on recovery from total knee replacement surgery (TKR) in adults with osteoarthritis. *Behav Med*. 2004;30:113-123.
- 36. Sullivan M, Tanzer M, Reardon G, Amirault D, Dunbar M, Stanish W.** The role of presurgical expectancies in predicting pain and function one year following total knee arthroplasty. *PAIN*. 2011;152:2287-2293.
- 37. Williams DM.** Outcome expectancy and self-efficacy: Theoretical implications of an unresolved contradiction. *Pers Soc Psychol Rev*. 2010;14:417-425.
- 38. Bisschop R, Brouwer RW, Van Raay JJ.** Total knee arthroplasty in younger patients: a 13-year follow-up study. *Orthopedics*. 2010;33:876.
- 39. Birdsall PD, Hayes JH, Cleary R, Pinder IM, Moran CG, Sher JL.** Health outcome after total knee replacement in the very elderly. *J Bone Joint Surg Br*. 1999;81:660–662.
- 40. Gong L, Dong JY.** Patient's personality predicts recovery after total knee arthroplasty: a retrospective study. *J Orthop Sci*. 2014 Mar;19(2):263-269.
- 41. Sahlqvist S, Song Y, Bull F, Adams E, Preston J, Ogilvie D et al.** Effect of questionnaire length, personalisation and reminder type on response rate to a complex postal survey: randomised controlled trial. *BMC Med Res Methodol*. 2011;11:62.

- 42. Hossain FS, Konan S, Patel S, Rodriguez-Merchan EC, Haddad FS.** The assessment of outcome after total knee arthroplasty: Are we there yet? *Bone Joint J.* 2015;97-B:3-9.
- 43. Artz N, Elvers KT, Lowe CM, Sackley C, Jepson P, Beswick AD.** Effectiveness of physiotherapy exercise following total knee replacement: systematic review and meta-analysis. *BMC Musculoskelet Disord.* 2015 Feb 7;16:15.
- 44. Joice MG, Bhowmick S, Amanatullah DF.** Perioperative Physiotherapy in Total Knee Arthroplasty. *Orthopedics.* 2017 Sep 1;40(5):e765-e773.
- 45. Bay S, Kuster L, McLean N, Byrnes M, Kuster MS.** A systematic review of psychological interventions in total hip and knee arthroplasty. *BMC Musculoskeletal Disorders* (2018) 19:201
- 46. Berge DJ, Dolin SJ, Williams AC, Harman R.** Pre-operative and post-operative effect of a pain management programme prior to total hip replacement: a randomized controlled trial. *Pain.* 2004;110:33–9.
- 47. Jacobson AF, Umberger WA, Palmieri PA, Alexander TS, Myerscough RP, Draucker CB, et al.** Guided imagery for Total knee replacement: a randomized, placebo-controlled pilot study. *J Altern Complement Med.* 2016;22:563–75.
- 48. Eccleston C, Morley SJ, Williams AC.** Psychological approaches to chronic pain management: Evidence and challenges. *Br J Anaesth.* 2013;111:59-63.
- 49. National Institute for Health and Clinical Excellence.** Depression in adults: recognition and management. www.nice.org.uk/CG90 (date last accessed 08 April 2019).

50. das Nair R, Mhizha-Murira JR, Anderson P, Carpenter H, Clarke S, Groves S et al.

Home-based pre-surgical psychological intervention for knee osteoarthritis (HAPPiKNEES):

A feasibility randomized controlled trial. *Clin Rehabil.* 2018;32:777-789

51. Engel GL. The need for a new medical model: A challenge for biomedicine. *Science.*

1977;196:129-136.

Table 1. Sociodemographic information for the study sample (n=102)

Sociodemographic variable	N (%)
Sex (% female)	60 (58.8%)
Age	
50-59 years old	12 (11.8%)
60-69 years old	45 (44.1%)
70-79 years old	37 (36.3%)
80+ years old	8 (7.8%)
Final level of education	
Primary	26 (25.5%)
Secondary	30 (29.4%)
Further and higher education	46 (45.1%)
Marital status	
Spouse / significant other	65 (63.7%)
No spouse / significant other	37 (36.3%)
Retired	73 (71.6%)

Pre- operation	1 year	p-value
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WOMAC Pain	12.04 (3.68)	5.68 (5.10)	t (101) = 12.38, p<0.001	Table 2. Mean (SD)
WOMAC Physical Function	41.62 (12.80)	21.83 (17.01)	t (101) = 12.22, p<0.001	WOMAC scores and
WOMAC Stiffness	5.19 (1.76)	3.15 (2.01)	t (101) = 8.69, p<0.001	OKS at pre- operation and
OKS	15.99 (7.95)	33.62 (10.40)	t (101) = 18.47, p<0.001	1 year

Table 3. Comparison of demographic factors and OKS between the study sample and all other patients who had TKA in the same time period

	Sample (n=102)	All other patients (n=263)	Difference
Sex (% male)	41%	41%	$\chi^2=0.02$, p=0.888
Side (% left)	53%	44%	$\chi^2=1.62$, p=0.203
Age, Median (IQR) years	60-69 (60-79)	60-69 (60-79)	Z=0.24, p=0.810
Pre-test OKS, Mean (SD)	15.99 (7.95)	14.39 (6.46)	t=2.03, p=0.050
1 year OKS, Mean (SD)	33.62 (10.40)	33.64 (9.68)	t=0.02, p=0.983

Table 4. Summary regression table for outcomes at 1 year

Outcome variable	Covariates	Standardized regression coefficient	p-value
WOMAC Pain	Pre-operative pain	0.17	0.074
	Neuroticism	0.12	0.272
	Depression	0.28	0.010
	Age	-0.17	0.062
	Extraversion	-0.13	0.168
WOMAC Stiffness	Pre-operative stiffness	0.11	0.201
	Neuroticism	0.35	0.001
	Depression	0.26	0.008
WOMAC Physical function	Pre-operative physical functioning	0.31	0.001
	Neuroticism	0.21	0.030
	Depression	0.23	0.025
	Age	-0.16	0.058
OKS	Pre-operative OKS	0.35	<0.001
	Neuroticism	-0.17	0.061
	Depression	-0.31	0.006
	Pain catastrophising	0.12	0.249
	Social support	0.14	0.099
	Expectations about postoperative physical functioning	0.11	0.187

