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Persistent pain after joint replacement: Prevalence, sensory qualities, and postoperative determinants

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ABSTRACT

Persistent postsurgical pain is a prevalent but underacknowledged condition. The aim of this study was to assess the prevalence, sensory qualities, and postoperative determinants of persistent pain at 3 to 4 years after total knee replacement (TKR) and total hip replacement (THR). Patients completed a questionnaire with included the Western Ontario and McMaster Universities Index of Osteoarthritis (WOMAC) Pain Scale, PainDetect Questionnaire, Short-Form McGill Pain Questionnaire, and questions about general health and socioeconomic status. A total of 632 TKR patients and 662 THR patients completed a questionnaire (response rate of 73%); 44% of TKR patients and 27% of THR patients reported experiencing persistent postsurgical pain of any severity, with 15% of TKR patients and 6% of THR patients reporting severe-extreme persistent pain. The persistent pain was most commonly described as aching, tender, and tiring, and only 6% of TKR patients and 1% of THR patients reported pain that was neuropathic in nature. Major depression and the number of pain problems elsewhere were found to be significant and independent postoperative determinants of persistent postsurgical pain. In conclusion, this study found that persistent postsurgical pain is common after joint replacement, although much of the pain is mild, infrequent, or an improvement on preoperative pain. The association between the number of pain problems elsewhere and the severity of persistent postsurgical pain suggests that patients with persistent postsurgical pain may have an underlying vulnerability to pain.

1. Introduction

Persistent postsurgical pain is a prevalent but underacknowledged problem affecting between 10% and 50% of surgical patients [23], and it has been defined by the International Association of the Study of Pain as pain that develops after surgery and has been present for at least 3 months, which is beyond the time for normal healing [21]. In comparison to the vast amount of funding that has been poured into researching the prevalence, impact, causes, and treatment of persistent pain in the community, there exists only a modest amount of research into persistent pain in surgical populations. One of the first studies to elude to the extent of this condition was a survey of the causes of persistent pain in patients attending pain clinics [12]. This survey found that after degenerative conditions, surgery was the second most common cause of persistent pain, cited as the cause of persistent pain in 22.5% of people attending a pain clinic. The problem of persistent postsurgical pain is now known to be extensive, with an estimated 41,000 to 103,000 new cases occurring in the UK every year [33]. Despite the magnitude of this condition, only a very limited number of reviews have been published on the topic to date [20,23,31–33,43]. The lack of research into persistent postsurgical pain is likely attributable to the fact that it occurs after many different surgical procedures, and therefore acknowledgement of the problem has been slow and fragmented because no single clinical specialty accepts "ownership" of the problem. Because of its underrecognition despite its prevalence, persistent postsurgical pain has been termed a silent epidemic [53].

Persistent postsurgical pain can occur after a wide range of different surgical procedures, ranging from hernia repair to limb amputation [32]. Somewhat ironically, it can be a consequence of surgery that that was performed to alleviate persistent pain. The classic example of this scenario is joint replacement, which is one of the most common elective surgical procedures performed in the National Health Service [39]. Research has highlighted that persistent pain after joint replacement is a considerable problem, affecting between 7% and 20% of total knee replacement (TKR) patients [1,5,45,56] and 2% to 8% of total hip replacement (THR)

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patients [40,50,56]. Experiencing persistent pain after an elective procedure that was performed to cure the pain can leave patients feeling confused or blaming themselves for the pain [54]. It can also contribute to tension or mistrust in the doctor–patient relationship, particularly when surgeons dismiss the existence of the pain, or downplay its importance [22]. Despite this, there exists very little research into persistent pain after joint replacement. Therefore, the aim of this study is to assess the prevalence, severity, sensory qualities, and postoperative determinants of persistent pain after primary THR and TKR.

2. Patients and methods

2.1. Patient recruitment

The recruitment of patients into this study is depicted in Fig. 1 for TKR patients and Fig. 2 for THR patients. All consecutive patients who underwent a primary TKR or THR at the Avon Orthopaedic Centre between April 2004 and April 2006 were invited to participate in an outcomes study [55]. Patients were identified from the Avon Orthopaedic Centre database. Patient details and the type of prosthesis were extracted from the database, and then patient details were traced by the Clinical Information Systems Manager for North Bristol Trust to ensure that deceased patients were excluded from the mail-out and changes of address were updated. Patients who had multiple primary joint replacements during the study period were sent a questionnaire about one joint only to reduce participation burden and to ensure that these patients were not overrepresented in the study. The joint that was included in the study was the first joint replacement performed in the time period included in the study. If simultaneous joint replacements were performed, the side was chosen at random.

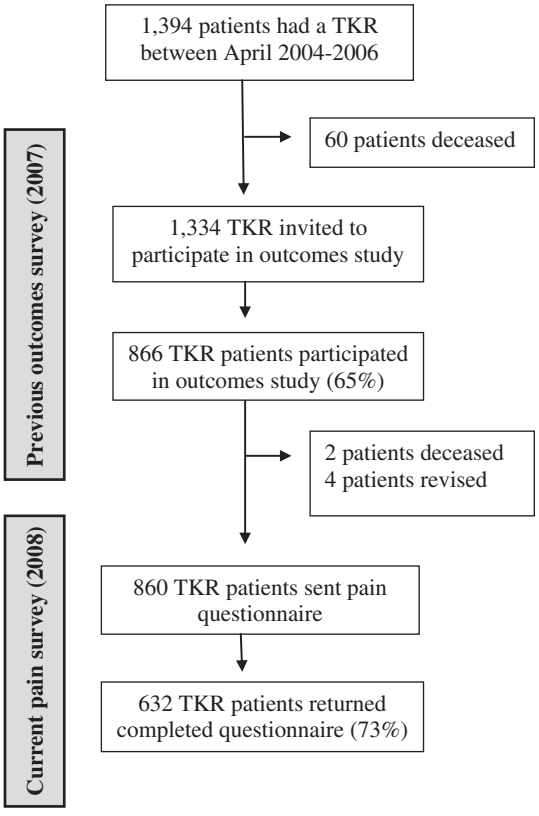

Fig. 1. Diagram of recruitment of total knee replacement (TKR) patients into the study.

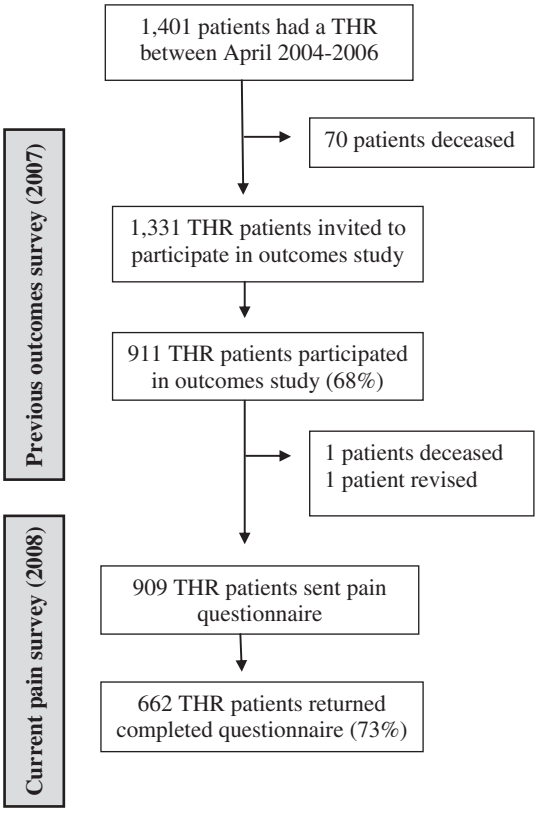

Fig. 2. Diagram of recruitment of total hip replacement (THR) patients into the study.

Overall, 866 TKR patients and 911 THR patients participated in the outcomes study [55], and these patients formed the sampling framework for the current study. A questionnaire was posted to these patients approximately 1 year after they participated in the outcomes study. The patient sample was cross-referenced against the hospital database to update changes in postal addresses and to exclude deceased patients or patients who had undergone revision surgery. Of the 866 TKR patients, 2 had died and 4 had undergone revision surgery, and therefore a questionnaire was posted to 860 patients. Of the 911 THR patients, 1 had died and 1 had undergone revision surgery, and therefore a questionnaire was posted to 909 patients. A reminder questionnaire was posted to nonresponders. Ethics approval for this study was obtained from the local research ethics committee.

2.2. Assessment

The questionnaire booklet asked participants about the pain they experienced in their replaced joint, their socioeconomic status, and other health problems. All patients were posted the full questionnaire, but only patients who experienced pain in their replaced joint were asked to complete the section about the sensory qualities of pain.

2.2.1. Severity of pain

The primary outcome in this study was the severity of pain in the replaced joint, which was assessed using the Western Ontario and McMaster Universities Index of Osteoarthritis (WOMAC) Pain Scale [3]. This questionnaire assesses pain experienced during 5 different activities: walking, using stairs, sitting or lying, standing upright, and in bed. Response options for each question are on a 5-point Likert Scale, ranging from none to extreme (0 to 4). To

aid interpretation, the total score was transformed to a 0 to 100 scale, with 0 indicating extreme pain and 100 indicating no pain.

2.2.2. Sensory qualities of pain

Only patients who reported pain in their replaced joint (score of <100) complete this section of the questionnaire. Questions about the nature of pain included whether the pain had been present for the past 3 months, how frequently the pain had occurred over the past week (not at all, rarely, sometimes, often, very often, or constantly), and whether the pain was better or worse than their preoperative pain. The Short-Form McGill Pain Questionnaire (SF-MPQ) and PainDETECT Questionnaire were used to assess the sensory qualities of the pain. The SF-MPQ [35] consists of 11 sensory pain descriptors and 4 affective pain descriptors, and the severity of each descriptor is rated on a 4-point Likert Scale from none to severe. The 9-item PainDETECT questionnaire [15], which was developed to identify pain of a neuropathic origin, is scored from −1 to 38, with a score $\leqslant$12 indicating that a neuropathic component is unlikely and a score of $\geqslant$19 indicating that a neuropathic component is likely.

2.2.3. Socioeconomic status

The assessment of socioeconomic status consisted of questions regarding educational attainment and social support. The highest level of educational attainment was recorded from the following options: less than secondary school, some secondary school, completed secondary school, college or university, or postgraduate education. Responses were then coded into either low education (did not complete secondary school) or high education (secondary school or higher education). Social support was assessed through marital status and living arrangements. These responses were then combined to produce a crude assessment of social support [14]. Patients who indicated that they were married or living with someone were defined as having high social support, and those people who were not married and lived alone were defined as having low social support.

2.2.4. General health

2.2.4.1. Pain problems elsewhere. Patients were asked whether they had suffered any pain in the past 4 weeks in any of the following 5 different body areas: contralateral hip (for THR patients) or contralateral knee (for TKR patients), hips (for TKR patients) or knees (for THR patients), ankles or feet, upper limbs, and neck or back. Patients were then asked whether they had ever been to see a doctor because of the presence of the following 5 pain conditions: migraine, irritable bowel syndrome, fibromyalgia, tinnitus, or chronic fatigue syndrome. The responses from these 2 questions were combined, and the total number of pain problems elsewhere was categorised as 0, 1 to 2, 3 to 4 or $\geqslant$5.

2.2.4.2. Obesity. Body mass index was calculated from asking patients to self-report their height (feet and inches) and weight (stone and pounds).

2.2.4.3. Depression. The presence of major depression was assessed using the Two-item Patient Health Questionnaire (PHQ-2) [25], which assesses the frequency of depressed mood and anhedonia over the past 2 weeks. The total score ranges from 0 to 6, with a score of $\geqslant$3 indicating a major depressive disorder [55].

2.3. Statistical analysis

A 1-sample Kolmogorov–Smirnov test found that all of the continuous outcome variables were nonparametric, and therefore medians (interquartile ranges) are presented and nonparametric statistical tests are used throughout. Mann–Whitney *U* tests were used to test for significant differences in continuous variables between 2 unpaired groups. χ^2 tests were used to test for significant associations between categorical variables. Ordinal logistic regression was performed to identify postoperative determinants of persistent pain after joint replacement, with the WOMAC Pain score being the dependent variable in the model. Logistic regression analysis was chosen over linear regression analysis because the WOMAC Pain score was nonparametric, and remained so after several different transformations (logarithm, exponential, and square root). In the model, the WOMAC Pain score was transformed into a 4-point ordinal scale (Table 1). The reference category for the model was severe persistent pain after joint replacement, and the odds ratio represents the probability of being in a worse pain group, independent of the level of severity chosen. Therefore, the ordinal logistic regression model calculates the probability of being in a worse pain category compared to a better one. The independent variables that were entered into the ordinal logistic regression model were age, gender, educational attainment, social support, body mass index, depression, and number of pain problems elsewhere. Statistical analysis was performed with the use of SPSS (version 16.0; SPSS, Chicago, IL, USA), and statistical significance was set at 5% ($P < .05$).

3. Results

3.1. Patient demographics

3.1.1. TKR patients

Completed questionnaires were received from 632 patients, giving a response rate of 73% (Fig. 1). The basic demographics of responders and nonresponders are presented in Table 2, alongside details of general health and socioeconomic status of the responders. The responder group were significantly younger ($P < .001$) and had a higher percentage of males ($P = .034$) than the nonresponder group. The median length of time since surgery was 41 months (34 to 49 months).

3.1.2. THR patients

Completed questionnaires were received from 662 patients, giving a response rate of 73% (Fig. 2). The basic demographics of responders and nonresponders are presented in Table 2, alongside details of general health and socioeconomic status of the responders. There was no significant difference in the demographics of responders and nonresponders. The median length of time since surgery was 41 months (35 to 48 months).

3.2. Prevalence of persistent postsurgical pain

Overall, 44% (276 of 632) of TKR patients and 27% (176 of 662) of THR patients reported persistent postsurgical pain (defined as a WOMAC Pain score of <100 and pain that had been present for at least the past 3 months).

3.3. Severity of persistent postsurgical pain

The median WOMAC Pain score was 65 (45 to 80) for the 276 patients with persistent pain after TKR and 70 (55 to 85) for the 176 patients with persistent pain after THR. Only 34% (93 of 276) of TKR patients and 22% (38 of 176) of THR patients with persistent postsurgical pain reported that the intensity of their pain was severe-extreme (defined as a WOMAC Pain score of <50). This equates to 15% (93 of 632) of TKR patients and 6% (38 of 662) of THR patients experiencing severe-extreme persistent pain in their replaced joint at between 3 to 4 years postoperatively. The frequency with which patients experienced persistent pain in their

Table 1
Distribution of patients (percentage) between the 4 WOMAC Pain categories used in the ordinal logistic regression analysis.

	TKR patients (n = 632)	THR patients (n = 662)
No persistent pain (WOMAC Pain score of 100 or pain for <3 months)	356 (56%)	486 (73%)
Mild persistent pain (WOMAC Pain score of 76 to 99)	77 (12%)	62 (9%)
Moderate persistent pain (WOMAC Pain score of 51 to 75)	106 (17%)	76 (11%)
Severe persistent pain (WOMAC Pain score of 0 to 50)	93 (15%)	38 (6%)

THR, total hip replacement; TKR, total knee replacement.

Table 2
Demographic and clinical details of TKR and THR responders and nonresponders.

	TKR patients			THR patients		
	Responders n = 632	Nonresponders n = 228	*P* value	Responders n = 662	Nonresponders n = 247	*P* value
Median age (IQ range) at time of postal survey	73 (66–79)	77 (70–82)	<.001	72 (65–78)	73 (64–81)	.60
Gender, men:women	43:57	34:66	.034	39:61	31:69	.06
Major depression, %	13%	–	–	12%	–	–
Pain problems elsewhere, %	87%	–	–	82%	–	–
Median BMI (IQ range)	28 (26–32)	–	–	26 (24–30)	–	–
Low education, %	24%	–	–	19%	–	–
Low social support, %	28%	–	–	29%	–	–

BMI, body mass index; IQ, interquartile; THR, total hip replacement; TKR, total knee replacement.

replaced joint is displayed in Fig. 3. Overall, 5% (33 of 632) of TKR patients and 3% (19 of 662) of THR patients experienced persistent pain that was constant. The percentage of patients who rated their pain as better or worse than their preoperative pain is displayed in Fig. 4. Overall, 7% (43 of 632) of TKR patients and 2% (12 of 662) of THR patients had pain that was worse than their preoperative pain.

3.4. Sensory qualities of persistent postsurgical pain

For both TKR and THR patients, the 3 SF-MPQ pain descriptors that were most frequently rated as moderate or severe were aching, tiring, and tender (Fig. 5). Overall, 13% (36 of 276) of TKR patients and 5% (8 of 176) of THR patients with persistent postsurgical pain had a score of ⩾19 on the PainDETECT questionnaire, indicating that a neuropathic component to their pain was likely. Therefore, after joint replacement, only 6% (36 of 632) of TKR patients and 1% (8 of 662) of THR patients experience persistent pain that is likely to be neuropathic in origin at 3 to 4 years postoperatively.

3.5. Postoperative determinants of persistent postsurgical pain

The results of the ordinal logistic regression model are shown in Table 3 for TKR patients and Table 4 for THR patients. The ordinal regression model revealed that the number of pain problems elsewhere and the presence of major depression were significant and independent postoperative determinants of persistent pain after THR and TKR. In terms of pain problems elsewhere, the likelihood of experiencing worse persistent postsurgical pain increasing incrementally with the number of pain problems elsewhere, with patients who had ⩾5 other pain problems being 11.8 and 14.8 times as likely as patients with no pain problems elsewhere to experience worse persistent pain after TKR and THR, respectively. Patients with major depression were 1.3 times as likely as nondepressed patients to experience worse persistent pain after both TKR and THR.

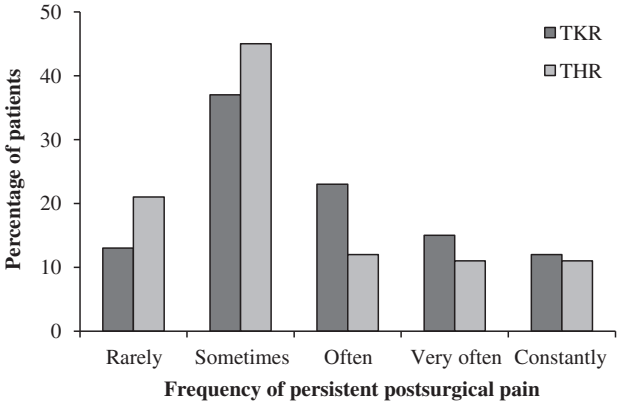

Fig. 3. The frequency with which total hip replacement (THR) patients (n = 176) and total knee replacement (TKR) patients (n = 276) experience their persistent pain in their replaced joint over the past week.

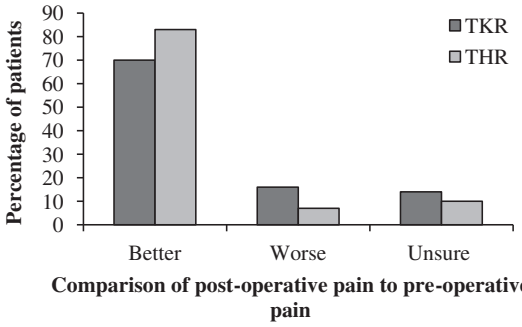

Fig. 4. A comparison of postoperative pain to preoperative pain by the total hip replacement (THR) patients (n = 176) and total knee replacement (TKR) patients (n = 276) with persistent pain after joint replacement.

4. Discussion

This study found that 44% of TKR patients and 27% of THR patients reported persistent postsurgical pain at 3 to 4 years postoperatively. Although this prevalence is high, much of the pain was mild in severity, infrequent, and an improvement from preoperative pain, which is in agreement with the findings of other studies [40,56]. This demonstrates that for the majority of patients, joint replacement is an effective procedure to reduce or eradicate persistent joint pain after medical management has been unsuccessful in controlling symptoms. Of concern, however, is the finding that 15% of TKR patients and 6% of THR patients reported severe-extreme

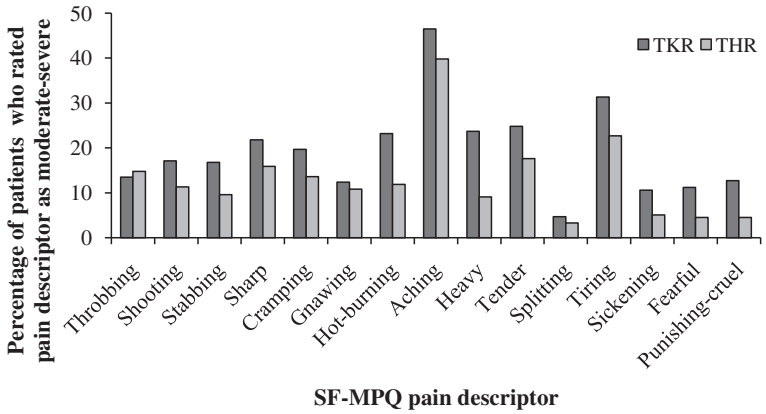

Fig. 5. Percentage of patients with persistent postsurgical pain who rated each Short-Form McGill Pain Questionnaire (SF-MPQ) pain descriptor as moderate-severe.

Table 3
Logistic regression results for TKR patients.

	Estimate	Standard error	Wald	Sig.	95% confidence interval		OR	95% confidence interval for OR	
					Lower bound	Upper bound		Lower bound	Upper bound
Female gender	0.08	0.18	0.21	0.65	−0.29	0.46	1.09	0.76	1.56
Age	−0.001	0.01	0.01	0.91	−0.02	0.02	0.99	0.98	1.02
Low educational attainment	−0.23	0.21	1.21	0.27	−0.64	0.18	0.79	0.53	1.20
Low social support	−0.81	0.20	0.16	0.69	−0.48	0.32	0.92	0.62	1.37
Major depression	0.26	0.05	24.33	<0.001	0.16	0.36	1.29	1.17	1.43
BMI	0.03	0.02	2.24	0.14	−0.01	0.06	1.03	0.99	1.06
1 to 2 pain problems elsewhere*	1.25	0.39	10.42	0.001	0.49	2.00	3.48	1.63	7.41
3 to 4 pain problems elsewhere*	2.14	0.40	29.13	<0.001	1.36	2.91	8.45	3.89	18.35
⩾5 pain problems elsewhere*	2.47	0.41	37.06	<0.001	1.67	3.26	11.78	5.33	26.07

BMI, body mass index; OR, odds ratio; Significance level; TKR, total knee replacement.
* Reference category is no pain problems elsewhere.

Table 4
Logistic regression results for THR patients.

	Estimate	Standard error	Wald	Sig.	95% confidence interval		OR	95% confidence interval for OR	
					Lower bound	Upper bound		Lower bound	Upper bound
Female gender	0.11	0.21	0.27	0.60	−0.30	0.52	1.16	0.74	1.69
Age	−0.01	0.01	1.22	0.27	−0.03	0.01	0.99	0.97	1.01
Low educational attainment	0.17	0.26	0.40	0.53	−0.35	0.68	1.18	0.71	1.98
Low social support	−0.32	0.22	2.10	0.19	−0.76	0.11	0.72	0.47	1.12
Major depression	0.24	0.06	14.85	<0.001	0.12	0.36	1.27	1.12	1.43
BMI	0.004	0.02	0.05	0.83	−0.04	0.04	1.00	0.97	1.04
1 to 2 pain problems elsewhere*	0.94	0.43	4.87	0.027	0.11	1.78	2.57	1.11	5.92
3 to 4 pain problems elsewhere*	1.95	0.43	20.71	<0.001	1.11	2.79	7.02	3.03	16.24
⩾5 pain problems elsewhere*	2.70	0.44	37.35	<0.001	1.83	3.56	14.80	6.24	35.11

BMI, body mass index; OR, odds ratio; Significance level; THR, total hip replacement.
* Reference category is no pain problems elsewhere.

persistent postsurgical pain. The prevalence of persistent pain after joint replacement has not been studied rigorously or reviewed systemically in the literature. However, previous research in orthopaedics has also uncovered the existence of a subgroup of patients who report severe persistent pain after joint replacement. The reported estimates of the prevalence of moderate-severe persistent postsurgical pain after joint replacement vary, but are in the region of 7% to 20% of TKR patients [1,5,45,56] and 2% to 8% of THR patients [40,50,56]. Therefore, although joint replacement is successful at providing pain relief for many patients, there is a proportion of patients who experience a poor outcome after surgery.

It could be argued that only a very small percentage of patients undergoing joint replacement develop persistent postsurgical pain. However, because of the high prevalence of joint replacement, this small percentage translates into a considerable number of people. For example, 58,373 TKRs were performed in the National Health Service in England and Wales in 2009 [39], and based on the results of this study, 8756 (15%) of these patients would report severe-extreme pain in their replaced joint 3 to 4 years later. These figures are likely to increase dramatically over the coming decades with the predicted increases in the need for joint replacement [27]. These findings highlight that persistent postsurgical pain is a prevalent and significant problem, and a pivotal first step in improving the management and treatment of persistent postsurgical pain is that it is acknowledged as a common outcome of surgery.

Previous research into persistent pain after joint replacement has predominantly focused on pain severity [13,18,38], but it is also valuable to explore the sensory qualities of pain. Melzack and Wall acknowledge the importance of assessing the qualities

of persistent pain by saying, "To describe pain solely in terms of intensity is like specifying the visual world only in terms of light flux without regard to pattern, colour, texture and the many other dimension of visual experience" [36]. In this study, the sensory quality of persistent pain after both THR and TKR was most commonly described as aching, tender, and tiring. Previous research has found that aching is often the most commonly chosen sensory descriptor of persistent pain after a range of different surgical procedures [2,8–10,30,44]. Interestingly, intraoperative nerve damage is often provided as an explanation for persistent postsurgical pain [23,31]. However, the words chosen from the SF-MPQ by patients to describe their pain are not considered characteristic of neuropathic pain [51]. Furthermore, only 13% of patients with persistent pain after TKR and 5% of patients with persistent pain after THR had pain that was likely to be of a neuropathic origin. These findings suggest that although intraoperative nerve damage may account for the occurrence of some persistent postsurgical pain, it is only a small percentage.

This study found that the presence of major depression was significantly and independently associated with persistent postsurgical pain. The association between psychological distress and persistent pain is well documented [42,52]. A systemic review of the literature on psychosocial predictors and correlates of persistent postsurgical pain found that depression had the strongest evidence of being a predictor [20]. Other studies have also found that depression is significantly associated with persistent pain after TKR [5,28] and THR [46,48,50]. However, from this cross-sectional study causality cannot be inferred, and so it is not clear whether persistent pain after joint replacement leads to depression or whether depression contributes to persistent pain after joint replacement. Persistent pain can contribute indirectly to depression through causing disability and fatigue [19]. Mechanisms by which depression could contribute to pain include impaired serotonergic function leading to enhanced central hyperexcitability [24], or through sleep disturbances that increase pain sensitivity [26].

Although the relationship between pain and depression is well established, a novel finding from this study is that the risk of experiencing worse persistent pain after joint replacement increases incrementally with the number of pain problems elsewhere. Persistent pain conditions tend to occur in clusters, and having one pain condition is associated with a higher likelihood than expected of having another pain condition [11]. Research in the surgical literature has also found that the existence of pain problems elsewhere is significantly associated with persistent pain after hernia repair [10], caesarean section [41], hysterectomy [6], breast surgery [16], and joint replacement [40,47]. This study builds on these previous studies to demonstrate that the number of pain problems elsewhere influences the severity of pain in the replaced joint. This suggests that multiple-site persistent pain is not simply the co-occurrence of independent pains. It has been proposed that multiple-site persistent pain is a chronic pain syndrome that develops because of an underlying generalised vulnerability to pain [11]. Therefore, it is possible that some patients develop persistent postsurgical pain because of an underlying vulnerability to pain. One mechanism by which this generalised vulnerability to pain could arise is by pain sensitisation. This is because chronic noxious input from one painful site could lead to widespread pain sensitisation, and therefore a vulnerability to developing other pain conditions. In support of this theory, research has found that preoperative pain sensitivity is associated with persistent postsurgical pain after TKR [29]. It is possible that as the number of painful sites increases, so does the extent of pain sensitisation and subsequent sensitivity to pain, which could explain the observation that pain severity in the replaced joint increases incrementally with the number of pain problems elsewhere. However, further research would be necessary to establish the mechanisms by which the severity of pain increases incrementally with the numbers of pain problems elsewhere.

Although the study has several strengths, including the use of validated patient-reported outcome measures and a large sample size, it is important to consider some of the limitations of this research when interpreting the results. A limitation of all cross-sectional studies into the prevalence of pain is that pain is not static in nature, but is dynamic and fluctuating [4,7,10,17,34,37]. Therefore, a cross-sectional study can only provide an insight into the prevalence of pain at a single time point, and future research into mapping persistent postsurgical pain would benefit from having a longitudinal design. A potential bias in this study was the demographic differences between the TKR responder and nonresponder groups. However, as age and gender were not found to be significantly associated with persistent pain after TKR, then the demographic differences should not have biased the results. Another issue that warrants acknowledgement is the definition of persistent pain. Arbitrary cut-off points were used to divide the WOMAC Pain score into no, mild, moderate, and severe pain categories for the ordinal regression analysis. However, this was necessary because of the nonnormal nature of the WOMAC Pain scores. Lastly, although many of the variables were assessed using validated questionnaires, some variables were assessed using nonvalidated questions. For example, the measure of social support in this study was crude, simply using marital status and living arrangements as estimates of low or high social support, which does not account for whether the support is positive or negative [49].

In conclusion, this study found that the prevalence of persistent pain after TKR and THR was high, although much of this pain was mild, infrequent, and an improvement on preoperative pain. However, 15% of TKR patients and 6% of THR patients reported severe-extreme pain at 3 to 4 years after surgery. The persistent pain experienced was most commonly described as aching, tender, and tiring, and only a small percentage of patients reported pain that was likely to have a neuropathic component. The presence of major depression and the number of pain problems elsewhere was found to be significantly and independently associated with persistent pain after both THR and TKR. Further research is necessary to establish the mechanisms by which the severity of persistent postsurgical pain increases incrementally with the number of pain problems elsewhere.

Conflict of interest statement

The authors have no conflict of interest.

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