Pre-operative Predictive Factors of Post-operative Pain in Patients With Hip or Knee Arthroplasty: A Systematic Review

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ABSTRACT

Objective: To analyze pre-surgical predictive factors of post-surgical pain in patients undergoing hip or knee arthroplasty.

Methods: A systematic literature review was performed. We defined a sensitive strategy on Medline, Embase and Cochrane Library up to May 2013. The inclusion criteria were: patients undertaking knee and/or hip arthroplasty, adults with moderate or severe pain (≥ 4 on a Visual Analog Scale) in whom predictive factors of post-surgical pain were evaluated before surgery. Systematic reviews, meta-analyses, controlled trials and observational studies were selected. We excluded animals and basic science articles, reviews of prosthesis, prosthesis due to fractures, patients with rheumatic diseases or studies with mixed population in which disaggregated data was not possible to obtain.

Results: A total 37 articles of moderate quality were selected. The articles included representative patients undergoing a knee or hip arthroplasty in our country; most of them were aged 60 years or above, with osteoarthritis, and with a high rate of obesity and comorbidities. We found great variability regarding the type of studies and predictive factors. There was a strong association between post-surgical pain and the following pre-surgical factors: female gender, low socio-economic status, higher pain, comorbidities, low back pain, poor functional status, and psychological factors (depression, anxiety or catastrophic pain).

Conclusions: There are pre-surgical factors that might influence post-surgical pain in patients undergoing a knee or hip arthroplasty. Therefore, they should be taken into account when considering an arthroplasty.

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Factores predictores prequirúrgicos de dolor posquirúrgico en pacientes sometidos a artroplastia de cadera o rodilla. Una revisión sistemática

Resumen

Objetivo: Analizar los factores prequirúrgicos que pueden tener efecto sobre los niveles de dolor posquirúrgico en pacientes que van a ser sometidos a una artroplastia de cadera (ATC) o rodilla (ATR).

Métodos: Revisión sistemática de la literatura. Se definió una estrategia de búsqueda sensible en Medline, Embase y Cochrane Library hasta mayo de 2013; se definió la población con los siguientes criterios: pacientes adultos con indicación de ATC o ATR y en los que se identificasen factores predictores prequirúrgicos de dolor posquirúrgico. Se incluyeron revisiones sistemáticas, metaanálisis, ensayos clínicos y estudios observacionales. Se excluyeron estudios en animales, ciencia básica, estudios sobre revisiones de prótesis, prótesis por fracturas, pacientes que tenían una enfermedad inflamatoria articular de base (artritis reumatoide, lupus, etc.) o estudios con población mixta donde fue imposible desagregar datos.

Resultados: Se seleccionaron 37 artículos de calidad moderada. Incluían pacientes representativos de aquellos a los que se les indica una ATC o ATR en nuestro país, la gran mayoría tenían artrosis de rodilla.

Palabras clave:
Artroplastia de cadera
Artroplastia de rodilla
Dolor
Factor predictivo

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Introduction

Total knee arthroplasty (TKA) or total hip arthroplasty (THA) can bring about an enormous improvement in pain relief and restored function in the patients who undergo these interventions to treat osteoarthritis (OA), with the resulting improvement in quality of life.\textsuperscript{1,2} and, thus, are considered among the most relevant surgical advances of the 20th century.\textsuperscript{3} However, this effect is not obtained in all the patients in which this surgical technique is performed.\textsuperscript{4} In fact, up to 30\% of the patients who undergo these procedures in Spain report no substantial improvement in their quality of life one year after surgery.\textsuperscript{5}

A number of studies have suggested that certain preoperative factors may have an effect on these outcomes. In general, both in THA and TKA, the best results (at least with respect to function and prosthesis survival) are obtained in patients between 45 and 75 years of age, with strong social support and a high level of education, without overweight/obesity, with better preoperative function and no comorbidities, among other characteristics.\textsuperscript{6-8} When the effect on postoperative pain is analyzed, other studies mention factors related to the patient, the surgical technique and other aspects that are associated with greater pain after surgery.\textsuperscript{9} However, there is no critically evaluated information in this respect, especially concerning chronic postoperative pain.

Our objective was to carry out a systematic and critical review of the available literature to identify possible preoperative factors that have an impact on postoperative pain in patients in whom THA or TKA is indicated. Although the size of the effect of these possible factors cannot be analyzed in depth, simply identifying them may be of great help to practicing clinicians in making decisions regarding hip and knee replacements.

Materials and Methods

We carried out a systematic review of the literature in accordance with the recommendations of the Cochrane Collaboration.\textsuperscript{10}

Study Selection Criteria

We selected studies that included adult patients in whom THA and/or TKA was indicated. Moreover, these studies should analyze preoperative predictive or determining factors for postoperative pain such as: age, sex, level of education, socioeconomic status, race, profession, underlying disease (type, duration, etc.), comorbidity, body mass index (BMI), level of self-care ability, quality of life, preoperative pain level (intensity, duration, etc.), surgeon-related factors (age, sex, experience), waiting list, type of hospital, expectations, depression, anxiety, etc. Finally, only studies with the following designs were included: meta-analyses, systematic reviews, clinical trials or observational studies.

Animal studies, basic science studies, studies on prosthesis revisions or prostheses to treat fractures were excluded, as were studies in which all the patients had an underlying inflammatory joint disease (rheumatoid arthritis, lupus, etc.) or that provided data only on these patients, and studies involving a mixed study population, but in which it was impossible to dissociate this subpopulation.

Search Strategy

For this review, we screened the following bibliographic databases: MEDLINE (from its inception to May 2013), EMBASE (from its inception to May 2013) and the Cochrane Library (from its inception to May 2013). Given the volume of literature that we expected to find, we decided, on the one hand, to include those articles in which the analysis had been adjusted for those factors that might influence the association and, on the other, not to search in the gray literature (abstracts from Spanish and international congresses). Subsequently, we carried out a secondary hand search of references from the articles that ultimately were included in the systematic review.

The strategies used in the MEDLINE search, as well as the number of citations retrieved, are shown in Table 1. For this purpose, we utilized MeSH terms and free-text terms. The search was limited to articles in humans and in English or Spanish.

Study Selection

Two reviewers independently analyzed the articles resulting from the search strategy in the three bibliographic databases, selected those that met the defined criteria and analyzed the included articles in depth. When there was disagreement, a third person, in this case, an expert methodologist, resolved the problem. First, the results of the search were refined according to the title and abstract, or the entire article when there was no abstract, in sessions with a maximum duration of 20 min. After this process, the selected articles were analyzed in depth (a reading of the entire article). Figure 1 shows the flowchart corresponding to the article selection process.

Finally, we performed a manual search for the works included in the reference lists of the articles selected for in-depth analysis. All the references were retrieved from the Internet and stored in the EndNote program to facilitate their use.

Data Collection and Appraisal of the Quality of the Studies

The two reviewers extracted the data from the selected studies using specific templates predesigned for this review. To evaluate the methodological quality of the studies included, they used the Oxford quality scale.\textsuperscript{11}

Data Analysis and Presentation

We created evidence tables to describe the main features of the selected studies. Some of the results are expressed as number and percentage (\%), mean and standard deviation, median and interquartile range ([P25–P75]), and others as odds ratio, relative risk
Table 1
Search Strategy in MEDLINE.

<table>
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</table>

Figure 1. Flowchart of the articles included.
or hazard ratio and their 95% confidence intervals (CI). On the other hand, the predictive factors analyzed in each article are presented in the evidence tables and results section as crude and adjusted for other variables (which are also specified). The possibility of carrying out a meta-analysis was considered only in the case of homogeneity.

Results

Originally, we selected 92 articles, which were reviewed in depth. Of these, 33 were selected; 4 more were added after the secondary search (Tables 2 and 3). The excluded articles and the reason for their exclusion are shown in Table 4 (their complete bibliography is provided in Appendix A, additional online material). The main reason for exclusion was the failure to consider postoperative pain as the main outcome variable of the study. A total of 4 were systematic reviews (SR), 12-15 and 1 randomized clinical trial16 and 32 observational studies (30 prospective, 2 retrospective) were included. Taking into account the fact that, in turn, the SR included 44 articles, this SR cites 77 different articles. In general, the quality was moderate and even high in some of them. Many articles scored in the range of 2 on the Oxford scale (Table 5).

With regard to the population, the great majority of the patients included had knee and hip OA and were over 60 years of age. We found a wide variability in the remaining characteristics of the patients, but it is noteworthy that in those for whom the BMI was recorded, it was high or very high, as was the mean number of comorbidities.

Some of the selected articles only evaluated the postoperative pain in patients who had undergone THA or TKA. There were also articles that included both procedures. It is important to point out that there was a wide variability when it came to measuring postoperative pain. Many of the studies utilized the Western Ontario and McMaster Universities Arthritis Index (WOMAC) or a self-reported pain system, but other forms of measuring postoperative pain were found, such as visual analog scales, indirect estimation by determining analgesic use, or quality of life questionnaires that included the pain dimension. We included scales such as the American Knee Society Score, which, in addition to pain, assesses function and range of motion, the Oxford Knee Score, a short questionnaire (12 items) based on patient responses, that is easy to employ. The Knee Injury and Osteoarthritis Outcome Score evaluates 5 dimensions: pain, symptoms, function in activities of daily living, function in sports and recreation and knee-related quality of life. The McGill Pain Questionnaire is based on the perception of pain as multidimensional: sensory/discriminative, affective/motivational and cognitive/evaluative. Other scales used, like the Osteoarthritis Knee and Hip Quality of Life questionnaire and the World Health Organization Quality of Life BREF, were based on the measurement of the quality of life of the patients.

Other available preoperative predictive variables included sociodemographic aspects (age, sex, level of education, socioeconomic status, race, etc.), clinical aspects (diagnosis, disease duration, preoperative pain, etc.), psychological aspects (anxiety, depression, expectations, coping skills, etc.) and aspects related to the hospital (which included the waiting list) and to the surgeon.

Sociodemographic predictive factors

Age: in general, an inverse association was observed between age and postoperative pain, which was greater among the youngest patients, 14,17-21 although in 2 studies the association was direct.22,23 In neither case did the size of the effect appear to be very great. Nevertheless, the association between age and postoperative pain did not reach statistically significant values in some studies.21,24-30

Sex: in general, female sex was associated with more intense postoperative pain. The effect of sex on postoperative pain was quite consistent, being greater in women, 20,25,29,31 although, in some studies, a differential effect was observed with respect to the site of the arthroplasty.14,20,25 It was not possible to show a statistically significant association between sex and postoperative pain in some studies.17,21,22,26,32 The size of the effect varied widely from one study to another.

Level of education: this was a controversial variable; it was not possible to draw a robust conclusion in this respect. The majority of the studies found no association16,17,28,33,34; only one article reported that the higher the level of education, the less intense the postoperative pain.35 Moreover, there was a wide variability in the definition of level of education depending on the country.

Socioeconomic status: being poor was associated with more intense postoperative pain, at least over the short term, in a number of studies.16,33 However, more studies and more homogeneous definitions would be necessary to enable the formulation of definitive recommendations.

Social support: this variable also proved to be controversial and, thus, a robust conclusion could not be drawn. In one article, the presence of social support was associated with less intense postoperative pain,19 but in another, weak social support was associated with greater postoperative pain.24 As occurred in the case of the socioeconomic status, further research would be needed in this respect.

Preoperative educational interventions: these measures had no effect on postoperative pain.13 We should point out that this was the conclusion reached in a SR in which there were different interventions, some of which were offered just a few days prior to surgery. Thus, perhaps they were not effective because the patients did not have enough time to assimilate them properly.

Race: African-American race was associated with worse postoperative pain17,27 Although there were few studies on this aspect, the size of the effect appeared to be considerable and consistent, reaching a β coefficient = –9.5 (95% CI –16.9 to –2.1).

Clinical Factors

Preoperative pain: the level of preoperative pain maintained a linear and direct relationship (quite consistent) to postoperative pain.25,29-31,33 The size of this effect was variable, but tended to be moderate. However, in some studies, an inverse relationship was observed,26 and another revealed a differential effect depending on the length of follow-up, with an inverse relationship during the first 6 months and a direct relationship at 2 years.21 No statistically significant relationship was observed in one study.23

Body mass index: the findings were controversial. The relationship between BMI and postoperative pain was not clear in many cases. Some studies found an association, especially with high degrees of obesity (obese obesity).9,29,22,30 According to multivariate analyses, the effect in these cases could come to be really important. The association of postoperative pain measured by the WOMAC in patients with BMI >35 who underwent THA was estimated to reach β coefficients of up to 5.91 and β coefficients = 9.7 in those with this BMI who underwent TKA (95% CI 4.3–14.4). However, the association did not reach statistically significant values in numerous other studies,17,24,26,28,29,31,37

Comorbidity: it was not possible to establish very robust conclusions with respect to the predictive role of the presence of comorbidities. A relationship was observed between the number of chronic diseases and postoperative pain in several studies,19,26 in which, as occurred with BMI, there was an important effect on postoperative pain in those patients with the highest number of comorbidities. In multivariate analyses, for example, in relation to the postoperative pain measured by the WOMAC, patients with
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<th>Predictive factor/s</th>
<th>Postoperative pain</th>
<th>Quality/comments</th>
</tr>
</thead>
</table>
| 1  | Allen Butler 2011,\textsuperscript{16} RCT, mean follow-up 3.2 years\textsuperscript{2-5} | n=108 THA (32% women, mean age 52 years) | -Quality of life (SF-12)  
- Income level  
- WOMAC  
- Race  
- Education level  
- ≥2 medical comorbidities  
- Thigh pain (drawing, yes/no)  
- Thigh pain (VAS)  | -Oxford 1b  
- Small sample size | |
| 2  | Bartelt 2010,\textsuperscript{17} retrospective observational, 1-year follow-up | n=269 THA (53% women, age 22-94 years, 70% OA) | -Age  
- Sex  
- Diagnosis  
- BMI  | -Groin pain  | -Oxford 3a |
| 3  | Becker 2011,\textsuperscript{41} prospective observational, 8-month follow-up | n=102 TKA (72% women, mean age 71 ± 8 years, 100% OA, 62% married, 32% living alone) | -Surgical technique  
- Patient expectations (15-item questionnaire)  | -WOMAC  | -Oxford 3a  
- Small sample size |
| 4  | Bin Nasser 2009,\textsuperscript{24} prospective observational, 12-61-month follow-up | n=116 THA (18% women, mean age 48 years, mean BMI 26.9) | -Age, sex, pain on hip flexion with knee extended, surgical approach, cup thickness, BMI, age, offset ratio, extent of cup coverage, internal rotation, impingement sign, cup inclination, stem-shaft angle, surgeon’s experience | -Groin pain  | -Oxford 2c  
- Small sample size |
| 5  | Davis 2008,\textsuperscript{25} prospective observational, 2-year follow-up | n=974 TKA (60% women, median age 71 years, 0-4 comorbidities, median BMI 29, over 60% retired, median preop WOMAC 41) | -Income level  
- Education level  | -WOMAC | -Oxford 2a |
| 6  | Dohnke 2005,\textsuperscript{45} prospective observational, 6-month follow-up | n=1065 THA (52% women, mean age 65 ± 10 years) | -Level of self-efficacy (modification of the Arthritis Self-Efficacy Scale)  | -VAS  | -Oxford 2b |
| 7  | Elson 2006,\textsuperscript{18} prospective observational, 5-year-follow-up | n=512 TKA (54% women, mean age 69 years, mean BMI 29) | -Age (<60 years)  
- Sex (female)  
- Unilateral and 1st knee replacement  
- Cruciate ligament removed  
- Lateral approach  | -AKSS  | -Oxford 2b  
- One or more patients with RA |
| 8  | Escobar 2007,\textsuperscript{26} prospective observational, 6-month follow-up | n=640 TKA (73.6% women, mean age 71 ± 6 years, mean BMI 29 ± 4, mean preop WOMACp 54 ± 18, Charlson index ≥ 2 12%, social support 86%) | -Age  
- Sex  
- Comorbidity  
- Social support  
- Low back pain  
- Preop pain (WOMAC)  
- Mental health (SF-12)  | -WOMAC | -Oxford 2a |
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<th>Postoperative pain</th>
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| 9  | Fortin 1999, prospective observational, 6-month follow-up | n=177 (n=92 TKA, n=85 THA, 43% women, mean age 67 ± 3 years, mean study duration 13 ± 3 years, Charlson index 0–1, 100% OA) | -Age  
-Sex  
-Center  
-Education level  
-Comorbidity (CIRS, Charlson index)  
-Peop pain (WOMAC)  
-Level of self-efficacy  
-Patient expectations  
-Different methods of measuring both, 50% do not provide a clear definition) | -WOMAC               | -Oxford 2b         |
| 10 | Haanstra 2012, SR of observational studies, 2-week to 5-year follow-up | n=18 studies (moderate-high quality), 9 studies evaluated postop pain, include THA and TKA | -Age  
-Sex  
-Site of arthroplasty (knee or hip)  
-Preop pain  
-BMI  
-WOMAC  
-Oxford 1c               | -WOMAC               | -Oxford 1c         |
| 11 | Halket 2010, prospective observational, 2–27-week follow-up | n=147 (46% women, mean age 62 ± 10 years, mean BMI 30 ± 5, 79 TKA, 29 THA) | -Age  
-Sex  
-Site of arthroplasty (knee or hip)  
-Preop pain  
-BMI  
-WOMAC  
-Oxford 3a               | -WOMAC               | -Small sample size |
| 12 | Hawker 2013, prospective observational, follow-up up to 23 years | n=202 (79.7% women, mean age 71 ± 7 years, 59.4% low education level, mean preop WOMAC 47 ± 17, 6.9% inflammatory arthritis, mean SF-36 52 ± 22, 30.2% without comorbidities, 17.8% normal weight, 69 THA, 133 TKA) | -Age  
-Sex  
-Education level (low vs high)  
-Income level (low vs high)  
-Place of residence (urban vs rural)  
-Living alone (yes/no)  
-Employed (yes/no)  
-BMI  
-OA severity (WOMAC)  
-Diagnosis  
-No. of other hips or knees affected  
-Low back pain  
-Comorbidities  
-Joint (hip vs knee)  
-Year operated  
-Center  
-Time to 1st postop evaluation  
-Waiting list  
-Mean hospital stay  
-No. of comorbidities  
-Preop pain (SF-36)  
-Cementless prosthesis  
-Implant fixation | -WOMAC               | -One or more patients with inflammatory diseases |
| 13 | Jones 2001, prospective observational, 6-month follow-up | n=454: 197 THA (62% women, 83% <80 years old, 32% live alone, 93% OA, mean no. comorbidities 3 ± 2, mean BMI 29 ± 5, 56% hybrid prostheses, 68% with no complications on admission, mean hospital stay 7 ± 5 days), 257 TKA (59% women, 86% <80 years old, 22% live alone, 93% OA, mean no. comorbidities 3 ± 2, mean BMI 31 ± 5, 56% hybrid prostheses, 70% with no complications on admission, mean hospital stay 7 ± 2 days) | -Age  
-Sex  
-Waiting list  
-Mean hospital stay  
-No. of comorbidities  
-Preop pain (SF-36)  
-Cementless prosthesis  
-Implant fixation | -WOMAC               | -One or more patients with inflammatory diseases |
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<tr>
<td>14</td>
<td>Jones 2012, prospective observational, 3-year follow-up</td>
<td>n=520: 231 THA (60% women, mean age 68 ± 10 years, 28% live alone, 94% OA, 9% DM, 25% heart disease, no. comorbidities 3 ± 2, 61% hybrid prostheses, mean hospital stay 7 ± 4 days, 68% with no complications on admission), 280 TKA (59% women, mean age 69 ± 9 years, 29% live alone, 94% OA, 9% DM, 24% heart disease, no. of comorbidities 3 ± 2, 59% hybrid prostheses, mean hospital stay 6 ± 2 days, 68% with no complications on admission)</td>
<td>-Age, -Sex, -BMI, -Heart disease, -DM</td>
<td>-WOMAC</td>
<td>-Oxford 2a - One or more patients with inflammatory diseases</td>
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<tr>
<td>15</td>
<td>Judge 2012, prospective observational, 6-month follow-up</td>
<td>n=1617 TKA (63% women, mean age 70 ± 9 years, mean BMI 30 ± 5, right knee 53%, median IMD 2004 11.5, OA 96%, ASA status 1-2 84%, mean OKS 40 ± 8, EQ5D without anxiety or depression 51%)</td>
<td>-Age, -Sex, -BMI, -IMD 2004, -Site (right or left), -Diagnosis, -OKS, -ASA status, -Year operated</td>
<td>-OKS</td>
<td>-Oxford 2c - One or more patients with inflammatory diseases</td>
</tr>
<tr>
<td>16</td>
<td>Lavernia 2009, prospective cohort, 3-year follow-up</td>
<td>n=62 THA (n=24 preop WOMAC ≥ 51, 50% women, mean age 59 ± 16 years; n=38 preop WOMAC &lt; 51, 58% women, mean age 61 ± 16 years) n=65 TKA (n=13 preop WOMAC ≥ 51, 85% women, mean age 69 ± 8 years; n=52 preop WOMAC &lt; 51, 77% women, mean age 68 ± 9 years)</td>
<td>-Function (WOMAC)</td>
<td>-WOMAC</td>
<td>-Oxford 4 - Small sample size</td>
</tr>
<tr>
<td>17</td>
<td>Li 2012, SR de RCT (and extensions), 12-97-month follow-up</td>
<td>n=24 studies on TKA (2799 patients, higher 5 women, mean age 59-78 years), 7 evaluated postop pain</td>
<td>-Type of prosthesis: mobile-bearing vs fixed-bearing</td>
<td>-WOMAC</td>
<td>-Oxford 1a</td>
</tr>
<tr>
<td>18</td>
<td>Louw 2013, SR of RCT, 1-week to 2-year follow-up</td>
<td>n=13 studies on THA and TKA (1021 patients, 58% women)</td>
<td>-Educational measures, -VAS, -SF-MPQ</td>
<td>-WOMAC</td>
<td>-Oxford 1b - Heterogeneity - Youngest patients excluded</td>
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<td>Predictive factor/s</td>
<td>Postoperative pain</td>
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<td>19</td>
<td>MacWilliam 1996, prospective observational, 6-month follow-up</td>
<td>n=442 THA (60% women, 57%&gt;65 years, 22% low education level, 43% with comorbidity, 35% unmarried, 13% African American)</td>
<td>-Age, -Sex, -Race, -Marital status, -Education level, -Comorbidity, -Polyarticular disease, -Preop pain, -Preop function</td>
<td>-HSQ</td>
<td>-Oxford 2c, -High number of study dropouts</td>
</tr>
<tr>
<td>20</td>
<td>Nilsdotter 2009, prospective observational, 1-year and 5-year follow-up</td>
<td>n=102 THA (62% women, mean age 76 years, mean BMI 28, 36.5%; 2 comorbidities)</td>
<td>-Age, -Sex, -Comorbidity, -Preop quality of life</td>
<td>-KOOS</td>
<td>-Oxford 2b, -Small sample size</td>
</tr>
<tr>
<td>21</td>
<td>Nuñez 2009, prospective cohort, 7-year follow-up</td>
<td>n=112 TKA (77% women, mean age 67 ± 16 years, 62.5% basic education, 24.1% live alone, 89.3% retired, mean no. comorbidities 5 ± 3, 51% BMI ≥ 30)</td>
<td>-Age, -Sex, -Education level, -Currently employed, -Live alone (yes/no), -Disease duration, -Other musculoskeletal pain, -Comorbidity, -Contralateral prosthesis, -Surgical difficulty, -Complications</td>
<td>-WOMAC</td>
<td>-Oxford 2c, -Small sample size</td>
</tr>
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<td>22</td>
<td>Papakostidou 2012, prospective observational, 12-month follow-up</td>
<td>n=204 TKA (79% women, mean age 69 ± 6 years, 17.6% with no social support, 96% OA, 52.9% BMI ≥ 30, mean waiting list 13 ± 10 weeks, Charlson index 1.6)</td>
<td>-Age, -Sex, -BMI, -Education level, -Place of residence, -Social support, -Preop pain</td>
<td>-WOMAC</td>
<td>-Oxford 2b, -Findings difficult to generalize to men, social support, -One or more patients with inflammatory diseases</td>
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<td>23</td>
<td>Puolakka 2010, retrospective observational, 4- and 22-month follow-up</td>
<td>n=528 TKA (70% women, mean age 68 ± 8 years, mean BMI 29 ± 4, 96% OA, 42% continuous severe or moderate pain)</td>
<td>-Type of arthroplasty: √ primary, √ revision</td>
<td>-Self-reported Analgesic use</td>
<td>-Oxford 2c, -High number of study dropouts, -One or more patients with inflammatory diseases, -Oxford 2c</td>
</tr>
<tr>
<td>24</td>
<td>Quintana 2009, prospective observational, 6-month and 2-year follow-up</td>
<td>n=590 THA (48.6% women, 49% over 70 years, 69.3% married, 84.6% primary studies, 33.6% BMI ≥ 30, 54.3% low back pain, 58.7% without comorbidities, 90.4% social support, 43% contralateral OA, mean waiting list 156 ± 151 days)</td>
<td>-Age, -Sex, -Comorbidity, -Mental health (SF-36), -Contralateral OA, -Low back pain, -Marital status, -Social support, -BMI, -Previous hip disease, -Expectations of relief, -Preop pain (WOMAC)</td>
<td>-WOMAC</td>
<td>-Oxford 2c</td>
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<td>#</td>
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<td>Postoperative pain</td>
<td>Quality/comments</td>
</tr>
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</tr>
</tbody>
</table>
| 25 | Rat 2010,Prospective observational studies, 3-year and 10-year follow-up | THA and TKA 3-year cohort: n=195 (57% women, mean age 72 ± 8 years, 74% basic studies, mean BMI 28 ± 4.54 low back pain) 10-year cohort: n=89 (56% women, mean age 73 ± 11 years, 77% basic studies, mean BMI 30 ± 14.59 low back pain) | -Age  
-Sex  
-Joint type  
-Quality of life  
-Comorbidity  
-Environmental factors (WHOQOL-BREF)  
-No. of pain sites  
-Preop pain (OAKHQOL) | -OAKHQOL | -Oxford 2b  
-Methological differences between the 2 cohorts |
| 26 | Riddle 2011,Prospective observational studies, 2-month follow-up | n=63 TKA Intervention group: 67% women, mean age 63 ± 11 years Control group: 73% women, mean age 60 ± 9 years | -Behavioral intervention on pain catastrophizing | -WOMAC  
-Pain catastrophizing (PCS) | -Oxford 2b  
-Small sample size |
| 27 | Rollson 2009,Prospective observational studies, 1-year follow-up | n=6158 THA (57% women, mean age 69 years, 100% OA) | -Anxiety (EQ5D)  
-Depression (EQ5D) | -VAS | -Oxford 2b |
| 28 | Santaguida 2008,Prospective observational studies | n=64 studies, 3 evaluate postop pain | -Age  
-Sex  
-Race  
-Weight  
-Height  
-BMI  
-Socioeconomic status | -VAS  
-Behavioral scale | -Oxford 2a  
-Majority retrospective studies |
| 29 | Singh 2008,Prospective observational studies, 2-year and 5-year follow-up | n=5290 TKA (56% women, mean age 68 ± 10 years, 95% OA) 5-year follow-up n=2602 TKA (56% women, mean age 68 ± 10 years, 94% OA) | -Age  
-Sex  
-Preop pain intensity  
-Age  
-Sex  
-BMI  
-Comorbidity  
-Depression  
-Anxiety  
-Charlson  
-H-ICDA  
-EQ5D  
-Oxford 2b  
-One or more patients with inflammatory diseases  
-Oxford 2c  
-Anxiety, depression underestimated  
-Oxford 2c  
-Time between predictor and pain may be prolonged | -Self-reported  
-Need for medication: NSAID and opioids | -Oxford 2b  
-One or more patients with inflammatory diseases |
| 30 | Singh 2010a,Prospective observational studies, 2-year and 5-year follow-up | n=5707 TKA (51% women, mean age 65 ± 13 years, 87% OA) 5-year follow-up n=3289 TKA (53% women, mean age 65 ± 13 years, 85% OA) | -Age  
-Sex  
-Preop pain intensity  
-Age  
-Sex  
-BMI  
-Comorbidity  
-Depression  
-Anxiety  
-Charlson  
-H-ICDA  
-EQ5D  
-Oxford 2b  
-One or more patients with inflammatory diseases  
-Oxford 2c  
-Anxiety, depression underestimated  
-Oxford 2c  
-Time between predictor and pain may be prolonged | -Self-reported  
-Need for medication: NSAID and opioids | -Oxford 2b  
-One or more patients with inflammatory diseases |
| 31 | Singh 2013,Prospective observational studies, 2-year and 5-year follow-up | n=7139 TKA (56% women, mean age 68 ± 10 years) 5-year follow-up n=4234 TKA (55% women, mean age 68 ± 10 years) 5-year follow-up n=3289 TKA (59% women, mean age 68 ± 9 years) | -Comorbidity (Charlson)  
-Anxiety (H-ICDA)  
-Depression (H-ICDA)  
-Age  
-Sex  
-BMI  
-Comorbidity (Charlson)  
-Operating time  
-Surgeon  
-Pessimistic/optimistic explanatory style (ICD-9)  
-WOMAC | -Self-reported  
-Self-reported  
-Need for medication: NSAID and opioids | -Oxford 2c  
-Anxiety, depression underestimated  
-Oxford 2c  
-Time between predictor and pain may be prolonged |
| 32 | Singh 2010b,Prospective observational studies, 2-year and 5-year follow-up | n=5707 TKA (61% women, mean age 68 ± 9 years) 5-year follow-up n=3289 TKA (59% women, mean age 68 ± 9 years) | -Comorbidity (Charlson)  
-Anxiety (H-ICDA)  
-Depression (H-ICDA)  
-Age  
-Sex  
-BMI  
-Comorbidity (Charlson)  
-Operating time  
-Surgeon  
-Pessimistic/optimistic explanatory style (ICD-9)  
-WOMAC | -Self-reported  
-Self-reported  
-Need for medication: NSAID and opioids | -Oxford 2c  
-Anxiety, depression underestimated  
-Oxford 2c  
-Time between predictor and pain may be prolonged |
| 33 | Smith 2012,Prospective observational studies, 1 to 3-year follow-up | n=911 THA (63% women, mean age 67 ± 11 years) | -Surgical procedure | -WOMAC | -Oxford 2b |

<table>
<thead>
<tr>
<th>#</th>
<th>Study</th>
<th>Population</th>
<th>Predictive factor/s</th>
<th>Postoperative pain</th>
<th>Quality/comments</th>
</tr>
</thead>
</table>
| 34 | Sullivan 2011,27 prospective observational, 12-month follow-up | n=120 TKA (61% women, 87% married, mean age (range) 67 (50-85) years, mean BMI (range) 31 (20-45), 97% with at least 12 years of schooling | -Age  
-Sex  
-BMI  
-Comorbidity  
-Pain catastrophizing (PCS)  
-Fear of movement (TSK)  
-Depression (PHQ-9)  
-Patient expectations | -WOMAC  
-Oxford 2c  
-Small sample size | |
| 35 | Thompson 2002,22 prospective observational, 6-month follow-up | n=1458 THA (57% women, mean age 67 years, deterioration of contralateral hip in 33% and of knee in 16%, 33% severe preop pain, 47% loss of mobility) | -Certified orthopedist  
-Caseload/surgeon  
-Caseload/hospital  
-Postgraduate studies  
-Proper management | -Matrix combining pain severity (0-5) with no. of activities in which pain appears (walking, climbing stairs, sitting down, lying down)  
-Oxford 2b  
-Situation other than the current care-provider | |
| 36 | Vissers 2012,13 SR of observational studies, 6-week to 5-year follow-up | n=35 studies, include THA and TKA, 12 evaluated postop pain  
-Psychological factors:  
✓ depression  
✓ anxiety  
✓ coping skills  
✓ optimism/pessimism  
✓ pain catastrophizing  
✓ mental health (SF-36)  
✓ expectations  
✓ emotional status  
✓ fear of movement | -WOMAC  
-VAS  
-MPQ | -Oxford 2a | |
| 37 | Wyld 2011,24 prospective observational 4 years | n=1294: 662 THA (57% women, median age 73 years, 24% low education level, 28% weak social support); 632 TKA (61% women, median age 72 years, 19% low education level, 29% weak social support) | -Age  
-Sex  
-Education level  
-Social support | -WOMAC  
-Oxford 2a | |

AKSS, American Knee Society Score; ASA, American Society of Anesthesiologists; BMI, body mass index; CIRS, Cumulative Illness Rating Scale; DM, diabetes mellitus; EQ5D, Euroqol 5 dimensions; H-ICDA, Mayo Clinic’s Hospital adaptation of International Code for Diseases codes; HSQ, Health Status Questionnaire; ICD-9, International Classification of Diseases – ninth revision codes; IMD 2004, Index of Multiple Deprivation; KOOS, Knee Injury and Osteoarthritis Outcome Score; MPQ, McGill Pain Questionnaire; NSAID, nonsteroidal anti-inflammatory drugs; OA, osteoarthritis; OARHQOL, Osteoarthritis Knee and Hip Quality of Life questionnaire; OKS, Oxford Knee Score; PCS, Pain Catastrophizing Scale; PHQ-9, Patient Health Questionnaire; postop, postoperative; preop, preoperative; RA, rheumatoid arthritis; RCT, randomized clinical trial; SF-12, 12-Item Short Form Health Survey; SF-36, 36-Item Short Form Health Survey; SF-MPQ, Short Form McGill Pain Questionnaire; SR, systematic review; ST, Stair Test; THA, total hip arthroplasty; TKA, total knee arthroplasty; TSK, Tampa Scale for Kinesiophobia; TUG, Timed Up and Go Test; VAS, Visual Analog Scale; WHOQOL-BREF, World Health Organization Quality of Life BREF; WOMAC, Western Ontario McMaster University; WOMACI, WOMAC functional scale; WOMACp, WOMAC pain scale. 
Quality according to the Oxford scale.
Table 3
Preoperative factors predictive of postoperative pain (main outcome measures).

<table>
<thead>
<tr>
<th>Study</th>
<th>Predictor postop pain</th>
<th>Crude association</th>
<th>Adjusted association</th>
<th>Adjustment factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen Butler 2011</td>
<td>Quality of life (SF-12), income level, WOMAC, race, education level, ≥2 medical comorbidities/thigh pain (drawing, VAS)</td>
<td>–</td>
<td>-Thigh pain (drawing) was associated with a lower SF-12 mental component score (P&lt;0.006), and a trend toward poverty level (P&lt;0.060), WOMAC &gt;51 (P&lt;0.060) and African American race (P&lt;0.080)</td>
<td>-Not specified (it is a RCT)</td>
</tr>
<tr>
<td>Bartelt 2010</td>
<td>Age, sex, BMI, diagnosis, surgical technique/groin pain</td>
<td>–</td>
<td>-Age (for every 10-year decrease) OR=1.38 (95% CI 1.05-1.81)</td>
<td>-See variables in preceding box</td>
</tr>
<tr>
<td>Becker 2011</td>
<td>Patient expectations/pain (WOMAC)</td>
<td>–</td>
<td>-The patients with higher preop expectations had less postop pain (P&lt;0.050)</td>
<td>-Age, sex, BMI, socioeconomic status, preop WOMAC, preop AKSS, preop SF-36</td>
</tr>
<tr>
<td>Bin Nasser 2009</td>
<td>Age, sex, pain on hip flexion with knee extended, surgical approach, cup thickness, BMI, age, offset ratio, extent of cup coverage, internal rotation, impingement sign, cup inclination, stem-shaft angle, surgeon’s experience/groin pain</td>
<td>–</td>
<td>-Female sex (P&lt;0.030)</td>
<td>-See variables in preceding box</td>
</tr>
<tr>
<td>Davis 2008</td>
<td>Income level, education level/pain (WOMAC)</td>
<td>–</td>
<td>-Income level (low) was associated with worse WOMAC at 12 months (P&lt;0.014) but not at 2 years</td>
<td>-Age, sex, no. of comorbidities, country, center</td>
</tr>
<tr>
<td>Dohnke 2005</td>
<td>Preop self-efficacy level/pain (VAS)</td>
<td>–</td>
<td>-The greater the preop self-efficacy the lesser the postop pain, β coeff=–0.20 (P&lt;0.010)</td>
<td>-Age, sex</td>
</tr>
<tr>
<td>Elson 2006</td>
<td>Preop self-efficacy level/pain (AKSS)</td>
<td>–</td>
<td>-Age (&lt;60 years) P&lt;0.010, -Sex (female) NS, -Unilateral prosthesis or 1st of 2 knees, cruciate ligament removed, lateral approach/pain (AKSS)</td>
<td>-See variables in preceding box</td>
</tr>
<tr>
<td>Study</td>
<td>Predictor postop pain</td>
<td>Crude association</td>
<td>Adjusted association</td>
<td>Adjustment factors</td>
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<tr>
<td>Escobar 2007&lt;sup&gt;15&lt;/sup&gt;</td>
<td>Age, sex, comorbidity, social support, low back pain, preop pain (WOMAC), mental health (SF-12)/pain (WOMAC)</td>
<td>–</td>
<td>Age: β coeff = –0.24 (95% CI –0.45 to –0.03)</td>
<td>–</td>
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<td></td>
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<td>Sex (female): β coeff = –3.30 (95% CI –0.15 to 6.81)</td>
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<tr>
<td></td>
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<td></td>
<td>Comorbidity (n=1): β coeff = 3.04 (95% CI –0.07 to 3.16)</td>
<td>–</td>
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<td>Comorbidity (≥2): β coeff = 6.50 (95% CI 2.00 to 11)</td>
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<td>Social support (yes): β coeff = –5.13 (95% CI –9.31 to –0.35)</td>
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<td></td>
<td>Low back pain: β coeff = –5.26 (95% CI –8.24 to –2.27)</td>
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<td></td>
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<td>Preop pain (WOMAC): β coeff = 0.26 (95% CI 0.18 to 0.34)</td>
<td>–</td>
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<tr>
<td></td>
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<td></td>
<td>Mental health (SF-12): β coeff = –0.10 (95% CI –0.17 to –0.04)</td>
<td>–</td>
</tr>
<tr>
<td>Fortin 1999&lt;sup&gt;13&lt;/sup&gt;</td>
<td>Age, sex, center, education level, comorbidity, preop pain (WOMAC)/pain (WOMAC)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
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<td>THA: Preop WOMAC β coeff = 0.27</td>
<td>–</td>
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<tr>
<td></td>
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<td></td>
<td>Education level β coeff = –0.18</td>
<td>–</td>
</tr>
<tr>
<td>Haanstra 2012&lt;sup&gt;41&lt;/sup&gt;</td>
<td>Self-efficacy level, patient expectations/pain (WOMAC)</td>
<td>Self-efficacy level: NS</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Patient expectations: indeterminate</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Halket 2010&lt;sup&gt;31&lt;/sup&gt;</td>
<td>Age, sex, prosthesis site (knee or hip), preop pain, BMI/WOMAC, 40-meter walk test, TUG, 6-min walk test, ST/pain (WOMAC, 40-m walk test, TUG, 6-min walk test, ST)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>WOMAC: Hip vs knee β coeff = 1.69 (95% CI 0.85 –2.64)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Preop pain β coeff = 0.24 (95% CI 0.12 –0.36)</td>
<td>–</td>
</tr>
<tr>
<td></td>
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<td>40-m walk test: female sex β coeff = 0.59 (95% CI 0.20 –0.98)</td>
<td>–</td>
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<tr>
<td></td>
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<td></td>
<td>TUG: female sex β coeff = 0.56 (95% CI 0.20 –0.93)</td>
<td>–</td>
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<td>6-min walk test: Preop pain β coeff = 0.24 (95% CI 0.12 –0.36)</td>
<td>–</td>
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<td>ST: female sex β coeff = 0.8 (95% CI 0.01 –0.22)</td>
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<tr>
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<td></td>
<td>Hip vs knee (P=.040), greater improvement in hip</td>
<td>–</td>
</tr>
<tr>
<td>Hawker 2013&lt;sup&gt;50&lt;/sup&gt;</td>
<td>Age, sex, education level (low vs high), income level (low vs high), place of residence (urban vs rural), living alone (yes vs no), employed (yes vs no), BMI, OA severity (WOMAC), diagnosis, no. of other hips or knees affected, low back pain, comorbidities, joint (hip vs knee), year operated, center, time to 1st postop evaluation/pain (WOMAC)</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

<sup>15</sup> See variables in preceding box
<sup>25</sup> See variables in 2nd box
<sup>31</sup> See variables in 2nd box
<table>
<thead>
<tr>
<th>Study</th>
<th>Predictor postop pain</th>
<th>Crude association</th>
<th>Adjusted association</th>
<th>Adjustment factors</th>
</tr>
</thead>
</table>
| Jones 2001<sup>25</sup> | -Age, sex, waiting list, mean hospital stay, no. of comorbidities, preop pain (SF-36), cementless prosthesis/pain (WOMAC) | – | THA:  
  -Age β coef = −0.01 P = 0.91  
  -Female sex β coef = 0.016 P = 0.02  
  -Waiting list β coef = 0.02 P = 0.80  
  -Mean hospital stay β coef = 0.10 P = 0.12  
  -No. of comorbidities β coef = −0.18 P = 0.01  
  -Preop pain (SF-36) β coef = −0.43 P = 0.001  
  -Cementless prosthesis β coef = −0.16 P = 0.05 | TKA:  
  -Age β coef = 0.03 P = 0.58  
  -Female sex β coef = −0.03 P = 0.68  
  -Waiting list β coef = 0.05 P = 0.40  
  -Mean hospital stay β coef = −0.12 P = 0.05  
  -No. of comorbidities β coef = 0.06 P = 0.31  
  -Preop pain (SF-36) β coef = −0.33 P = 0.001  
  -Cementless prosthesis β coef = −0.17 P = 0.01 | -See variables in preceding box |
| Jones 2012<sup>20</sup> | -Age, sex, BMI, heart disease, DM/pain (WOMAC) | – | THA:  
  -Age β coef = −0.06 P = 0.47  
  -Female sex β coef = 2.58 P = 0.12  
  -BMI ± 35 β coef = 5.01 P = 0.014  
  -Heart disease β coef = 4.71 P = 0.014  
  -DM β coef = 2.15 P = 0.44 | TKA:  
  -Age β coef = −0.25 P = 0.007  
  -Female sex β coef = 7.67 P = 0.001  
  -BMI ± 35 β coef = 4.01 P = 0.059  
  -Heart disease β coef = 1.61 P = 0.404  
  -DM β coef = 0.27 P = 0.921 | -Education level, living alone, mean hospital stay, type of prosthesis, diagnosis, complications on admission, rehab, no. of comorbidities |
| Judge 2012<sup>26</sup> | -Age, sex, BMI, IMD 2004, site (right or left), ASA status, OKS, diagnosis, year operated/pain (OKS) | -Preop pain (OKS) β coef = 1.54 (95% CI 1.30 to 1.78)  
  -Age NS  
  -Female sex NS  
  -BMI NS  
  -IMD 2004 β coef = −0.69 (95% CI −0.95 to −0.43)  
  -Right vs left NS  
  -RA vs OA β coef = 1.68 (95% CI 0.55–2.82)  
  -ASA status 3 vs 2 NS  
  -ASA status 1 vs 2 NS  
  -Year operated NS  
  -EQSD moderately anxious/depressed vs no anxiety/depression β coef = −0.48 (95% CI −0.87 to −0.08)  
  -EQSD very anxious/depressed vs no anxiety/depression β coef = −1.09 (95% CI −2.10 to −0.08) | -Preop pain (OKS) β coef = 1.30 (95% CI 1.03–1.57)  
  -Age β coef = 0.01 (95% CI −0.10 to 0.12)  
  -Female sex β coef = −0.13 (95% CI −0.52 to 0.25)  
  -BMI β coef = 0.13 (95% CI −0.36 to 0.09)  
  -IMD 2004 β coef = −0.64 (95% CI −0.91 to −0.37)  
  -Right vs left β coef = 0.13 (95% CI −0.50 to 0.23)  
  -RA vs OA β coef = 1.75 (95% CI 0.61–2.89)  
  -ASA status 3 vs 2 β coef = 0.18 (95% CI −0.40 to 0.75)  
  -ASA status 1 vs 2 β coef = 0.51 (95% CI −0.12 to 1.14)  
  -Year operated NS  
  -EQSD moderately anxious/depressed vs no anxiety/depression β coef = −0.43 (95% CI −0.82 to −0.03)  
  -EQSD very anxious/depressed vs no anxiety/depression β coef = −1.19 (95% CI −2.19 to −0.18) | -See variables in preceding box |
| Lavernia 2009<sup>19</sup> | -Function (WOMAC)/pain (WOMAC) | – | THA: the worse the preop function, the worse the postop pain (P = 0.001)  
  -TKA: the worse the preop function, the worse the postop pain (P = 0.006) | -Age, sex |
| Li 2012<sup>12</sup> | -Type of prosthesis: mobile-bearing vs fixed-bearing/pain (WOMAC) | – | -The differences persist at 1, 2 and 3 years  
  -Mobile-bearing prosthesis: OR = 0.66 (95% CI 0.46–0.94) P = 0.022 P = 25.5% | -Not specified |
<p>| Louw 2013&lt;sup&gt;13&lt;/sup&gt; | -Educational measures/pain (WOMAC), VAS, SF-MFQ | – | Educational measures produced no effect on postop pain except in 1 of the 13 studies | -Not specified, although similarity among the groups is assumed due to randomization |</p>
<table>
<thead>
<tr>
<th>Study</th>
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<th>Adjusted association</th>
<th>Adjustment factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>MacWilliam 1996²⁷</td>
<td>-Age, sex, race, marital status, education level, comorbidity, polyarticular disease, preop pain (HSQ), preop function/pain (HSQ)</td>
<td>Difference in means (95% CI) -Age ≥ 65: 2.7 (–2.6 to 8.0) -Female sex: 4.3 (–1.0 to 9.6) -African American: –9.2 (–17.2 to –1.2) -Unmarried: 2.7 (–2.9 to 8.3) -Low education level: –4.4 (–10.7 to 1.9) -Polyarticular disease: –1.9 (–7.5 to 3.7) -No. of comorbidities: –2.7 (–5.6 to 0.3) -Preop pain: –0.6 (–0.8 to –0.5)</td>
<td>Difference in means HSQ pain (95% CI) -Age ≥ 65: 4.4 (–0.7 to 9.5) -African American: –9.5 (–16.9 to –2.1) -Low education level: –6.2 (–12.3 to –0.1) -No. of comorbidities: –4.6 (–7.5 to –1.7) -Preop pain (HSQ): –0.7 (–0.5 to –0.9) -Preop function: –0.6 (–0.8 to –0.5) -Female sex, unmarried, polyarticular: NS</td>
<td>-See variables in 2nd box</td>
</tr>
<tr>
<td>Nilsson 2009²²</td>
<td>-Age, sex, comorbidity, preop quality of life/pain (KOOS)</td>
<td>-Pain at 1 year: age (being 10 years older) coef = 5 (95% CI 1–16) -Preop pain = 0.10 (95% CI 0.29–0.89); P = 0.020 -Female sex = 7 (95% CI 1–13) -Sex, comorbidity, preop quality of life: NS -BMI &gt; 35 kg/m² coef = 5.7 (95% CI 4.3–14.4)</td>
<td>-See variables in 2nd box</td>
<td></td>
</tr>
<tr>
<td>Núñez 2009³⁶</td>
<td>-Age, sex, education level, currently employed, living alone (yes or no), disease duration, other musculoskeletal pain, comorbidity, contralateral prosthesis, surgical difficulty, complications/pain (WOMAC)</td>
<td>-Pain &gt; 12 months OR = 2.84 (1.44–8.65) -Female sex OR = 1.91 (1.14–3.28)</td>
<td>-Age, sex, comorbidity, NS</td>
<td></td>
</tr>
<tr>
<td>Papakostidou 2012²⁵</td>
<td>-Age, sex, BMI, education level, place of residence, social support, preop pain/pain (WOMAC)</td>
<td>-Preop pain: 0.10 (95% CI 2.29–0.02); P &lt; 0.001 -Age, sex, low education level, BMI, rural vs urban, social support: NS</td>
<td>-See variables in 2nd box</td>
<td></td>
</tr>
<tr>
<td>Puolakka 2010³⁰</td>
<td>-Age, sex, type of arthroplasty, preop pain/pain (self-reported), analgesic use</td>
<td>-Preop pain: 0.10 (95% CI 2.29–0.02); P &lt; 0.001 -Age, sex, low education level, BMI, rural vs urban, social support: NS</td>
<td>-See variables in 2nd box</td>
<td></td>
</tr>
<tr>
<td>Quintana 2009²¹</td>
<td>-Age, sex, comorbidity, mental health (SF-36), contralateral OA, low back pain, marital status, social support, BMI, previous hip deterioration, expectations of relief, preop pain (WOMAC)/pain (WOMAC)</td>
<td>-Age coef = 0.50 -Female sex coef = 0.56 -Education level coef = 0.001 -Marital status coef = 0.15 -Social support coef = 0.19 -BMI coef = 0.15 -Previous hip deterioration coef = 0.57 -Contralateral OA coef = 0.43 -OA in lower limb coef = 0.92 -Low back pain coef = 0.16 -Comorbidity (Charlson) coef = 0.92 -Expectations of pain relief coef = 0.002 -Mental health (SF-36) coef = 0.002</td>
<td>-See variables in 2nd box</td>
<td></td>
</tr>
</tbody>
</table>

Note: The table continues with additional studies and data not shown here. The study information includes details on predictor postop pain, crude association, adjusted association, and adjustment factors. The data are presented in a structured format with specific parameters and coefficients for each study, indicating differences in means and means of pain scores, adjusted for various factors.
<table>
<thead>
<tr>
<th>Study</th>
<th>Predictor postop pain</th>
<th>Crude association</th>
<th>Adjusted association</th>
<th>Adjustment factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rat 2010<strong>30</strong></td>
<td>- Age, sex, type of joint, quality of life, comorbidity, environmental factors (WHOQOL-BREF), no. of pain sites, preop pain (OAKHQOL)/pain (OAKHQOL)</td>
<td>–</td>
<td>Pain at 3 years:&lt;br&gt;- Age: NS&lt;br&gt;- Preop pain coefficient = 0.28 (P &lt; 0.001)&lt;br&gt;- Pain other regions coefficient = 12.93 (P &lt; 0.001)&lt;br&gt;- Comorbidity coefficient = –2.37 (P &lt; 0.006)&lt;br&gt;- Environmental factors coefficient = 0.33 (P &lt; 0.001)</td>
<td>- Sex, marital status, location: hip or knee</td>
</tr>
<tr>
<td>Riddle 2011<strong>44</strong></td>
<td>- Behavioral intervention on pain catastrophizing/pain (WOMAC), pain catastrophizing (PCS)</td>
<td>Intervention (change baseline-end):&lt;br&gt;- WOMAC = 6.9 ± 4.7&lt;br&gt;- PCS = 19.6 ± 9.6</td>
<td>Adjusted mean difference:&lt;br&gt;- WOMAC = 2.8 (95% CI 0.5–5.1) (P = 0.017)&lt;br&gt;- PCS = 9.1 (95% CI 3.3–14.9) (P = 0.003)</td>
<td>- Unspecified baseline characteristics</td>
</tr>
<tr>
<td>Rolfson 2009<strong>15</strong></td>
<td>- Anxiety (EQSD), depression (EQSD)/pain (VAS)</td>
<td>–</td>
<td>- Preop anxiety and depression: pain reduction 4.4% lower (P &lt; 0.001)</td>
<td>- Comorbidity (Charlson), age, sex, preop EQSD</td>
</tr>
<tr>
<td>Santaguida 2008<strong>14</strong></td>
<td>- Age, sex, race, weight, height, BMI, socioeconomic status/pain (VAS), pain (behavioral scale)</td>
<td>–</td>
<td>- TKA = women experience less pain than men&lt;br&gt;- TKA = women &gt; 65 years of age experience less pain&lt;br&gt;- TKA = women experience more pain and take more analgesics</td>
<td>- See variables in 2nd box</td>
</tr>
<tr>
<td>Singh 2008<strong>23</strong></td>
<td>- Age, sex, preop pain intensity/pain (self-reported)</td>
<td>Pain at 2 years:&lt;br&gt;- Age 60–70 years OR = 0.58 (P &lt; 0.05)&lt;br&gt;- Age 70–80 years OR = 0.69 (P &lt; 0.05)&lt;br&gt;- Age &gt; 80 years OR = 1.12 NS&lt;br&gt;- Female sex OR = 1.40 (P &lt; 0.05)&lt;br&gt;- Preop pain OR = 1.37 NS</td>
<td>Pain at 2 years:&lt;br&gt;- Age 60–70 years OR = 0.49 (95% CI 0.31–0.77)&lt;br&gt;Female sex OR = 1.45 (95% CI 1.01–2.08)</td>
<td>- See variables in 2nd box</td>
</tr>
<tr>
<td>Singh 2010<strong>9</strong></td>
<td>- Age, sex, BMI, comorbidity, depression, anxiety/pain (self-reported), need for NSAID and opioids</td>
<td>–</td>
<td>Pain at 2 years:&lt;br&gt;- COPD OR = 1.4 (95% CI 1.1–1.8)&lt;br&gt;- DM OR = 1.3 (95% CI 1.0–1.8)&lt;br&gt;- Depression OR = 1.5 (95% CI 1.2–2.0)&lt;br&gt;- Anxiety OR = 1.6 (95% CI 1.2–2.3)&lt;br&gt;- Heart disease, PVD, renal disease, connective tissue disease: NS</td>
<td>- BMI 35–39 OR = 1.8 (95% CI 1.2–2.6)&lt;br&gt;- BMI ≥ 40 OR = 1.7 (95% CI 1.0–2.9)&lt;br&gt;- Depression OR = 2.1 (95% CI 1.4–3.0)&lt;br&gt;- Age, sex, anxiety, comorbidity: NS</td>
</tr>
<tr>
<td>Singh 2013<strong>18</strong></td>
<td>- Comorbidity (Charlson), anxiety (H-ICDA), depression (H-ICDA)/pain (self-reported)</td>
<td>–</td>
<td>Pain at 2 years:&lt;br&gt;- COPD OR = 1.3 (95% CI 1.0–1.8) (P = 0.060)&lt;br&gt;- Depression OR = 1.3 (95% CI 1.0–1.8) (P = 0.080)&lt;br&gt;- Anxiety OR = 1.4 (95% CI 1.0–2.0) (P = 0.050)&lt;br&gt;- Heart disease, renal disease, connective tissue disease, DM: NS</td>
<td>Pain at 5 years:&lt;br&gt;- Heart disease OR = 1.7 (95% CI 1.1–2.6) (P = 0.010)&lt;br&gt;- Depression OR = 1.7 (95% CI 1.1–2.5) (P = 0.010)&lt;br&gt;- Anxiety OR = 1.9 (95% CI 1.2–3.1) (P = 0.010)&lt;br&gt;- COPD, PVD, renal disease, connective tissue disease, DM: NS</td>
</tr>
</tbody>
</table>
Table 3 (Continued)

<table>
<thead>
<tr>
<th>Study</th>
<th>Predictor postop pain</th>
<th>Crude association</th>
<th>Adjusted association</th>
<th>Adjustment factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singh 2010b</td>
<td>-Age, sex, BMI, comorbidity (Charison), operative time, surgeon, pessimistic/optimistic explanatory style (ICD-9)/pain (self-reported)</td>
<td>-Pain at 2 years pessimistic explanatory style OR=2.21 (95% CI 1.12–4.35)</td>
<td>-Pain at 5 years pessimistic explanatory style OR=1.21 (95% CI 0.51–2.83)</td>
<td>-Age, sex, depression, distance from hospital</td>
</tr>
<tr>
<td>Smith 2012</td>
<td>-Surgical procedure/pain (WOMAC)</td>
<td>-OR (95% CI) (P value)</td>
<td>-Female sex OR=0.76 (95% CI 0.57–1.00) (P=0.050)</td>
<td>-Age</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Mental health OR=1.05 (95% CI 1.04–1.06)</td>
<td>-Posterior vs anterolateral approach OR=1.61 (95% CI 1.26–2.05) (P=0.001)</td>
<td>-Patient expectations regarding the recovery of behavioral activities (daily tasks and social activities)</td>
</tr>
<tr>
<td>Sullivan 2011</td>
<td>-Age, sex, BMI, comorbidity, pain catastrophizing (PCS), fear of movement (TSK), depression (PHQ-9), patient expectations/pain (WOMAC)</td>
<td></td>
<td>-Preop pain catastrophizing predicts worse outcome in terms of pain (coef =0.44; P=0.001)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Fear of movement and depression also predict greater postop pain, but only in univariate analyses</td>
<td>-Effect mediated by patient expectations for response and recovery</td>
<td></td>
</tr>
<tr>
<td>Thompson 2002</td>
<td>-Certification in orthopedics, caseload/surgeon, caseload/hospital, postgraduate studies, proper management matrix that combines pain severity (0-5) with number of activities in which pain appears (walking, climbing stairs, sitting down, lying down)</td>
<td>-Cemented prostheses</td>
<td>-Postop pain is not associated with caseload (surgeon/hospital)</td>
<td>-See box 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Postoperative prostheses</td>
<td>-Cementless prostheses</td>
<td></td>
</tr>
<tr>
<td>Vissers 2012</td>
<td>-Psychological factors (depression, anxiety, coping skills, optimism, pessimism, pain catastrophizing, mental health (SF-36), expectations, emotional status, fear of movement/pain (WOMAC,VAS, MPQ)</td>
<td>-Pain &lt;1 year after surgery</td>
<td>-Robustly associated with greater pain are: poorer preop mental health, preop pain catastrophizing Pain &gt;1 year after surgery</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Poorer preop mental health is robustly associated with greater pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wylde 2011</td>
<td>Age, sex, education level, social support/WOMAC</td>
<td>-THA:</td>
<td>TKA:</td>
<td>-See variables in preceding box</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-age: OR=0.99 (95% CI 0.97-1.01)</td>
<td>-Age: OR=0.99 (95% CI 0.98-1.02)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Sex: OR=1.16 (95% CI 0.74-1.69)</td>
<td>-Sex: OR=1.09 (95% CI 0.76-1.56)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Low education level: OR=1.18 (95% CI 0.71-1.98)</td>
<td>-Low education level: OR=0.79 (95% CI 0.53-1.20)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Weak social support: OR=0.72 (95% CI 0.47-1.12)</td>
<td>-Weak social support: OR=0.92 (95% CI 0.62-1.37)</td>
<td></td>
</tr>
</tbody>
</table>

AKSS, American Knee Society Score; ASA, American Society of Anesthesiologists; BMI, body mass index; CI, confidence interval; COPD, chronic obstructive pulmonary disease; DM, diabetes mellitus; EQ5D, Euroqol 5 dimensions; H-ICDA, Mayo Clinic’s Hospital adaptation of International Code for Diseases codes; HSQ, Health Status Questionnaire; ICD-9, International Classification of Diseases – ninth revision codes; IMD 2004, Index of Multiple Deprivation; KOOS, Knee Injury and Osteoarthritis Outcome Score; MPQ, McGill Pain Questionnaire; NS, not significant; NSAID, nonsteroidal anti-inflammatory drugs; OA, osteoarthritis; OAKHQOL, Osteoarthritis Knee and Hip Quality of Life questionnaire; OCS, Oxford Knee Score; OR, odds ratio; PCS, Pain Catastrophizing Scale; PHQ-9, Patient Health Questionnaire; postop, postoperative; preop, preoperative; PVD, peripheral vascular disease; RA, rheumatoid arthritis; RCT, randomized clinical trial; rehab, rehabilitation; SF-12, 12-Item Short Form Health Survey; SF-36, 36-Item Short Form Health Survey; SF-MPQ, Short Form McGill Pain Questionnaire; ST, Stair Test; THA, total hip arthroplasty; TKA, total knee arthroplasty; TSK, Tampa Scale for Kinesiophobia; TUG, Timed Up and Go Test; VAS, Visual Analog Scale; WHOQOL-BREF, World Health Organization Quality of Life BREF; WOMAC, Western Ontario McMaster University.
Table 4  
Studies Excluded and the Reasons for Their Exclusion.

<table>
<thead>
<tr>
<th>#</th>
<th>Study</th>
<th>Reasons for exclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anakwe 2011</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>2</td>
<td>Alzahrani 2011</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>3</td>
<td>Anouchi 1996</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>4</td>
<td>Arbuthnot 2011</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>5</td>
<td>Ayers 2004</td>
<td>Included in a systematic review</td>
</tr>
<tr>
<td>6</td>
<td>Ayers 2005</td>
<td>Included in a systematic review</td>
</tr>
<tr>
<td>7</td>
<td>Bachmeier 2001</td>
<td>Utilizes the SF-36 bodily pain subscale</td>
</tr>
<tr>
<td>8</td>
<td>Baker 2007</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>9</td>
<td>Barrack 2000</td>
<td>Certain variables are not evaluated as predictive factors; the text only establishes differences</td>
</tr>
<tr>
<td>10</td>
<td>Beaufre 2004</td>
<td>Included in a systematic review</td>
</tr>
<tr>
<td>11</td>
<td>Brander 2003</td>
<td>Included in a systematic review</td>
</tr>
<tr>
<td>12</td>
<td>Briton 1997</td>
<td>Sex is not evaluated as a predictive factor; the text only establishes differences</td>
</tr>
<tr>
<td>13</td>
<td>Busato 2008</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>14</td>
<td>Caraccio 2005</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>15</td>
<td>Carroll 2012</td>
<td>There is a mix of different types of surgery; there is no subanalysis by group</td>
</tr>
<tr>
<td>16</td>
<td>Chalidis 2010</td>
<td>The surgical technique is not evaluated as a predictive factor; the text only establishes differences</td>
</tr>
<tr>
<td>17</td>
<td>Cheng 2012</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>18</td>
<td>Choi 2012</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>19</td>
<td>Clement</td>
<td>Could not be found</td>
</tr>
<tr>
<td>20</td>
<td>Crooksbe 2010</td>
<td>The variables predictive of postop pain are not preop factors</td>
</tr>
<tr>
<td>21</td>
<td>D’Apuzzo 2012</td>
<td>All the patients have fibromyalgia</td>
</tr>
<tr>
<td>22</td>
<td>Dickob 1996</td>
<td>Certain variables are not evaluated as predictive factors; the text only establishes differences</td>
</tr>
<tr>
<td>23</td>
<td>Dowsey 2009</td>
<td>Language is not evaluated as a predictive factor; the text only establishes differences</td>
</tr>
<tr>
<td>24</td>
<td>Fisher 2007</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>25</td>
<td>Fitzgerald 2004</td>
<td>Utilizes the SF-36 bodily pain subscale</td>
</tr>
<tr>
<td>26</td>
<td>Fortin 2002</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>27</td>
<td>Gandhi 2009</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>28</td>
<td>Hall 2002</td>
<td>Postop pain refers to pain at hospital discharge</td>
</tr>
<tr>
<td>29</td>
<td>Hosaka 2011</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>30</td>
<td>Kamath 2010</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>31</td>
<td>Kennedy 2013a</td>
<td>Certain variables are not evaluated as predictive factors; the text only establishes differences</td>
</tr>
<tr>
<td>32</td>
<td>Kennedy 2013b</td>
<td>Certain variables are not evaluated as predictive factors; the text only establishes differences</td>
</tr>
<tr>
<td>33</td>
<td>Konig 1997</td>
<td>Could not be found</td>
</tr>
<tr>
<td>34</td>
<td>Kostamo 2009</td>
<td>Certain variables are not evaluated as predictive factors; the text only establishes differences</td>
</tr>
<tr>
<td>35</td>
<td>Kulkarni 2000</td>
<td>Certain variables are not evaluated as predictive factors; the text only establishes differences</td>
</tr>
<tr>
<td>36</td>
<td>Lavernia 2011</td>
<td>Sex is not evaluated as a predictive factor; the text only establishes differences</td>
</tr>
<tr>
<td>37</td>
<td>Lavernia 2009</td>
<td>Could not be found</td>
</tr>
<tr>
<td>38</td>
<td>Lavernia 2013a</td>
<td>Could not be found</td>
</tr>
<tr>
<td>39</td>
<td>Lavernia 2013b</td>
<td>Could not be found</td>
</tr>
<tr>
<td>40</td>
<td>Lee 2011</td>
<td>The surgeon’s impression of the intervention is not evaluated as a predictive factor; the text only establishes differences</td>
</tr>
<tr>
<td>41</td>
<td>Liehs 2011</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>42</td>
<td>Lingard 2004</td>
<td>Could not be found</td>
</tr>
<tr>
<td>43</td>
<td>Lingard 2006</td>
<td>Included in a systematic review</td>
</tr>
<tr>
<td>44</td>
<td>Lingard 2007</td>
<td>Included in a systematic review</td>
</tr>
<tr>
<td>45</td>
<td>Lizarr-Utrilla 2012</td>
<td>Included in a systematic review</td>
</tr>
<tr>
<td>46</td>
<td>Lopez-Olivo 2011</td>
<td>Included in a systematic review</td>
</tr>
<tr>
<td>47</td>
<td>MacDonalds 2008</td>
<td>Certain variables are not evaluated as predictive factors; the text only establishes differences</td>
</tr>
<tr>
<td>48</td>
<td>Mahomed 2002</td>
<td>Included in a systematic review</td>
</tr>
<tr>
<td>49</td>
<td>Manion 2009</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>50</td>
<td>Marti-Valls 2000</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>51</td>
<td>Molli 2012</td>
<td>Certain variables are not evaluated as predictive factors; the text only establishes differences</td>
</tr>
<tr>
<td>52</td>
<td>Munk 2011</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>53</td>
<td>Nilsdotter 2000</td>
<td>Certain variables are not evaluated as predictive factors; the text only establishes differences</td>
</tr>
<tr>
<td>54</td>
<td>Nilsdotter 2002</td>
<td>Certain variables are not evaluated as predictive factors; the text only establishes differences</td>
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<tr>
<td>55</td>
<td>Rolfson 2009</td>
<td>Included in a systematic review</td>
</tr>
<tr>
<td>56</td>
<td>Rooks 2006</td>
<td>Certain variables are not evaluated as predictive factors; the text only establishes differences</td>
</tr>
<tr>
<td>57</td>
<td>Samson 2010</td>
<td>Postop pain is not the dependent variable</td>
</tr>
<tr>
<td>58</td>
<td>Street 2005</td>
<td>There is no adjusted analysis</td>
</tr>
<tr>
<td>59</td>
<td>Van Der Straeten 2013</td>
<td>Postop pain is not the dependent variable</td>
</tr>
</tbody>
</table>

Postop, postoperative; preop, preoperative.

Table 5  
Major Conclusions With Their Level of Evidence and Grade of Recommendation.

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>LE; GR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced age, female sex are associated with greater postoperative pain</td>
<td>2a; B</td>
</tr>
<tr>
<td>African American and low socioeconomic status are associated with greater postoperative pain</td>
<td>1b; A</td>
</tr>
<tr>
<td>The presence of greater preoperative pain is a highly robust independent predictor of postoperative pain</td>
<td>2b; B</td>
</tr>
<tr>
<td>Poor preoperative functional status is a predictor of greater postoperative pain</td>
<td>2c; B</td>
</tr>
<tr>
<td>High BMI may be associated with greater postoperative pain, especially in cases of morbid obesity</td>
<td>2a; B</td>
</tr>
<tr>
<td>The presence of comorbidities is associated with greater postoperative pain, especially when there are several concomitant diseases</td>
<td>1b; A</td>
</tr>
<tr>
<td>Psychological factors such as depression, anxiety and pain catastrophizing are strong predictors of greater postoperative pain</td>
<td>1c; A</td>
</tr>
</tbody>
</table>

BMI, body mass index; GR, grade of recommendation; LE, level of evidence.

* The levels of evidence and grades of recommendation were established in accordance with the Oxford quality scale.
278 comorbidities reached a β coefficient = 6.50 (95% CI 2.00–11.19 but when measured in another study by the Health Status Questionnaire (HSQ), the β coefficient was = −4.6 (95% CI −7.5 to −1.7).27 It was also demonstrated that comorbidity could affect postoperative pain both at 3 years and at 10 years. However, the results contradicted those of another study25 and did not reach statistical significance in many others.15,20,21,38–38

Diagnosis: there were no differences between patients with OA and hip dysplasia17 in terms of postoperative pain; nevertheless, it was found that patients with RA experienced greater postoperative pain than those with OA.26 However, given that we searched expressly for articles in which the majority of the patients did not have an inflammatory disease, it was not possible to draw a conclusion in this respect.

Preoperative functional capacity: a poorer preoperative functional status was a predictor of greater postoperative pain.27,39 However, on the basis of findings published to date, the size of the effect was not large.

Low back pain: the preoperative presence of this condition was associated with worse postoperative pain,19,40 but there was not enough data to draw a robust conclusion. The effect of preoperative low back pain may have been an important factor in postoperative pain. In fact a β coefficient = −5.26 (95% CI = −8.24 to −2.27) was reported.19,40

Psychological Predictive Factors

Level of self-efficacy: the effect of this factor was indeterminate.15,41 Although there were high-quality articles that suggested that those patients with a higher level of preoperative self-efficacy had less intense postoperative pain,42 one SR failed to obtain clear findings and dismissed this aspect as indeterminate.15 The possibility that it be a moderator (of other psychological aspects of the patient and of pain), rather than a predictor in the strictest sense should be examined. This would indicate the need for further studies on interactions to evaluate its real effect on postoperative pain.

Patient expectations: as was the case in the preceding variable, its effect remained indeterminate.15,37,41 Again, although there were high-quality articles that suggested that the patients with higher preoperative expectations experienced less postoperative pain,43 the same SR15 concluded that its effect could not be determined. In this case, also, it is necessary to examine the possibility that it be a moderator (of other psychological aspects of the patient and of pain), rather than a predictor in the strictest sense.

Catastrophism (pain experience that focuses on and exaggerates excessively the feeling of pain, accompanied by the perception of being unable to control it): the preoperative presence of pain catastrophizing (catastrophism) was clearly associated with greater postoperative pain.15,37 The size of the effect was also important. Moreover, a behavioral intervention to deal with pain catastrophizing reduced postoperative pain.44

Depression and/or anxiety: their presence prior to surgery was associated with greater postoperative pain, a finding that was highly consistent, especially for depression,9,15,37,38,45 and in which there was also a substantial effect size.

Pessimistic explanatory style: it was not possible to determine its effect.15,46 Like other variables, it may be a modulating factor.

Worse preoperative mental health: a number of studies reported its association with greater postoperative pain,15,16,21 finding a substantial effect size.

Other psychological factors: many of the other psychological factors studied were found to have an indeterminate effect on postoperative pain.15

Surgery-related Predictive Factors

Waiting list: the longer the waiting list, the greater the postoperative pain, but this variable did not reach statistical significance for either THA or TKA.25 We should point out that the cited study was not carried out in Spain. Thus, the indication for surgery, criteria and timing may be different.

Pain did not appear to be related to questions of caseload, either of the surgeon or the hospital, but it did seem to be less intense when the surgeon was a certified orthopedist.47

Discussion

This systematic review has enabled the identification of a large group of preoperative factors that have a significant effect on postoperative pain in patients in whom THA or TKA is indicated. The original idea behind the present study was to carry out a meta-analysis, but due to the extraordinary heterogeneity found, that proved to be impossible. However, the fact that studies were selected and the conclusions drawn on the basis of adjusted analyses enabled us to show the independent effect of each factor. This is highly valuable for decision-making in routine practice since, moreover, these factors were compiled from observational studies with populations similar to those encountered on a daily basis. The quantification of the exact effect sizes of these predictors would be of great utility.

It is surprising to see the large number of articles in which the objectives, title and conclusions refer literally to predictive factors, when what they really analyze are intergroup differences (crude data, which can vary when adjusted for cofactors). That is, the predictive value of a given variable is not evaluated robustly.48 On the other hand, many articles evaluate pain in the descriptive part, but in regression analyses evaluate only function. Moreover, despite the fact that multivariate analyses often include variables that could be subject to collinearity, this phenomenon is not taken into account.35 Finally, the approach to the measurement of the predictive variables is highly inconsistent, another circumstance that makes it difficult to generalize the results. Consequently, the conclusions of this review should be evaluated with care.

With respect to the predictive variables analyzed, some of the ones that should be taken into account when it comes to indicating hip or knee arthroplasty, like age, sex and socioeconomic status, are not modifiable (or very difficult to modify). Aside from the fact that these variables may, moreover, be associated with other important results, such as prosthesis survival or anesthetic risk, the effect on postoperative pain is a key factor, as one of the main reasons for indicating this procedure is to relieve pain. It is essential that orthopedic surgeons include these parameters, although they are not modifiable, and explain their effect on the expected results of the arthroplasty, when it comes to asking their patients on an individual basis for their consent to perform the intervention. The combination of several of these unmodifiable factors could be a motive for an eventual reevaluation of the indication for surgery.

On the other hand, there is another group of preoperative factors that can influence postoperative pain and that may be modifiable in some way. Surgeons should suggest interventions that make it possible to modify them whenever possible. Special attention should be given to those predictive factors with the greatest impact on postoperative pain and the widest margin for modification, provided this does not result in a negative impact on the arthroplasty in terms of time and/or costs or for the patients themselves.44,49

One predictive factor whose effect on postoperative pain is highly controversial is BMI. Depending on the study, it was9,20,22,36 or was not17,24,26,28,29,31,37 associated with greater postoperative pain. There is evidence that at least those patients with very high
BMI (morbidly obese) do tend to present poorer postoperative results. Taking into account the fact that obesity can have a negative effect on other aspects, such as prosthesis survival, it seems appropriate to stress the need that the patients control overweight prior to surgery. With comorbidities, the situation is very much the same.15,16 Although many correspond to chronic and incurable conditions, the necessary control over medication and careful vigilance would probably have a positive influence on the outcome of the surgery.

Another of the modifiable factors is the preoperative pain.25,29–31,35 It is true that, in most cases, the failure of pain medications is precisely one of the main reasons for the indication for arthroplasty. In this respect, pain treatment should be aimed at reducing it to the greatest possible extent so that the patients feel greater comfort and better postoperative results can be obtained. Once arthroplasty has been indicated, the management of pain and of the loss of function in patients of this type is not over, and there should be an active search for interventions to target their pain. Among the factors of this type, we could include the presence of preoperative low back pain.19,40

In this review, the psychological factors appear as being among those that, in general, have the greatest influence on postoperative pain.3,4,15,37,38,45 Intervention on these psychological components can achieve their modification, although it may take more time and resources to accomplish this aim. Here we find depression, anxiety and the presence of pain catastrophizing. We should consider including at least an evaluation and a rapid and systematic detection of the presence of any of these conditions in the assessment of the candidate for THA or TKA, which would enable us to look for the best possible solution on an individual basis.

In conclusion, once the indication for THA and/or TKA is clear, it is essential to take into account certain preoperative variables that influence the outcome of the intervention as far as postoperative pain is concerned. Nonmodifiable variables, such as female sex, younger patient age, low socioeconomic status and the presence of comorbidities, should be taken into account when deciding on the indication for arthroplasty. Modifiable variables or those amenable to intervention, such as obesity, the presence of intense preoperative pain or severe functional impairment, and the existence of psychological disturbances, should be evaluated systematically to assess the performance of preoperative interventions that contribute to the achievement of better outcomes with THA and TKA.

Ethical Disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Conflicts of Interest

Jorge Díaz Heredia, Pablo Crespo, Clara Hernández and María Luisa Berraquero have received fees from MSD in payment for scientific work.

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Appendix A. Additional material

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