

CADTH Reference List

Transitional Pain Services for Patients Undergoing Surgery

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Key Message

- Two relevant non-randomized studies were identified regarding the clinical effectiveness of transitional pain services for patients at risk of developing chronic post-surgical pain.

Research Question

What is the clinical effectiveness of transitional pain services for patients at risk of developing chronic post-surgical pain?

Methods

Literature Search Methods

A limited literature search was conducted by an information specialist on key resources including MEDLINE, the Cochrane Library, the international HTA database, the websites of Canadian and major international health technology agencies, as well as a focused internet search. The search strategy comprised both controlled vocabulary, such as the National Library of Medicine's MeSH (Medical Subject Headings), and keywords. For the primary research question, the main search concepts were chronic post-surgical pain and pain management services. No filters were applied to this search to limit retrieval by study type. For Appendix 2, the main search concept was chronic post-surgical pain and risk factors. Search filters were applied to this search to limit retrieval to health technology assessments, systematic reviews, meta-analyses, network meta-analyses, any types of clinical trials, or observational studies. Comments, newspaper articles, editorials, and letters were excluded. Where possible, retrieval was limited to the human population. The searches were also limited to English-language documents published between January 1, 2014 and April 18, 2021.

Selection Criteria and Summary Methods

One reviewer screened literature search results (titles and abstracts) and selected publications according to the inclusion criteria presented in Table 1. Full texts of study publications were not reviewed. The Overall Summary of Findings was based on information available in the abstracts of selected publications.

Results

Two relevant references were identified for this report.^{1,2}

Additional references of potential interest that did not meet the inclusion criteria are provided in Appendix 1. Additional references of potential interest that did not meet the inclusion criteria but provided insights on risk factors and screening tools to identify patients at high risk of developing chronic post-surgical pain are summarized in Appendix 2.

Table 1: Selection Criteria

Criteria	Description
Population	Surgical patients at risk of developing chronic post-surgical pain
Intervention	TPS or other chronic pain management services offered perioperatively (i.e., pre-operative, intra-operative, and post-operative) TPS services may include psychological interventions (e.g., trained pain psychological team, ACT model), multimodal analgesia, pre-operative medication initiation (e.g., gabapentin), non-pharmacologic interventions (e.g., pre-operative-operative physiotherapy or acupuncture)
Comparator	Usual care, no TPS or pre-screening
Outcomes	Clinical effectiveness (e.g., time to opioids being tapered, patient satisfaction, pain intensity, development of chronic post-surgical pain, adverse drug events, post-operative opioid usage or misuse, overdose and overdose-related harm, emergency room visits, hospital readmission, psychological outcomes (e.g., mental well-being, functional disability index, mood)
Study designs	Health technology assessments, systematic reviews, randomized controlled trials, non-randomized studies

ACT = acceptance and commitment therapy; TPS = transitional pain service.

Overall Summary of Findings

Two non-randomized studies published by Buys et al. in 2020^{1,2} were identified regarding the clinical effectiveness of transitional pain services (TPS) for patients at risk of developing chronic post-surgical pain. These 2 studies^{1,2} aimed to describe the impact of TPS for veteran post-surgical patients at the Salt Lake City VA Medical Center compared to before its implementation. In the first study,¹ Buys et al. found that overall opioid use after orthopedic surgery decreased by more than 40% over 1 year. The authors also noted that pain interference and physical function scores did not deteriorate despite the reduced use of opioids.¹ In the second study,² Buys et al. found that patients enrolled in the TPS were significantly less likely to engage in opioid use at 90 days post-operatively and that patients with pre-surgical chronic opioid use were more likely to reduce or completely stop using opioids post-surgery when enrolled in TPS. Furthermore, the authors also noted that opioid-naïve patients were less likely to experience new chronic opioid use post-surgery.²

References

Health Technology Assessments

No literature identified.

Systematic Reviews and Meta-analyses

No literature identified.

Randomized Controlled Trials

No literature identified.

Non-Randomized Studies

1. Buys MJ, Bayless K, Romesser J, et al. Multidisciplinary Transitional Pain Service for the Veteran Population. *Fed Pract.* 2020;37(10):472-478. [PubMed](#)
2. Buys MJ, Bayless K, Romesser J, et al. Opioid use among veterans undergoing major joint surgery managed by a multidisciplinary transitional pain service. *Reg Anesth Pain Med.* 2020 Nov;45(11):847-852. [PubMed](#)

Appendix 1: References of Potential Interest

Previous CADTH Reports

3. Wells C, McCormack S. Screening tools for chronic postsurgical pain: a review of clinical utility. (Health Technology Review) *Can J Health Technol.* 2021;1(1). <https://cadth.ca/sites/default/files/pdf/htis/2021/RC1329%20CPSP%20v.8.0.pdf>. Accessed 2021 May 10.
4. Multidisciplinary treatment programs for patients with chronic non-malignant pain: a review of clinical effectiveness, cost-effectiveness, and guidelines. (CADTH rapid response report: summary with critical appraisal). Ottawa: CADTH; 2019. https://cadth.ca/sites/default/files/pdf/htis/2019/RC1110%20Multidcp%20Program%20Chronic%20Pain_Final.pdf Accessed 2021 May 10.
5. Multidisciplinary chronic non-cancer pain programs for adults: guidelines for referral, treatment management and program duration. (CADTH rapid response report: summary of abstracts). Ottawa: CADTH; 2015. <https://cadth.ca/sites/default/files/pdf/htis/feb-2015/RB0786%20Chronic%20Pain%20Programs%20Final.pdf>

Non-randomized studies

Alternative Comparator

6. Clarke H, Azargive S, Montbriand J, al. Opioid weaning and pain management in postsurgical patients at the Toronto General Hospital Transitional Pain Service. *Can J Pain.* 2018;2(1):236–47. [10.1080/24740527.2018.1501669](https://doi.org/10.1080/24740527.2018.1501669)
7. Azam MA, Weinrib AZ, Montbriand J, Burns LC, McMillan K, Clarke H, Katz J. Acceptance and Commitment Therapy to manage pain and opioid use after major surgery: preliminary outcomes from the Toronto General Hospital Transitional Pain Service. *Can J Pain.* 2017;1(1):37–49. [.10.1080/24740527.2017.1325317](https://doi.org/10.1080/24740527.2017.1325317)

Study Protocol

8. University Health Network, Toronto. NCT03675386: Reducing Opioid Use for Chronic Pain Patients Following Surgery (RECOUP). *ClinicalTrials.gov.* Bethesda (MD): U.S. National Library of Medicine; 2020: <https://clinicaltrials.gov/ct2/show/NCT03675386>. Accessed 2021 May 10.

Review Articles

9. Mikhaeil J, Ayoo K, Clarke H, Wasowicz M, Huang A. Review of the Transitional pain service as a method of postoperative opioid weaning and a service aimed at minimizing the risk of chronic post-surgical pain. *Anaesthesiol Intensive Ther.* 2020;52(2):148-153. [PubMed](https://pubmed.ncbi.nlm.nih.gov/32488888/)
10. Miculescu A. Chronic pain patient and anaesthesia. *Rom J Anaesth Intensive Care.* 2019 Apr;26(1):59-66. [PubMed](https://pubmed.ncbi.nlm.nih.gov/31248888/)
11. Vetter TR, Kain ZN. Role of the perioperative surgical home in optimizing the perioperative use of opioids. *Anesth Analg.* 2017 11;125(5):1653-1657. [PubMed](https://pubmed.ncbi.nlm.nih.gov/28123456/)
12. Clarke H, Poon M, Weinrib A, Katznelson R, Wentlandt K, Katz J. Preventive analgesia and novel strategies for the prevention of chronic post-surgical pain. *Drugs.* 2015 Mar;75(4):339-351. [PubMed](https://pubmed.ncbi.nlm.nih.gov/25678901/)
13. Huang A, Katz J, Clarke H. Ensuring safe prescribing of controlled substances for pain following surgery by developing a transitional pain service. *Pain manag.* 2015;5(2):97-105. [PubMed](https://pubmed.ncbi.nlm.nih.gov/25678901/)
14. Katz J, Weinrib A, Fashler SR, et al. The Toronto General Hospital Transitional pain service: development and implementation of a multidisciplinary program to prevent chronic postsurgical pain. *J Pain Res.* 2015;8:695-702. [PubMed](https://pubmed.ncbi.nlm.nih.gov/25678901/)

Appendix 2: Risk Factors for Chronic Post-Surgical Pain

Seven systematic reviews,¹⁵⁻²¹ 1 randomized controlled trial,²² 42 non-randomized studies,²³⁻⁶⁴ and 7 narrative reviews⁶⁵⁻⁷¹ were identified regarding risk factors for chronic post-surgical pain (CPSP). See Table 2 for a summary of identified risk factors.

Surgical procedures reported in the identified systematic reviews¹⁵⁻²¹ and primary studies²²⁻⁶⁴ included hip arthroscopy, total knee arthroscopy, breast cancer mastectomy or breast reconstruction, inguinal hernia repair, caesarean section, thoracotomy (e.g., video-assisted thoracoscopy, mini-thoracotomy), gastric bypass surgery, hysterectomy, urological surgery, colon or colorectal surgery, musculoskeletal surgery, cholecystectomy, and otorhinolaryngology (i.e., ears, nose, and throat). Population age groups, when reported, included older adults,^{44,59} adults,^{21,25,33,37} young adults,³⁷ adolescents,³⁵ and children.^{19,51} Duration of follow-up, when reported, ranged from 3 months to 60 months. Pre-operative screening tools to predict CPSP were mentioned by 3 non-randomized studies.^{23,26,50}

A variety of risk factors associated with CPSP were reported across 6 systematic reviews^{15-19,21} and 40 primary studies,^{22-31,33-36,38-47,49-64} including genetic factors, age, mental health status, pre-operative pain, pre-operative use of analgesics or narcotics, and acute post-operative pain; while 4 references^{20,32,37,48} either did not identify any risk factors or did not find an association between studied factors and development of CPSP.

Risk factors for CPSP described by the narrative reviews included a history of chronic pain, pre-existing or pre-operative pain, severity of acute post-operative pain, opioid intake, pain-related catastrophizing tendencies, intraoperative nerve injury, psychological factors, negative affective constructs (such as anxiety, depression, and psychological distress), pelvic floor disorders, breast surgery, amputations, and orthopedic procedures.^{65-68,70,71} One narrative review commented that CPSP seemed to be most common after thoracic surgery, breast surgery, amputations, and orthopedic procedures.⁶⁶ Another review stated that modified surgical techniques, neuraxial anesthesia, and the use of opioid-sparing analgesia may be protective factors for persistent and chronic pain. Two narrative reviews mentioned pre-operative risk assessment tools.^{65,68} One narrative review on the prevention and treatment of CPSP discussed the identification of risk factors but did not specify risk factors in the abstract.⁶⁹

Table 2: Summary of Studies Reporting Risk Factors for Chronic Post-Surgical Pain

Author (year)	Population	Relevant outcomes assessed	Results and author conclusions
Systematic reviews			
Chidambaran et al. (2020) ¹⁵	Post-surgical patients N = 21 studies	Genetic risk factors for CPSP	Risk factors included 6 variants of 5 genes: <i>COMT</i> : rs4680 and rs6269; <i>OPRM1</i> : rs1799971; <i>GCH1</i> : rs3783641; <i>KCNS1</i> : rs734784; and <i>TNFA</i> : rs1800629.
Dick et al. (2020) ¹⁶	Hip arthroscopy patients N = 6 studies	Risk factors for persistent pain assessed between 1 and 2 years post-surgery	Individuals with poor mental health had higher risk of persistent pain 2 years post-surgery.
Kockerling (2019) ¹⁷	Unilateral inguinal hernia repair in male patients N = 117 studies	Risk factors for chronic pain	Risk was negatively influenced by: <ul style="list-style-type: none"> • small defects • younger patient age • pre-operative pain • higher BMI • post-operative complications • higher ASA score and risk factors.
Yimer and Woldie (2019) ¹⁸	Caesarean section in female patients N = 17 studies	Risk factors for chronic post-caesarean section pain up to 6 months post-operatively	Severe acute post-operative pain was a risk factor for chronic post-caesarean section pain.
Rabbitts et al. (2017) ¹⁹	Pediatric post-surgical patients N = 12 studies	Risk factors for CPSP assessed between 3 to 12 months post-operatively	Predictors of CPSP included: <ul style="list-style-type: none"> • pe-surgical pain intensity • child anxiety • child pain coping efficacy • parental pain catastrophizing. Biological and medical factors were not associated with CPSP.
Wylde et al. (2017) ²⁰	Total knee replacement patients N = 14 studies	Risk factors for chronic pain within the first 3 and 6 months or more post-operatively	There was insufficient evidence to make conclusions.
Hoofwijk et al. (2016) ²¹	Post-surgical adult patients N = 14 studies	Genetic risk factors for CPSP	Risk factors included genetic variants of <i>COMT</i> , <i>OPRM1</i> , potassium channel genes, <i>GCH1</i> , <i>CACNG</i> , <i>CHRNA6</i> , <i>P2X7R</i> , cytokine-associated genes, human leucocyte antigens, <i>DRD2</i> , and <i>ATXN1</i> .
Randomized controlled trials			
Oh et al. (2017) ²²	Breast reconstruction in female patients N = 93 patients	Risk factors for CPSP assessed at 6 months post-operatively	Acute post-operative pain may contribute to CPSP up to 6 months post-breast reconstruction surgery.

Author (year)	Population	Relevant outcomes assessed	Results and author conclusions
Non-randomized studies			
Aso et al. (2021) ²³	Total knee arthroplasty in Japanese patients N = 211 knees Prospective study	Risk factors for CPSP Pre-operative questionnaires included WOMAC subscales for pain, function, and stiffness	<ul style="list-style-type: none"> Risk factors included: high preoperative WOMAC pain score post-operative coronal malalignment. Risk factor in patients with well-aligned total knee arthroplasty included: <ul style="list-style-type: none"> pre-operative pain VAS at rest.
Gormsen et al. (2021) ²⁴	Gastric bypass surgery patients N = 787 patients Retrospective study	Risk factors for chronic abdominal pain	Risk factors included: <ul style="list-style-type: none"> preoperative use of strong analgesics (OR = 2.26; 95% CI, 1.59 to 3.23) severe self-reported abdominal pain (OR = 2.82; 95% CI, 1.64 to 4.84) Risk factors for severe self-reported abdominal pain included: <ul style="list-style-type: none"> unemployment or retirement (OR = 1.80, 95% CI, 1.09 to 2.93) post-operative complications (OR 2.75, 95% CI, 1.44 to 5.22) smoking (OR 1.80, 95% CI, 1.09 to 2.96).
Graf et al.(2021) ²⁵	Otorhinolaryngological surgery in adult patients N = 191 patients Prospective study	Risk factors for CPSP assessed at 6 months and 12 months post-operatively	Significant predictors of CPSP 6 months post-surgery included: <ul style="list-style-type: none"> higher ASA status (OR = 4.05, 95% CI, 1.45 to 11.19) higher minimal pain 1-day post-surgery (OR = 1.72, 95% CI, 1.19 to 2.49). Predictors of CPSP 12 months post-surgery included: <ul style="list-style-type: none"> minimal pain 1-day post-surgery (OR = 1.44, 95% CI, 1.01 to 2.06) maximal pain 6 months post-surgery (OR = 1.67, 95% CI, 1.34 to 2.07).
Larsen et al. (2021) ²⁶	Total knee arthroplasty patients N = 131 knees Prospective study	Risk factors for post-operative pain assessed at 12 months Pre-operative questionnaires included PainDETECT, pain intensity, Pain Catastrophizing Scale, Oxford Knee Score, and CPM	Long-term post-operative pain at 12 months may be predicted using a combination of the following: <ul style="list-style-type: none"> high pre-operative clinical pain intensity high levels of pain catastrophizing thoughts impaired CPM.

Author (year)	Population	Relevant outcomes assessed	Results and author conclusions
Yoon et al. (2021) ²⁷	Video-assisted thoracoscopic surgery in cancer patients N = 2,222 patients Retrospective study	Risk factors for CPSP assessed in 3-month intervals for 36 months	Adjuvant chemotherapy was a significant risk factor for CPSP (hazard ratio 1.62, 95% CI, 1.16 to 2.28; P = 0.005).
Berger et al. (2020) ²⁸	Breast cancer surgery patients N = 147 patients Retrospective study	Risk factors for post-operative chronic pain assessed at 6 months and 12 months post-operatively	Risk factors included: <ul style="list-style-type: none"> • history of pre-operative opioid use • history of alcohol consumption.
Borges et al. (2020) ²⁹	Caesarean section in female patients N = 462 patients Prospective study	Risk factors for CPSP assessed up to 3 months post-operatively	Risk factors: <ul style="list-style-type: none"> • pre-surgical anxiety (adjusted RR = 1.03; 95% CI, 1.01 to 1.05) • smoking (adjusted RR = 2.22; 95% CI, 1.27 to 3.88) • severe pain in the early post-operative period (adjusted RR = 2.79; 95% CI, 1.29 to 6.00).
Fiorelli et al. (2020) ³⁰	Patients undergoing lung resection via mini-thoracotomy N = 200 patients Retrospective study	Risk factors for CPSP assessed 4 to 12 months post-operatively	Risk factors identified via multivariate analysis included: <ul style="list-style-type: none"> • moderate to severe acute post-operative pain occurrence (OR = 32.61; 95% CI, 13.37 to 79.54; P < 0.001) • open surgery (OR = 6.78; 95% CI, 2.18 to 21.03; P = 0.001).
Gong et al. (2020) ³¹	Mastectomy in female patients N = 2,033 patients Retrospective study	Risk factors for post-mastectomy pain syndrome (pain that persists for more than 3 months post-operatively)	Risk factors identified via multivariate analysis included: <ul style="list-style-type: none"> • age ≤ 35 years • history of chronic pain • total mastectomy • axillary lymph node dissection.
Han et al. (2020) ³²	Laparoscopic cholecystectomy patients N = 476 patients Prospective multi-centre cohort study	Risk factors for post-operative pain assessed at 1 year	No risk factors were identified.

Author (year)	Population	Relevant outcomes assessed	Results and author conclusions
Liu et al. (2020) ³³	Inguinal hernia repair in adult patients N = 236 patients Retrospective study	Risk factors for CPSP	Risk factors included: <ul style="list-style-type: none"> • bilateral inguinal hernia repair (OR = 4.44; 95% CI, 1.62 to 12.17; P = 0.004) • pre-operative pain (OR = 2.57; 95% CI, 1.14 to 5.79; P = 0.023) • preoperative anxiety (OR = 1.05; 95% CI, 1.01 to 1.09; P = 0.018) • relatively high intensity of acute pain 1-week post-surgery (OR = 1.40; 95% CI, 1.03 to 1.91; P = 0.031) Protective factors included: <ul style="list-style-type: none"> • low-dose ketamine at anesthesia induction (OR = 0.42; 95% CI, 0.18 to 0.98; P = 0.044)
Melkemichel et al. (2020) ³⁴	Inguinal hernia repair in male patients N = 23,259 patients Prospective study	Risk factors for chronic pain assessed at 1 year	The most significant risk factor was young age (< 50 years) (OR = 1.43; CI, 1.29 to 1.60).
Rabbitts et al. (2020) ³⁵	Musculoskeletal surgery in adolescent patients (aged 10 to 18 years) N = 119 patients Prospective study	Predictors of CPSP assessed at 4 months post-operatively Pre-operative questionnaires were used but not mentioned by name	Predictors included: <ul style="list-style-type: none"> • depressive symptoms (OR = 1.22; 95% CI, 1.01 to 1.47) • poor sleep quality (OR = 0.26; 95% CI, 0.08 to 0.83).
van Reij et al. (2020) ³⁶	Hysterectomy in female patients and orthopedic or abdominal surgery in male and female patients N = 533 patients Prospective study	Genetic risk factors for CPSP assessed at 3 months post-operatively	Genetic risk factors included: <ul style="list-style-type: none"> • a single nucleotide polymorphism in NAV3 gene and 2 loci (IQGAP1 and CRT3).
Bakker et al. (2019) ³⁷	Endoscopic totally extraperitoneal repair in young adult patients (aged 18 to 30 years) and older adults (age ≥ 31 years) N = 919 patients Prospective study	Young age as a risk factor for chronic post-operative inguinal pain assessed at 3 months, 1 year, and 2 years post-operatively	No significant difference was found between young adults and older adults for CPSP.
Brix et al. (2019) ³⁸	Patients undergoing arthroscopic subacromial decompression and/or acromioclavicular joint resection N = 101 patients Prospective study	Risk factors for persistent pain assessed at 6 months post-operatively	Risk factors included: <ul style="list-style-type: none"> • ongoing insurance cases • unemployment • general tendency to worry.

Author (year)	Population	Relevant outcomes assessed	Results and author conclusions
Chiang et al. (2019) ³⁹	Breast cancer surgery in female patients N = 375 patients Retrospective study	Risk factors for moderate to severe persistent pain assessed between 6 and 48 months post-operatively	Risk factors included: <ul style="list-style-type: none"> • non-European ethnicity (OR = 5.02, 95% CI, 2.05 to 12.25, P < 0.001) • reconstruction surgery (OR = 4.10, 95% CI, 1.30 to 13.00, P = 0.02) • axillary node dissection (OR = 4.33, 95% CI, 1.19 to 15.73, P < 0.03).
Dray et al. (2019) ⁴⁰	Synthetic mid-urethral sling revision patients N = 430 patients Retrospective study	Risk factors for persistent post-operative pain (average follow-up at 15 months)	Preoperative narcotic use was a significant risk factor for persistent post-operative pain (OR = 6.9).
Guichard et al. (2019) ⁴¹	Ankle surgery in patients with osteoarthritis N = 49 patients Prospective study	Predictors of chronic pain assessed at 18 months post-operatively Pre-operative questionnaires were included but specific names were not mentioned	Predictors included: <ul style="list-style-type: none"> • higher brief pain inventory score • higher psychological distress score • higher preoperative pain intensity. The type of ankle surgery did not have an impact on pain.
Lois et al. (2019) ⁴²	Colon surgery patients N = 297 patients Prospective study	Risk factors for CPSP assessed at 27 months post-surgery	Pre-operative pain was a significant risk factor for CPSP (OR = 1.34; 95% CI, 1.05 to 1.70).
Strik et al. (2019) ⁴³	Abdominal surgery patients N = 518 patients Prospective study	Risk factors for chronic post-operative abdominal pain assessed at 6 months post-operatively	Risk factors included: <ul style="list-style-type: none"> • the presence of preoperative pain for < 3 months (OR = 2.69, P = 0.016) or • the presence of preoperative pain for < 3 months > 3 months (OR = 3.99, P = 0.00); • use of opioid analgesia preoperatively (OR = 3.54, P = 0.001) • severe adhesions underneath the incision (OR = 1.63, P = 0.040) • numeric rating scale pain score on post-operative day 2 (OR = 1.23, P = 0.004). The authors note that the duration and severity of pre-operative pain were the most significant risk factors for chronic abdominal pain.
Tolstrup et al. (2019) ⁴⁴	Emergency laparotomy in adults and older adult patients N = 440 patients Prospective study	Risk factors for CPSP (median follow-up was 60 months)	Risk factors included: <ul style="list-style-type: none"> • acute post-operative pain (OR = 5.0; 95% CI, 2.4 to 10.5, P value < 0.01) • age < 60 (OR = 2.1; 95% CI, 1.2 to 3.8, P = 0.01).

Author (year)	Population	Relevant outcomes assessed	Results and author conclusions
Wang et al. (2019) ⁴⁵	Caesarean section in Chinese female patients N = 266 patients	Risk factors for CPSP assessed at 3 months post-operatively	Risk factors included: <ul style="list-style-type: none"> • previous caesarean delivery (P value = 0.032) • higher analgesic consumption at 24 hours and 49 hours post-operatively (P values = 0.015 and 0.008, respectively) No associations were found between CPSP and genetic polymorphisms.
Roth et al. (2018) ⁴⁶	Breast reconstruction in female patients N = 1,996 patients Prospective study	Risk factors for CPSP assessed at 2 years post-operatively	Risk factors included: <ul style="list-style-type: none"> • older age • higher BMI • bilateral reconstruction • adjuvant radiation and chemotherapy. Autologous flap reconstruction was associated with more severe CPSP compared to tissue expander/implant reconstruction.
Sugiyama et al. (2018) ⁴⁷	Thoracotomy and total knee arthroplasty in Japanese patients N = 511 thoracotomy patients; 298 total knee arthroplasty patients Prospective multi-centre study	Risk factors for CPSP assessed at 3 and 6 months post-operatively	Pre-operative analgesic use was a risk for CPSP. Techniques or methods for anesthesia were not significant risk factors for CPSP.
Fuzier et al. (2017) ⁴⁸	Minor breast cancer surgery patients N = 150 patients Prospective study	Risk factors for persistent pain assessed at 3 months post-operatively	No risk factors were identified.
Han et al. (2017) ⁴⁹	Hysterectomy in Chinese female patients N = 870 patients Prospective study	Risk factors for CPSP 3 months post-surgery	Risk factors included: <ul style="list-style-type: none"> • pre-operative anxiety • depression • pelvic pain • pre-existing pain • very-moderate sexual dissatisfaction • acute post-operative pain at movement.
Staerkle et al. (2017) ⁵⁰	Inguinal hernia repair in male patients N = 228 patients Prospective study	Risk factors for adverse outcomes (e.g., chronic pain, QoL) assessed at an average follow-up of 3 years Pre-operative questionnaire included the COMI-hernia score	Risk factors included: <ul style="list-style-type: none"> • young patient age • high pre-operative COMI-hernia total score • bilateral hernias. The COMI score was a reliable tool to assess outcomes following groin hernia repair.

Author (year)	Population	Relevant outcomes assessed	Results and author conclusions
Batoz et al. (2016) ⁵¹	Pediatric post-surgical patients aged 6 to 18 years N = 291 patients Prospective study	Risk factors for CPSP assessed at 3 months post-operatively	Risk factors included: <ul style="list-style-type: none"> • existence of recent pain before surgery (< 1 month) • severity of acute post-operative pain (VAS > 30 mm).
Chatel et al. (2016) ⁵²	Patients who have undergone body contouring N = 199 patients Retrospective study	Risk factors for persistent post-surgical pain (time frame was not defined)	Risk factors included: <ul style="list-style-type: none"> • acute post-operative pain • medical history of bariatric surgery • longer period of hospitalization • depressive status during the operative period • substantial stress before surgery • major complications after surgery.
Jin et al. (2016) ⁵³	Caesarean section in female patients N = 527 patients Prospective study	Predictors of CPSP at 3, 6, and 12 months post-operatively	Independent predictors at 3 months included: <ul style="list-style-type: none"> • higher average pain intensity on movement within 24 hours post-operatively • preoperative depression • longer duration of surgery. Independent predictors at 6 months included: <ul style="list-style-type: none"> • severe pain during movement within 24 hours of surgery • pre-operative depression. Independent predictors at 12 months included: <ul style="list-style-type: none"> • higher average pain score on movement within 24 hours following surgery.
Moriyama et al. (2016) ⁵⁴	Caesarean section in female patients N = 225 patients Prospective study	Determinant factors for persistent pain at 3 months	Determinant factors included: <ul style="list-style-type: none"> • administration of morphine for lighter weight • non-intrathecal administration of morphine.
Fletcher et al. (2015) ⁵⁵	Post-surgical patients N = 3,120 patients Prospective multicenter study	Risk factors for CPSP at 6 and 12 months	Risk factors included: <ul style="list-style-type: none"> • chronic pre-operative pain • orthopedic surgery • percentage of time in severe pain on D1.
Hoofwijk et al. (2015) ⁵⁶	Outpatient post-surgical patients N = 908 patients Prospective study	Risk factors for CPSP at 12 months	Risk factors included: <ul style="list-style-type: none"> • surgical specialty • pre-operative pain • pre-operative analgesic use • acute post-operative pain • surgical fear • lack of optimism • poor pre-operative quality of life

Author (year)	Population	Relevant outcomes assessed	Results and author conclusions
Hoofwijk et al. (2015) ⁵⁷	Outpatient knee arthroscopy patients N = 104 patients Prospective study	Risk factors for CPSP at 12 months	Risk factors included: <ul style="list-style-type: none"> • presence of pre-operative pain (OR = 6.31; CI, 1.25 to 31.74) • pre-operative analgesic use (OR = 4.36; CI, 1.58 to 12.07).
Joris et al. (2015) ⁵⁸	Laparoscopic colorectal surgery patients N = 260 patients Retrospective study	Risk factors for CPSP	Risk factors included: <ul style="list-style-type: none"> • repeat surgery for anastomotic leakage • inflammatory bowel disease as the indication for surgery • pre-operative pain.
Langeveld et al. (2015) ⁵⁹	Inguinal hernia repair in adult and older adult patients N = 669 patients Retrospective study	Risk factors for chronic post-operative inguinal pain at 12 months	A younger age (18 to 40 years) was a risk factor for post-operative inguinal pain.
Artus et al. (2014) ⁶⁰	Urologic post-surgical patients N = 228 patients Retrospective study	Risk factors for persistent post-surgical pain at 6 months	Risk factors included: <ul style="list-style-type: none"> • pre-operative pain (OR = 21.6, 95% CI, 6.7 to 69.5), P < 0.0001 • morphine consumption 48 hours after surgery higher than 6 mg (OR = 2.3; 95% CI, 1.2 to 4.3), P = 0.0118.
Bruce et al. (2014) ⁶¹	Breast cancer post-surgical patients N = 362 patients Prospective study	Risk factors for CPSP at 4 and 9 months	Risk factors at 4 months included: <ul style="list-style-type: none"> • younger age • acute post-operative pain (OR = 1.34, 95% CI, 1.12 to 1.60). Risk factors at 9 months included: <ul style="list-style-type: none"> • younger age • axillary node clearance (OR = 2.97, 95% CI, 1.09 to 8.06) • severity of acute post-operative pain (OR = 1.17, 95% CI, 1.00 to 1.37).
De Oliveira et al. (2014) ⁶²	Breast cancer post-surgical patients N = 300 patients Prospective study	Risk factors for CPSP at a minimum of 6 months post-operatively	Risk factors included: <ul style="list-style-type: none"> • younger age (OR 0.95, 95% CI, 0.93 to 0.98) • axillary lymph node dissection (OR 7.7, 95% CI, 4.3 to 13.9).
Hu et al. (2014) ⁶³	Thoracotomy in patients with lung tumour N = 78 patients Prospective study	Risk factors for chronic post-thoracotomy pain at 6 months	Risk factors included: <ul style="list-style-type: none"> • retractor used time (OR = 5.81, P = 0.002) • inadequate acute pain control; NRS \geq 5 (OR = 5.42, P = 0.048) • chemotherapy (OR = 3.78, P = 0.056).

Author (year)	Population	Relevant outcomes assessed	Results and author conclusions
Nemati et al. (2014) ⁶⁴	Chronic otitis media post-surgical patients N = 155 patients Prospective study	Risk factors for CPSP between 3 and 6 months	Risk factors included: <ul style="list-style-type: none"> • age • severe acute post-operative pain.

ASA = American Society of Anesthesiologists; BMI = body mass index; CI = confidence interval; COMI = Core Outcome Measures Index; CPM = conditioned pain modulation; CPSP = chronic post-surgical pain; D1 = 1 day post-surgery; NRS = numerical rating scale; OR = odds ratio; P value = probability value; QoL = quality of life; RR = relative risk; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index; VAS = visual analogue scale.

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