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Prevalence of postoperative pain after hospital discharge: systematic review and meta-analysis

Rex Park[a], Mohammed Mohiuddin[a], Ramiro Arellano[a], Esther Pogatzki-Zahn[b], Gregory Klar[a], Ian Gilron[a,c,d,e,*]

Abstract

Assessment and management of postoperative pain after hospital discharge is very challenging. We conducted a systematic review to synthesize available evidence on the prevalence of moderate-to-severe postoperative pain within the first 1 to 14 days after hospital discharge. The previously published protocol for this review was registered in PROSPERO. MEDLINE and EMBASE databases were searched until November 2020. We included observational postsurgical pain studies in the posthospital discharge setting. The primary outcome for the review was the proportion of study participants with moderate-to-severe postoperative pain (eg, pain score of 4 or more on a 10-point Numerical Rating Scale) within the first 1 to 14 days after hospital discharge. This review included 27 eligible studies involving a total of 22,108 participants having undergone a wide variety of surgical procedures. The 27 studies included ambulatory surgeries (n = 19), inpatient surgeries (n = 1), both ambulatory and inpatient surgeries (n = 4), or was not specified (n = 3). Meta-analyses of combinable studies provided estimates of pooled prevalence rates of moderate-to-severe postoperative pain ranging from 31% 1 day after discharge to 58% 1 to 2 weeks after discharge. These findings suggest that moderate-to-severe postoperative pain is a common occurrence after hospital discharge and highlight the importance of future efforts to more effectively evaluate, prevent, and treat postsurgical pain in patients discharged from the hospital.

Keywords: Acute pain, Postoperative pain, Postsurgical pain, Epidemiology, Systematic review

1. Introduction

Global surgery volumes are growing, with ~312.9 million operations performed in 2012.[47] Based on in-hospital data, up to 80% of patients experience postsurgical pain, with >70% as moderate to severe.[2] Various clinical advances and institutional changes are resulting in shorter postsurgical hospital stays.[9,10] Shorter hospital stays shift the onus of pain management from hospital staff to the patient and their home caregivers. However, discharge instructions to patients may be inadequate or forgotten by the patient, potentially explaining reports of higher pain levels postdischarge vs in hospital.[9]

Postsurgical analgesia is imperative for functional recovery, and poorly controlled pain results in personal suffering and contributes to cardiorespiratory complications.[5] Such complications increase economic burden of hospital readmissions, emergency room visits, and caregiver burden.[32] Furthermore, undertreated acute pain is associated with an increased risk of chronic postsurgical pain (CPSP).[20] Chronic postsurgical pain affects 10% to 40% of patients, with a growing impact given rising surgical volumes.[41] Chronic postsurgical pain is associated with high symptom burden and large economic impact.[21]

Managing postoperative pain after hospital discharge incorporates managing the adverse effects of analgesic treatments and minimizing other risks, such as persistent opioid use.[41] In addition to acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), and regional analgesia, opioids are the mainstay of postoperative pain management after discharge.[49] Adverse effects of commonly used nonopioids necessitate careful prescribing and may limit their use as opioid-sparing analgesics.[49] Regional analgesia, on the

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[a] Department of Anesthesiology and Perioperative Medicine, Queen's University, Kingston, Canada, [b] Department of Anesthesiology, Critical Care Medicine and Pain Therapy, University Hospital Muenster, Muenster, Germany, [c] Department of Biomedical and Molecular Sciences, Queen's University, Kingston, Canada, [d] Centre for Neuroscience Studies, Queen's University, Kingston, Canada, [e] School of Policy Studies, Queen's University, Kingston, Canada

**Corresponding author. Address: Department of Anesthesiology and Perioperative Medicine, Kingston General Hospital, Queen's University, Kingston, ON K7L2V7, Canada. Tel.: 16135487827. E-mail address: gilroni@queensu.ca (I. Gilron).*

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other hand, is often limited by their short duration. Postsurgical data suggest that opioids are frequently prescribed in excess, with potentially inadequate follow-up.[21] This is concerning given reports of high rates of persistent opioid use after surgery.[13,24] Since perioperative clinicians may have limited follow-up with their postoperative patients and general practitioners may be uncomfortable managing complex postsurgical patients while they are recovering at home, the early postdischarge postoperative period may be a vulnerable period, leaving patients' pain inadequately managed.

Appropriate pain management for surgical patients after hospital discharge gets little attention yet is critical in a patient's healing trajectory. Most studies focusing on postoperative pain have been conducted on patients before discharge, whereas the period after discharge seems to be much less investigated. To the best of our knowledge, no previous systematic reviews have been conducted investigating the issue of postoperative pain after hospital discharge. Thus, this systematic review aims to investigate this period for patients in regard to postoperative pain to quantify the extent of this problem and identify future research and clinical needs.

The objective of this review is to provide an up-to-date synthesis of available evidence on the prevalence of moderate-to-severe postoperative pain within the first 1 to 14 days after hospital discharge and compare the findings in patients who undergo ambulatory surgery (same day) with those having inpatient surgery (at least 1-night hospital stay).

2. Methods

2.1. Guidelines

The review protocol has been previously published,[36] registered in the International Prospective Register of Systematic Reviews (PROSPERO) database (registration number CRD42020194346), and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) checklist.[34] The systematic review is performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines[33] and the Meta-analyses Of Observational Studies in Epidemiology (MOOSE) checklist.[42]

2.2. Sources of evidence

We conducted a detailed search on MEDLINE and EMBASE from their inception until November 2020. The search included terms relating to postoperative pain, the time frame after hospital discharge, and search filters for epidemiological studies. The search strategies were developed in consultation with a librarian with expertise in literature searches. The search strategy for MEDLINE is shown in Appendix 1 (available as supplemental digital content at http://links.lww.com/PR9/A193). We also reviewed the bibliographies of any studies identified for relevance.

2.3. Types of studies

The review included observational studies of postsurgical patients as study participants that assessed postoperative pain at home, or other nonhospital settings, after hospital discharge.

2.4. Types of participants

We included studies with adult participants (eg, aged 18 years and older) who underwent a surgical procedure.

2.5. Data collection, extraction, and management

Two trained reviewers (R.P. and M.M.) independently evaluated studies for eligibility. Screening was performed on titles and abstracts using Covidence software.[14] Citations were stored in EndNote software (Clarivate Analytics, London, United Kingdom). Full-text screening was performed on citations deemed to be potentially eligible. Disagreements between reviewers was resolved by discussion and consensus, and if necessary, a third reviewer was consulted (I.G.).

Data from included studies were extracted using standardized extraction forms specifically designed for this review. These forms captured information about the surgical procedure, total number of participants before and after dropouts, patient inclusion and exclusion criteria, patient characteristics, time points for pain intensity measurements, primary and secondary outcome measures, and other study characteristics.

2.6. Primary outcome

The primary outcome of this review is the proportion of patients reporting moderate-to-severe postoperative pain at rest or with movement, or both, within the first 1 to 14 days after hospital discharge. We chose this time frame because the first 2 weeks after surgery are most commonly associated with pain of the highest severity and most functional consequences. We preferentially used 4/10 (Numerical Rating Scale), 40/100 (Visual Analog Scale), or ≥moderate pain (category scale) as the threshold for moderate pain. If those specific data were not available and if a study provided pain prevalence estimates using their own definition of moderate pain (eg, fair pain), we used the data as provided, but these prevalence estimates were not included in pooled analyses.

2.7. Secondary outcomes

Our secondary outcomes for this review are (1) a comparison of the proportion of participants reporting moderate-to-severe postoperative pain within the first 1 to 14 days after discharge between those who underwent ambulatory surgery (same day) and those who underwent inpatient surgery (at least 1-night hospital stay) and (2) adverse outcomes experienced by participants within the first 1 to 14 days after discharge that are attributable to poor pain control, including readmission to hospital, emergency room, or other unplanned medical visits, and decreased quality of life.

2.8. Analysis of outcomes

Only similar studies (eg, outcomes measured, similar postoperative days when outcomes were measured) were combined for analysis. Extracted data were recorded in Microsoft Excel for analysis. Analyses were performed using Comprehensive Meta-Analysis Version 3 software. We used a random-effects model for meta-analysis to calculate prevalence estimates if deemed appropriate to combine studies. Prevalence estimates were reported using the event rate. The 95% confidence intervals (CIs) were calculated using standard error and sample size.

We assessed statistical heterogeneity using the I^2 statistic.

If inappropriate to combine studies, a descriptive approach was used to report the primary and secondary outcomes.

2.9. Assessment of risk of bias in included studies

Risk of bias for each study was independently assessed by 2 reviewers (R.P. and M.M.). We used the risk-of-bias tool for

prevalence studies developed by Hoy et al.,[23] which includes 10 items plus a summary assessment. Items 1 to 4 assess the external validity of the study, and items 5 to 10 assess the internal validity. Disagreements between reviewers were resolved with discussion and consensus. If necessary, a third reviewer (I.G.) was consulted.

3. Results

Our search yielded 8626 citations. After removal of duplications, 8499 studies were reviewed for title and abstract screening. We identified 72 relevant records for full-text screening and excluded 45 studies (**Fig. 1**). Twenty-seven studies fulfilled the inclusion criteria and were included into the systematic review.

3.1. Study characteristics

Table 1 displays the characteristics of the included studies, including study size, participant age range, surgery type, ambulatory vs inpatient setting, postoperative time points at which pain was assessed, and pain prevalence estimates. The 27 studies enrolled a total of 22,108 participants from: studies involving mixtures of different surgical procedures (n = 20 studies),[2–4,6,7,11,16–18,22,26,28,30–32,35,37,40,45,46] total knee replacement (n = 2 studies),[8,9] sternotomy (n = 1 study),[44] laparoscopic surgery (n = 1 study),[48] cataract surgery (n = 1 study),[39] orthopedic surgery (n = 1 study),[43] and routine dentoalveolar surgery (n = 1 study).[25] The 27 studies included ambulatory surgeries (n = 19),[3,4,7,11,16,17,22,25,26,28,30–32,35,37,39,40,46,48] inpatient surgeries (n = 1),[6] mixtures of both inpatient and ambulatory surgeries (n = 4),[2,18,43,45] or was not specified (n = 3).[8,9,44] Only one study specified whether the pain being assessed was at rest or with movement.[16]

3.2. Risk-of-bias assessment

The results of each individual risk-of-bias domain are presented as a risk-of-bias table in **Table 2**. Twelve studies were judged to be at a high or unclear risk of bias for sample selection, and 7 studies were judged to be at a high or unclear risk of nonresponse bias. Overall, 19 studies were judged to be low risk of bias, 7 to be moderate risk of bias, and 1 to be high risk of bias.

3.3. Primary outcome—qualitative synthesis

3.3.1. Day 1

Fourteen studies reported the prevalence of moderate-to-severe pain 1 day after discharge.[3,4,7,11,16,22,25,28,30,31,35,37,39,48] The prevalence ranged from 7% to 60%. The 2 studies with the lowest prevalence were after cataracts (7%)[39] and routine dentoalveolar surgery (8.7%).[25] The remaining 12 studies included participants that underwent a mixture of surgeries.[3,4,7,11,16,22,28,30,31,35,37,48] The prevalence of moderate-to-severe pain in these groups ranged from 13% to 66%. Only one of these studies reported pain at rest vs movement.[16] Of the 300 participants after day-case surgery, the prevalence of moderate-to-severe postoperative pain was 25.3% and 41.3% at rest and on movement, respectively.[16]

One study reported only the prevalence of very severe pain (pain score of 9 or 10 of 10), rather than moderate-to-severe.[26] This study included participants that underwent orthopedic lower limb, hand, and general surgery and found that 4.5% of participants rated their average pain as very severe.

3.3.2. Day 2

Eight studies reported the prevalence of moderate-to-severe or severe pain 2 days after discharge.[4,7,17,22,25,32,35,40] The prevalence ranged from 6.2% to over 51%. The lowest prevalence followed routine dentoalveolar surgery.[25]

Two studies reported the prevalence of only severe pain 2 days after discharge.[17,32] The prevalence of the first study was 51% following a variety of minor and intermediate procedures.[17] The prevalence of the second study was 21% following a variety of surgical procedures.[32]

3.3.3. Weeks 1 to 2

Eleven studies reported the prevalence of moderate-to-severe pain after 1 to 2 weeks after discharge.[2,6–9,18,30,39,43–45] The prevalence ranged from 2% to 92%. Specifically, 2 studies that included knee replacement participants reported a prevalence of 92% and 58%.[8,9] Another study that included orthopedic surgery reported a prevalence of 43.6%.[43] One study specifically included cataract surgery,[39] and another study specifically

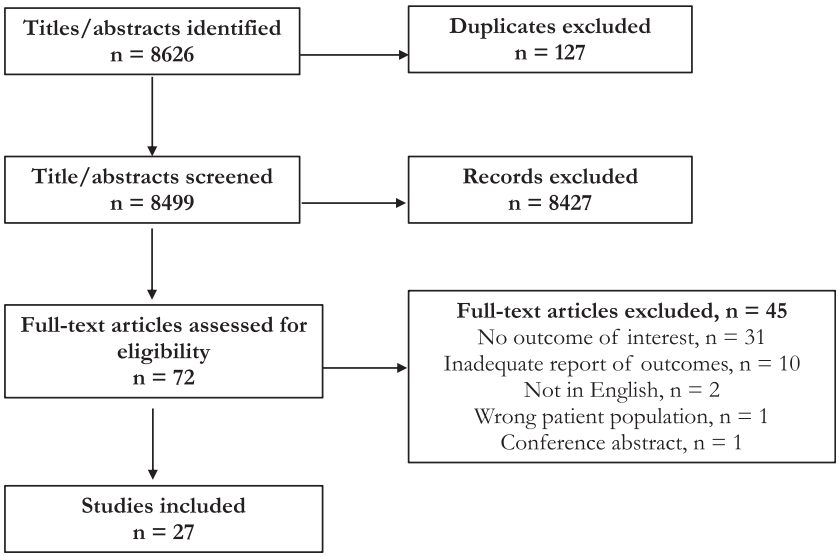

Figure 1. PRISMA flow diagram. PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

Table 1

Summary of included studies.

Author, y	Study size (dropouts or nonparticipants)	Age range or mean (SD)	Surgery type	Ambulatory or inpatient	Timepoint after discharge	Prevalence of moderate-to-severe pain	95% CI (%)
Apfelbaum, 2003[2]	n = 250 (unclear)	Median: 46	Various (not specified)	Both	First 2 wk	81%	75.7–85.4
Bain, 1999[3]	n = 5069 (1661)	Not reported	Various General surgery, urology, gynecology, orthopedics, ENT, and ophthalmology	Ambulatory	Day 1	26% (19% reported "fair amount of pain" and 7% reported "a lot of pain")	24.5–27.5
Beauregard, 1998[4]	n = 89 (11)	39.6 (8.9)	Knee arthroscopy (47%), laparoscopy (39%), carpal tunnel decompression (8%), and shoulder arthroscopy (6%)	Ambulatory	Day 1 Day 2 Week 1	Day 1: 40% Day 2: 24% Week 1: 13%	30.4–50.5 16.3–33.9 7.5–21.7
Buvanendran, 2015[6]	n = 441 (85 by week 1, 244 by week 2)	Not reported	Various Orthopedic (43%), general (34%), neurosurgery (13%), and gynecological (10%)	Inpatient	First 2 wk	46%	41.4–50.7
Campagna, 2016[7]	n = 276 (unclear)	56.1 (14.2)	Various Orthopedic and general	Ambulatory	Day 1 Day 2 Week 1	Day 1: 51% Day 2: 38% Week 1: 9%	45.1–56.9 32.5–43.9 6.1–13.0
Chan, 2013[9]	n = 171 (3)	65 (6.2)	Total knee arthroplasty	Unspecified	First 2 wk	92%	86.9–95.2
Chan, 2013–2[8]	n = 105 (7)	64.7 (7.2)	Total knee arthroplasty	Unspecified	First 2 wk	58%	48.4–67.0
Chung, 1997[11]	n = 3729 (6279)	46 (21)	Various Orthopedic, urology, general, plastics, neurosurgery, ENT/dental, and ophthalmology	Ambulatory	Day 1	26.1%	24.7–27.5
Elaqoul, 2017[16]	n = 300 (12)	18–80	Various Port catheter insertion, cystoscopy, breast mass excision, biopsy, hysteroscopy, port catheter removal, laryngoscopy, wider excision and nasal flap, excision and reconstruction of eyelid, and bone marrow aspiration	Ambulatory	Day 1	25.3% (on rest) 41.3% (on movement)	20.7–30.5 35.9–47.0
Fadiora, 2007[17]	n = 102 (unclear)	1 mo—83	Minor and intermediate procedures Minor: excisional biopsy (29.4%), incisional biopsy for breast malignancy (9.8%), bouginage for urethral stricture (8.8%), and circumcision (2%) Intermediate: inguinal herniorrhaphy (31.4%), hydrocelectomy (6.9%), inguinal herniotomy (5.9%), umbilical hernia repair (2%), varicocelectomy (2%), and epigastric hernia repair (2%)	Ambulatory	First 48 h	51% of participants rated their pain as severe	41.4–60.5
Gan, 2014[18]	n = 225 (75)	Not reported	Various (not specified)	Both	First 2 wk	73.6%	67.5–78.9
Gramke, 2007[22]	n = 648 (77)	Not reported	Various General, orthopedics, ophthalmology, plastics, gynecology, ENT, urology, and oral	Ambulatory	Day 1 Day 2 Day 3 Day 4	Day 1: 21% Day 2: 10% Day 3: 10% Day 4: 9%	18.0–24.3 7.9–12.6 7.9–12.6 7.0–11.5

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Table 1 (*continued*)

Summary of included studies.

Author, y	Study size (dropouts or nonparticipants)	Age range or mean (SD)	Surgery type	Ambulatory or inpatient	Timepoint after discharge	Prevalence of moderate-to-severe pain	95% CI (%)
Joshi, 2000[25]	n = 161 (13)	14–61	Routine dentoalveolar surgery (age range: 14–61)	Ambulatory	Day 1 Day 2	Day 1: 8.7% Day 2: 6.2%	5.3–13.9 3.4–10.9
Kangas-Saarela, 1999[26]	n = 203 (10)	16–57	Various Orthopedic lower limb (65%), hand surgery (11%), and general surgery (24%)	Ambulatory	Day 1	4.5% rated their average pain as very severe	2.4–8.4
Kemper, 2002[28]	n = 93	60–84	Various Hernia (25%), hand (16%), laparoscopic cholecystectomy (15%), TURP (13%), rectal (7%), foot (7%), arthroscopic knee (5%), shoulder/elbow (5%), and others (7%)	Ambulatory	Day 1	66% rated their worst pain at a level of 5 or above	55.8–74.9
Mattila, 2005[30]	n = 2144 (unclear)	15–86	Various Orthopedics, ENT, gynecology, gastroenterological, vascular, other general, pediatric surgery, urology, neurosurgery, dental, and ophthalmology	Ambulatory	Day 1 Day 3 Day 7	Day 1: 18% Day 3: 6% Day 7: 2%	16.4–19.7 5.1–7.1 1.5–2.7
McGrath, 2004[31]	n = 5703 (3787)	Not reported	Various Neurosurgery, general, orthopedic, hand, plastics, nerve block, urology, gynecology, and ophthalmology	Ambulatory	Day 1	29.50%	28.3–30.7
McHugh, 2002[32]	n = 102 (8)	17–71	Various Laparoscopy (31%), dental extractions (23%), vasectomy (13%), hernia repair (10%), arthroscopy (8%), cyst removal (4%), and others (11%)	Ambulatory	Day 2 Day 4	Severe pain was reported for 21% of participants at day 2 and 7% of participants at day 4	Day 2: 14.2–30.0 Day 4: 3.4–13.9
Mwaka, 2013[35]	n = 147 (3)	18–68	Various General (41.3%), gynecology (34%), urology (8%), ophthalmology (6.6%), orthopedics (5.3%), maxillofacial (2.6%), pain management (1.3%), and ENT (0.7%)	Ambulatory	Day 1 Day 2	Day 1: 13% Day 2: 11.7%	8.5–19.5 7.4–18.0
Pavlin, 2004[37]	n = 175 (19)	42 (not reported)	Various Knee arthroscopy (28.6%), inguinal hernia repair (14.3%), pelvic laparoscopy (14.3%), transvaginal uterine surgery (14.3%), surgery for breast disease (14.3%), and plastics (14.3%)	Ambulatory	Day 1	60%	52.6–67.0
Porela-Tiihonen, 2013[39]	n = 201 (5)	40–91	Cataract surgery	Ambulatory	Day 1 Day 7	Day 1: 7% Day 7: 5%	4.2–11.5 2.7–9.0
Serra, 2016[40]	n = 1128 (unclear)	15–87	Patients who were prescribed home-based continuous IV analgesia Foot surgery (38.2%), hand (13.1%), knee (13.9%), shoulder (18.6%), anorectal (10.9%), and others (5.2%)	Ambulatory	First 48 h	9%	7.5–10.8
Veal, 2015[43]	n = 87 (14)	Not reported	Orthopedic surgery	Both	Day 10	43.6%	33.6–54.1
Veal, 2016[44]	n = 110 (12)	69.6 (not reported)	Sternotomy	Inpatient	Day 10	30%	22.2–39.2

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Table 1 (continued)

Summary of included studies.

Author, y	Study size (dropouts or nonparticipants)	Age range or mean (SD)	Surgery type	Ambulatory or inpatient	Timepoint after discharge	Prevalence of moderate-to-severe pain	95% CI (%)
Veal, 2017[45]	n = 169 (331)	18–92	Various Head, MSK, open abdominal/genitourinary, laparoscopic abdominal/genitourinary, washout/debridement of wound, and cardiothoracic	Both	Day 7	47.3%	39.9–54.8
Watt-Watson, 2004[46]	n = 180 (unclear)	42 (15)	Hand (43.3%), laparoscopic cholecystectomy (30%), and shoulder (26.7%)	Ambulatory	Day 7	At day 7, the worst pain in the previous 24 h was reported as severe by 31% of hand patients, 55% of shoulder patients, and 8% of laparoscopic cholecystectomy patients	Hand: 21.8–42.1 Shoulder: 40.9–68.3 Laparoscopic cholecystectomy: 3.2–18.9
Willsher, 1998[48]	n = 100 (unclear)	45 (not reported)	Laparoscopic surgery Cholecystectomy (60%), groin hernia repair (36%), diagnostic laparoscopy (3%), and excision of a varicocele (1%)	Ambulatory	Day 1	Day 1 incisional pain: 40%	30.9–49.9

ENT, Ear, Nose, Throat; MSK, musculoskeletal; TURP, transurethral resection of the prostate.

included sternotomy surgeries,[44] and they found the prevalence to be 5% and 30%, respectively. The remainder of the studies included participants who underwent a variety of different surgeries and procedures.

One study reported worst pain rather than moderate-to-severe pain. This study found that the worst pain was severe for 31%, 55%, and 8% of participants who underwent hand surgery, shoulder surgery, and laparoscopic cholecystectomy, respectively.[46]

3.4. Primary outcome—quantitative synthesis

Table 3 provides the results of pooled prevalence rates. Although several studies assessed our primary outcome, some studies could not be included for pooling due to differences in pain reporting (eg, only reporting severe rather than moderate-to-severe pain), patient population and type of surgery, and prescribed home analgesia. There was a sufficient number of similar studies that evaluated postoperative pain 1 day after discharge and 1 to 2 weeks after discharge. Meta-analysis could not be performed on other timepoints due to insufficient number of studies.

3.4.1. Day 1

Nine studies with a combined population of 13,011 were pooled for postoperative pain 1 day after discharge.[7,11,22,30,31,35,37,43,48] All these studies involved ambulatory surgeries including orthopedic, general, urology, gynecology, vascular, neurosurgery, plastic, otolaryngology, ophthalmology, and oral surgery. The random-effects pooled prevalence for this timepoint was 31.5% (95% CI 25.5–37.9, $I^2 = 97.35$).

3.4.2. Weeks 1 to 2

Ten studies with a combined population of 3978 were pooled for postoperative pain 1 to 2 weeks after discharge.[2,6–9,18,30,43–45] These studies involved both ambulatory and inpatient surgeries including orthopedic, general, neurosurgery, gynecology, urology, and cardiothoracic surgery. The random-effects pooled prevalence for this timepoint was 44.1% (95% CI 21.5–69.4, $I^2 = 99.05$).

3.5. Secondary outcomes

3.5.1. Ambulatory vs inpatient surgery

Studies that evaluated postoperative pain 1 day after discharge included only ambulatory surgeries. However, among the studies that evaluated postoperative pain weeks 1 to 2 after discharge, 4 studies included pain data for ambulatory surgeries[2,7,18,30] and 4 studies included pain data for inpatient surgeries.[2,6,18,44] The remainder of the studies did not report separate pain scores for those who underwent ambulatory surgery vs those who underwent inpatient surgery. As such, 2 pools of 4 studies each were deemed appropriate for meta-analysis (**Table 3**).

The random-effects pooled prevalence for postoperative pain weeks 1 to 2 after discharge for ambulatory surgery was 29.0% (95% CI 2.6–86.1, $I^2 = 99.51$).

The random-effects pooled prevalence for postoperative pain weeks 1 to 2 after discharge for inpatient surgery was 58.0% (95% CI 36.8–76.7, $I^2 = 96.38$).

3.5.2. Adverse outcomes attributable to poor pain control

The adverse events that participants experienced were inconsistently reported and any meaningful statistical analyses

Table 2

Risk of bias assessments for included studies.

Author, y	Was the study's target population a close representation of the national population in relation to relevant variables?	Was the sampling frame a true or close representation of the target population?	Was some form of random selection used to select the sample, or was a census undertaken?	Was the likelihood of nonresponse bias minimal?	Were data collected directly from the subjects (as opposed to a proxy)?	Was an acceptable case definition used in the study?	Was the study instrument that measured the parameter of interest shown to have validity and reliability?	Was the same mode of data collection used for all subjects?	Was the length of the shortest prevalence period for the parameter of interest appropriate?	Were the numerator(s) and denominator(s) for the parameter of interest appropriate?	Summary item on the overall risk of study bias
Apfelbaum, 2003[2]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Bain, 1999[3]	Low	Low	High	Low	Low	Low	High	Low	Low	Low	Moderate
Beauregard, 1998[4]	Low	Low	High	Low	Low	Low	Low	Low	Low	Low	Low
Buvanendran, 2015[6]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Campagna, 2016[7]	Low	Low	High	High/Unclear	Low	Low	Low	Low	Low	Low	Moderate
Chan, 2013[9]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Chan, 2013–2[8]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Chung, 1997[11]	Low	Low	Low	High	Low	Low	Low	Low	Low	Low	Low
Elaqoul, 2017[16]	Low	Low	High	Low	Low	Low	Low	Low	Low	Low	Low
Fadiora, 2007[17]	High	Low	High	Low	Low	High/unclear	Low	Low	Low	Low	High
Gan, 2014[18]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Gramke, 2007[22]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Joshi, 2000[25]	Low	Low	High/unclear	Low	Low	Low	Low	Low	Low	Low	Low
Kangas-Saarela, 1999[26]	Low	Low	Low	Low	Low	High/unclear	Low	Low	Low	Low	Low
Kemper, 2002[28]	Low	Low	High	High/unclear	Low	Low	Low	Low	Low	Low	Moderate
Mattila, 2005[30]	Low	Low	Low	High	Low	Low	Low	Low	Low	Low	Low
McGrath, 2004[31]	Low	Low	Low	High	Low	Low	Low	Low	Low	Low	Low
McHugh, 2002[32]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Mwaka, 2013[35]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Pavlin, 2004[37]	Low	Low	High	Low	Low	Low	Low	Low	Low	Low	Moderate

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Table 2 (continued)

Risk of bias assessments for included studies.

Author, y	Was the study's target population a close representation of the national population in relation to relevant variables?	Was the sampling frame a true or close representation of the target population?	Was some form of random selection used to select the sample, or was a census undertaken?	Was the likelihood of nonresponse bias minimal?	Were data collected directly from the subjects (as opposed to a proxy)?	Was an acceptable case definition used in the study?	Was the study instrument that measured the parameter of interest shown to have validity and reliability?	Was the same mode of data collection used for all subjects?	Was the length of the shortest prevalence period for the parameter of interest appropriate?	Were the numerator(s) and denominator(s) for the parameter of interest appropriate?	Summary item on the overall risk of study bias
Porela-Tiihonen, 2013[39]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Serra, 2016[40]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Veal, 2015[43]	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low	Low
Veal, 2016[44]	Low	Low	High/unclear	Low	Low	Low	Low	Low	Low	Low	Low
Veal, 2017[45]	Low	Low	High/unclear	High	Low	Low	Low	Low	Low	Low	Moderate
Watt-Watson, 2004[46]	Low	Low	High	High/unclear	Low	Low	Low	Low	Low	High	Moderate
Willsher, 1998[48]	Low	Low	High	Low	Low	High/unclear	Low	Low	Low	Low	Moderate

could not be performed. After discharge from a variety of ambulatory surgeries, included studies found 0%,[4,17] 0.02%,[31] and 0.16%[11] required readmission due to pain. One study found that 0.26% of participants required emergency room visit due to pain,[31] whereas another study found that 2.48% of participants required additional contact with a medical worker due to pain.[30] One study that included participants that underwent outpatient laparoscopic surgeries found 3% of patients needed to contact a doctor due to pain, but no participants required readmissions.[48] After a variety of both ambulatory and inpatient surgeries, up to 14.7%,[17] 21%,[28] 43%,[37] and 69.3%[43] experienced sleep disturbances as a result of pain.

4. Discussion

This systematic review included 27 studies (22,108 participants) that estimated the prevalence of postoperative pain 1 to 14 days after hospital discharge. Meta-analyses of combinable studies provided pooled prevalence rates of moderate-to-severe postoperative pain ranging from 31% 1 day after discharge to 58% 1 to 2 weeks after discharge. For pain assessed between 1 and 2 weeks after hospital discharge, stratified analyses suggest that pain prevalence after inpatient surgery (involving at least one night of hospital stay—58%) is considerably higher than pain prevalence after ambulatory surgery (involving same day hospital discharge—29%). This suggests that at least 1 in every 3 adults experience moderate-to-severe pain on their first day home after surgery and even more in the following weeks. Given that surgical procedures requiring hospital admission are likely to be associated with a greater degree of surgical tissue injury, it is perhaps not surprising that posthospital discharge pain prevalence is higher after inpatient compared with ambulatory surgery.

Careful review of these included studies points to some limitations of this body of evidence and highlights future research and clinical needs in this area. First, the great majority of studies included in this review involve a mixture of different surgical procedures. Therefore, the pain prevalence estimates reported in most studies and, in this review, are not specific enough to guide treatment decisions or treatment strategies for any one specific surgical procedure. Despite this, however, these global pain prevalence estimates are indeed important for highlighting the overall magnitude of this problem and should be used to inform health policy decisions to allocate resources for improved assessment and treatment of postoperative pain after hospital discharge. Second, pain assessment methods (eg, Visual Analog Scale vs Numerical Rating Scale), timepoints (eg, same postoperative day and same time of day) and postoperative pain assessment conditions (eg, pain at rest vs pain during/after movement) are seen to vary widely across included studies and thus limit the precision of pain prevalence estimates. This may, in part, explain the high I^2 statistics for our pooled estimates and also why prevalence estimates from included studies are seen to vary from as low as 2% to 6% (eg, after dental or cataract surgery) up to as high as 92% (eg, after knee arthroplasty). That being said, only 6 to 8 of the 27 included studies reported pain prevalence considerably lower than 30%, thus suggesting that our pooled prevalence rates of 31% to 58% are unlikely to be overestimated.

The magnitude of our pooled prevalence estimates suggests, in the least, that postoperative moderate-to-severe pain after hospital discharge is a common occurrence and, at most, that this is a substantial public health problem that requires more aggressive clinical and health policy attention. The well recognized and worsening epidemic of opioid oversupply and overuse in several parts of the world has highlighted the need for more

Table 3

Pooled and stratified prevalence of acute moderate-to-severe postoperative pain after discharge in adults.

Analysis group	No. of studies (total number of participants)	Prevalence % (95% CIs)	I^2
Moderate-to-severe postoperative pain 1 d after discharge	9 (n = 13,011)	31.5 (25.5–37.9)	97.35
Moderate-to-severe postoperative pain 1–2 wk after discharge	10 (n = 3978)	44.1 (21.5–69.4)	99.05
Moderate-to-severe postoperative pain 1–2 wk after discharge: ambulatory surgery only	4 (n = 2695)	29.0 (2.6–86.1)	99.51
Moderate-to-severe postoperative pain 1–2 wk after discharge: inpatient surgery only	4 (n = 826)	58.0 (36.8–76.7)	96.38

95% CI, 95% confidence interval.

rational and closely monitored prescribing of opioids in the postoperative period.[1,13] As such, a "one-size-fits-all" approach is likely inadequate because, on the one hand, global overprescribing of opioids increases the risk of opioid toxicity, overuse, and development of long-term opioid use or misuse,[13] and on the other hand, global underprescribing will lead to poorly managed pain.[2] Therefore, reliance on multimodal and regional analgesics as well as closer patient monitoring with an individualized approach (eg, nurse-led follow-up service)[12] may provide more effective pain management with fewer outcomes. Also, recognition of and research into chronic postsurgical pain as an important complication of surgery has revealed the association between poorly controlled acute postoperative pain and the development of chronic postsurgical pain[19–21,27] and, further, pointed to the need to follow surgical patients after hospital discharge to identify those at risk of developing this devastating complication.[24] The development and implementation of "early postoperative" follow-up pain services could coordinate with emerging "transitional pain services"[24] to identify patients who require more careful pain assessment and treatment.

Results from this review point to some possible future directions for this area of research. First, given ongoing changes to postoperative pain management, including a growing rate of outpatient procedures, increased use of regional analgesic techniques, and more judicious opioid prescribing point to the need for new updated pain prevalence studies. As discussed above, such new studies should follow a standardized framework for pain assessment methods, timepoints, and pain conditions such that results can be more reliably pooled across different studies. Here, the assessment of outcome beyond pain intensity, including pain-related (impairment) of physical function or self-efficacy, is relevant to estimate how pain affects recovery and quality of life after surgery.[38] The need for larger scale epidemiological studies that may provide more accurate prevalence estimates could be addressed through the use of postoperative pain registries.[15,29]

In conclusion, our findings suggest that moderate-to-severe postoperative pain is a common occurrence after hospital discharge and highlight the importance of future research to more effectively evaluate, prevent, and treat postsurgical pain in patients recovering at home.

Disclosures

The authors have no conflict of interest to declare.

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Appendix A. Supplemental digital content

Supplemental digital content associated with this article can be found online at http://links.lww.com/PR9/A193.

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