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Review Article

Overview of Pain Interventions for Hospital and Community Care Nurses: A Systematic Scoping Review

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Abstract

Objective: Identifying the scope of pain interventions executed by nurses for adult patients in hospital and community care settings. This endeavour should help to formulate evidence-based recommendations for this nursing-sensitive outcome.

Background: In health care settings, patients are prone to experience pain. Nurses play a vital role in pain prevention and treatment and make patients feel comfortable. Although nursing care is the most provided care, it is the least evidence based, resulting in over- or under-treatment. Identifying the scope of effective nursing pain interventions can contribute to promote a better quality of care and use of evidence-based practice. **Design:** Systematic scoping review (in accordance with PRISMA-Scr).

Methods: Medline, CINAHL, EMBASE, PsycINFO, Cochrane and Web of Science were searched up to November 2019. Western, controlled intervention studies executed by nurses involving adult patients in the hospital and community care setting were eligible for inclusion. The reviewers independently screened the title/abstract and full-text and performed a structured data extraction. In addition, they methodologically assessed the quality of the studies with the Cochrane Risk of Bias 2.0 tool.

Results: Out of 5,697 studies, 47 were included. All studies had a (quasi)experimental design and were performed in a hospital or community care setting. Selected interventions were divided into three subcategories: (a) distraction interventions, like listening to music; (b) health education interventions, for example, improving self-management; and (c) pain prevention interventions, like numbing sprays, cold or hot application, specific positioning and pain-preventing devices. Risk of bias assessment resulted in two studies with a high score, 28 studies with a moderate score and 17 with a low score on methodological quality.

Conclusion: This systematic scoping review provides an overview of the scope of pain interventions carried out by nurses in daily practice. More research is necessary to determine the full value these interventions.

Keywords: Fundamental care; Nursing interventions; Nursing sensitive outcome; Pain; Hospital; Community care; Systematic scoping review

What does this paper contribute to the wider global clinical community?

- This paper provides an overview of the scope of interventions carried out by nurses that address pain. In addition we provided an overview of the quality of the included studies.
- Three main categories of pain interventions were found: distraction, health education and pain prevention interventions.
- Insight in the quality and results of interventions, like music or self-management interventions or application of warmth or cold, provides a basis for systematic reviews that can be used to determine their final value for the nursing profession.

Introduction

Meeting patients' basic human needs and guiding them to address themselves is the key task of the nursing profession. Essential care that all patients require is captured in the Fundamental of Care Framework by Kitson, et al. [1]. The Fundamental of Care Framework provides guidance for holistic and patient-centred nursing care, in which enabling or hindering factors of the context of care are considered for the delivery of high-quality care [2]. The relation between nurse and patient is the central point in the Fundamental of Care Framework in which empowering patients is an important aspect. Kitson, et al. [1], divide nursing care into three dimensions: physical needs like keeping the patient safe or fed; psychosocial needs like keeping the patient involved or hopeful; and relational aspects for the establishment of a working patient-nurse relationship.

A key aspect of the physical needs dimension is keeping the patient comfortable and free of pain [1]. The International Association for the Study of Pain defines pain as: 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage' [3]. Pain is an important nursing-sensitive outcome because of its tremendous impact on a patient's comfort and quality of life [4,5]. Intensity, pain-related distress and functional impairment influence the severity of pain. The treatment depends on the cause of the pain, pain perception and pain behaviour, all of which differ from patient to patient [3].

Pain starts acutely and is often treated by taking away the cause of the pain, for example, with surgery, or to treat symptoms with analgesics like paracetamol, non-steroidal anti-inflammatory drugs or opiates. In addition, regional analgesia of continuous peripheral nerve blocks has become an acute treatment. Finally, there are non-pharmacological approaches, like transcutaneous electrical nerve stimulation or the use of distraction, like music, books or videos [6]. When pain is persistent or recurrent and lasts longer than 3 months, it is classified as chronic. This form of pain can be divided into several subcategories: chronic primary pain, chronic cancer pain, chronic postsurgical and posttraumatic pain, chronic neuropathic pain, chronic headache and orofacial pain, chronic visceral pain and chronic musculoskeletal pain [7]. Chronic pain treatment is focused on remedying or minimising the pain and includes pharmaceutical interventions, surgery, physical therapy or a combination of an interdisciplinary therapy [8].

Adequate pain treatment and prevention is essential because pain seriously impacts a patient's well-being, quality of life and even recovery after surgery [5,9,10]. Boekel, et al. found that 55% of patients experience moderate to severe pain on the first post-operative day and patients with unacceptable pain had more complications (adjusted odds ratio 2.17, 95% Confidence Interval [CI] 1.51-3.10, $p<0.001$) [11]. Unfortunately, pain treatment is often suboptimal and since the mid-1990s, opioid use in Europe has increased rapidly. For example, approximately 20% of the population worldwide experiences chronic pain. Between 1990 and 2017, a quarter of this population was using opioid analgesics as a treatment. The percentage of patients using opioids has not changed over time [12]. Bosetti, et al. [13], stated that more attention needs to be paid to pain management to avoid misuse or abuse of pain medication.

Hospital and community care nurses have an important role in helping their patients to be comfortable and pain free to improve quality of life. Although nursing care is the most provided form of care, it is the least evidence based [14]. Nurses are often guided by experience, intuition and tradition [15]. This can result in the use of low-value care that is harmful, inadequate or incomplete and affects a patient's safety or health outcomes [16,17]. Replacing low-value care by evidence-based interventions, also known as high-value care, improves the quality of care. Verkerk and colleagues [17], first identified low- and high-value nursing interventions by assessing Dutch clinical nursing practice guidelines. As a result, they identified 66 low-value care practices often used in clinical practice. For example, for pain they found that subcutaneous, transdermal, oral or intramuscular opioid administration is unsuited for post-operative pain management and intravenous administration is preferred because of its rapid and predictable effects [17]. In addition, to improve pain management by health care professionals, Berben, et al. [18], recommended that aspects like adequate knowledge, attitude, professional communication, organisational aspects and patient input should be taken into account.

To increase the quality of care and to further professionalise nursing, it is necessary to reduce the level of low-value care and increase the level of high-value care [17]. To achieve this goal, first of all we need insights into in to the scope nursing interventions

that address pain. A systematic scoping review will guide this endeavour.

Aims

The aim of this systematic scoping review is to identify the scope of pain interventions carried out by nurses for adult patients in hospital and community care settings and asses their quality.

Methods

To identify pain interventions that are carried out by nurses we used a systematic scoping review as an approach. This approach is suitable to identify interventions in a broad field of evidence when the scope is not clear and helps researchers with inclusion criteria for full systematic reviews [19]. In addition we assessed the quality of the included to help research in prioritising interventions for further research. This systematic scoping review follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) for Scoping Reviews [20] and the Cochrane Handbook for Systematic Reviews of Interventions [21]. In October 2019, we submitted a PROSPERO registration, ID CRD4202153093. This systemic scoping review was performed by the Improve! Project team, which includes five nursing scientists, an educational scientist and a researcher.

Search Strategy

We worked together with an experienced medical librarian to define a comprehensive systematic search strategy. This included both MeSH and free text terms related to nursing interventions focused on pain care, like 'pain management', 'pain measurement' and 'pain perception', in combination with 'nursing' and a special controlled trail filter; no additional limits were added (Appendix S1). Medline, CINAHL, EMBASE, PsycINFO, Cochrane and Web of Science were searched up to November 2019. In addition, we checked the references of the included articles for additional studies.

Eligibility Criteria

Original research articles written in English or Dutch, published in peer journals in or after 2010 were eligible. We chose only to select studies published after 2010 to ensure inclusion of recent and up-to-date scientific nursing outcomes. According to the guidance of the Cochrane Effective Practice and Organization of Care group, studies were included if the data could be compared with a control or baseline measure, such as randomised controlled trials, controlled before-and-after studies or interrupted time series methods. In addition, the studies had to include interventions of a Western origin, be focused on pain care performed by a nurse and include adult patients >18 years. Finally, studies had to be conducted in a hospital or community care setting or contain an intervention transferable to these settings and executed in an Organisation for Economic Co-operation and Development country. Studies involving women in labour or breastfeeding and/or Chinese, alternative or non-Western interventions were excluded.

Screening Process

All databases were searched separately in November 2019. All the resulting articles were imported to Endnote version X9.2. After removing duplicates automatically and by hand, Rayyan QCRI-a web and mobile app for systematic reviews (Mourad Ouzzani)-was used for independent title/abstract and full text screening with a team of four researchers. Studies were screened by a research couple and discrepancies were discussed until a consensus was reached; if needed, a couple consulted a third researcher.

Data Extraction and Synthesis

Using a structured format, the following data were extracted: author, year, country, study design, aim, participants, setting, study group, intervention, measurement scale and point and results. One research assistant extracted the data; one of the authors subsequently checked the extraction. Discrepancies were discussed until a consensus was reached, or a third team member was consulted.

Quality Appraisal

To give the reader an overview of the quality of the included studies we used the The Cochrane Risk of Bias (RoB) 2.0 tool [22], this was done independently by three researchers. Again, studies were assessed by a research couple and discrepancies were discussed until a consensus was reached or a third researcher was consulted. All assessment data were recorded in the RoB 2.0 Excel form and the algorithm function was used to determine the level of bias. In addition, a study was scored as high-quality when there was no risk found for the five bias assessment items. If at least one item had some concerns, the study was of moderate quality; when one or more items had some concerns, the study was scored as low quality [22].

Results

Description of the Included Studies

The database searches resulted in 13,061 hits. After removing duplicates, the titles and abstracts of 5,697 papers were screened in Rayyan QCRI [23], in total, 227 full-text papers were screened for eligibility. Finally, 47 papers [24-68], met the inclusion criteria (Figure 1). No additional records were identified after checking the references of the included articles.

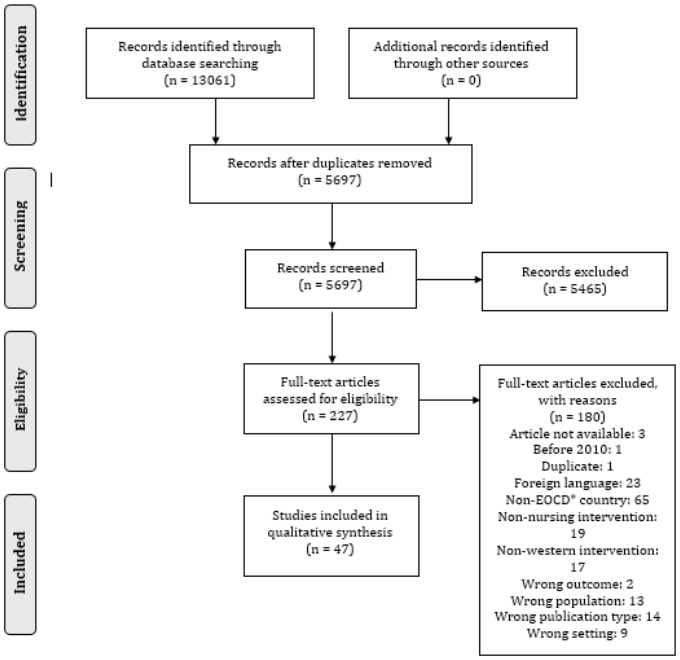

Figure 1: PRISMA flow diagram.

The 47 included studies were performed in 14 different countries. Most studies were performed in Turkey (n = 14) [24 ,26,29,30,34,40,42,54,55,58,63,64,68,69], and the United States (n=12) [25,28,36,41,43,45,46,59,60,61,66,70]. In addition, four were performed in South Korea [29,37,49,50], four in Italy [27,31-33], two in Germany [53,56], two in France [48,52] and two in the United Kingdom [39,51]. Finally, countries where one study was performed were: Australia [38], Canada [35], Denmark [47], Greece [65], Finland [67], Norway [62] and Spain [44].

In total, 37 studies had a randomised controlled trial design [24,27-32,34,36-42,44,46-48,51,53-56,58-63, 65,66,68-70], of which two studies were pilot randomised controlled trials [32,56] and 10 studies used a quasi-experimental design [25,26,43,45,4 9,50,52,57,64,67], Most studies were performed in a hospital (n=39) [24,25, 70,69,26-41,44,47,52-60,63-68] or a specialised care centre (n=7) [36,45,46,48,51,61,62]; one study included patients from a hospital and community care centre [62]. In addition, one study was performed amongst nursing students of a university [42], but contained an intervention transferable to the hospital and community care setting and was therefore included. In 44 studies inpatients were involved, and in the remaining three studies outpatients were involved [45,62,69]. In total, there were >5,581 participants in the included studies, with a range from 17 to 497 per study. In one study exact number of participants was not reported [25]. The age of the participants approximately ranged from 19 to 78 years, four studies did not mention the range of age of the participants [25,26,41,43]. In addition, approximately 33.6% of the participants were male, 58.6% female and for 7.8% gender was not reported [25,26,41,43,50]. After data analysis, three pain intervention subgroups emerged: distraction (n=19), health education (n=13) and prevention (n=19). These subgroups were used to describe the study the results and quality scores (Table 1).

Table 1: Overview of the included studies

Countries		Design		Setting		Patients		Interventions	
Turkey	14	RCT	35	Hospital	39	>5,581 (range)	17–497	Distraction	
United States	12	Pilot RCT	2	SC centre	7	Age, years (range)	19–78	Music	14
South Korea	4	Quasi-experimental	10	CC centre	1	Male	33.6%	VR	2
Italy	4			University	1	Female	58.6%	Other distractions	3
Germany	2					Not reported	7.8%		
France	2							Health education	
United Kingdom	2					Inpatients	44	Self-management	7
Australia	1					Outpatients	3	Educational information	6
Canada	1					CC	1		
Denmark	1					University	1	Prevention	
Greece	1							Numbing spray	4
Finland	1							Special positions	3
Norway	1							Application of cold/ warmth	6
Spain	1							‘Buzzy’ device	3
								Other devices	

Abbreviations: CC, community care; RCT, randomised controlled trial; SC, specialised care; VR, virtual reality

Results of Distraction Interventions

The distraction intervention subgroup included 16 studies that tested 14 music interventions [31-33,36,38,46-48,65,67,69,70], two virtual reality interventions [45,66] and three 'other' interventions, namely watching an DVD, distraction by an nurse and using a stress ball [51]. All studies were performed in a hospital or specialised treatment centre. In total, 1,452 participants were included with a range from 17 to 398 participants per study and an average age of 41 years (range 3-78 years).

Music Interventions

Music therapy as a distraction intervention included patients with fibromyalgia [69], patients receiving haemodialysis [31,32], patients with chronic pain [48], patients on mechanical ventilators [52], patients with obesity, patients who underwent abdominal surgery [46,65], patients who received a total knee arthroplasty [70], patients who underwent laparoscopic cholecystectomy [47], patients with cancer undergoing chemotherapy [32], patients with cervical cancer [36], post-operative patients in the intensive care unit [38] and patients undergoing conscious surgery [51] (Table 2, Appendix 2).

In 11 studies, an audio tape or music video was used with a duration varying between 20 and 30 minutes. Patients could select the music of choice in these studies. In seven studies, the patients listened to music after the procedure [25,36,46,48,65,67,70] with a variation of listening of one time or multiple times a day and at home. In three studies, music was listened to before/after and during the procedure [38,47,52] and in one study it was listened to only during surgery [51]. In six studies, there was a significant reduction in pain ($p<0.05$, 95% CI not reported) in the intervention group compared with the control group [36,46,48,52,65,69]. Allred, et al. [70], reported a significant effect in the intervention group, but not between groups. Cook, et al. [38] and Hutson et al. [51], found no effect. In addition, Vaajoki, et al. [67], showed only significant results on day two and Graverse, et al. [47], on day 7, although the intervention was performed on day one. Therefore, a confounder should be considered (Table 2, Appendix 2).

In three studies, 15 minutes of live singing or saxophone music performed by the nurse was used [31-33]. Measurements were performed directly before and after the intervention that was preformed once a week. There was a significant reduction in the level of pain in the intervention group ($p<0.05$, 95% CI not reported) [31-33]. However, Burrai, et al. [32], did not find a significant effect between groups. In addition, in one study [31], there was a significant reduction in systolic blood pressure ($p<0.001$, 95% CI not reported) and diastolic blood pressure ($p=0.045$, 95% CI not reported) (Table 2, Appendix 2).

Virtual Reality Interventions

Two studies had a virtual reality intervention including patients with a hematologic disease [45] and patients with pain [66]. Patients wore virtual reality googles during the procedure [45] or for 15 minutes three times a day or as needed [66]. In both studies patients could choose a virtual reality programme they liked. There was significant pain reduction ($p<0.04$, 95% CI not reported) up to 72 hours post-intervention in hospitalised patients with pain [66]. However, Glennon, et al. [45] reported that patients who wore virtual reality googles during the procedure showed no significant decrease in pain experience (Table 2, Appendix 2).

Other Distraction Interventions

Hudson, et al. [51], evaluated patients with varicose veins listening to music, watching a DVD, interacting with nurses and using a stress ball during conscious surgery. Distraction by a nurse ($p=0.022$, 95% CI not reported) and using a stress ball ($p=0.002$, 95% CI not reported) reduced pain significantly compared with the control group. There was no effect found for listening to music ($p=0.17$) and watching a DVD ($p=0.18$, 95% CI not reported) (Table 2, Appendix 2).

Results of Health Education Intervention Results

This subgroup included 13 studies [25,34,39,44,46,49,50 ,53,54,56,57,62,64], of which seven tested a self-management intervention [39,46,49,50,53,56,62] and six provided educational information [25,34,44,54,57,64]. All studies were performed in a hospital or specialised medical centre. One study was also performed in a community care setting [62]. Studies included >1,943 patients, with an estimated range of 39-436 patients per study and an age range of 41-70 years, one study did not provide the exact numbers of participants [25].

Self-Management

The studies focused on health education by stimulating self-management included patients undergoing knee replacement [39], abdominal [46] or gynaecological [49,50], surgery as well as patients with cancer [53,56,62]. The interventions focused on patient-directed self-management of pain [39], teaching for pain management [46], a structured educational programme on patient-

controlled analgesia [49,50], a modular transitional nursing intervention [53], the Pain Self-management Support Intervention [56] and the Pro-Self Pain Control Program [62]. There was a significant effect of the intervention ($p < 0.05$, 95% CI not reported) reported in two studies focusing on patient-controlled analgesia [49,50] and the Pro-Self Pain Control Program [62]. In the other four studies, there was no significant effect [39,46,53,56] (Table 2, Appendix 2).

Educational Information

The studies focusing on health education by providing educational information included patients with various medical-surgical diagnoses [25], patients who underwent thoracotomy or pulmonary procedures [54], patients who underwent digestive cancer surgery [57], patients with lung cancer [34], women undergoing breast screening exams [44] and women who underwent mastectomy/ breast conserving surgery [64]. Interventions used were a script-based communication intervention [25], patient education booklet [34], face-to-face information/emotional support [44], active patient participation in the management of daily nursing goals [57] and information about surgical pain and analgesics [64]. All six studies had a significant effect on pain ($p<0.05$, 95% CI not reported) (Table 2, Appendix 2).

Results of Pain Prevention Intervention

This subgroup included 19 studies: four focused on using a numbing spray [27,28,41,43] three assessed a specific position to reduce pain [26,37,59] five examined the application of cold [29,35,40,55,60], one examined the application of warmth [30]; three evaluated a 'Buzzy' device [58,61,63] and one each focused on changing the needle [24], using a shot-blocker [42] and using a transcutaneous electrical nerve stimulation device [68]. All studies were performed in a hospital or specialized centre and one study on a university. In total, 2186 participants were included with a range from 32-497 participants per study and an average age of 51.50 years (range 19-63 years).

Numbing Sprays

Of the studies focused on using a numbing spray to prevent pain during intravenous catheterisation [27,28,41-43], two reported a significant effect ($p=.001$, 95% CI not reported) [27] and ($p<.001$, 95% CI not reported) [28]. Edwards and Noah [41], found no difference in the pain levels of the intervention and control groups and Falitico and Rayn [43], actually found increased pain in the intervention group ($p=.049$, 95% CI not reported) (Table 2, Appendix 2).

Specific Positioning

A specific position to prevent pain was used in three studies [26,37,59]. The exaggerated lithotomy position, in which patients lie on their back with legs in the air to relieve pain after a laparoscopic cholecystectomy, had a significant effect (p.000, 95% CI not reported) [26]. Choi and Chang [37], found a significant increased incidence of backache due to a resting intervention in patients who underwent dural puncture ($p=.007$, 95% CI not reported), but no differences in the incidence of headaches. In addition, raising the head of the bed did not have a significant impact on pain or discomfort in patients subjected to angiography [59] (Table 2, Appendix 2).

Application of Cold and Warmth

Application of ice bags was used for patients subjected to femoral catheter removal [29], sternal incision pain [35], chest tube removal [40], chest tube incision [55] and spinal infusion [60]. In three out of the five studies, the application of cold reduced pain significantly ($p<0.05$, 95% CI not reported) [29,35,55], the other two studies reported no effect [40,60]. In one study, heat was used to reduce pain during catheter incision in patients receiving chemotherapy; pain reduction was significant ($p=0.011$, 95% CI not reported) [30] (Table 2, Appendix 2).

Special Devices ('Buzzy')

In these studies, a combination of cold and vibration delivered by a 'Buzzy' device was used by patients receiving an intramuscular injections [61,63] or intravenous catheterisation [58]. In all three studies, there was a significant reduction in pain ($p<0.05$, 95% CI not reported) [58,63] (Table 2, Appendix 2).

Special Devices (Other)

In trauma patients receiving intramuscular diclofenac sodium, the two-needle technique significantly reduced pain ($p<0.001$, 95% CI not reported) compared with not changing the needle [24]. In addition, in students receiving an intramuscular vaccination, a shot-blocker device, to prevent too deep of a needle puncture, no effect on pain prevention [42]. Finally, in patients who underwent inguinal herniorrhaphy, transcutaneous electrical nerve stimulation significantly reduced pain up to 24 hours ($p<0.001$, 95% CI not reported) [68] (Table 2, Appendix 2).

Table 2: Results

Author (year)	Participants	Measurement scale	Points of measurement	Outcome	p-value	Mean (SD)/ Mean Range (R) percentage points (%) (CG)	Mean (SD)/M range (R) percentage points (%) (IG)	Mean difference (MD)	SD	95% confidence interval (CI) lower and upper limits	
Distraction interventions											
Music											
Allred et al. (2010)	56	VAS (1–100) MPQ-SF BP (mmHg)	20 min before, directly after and 20 min after PhT Pre-operative Post-operative 20 min before/ after PhT	Level of pain (IG vs CG) Level of pain (IG) Level of pain (CG) Pain (MPQ-SF) Blood pressure	0.337 0.001* 0.001* NR 0.01*	45.1 (31.2) (SD) 36.2–46.4 (R) . 10.3–14.9 (R) 92.7–88.3	41.2 (25.8) (SD) . 36.5–52.4 (R) 13.4–15.9 95.8–90.3	3.9↓ . . 3.1-1↑ 2-3.1↓	NR NR NR NR NR	NR NR NR NR NR	NR NR NR NR NR
Alparslan et al. (2016)	37	VAS (1–10)	Day 1, 7, 14	Level of pain (IG vs CG) Level of pain (IG) Level of pain (CG)	0.022* 0.026* 0.853	NR . 6.25–5.40	NR 5.45–4.14 .	 1.31↓ 0.85↓	NR NR NR	NR NR NR	NR NR NR
Burrai et al. (2014a)	52	VAS (1–10) Blood pressure (mmHg)	Week 1 before I or C Week 2,3,4 after I or C	Level of pain (IG vs CG) Level of pain (IG) Level of pain (CG) Blood pressure (syst) Blood pressure (dia)	0.136 0.001* 0.148 0253 0.223	1.4 (0.5) . 1.3–1.4 104.6 (14.2) 68.4(6.7)	0.7 (1.1) 1.8–0.7 . 108.0 (12.0) 70.7 (6.2)	0.7↓ 1.1↓ 0.1↑ 3.4↑ 2.3↑	NR NR NR NR NR	NR NR NR NR NR	NR NR NR NR NR
Burrai (2014b)	114	VAS (1–10) BP (mmHg)	Week 1 before I or C Weeks 2, 3, 4 after I or C	Level of pain (IG vs CG) Level of pain (IG) Level of pain (CG) Blood pressure (syst) Blood pressure (dia)	< 0.001* < 0.001* 0.317 0.463 0.939	3.5 (3.1) . 3.6-3.5 134.5 (26.2) 69.2 (12.5)	1.04 (2.2) 2.7–1.04 . 132.54 (25.8) 69.6 (14.1)	2.46↓ 1.66↓ 0.1↓ 1.96↓ 0.4↑	NR NR NR NR NR	NR NR NR NR NR	NR NR NR NR NR
Burrai et al. (2019)	24	VAS (1–10) BP (mmHg)	Before/after I or C	Level of pain (IG vs CG) Level of pain (IG) Level of pain (CG) Blood pressure (syst) Blood pressure (dia)	< 0.05* < 0.001* NR < 0.001* 0.045*	NR NR NR 123.0 (5.6) 65.3 (3.2)	NR NR NR 119.4 (3.5) 67.3 (2.2)	. . . 3.6↓ 2↑	NR NR NR NR NR	NR NR NR NR NR	NR NR NR NR NR
Chi et al. (2015)	60	VRS (0–100)	Before and after the four I and C sessions	Level of pain (IG vs CG) Level of pain (IG) Level of pain (CG)	0.027* 0.054 NR (NS)	25.66 (15.37) NR NR	17.21 (13.52) NR NR	8.45↓ . .	NR NR NR	NR NR NR	NR NR NR
Cooke et al. (2010)	17	NRS (0–10)	15 min before I and after I	Discomfort	0.12	2.8	3.6	0.8↓	-0.04	-1.2	0.5
Graversen et al. (2013)	75	VAS (0–10) NRS (1–10)	Prior, 1 h, 3 h after surgery days 1, 7	Level of pain (3 h) Level of pain (day 14)	0.207 0.014*	2.0 (1.0–3.0) 0.0 (0.0–1.25)	2.0 (0.25–3.0) 1.0 (1.00–2.0)	0.0 1.0↓	NR NR	NR NR	NR NR
Guetin et al. (2012)	87	VAS (0–10)	Days: 0, 5, 10, 60 and 90	Pain difference (D0–60) Pain difference (D0–90)	< 0.001* < 0.001*	-1.6 (2.2) -1.5 (2.4)	-3.4 (2.3) -3.1 (1.9)	1.8↓ 1.6↓	NR NR	NR NR	NR NR
Jacq et al. (2018)	60	BPS	Before; during; 30, 60, 120 min after bathing	Pain intensity Pain duration	< 0.0001* < 0.005*	10 [4.3;18.0] 3.5 [2.0;6.0]	2.0 [0.3;4.0] 1.5 [0;3.0]	8.0↓ 2.0↓	NR NR	NR NR	NR NR
Sfakianakis et al. (2017)	87	VAS (1–10) BP (mmHg)	Before and after I	Level of pain (IG vs CG) Blood pressure	< 0.001* 0.010*	-0.22 96.48 (12.81)	-1.78 92.04 (14.23)	1.56↓ 4.40↓	NR NR	NR NR	NR NR
Vaajoki et al. (2012)	168	VAS (1–10)	Day 1, 2 pre/post and day 3 once	Level of pain (day 1) Level of pain (day2) Pain intensity (BR) Pain distress (BR) Pain intensity (DB) Pain distress (DB) Pain intensity (SP) Pain distress (SP) Level of pain (day 3)	> 0.05 < 0.05* 0.02* 0.01* 0.03* 0.04* 0.02* 0.04* NR	NR NR 1.5 1.5 1.9 1.8 3.3 3.2 NR	NR NR 1.0 0.9 1.3 1.3 2.5 2.5 NR	. . 0.5↓ 0.6↓ 0.6↓ 0.5↓ 0.8↓ 0.7↓ .	NR NR NR NR NR NR NR NR NR	NR NR NR NR NR NR NR NR NR	NR NR NR NR NR NR NR NR NR
Virtual reality											
Glennon et al. (2018)	97	NPS (1–10)	Pre/post I	Level of pain Pain diff (pre-post)	> 0.05 NR	4 (2.7) 1.1 (2.1)	3.9 (2.3) 1.62 92.3)	0.1↓ 0.52↓	NR NR	NR NR	NR NR
Spiegel et al. (2019)	120	NRS (0–10) HCAHPS	Pre/post I; 48, 72 h after I Discharge	Pain diff (pr-post) Level of pain (48 h) Level of pain (72 h) Sever pain Pain control Pain management by staff	< 0.04* 0.03* 0.04* 0.02* 0.48 0.42	-0.46 (3.01) NR NR -0.93(2.16) NR NR	-1.72 (3.56) NR NR -3.04 (3.75) NR NR	1.26↓ . . 2.11↓ . .	NR -0.59 -0.56 NR NR NR	NR -1.13 -1.09 NR NR NR	NR -0.06 -0.03 NR NR NR
Multiple interventions (music IG1, watching a DVD IG2, distraction by an nurse IG3, stress ball IG4)											
Hudson et al. (2015)	398	NRS (0–10) SF-MPQ	Before/after surgery	Level of pain (IG1 vs CG) Level of pain (IG2 vs CG) Level of pain (IG3 vs CG) Level of pain (IG4 vs CG) Sensory pain (procedure) Sensory pain (I type) Affective pain (procedure) Affective pain (I type)	0.17 0.18 0.022* 0.002* 0.89 0.27 0.57 0.94	4.17 (1.80) 4.17 (1.80) 4.17 (1.80) 4.17 (1.80) NR NR NR NR	3.94 (2.01) 3.95 (1.79) 3.49 (1.93) 3.26 (1.51) NR NR NR NR	0.23 0.22 0.68 0.91	NR NR NR NR 0.016 1.30 0.33 0.21	NR NR NR NR NR NR NR NR	NR NR NR NR NR NR NR NR
Health education interventions											
Self-management											

Deane et al. (2018)	137	VAS (0–100)	4 h before surgery; 72 h, 6 weeks after surgery	Level of pain (static) Level of pain (mobilisation) Level of pain (6 weeks)	0.441 0.228 0.808	33.4 (24.0) 41.2 (28.9) 25.9 (20.6)	30.3 (21.7) 34.6 (24.9) 24.4 (19.6)	1.1↓ 6.6↓ 1.5↓	NR NR NR	NR NR NR	NR NR NR
Good et al. (2010)	517	VAS (0–100)	5 pre/post I (immediate) and 4 times a day	Level of pain (PT vs C) D1AM Level of pain (PT vs C) D1PM Level of pain (PT vs C) D2AM Level of pain (PT vs C) D2PM Level of pain (PTRM vs C) D1AM Level of pain (PTRM vs C) D1PM Level of pain (PTRM vs C) D2AM Level of pain (PTRM vs C) D2AM Level of pain (RM vs C) D1AM Level of pain (RM vs C) D1PM Level of pain (RM vs C) D2AM Level of pain (RM vs C) D2PM	0.90 0.92 0.33 0.45 0.01* 0.64 0.02* 0.39 0.001* 0.04 0.02 0.86	NR NR NR NR NR NR NR NR NR NR NR NR	NR NR NR NR NR NR NR NR NR NR NR NR	2.29 (2.196) 2.50 (2.186) 0.42 (2.148) 0.11 (2.140) 3.97 (2.199) 1.01 (2.189) 3.37 (2.186) 0.24 (2.140) 7.03 (2.194) 2.59 (2.194) 3.23 (2.183) 0.15 (2.127)	NR NR NR NR NR NR NR NR NR NR NR NR	NR NR NR NR NR NR NR NR NR NR NR NR	NR NR NR NR NR NR NR NR NR NR NR NR
Hong and Lee (2012)	79	NRS (0–10)	2, 6, 24 h after surgery	Level of pain (2 h) Level of pain (6 h) Level of pain (12 h)	< 0.05* < 0.01 < 0.01*	6.7 (1.97) 5.8 (1.30) 4.3 (1.28)	5.4 (2.16) 3.9 (1.50) 2.9 (1.00)	1.3↓ 1.9↓ 1.4↓	NR NR NR	NR NR NR	NR NR NR
Hong and Lee (2014)	79	NRS (0–10)	2, 6, 12, 24, 48 h after surgery	Level of pain (2 h) Level of pain (6 h) Level of pain (12 h) Level of pain (24 h) Level of pain (48 h)	< 0.009* < 0.032* < 0.014* < 0.100 < 0.063	6.4 (2.2) 4.9 (2.4) 4.6 (2.5) 4.1 (2.2) 3.6 (2.0)	5.5 (2.1) 4.1 (2.3) 3.8 (1.1) 3.5 (2.1) 3.0 (2.0)	0.9↓ 0.8↓ 0.8↓ 0.6↓ .06↓	NR NR NR NR NR	NR NR NR NR NR	NR NR NR NR NR
Jahn et al. (2014)	207	BQ-II/BPI	Trial inclusion, 0, 7, 14, 28 days after discharge	Pain related barriers Pain intensity (average) Pain intensity (maximum)	0.02 0.75 0.79	81 86 87	69 75 76	12↓ 11↓ 11↓	NR NR NR	NR NR NR	NR NR NR
Koller et al. (2018)	39	BPI/NRS (0–10)	B, 0, 6 weeks after discharge	Pain level (average) Pain level (worst)	0.36 0.55	-3.14 (4.00) -1.71 (1.77)	-4.27 (2.41) -2.45 (1.51)	1.13↓ 0.74↓	NR NR	NR NR	NR NR
Rustøen et al. (2012)	179	PES (9 items)	Before I, after study period	Pain experience(group × time) Pain experience (IG) Pain experience (CG)	< 0.0001 < 0.0001	2.97 . 51.38 - 54.35	-21.45 53.48–74.93 .	24.42↓ 21.45↓ 2.97↑	NR NR NR	NR NR NR	NR NR NR
Educational information											
Alaloul et al. (2015)	NR	3 items of the HCAHPS	Once a month, 2 times before, 1 time during and 4 times after intervention	Staff effort (IG) Staff effort (CG) Pain controlled (IG) Pain controlled (CG)	0.022* 0.004* 0.318 0.001*	NR NR NR NR	NR NR NR NR	. . . .	NR NR NR NR	NR NR NR NR	NR NR NR NR
Cetkin and Tuna (2019)	60	VAS (0–10)	Before/after surgery	Pain level (Resting) Pain level (coughing) Pain level (mobilising in bed) Pain duration	0.001* 0.032* 0.003* 0.031*	7.13 (1.87) 8.83 (1.19) 8.60 (1.27) 6.96 (1.79)	5.48 (1.59) 8.12 (1.32) 7.40 (1.70) 5.83 (2.17)	1.65↓ 0.71↓ 1.20↓ 1.13↓	NR NR NR NR	NR NR NR NR	NR NR NR NR
Fernández-Feito et al. (2015)	436	VAS (0–10)	Directly, 10 min after I	Level of pain Experience of pain	0.030*	1.48 (2.29) 26%	0.98 (2.28) 19%	0.50↓ 5%↓	NR 0.44 (OR)	NR 0.24	NR 0.81
Kol et al. (2014)	70	VCS/BPS	2, 4, 8, 12, 24, 48 h	Perceived pain score Behavioural pain scale scores	< 0.01 < 0.01	1.60- 4.88 (R) (3.26) 2.45-7.77 (R)	1.02-3.40 (R) 2.00-5.42 (R)	0.88↓ 1.90↓	NR NR	NR NR	NR NR
Lee et al. (2018)	56	NRS (0–10)	Days 1, 2, 3, 4, 5, 6, 7 after surgery	Level of pain (CG vs IG) Level of pain (over time) Level of pain (group × time)	< 0.001* < 0.001* 0.208	3.33-4.81 (R) 3.33-4.81 (R) .	2.48-4.55 (R) 2.48-4.55 (R) .	0.25–0.84 0.25–0.84 .	NR NR .	NR NR .	NR NR .
Sayin and Aksoy (2012)	84	VAS (0–10)	0, 1, 2, 3, 4, 5, 6, 12 h discharge after surgery	Level of pain (CG vs IG)	0.002*	44.22 (10.48)	50.24 (6.68)		NR	NR	NR
Prevention interventions											
Numbing spays											
Balanyuk et al. (2018)	72	NRS (0–10)	Directly after PVC insertion	Level of pain	0.001*	1.86 (1.73)	0.69 (1.26)	1.17↓	NR	NR	NR
Barbour et al. (2018)	100	Questionnaire	Directly after intervention	Pain experience	< 0.001*	14%	76%	62%↓	NR	NR	NR
Edwards and Noah (2017)	72	Questionnaire	Before/during incision	Level of pain	0.330	2.5 (0–10)	2 (0–9)	0.5↓	NR	NR	NR
Falotico and Ryan (2016)	100	VAS (0–10)	Before/after IV insertion	Level of pain	0.049*†	22.94 (20.03)	31.17 (22.54)	8.23↑	NR	NR	NR
Specific positioning											
Aydemir et al. (2018)	102	VAS (0–10)	Before/after positioning	Level of pain	0.000*	4.098 (0.831)	1.784 (1.006)	2.314↓	NR	NR	NR
Choi and Chang (2018)	119	PDPH (1–4)/ VAS (0–10)	Days 1, 2, 3, 4, 5	Incidence headache Incidence headache (4h) Incidence headache (6h) Incidence backache Incidence backache (4h) Incidence backache (6h)	0.879 0.695 0.643 0.007* 0.839 0.013*†	. 11.1% 11.1% . 0.0% 0.0%	. 12.5% 8.6% . 10.0% 20.6%	. 1.4%↑ 2.5%↓ . 10.0%↑ 20.6%↑	NR 1.268 (OR) 0.726 (OR) NR 1.143 (OR) 5.250 (OR)	NR 0.389 0.187 NR 0.314 1.426	NR 4.161 2.811 NR 4.160 19.329
Pool et al. (2015)	71	VAS (0–10)	Before/after intervention	Level of pain (CG vs IG1) Level of pain (CG vs IG2)	0.11 0.09	NR NR	NR NR	NR NR	NR NR	NR NR	NR NR
Application of cold or warmth											

Bayındır et al. (2017)	104	NRS (0–10)	Before/during/ after I	Level of pain	< 0.001*	6.0 (4.0–7.0)	4.0 (3.0–4.0)	2.0↓	NR	NR	NR
Biyik Bayram and Caliskan (2016)	80	VAS (0–10)	Before/after catheterisation	Level of pain (CG vs IG) Level of pain (IG) Level of pain (CG)	0.011* 0.314 0.021	2.82 (2.57) . -0.25 (2.15)	0.80 (1.65) 1.15 (3.20) .	2.02↓ . .	NR NR NR	NR NR NR	NR NR NR
Chailler et al. (2010)	32	NRS (0–10)	Before/after I	Level of pain	< 0.001*	3.44-3.84	2.56-2.72 (R)	1.12-0.88↓	NR	NR	NR
Demir and Khorshid (2010)	90	VAS (0–10)	Before, directly, 15 min after removal	Level of pain (CG vs PG vs IG) Level of pain (IG) Level of pain (PG) Level of pain (CG)	0.270 0.251 0.342 0.408	NR . 2.73-3.27-7.13 2.73-3.07-7.23	NR 2.03-3.27-6.77 . .	. . . .	1.313 NR NR NR	NR NR NR NR	NR NR NR NR
Kol et al. (2013)	40	VCS/BPS	Before/after intervention	Level of pain (mobilisation) Level of pain (breathing) Level of pain (coughing)	0.003* 0.519 0.677	90% 45% 85%	55% 35% 80%	35%↓ 10%↓ 5%↓	NR NR NR	NR NR NR	NR NR NR
Quinlan et al. (2017)	74	NRS	12 pain checks	Level of pain	0.589	-1.0 (0.8)	-1.1 (0.8)	0.1↓	NR	NR	NR
Special devices ('Buzzy')											
Pakış Çetin and Çevik (2019)	100	VAS (0–10)	Before/after intervention	Level of pain	< 0.001*	5.32 (1.64)	1.04 (0.96)	4.28↓	NR	NR	NR
Redfern et al. (2019)	497	VAS (0–10)	Before/after vaccination	Level of pain	0.035*	1.12 (0.10)	0.87 (0.07)	0.25↓	NR	NR	NR
Şahin and Eşer (2018)	65	VAS (0–100)	Before/after injection	Level of pain	< 0.05*	17.69 (9.85)	4.67 (4.94)	13.02↓	NR	NR	NR
Special devices (other)											
Ağaç and Güneş (2011)	100	NRS (0–10)	Pain during injection	Level of pain	< 0.001*	6.43 (1.35)	5.53 (1.64)	0.9↓	NR	NR	NR
Emel et al. (2017)	242	VAS (0–10)	Before/after vaccination	Level of pain	0.796	33.0 (23.87)	33.8 (26.05)	0.8↑	NR	NR	NR
Yılmaz et al. (2019)	52	VAS (0–10)	0, 2, 4, 8, 24 h before/after	Level of pain 2 h Level of pain 4 h Level of pain 8 h Level of pain 24 h	< 0.001* < 0.001* < 0.001* < 0.001*	3.0 (3.0–4.25) 5.0 (4.0–6.0) 5.0 (5.0–6.0) 4.0 (2.0–4.0)	2.0 (1.0–3.0) 2.0 (1.0–3.0) 2.0 (1.75–3.0) 1.0 (1.0–1.0)	1.0↓ 3.0↓ 3.0↓ 3.0↓	NR NR NR NR	NR NR NR NR	NR NR NR NR

Abbreviations: Physical therapy (PhT); post-dural headache (PDHA); patient teaching (PT); relaxation and music (RM); systolic (Syst); diastolic (Dia) Randomised controlled trail (RCT), Intervention group 1 (IG1), Intervention group 2 (IG2), Intervention group 3 (IG3), Intervention group 4 (IG4); Day 1 morning (D1AM); Day 1 evening (D1PM); Day 2 morning (D2AM); Day 2 Evening (D2PM); four hours (4h); six hours (6h); bed rest (BR); deep breathing (DB); shifting position (SP) Intravenous catherization (IV); control group (CG); intervention group (IG); control (C); intervention (I); not reported (NR)

Measurement scales: Behavioural Pain Scale (BHP); Brief Pain Inventory (BPI); blood pressure (BP); Behavioural Pain Scale (BPS); Barriers Questionnaire (BQ-II); Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS); McGill Pain Questionnaire Short Form (MPQ-SF/SF-MPQ); Numeric Rating Scale (NRS);, Numeric Pain Scale (NPS); Pain Experience Scale(PES); Visual Analogue Scale (VAS); Verbal Category Scale (VCS);, Visual Rating Scale (VRS)

*Significant result

† result in negative direction

Risk of Bias

Of the 15 studies researching a distraction intervention, eight were scored moderate quality because of concerns regarding the risk of bias for one or two of the assessment items [31-33,47,48,51,70]. In addition, seven had high risk of bias on one or more items and were therefore scored low quality [36,38,45,65-67,69]. None of the studies was considered high quality because blinding to the distraction interventions was not possible (Table 3).

Of the health education interventions, nine of the 13 were scored moderate quality [25,34,44,49,50,54,56,57,65] and four low quality [39,46,53,64]. Blinding patients for the health education interventions was also not possible, and therefore none of the studies were considered high quality (Table 3).

For the pain prevention interventions, two of the 19 were considered high quality due to a low risk of bias on all assessment items [24,41], 11 were moderate quality [26-30,35,40,42,43,55,63] and six were low quality [37,58-61,68] Because blinding of patients was possible for some of the pain prevention interventions, a high-quality score in this intervention category was possible (Table 3).

Table 3: Assessment of the risk of bias

	Randomisation process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	**Overall**
Distraction interventions						
Music						
Allred et al. (2010)	+	+	/	/	+	/
Alparslan et al. (2016)	+	-	-	/	+	-
Burrai et al. (2014a)	+	+	+	/	+	/†
Burrai (2014b)	+	+	+	/	+	/†
Burrai et al. (2019)	+	+	+	/	+	/†
Chi et al. (2015)	+	+	-	-	+	-
Cooke et al. (2010)	+	-	+	/	+	-
Graversen et al. (2013)	+	+	+	/	+	/†
Guetin et al. (2012)	+	+	+	/	+	/†
Jacq et al. (2018)	/	+	+	/	+	/
Sfakianakis et al. (2017)	/	+	-	/	+	-
Vaajoki et al. (2012)	/	-	+	/	+	-
Virtual reality						
Glennon et al. (2018)	/	-	+	/	+	-
Spiegel et al. (2019)	/	+	-	/	+	-
Multiple interventions (music IG1, watching a DVD IG2, distraction by an nurse IG3, stress ball IG4)						
Hudson et al. (2015)	+	+	+	/	+	/†
Health education interventions						
Self-management						
Deane et al. (2018)‡	+	+	-	-	+	-
Good et al. (2010)	+	-	-	+	+	-

Hong and Lee (2012)	/	+	+	/	+	/
Hong and Lee (2014)	+	+	+	/	+	/†
Jahn et al. (2014)#	/	+	-	/	+	-
Koller et al. (2018)	+	+	+	/	+	/†
Rustøen et al. (2012)	+	+	+	/	+	/†
Educational information						
Alaloul et al. (2015)	/	+	+	/	+	/
Cetkin and Tuna (2019)	/	+	+	/	+	/
Fernández-Feito et al. (2015)	+	+	+	/	+	/†
Kol et al. (2014)	/	+	+	/	+	/
Lee et al. (2018)	/	+	+	/	+	/
Sayin and Aksoy (2012)	/	+	+	-	+	-
Pain prevention interventions						
Numbing spays						
Balanyuk et al. (2018)‡	+	+	+	/	+	/†
Barbour et al. (2018)	+	+	+	+	/	/
Edwards and Noah (2017)	+	+	+	+	+	+
Falotico and Ryan (2016)	/	+	+	+	+	/
Specific positioning						
Aydemir et al. (2018)	/	+	+	/	+	/
Choi and Chang (2018	+	+	-	/	+	-
Pool et al. (2015)	+	-	-	-	+	-
Application of cold/warmth						
Bayındır et al. (2017)	+	+	+	/	+	/†
Biyik Bayram and Caliskan (2016)	/	+	+	/	+	/
Chailler et al. (2010)	+	+	+	/	/	/
Demir and Khorshid (2010)	+	+	+	/	+	/†
Kol et al. (2013)	+	+	+	/	+	/†
Quinlan et al. (2017)	+	+	-	/	/	-
Special devices ('Buzzy')						
Pakiş Çetin and Çevik (2019)	+	+	+	-	+	-
Redfern et al. (2019)	+	+	+	-	-	-
Şahin and Eşer (2018)	/	+	+	/	+	/
Special devices (two needle-technique, shot-blocker, transcutaneous electrical nerve stimulation)						

Ağaç and Güneş (2011)	+	+	+	+	+	+
Emel et al. (2017)	+	+	+	/	/	/
Yılmaz et al. (2019)	+	+	-	+	+	-

Note. ‡ Intention to treat principle; + low risk of bias; / some concerns; - high risk of bias; † blinding not possible
Abbreviations: IG, intervention group

Discussion

Summary of Evidence

Our systematic scoping review provides an overview nursing interventions to prevent and to treat the pain of hospital or community patients; each has been studied in a controlled design. In total, 47 studies were included from a comprehensive search through six databases up to December 2019; we also checked the references included studies. We were able to identify three main categories of nursing interventions: distraction interventions (like listening to music, using virtual reality, talking to a nurse, watching a DVD or squeezing a stress ball), health education interventions (like promoting self-management and providing educational information) and pain prevention interventions (using a numbing spray, placement of the patient in a specific position, applying cold or warmth, a 'Buzzy' device, the two-needle technique, a shot-blocker and a transcutaneous electrical nerve stimulation device). For quality assessment, we used the RoB 2.0 [22]. The inability to blind patients and nurses from the intervention was a main problem in the assessment of the risk of bias.

Comparison with Other Studies

When comparing our results with other studies, we found that distraction reduces pain, which is caused by shifting a patient's attention to more pleasant stimuli. A combination of audio and visual distractions has a higher effect than audio distraction alone [71]. This supports the application of easy-to-use distraction interventions like listening to self-selected music, being immersed in virtual reality or having a conversation with a nurse in which the preferences of the patients should be considered. Another distraction intervention is live music performed by a nurse. Not all nurses can play an instrument – it is time consuming and does not fall within the scope of the nursing profession. These doubts need to be taken into consideration when researching and applying new interventions and attention needs to be given to the work context [72,73], especially considering that one of the main barriers found for implementing evidence-based nursing care is insufficient time on the job [74]. Ball [75], found that 86% of the surveyed nurses reported one or more important care activities left undone due to lack of time. In addition, we found two studies focusing on virtual reality. A recent systemic review on the effect of virtual reality on depression, anxiety, fatigue and pain showed that virtual reality can be an effective intervention for pain in adults and paediatric patients with burn injury and to reduce acute or chronic pain from medical procedures. Although the quality of the studies was not consistent, the patients found virtual reality to be a pleasant experience [76].

When comparing the health education interventions, self-management and providing educational information, we found a strong connection with the psychosocial and relational aspects of the Fundamental of Care Framework, like keeping the patient informed and involved and ensuring goals are set [77]. By using these aspects, nurses can keep the patient comfortable and pain free. This is an example of how the three dimensions are connected. Nevertheless, nurses in the hospital setting are mainly focused on tasks and not yet able to integrate the physical, relational and physical elements of care and promote person□ centred fundamental care [78].

Studies on pain prevention like application of cold (cryotherapy) and warmth and a 'Buzzy' device have shown significant results on pain reduction and are easy-to-use interventions for nurses. In their narrative review, Garcia et al. [79], found that these procedures are beneficial for chronic pain and appear to be a safe therapy with minimal adverse effects. However, for application of a 'Buzzy' device by nurses, we found only additional evidence in research with children; this was the same for application of numbing sprays [80].

Limitations

Some limitations should be taken into consideration when reading this systemic scoping review. First, almost all studies were performed in the hospital setting. In three studies, outpatients were involved and in only two studies in the health education category patients received an intervention after admission or at home. We did not find rigorous evidence for interventions in the community care setting. However, interventions like music, virtual reality, and distractions by a nurse, application of hot or cold and other special devices do not seem to be limited to the hospital setting and could be applied by community care nurses. The health education interventions are often more complex, and it is advisable to assess them for applicability in the community care setting.

Second, the algorithm function was used to determine the

risk of bias in the RoB 2.0 tool [22]. In total, 14 out of the 47 studies scored moderate quality because blinding patients was not possible due to the nature of the intervention. Therefore, using the RoB 2.0 tool may not be suitable for assessment of the quality of nursing studies. We chose to use the algorithm function for transparency, but this approach was perhaps too strict for our kind of research. Third, all studies presented limited statistical results, including almost no standard deviations or confidence intervals; hence, it is hard to determine the impact of effects.

Fourth, this study was designed to identify nursing intervention in the area of pain. Therefore, we could not give a final answer whether the interventions should be valued as high- or low value care. However, we did identify interesting research areas and gave an overview of the quality of the studies that can be used as a basis for systematic reviews. In order to be able to identify all studies about pain interventions of interest of nurses, one should avoid the nursing filter in the search strategy. In addition, when a search strategy without a nursing filter is used special attention is required on applicability of the intervention in the nursing profession.

Finally, we focused on Western medicine and excluded alternative medicine. Sandvik, et al. [81], found, in their scoping review on pain relief in patients in the intensive care unit, interventions like hypnosis, simple massage, spiritual care, passive exercise and acupuncture as non-pharmacological options for pain treatment. However, not all of these interventions fall within the scope of the nursing profession or they would require nurses to receive additional, extensive training.

Areas for Further Research

We identified the scope of pain interventions that are easy to use and can be carried out by nurses, like virtual reality, providing educational interventions and application of cold. To confirm their status as high- or low-value care more systematic reviews on the individual pain intervention topics are necessary. In addition, almost all studies were performed in a hospital. Although multiple interventions like application of cold or listening to music seem to be applicable in the community care setting or other areas, it is advisable to research the transferability of these pain interventions. Moreover, patient comfort and quality of life should be addressed.

Conclusion

In this systemic scoping review, we assessed 47 studies on nursing pain interventions, mostly performed in the hospital setting. We identified three main categories: distraction interventions, health education interventions and prevention interventions. These include interventions like listening to music, promoting self-management and application of hot and cold. The overall quality of pain interventions researched was moderate to low. We recommend systematic reviews in clusters of pain interventions that can be carried out by nurses, to determine their status as high or low value care.

Relevance to Clinical Practice

Identifying the scope of pain interventions executed by nurses for adult patients in hospital and community care settings gives insight in relevant research areas for the nursing profession. This systematic scoping review is the first step to help formulate evidence-based recommendations for nursing-sensitive outcomes and to assess their full value.

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Appendix 1: Search strategy

Example: Medline Search 25 November 2019

Medline search: nursing pain interventions		
#	**Searches**	**Results**
1	Pain Management/ or Pain Measurement/ or exp Pain Perception/ or (exp pain/ and exp "Surveys and Questionnaires"/) or ((Pain* or Arthralgia* or Dysmenorrhea* or Earache* or Failed Back Surgery Syndrome or Glossalgia* or headache* or Mastodynia* or Metatarsalgia* or migrain* or Myalgia* or Neuralgia* or Physical Suffering or Renal Colic* or Sciatica* or Toothache*) adj3 (relief or manag* or intensit* or perception* or sens* or assessment* or test or tests or testing or scale* or score* or rating* or questionnaire* or Reliev* or Improv* or Alleviat* or Lower levels or decreased levels or index or inventry or measure*)).ti,ab,kf.	258293
2	nursing.fs. or exp Nursing/ or nurses/ or nurse administrators/ or exp nurse specialists/ or nurses, community health/ or nurses, international/ or nurses, male/ or nurses, public health/ or exp Nursing Staff/ or exp Nursing Care/ or nursing process/ or exp nursing assessment/ or Licensed Practical Nurses/ or (Nurse or Nurses or nursing).ti,ab,kf.	661413
3	(exp clinical trial/ or (Randomi#ed or Placebo or Randomly or Quasi-experimental or Experimental group* or Intervention group* or Control group* or Clinical trial or Quasiexperimental or Semiexperimental or Semi-experimental or Nonrandomized group*).ti,ab,kf. or trial.ti. or clinical trials as topic/) not (exp animals/ not humans/)	1657320
4	1 and 2 and 3	**2648**

Appendix 2: Summary of study characteristics of pain interventions

Author (year), Country	Study design	Aim	Participants/ Study group / setting			Intervention
Distraction interventions						
			Music			
Allred et al. (2010), USA	RCT	Determining effectiveness of listening to music and/or having a quiet rest period on pain before and after first ambulation on postoperative day 1	Patients with total knee arthroplasty - Hospital			IG: listening to music (20 min.) before and after first ambulation, one day CG: quiet rest group (20 min.) before and after first ambulation, one day
			Total: n=56 IG: n=28 CG: n=28	Age: years (SD): IG: 64.3 (9.6) CG: 63.5 (9.6)	Gender: n (%): IG: M 14 (50,0)/ F 14 (50,0) CG:M 11 (39.3)/F 17 (60.7)	
Alparslan et al. (2016), Turkey	RCT	Determining effectiveness of music on pain in patients with fibromyalgia	Fibromyalgia outpatients - Rheumatology outpatient clinics			IG: listening to music (25 min) twice a day for 14 days at home CG: Care as usual
			Total: n=37 IG: n=21 CG: n=16	Age: years (SD): IG: 42.95 (9.94) CG: 44.43 (11.02)	Gender: n (%): IG: M 1 (4.8)/F 20 (95.2) CG: M 1 (6.3)/F 15 (93.8)	
Burrai et al. (2014a), Italy	RCT (pilot)	Determining effectiveness of live saxophone music on cancer pain	Cancer patients on chemo treatment - Hospital			IG: Listening to live saxophone music therapy (30 min.) For 4 weeks. once a week. CG: Care as usual
			Total: n=52 IG: n=26 CG: n=26	Age: years (SD): IG: 64.3 (12.9) CG: 64.6 (12.8)	Gender: n (%): IG: M 1 (3.8)/F 25 (96.2) CG: M 8 (30.7) F 18 (62.3)	
Burrai et al. (2014b), Italy	RCT	Determining effectiveness of live saxophone music on pain of patients undergoing hemodialysis	Hemodialysis patients - Hospital			IG: Listening to live saxophone music therapy (30 min.) For 4 weeks, once a week. CG: Care as usual
			Total: n=114 IG: n=57 CG: n=57	Age: years (SD): IG: 68.9 (9.5) CG: 67.4 (13.7)	Gender: n (%) IG: M 25 (43.9)/ F 32 (56.1) CG: M 24 (42.1) F 33 (57.9)	
Burrai et al. (2019), Italy	RCT	Determining effectiveness of listening to live singing on pain in patients undergoing hemodialysis	End-stage kidney disease patients during hemodialysis - Hospital			IG : listening to live singing (15 min), for 2 weeks. once a week. CG Care as usual
			Total: n=24 IG: n=12 CG=12	Age total group: years (SEM): 62.3 (2.8)	Gender total group: n (%) M: 15 (62.5) F: 9 (37.5)	
Chi et al. (2015), USA	RCT	Determining effectiveness of music relaxation video on pain severity during intracavitary brachytherapy	Cervical cancer patients receiving intracavitary brachytherapy – Cancer Centre			IG: watching a music relaxation video (30 min.) 4 times during the first 44 hours after brachytherapy GG: Care as usual
			Total: n=60 IG: n=31 CG: n=29	Age total group: years (SD): 45.85 (10.55)	Gender total group: n (%) F: 60 (100%)	
Cooke et al. (2010), Australia	RCT	Determining effectiveness of music on discomfort experienced by intensive care unit patients during turning procedure	Postoperative ICU-patients being turned in an intensive care unit - Hospital			IG: listening to music (15 min.) before and during one turning procedure GG: Care as usual
			Total: n=17	Median age: years (min-max): 72 (19-7)	Gender: n (%) M: 12 (71)/ F: 5 (29)	
Graversen & Sommer (2013), Denmark	RCT	Determining efficacy of perioperative music on reducing pain in patients undergoing laparoscopic cholecystectomy	Patients undergoing laparoscopic cholecystectomy - Hospital			IG: soft music (peri- and postoperative) played by a music pillow. Until discharge (one day). GG: Care as usual
			Total: n=75 IG: n=40 CG: n=35	Age: years (IQR): IG: 50 (35–57) CG: 44 (36–58)	Gender: n (%) IG: M: 12 (30)/F: 28 (70) CG: M: 8 (22)/F: 27 (77)	
Guétin et al. (2012), France	RCT	Determining effectiveness of a music intervention in the management of chronic pain	Patients with chronic pain - Pain Assessment and Treatment Centre and post discharge			IG: 20 to 30 listening to music in a relaxed position twice a day (in the hospital 10 days and at home 50 days) GG: Care as usual
			Total: n=87 IG: n=44 CG: n=43	Age: years (SD): IG: 47.8 (10.3) CG: 49.9 (11.6)	Gender: n (%) IG: M: 9 (20.5)/ F: 35 (79,5) CG: M: 10 (23,3) F: 33 (76.7)	
Jacq et al. (2018), France	Quasi-experimental	Assessing effectiveness of music on pain during morning bed bathing of mechanically ventilated patients	Mechanically ventilated patients in an intensive care unit - Hospital			IG: Listening to music during bathing and 30m in after (Mozart) GG: Care as usual
			Total: n=60 IG: n=30 CG: n=30	Age: years, median: IG: 78 (63;80) CG: 65 (59;77)	Gender: n (%) IG: M: 11 (36.7) F: 19 (63.3) CG: M: 20 (66.7) F: 10 (33.3)	
Sfakianakis et al. (2017), Greece	RCT	Assessing effectiveness of Music Therapy Intervention in acute postoperative pain	Obese patients who underwent a major abdominal surgery - hospital			IG: Listening to music therapy twice postoperative (30 min) (classical music) GG: Care as usual
			Total: n=87 IG: n=45 CG: n=42	Age: years (SD): IG: M: 43.13 (12.54) /F 41.30 (11.59) CG: M: 44.81 (9.97) /F: 43.35 (12.47)	Gender: n (%) IG: M: 15 (33,0)/F: 30 (66,0) CG: M: 16 (38,0)/ F: 26 (61,0)	
Vaajoki et al. (2011), Finland	Quasi-experimental	Evaluating effectiveness of listening to music on pain intensity and pain distress after surgery	Abdominal surgery patients - Hospital			IG: listen to music of choice for 30 min on post-operative day 1 and 2 GG: Care as usual
			Total: n=168 IG: n=83 CG: n=85	Age: years (SD): IG: 60 (13) CG: 63 (12)	Gender: n (%) IG: M: 42 (50,6)/ F: 41 (49,4) CG: M: 48 (56,5)/ F 37 (43,5)	
			Virtual reality			
Glennon et al. (2018), USA	Quasi-experimental	Determining effectiveness of a virtual reality intervention on pain in patients undergoing a bone marrow aspiration and biopsy procedure	Patients with a hematologic disease - Outpatient cancer center			IG: use of virtual reality goggles during procedure GG: Care as usual (watching and listening to a television)
			Total: n=97 IG: n=49 CG: n=48	Age: years (SD): IG: 51.4 (12.4) CG: 48.9 (12.8)	Gender: n (%) IG: M: 30 (61,0)/ F: 19 (38,0) CG: M: 22 (45,0)/ F: 26 (54,0)	
Spiegel et al. (2019), USA	RCT	Comparing effectiveness of virtual reality (VR) vs. “health and wellness” television for management of pain in hospitalized patients	Patients with pain - Hospital			IG: library of 21 VR experiences, thrice daily for 10 min or as needed GG: “health and wellness” television programming
			Total: n=120 IG: n=61 CG: n=59	Age: years (SD): IG: 51.6 (15.1) CG: 50.0 (15.9)	Gender: n (%) IG: M: 30 (49.1)/F: 31 (50.9) CG: M: 30 (50.8)/F: 29 (49.2)	
			Multiple interventions (music IG1, watching a DVD IG2, distraction by an nurse IG3, stress ball IG4,)			
Hudson et al. (2015), UK	RCT	Comparing efficacy of simple distraction interventions on pain during conscious surgery	Patients with varicose veins - Private clinic.			IG1: Listening to music IG2: Watching a DVD IG3: Interaction with nurses IG4: Touch (squeeze stress balls) CG: Treatment as usual (TAU)
			Total: n=398 IG1: n=84 IG2: n=80 IG3: n=78 IG4: n=80 CG: n=76	Age: years (SD): IG1: 53.71 (13.17) IG2: 50.51 (12.23) IG3: 52.1 (14.49) IG4: 53 (13.01) CG: 55.06 (11.86)	Gender: n IG1: M: 18 (21,0)/F: 66 (78,0) IG2: M: 13 (16,0)/F: 67 (83,0) IG3: M: 20 (25,0)/F: 58 (74,0) IG4: M: 21 (26,0)/F: 59 (73,0) CG: M: 18 (23,0)/F: 58 (76,0)	
Health education interventions						
			Self-management			
Deane et al. (2018), UK	RCT	Comparing efficacy of patient-directed self-management of pain (PaDSMaP) vs. treatment as usual following total knee replacement	Elderly patients after total knee replacement surgery - Hospital			IG: self-medication of oral analgesics (PaDSMaP) GG: nurse controlled oral analgesia (TAU)
			Total: n=137 IG: n=68 CG: n=69	Age: years (SD): IG: 70.0 (8.7) CG: 69.7 (7.5)	Gender: n (%) IG: M: 29 (42.6)/F: 39 (57.4) CG: M: 30 (43.5)/F: 39 (56,5)	

Good et al. (2010), USA	RCT	Testing an intervention of patient teaching for pain management (PT) and compare it with RM for immediate and general effects on postoperative pain.	Patients scheduled for abdominal surgery - Hospital			PT-group: preoperative patient teaching for pain management RM-group: relaxation and music PTRM-group: combination of PT and RM CG: Resting quietly
			Total: n=517 PT: n=129 RM: n=132 PTRM: n=129 CG: n=127	Age total group years (SD): 48.67 (12.11)	Gender total group: n (%) M: 164 (32)/F: 353 (68)	
Hong & Lee (2012), South Korea	Quasi- experimental	Determining the effectiveness of a structured educational program on patient-controlled management of postoperative pain	Patients who have undergone gynecological surgery - Hospital			IG: structured preoperative education on the patient-controlled analgesia device GG: general instruction for the PCA
			Total: n=79 IG: n=39 CG: n=40	Age: years (SD): IG: 42.31 (11.37) CG: 41.65 (11.47)	Gender: n (%) Not reported	
Hong & Lee (2014), South Korea	Quasi- experimental	Determining the effectiveness of a structured educational program on patient-controlled management of postoperative pain	Patients who have undergone gynecological surgery - Hospital			IG: structured preoperative education on the patient-controlled analgesia device GG: general instruction for PCA
			Total: n=79 IG: n=39 CG: n=40	Age: years (SD): IG: 42.31 (11.37) CG: 41.65 (11.47)	Gender: n (%) Not reported	
Jahn et al. (2014), Germany	RCT	Improving pain-related self-management for cancer patients through a modular transitional nursing intervention	Cancer-patients with pain - Hospital and post discharge			IG: Self Care Improvement through Oncology Nursing (SCION)-PAIN program GG: care as usual
			Total: n=207 IG: n=102 CG: n=105	Age: years (SD): IG: 57.75 (11.97) CG: 55.90 (12.62)	Gender: n (%) IG: M: 59 (57.8)/F: 43 (42.2) CG:M: 60 (57.1)/F: 45 (42.9)	
Koller et al. (2018), Germany	RCT (pilot)	Assessing effectiveness of a Pain Self-management Support Intervention on pain in oncology patients	Oncology patients - Hospital and post discharge			IG: ANtiPain intervention (cancer pain self-management support intervention based on the PRO-Self Plus Pain Control Program GG: standard care
			Total: n=39 IG: n=20 CG: n=19	Age: years (SD): IG: 55.3 (10.2) CG: 58.1 (11.2)	Gender: n (%) IG: M: 8 (40.0)/F: 12 (60.0) CG: M: 12 (63.2)/F: 7 (36.8)	
Rustøen et al. (2012), Norway	RCT	Evaluating the effectiveness of the Pro-Self Pain Control Program in improving patients' knowledge of cancer pain management	Adult oncology outpatients with bone metastases - Cancer center/ community care			IG: Pro-Self Pain Control Program GG: booklet about cancer pain management
			Total: n=179 IG: n=87 CG: n=92	Age: years (SD): IG: 64.32 (11.4) CG: 67.38 (11.4)	Gender: n (%) IG: M: 41 (47.1)/F: 46 (52.9) CG: M: 51 (55.4)/ F: 41 (44.6)	
Educational information						
Alaloul et al. (2015), USA	Quasi-experimental	Evaluating patient satisfaction with pain management when nursing staff used a pain management intervention	Patients with a variety of medical-surgical diagnoses of 2 units - Hospital			IG: Script-based Communication intervention CG: Care as usual
			All patients of 2 units	Age: Not reported	Gender: Not reported	
Cetkin & Tuna (2019), Turkey	RCT	Determining effectiveness of Health Education given to lung cancer patients before thoracotomy on postoperative pain level.	Lung cancer patients indicated for pulmonary resection - Hospital			IG: patient education booklet GG: usual clinical nursing information
			Total: n=60 IG: n=30 CG: n=30	Age: years (SD): IG: 62.47 (4.77) CG: 60.90 (11.56)	Gender: n (%) IG: M: 25 (83.3)/F: 5 (16.6) CG: M: 29 (96.6)/F: 1 (3.4)	
Fernández-Feito et al. (2015), Spain	RCT	Determining effectiveness of Face-to-face Information and Emotional Support from Trained Nurses in reducing pain during screening mammography	Women undergoing a breast screening exam - Hospital			IG: face-to-face Information and emotional support GG: usual care
			Total: n=436 IG: n=231 CG: n=205	Age: years (SD): IG: 59.13 (5.58) CG: 59.38 (5.57)	Gender: n (%) F: 436 (100,0%)	
Kol et al. (2014), Turkey	RCT	Evaluating effectiveness of preoperative pain management education before the onset of pain postoperatively	Thoracotomy and pulmonary patients with chest tube insertions - Hospital			IG: preoperative education pain management and the pharmacological methods used after surgery GG: no education
			Total: n=70 IG: n=35 CG: n=35	Age: years (SD): IG: 52.74 (11.01) CG: 49.91 (11.62)	Gender total group: n (%) M: 49 (70)/ F: 21 (30)	
Lee et al. (2018), South Korea	Quasi-experimental	Assessing effectiveness of active patient participation in the management of daily nursing goals (DNG) on function recovery and resilience in surgical patients	Patients recovering from digestive cancer surgery in a surgical ward - Hospital			IG: daily nursing goal (DNG) (goal setting and registration) GG: routine care
			Total: n=56 IG: n=29 CG: n=27	Age: years (SD): IG: 64.19 (10.42) CG: 58.44 (15.26)	Gender: n (%) IG: M: 15 (51.7)/F: 14 (48.3) CG: M: 13 (48.1)/F: 14 (51.9)	
Sayin & Aksoy (2012), Turkey	Quasi-experimental	Assessing effectiveness of analgesic education on pain in patients undergoing breast surgery	Patients undergoing a mastectomy/breast-conserving surgery – Hospital			IG: information about surgical pain and analgesics used postoperatively GG: information as usual
			Total: n=84 IG: n=42 CG: n=42	Age total: 63.1% were 38–57 years of age	Gender: n (%) F: 84 (100,0)	
Pain prevention intervention						
Numbing spray						
Balanyuk et al. (2018), Italy	RCT	Comparing efficacy of distraction vs. anesthetic cream (EMLA) for the reduction of pain during Peripheral Venous Catheterization (PVC)	Computerized Tomography (CT) or Nuclear Magnetic Resonance (NMR) patients - Hospital			IG: distraction technique (simple questions on different subjects) GG: application of EMLA
			Total: n=72 IG: n=36 CG: n=36	Age: years (SD): IG: 61.9 (16.2) CG: 63.0 (13.25)	Gender: n (%) IG: M: 21 (58.3)/F: 15 (41.7) CG: M: 25 (69.4)/F: 11 (30.6)	
Barbour et al. (2018), US.	RCT	Comparing efficacy of vapocoolant spray vs. placebo in reducing venipuncture pain	Adult patients undergoing venipuncture - Hospital			IG: vapocoolant spray GG: placebo spray (sterile water)
			Total: n=100 IG: n=50 CG: n=50	Age: years (SD): IG: 53.0 (13.4) CG: 51.5 (11.5)	Gender: n (%) IG: M: 19 (38)/F: 31 (62) CG: M: 27 (54)/F: 23 (46)	
Edwards & Noah (2017), USA	RCT	Comparing efficacy of Vapocoolant Spray vs. placebo spray in reducing pain during peripheral intravenous (PIV) catheter insertion.	Adult patients undergoing intravenous catheter insertion - Hospital			IG: vapocoolant spray (topical anesthetic) GG: placebo spray
			Total: n=72 IG: n=38 CG: n=34	Age: not reported	Gender: not reported	
Falotico & Ryan (2016), USA.	Quasi-experimental	Determining effectiveness of a numbing spray for anesthetizing an intravenous injection site	Same-day surgery patients needing an intravenous catheter - Hospital			IG: numbing spray (topical anesthetic) GG: standard care
			Total: n=100 IG: n=50 / CG: n=50	Age: not reported	Gender: not reported	
Special positioning						

Aydemir et al. (2018), Turkey	Quasi-experimental	Determining effectiveness of exaggerated lithotomy position on postoperative shoulder pain after laparoscopic cholecystectomy	Elective laparoscopic cholecystectomy patients - Hospital			IG: exaggerated lithotomy position GG: analgesic
			Total: n=102 IG: n=51 CG: n=51	Age: not reported	Gender not reported	
Choi & Chang (2018), South Korea	RCT	Comparing the incidence of post-dural puncture headache (PDPH) and backache after different periods of bed rest following spinal anesthesia	Patients who experienced a dural puncture - Hospital			IM group: immediate mobilization 4BR group: 4-h. bed rest 6BR group: 6-h. bed rest
			Total: n=119 IM : n=45 4BR: n=40 6BR: n=34	Age: years (SD): IM: 55.4 (14.8) 4BR: 56.7 (14.5) 6BR: 53.1 (15.6)	Gender: n (%) IM: M: 23 (51.1) /F: 22 (48.9) 4BR: M: 19 (47.5)/ F: 21 (52.5) 6BR: M: 18 (52.9)/ F: 16 (47.1)	
Pool et al. (2015), USA	RCT	Determining if raising the Head of Bed (HOB) during the first hour of bed rest to 15 degrees would impact patient comfort after cardiac angiography	Angiography patients in a cardiovascular recovery unit - Hospital			IG A: first 30 min. HOB: 15 degrees next 30 min. HOB: 0 degrees IG B: first 30 min. HOB: 0 degrees next 30 min. HOB: 15 degrees CG C: entire hour HOB: 0 degrees
			Total: n=71 IG A: n=23 IG B: n=24 CG C: n=24	Age: years (SD): IG A: 62.8 (12.5) IG B: 64.0 (13.1) CG C: 66.2 (11.8)	Gender: n (%) IG A: M: 18 (78.3)/F: 5 (21.7) IG B: M: 15 (62.5)/F: 9 (37.5) CG C: M: 17 (70.8)/F: 7 (29.2)	
Application of cold and warmth						
Bayındır et al. (2017), Turkey	RCT	Compare the efficacy of ice bag applications versus standard care in reducing catheter removal pain	Patients undergoing percutaneous coronary intervention – Hospital			IG: ice bag application to the femoral region (20 min) CG: standard care
			Total n = 104 IG: n = 52 CG: n = 52	Age, years (SD): IG: 62.1 (13.4) CG: 61.6 (12.7)	Gender, n (%) IG: M: 39 (75.0)/F: 13 (25.0) CG: M: 38 (73.1)/F: 14 (26.9)	
Biyik Bayram and Caliskan (2016), Turkey	RCT	Determine the effectiveness of local heat application before intravenous catheter insertion on pain	Patients receiving chemotherapy – Hospital			IG: heat application (10 min) to the arm before intravenous catheter insertion CG: standard care
			Total n = 80 IG: n = 40 CG: n = 40	Age, years (SD): IG: 55.22 (14.59) CG: 54.00 (10.23)	Gender, n (%) IG: M: 21 (52.5)/F: 19 (47.5) CG: M: 25 (62.5)/F: 15 (37.5)	
Chailler et al. (2010), Canada	RCT	Determine the effectiveness of cold therapy for the management of pain associated with deep breathing and coughing (DB &C) after cardiac surgery	Cardiac patients with sternal incisions – Hospital			Group 1: begin the DB & C sessions with frozen gel pack (20 min) Group 2: begin without frozen gel pack
			Total n = 32	Age total group, years (SD): 66 (7.17)	Gender total group, n (%) M: 25/F: 7	
Demir and Khorshid (2010), Turkey	RCT	Determine the effectiveness of cold application on pain during chest tube removal (CTR)	Patients recovering from cardiac surgery or sternotomy procedures – Hospital			IG: cold application pack CG1: room-temperature pack, placebo CG2: no application
			Total n = 90	Age total group, years (SD): 53.40 (14.04)	Gender total group, n (%) M: 53 (58.9)/F: 37 (41.1)	
Kol et al. (2013), Turkey	RCT	Evaluate the effectiveness of ice application for the control of pain associated with chest tube irritation	Patients who underwent thoracotomy with chest tube placement – Hospital			IG: cold gel packs CG: no cold therapy
			Total n = 40 IG: n = 20 CG: n = 20	Age, years (%): IG: 51.95 (12.8) CG: 55.05 (11.4)	Gender, n (%) IG: M: 13 (65)/F: 7 (35) CG: M: 14 (70)/F: 6 (30)	
Quinlan et al. (2017), United States	RCT	Evaluate the effects of localised cold therapy on pain in post-operative spinal fusion patients	Post-operative spinal fusion patients – Acute care facility			IG: cold therapy (cold packs) CG: no cold therapy
			Total n = 148 IG: n = 74 CG: n = 74	Age, years (SD): IG: 62.4 (11.7) CG: 61.4 (14.9)	Gender, n (%) IG: M: 32 (43.2)/F: 42 (56.8) CG: M: 26 (35.1)/F: 48 (64.9	
Special devices ('Buzzy')						
Pakiş Çetin and Çevik (2019), Turkey	RCT	Determine the effectiveness of vibration and cold application on pain during intravenous catheterisation (IV)	Adult patients who underwent intravenous catheterisation – Hospital			IG: vibration and cold gel pack before IV (Buzzy) CG: standard procedure
			Total n = 100 IG: n = 50 CG: n = 50	Age, years (SD): IG: 52.12 (12.47) CG: 47.04 (14.73)	Gender, n (%) IG: M: 30 (60.0)/F: 20 (40.0) CG: M: 28 (56.0)/F: 22 (44.0)	
Redfern et al. (2019), United States	RCT	Evaluate the effectiveness of thermomechanical stimulation (Buzzy) on post-procedure pain during vaccination	Adult employees presenting to annual influenza – Hospitals and community health centres			IG: Buzzy device (cold, vibration, and distraction) CG: standard injection protocol
			Total n = 497 IG: n = 250 CG: n = 247	Age, years (SD): IG: 44.4 (13.4) CG: 41.7 (12.9)	Gender, n (%) IG: M: 44 (17.6)/F: 206 (82.4) CG: M: 40 (16.2)/F: 206 (83.4)	
Şahin and Eşer (2018), Turkey	RCT	Assess the effectiveness of the Buzzy application on pain during intramuscular injections	Adult patients receiving intramuscular injections – Hospital			IG: Buzzy device (cold, vibration, and distraction) CG: standard injection protocol
			Total n = 65 IG: n = 33 CG: n = 32	Age, years (SD): IG: 51.58 (13.7) CG: 52.79 (12.9)	Gender, n (%) IG: M: 13 (39.39)/F: 20 (60.61) CG: M: 10 (31.25)/F: 22 (68.75)	
Special devices (two needle technique, shot-blocker, transcutaneous electrical nerve stimulation (TENS))						
Ağaç and Güneş (2011), Turkey	RCT	Compare the one-needle and two-needle techniques in reducing pain during administration of an intramuscular injection	Trauma patients receiving diclofenac sodium intramuscularly – Hospital			IG: two-needle technique CG: one-needle technique
			Total n = 100 IG: n = 50 CG: n = 50	Age total, years, range (SD) 43.2, 18-54 (9.8)	Gender total, n (%) M: 65 (65.0)/F: 35 (35.0)	
Emel et al. (2017), Turkey	RCT	Determine the effectiveness of a shot-blocker on relief of pain due to hepatitis B vaccine injection into the deltoid muscle	First-year students in need of a hepatitis B vaccine – University			IG: Shot-blocker (small, flat plastic device applied to skin for blocking pain signals) CG: routine vaccination
			Total n = 242 IG: n = 121 CG: n = 121	Age, years (SD): IG: 19 (1.69) CG: 19 (1.35)	Gender, n (%) IG: M:21 (17.4)/F:100 (82.6) CG: M:21 (17.4)/F:100 (82.6)	
Yılmaz et al. (2019), Turkey	RCT	Assess the effectiveness of transcutaneous electrical nerve stimulation (TENS) on post-operative pain after inguinal herniorrhaphy	Patients who had inguinal herniorrhaphy – Hospital			IG: transcutaneous electrical nerve stimulation CG: electrodes placed, but device not started
			Total: n = 52 IG: n = 26 CG: n = 26	Age, years (SD): IG: 44.96 (14.48) CG: 50.04 (15.04)	Gender, n (%) IG: M: 24 (49.0)/F: 2 (66.7) CG: M: 25 (51.0)/F: 1 (33.3)	

Abbreviations: Randomised controlled trail (RCT), Intervention Group (IG), Control Group (CG), Male, (M), Female (F) Intervention group 1 (IG1), Intervention group 2 (IG2), Intervention group 3 (IG3), Intervention group 4 (IG4), Standard deviation (SD)