Non-pharmacological interventions feasible in the nursing scope of practice for pain relief in palliative care patients: a systematic review

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Abstract

Background: Palliative care patients desire more symptom management interventions that are complementary to their medical treatment. Within the multi-professional team, nurses could help support pain management with non-pharmacological interventions feasible for their practice and adaptable to palliative care patients' needs.

Objectives: The objective was to identify non-pharmacological interventions feasible in the nursing scope of practice affecting pain in palliative care patients.

Design: A systematic review.

Data sources and methods: A defined search strategy was used in PubMed, CINAHL, PsycINFO, and Embase. Search results were screened double-blinded. Methodological quality was double-appraised with the Joanna Briggs Institute Critical Appraisal Tools. Data were extracted from selected studies and the findings were summarized. The methodological quality, quantity of studies evaluating the same intervention, and consistency in the findings were synthesized in a best-evidence synthesis to rank evidence as strong, moderate, limited, mixed, or insufficient.

Results: Out of 2385 articles, 22 studies highlighted non-pharmacological interventions in the nursing scope of practice. Interventions using massage therapy and virtual reality demonstrated most evidentiary support for pain management, while art therapy lacked sufficient evidence. Mindful breathing intervention showed no significant reduction in pain. Hypnosis, progressive muscle-relaxation-interactive-guided imagery, cognitive-behavioral audiotapes, wrapped warm footbath, reflexology, and music therapy exhibited promising results in pain reduction, whereas mindfulness-based stress reduction program, aromatherapy, and aroma-massage therapy did not.

Conclusion: Despite not all studies reaching significant changes in pain scores, non-pharmacological interventions can be clinically relevant to palliative care patients. Its use should be discussed for its potential value and nurses to be trained for safe practice. Methodologically rigorous research for non-pharmacological interventions in nursing scope of practice for pain relief in palliative care patients is necessary.

Trial registration: The protocol for this study is registered in the International Prospective Register of Systematic Review (PROSPERO registration number: CRD42020196781).

Keywords: complementary therapies, hospice and palliative care nursing, pain management, palliative care, symptom management

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Introduction

Palliative care aims to optimize the quality of life in patients with life-limiting illnesses. It prevents and relieves health-related suffering through early identification, correct assessment, and treatment of pain and other problems.[1] Pain is one of the most frequent and serious symptoms experienced by palliative care patients.[1] Pain management is required for patients experiencing pain suffering from incurable nonmalignant and malignant diseases.[1]

The total pain concept describes pain as a multidimensional experience with interacting components in physical, psychological, social, and spiritual dimensions.[2] Therefore, management of pain requires a multi-professional approach.[2] Besides conventional pharmacological interventions, prescribed by physicians, palliative care patients desire more symptom management interventions that are complementary to their medical treatment.[3] As part of a multi-professional team, pain management plays an important role in supporting palliative care patients. Various specialized professionals, including psychologists, physiotherapists, chaplains, and social workers, offer interventions and specialized knowledge to manage pain. Nurses are also a crucial part of this team, often being the first healthcare professionals to encounter patients' pain.[4] When interventions or techniques are general, nurses can incorporate them into their scope of practice. Therefore, by including non-pharmacological interventions (NPI) in the nursing scope of practice in patients' pain management plans, pain management can be improved.

For this study, NPI are set within integrative nursing and are defined as complementary interventions within the nursing scope of practice.[5] NPI can be classified based on their primary therapeutic input or their working mechanisms. For this review, NPI are classified according to their working mechanisms, using four modalities: (1) mind–body interventions, (2) biologically based treatments, (3) manipulative and body-based practices, and (4) energy therapies, as this classification system has less overlap between categories and supports the clarity of this review.[6] Mind–body interventions, such as meditation, are based on the human mind and affect the human body and physical health. Biologically based treatments involve natural substances, such as herbs or essential oils. Manipulative and body-based practices, such as massage therapy, consist of therapies involving movement or manipulation of one or more parts of the patients' body. Energy therapies, such as reiki or therapeutic touch, are defined as influencing and applying energy fields to the body.[7]

NPI could be beneficial for reducing pain through the stimulation of endorphin release enhancing natural pain killer cells, relaxation, and distraction by refocusing pain perception and relieving tension in the body.[3] Thereby, it can add value to a pain management plan by providing extra relief measures as well as reducing the doses of medication and potential side effects. Importantly, NPI can be adapted according to palliative patients' needs, for example, gentler techniques or other types of interventions because being touched is too painful or uncomfortable.[8] Additionally, NPI could benefit patients' ability to proactively participate in their pain management plan.[9] If appropriate, fitting the values, wishes, and needs of patients and their carers, patients could learn to apply some of the interventions themselves or by their informal caregiver without the interference of a nurse, having an immediate influence on pain and supporting autonomy. When training or getting instructions on interventions is considered to be an additional burden by patients or caregivers, support from nurses stays best suited.

There have been quite some efforts in research on complementary and integrative medicine across different fields and regarding symptom burden. Complementary therapies such as acupressure, acupuncture, aromatherapy massage, breathing, hypnotherapy, massage, meditation, music therapy, reflexology, herbal supplements, support groups, healing touch, and reiki are associated with a reduction in symptom burden of palliative care patients.[10,11] However, these complementary therapies are often administered or taught by a trained practitioner or expert, for example, acupuncture, or use of herbal supplement which entails specialized knowledge and training. The nursing scope of practice cannot accommodate these interventions. However, since nurses play a vital role in pain management and are part of a multi-professional team, integrating NPI into nursing practice can help support palliative care patients who are experiencing pain.

There is a lack of knowledge regarding NPI being feasible for nursing staff in care settings for pain relief in adult patients receiving palliative care. This systematic review aimed to identify NPI feasible in the nursing scope of practice affecting

Table 1. Best-evidence synthesis.[16,17]

Level of evidence	Minimum methodological quality	Minimum quantity	Consistency in findings	Conclusion for practice
Strong	High (⩾85%)	Three	Three high-quality studies agree If more than three studies, 3/4 of the medium and high-quality studies agree	Recommendation
Moderate	Medium (50–85%)	Two high quality OR two or more medium and one high quality OR three or more medium quality	Two high-quality studies agree OR two medium-quality studies and one high-quality study agree OR three medium-quality studies agree If more than three studies, more than 2/3 of the medium and high-quality studies agree	Consideration
Limited	Medium (50–85%)	One high quality OR two medium quality OR one medium quality and one high quality	If two studies (medium and/or high quality) agree If more than two studies, more than 1/2 of the medium and high-quality studies agree	Consideration
Mixed	Medium/low and high	Two	Findings from medium/low and high-quality studies are contradictory	Consideration
Insufficient	Low (⩽50%)		No high-quality studies, only one medium/high-quality study, and/or any number of low-quality studies	

pain in palliative care patients and to give nurses evidence-based interventions to support palliative care patients experiencing pain effectively.

Methods

Protocol and registration

This systematic review was conducted according to the *Cochrane Handbook for Systematic Reviews of interventions* and was written from 27 July 2020 until 28 August 2022. Results were described using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.[12] The completed PRISMA checklist is available in the Supplemental Material. This review is registered in the International Prospective Register of Systematic Review (PROSPERO registration number: CRD42020196781).[13]

Literature search

A literature search was conducted in electronic databases: MEDLINE through PubMed, CINAHL, PsycINFO, and Embase for studies assessing the efficacy of NPI in the nursing scope of practice for pain relief in palliative care patients. The final search was conducted on 15 July 2022. Specific terms were used according to the preferred terminology defined for each database. Medical subject heading terms, headings, thesaurus terms, and Emtree terms were used. Searches were based on the domain, determinant, and outcome (DDO) framework. The search terms were grouped per database according to the DDO framework and linked with Boolean operators into one search phrase. The defined search strategy was used for MEDLINE and was adapted to the other databases (see Appendix 1). From the eligible studies, reference lists were checked for other studies.

Eligibility criteria

Studies were eligible for inclusion when they involved adult patients (⩾18 years) with advanced and incurable diseases who received palliative care in a hospital, in outpatient care, or were admitted to a palliative ward/hospice. Eligible NPI were interventions that: (a) fit within the nursing scope of practice (e.g. music therapy with guitar is excluded whereas headphones are included), (b) can require instruction or training to secure safe practice of the interventions, and (c) is not restricted to in- or outpatient facilities (e.g. biofeedback with the use of sonogram is excluded). All types of quantitative effect studies and articles written in English or Dutch were eligible for inclusion. Studies stating a diagnosis of dementia or mild cognitive impairment were excluded to ensure reliability on pain scores. Case studies and qualitative design studies were excluded to be able to summarize NPI affecting pain scores. If interventions require specialized

knowledge or techniques, the studies are excluded because they do not fit within the nursing scope of practice.

Study selection

Results were screened double-blinded by two reviewers (SvV and EdG) on title and abstract using the online program Rayyan.[14] Differences in selection were discussed between reviewers, and a consensus was achieved for all selected studies.

Data extraction and study quality

Data extraction was conducted by one reviewer and recorded in a data-extraction table with items for (a) general characteristics of the study compromising author, year of publication, country, study design, sample, measuring scale used, data collection interval(s), and statistical analysis; (b) characteristics of the NPI used and the professional performing the intervention during study; and (c) results on pain scores.

The methodological quality in the included studies was assessed independently by two reviewers (SvV and HD) using the Critical Appraisal Tools from the Joanna Briggs Institute.[15] They were employed to determine whether a criterium was met, whether it was unclear if it was met, or if that criterion was not applicable.[15] One point was awarded for each criterion that was met. The number of points was summed and compared to the maximum points possible. If an item was not applicable, the maximum number of points was reduced by one item. The checklists for randomized controlled trials (RCTs) and quasi-experimental studies were used in accordance with the study designs. Differences in the appraisal were discussed with a third reviewer (EdG), and consensus was achieved between all reviewers concerning the methodological quality of all studies.

Best-evidence synthesis

A best-evidence synthesis approach was used to synthesize the data to allow reviewers to compare the outcomes of studies, taking into account the heterogeneity in the included studies in terms of interventions and outcome measures.[16] The best-evidence synthesis considers the methodological quality, quantity of studies evaluating the same intervention, and consistency in their findings to rank evidence as strong, moderate, limited, mixed, or insufficient.[16] The methodological quality of the studies was placed into three quality categories: high (⩾85%), medium (50–85%), or low (⩽50%).[17] A strong level of evidence indicated a recommendation for practice while moderate, limited, and mixed evidence indicated considerations for practice. The best-evidence synthesis described by Kennedy *et al.*[17] was adapted by the authors to determine and establish cutoff values and propose recommendations for daily practice for this systematic review.[17] The best-evidence synthesis is summarized in Table 1.

Results

Study selection

In total, 2385 studies were identified through database searching. Duplicates ($n=246$) were removed, and the first selection based on title and abstract resulted in 87 articles. Of these, 65 were excluded because (a) the intervention was not in the nursing scope of practice ($n=27$), (b) the sample did not include palliative patients or patients with advanced illnesses without curative options ($n=17$), (c) wrong outcome ($n=7$), (d) full-text was unavailable even after contacting the first author ($n=3$), (e) wrong publication type or a congress abstract ($n=6$), and (f) wrong study design ($n=5$). Of the eligible studies, reference lists were checked resulting in the addition of one study to this systematic review for a total of 22 studies. A flow chart of the study selection procedure is presented in Figure 1.

Data extraction and study quality

The included studies consisted of 12 quasi-experimental and 10 RCT's involving a total of 1463 patients (ranging from 14 to 380 patients). Patient settings were inpatient ($n=15$) and outpatient facilities ($n=7$). Pain was measured on the one-item pain scales of numerical rating scale (NRS) ($n=13$) and visual analog scale (VAS) ($n=8$), and one study used a combination of the VAS and NRS. All studies were published between 2000 and 2021. Cancer was the primary diagnosis of patients in all but one of the studies, and four studies also included a non-cancer diagnosis. Results of the NPI in the nursing scope of practice found in this review are divided and described into the four modalities.[8] Eight different interventions were ascertained on mind–body interventions, one for biologically based treatments and three for manipulative and body-based practices. No studies were found that could be ascertained

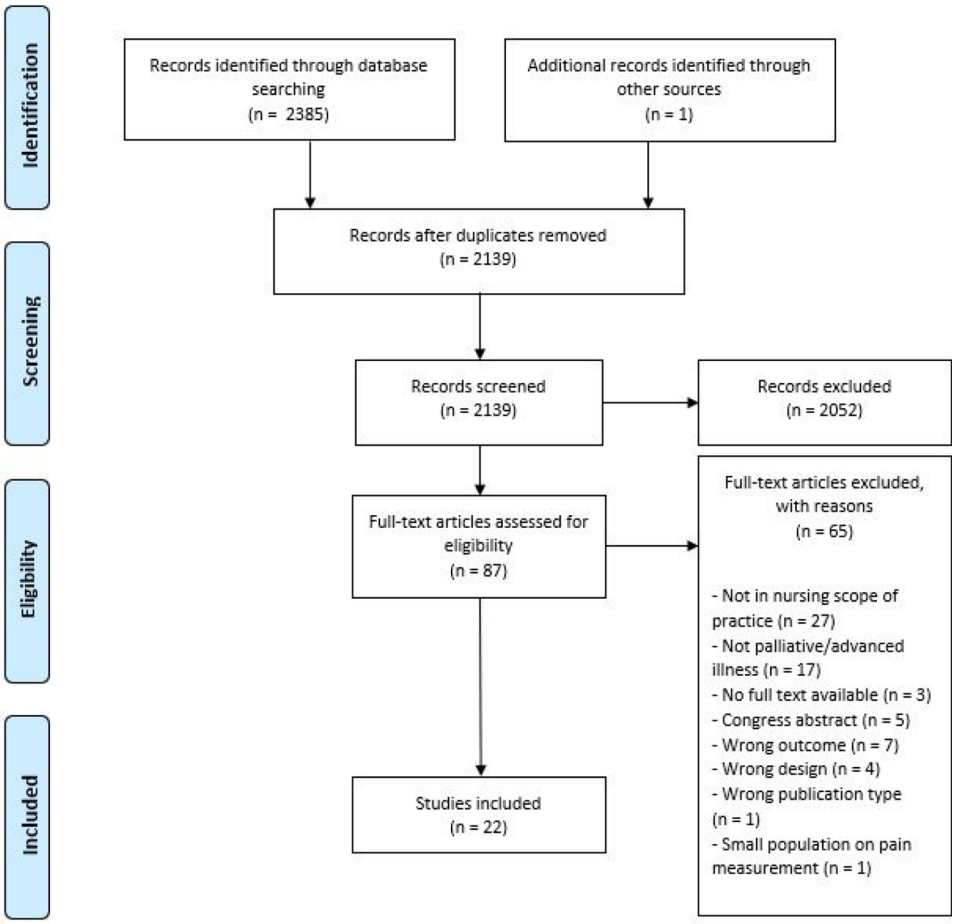

Figure 1. PRISMA 2020 flow diagram of selected studies.
PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

into the modality of energy therapies. The NPI studied were massage ($n = 6$),[18–23] mindful breathing ($n = 3$),[24–26] art therapy ($n = 2$),[27,28] aromatherapy massage ($n = 1$),[29] aromatherapy ($n = 1$),[30] progressive muscle-relaxation and interactive guide imagery (PMR-IGI) ($n = 1$),[31] mindfulness-based stress reduction (MBSR) program ($n = 1$),[32] cognitive-behavioral audiotapes ($n = 1$),[33] hypnosis ($n = 1$),[34] wrapped warm footbath ($n = 1$),[35] reflexology ($n = 1$),[36] virtual reality (VR) ($n = 2$),[37,38] and music therapy ($n = 1$).[39] An overview of the characteristics of the included studies is presented in Table 2.

The methodological quality was assessed for the individual studies. Of the RCTs, one study was rated as having high methodological quality,[18] eight with medium quality,[24–26,29,31,33,35–36] and one with low quality.[19] The low and medium-quality studies lacked consistent documentation on randomization, concealment of treatment groups, similar groups at baseline and analyzed in randomized groups, and blinding processes. Of the quasi-experimental design, three studies were rated as high methodological quality,[32,34,37] seven of medium quality,[20–22,27,30,38,39] and two as low quality.[23,28] The high-quality studies generally scored well on describing a control group, given similar treatment, and participants in any comparison being equal. Low-quality studies lacked these descriptions and did not measure multiple pre-intervention measurements when there were multiple post-intervention measurements. The quality assessment per item and an overall methodological quality appraisal are listed in Table 3.

Mind–body interventions. Within the modality mind–body interventions, eight different interventions were found.

Mindful breathing. Two studies reported a 20-min mindful breathing intervention, and one study described a 5-min mindful breathing intervention, guided breathing exercises were

Table 2. Study characteristics and data-extraction table.

References	Study design	Total participants + chronic/acute pain, characteristics mean ± SD, range, (*n*) and/or *n* (%)	Intervention(s) + professional performing the intervention during study	Data collection interval	Scale used	Data analysis (within/between groups)	Results (data of pain); mean ± SD
Mitchinson *et al.*[21] 2014 USA	Observational study	153 veterans with advanced illnesses; Chronic/acute pain: 70% preexisting chronic pain Age 65.2 ± 12.2; Gender (male) 146; Primary cancer site (105): lung (31), head and neck (17), gastrointestinal (25), genitourinary (16), hematologic (6), other (10) Primary non-cancer diagnosis (48): COPD (10), End-stage renal disease (6), congestive heart failure (8), dementia (5), other (19)	20–30 min massage: consisting of effleurage massage with some limited trigger point. Light to moderate pressure applied depending on patient's health. Professional: hospice and palliative medicine fellow or a member of the palliative care consultation team	Pretreatment and posttreatment	0–10 scale adapted from Well-Being Scale of Giasson 0 = no pain, 10 = severe pain	One-sided sign test Chi-square test	Mean change pain intensity 1.65 ± 2.14; Significantly decreased ($p < 0.001$) Chronic pain showed greater decrease in pain intensity compared to non-chronic pain patients Cancer patients showed greater decrease in pain intensity compared to non-cancer patients
Kutner *et al.*[18] 2008 United States	Randomized trial	380 hospice patients with advanced cancer; Chronic/acute: not stated Intervention group ($n = 188$)/Control group ($n = 192$): Age 65.2 (14.4%)/64.2 (14.4%); Gender (female) 120 (64%)/112 (58%); Primary cancer site: lung (48/48), breast (34/29), pancreas (13/22), colorectal (12/17), prostate (10/11)	Massage group ($n = 188$): 6× 30-min massage light/gentle effleurage (smooth/gliding strokes), petrissage (squeezing, rolling, and kneading the muscles) and myofascial trigger point release (concentrated finger pressure to painful localized areas in muscles). Masseur judgment dictated rhythm/rate/stroke frequency, sequence/mix of strokes, time spent each stroke, stroke length, and body area massaged. Control group (simple touch): placement of both hands for 3 min at each of the following locations bilaterally: base of neck, shoulder blades, lower back, calves, heels, clavicles, lower arms, hands, patellae, and feet. Professional: massage therapist	Pretreatment and posttreatment for immediate effect Weekly follow-up for sustained effect	Immediate effect: MPAC (0–10); 10 = worst pain Sustained effect: BPI scales for worst pain, least pain, pain on the average, pain right now (0–10); 0 = no pain, 10 = pain as bad as you can imagine	*T*-test (continuous); Chi-square test (categorical) Sustained outcome: comparison average of three post-baseline means and baseline mean Immediate outcome: average across means (all six visits)	Immediate outcome; Massage group ($n = 151$): −1.87 points improvement (95% CI: −2.07, −1.67); Clinically significant Control group ($n = 147$): −0.97 (95% CI: −1.18, −0.76) Mean difference: −0.9 (95% CI: −1.19, −0.61); Approaches clinical significance Both groups (massage $n = 171$, control $n = 177$) demonstrated statically, but not clinically, significant sustained improvements in pain
Jane *et al.*[22] 2009 Taiwan	Quasi-experimental	30 hospitalized cancer patients with bone metastases; Chronic/acute pain: not stated Age 51.7 ± 11.6; Gender (female): 19 (63%); Primary cancer site: lung (11), breast (11), head and neck (2), gastrointestinal (4)	45-min of massage therapy: hands-on and skin-to-skin manipulation of soft tissue of highly innervated (i.e. head, hand, feet) and less innervated (i.e. back, limbs) regions Professional: registered nurse	Pretreatment, posttreatment, short-term (20–30 min follow-up), intermediate (1–2.5 h) and long-term (16–18 h)	PPI with a vertical form of VAS (0–100 mm); 0 = no pain, 100 = pain as bad as it could be	Paired *t*-test Repeated measures analysis of variance	Baseline: 5.4 ± 1.2; Immediate effect: 3.1 ± 1.4 ($p = 0.000$); Short-term effect: 2.8 ± 1.8 ($p = 0.000$); Intermediate effect: 3.2 ± 2.0 ($p = 0.000$); Long-term effect: 3.8 ± 2.0 ($p = 0.000$) Most significant impact occurred 15 ($p < 0.002$) or 20 ($p < 0.000$) minutes after the intervention
Wilkie *et al.*[19] 2000 USA	Randomized clinical trial (pilot)	29 hospice patients; Chronic/acute pain: not stated Age 63 (3085); Gender (female): 21 (38%); Primary cancer site: lung (21%), breast (7%), prostate (7%), colorectal (10%), other (55%)	30–45 min full-body massage twice weekly massage for 2 weeks; Following strokes delivered: effleurage, light petrissage, nerve stroke, light compression, vibration, tapotement ($n = 15$) Control: usual hospice care ($n = 14$); Professional: massage therapists	Pretreatment and posttreatment (before and after each of four massages)	Pain Assessment Tool or Skilled Nursing Visit Report form (0–10); 0 = no pain, 10 = worst ever	Paired *t*-test (within groups) Independent *t*-test (between groups)	Control: Baseline: 1.6 ± 2.1, Outcome: 1.2 ± 1.3 Massage: Baseline: 2.4 ± 2.8, Outcome: 1.5 ± 1.4 Between groups: Baseline: $p > 0.43$, Outcome: $p > 0.73$

(Continued)

Table 2. (Continued)

References	Study design	Total participants + chronic/acute pain, characteristics mean ± SD, range, (*n*) and/or *n* (%)	Intervention(s) + professional performing the intervention during study	Data collection interval	Scale used	Data analysis (within/between groups)	Results (data of pain); mean ± SD
Pedersen *et al.*[23] 2017 Sweden	Observational study	41 patients at hospice ward; Chronic/acute pain: not stated Age 71 (38–95); Gender (female): 24 (59%); Primary diagnosis: advanced cancer (35), COPD (3), terminal heart failure (3)	Tactile massage: soft and superficial form of massage with slow strokes, light pressure and circling movement on the feet, hands, and/or back. Relaxing music played in the background for 15–45 min Professional: tactile masseuse	Pretreatment and posttreatment	ESAS (0–10); 0 = no pain, 10 = worst possible pain Rescue dose medication (opioids) 24 h before and after treatment	Paired *t*-test	Difference $p < 0.0001$ [Figure estimation] Pretreatment: 2.7, Posttreatment: 1.0 (*n*) of rescue doses Pretreatment: 1.8, Posttreatment: 0.8, $p = 0.0005$ Same patients 4 (control day 1) and 3 (control day 2) days before first treatment Control day 1: 1.8, Control day 2: 1.9, $p = 0.20$
Havyer *et al.*[20] 2020 USA	Single-arm pilot study	27 hospice patients; Chronic/acute pain: not stated Age: 77 (44–102); Gender (female): 10 (37%); Primary diagnosis: cancer 19 (70.4%), heart disease 2 (7.4%), pulmonary disease 1 (3.7%), dementia 1 (3.7%), renal disease 2 (7.4%), multisystem atrophy 1 (3.7%), parkinsonism 1 (3.7%)	Massage therapy (20–45 min sessions up to three sessions every 1–2 weeks) Professional: massage therapist	72 h prior to and after each session and final assessment 1 week after final session	ESAS-r	Sign rank test	Median change (final measure – baseline measure): 0 (−6 – 7), $p = 0.3787$
Soden *et al.*[29] 2004 United Kingdom	Randomized controlled trial	42 cancer patients in hospice; Chronic/acute pain: not stated Age 73 (44–85); Gender (female) 32 (75%); Primary cancer site: breast (15), lung (8), gastrointestinal (4), head and neck (4), prostate (3), other (8)	Aromatherapy group: 30-min back massage with lavender essential oil and an inert carrier oil (sweet almond oil) to a dilution of 1% Massage group: massage with an inert carrier oil only Control group: no massage Professional: not stated	Pretreatment and posttreatment (4 h after) Baseline and after 4 weeks follow-up	VAS (0–10 cm); 0 = least possible pain, 10 = worst possible pain	Paired *t*-test ANOVA	Mean change baseline – final assessment: Aromatherapy 0.19 ($p = 0.87$), Massage 0.32 ($p = 0.63$), Combined massage 0.25 ($p = 0.69$), Control group 0.78 ($p = 0.32$) Statistically significant reduction in both aromatherapy ($p = 0.03$) and combined massage ($p = 0.01$) after the second treatment
Louis *et al.*[30] 2002 United States	Quasi-experimental	17 in-home hospice patients; Chronic/acute pain: not stated Age 61.76 (42–79); Gender (female) 8 (47%); Terminal cancer 17 (100%)	60 min of humidified inhalation of 3% essential lavender oil (*Lavandula angustifolia*). Three drops of essential oil mixed with 5 cc of water in an electric potpourri pot at 4 ft from the subject (for 60 min a total of 30 drops and 50 cc water was used) ($n = 17$, same group as control) Control group: no intervention (day 1) ($n = 17$); Humidified water intervention group (day 2) (same group as control) Professional: self-applied by patients	Pretreatment and posttreatment	NRS (0–10); 0 = no pain, 10 = highest level of unbearable, excruciating pain	Paired *t*-test	Control group: Pretest: 1.38, Posttest: 1.70 Water group: Pretest: 2.09, Posttest: 1.66 Lavender group: Pretest: 1.59, Posttest: 1.25 Not statistically significant within groups
Lee *et al.*[32] 2017 South Korea	Prospective interventional	18 outpatients with metastatic breast cancer; Chronic/acute pain: not stated Intervention group/Control group: Age 52 (35–64)/57 (37–67); Median time diagnosis of metastasis and enrolment: 18 months; Metastatic lesion: Brain (1/1), lung (5/4), liver (4/3), bone (4/5), lymph nodes (4/6), anterior chest wall (3/3), skin (0/2), pleural effusion (1/0)	MBSR program: once a week, 2-h session for 8 weeks. Daily home practice with 54-min compact discs of mindfulness practices ($n = 9$) MBSR: body scan that concentrated on the body from head to toe to observe the sensations felt in each area, sitting meditation, some group discussions in which patients had time to share experiences, and mindfulness in communication and everyday life. Control group: usual care ($n = 9$) Professional: MBSR instructor	Pretreatment and posttreatment	Wisconsin Brief Pain Inventory. Pain intensity (0–10)	Wilcoxon signed-rank test	MBSR: Pretest: 3.44 ± 1.74, Posttest: 3.11 ± 2.09 Control group: Pretest: 1.78 ± 1.99, Posttest: 3.11 ± 2.57 Change was not statistically significant between groups ($p = 0.080$)

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Table 2. (Continued)

References	Study design	Total participants + chronic/acute pain, characteristics mean ± SD, range, (*n*) and/or *n* (%)	Intervention(s) + professional performing the intervention during study	Data collection interval	Scale used	Data analysis (within/between groups)	Results (data of pain); mean ± SD
Guan *et al.*[24] 2021 Malaysia	Randomized controlled trial	60 cancer patients from a palliative care unit; Chronic/acute pain: not stated Age 47.03 ± 16.46; Gender (female) 31 (51.7%); Primary cancer site: breast (16.7%), bone (18.3%), lungs (10%), hepatopancreatic (6.6%), esophageal (3.3%), nasopharyngeal (10%), prostate (5%), testicular (5%), brain (3.3%), cervical (1.7%), other (20%)	5-min mindful breathing ($n = 30$) Control: 5-min normal listening (list of semi-structured questions) ($n = 30$) Professional: psychiatrist trained in mindfulness therapy	Pretreatment and posttreatment T1: beginning of session, T2: immediately after completion of the session, T3: 5–10 min after completion session	10-point analog scale; 0 = no pain at all, 10 = severe pain	Student's *t*-test (within group T1–T2, T1–T3) Mann–Whitney (between group T1–T2, T1–T3)	Intervention group: T1: 4.12 ± 2.62, T2: 3.65 ± 2.5, T3: 3.48 ± 2.49, T1–T2: $p = 0.46$, T1–T3: $p = 0.32$ Control group: T1: 4.17 ± 2.62, T2: 3.93 ± 2.37, T3: 3.93 ± 2.37, T1–T2: $p = 0.72$, T1–T3: $p = 0.72$ Between-group analysis were not done as reduction of pain within group was not statistically significant
Look *et al.*[26] 2020 Malaysia	Randomized controlled trial	40 palliative care inpatients; Chronic/acute pain: not stated Intervention/control: Age: 66.75 ± 3.22/69.2 ± 2.54, Gender (female): 9 (45%)/11 (55%); Diagnosis: hepatobiliary and gastrointestinal malignancy 8 (40%)/8 (40%), lung malignancy 0/2 (10%), urological malignancy 1 (5%)/3 (15%), breast malignancy 1 (5%)/3 (15%), gynecological malignancy 3 (15%)/2 (10%), endocrine malignancy 1 (5%)/0, musculoskeletal malignancy 1 (5%)/0, nonmalignant 5 (25%)/1 (5%)	Single session 20-min mindful breathing: 4× 5-min guided breathing exercises with instructions to relax their body, focus their attention on their breathing and redirect attention back to their breathing when distracted ($n = 20$) Control group: 20-min conversation ($n = 20$) Professional: investigator	Pretreatment and posttreatment	ESAS (0–10); 0 = no symptoms, 10 = worst possible severity	Wilcoxon signed-rank test Mann–Whitney *U* test	Intervention group [median ([IQR])]: Pretest: 3.0 (4), Posttest 2.5 (6), $p = 0.468$ Control group: Pretest: 1.0 (5), Posttest: 2.0 (5), $p = 0.152$ Mean rank: Intervention: 23.2, Control: 17.8, $p = 0.149$
Beng *et al.*[25] 2018 Malaysia	Randomized controlled study	40 palliative care inpatients; Chronic/acute pain: not stated Intervention/control: Age: 56.9 ± 10.98/58.1 ± 14.53, Gender (female): 12/12	20-min mindful breathing Control group: 20-min supportive listening with semi-structured questions Professional: research assistants (MD)	T1: baseline, T2: during 5 min, T3: at 5 min, T4: during 20 min, T5: at 20 min	Numerical rating scale (0–10); 0 = no pain, 10 = worst possible pain	Independent samples *t*-test (between groups) Repeated measures analysis of variance (pairwise comparisons)	Intervention group: T1: 4.10 ± 2.67, T2: 2.45 ± 2.21, T3: 2.75 ± 2.29, T4: 1.85 ± 1.95, T5: 2.00 ± 2.10 Control group: T1: 3.35±3.39 T2: 3.00±2.99 T3: 2.95 ± 2.98 T4: 2.85 ± 2.96 T5: 2.95 ± 2.98 p-Values comparisons: T1(0.44), T2(0.51), T3(0.81), T4(0.22), T5(0.25) Mean difference (p): T2–T1: −1.65 (0.01), T3–T1: −1.35 (0.01), T4–T1: −2.25(0.00), T5–T1: −2.10 (0.00) Statistically significant reduction of pain score in the mindful breathing group but not in the control group
Anderson *et al.*[33] 2006 United States	Randomized controlled trial	57 ambulatory outpatients with cancer; Chronic/acute pain: chronic cancer-related pain Age 52 (30–80); Gender (female) 45 (79%); Primary cancer site: breast (38), prostate (5), multiple myeloma (8), lung (6)	Cognitive-behavioral audiotapes interventions: Positive mood group: 20-min audiotape including positive mood statements and positive imagery suggestions Relaxation group: 20-min audiotape including standard progressive muscle-relaxation instructions Distraction group: 20-min audiotape including topics as history, foreign language, geography, or vocabulary Waiting-list group: offered a choice of audiotapes from the other groups at third assessment (4–5 weeks after baseline) Professional: self-applied by patients	Pretreatment and posttreatment Follow-up T1 (baseline), T2 (week 2–3), T3 (week 4–5), T4 (week 8–9)	0–10 scale BPI (0–10 scale): change in BPI 'worst pain' ratings from T1 to T2	Paired *t*-test ANOVA across four time points	Mean reduction in pain scores: Distraction group: 1.16 (95% CI: 0.47, 1.85; $p = 0.004$) Relaxation group: 0.9 (95% CI: 0.16, 1.65; $p = 0.023$) Positive mood group: −0.08 (95% CI: −1.53, 0.138; $p = 0.91$) Pairwise comparisons at each time point indicated no significant differences between groups

(Continued)

Table 2. (Continued)

References	Study design	Total participants + chronic/acute pain, characteristics mean ± SD, range, (*n*) and/or *n* (%)	Intervention(s) + professional performing the intervention during study	Data collection interval	Scale used	Data analysis (within/between groups)	Results (data of pain); mean ± SD
De Paolis *et al.*[31] 2018 Italy	Randomized controlled Non-pharmacological trial	104 hospice patients; Chronic/acute pain: not stated Age 71.83 ± 11.57; Gender (female) 54 (48.07%); Primary cancer site: breast (7), gastrointestinal tract (22), genitourinary apparatus (18), reproductive organs (5), head and neck (6), lung (12), liver and pancreas (24), blood (1), other (8).	20-min PMR-IGI sessions ($n=46$): 4-min prolonged deep breathing and relaxation of the main muscle groups (PMR) Patients chooses script (e.g. walk along deserted beach, through woods), closing of the eyes, practitioner uses questions and prompts to participate in the scene (hear, smell, touch, taste), opening of the eyes, and contact with surroundings Control group: usual care ($n=45$) Professional: practitioner experienced with guided imagery	Pretreatment and posttreatment	NRS (0–10); 0 = no symptom, 10 = worst possible symptom intensity PID (NRS pretreatment–NRS posttreatment)	Paired *t*-test	PMR-IGI: Pretest: 4.11 ± 2.05, Posttest: 2.28 ± 2.15, PID: 1.83 Control group: Pretest: 4.51 ± 2.39, Posttest: 3.96 ± 3.04, PID: 0.55 PID was significant ($p<0.0001$) in both groups. The average value suggests a greater effect of the intervention group compared with usual care
Brugnoli *et al.*[34] 2018 Italy	Non-randomized clinical trial	50 outpatients of the pain therapy clinic; Chronic/acute pain: chronic Intervention group/Control group: Age 61 ± 13/67 ± 14, Gender(female) 19 (76%)/17 (68%); Diagnosis (severe chronic): Rheumatic 11 (44%)/10 (40%), Neurologic 7 (28%)/9 (36%), Cancer 7 (28%)/6 (24%)	1 and 2-years follow-up, both conventional pharmacological therapies. Hypnosis group: clinical and self-hypnosis ($n=25$); Control group: usual care ($n=25$) Techniques used: exercise 'warm hands', transferred symptoms techniques, positive visualization technique, desensitization of pain technique, self-hypnosis technique, self-hypnosis CD method Professional: primary investigator (MD)	Baseline, 1 year follow-up and 2 years follow-up	VAS (0–100 mm); 0 = no pain, 100 = worst imaginable pain Opioid use: yes/no	Students *t*-test ANOVA Chi-square test	Hypnosis group: Baseline: 81.9 ± 14.6, 1 year: 45.9 ± 13.8, 2 years: 38.9 ± 12.4 Control group: Baseline: 78.5 ± 14.8, 1 year: 62.1 ± 15.4, 2 years: 57.1 ± 15.9 Variance analysis indicated that the decrease in perceived pain was more significant ($p=0.0001$) in the hypnosis group patients after 1- and 2-year follow-up Hypnosis therapy was associated with a decreased risk of 66% of needing to increase the opioids treatment for pain control ($p=0.03$)
Lefèvre *et al.*[27] 2020 France	Mixed-method quasi-experimental	20 palliative care patients on palliative care unit; Chronic/acute pain: not stated Age 57.9 ± 11.5; Gender (female): 14 (80%); Primary cancer site: gastrointestinal (25%), breast (15%), blood (15%), melanomas (15%), head and neck (10%), urological (10%), other (10%)	Art therapy session using techniques: painting, drawing, photography, modeling, and sculpture. Patients choose technique and topic and could be assisted by a family member if they wished. Focus was on orientating the patient toward a positive affective state. Professional: art therapist	Pretreatment (5-min before) and posttreatment (5-min after)	ESAS (0–10); 0 = no pain, 10 = worst imaginable pain	Wilcoxon's test for paired sample	Pain improved from a median of 2 to a median of 1.3 ($p<0.001$) Art therapy sessions significantly reduced pain (–42%, Cohen's $d=0.59$)
Collette *et al.*[28] 2020 Spain	Pre-post single-arm intervention study	80 advanced cancer patients on tertiary hospital palliative care unit; Chronic/acute pain: not stated Age 60.2 ± 12.7; Gender (female): 41 (49%); Primary cancer site: colorectal 19 (22.9%), lung 14 (16.9%), breast 8 (9.6%), prostate 7 (8.4%), pancreas 5 (6%), hematologic 5 (6%), ovary 4 (4.8%), bone/soft tissues 4 (4.8%), other 17 (20.5%)	60-min daily/alternate-days art therapy consisting of drawing, painting, collage, and modeling. Professional: art therapist	Pretreatment and posttreatment Before the sessions, T1 after first session, T3 after third session, T5 after fifth session	ESAS (VAS); 10 = most severe pain	Wilcoxon signed-rank test	T1 pretest: 3.05, T1 posttest: 2.75, T3 pretest: 2.93, T3 posttest: 2.34, T5 pretest: 2.27, T5 posttest: 1.67 $p<0.005$ is all pre–post comparisons
Yamamoto *et al.*[35] 2011 Japan	Pilot experimental design	18 hospitalized patients with incurable cancer; Chronic/acute pain: chronic Intervention group/Control group: Age 50–59 (2/3); 60–69 (5/3), ⩾70 (2/3); Gender (female) (3/3); Primary cancer site: gastric (0/3), colon (2/2), liver (1/2), pancreatic (2/0), breast (0/1), uterine (1/0), bronchogenic (2/0), chronic myelogenous leukaemia (1/1)	Wrapped warm footbath procedure ($n=9$): lower legs and feet rubbed with olive oil (5 min), soak feet, modulation hot water 38°C and patient's legs wrapped with plastic bag and cover legs with blanket (20 min), wash feet with foamy body shampoo using cotton gloves (5 min). Control group ($n=9$): rest in recumbent position for 80 min. Professional: not stated	Pretreatment, three different treatment periods (different stages intervention), posttreatment	VAS (0–100 mm); 0 = painless, 100 = pain	Paired *t*-test	Footbath Pretest: 4.11 ± 2.58; Posttest: 1.78 ± 1.82; $T(2.347)$, $p=0.047$; average VAS decreased significantly Control group: Pretest: 2.44 ± 2.30; Posttest: 2.54 ± 2.54; $T(-0.245)$, $p=0.813$

(Continued)

Table 2. (Continued)

References	Study design	Total participants + chronic/acute pain, characteristics mean ± SD, range, (*n*) and/or *n* (%)	Intervention(s) + professional performing the intervention during study	Data collection interval	Scale used	Data analysis (within/between groups)	Results (data of pain); mean ± SD
Sikorskii *et al.*[36] 2020 United States	Randomized controlled trial	209 patients with advanced breast cancer; Chronic/acute pain: not stated Intervention group/Control group: Age 58.95 ± 11.32/55.54 ± 10.08; Metastatic (yes) 59 (58%)/66 (62%); Recurrent (yes) 31 (30%)/30 (28%)	30-min home-based reflexology session (*n* = 102): applying of firm walking motion pressure to specific areas on the feet referred to as reflexes (15 min/foot). At least one per week (for 4 weeks) Control group (*n* = 107): attention control Professional: caregivers	Weekly symptom assessment	MD Anderson Symptom Inventory (0–10); 0 = not present, 10 = as bad as you can imagine Cutoff points: 1 = mild, 2–4 = moderate, 5–10 = severe	Responders: Moved from (onset to last symptom assessment) - severe to moderate/mild - moderate to mild/none - remained mild Nonresponders: - mild to moderate/severe - moderate to severe - remained severe Odds ratios	Response/nonresponse (%) Reflexology: Severe (*n* = 44) 72/27, Moderate (*n* = 40) 38/62, Mild (*n* = 18) 100/0 Control: Severe (*n* = 44) 55/45, Moderate (*n* = 48) 29/71, Mild (*n* = 15) 100/0 Reflexology was more successful than attention control in producing response for pain. Odds ratio = 1.84; 95% CI: 1.05, 3.23; *p* = 0.03.
Niki *et al.*[37] 2019 Japan	Prospective multicenter, single-arm study	20 patients with terminal cancer from two palliative care wards; Chronic/acute pain: not stated Age 72.3 ± 11.9; Gender (female) 6 (30%); Primary cancer site: pancreas (3), uterus (2), lung (2), head and neck (2), prostate (2), kidney (2), biliary duct (2), other (5)	30-min VR travel session with VR headset HTC VIVE and free VR software Google Earth VR® Professional: self-applied by patients	Pretreatment and posttreatment	ESAS	Paired *t*-test For detecting moderate/severe symptoms the cutoff value is ⩾3 for pain	Before VR travel: 2.35 ± 2.25 After VR travel: 1.15 ± 2.03 (*p* = 0.005) Moderate/severe pain: Before VR travel (*n* = 10) 30%; After VR travel (n=3) 15% Significant improvement on pain for *n* = 15 (75%) that went to memorable places (*p* = 0.018). No significant improvements for *n* = 5 who went to places desired to visit, but never visited (*p* = 0.317).
Moscato *et al.*[38] 2021 Italy	Pre-post single-arm study	14 advanced cancer patients assisted within home-palliative care program; Chronic/acute pain: not stated Age 47.2 ± 14.2; Gender (female) 11 (78.6%); Primary cancer site: gastrointestinal (4), genital tract (2), hematological (2), breast (2), urinary (2), bone and soft tissues (1), endocrine (1)	At least one session of mirage sole VR with interactive and noninteractive contents. Noninteractive: immersive 360° videos with different natural and relaxing scenarios, such as a seascape, a park e.g.. Interactive: basic skill game 'Yuma's world' Average of 55 min per participant. Minimum of one session of 3 min Professional: self-applied by patients	Pretreatment and posttreatment	ESAS	Wilcoxon signed-rank test	T0: 1.06 ± 0.25, T1: 0.66 ± 0.1 Difference pre- and posttest: −37.73% (*p* ⩽ 0.01)
Krishnaswamy *et al.*[39] 2016 India	Comparative pilot study	14 cancer patients at a palliative care ward; Chronic/acute pain: not stated Intervention group/control group: Gender (female): 5 (71%)/3 (43%)	20-min music (instrumental music – Veena and Flute: combination of traditional Indian raga Anandabhairavi and modern contemporary tune) administered by headphones and MP3 player Control group: kept occupied with 20 min of talking to them Professional: self-applied by patients	Pretreatment and posttreatment	NRS (0–10); 0 = no pain, 10 = worst pain imaginable	Students *t*-test Two-sample *t*-test	Music Pretest: 5.43 ± 1.27, Posttest: 4.00 ± 1.29, Decrease 1.43 ± 0.78; Statistically significant (*p* = 0.003) Control Pretest: 5.86 ± 1.21; Posttest 5,71 ± 1.38; Decrease 0.14 ± 0.38; Not statistically significant (*p* = 0.356) Difference between groups: −1.71 ± 0.71. Statistically significant (*p* = 0.034)

BPI, Brief Pain Inventory; MBSR, Mindfulness-Based Stress Reduction; MPAC, Memorial Pain Assessment Card; NRS, numerical rating scale; PID, pain intensity difference; PMR-IGI, progressive muscle-relaxation and interactive guide imagery; PPI, present pain intensity; VAS, visual analog scale; VR, virtual reality; ESAS-r, Edmonton System Assessment System-revised; IQR, Interquartile range.

Table 3. Critical appraisal .[15]

Questions checklist RCT	Yamamoto *et al.*[35]	Sikorskii *et al.*[36]	Soden *et al.*[29]	Anderson *et al.*[33]	Kutner *et al.*[18]	De Paolis *et al.*[31]	Wilkie *et al.*[19]	Guan *et al.*[24]	Look *et al.*[26]	Beng *et al.*[25]
Was true randomization used for assignment of participants to treatment groups?	U	N	Y	Y	Y	U	U	Y	Y	Y
Was allocation to treatment groups concealed	U	U	Y	Y	Y	Y	U	U	Y	U
Were treatment groups similar at the baseline?	Y	Y	N	Y	Y	U	U	U	Y	Y
Were participants blind to treatment assignment?	U	N	N	N	Y	N	N	U	N	N
Were those delivering treatment blind to treatment assignment?	N	N	U	N	N	N	N	N	N	N
Were outcomes assessors blind to treatment assignment?	N	U	Y	N/A	Y	N	Y	N	N	N
Were treatment groups treated identically other than the intervention of interest?	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analyzed?	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Were participants analyzed in the groups to which they were randomized?	N	U	U	Y	N	N	Y	Y	Y	Y
Were outcomes measured in the same way for treatment groups?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were outcomes measured in a reliable way?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was appropriate statistical analysis used?	Y	Y	U	Y	Y	Y	Y	N	Y	Y
Was the trial design appropriate, and any deviations from the standard RCT design accounted for in the conduct and analysis of the trial?	Y	Y	Y	Y	Y	Y	N	Y	Y	Y
Overall appraisal*	7/13	7/13	8/13	10/12	11/13	7/13	5/13	8/13	9/13	9/13
Methodological quality	54%	54%	62%	77%	85%	54%	39%	62%	69%	69%

*The number of points were summed and compared to the maximum points possible. If an item was not applicable, the maximum number of points was reduced by one item.
Green = high methodological quality, orange = medium and red = low.
N, no; N/A, not applicable; RCT, randomized controlled trial; U, unclear; Y, yes.

	Brugnoli *et al.*[34]	Louis and Kowalsk[30]	Lee *et al.*[32]	Krishnaswamy and Nair[39]	Jane *et al.*[22]	Niki *et al.*[37]	Mitchinson *et al.*[21]	Lefèvre *et al.*[27]	Pedersen and Björkhem-Bergman[23]	Collette *et al.*[28]	Havyer *et al.*[20]	Moscato *et al.*[38]
Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	Y	Y	Y	Y	Y	Y	U	U	Y	U	Y	Y
Were the participants included in any comparisons similar?	Y	Y	Y	U	Y	Y	Y	Y	N	N	N	Y
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Y	Y	Y	N	Y	Y	U	U	U	Y	Y	N
Was there a control group?	Y	N	Y	Y	N	N	N	N	N	N	N	N
Were there multiple measurements of the outcome both pre and post the intervention/exposure?	Y	Y	Y	Y	N	Y	Y	Y	N	N	N	Y
Was follow-up complete and if not, were differences between groups in terms of their follow-up adequately described and analyzed?	Y	Y	Y	Y	Y	Y	Y	N	Y	N	Y	Y
Were the outcomes of participants included in any comparisons measured in the same way?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Were outcomes measured in a reliable way?	Y	U	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Was appropriate statistical analysis used?	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	U	Y
Overall appraisal*	9/9	7/9	9/9	7/9	7/9	8/9	5/9	5/9	4/9	3/9	5/9	7/9
Methodological quality	100%	78%	100%	78%	78%	89%	56%	56%	44%	33%	56%	78%

*The number of points were summed and compared to the maximum points possible. If an item was not applicable, the maximum number of points was reduced by one item.
Green = high methodological quality, orange = medium and red = low
N, no; N/A, not applicable; U, unclear; Y, yes.

provided in all of them.[24–26] A single session of 20 min of mindful breathing did not significantly reduce pain (−0.5 points; $p = 0.468$), and the control group consisting of 20 min of conversation also did not reach statistical significance (+1.0; $p = 0.152$). Compared with the control group, the latter intervention was not significantly reducing pain ($p = 0.149$).[26] Another 20-min mindful breathing intervention was compared to an active control group consisting of supportive listening. A within-group analysis showed a statistically significant pain score reduction at all intervals compared to baseline (−1.35–(−2.25), $p = 0.0$–0.1) in the intervention group but not in the control group. The between-group comparison showed no statistically significant improvements in pain scores at all intervals up to 20 min ($p = 0.22$–0.81).[25] The 5-min mindful breathing intervention showed no statistically significant reduction in pain scores in comparison to active control (5 min of normal listening) within and between groups ($p > 0.05$).[24]

Art therapy. Two studies outlined art therapy interventions.[27,28] The art therapy session in which patients chose techniques of painting, drawing, photography, modeling, and sculpturing improved pain from a median of 2.0 to a median of 1.3 ($p < 0.001$).[27] A 60-min daily or alternate-day art therapy session with techniques of drawing, painting, making a collage, and modeling showed significant pain score reduction after one, three, and five therapy sessions (T1 = −0.3, T3 = −0.59, T5 = −0.6; $p < 0.005$).[28]

Progressive muscle-relaxation and interactive guided imagery. The PMR-IGI intervention consisted of 4-min prolonged deep breathing guided with a chosen script (IGI) and relaxation of the main muscle groups (PMR). The study described that the within-group pain intensity difference (PID) was significant in the intervention group (PMR-IGI) as well as in the control group (usual care). The mean PID between the PMR-IGI and control group was 1.28 (95% CI: 0.30, 2.26). Based on the average value, a greater effect was found in the intervention group (PID = 1.83, $p < 0.0001$) in comparison with usual care (PID = 0.55, $p < 0.0001$).[31]

MBSR program. The MBSR program consisted of: a body scan that concentrated and gave attention to the body from head to toe to observe and experience the sensations felt in each area of the body, sitting meditation, some group discussions in which patients had time to share experiences, and mindfulness in communication and everyday life. The intervention was once a week for 8 weeks with a duration of 2 h and also daily home practice with 54 min of mindfulness practices from compact discs. This study reported the effect of improving average pain (−0.33 points) compared to the control group (+1.33). A change in scores was not statistically significant between groups ($p = 0.080$).[32]

Cognitive-behavioral audiotapes. The cognitive-behavioral audiotapes intervention used 20-min audiotapes including: (a) positive mood statements and positive imagery suggestions; (b) standard progressive muscle-relaxation instructions; and (c) topics on history, foreign language, geography, or vocabulary. This study showed patients in the relaxation-tape group (−0.9, 95% CI: 0.16, 1.65; $p = 0.023$) and distraction-tape group (−1.16, 95% CI: 0.47, 1.85; $p = 0.004$) reported significantly reduced pain intensity immediately after listening to the tapes. No significant differences in pain intensity were found at the 2-week follow-up.[33] Pairwise comparisons at each time point indicated no significant differences between the groups.

Hypnosis. The hypnosis intervention used the following techniques: the exercise 'warm hands', transferred symptoms techniques, positive visualization technique, desensitization of pain technique, self-hypnosis technique, and self-hypnosis on compact disc method. It showed a statistically significant decrease in perceived pain in the hypnosis group after 1- and 2-year follow-up compared to the control group (95% CI: −23.1, −9.3). The pain scores on a 100-point scale decreased from 81.0 baseline to 45.9 after 1-year follow-up, to 38.9 after 2-year follow-up ($p = 0.0001$). The scores in the control group were 78.5, 62.1, and 57.1, respectively. The hypnosis therapy was associated with a decreased risk of 66% of needing to increase opioids treatment for pain control ($p = 0.03$).[34]

Virtual reality. Two studies described a VR intervention.[37,38] The VR intervention with Google Earth software in which patients could 'travel' to a familiar or desired place reported significantly improved observed pain (2.35 ± 2.25 to 1.15 ± 2.03, $p = 0.005$), with 30% of patients reporting moderate to severe pain before VR travel and 15% after VR travel.[37] Specifically, pain significantly improved for those who 'traveled' to

memorable places ($p = 0.018$). For the patients who virtually went to places they desired to visit but never had, pain scores did not statistically differ ($p = 0.317$).[37] A VR intervention with noninteractive and/or interactive contents significantly improved pain (1.06 ± 0.25 to T1: 0.66 ± 0.1, $p \leqslant 0.01$). There was no minimum or maximum on usage time nor on the number of sessions.[38]

Music therapy. One music intervention consisting of 20 min of listening to music administered by headphones with instrumental Indian music showed a statistically significant reduction in pain scores in the music group (-1.43 ± 0.78, $p = 0.003$). The control group that was kept occupied with 20 min of talking to them showed no statistically significant results in pain scores ($p = 0.356$). Compared with the control group, the music group significantly reduced posttreatment pain scores (-1.71 ± 0.71, $p = 0.034$).[39]

Biologically based treatments. There was one intervention found within the modality biologically based treatments.

Aromatherapy. The aromatherapy intervention consisting of 60 min of humidified inhalation of 3% essential lavender oil did not reach a significant statistical reduction in pain scores after both the lavender treatment (−0.34 points, 0–10 scale) and the humified water (active control group) (−0.43 points) compared with the control group (no intervention) (+0.32 points).[30]

Manipulative and body-based practices. Three different interventions were found within the modality manipulative and body-based practices.

Massage. Seven studies investigated massage interventions. The massage techniques that were primarily used included effleurage (smooth and sliding strokes), petrissage (squeezing, rolling, and kneading the muscles), and trigger point release (concentrated finger pressure). Multiple sessions were conducted in three studies,[18–20] whereas there was only one massage session for the remainder. The duration of a massage session fluctuated between 15 and 45 min per session across the studies.

A 20- to 30-min massage intervention consisting of smooth and sliding strokes (effleurage) with some pressure on trigger points reported significantly decreased pain intensity by 1.65 ± 2.14 (0–10 scale, $p < 0.001$).[21] A massage group was compared with an active control group (simple touch). It consisted of six sessions of a 30-min massage consisting of light effleurage, squeezing, rolling, and kneading of the muscles (petrissage), and trigger point release. In both groups pain scores immediately improved with the massage group with −1.87 points (0–10 scale, 95% CI: −2.07, −1.67) and the control group with −0.97 points (95% CI: −1.18, −0.76). The mean difference between study arms (−0.9, 95% CI: −1.19, −0.61; $p < 0.001$) showed massage as the better intervention for improving pain intensity, and there were no between-group differences over time in pain or analgesic medication use.[18] One full-body massage intervention of 45 min showed immediate, short-term, intermediate, and long-term effects ($p = 0.000$) on pain intensity. The most significant impact occurred 15 ($p < 0.002$) or 20 min ($p < 0.000$) after the intervention.[22] Another massage intervention consisted of a 30- to 45-min full-body massage twice weekly for 2 weeks. The massage therapy intervention was compared with a control group receiving usual care. Pain intensity significantly reduced immediately after the massages. Compared at baseline, the massage group reported higher pain intensity (0–10 scale, 2.4 ± 2.8) than the control group (1.6 ± 2.1). On average, pain decreased by 42% for the intervention group compared to 25% for the control group ($p > 0.05$). Massage therapy significantly reduced pain intensity immediately after the first and third massages but did not reach statistical significance after the fourth massage ($p < 0.09$).[19] Tactile massage intervention which consisted of a soft and superficial form of massage with slow strokes, light pressure, and circling movement on the feet, hands, and/or back for 15 to 45 min reported pain improvement by 1.7 points (SD 1.6). Additionally, the rescue doses for pain were reduced from 1.6 to 0.84 doses/patient ($p = 0.0005$) compared with the same patients as controls ($p = 0.20$).[23] One study reported on massage therapy sessions lasting for 20–45 min and applied up to three sessions every 1–2 weeks. It showed a median change of pain intensity scores of 0 (−6.0, 7.0), indicating no significant temporal change in pain ($p = 0.378$).[20] The aromatherapy back massage intervention that lasted for 30 min using lavender essential oil and sweet almond oil showed statistically significant pain score reduction in the aromatherapy massage group (−1.15, $p = 0.01$) and in the aromatherapy group (−1.55, $p = 0.03$) after the second of four massages. The mean change from baseline to the final assessment did not show a

statistically significant reduction in pain scores in the aromatherapy ($p = 0.87$), massage ($p = 0.63$), combined massage ($p = 0.69$), and control group ($p = 0.32$). There were no significant long-term benefits of improving pain control with aromatherapy or massage.[29]

Wrapped warm footbath. Wrapped warm footbath is an intervention that entails the following procedure: lower legs and feet are rubbed with olive oil, soaking of the feet, modulation of hot water to 38°C, patient's legs wrapped with a plastic bag, covering of the legs with a blanket, and washing feet with foamy body shampoo using cotton gloves.[35] This study reported that changes in VAS scores (4.11 ± 2.58 to 1.78 ± 1.82) showed that the wrapped warm footbath gave significant pain relief ($p = 0.047$) compared to the control group (2.44 ± 2.30 to 2.54 ± 2.54, $p = 0.813$).[35]

Reflexology. One study described a home-based reflexology intervention on the feet and entails applying firm walking motion pressure to specific areas on the feet, referred to as reflexes, for 15 min/foot. The intervention was applied once per week for 4 weeks and was more successful in its effect on pain than the attention control (odds ratio = 1.84; 95% CI: 1.05, 3.23; $p = 0.03$).[36]

Best-evidence synthesis. Moderate evidence was ascertained for the use of massage therapy interventions based on two studies of low quality, four of medium quality, and one of high methodological quality. One study of low methodological quality did not have significant improvements in pain scores ($p < 0.05$), whereas the remainder did find significant improvement in pain scores. For the aromatherapy massage intervention insufficient evidence was found based on one medium methodological quality study not reaching statistical significance.

Moderate evidence for no effect was determined for mindful breathing interventions based on three medium methodological quality studies that failed to reach statistical significance.

Limited evidence was found for the VR intervention based on one medium and one high methodological quality study for which both reached statistically significant reduced pain scores. For one intervention, the reduction in pain scores was only statically significant when patients virtually visited a memorable place.

Insufficient evidence was found for the art therapy interventions based on one medium and one low methodological quality study for which both reached statistically significant reduced pain scores.

All other interventions were single studies with different methodological qualities; therefore, insufficient evidence was found for these interventions.

In order of the level of methodological quality of the study and the intervention reaching statistically significant reduction in pain scores, insufficient evidence was found for: (a) hypnosis, based on one high methodological quality study with a statistically significant reduction in pain scores immediately and at the 1- and 2-year follow-up and (b) PMR-IGI, cognitive-behavioral audiotapes, wrapped warm footbath, reflexology, and music therapy based on one medium methodological quality study.

In order of the level of methodological quality of the study and the interventions not reaching statistical significant reduction in pain scores, insufficient evidence was found for: (a) MBSR based on one high methodological quality study that failed to reach statistical significance even at the follow-up of 8 weeks and home-practice exercises and (b) aromatherapy intervention based on one medium methodological quality study that did not reach statistically significant results on pain reduction.

An overview of the results of the best-evidence synthesis is provided in Table 4.

Discussion

Main findings

The objective of this systematic review was to identify NPI in the nursing scope of practice to help manage pain in palliative care patients. This review found moderate evidence supporting the use of massage therapy and limited evidence for the use of VR in reducing pain. Art therapy, which did show significant pain reduction, had insufficient evidence to support its use. Moreover, moderate evidence was found that mindful breathing did not reduce pain. All other interventions were insufficiently investigated. Hypnosis, PMR-IGI, cognitive-behavioral audiotapes, wrapped warm

Table 4. Results of the best-evidence synthesis.

Intervention	Methodological quality per study	Level of evidence*
Statistically significant pain reduction		
Massage	Two low, four medium, and one high	Moderate
VR	One high and one medium	Limited
Art therapy	One low and one medium	Insufficient
Hypnosis	One high	Insufficient
PMR-IGI, audiotapes, wrapped warm footbath, reflexology, and music therapy	One medium	Insufficient
Not statistically significant pain reduction		
Mindful breathing	Three medium	Moderate
MBSR and aromatherapy	One high	Insufficient
Aromatherapy massage	One medium	Insufficient

*Colors are consistent with methodological quality table and based on the determined level of evidence found.
Orange = moderate or limited evidence, Red = insufficient evidence.
MBSR, Mindfulness-Based Stress Reduction; PMR-IGI, progressive muscle-relaxation and interactive guide imagery; VR, virtual reality.

footbath, reflexology, and music therapy showed promise in reducing pain. However, MBSR, aromatherapy, and aroma-massage therapy did not. Although some interventions showed positive results on pain reduction, the evidence is still insufficient due to the small number of studies per intervention. Based on the available evidence, massage therapy and VR are the most recommended NPI for nurses to use in pain management. Art therapy had insufficient evidence due to lower quality studies but showed potential due to significant reduction in pain scores. Art therapy has potential but requires more research. Mindful breathing did not support pain management.

Implications for practice

Despite not always finding a statistical significance or being a low methodological quality study, the potential of NPI in this systematic review should not be overlooked. The studies included in this review did not state or report any adverse effects. All studies showed an immediate short-term change in pain scores. For palliative care patients, these possible benefits without any identified risks could be valuable in their pain management. Nurses are essential in the identification of pain, providing pain management (information and interventions), and evaluating its effect.[4] The NPI identified all fit within the nursing scope of practice, either by providing information and/or providing NPI. Most interventions found were not delivered by nurses, but by other professionals. Therefore, to ensure safe practice of these interventions instructions or training of nurses is advised and/or presence of the professional in administering the interventions when instructing patients, providing physical touch, or actively participating in the intervention.[40] If appropriate, certain NPI can be easily self-administered by patients themselves or their informal caregivers, promoting autonomy and a sense of control.

With the feasibility of the NPI to nursing scope of practice, nurses can help alongside the multi-professional team in direct pain management in palliative care patients. The local context matters for the feasibility of the interventions in the nursing scope of practice. The fact that nurses can perform or learn these interventions can increase the transfer to other contexts, of course the availability of resources is a possible limiting factor in this transfer.

Comparisons with literature

The NPI with evidentiary support identified in this review, VR, massage therapy, and art

therapy, a promising trend is seen in comparison with other studies. A systematic review on the effect of VR on acute pain stated that 83% of all studies found ($n = 23$) reported pain reduction while using VR compared with no VR use.[41] This review highlights the importance of acknowledging the patient's sense of presence and levels of immersion, interaction, and interest when deploying VR, which will also be very important in palliative care, taking the vulnerable cognition into account.[41] Visual art therapy in general cancer care showed that program-based art-making may provide participants with opportunities for learning about themselves, support, enjoyment, and distraction. Learning about self-management of pain and a sense of control were also mentioned within the individual art-making.[42] The distraction component is something that was apparent in many studies identified in this systematic review as well the presence and engagement with others may have reduced the pain scores.[42] Massage therapy is a common practice proposed for many painful conditions. Its potential is thoroughly researched, as various conditions may respond differently to massage. In the evidence map-article on massage for pain, the authors identified 49 systematic reviews on this topic.[43] The authors state that the conclusions have a low strength of evidence because few primary studies with large samples and rigorous methods had been conducted, leaving knowledge gaps about specific massage types for specific pain.[43] In this systematic review the evidence on massage therapy was found within the same population of interest, palliative care patients. Within the best-evidence synthesis, massage therapy interventions were compared, and they had some comparisons in massage techniques that were used and differences in duration and frequencies.[43] The findings were contradictory within immediate and sustained outcomes, and the methodological quality differed between studies. The trend showed that most massages statistically significantly reduced pain.[43]

Strengths and limitations

This systematic review has some strengths and limitations. One strength is its adherence to a reproducible methodology outlined in the *Cochrane Handbook for Systematic Reviews of I*nterventions. Furthermore, various stages of the review were double-checked such as the detailed search strategy, title and abstract selection, and the methodological quality of individual studies. Another strength is the use of a best-evidence synthesis to draw a conclusion from the found evidence despite the heterogeneity of the interventions, subjective measurement tools, and differences in populations.

This systematic review also had some limitations. Studies could have been missed that were written in languages other than English or Dutch. Despite contacting the authors, three articles remained unavailable in full-text. Therefore, not all current information could be presented, potentially influencing the conclusion. A couple of limitations had an influence on the generalizability of this review. Most studies had pretest and posttest measurement(s). Some studies examined the immediate and sustained effect of the intervention on pain scores. The sustained effect varied from hours after intervention delivery to 8–9 weeks using the intervention. One study assessing hypnosis and self-hypnosis had a long-term follow-up of 1 and 2 years and was performed on outpatients of a pain therapy clinic with varying chronic diagnoses. A long-term follow-up might have been possible due to these patients having a different life expectancy than the participants in the other studies. The baseline pain scores were also high, and their referral to the pain clinic might indicate that this intervention could be helpful for palliative care patients with severe chronic pain conditions. Referral to the pain clinic is indicated for patients with more severe pain, this can influence the effect of intervention in terms of pain scores. Many studies did not specify the type of pain, acute or chronic, for which the intervention was provided. This also applies to this review on the total pain experience. Also, most studies assessed the effects of the intervention on symptom burden, such as anxiety of distress. Although this fits the total pain approach, a direct pain-relieving factor is difficult to ascertain. For several studies, it remains unclear whether the intervention was fully accountable for the change in pain scores or if it was partly due to the attention given to the palliative care patients. Various study designs were used, and what was considered 'control' differed among them. Depending on what is considered as an NPI, the active control groups of a study may be considered as another NPI. Another limitation on generalizability was the country- or culture-specific interventions. A study on music therapy was conducted in India, utilizing a particular type of traditional music. It is possible that the results may differ if the intervention is tested in a different country, suggesting that

culture-specific music may be more effective in reducing pain scores rather than Indian music itself. Other interventions are not limited to a specific culture. Therefore, the application of such studies should be assessed as the intervention techniques may vary depending on the country. Some studies had a small sample size concerning the generalizability of the results to the population of palliative care patients. Although getting a large enough sample in this vulnerable group of patients is a challenge at the onset, the results could be falsely concluded because the true effect can be underestimated due to the smaller sample sizes.

The studies were divided into the four modalities of NPI according to the Dutch national standard. Results could have been grouped differently when divided into the international standard for complementary therapies provided by the National Center for Complementary and Integrative Health. No studies were ascertained into the modality of energy therapies. This might be due to this review assessing their effect on pain and not on other symptoms or energy therapies being researched in other populations other than palliative care patients. For the population of oncology patients and patients with chronic illnesses, reviews were found on the use of energy therapies. A review on energy therapies in general oncology nursing showed that reiki, therapeutic touch, and healing touch are used to help patients feel relaxed, calm, or soothed; to decrease anxiety; improve the ability to fall asleep and stay asleep; reduce pain; and increase inner peace.[44] It showed the potential of this modality on the value for cancer patients.[44] A review of energy healing on chronic illnesses indicated some improvement in illness symptoms; however, high-level evidence consistently demonstrating efficacy is lacking.[45] Furthermore, it is unclear which elements of energy healing interventions are associated with positive outcomes.[45] Both reviews show promising results on symptom management and quality of life and thus robust trials to assess its effect on pain scores in palliative care patients are necessary.

To increase the level of evidence for NPI, more clinical trials should be performed, comparing NPI and studying the length of their effect. Besides, studies should include a thorough description of the intervention and the comparison, including the professional performing the intervention and the definition and measure of the outcome of interest.

Conclusion

This systematic review identified studies of NPI in the nursing scope of practice for pain relief in palliative care patients. VR, massage therapy, and art therapy are NPI identified with the most evidentiary support within the best-evidence synthesis. VR and massage therapy have moderate and limited evidence and art therapy has insufficient evidence to support pain management. Despite not all studies reaching statistically significant changes in pain scores, the changes can be clinically relevant to palliative care patients as there are no adverse effects. All NPI can be applied in pain management in which the palliative care patients' needs and wishes, together with disease progression and contra-indications are to be reviewed. Nurses would need specific instructions or training to deliver most of the interventions to ensure safe practice. Evidence-based NPI in the nursing scope of practice have a possible influence on pain and thereby on patients' quality of life and care in an end-of-life situation. In educating nurses, awareness should be increased about their competencies and tasks with regard to NPI in pain management for their patients. It should be discussed with the patient for consideration because of its potential value, however, methodologically rigorous research for NPI in the nursing scope of practice for pain relief in palliative care patients is still a necessity.

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Author contributions

Suzan van Veen: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Validation; Visualization; Writing – original draft; Writing – review & editing.

Hans Drenth: Formal analysis; Supervision; Validation; Visualization; Writing – original draft; Writing – review & editing.

Hans Hobbelen: Formal analysis; Visualization; Writing – review & editing.

Evelyn Finnema: Formal analysis; Visualization; Writing – review & editing.

Saskia Teunissen: Conceptualization; Methodology; Writing – original draft.

Everlien de Graaf: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Supervision; Validation; Visualization; Writing – original draft; Writing – review & editing.

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Supplemental material
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Appendix

Appendix 1. Search string databases.

PubMed	**Search**
Domain (#1)	'palliative care'[MeSH Terms] OR 'Hospice and Palliative Care Nursing'[MeSH Terms] OR 'Palliative Medicine'[MeSH Terms] OR 'Terminal Care'[MeSH Terms] OR 'end of life'[Tiab] OR 'palliation'[Tiab] OR 'palliative*'[Tiab] OR 'hospice*'[Tiab] OR 'terminal care'[Tiab] OR 'advanced care' OR 'terminally ill'[MeSH Terms] OR 'terminally ill'[Tiab]
Determinant (#2)	('oils, volatile'[MeSH Terms] OR ('oils'[Tiab] AND 'volatile'[Tiab]) OR 'volatile oils'[Tiab] OR ('essential'[Tiab] AND 'oils'[Tiab]) OR 'essential oils'[Tiab]) OR ('acupressure'[MeSH Terms] OR 'acupressure'[Tiab]) OR biofield[Tiab] OR ('therapeutic touch'[MeSH Terms] OR ('therapeutic'[Tiab] AND 'touch'[Tiab]) OR 'therapeutic touch'[Tiab] OR 'reiki'[Tiab]) OR ('cognitive behaviour therapy'[Tiab] OR 'cognitive behavioral therapy'[MeSH Terms] OR 'cognitive behavioral therapy'[Tiab] OR 'cognitive behavior therapy'[Tiab]) OR ('biofeedback, psychology'[MeSH Terms] OR 'biofeedback'[Tiab]) OR ('phototherapy'[MeSH Terms] OR 'phototherapy'[Tiab] OR ('light'[Tiab] AND 'therapy'[Tiab]) OR 'light therapy'[Tiab]) OR ('hypnosis'[MeSH Terms] OR 'hypnosis'[Tiab]) OR ('musculoskeletal manipulations'[MeSH Terms] OR ('musculoskeletal'[Tiab] AND 'manipulations'[Tiab]) OR 'musculoskeletal manipulations'[Tiab] OR 'reflexology'[Tiab]) OR (('relaxation'[MeSH Terms] OR 'relaxation'[Tiab]) AND ('exercise'[MeSH Terms] OR 'exercise'[Tiab])) OR (('abdomen'[MeSH Terms] OR 'abdomen'[Tiab] OR 'abdominal'[Tiab]) AND ('respiration'[MeSH Terms] OR 'respiration'[Tiab] OR 'breathing'[Tiab])) OR ('autogenic training'[MeSH Terms] OR ('autogenic'[Tiab] AND 'training'[Tiab]) OR 'autogenic training'[Tiab] OR ('progressive'[Tiab] AND 'muscle'[Tiab] AND 'relaxation'[Tiab]) OR 'progressive muscle relaxation'[Tiab]) OR (('imagery, psychotherapy'[MeSH Terms] OR ('imagery'[Tiab] AND 'psychotherapy'[Tiab]) OR 'imagery'[Tiab]) AND ('education'[Subheading] OR 'education'[Tiab] OR 'training'[Tiab] OR 'education'[MeSH Terms] OR 'training'[Tiab])) OR ('meditation'[MeSH Terms] OR 'meditation'[Tiab]) OR ('yoga'[MeSH Terms] OR 'yoga'[Tiab]) OR ('music'[MeSH Terms] OR 'music'[Tiab]) OR ('massage'[MeSH Terms] OR 'massage'[Tiab]) OR ('aromatherapy'[MeSH Terms] OR 'aromatherapy'[Tiab]) OR ('odorants'[MeSH Terms] OR 'odorants'[Tiab] OR 'aroma'[Tiab]) OR ('mindfulness'[MeSH Terms] OR 'mindfulness'[Tiab]) OR ('diet'[MeSH Terms] OR 'diet'[Tiab] OR 'diets'[Tiab]) OR ('art'[MeSH Terms] OR 'art'[Tiab]) OR psychoeducation[Tiab] OR herbs[Tiab] OR ('dietary supplements'[MeSH Terms] OR ('dietary'[Tiab] AND 'supplements'[Tiab]) OR 'dietary supplements'[Tiab] OR ('nutritional'[Tiab] AND 'supplements'[Tiab]) OR 'nutritional supplements'[Tiab]) OR ('homeopathy'[MeSH Terms] OR 'homeopathy'[Tiab] OR 'homoeopathy'[Tiab] OR 'homeopathic'[Tiab]) OR 'shiatsu'[Tiab] OR ('virtual reality'[MeSH Terms] OR 'virtual reality'[Tiab]) OR 'color therapy'[Tiab] OR ('color*'[Tiab] AND 'therapy'[Tiab]) OR 'acoustic stimulation' [Tiab] OR 'acoustic stimulation' [MeSH Terms] OR 'auditory stimulation' [Tiab] OR (('acoustic' [Tiab] OR 'auditory' [Tiab]) AND ('therapy'[Tiab] OR 'stimulation'[Tiab])) OR complementary[Tiab] OR complementary[Tiab] OR (('complementary' [Tiab] AND 'alternative' [Tiab] AND 'medicine'[Tiab]) OR 'complementary alternative medicine'[Tiab]) OR ('complementary therapies'[MeSH Terms] OR 'complementary therapies'[Tiab])
Outcome (#3)	(('pain'[MeSH terms] OR 'pain*'[Tiab] OR 'discomfort*'[Tiab] OR 'ache*'[Tiab] OR 'aching'[Tiab] OR 'sore*'[Tiab] OR 'suffer*'[Tiab] OR 'agony'[Tiab] OR 'hurt*'[Tiab] OR 'strain'[Tiab] OR 'torment'[Tiab] OR 'twinge'[Tiab] OR 'symptom'[Tiab] OR 'symptom burden'[Tiab] OR ('symptom'[Tiab] AND 'burden'[Tiab])) AND (assess*[Tiab] OR relief[Tiab] OR reliev*[Tiab] OR reduc*[Tiab]))
Embase (not MEDLINE)	**Search**
Domain (#1)	'palliative nursing'/exp OR 'palliative therapy'/exp OR 'terminal care'/exp OR 'end of life care':ti,ab OR 'palliation':ti,ab OR 'palliative*':ti,ab OR 'hospice*':ti,ab OR 'terminal care':ti,ab OR 'terminally ill patient'/exp OR 'terminally ill':ti,ab OR 'advance care':ti,ab

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Appendix 1. (Continued)

PubMed	Search
Determinant (#2)	'essential oil'/exp OR 'essential oil':ab,ti OR ('oils':ab,ti AND 'volatile':ab,ti) OR 'acupressure'/exp OR 'acupressure':ab,ti OR 'biofield therapy'/exp OR 'biofield therapy':ab,ti OR 'therapeutic touch'/exp OR 'therapeutic touch':ab,ti OR 'reiki'/exp OR 'reiki':ab,ti OR 'cognitive behavioral therapy'/exp OR 'cognitive behavioral therapy':ab,ti OR 'biofeedback'/exp OR 'biofeedback':ab,ti OR 'phototherapy'/exp OR 'phototherapy':ab,ti OR ('light':ab,ti AND 'therapy':ab,ti) OR 'hypnosis'/exp OR 'hypnosis':ab,ti OR 'musculoskeletal manipulation'/exp OR 'musculoskeletal manipulation':ab,ti OR ('musculoskeletal':ab,ti AND 'manipulation':ab,ti) OR 'reflexology':ab,ti OR 'relaxation training'/exp OR 'relaxation training':ab,ti OR 'abdominal breathing'/exp OR 'abdominal breathing':ab,ti OR 'autogenic training'/exp OR 'autogenic training':ab,ti OR 'progressive muscle relaxation'/exp OR 'progressive muscle relaxation' OR 'sleep hygiene'/exp OR 'sleep hygiene':ab,ti OR 'imagery training':ab,ti OR (('imagery'/exp OR imagery:ab,ti) AND ('training'/exp OR training:ab,ti)) OR 'meditation'/exp OR 'meditation':ab,ti OR 'yoga'/exp OR 'yoga':ab,ti OR 'music therapy'/exp OR 'music therapy':ab,ti OR 'massage'/exp OR 'massage':ab,ti OR 'aromatherapy'/exp OR 'aromatherapy':ab,ti OR 'fragrance'/exp OR 'fragrance':ab,ti OR 'aroma'/exp OR 'aroma':ab,ti OR 'mindfulness'/exp OR 'mindfulness':ab,ti OR 'diet'/exp OR 'diet':ab,ti OR 'art'/exp OR 'art':ab,ti OR 'psychoeducation'/exp OR 'psychoeducation':ab,ti OR 'herb'/exp OR 'herb:ab,ti OR 'dietary supplement'/exp OR 'dietary supplement':ab,ti OR 'nutritional supplements':ab,ti OR ('nutritional':ab,ti AND 'supplements':ab,ti) OR 'homeopathy'/exp OR 'homeopathy':ab,ti OR 'shiatsu'/exp OR 'shiatsu':ab,ti OR 'virtual reality'/exp OR 'virtual reality':ab,ti OR 'color therapy'/exp OR 'color therapy':ab,ti OR ('color*':ab,ti AND 'therapy':ab,ti) OR 'auditory stimulation'/exp OR 'auditory stimulation':ab,ti OR (('auditory':ab,ti OR 'acoustic':ab,ti) AND ('stimulation':ab,ti OR 'therapy':ab,ti)) complementary:ab,ti OR 'complementary alternative medicine':ab,ti OR (complementary:ab,ti AND alternative:ab,ti AND ('medicine'/exp OR medicine:ab,ti)) OR 'alternative medicine'/exp OR 'alternative medicine':ab,ti
Outcome (#3)	(('pain'/exp OR 'pain*':ab,ti OR 'discomfort':ab,ti OR 'suffer*':ti,ab OR 'ache*':ti,ab OR 'aching':ab,ti OR 'sore*':ab,ti OR 'agony':ti,ab OR 'hurt*':ti,ab OR 'strain*':ti,ab OR 'torment*':ti,ab OR 'twinge':ti,ab OR 'symptom*':ab,ti OR 'symptom burden':ab,ti) AND ('assess*':ab,ti OR 'relief':ab,ti OR 'reliev*':ab,ti OR 'reduc*':ab,ti))
CINAHL	**Search**
Domain (#1)	MH ((MH 'Terminal care') OR (MH 'Hospice care') OR (MH 'Palliative care') OR (MH 'Hospice and Palliative Nursing')) OR TI ('end of life care' OR 'palliation' OR 'palliative*' OR 'hospice*' OR 'terminal care' OR 'terminally ill' OR 'advance care') OR AB ('end of life care' OR 'palliation' OR 'palliative*' OR 'hospice*' OR 'terminal care' OR 'terminally ill' OR 'advance care')
Determinant (#2)	MH (MH 'essential oils') OR (MH 'acupressure') OR (MH 'therapeutic touch') OR (MH 'reiki') OR (MH 'phototherapy') OR (MH 'hypnosis') OR (MH 'reflexology') OR (MH 'progressive muscle relaxation') OR (MH 'guided imagery') OR (MH 'meditation') OR (MH 'yoga') OR (MH 'music therapy') OR (MH 'music') OR (MH 'massage') OR (MH 'aromatherapy') OR (MH 'odors') OR (MH 'mindfulness') OR (MH 'diet') OR (MH 'art') OR (MH 'psychoeducation') OR (MH 'dietary supplements') OR (MH 'homeopathy') OR (MH 'shiatsu') OR (MH 'virtual reality') OR (MH 'acoustic stimulation') OR (MH 'alternative therapies') OR (MH (MH 'relaxation') OR TI ('relaxation') OR AB ('relaxation')) AND (TI ('exercise*') OR AB ('exercise*')) OR (MH (MH 'abdomen') OR TI ('abdomen' OR 'abdominal') OR AB ('abdomen' OR 'abdominal')) AND (MH (MH 'respiration') OR TI ('respiration' OR 'breathing') OR AB ('respiration' OR 'breathing')) OR (MH (MH 'autogenic training') OR TI ('autogenic' AND 'training') OR 'autogenic training' OR AB ('autogenic' AND 'training') OR 'autogenic training') OR ((MH (MH 'guided imagery') OR TI ('psychotherapy imagery' OR ('psychotherapy' AND 'imagery') OR 'imagery') OR AB ('psychotherapy imagery' OR ('psychotherapy' AND 'imagery') OR 'imagery')) AND (MH (MH 'education') OR TI ('education' OR 'training') OR AB ('education' OR 'training'))) OR TI ('volatile oils' OR ('oils' AND 'volatile') OR 'essential oils' OR ('essential' AND 'oils') OR 'acupressure' OR 'biofield' OR 'therapeutic touch' OR ('therapeutic' AND 'touch') OR 'reiki' OR 'cognitive behaviour therapy' OR 'cognitive behavioural therapy' OR 'biofeedback' OR 'phototherapy' OR ('light' AND 'therapy') OR 'light therapy' OR 'hypnosis' OR 'musculoskeletal manipulations' OR ('musculoskeletal' AND 'manipulations') OR 'reflexology' OR ('progressive' AND 'muscle' AND 'relaxation') OR 'progressive muscle relaxation' OR 'meditation' OR 'yoga' OR 'music therapy' OR 'music' OR 'massage*' OR 'aromatherapy' OR 'odors' OR 'odorants' OR 'aroma' OR 'mindfulness' OR 'diet' OR 'diets' OR 'art*' OR 'psychoeducation' OR 'herbs' OR 'dietary supplement*' OR ('dietary' AND 'supplement*') OR ('nutritional' AND 'supplement*') OR 'nutritional supplements' OR 'homeopathy' OR 'homoeopathy' OR 'homeopathic' OR 'shiatsu' OR 'virtual reality' OR ('virtual' AND 'reality') OR 'color therapy' OR ('color' AND 'therapy') OR 'acoustic stimulation' OR ('acoustic' AND ('stimulation' OR 'therapy')) OR 'auditory stimulation' OR ('auditory' AND ('stimulation' OR 'therapy')) OR 'alternative therapy' OR 'alternative therapies' OR 'complementary' OR ('complementary' AND 'alternative' AND 'medicine') OR 'complementary alternative medicine' OR 'complementary therapy' OR 'complementary therapies') OR AB ('volatile oils' OR ('oils' AND 'volatile') OR 'essential oils' OR ('essential' AND 'oils') OR 'acupressure' OR 'biofield' OR 'therapeutic touch' OR ('therapeutic' AND 'touch') OR 'reiki' OR 'cognitive behaviour therapy' OR 'cognitive behavioural therapy' OR 'biofeedback' OR 'phototherapy' OR ('light' AND 'therapy') OR 'light therapy' OR 'hypnosis' OR 'musculoskeletal manipulations' OR ('musculoskeletal' AND 'manipulations') OR 'reflexology' OR ('progressive' AND 'muscle' AND 'relaxation') OR 'progressive muscle relaxation' OR 'meditation' OR 'yoga' OR 'music therapy' OR 'music' OR 'massage*' OR 'aromatherapy' OR 'odors' OR 'odorants' OR 'aroma' OR 'mindfulness' OR 'diet' OR 'diets' OR 'art*' OR 'psychoeducation' OR 'herbs' OR 'dietary supplement*' OR ('dietary' AND 'supplement*') OR ('nutritional' AND 'supplement*') OR 'nutritional supplements' OR 'homeopathy' OR 'homoeopathy' OR 'homeopathic' OR 'shiatsu' OR 'virtual reality' OR ('virtual' AND 'reality') OR 'color therapy' OR ('color' AND 'therapy') OR 'acoustic stimulation' OR ('acoustic' AND ('stimulation' OR 'therapy')) OR 'auditory stimulation' OR ('auditory' AND ('stimulation' OR 'therapy')) OR 'alternative therapy' OR 'alternative therapies' OR 'complementary' OR ('complementary' AND 'alternative' AND 'medicine') OR 'complementary alternative medicine' OR 'complementary therapy' OR 'complementary therapies')

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Appendix 1. (Continued)

PubMed	**Search**
Outcome (#3)	((MH (MH 'pain') OR TI ('pain*' OR 'discomfort' OR 'suffer*' OR 'ache*' OR 'aching' OR 'sore' OR 'agony' OR 'hurt*' OR 'strain*' OR 'torment*' OR 'twinge' OR 'symptom' OR 'symptom burden') OR AB ('pain*' OR 'discomfort' OR 'suffer*' OR 'ache*' OR 'aching' OR 'sore' OR 'agony' OR 'hurt*' OR 'strain*' OR 'torment*' OR 'twinge' OR 'symptom' OR 'symptom burden') AND (TI ('asses*' OR 'relief' OR 'reliev*' OR 'reduc*') OR AB ('asses*' OR 'relief' OR 'reliev*' OR 'reduc*')))
Psycinfo	**Search**
Domain (#1)	exp Palliative Care/ OR exp Alternative Medicine/ OR exp Hospice/ OR exp Terminally ill patients/ OR palliative care.ti,ab. OR terminal care.ti,ab. OR end of life.ti,ab. OR palliation.ti,ab. OR palliative*.ti,ab. OR hospice*.ti,ab. OR advance care.ti,ab. OR terminally ill.ti,ab.
Determinant (#2)	exp Aromatherapy/ OR exp Cognitive behavior therapy/ OR exp Biofeedback/ OR exp Phototherapy/ OR exp Hypnosis/ OR exp Autogenic Training/ OR exp Progressive Relaxation Therapy/ OR exp Guided Imagery/ OR exp Imagery/ OR exp Meditation/ OR exp Yoga/ OR exp Music Therapy/ OR exp Massage/ OR exp Aromatherapy/ OR exp Mindfulness/ OR exp Diets/ OR exp Art Therapy/ OR exp Psychoeducation/ OR exp Medicinal Herbs and Plants/ OR exp Dietary Supplements/ OR exp Virtual Reality/ OR exp Auditory Stimulation/ OR volatile oils.ti,ab. OR (volatile AND oils).ti,ab. OR essential oils.ti,ab. OR (essential AND oils).ti,ab. OR acupressure.ti,ab. OR biofield.ti,ab. OR therapeutic touch.ti,ab. OR (therapeutic AND touch).ti,ab. OR reiki.ti,ab. OR cognitive behavior therapy.ti,ab. OR (cognitive AND behavior AND therapy).ti,ab. OR (cognitive AND behavioral AND therapy).ti,ab.OR cognitive behavioral therapy.ti,ab. OR (cognitive AND behaviour AND therapy).ti,ab. OR cognitive behaviour therapy.ti,ab. OR biofeedback.ti,ab. OR psychology biofeedback.ti,ab. OR (psychology AND biofeedback).ti,ab. OR phototherapy.ti,ab. OR light therapy.ti,ab. OR (light AND therapy).ti,ab. OR hypnosis.ti,ab. OR musculoskeletal manipulations.ti,ab. OR (musculoskeletal AND manipulations).ti,ab. OR reflexology.ti,ab. OR ((exp Relaxation/ OR relaxation.ti,ab.) AND (exp Exercise/ OR exercise*.ti,ab.)) OR ((exp Abdomen/ OR abdomen.ti,ab. OR abdominal.ti,ab.) AND (exp Respiration/ OR respiration.ti,ab. OR breathing.ti,ab.)) OR autogenic training.ti,ab. OR (autogenic AND training).ti,ab. OR progressive muscle therapy.ti,ab. OR progressive muscle relaxation.ti,ab. OR (progressive AND muscle AND relaxation).ti,ab. OR (progressive AND relaxation AND therapy).ti,ab. OR ((guided imagery.ti,ab. OR psychotherapy imagery.ti,ab. OR (psychotherapy AND imagery).ti,ab. OR imagery.ti,ab.) AND (education.ti,ab. OR training.ti,ab.)) OR meditation.ti,ab. OR yoga.ti,ab. OR music therapy.ti,ab. OR (music AND therapy).ti,ab. OR massage*.ti,ab. OR aromatherapy.ti,ab. OR odorants.ti,ab. OR aroma.ti,ab. OR mindfulness.ti,ab. OR diet*.ti,ab. OR art*.ti,ab. OR art therapy.ti,ab. OR (art AND therapy).ti,ab. OR psychoeducation.ti,ab. OR herbs.ti,ab. OR dietary supplement*.ti,ab. OR (dietary AND supplement*).ti,ab. OR nutritional supplement*.ti,ab. OR (nutritional AND supplement*).ti,ab. OR homeopathy.ti,ab. OR homoeopathy.ti,ab. OR homeopathic.ti,ab. OR shiatsu.ti,ab. OR virtual reality.ti,ab. OR (virtual AND reality).ti,ab. OR acoustic stimulation.ti,ab. OR acoustic therapy.ti,ab. OR (acoustic AND (stimulation OR therapy)).ti,ab. OR (auditory AND (stimulation OR therapy)).ti,ab. OR complementary therapy.ti,ab. OR complementary.ti,ab. OR (complementary AND alternative AND medicine).ti,ab. OR complementary alternative medicine.ti,ab. OR complementary therapies.ti,ab
Outcome (#3)	(exp Pain/ OR pain.ti,ab. OR discomfort*.ti,ab. OR ache*.ti,ab. OR aching.ti,ab. OR sore*.ti,ab. OR suffer*.ti,ab. OR agony.ti,ab. OR hurts.ti,ab. OR strain.ti,ab. OR torment.ti,ab. OR twinge.ti,ab. OR symptom.ti,ab. OR (symptom AND burden).ti,ab. OR symptom burden.ti,ab.) AND (assess* OR relief OR reliev* OR reduc*).ti,ab.