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ORIGINAL ARTICLE / ÖZGÜN MAKALE

The effect of non-pharmacological methods on pain in patients undergoing open heart surgery: A systematic review and meta-analysis

Açık kalp cerrahisi geçiren hastalarda farmakolojik olmayan yöntemlerin ağrı üzerine etkisi: Bir sistematik derleme ve meta-analiz

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ABSTRACT

Background: In this meta-analysis, we aimed to determine the effect of non-pharmacological methods on pain in patients undergoing open heart surgery.

Methods: Scientific articles published between January 2002 and April 2022 were scanned in ScienceDirect, Scopus, PubMed, Web of Science, Google Scholar, Mendeley, Wiley Online Library databases. The keywords "open heart surgery," "cardiovascular surgery," "non-pharmacological," "complementary medicine," and "pain" were used in Turkish and English language. As a result of the search, 7,952 studies were identified and analyzed. Research data were obtained from 49 scientific articles.

Results: The total sample size of the studies included in the analysis was 3,097. The total effect size was found to be 3.070, with a 95% confidence interval of 2.522 at the lower limit and 3.736 at the upper limit. Non-pharmacological pain methods in open heart surgery included positive environmental experience, distraction, massage therapy, hand massage, foot massage, acupuncture therapy, lavender essential oil inhalation, cold application, music therapy, breathing and relaxation exercises, neurolinguistic programming, guided visualization, imagery, therapeutic touch, osteopathic treatment, and transcutaneous electrical nerve stimulation.

Conclusion: The pain of patients who underwent open heart surgery with non-pharmacological methods combined with pharmacological methods was three times less than those without non-pharmacological methods. Based on these findings, non-pharmacological methods are recommended for use due to their ease of application, and low side effects.

Keywords: Cardiovascular surgery, complementary medicine, non-pharmacological, nursing care, open heart surgery, pain.

ÖZ

Amaç: Bu meta-analizde, açık kalp cerrahisi geçiren hastalarda farmakolojik olmayan yöntemlerin ağrı üzerine etkisi belirlendi.

Çalışma planı: Ocak 2022 - Nisan 2022 tarihleri arasında ScienceDirect, Scopus, PubMed, Web of Science, Google Scholar, Mendeley, Wiley Online Library veri tabanlarında yayımlanan bilimsel makaleler tarandı. Türkçe ve İngilizce dillerinde "açık kalp cerrahisi", "kardiyovasküler cerrahi", "farmakolojik olmayan", "tamamlayıcı tıp" ve "ağrı" anahtar kelimeleri kullanıldı. Yapılan tarama sonucunda 7952 çalışma tespit edildi ve incelendi. Araştırma verileri 49 bilimsel makale üzerinden elde edildi.

Bulgular: Analiz kapsamına alınan çalışmaların toplam örneklem büyüklüğü 3097 idi. Toplam etki büyüklüğü 3.070 olarak bulunurken, %95 güven aralığında 2.522 alt sınır ve 3.736 üst sınır idi. Açık kalp cerrahisinde farmakolojik olmayan ağrı yöntemleri olumlu çevresel deneyim, dikkati dağıtma, masaj tedavisi, el masajı, ayak masajı, akupunktur tedavisi, lavanta esansiyel yağı inhalasyonu, soğuk uygulama, müzik terapisi, nefes alma ve gevşeme egzersizleri, nöro-dilsel programlama, rehberli görselleştirme, imgeleme, terapötik dokunma, osteopatik tedavi ve transkütanöz elektriksel sinir uyarımını içeriyordu.

Sonuç: Açık kalp cerrahisi geçiren hastaların ağrı kontrolünde farmakolojik yöntemlerin yanı sıra farmakolojik olmayan yöntemlerin kullanıldığı hastaların ağrısı, kullanılmayanlara kıyasla üç kat daha azdı. Bu bulgulara dayanarak, farmakolojik olmayan yöntemlerin uygulama kolaylığı ve yan etkilerinin az olması ile kullanımı önerilmektedir.

Anahtar sözcükler: Kardiyovasküler cerrahi, tamamlayıcı tıp, farmakolojik olmayan, hemşirelik bakımı, açık kalp cerrahisi, ağrı.

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Globally, an estimated 230 million major surgical procedures are performed each year.[1] As the number of population increases worldwide, there is an increasing interest in managing common and often poorly managed postoperative pain.[1]

Pain is a common problem which occurs after many surgical operations. It is more common in patients undergoing cardiovascular operations.[2] Despite the use of benzodiazepines and opioids, patients undergoing cardiac surgery may experience high-intensity pain. This leads to increased patient demand for opioids.[3] However, postoperative pain and serious side effects of opioid use also pose a clinical challenge after cardiothoracic surgery.[3,4] Satisfactory pain relief is a fundamental right of every patient with pain. Non-pharmacological methods (NPMs) of pain management are methods that do not replace pharmacological methods and can be used in conjunction with pharmacological pain interventions to improve patients' pain relief.[5,6] They are independent nursing practices that can be applied alone or in combination with analgesics, have no side effects, can be used as needed, can be easily taught to patients, do not impose an economic burden, can be easily applied and their effects can be observed immediately. Therefore, non-pharmaceutical interventions are considered means of improving pain relief and reducing opioid use, and many guidelines recommend the use of multimodal pain management strategies using both pharmacological and non-pharmacological interventions.[3,5,6]

Non-pharmacological pain management methods used in the studies include cognitive and behavioral methods including distraction, listening to music, relaxation, imagery, breathing techniques, meditation, hypnosis, physical or skin stimulation methods including hot/cold applications, massage, position changes and transcutaneous electrical nerve stimulation (TENS), acupuncture, acupressure, therapeutic touch, and environmental or emotional methods such as touch, reassurance or interior decoration of the room.[6-8]

Non-pharmacological methods such as kinesiotaping, TENS, and cold application improve respiratory functions and can provide less pain during deep breathing and coughing exercises or the use of a spirometer.[9-14] In open heart surgery, by applying music and aromatherapy at different times and methods, starting from the preoperative period and in the postoperative period, vital signs can improve, physical and psychological comfort can be achieved, anxiety levels can decrease, and pain intensity can decrease.[15-24] Therapeutic touch, osteopathic manipulative treatment, individual exercise programs, neurolinguistic programming and guided visualization methods can be effective in increasing life skills, accelerating functional recovery, increasing comfort, supporting early recovery, and reducing pain and tension.[25-31] In addition to all these methods, it is possible to reduce the pain intensity, analgesic needs, and opioid and non-opioid drug intake of individuals after open heart surgery by using non-pharmacological methods such as acupuncture, reflexology, massage, and Benson relaxation exercises.[32-36]

There is a limited number of studies investigating whether non-pharmacological methods have an effect on pain in patients undergoing open heart surgery compared to pharmacological methods. In the present study, we, therefore, aimed to examine the effect of non-pharmacological methods on pain relief in patients undergoing open heart surgery compared to pharmacological methods through a systematic review and meta-analysis.

MATERIALS AND METHODS

In this systematic review and meta-analysis, we analyzed the effects of non-pharmacological methods on pain in patients undergoing open heart surgery in national and international literature.

This systematic review was conducted according to the Cochrane guidelines and was reported using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA). This study is registered in the PROSPERO (The International Prospective Register of Systematic Reviews) database with protocol number CRD42024499619.

Literature search

This meta-analysis utilized ScienceDirect, Scopus, PubMed, Web of Science, Google Scholar, Mendeley, Wiley Online Library databases. Two researchers evaluated all included studies independently. The literature review was completed on April 25th, 2022. Studies were recorded via Microsoft Excel Program. When the inclusion criteria of the studies were met by two independent researchers, they were included in the meta-analysis. In case of disagreement, third reviewers reviewed the documents until a consensus was reached (Figure 1).

Eligibility criteria

The inclusion criteria of the study included articles and research articles covering patients who underwent

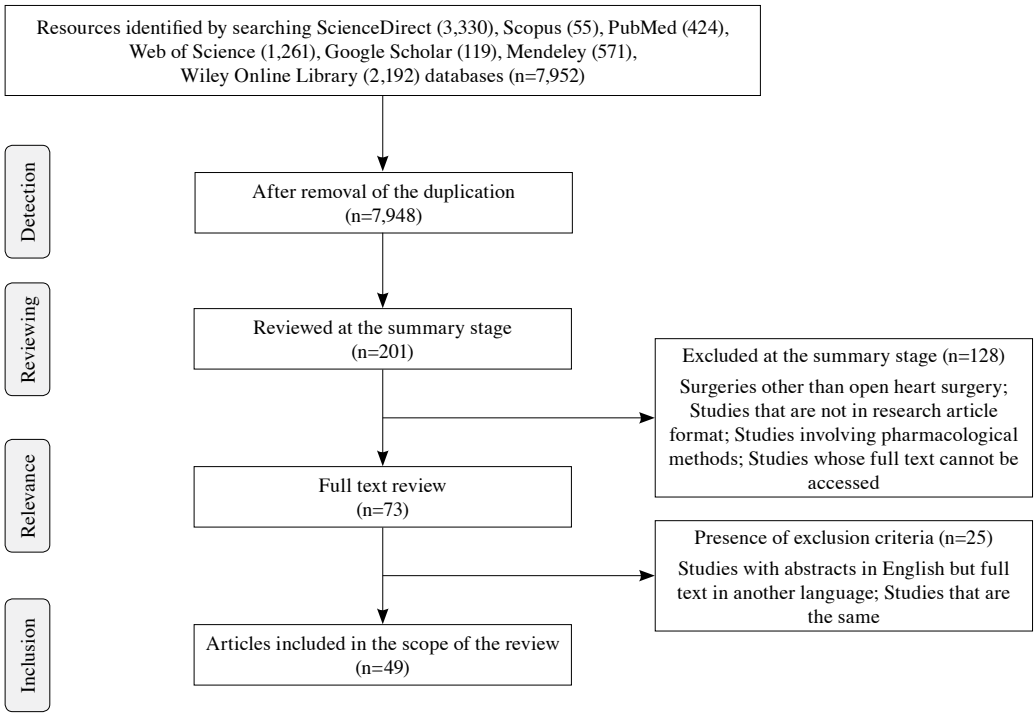

Figure 1. Flowchart of the meta-analysis.

open heart surgery between January 2002 and April 2022, full-text studies, studies in English and Turkish languages, and studies containing non-pharmacological pain methods. Quantitative analysis values, access to full texts, and having full statistical results for calculating the effect size were also included in the inclusion criteria for the study.

Exclusion criteria

Editorials, Letters to the Editor, Experience Reports, studies with inappropriate publication years, qualitative studies, theses and abstracts of conference proceedings were excluded. In addition, studies with duplication were not included in the meta-analysis.

Statistical analysis

Statistical analysis was performed using the licensed software Comprehensive Meta-Analysis Academic/Non-profit Pricing version 3.0. The data of all articles meeting the inclusion criteria and decided to be included in the study were entered into the CMA software, and the heterogeneity status of the articles was evaluated. Effect sizes, study weights, 95% confidence intervals, and overall effect size of all studies were calculated under the random effects model in group analyses with a p value of <0.05 in the heterogeneity test and under the fixed effects model in group analyses with a p value of >0.05. The "R.R. and OR" values were taken as a basis for evaluating the overall effect size in the analyses performed for binary data. Heterogeneity test was applied to determine the effect of non-pharmacological methods on pain in patients undergoing open heart surgery in the articles included in the study. The I^2 statistic was used to quantify heterogeneity. Using accepted guidelines, an I^2 between 0 and 40% was considered to exclude heterogeneity, 30 and 60% moderate heterogeneity, 50 and 90% substantial heterogeneity, and 75 and 100% considerable heterogeneity. As a result of the heterogeneity test, a p value was set less than 0.05 ($p<0.001$) and the Q (115.944) value was greater than the value corresponding to the 49 df (degrees of freedom) value in the χ^2 table (χ^2 (0.95)=34.764 for df=49). As a result of the individual studies included in the analysis, it was determined that the studies examined in the meta-analysis application had a heterogeneous structure. The Cohen's d coefficient was used to compare means and calculate the overall effect size, and this coefficient was converted to the OR coefficient to compare the effectiveness between sites. The Begg and Mazumdar rank correlation tests and Egger's regression intercept tests were used for publication bias tests. The statistical significance

Table 1. Assessment details of all studies that underwent quality assessment (n=49)

No	Reference	Research type	S1	S2	S3	S4	S5	S6	S7	S8	S9	Total score	Pain relief methods	Number of patients
1	Aslan and Tosun[42] 2015	Descriptive	1/1	1/1	1/1	1/0	1/1	1/1	1/1	1/1	0/1	8/8	Experimental group: Positive environment Control group: No intervention	106
2	Alameri et al.[5] 2020	Randomized controlled	1/1	0/0	1/1	1/0	1/1	1/1	1/1	1/1	0/0	8/8	Experimental group: Foot massage for 10 min, twice a day Control group: Lavender cream on each foot and hold for 10 minutes	Experimental: 16 Control: 15
3	Babamohamadi et al.,[43] 2021	Randomized controlled	1/1	0/0	1/1	1/1	1/1	1/1	1/1	1/1	1/1	8/8	Experimental group: Rhythmic breathing every 12 h, 3 consecutive days Control group: Routine care	Experimental: 30 Control: 30
4	Boitor et al.,[44] 2019	Randomized controlled	0/1	0/0	1/1	1/1	1/1	1/0	1/1	1/1	1/0	7/7	Experimental group: Hand Massage Active control group: Hand holding Passive control group: Routine care	Experimental: 18 Active control: 16 Passive control: 12
5	Bauer et al.,[48] 2010	Randomized	0/1	1/0	1/1	1/1	1/1	1/1	1/1	1/1	1/1	8/8	Experimental group: Massage therapy control group: Quiet relaxation time (20 min on postoperative days 2 and 4 for both groups)	Experimental: 62 Control: 51
6	Brockmann and Klein[14] 2018	Controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Kinesio taping Control group: Routine care	Experimental: 23 Control: 16
7	Chandrababu et al.,[50] 2020	Prospective randomized controlled	0/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	8/9	Experimental group: Foot massage therapy for 2-5 days after surgery. 20 min between days and preoperative, postoperative education, and self-care booklet Control group: Routine care and education	Experimental: 65 Control: 65
8	Ciğerci and Özbayır[18] 2016	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Music therapy for 1 h 30 min before the patients were taken to the operation, once for 30 min in the ICU, and every day for 30 min in the ward, until discharge. Control group: Routine care	Experimental: 34 Control: 34
9	Cipriano et al.,[11] 2008	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Electrical nerve stimulation for during 4 h on the third postoperative day (240 min) Control group: Sham group received only 2.37 min of active current.	Experimental: 23 Control: 22
10	Colak et al.,[35] 2010	Prospective and randomized	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Acupuncture for during the first 7 postoperative days Control group: Routine care	Experimental: 15 Control: 15
11	Cevik et al.,[55] 2020	Case-control	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental: Cold gel pack for 15 min before deep breathing and cough exercises Placebo group: Warm gel pack for 15 min before deep breathing and cough exercises Control group: Deep breathing and coughing exercise without any practice 15 min after pain measurement	Experimental: 15 Placebo: 15 Control: 16

Table 1. Continued

No	Reference	Research type	S1	S2	S3	S4	S5	S6	S7	S8	S9	Total score	Pain relief methods	Number of patients
12	Dąbek et al.,[31] 2017	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Cardiac rehabilitation Control group: Routine care	100
13	Darzi et al.,[15] 2020	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group 1: Cotton swab containing three drops of rose, 15 min Experimental group 2: Cotton swab containing three drops of lavender essence, 15 min Placebo group: Cotton swab dipped in water, 15 min Control group: Routine care	Experimental group 1: 40 Experimental group 2: 40 Placebo group: 40 Control group: 40
14	Doğan and Saritaş,[27] 2021	Double-blind randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group 1: Neuro-linguistic programming, 30 min Experimental group 2: Guided visualization, 30 min Control group: Routine care	Experimental group 1: 132 Experimental group 2: 44 Control group: 44 44
15	Edelen and Perlow.,[45] 2002	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group 1: Breathing and relaxation exercises Experimental group 2: Treatment group Control group: Routine care	Experimental group 1: 72 Experimental group 2: 26 Control group: 26 24
16	Ghazal,[51] 2014	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Two sessions of a 20 min foot and hand massage, 5 min for each extremity control group: Routine care and rest in the bed for the same time (20 min)	Experimental group: 15 Control group: 15
17	Jafari et al.,[19] 2012	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Music therapy for 30 min. Control group: Routine care	Experimental group: 30 Control group: 30
18	Jahangirifard et al.,[9] 2017	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Transcutaneous electrical nerve stimulation for 30 min every 4 h for 3 days Control group: Routine care	Experimental group: 50 Control group: 50
19	Jiandani et al.,[10] 2017	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Kinesio taping for postoperative 7 days Control group: Routine care	Experimental group: 30 Control group: 30
20	Fiore et al.,[46] 2008	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Breathing and relaxation exercises. Cough evaluation was undertaken on the first and second morning after surgery	Randomized intra-subject crossover trial 21
21	Özer N. et al.,[20] 2010	Quasi-experimental	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Music therapy for 30 min Control group: Routine care	Experimental group: 44 Control group: 43
22	JaKaur et al.,[52] 2013	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Hand-Foot massage for 20 min Control group: Routine care	Experimental group: 15 Control group: 15

Table 1. Continued

No	Reference	Research type	S1	S2	S3	S4	S5	S6	S7	S8	S9	Total score	Pain relief methods	Number of patients
23	Kavrut Öztürk et al.,[12] 2015	Prospective-randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group 1: Transcutaneous electrical nerve stimulation and patient-controlled analgesia Experimental group 2: Parasternal block and patient-controlled analgesia Control group: Routine care and patient-controlled analgesia	Experimental group 1: 40 Experimental group 2: 38 Control group: 37
24	Khalil et al.,[16] 2018	Quasi-experimental	0/1	0/0	1/1	1/1	1/1	1/0	1/1	1/1	1/0	7/7	Experimental group: Aromatherapy by inhaling a cotton ball saturated with 2 drops of lavender oil and opioid drugs Control group: Routine care and opioid drugs	Experimental group: 45 Control group: 45
25	Khalkhali et al.,[56] 2014	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	All patients performed four episodes of two with cold gel pack and two without cold gel pack every 2 h.	Randomized controlled trial with crossover design 50
26	Kiran et al.,[13] 2016	Quasi-experimental	1/1	0/0	1/1	1/1	1/1	1/1	1/1	1/1	1/1	8/8	Experimental group: Transcutaneous electrical nerve stimulation for 20 min with 30 min of traditional physiotherapy/session for 2 sessions per day for 5 days Control group: 30 min of traditional physiotherapy/session for 2 sessions per day for 5 days	Experimental group: 15 Control group: 15
27	Küçükakça Çelik,[57] 2021	Case-control	1/1	0/0	1/1	1/1	1/1	1/1	1/1	1/1	1/1	8/8	Experimental group: Cold Application for 15 min Control group: Routine care	Experimental group: 29 Control group: 28
28	Braun et al.,[53] 2012	Randomized controlled	1/1	0/0	1/1	1/1	1/1	1/1	1/1	1/1	1/1	8/8	Experimental group: Massage therapy for 20 min Control group: Rest time for 20 min	Experimental group: 76 Control group: 76
29	Mirbagher Ajorpaz et al.,[21] 2014	Case-control	1/1	0/0	1/1	1/1	1/1	1/1	1/1	1/1	1/1	8/8	Experimental group: Music therapy for 30 min Control group: Routine care	Experimental group: 30 Control group: 30
30	Mohamed et al.,[32] 2021	Randomized controlled	1/1	0/0	1/1	1/1	1/1	1/1	1/1	1/1	1/1	8/8	Experimental group 1: Foot Reflexology Massage, 20 min each Experimental group 2: Benson's relaxation response technique Control group: Routine care	Experimental group 1: 30 Experimental group 2: 30 Control group: 30
31	Albert et al.,[54] 2009	Randomized controlled	0/1	0/0	1/1	1/1	1/1	1/1	1/1	1/1	1/1	7/8	Experimental group: Massage therapy for 30 min Control group: Routine care	Experimental group: 126 Control group: 126
32	Nilsson,[22] 2009	Randomized controlled	1/1	1/0	1/1	1/1	1/1	1/1	1/1	1/1	1/1	9/8	Experimental group: Music therapy for 30 min of uninterrupted bed rest with music and then 30 min of bed rest Control group: Routine care and 60 min of uninterrupted bed rest	Experimental group: 28 Control group: 30

Table 1. Continued

No	Reference	Research type	S1	S2	S3	S4	S5	S6	S7	S8	S9	Total score	Pain relief methods	Number of patients
33	Nilsson[23] 2008	Randomized controlled	1/1	0/0	1/1	1/1	1/1	1/1	1/1	1/1	1/1	8/9	Experimental group: Music therapy for 30 min of uninterrupted bed rest with music and bed rest Control group: Routine care and bed rest	Experimental: 20 Control: 20
34	Öğüt and Sucu Dağ[59] 2018	Descriptive cross-sectional	1/0	0/0	1/1	1/1	1/1	1/1	1/1	1/1	0/0	9/8	Experimental group: Pain education Control group: Routine care	Experimental and control group: 70
35	Pritha et al.[36] 2019	Case-control	1/0	1/0	1/1	1/1	1/1	1/1	1/1	1/1	0/1	8/7	Experimental group: PC6 acupressure three times a day for four days. Control group: Routine care	Experimental: 10 Control: 10
36	Racca et al.[29] 2017	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Standardized cardiorespiratory rehabilitation program alone and osteopathic manipulative treatment Control group: Standardized cardiorespiratory rehabilitation program alone	Experimental: 40 Control: 40
37	Roncada[30] 2020	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Therapeutic touch and osteopathic treatment for 12 weeks. Control group: Routine care	Experimental: 41 Control: 41
38	Salamati et al.[17] 2013	Single-blind randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Aromatherapy by inhaling a cotton ball saturated with 2 drops of lavender oil for 10 min Control group: Routine care	Experimental and control group: 40
39	Brent et.al.[48] 2010	Randomize controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Massage therapy for 20 min Control group: Routine care and quiet relaxation time for 20 min	Experimental: 62 Control: 51
40	Saramma and Aswathi[28] 2011	Descriptive	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Imagery intervention	Imagery intervention 101
41	Seweid et al.[58] 2021	Cross layout	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Cold application, 20 min	Crossover study 60
42	Sturgess et al.[26] 2014	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Individualised thoracic exercise program and twice-daily walking program Control group: Routine care and twice-daily walking program	Experimental: 23 Control: 15
43	Taherian et al.[33] 2020	Single-blind randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Ice massage at the Hegu point for 10 min in postoperative day 1 and 2 Control group: Glass marbles at the Hegu point with no pressure and massage for 10 min.	Experimental: 40 Control: 40
44	Tufekci et al.[60] 2022	Descriptive	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Follow up by phone	Experimental and control group: 65

Table 1. Continued

No	Reference	Research type	S1	S2	S3	S4	S5	S6	S7	S8	S9	Total score	Pain relief methods	Number of patients
45	Uzun Şahin and Çilingir[34] 2022	Case-control	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Foot reflexology for 20 min Control group: Routine care	Experimental: 35 Control: 35
46	Kshettry et al.[25] 2006	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group: Preoperative guided imagery training with gentle touch or light massage and postoperative music with gentle touch or light massage and guided imagery. Control group: Routine care	Experimental: 56 Control: 59
47	Voss et al.[24] 2004	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Experimental group 1: Music therapy for 30 min Experimental group 2: Scheduled rest for 30 min Control group: Routine care	Experimental group 1: 19 Experimental group 2: 21 Control group: 21
48	Zencir and Eser[47] 2016	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Four episodes of deep breathing and coughing exercises using an incentive spirometer	Crossover design 34
49	Ertürk and Ünlü[60] 2018	Randomized controlled	1/1	1/1	1/1	1/1	1/1	1/0	1/1	1/1	1/1	9/9	Individualized education	Quasi-experimental 109

S1: Was study based on a random or pseudo-random sample?; S2: Were the criteria for inclusion in the sample clearly defined?; S3: Were confounding factors identified and strategies to deal with them stated?; S4: Were outcomes assessed using objective criteria?; S5: If comparisons are being made, was there sufficient descriptions of the groups?; S6: Was follow-up carried out over a sufficient time period?; S7: Were the outcomes of people who withdrew described and included in the analysis?; S8: Were outcomes measured in a reliable way?; S9: Was appropriate statistical analysis used?

limit was accepted as $p<0.05$ in evaluating the overall effect. The kappa (κ) statistic was used in the IBM SPSS version 22.0 software (IBM Corp., Armonk, NY, USA) for inter-rater agreement.

RESULTS

Study characteristics

The sample size of the studies included in the analysis was 3,097. All 49 studies included in the meta-analysis, which evaluated the effect of non-pharmacological methods on pain in patients undergoing open heart surgery, were research articles published in peer-reviewed journals. The studies included in the study were as follows: Descriptive: 3, Descriptive-Sectional: 1, Randomized-Controlled: 28, Single-Blind Randomized-Controlled: 2, Prospective Single-Blind Randomized-Controlled: 1, Double-Blind Randomized-Controlled: 1, Case-Control: 5, Quasi-Experimental: 3, Crossover Design: 1, Prospective Randomized-Controlled: 4. Sample numbers varied between 10 and 200. The average sample size was 72. The characteristics of each primary study are summarized in Table 1. Non-pharmacological treatments used in studies evaluating pain in open heart surgery are given in Table 2.

Study quality evaluation

As a result of the review of the articles, for the remaining 49 publications, the Joanna Briggs Institute MAStARI Critical Appraisal Tool for Descriptive/Case Series Studies adapted into Turkish by Nahcivan and Secginli[37] was used. The tool has a total of nine items. For each study included in the scope of the review, the fulfillment of each feature included in the nine items in the form was examined, and an evaluation was made by giving 1 point if the relevant feature was met and 0 points if it was not met. These criteria allow for a general evaluation of the aims, sample characteristics, findings, and results of the studies. In the study, the articles belonging to all subgroups were examined independently by two researchers, and the articles with a score of ≥6 in the quality assessment were evaluated as high quality. An inter-coder agreement was found to be 76% based on the quality assessment score. The κ value <0 is worse agreement than chance agreement; 0.01-0.20 is insignificant agreement; 0.21-0.40 is poor agreement; 0.41-0.60 is moderate agreement; 0.61-0.80 is good agreement; and 0.81-1.00 is very good agreement or 0.75 and above is excellent, 0.40-0.75 is moderate-good and below 0.40 is poor agreement.[37,38] The κ value in this study (0.76) showed excellent inter-coder agreement (Table 1).

Table 2. Non-pharmacological treatments used in studies assessing pain in open heart surgery

No	Reference	Positive environment	Foot massage	Lavender cream	Rhythmic breathing	Hand massage	Hand holding	Massage therapy	Quiet relaxation and rest time	Kinesio taping	Education, and self-care booklet	Music therapy	TENS	Acupuncture	Cold gel pack	Warm gel pack	Cardiac rehabilitation	Aromatherapy	Neuro-linguistic programming	Guided visualization	Breathing and relaxation exercises	Traditional physiotherapy	Foot Reflexology Massage	Benson's relaxation response technique	Osteopathic manipulative treatment	Therapeutic touch	Individualized thoracic exercise program and walking program	Ice massage	Follow-up by phone
1	Aslan and Tosun[42], 2015	*																											
2	Alameri et al.[5], 2020		*	*																									
3	Babamohamadi et al.[43], 2021				*																								
4	Boitor et al.[44], 2019					*	*																						
5	Bauer et al.[48], 2010							*	*																				
6	Brockmann and Klein[14], 2018									*																			
7	Chandrababu et al.[50], 2020		*								*																		
8	Ciğerci and Özbayır[18], 2016											*																	
9	Cipriano et al.[11], 2008												*																
10	Colak et al.[35], 2010													*															
11	Cevik et al.[55], 2020														*	*													
12	Dąbek et al.,[31] 2017																*												
13	Darzi et al.,[15] 2020																	*											
14	Dogan and Sarittas,[27] 2021																		*	*									
15	Edelen and Perlow.,[45] 2002																				*								
16	Ghazal,[51] 2014		*			*			*																				
17	Jafari et al.,[19] 2012											*																	
18	Jahangirifard et al.,[9] 2017												*																
19	Jiandani et al.,[10] 2017									*																			
20	Fiore et al.,[46] 2008																				*								
21	Özer N. et al.,[20] 2010											*																	
22	JaKaur et al.,[52] 2013		*				*																						
23	Kavrut Öztürk et al.,[12] 2015												*																
24	Khalil et al.,[16] 2018																	*											
25	Khalkhali et al.,[56] 2014														*														
26	Kiran et al.,[13] 2016												*									*							

Table 2. Continued

No	Reference	Positive environment	Foot massage	Lavender cream	Rhythmic breathing	Hand massage	Hand holding	Massage therapy	Quiet relaxation and rest time	Kinesio taping	Education, and self-care booklet	Music therapy	TENS	Acupuncture	Cold gel pack	Warm gel pack	Cardiac rehabilitation	Aromatherapy	Neuro-linguistic programming	Guided visualization	Breathing and relaxation exercises	Traditional physiotherapy	Foot Reflexology Massage	Benson's relaxation response technique	Osteopathic manipulative treatment	Therapeutic touch	Individualised thoracic exercise program and walking program	Ice massage	Follow-up by phone
27	Küçükakça Çelik[57], 2021														*														
28	Braun et al.[53], 2012							*	*																				
29	Mirbagher Ajorpaz et al.[21], 2014											*																	
30	Mohamed et al.[32], 2021																						*	*					
31	Albert et al.[54], 2009							*																					
32	Nilsson[22], 2009								*			*																	
33	Nilsson[23], 2008								*			*																	
34	Öğüt and Sucu Dağ[59], 2018										*																		
35	Pritha et al.[36], 2019													*															
36	Racca et al.[29], 2017																*								*				
37	Roncada[30], 2020																								*	*			
38	Salamati et al.[17], 2013																	*											
39	Brent et.al.,[48] 2010							*	*																				
40	Saramma and Aswathi[28], 2011																			*									
41	Seweid et al.[58], 2021														*														
42	Sturgess et al.[26], 2014																										*		
43	Taherian et al.[33], 2020																											*	
44	Tufekci et al.[60], 2022																												*
45	Uzun Şahin and Çilingir[34], 2022																						*						
46	Kshettry et al.[25], 2006							*				*								*									
47	Voss et al.[24], 2004								*			*																	
48	Zencir and Eser[47], 2016																				*								
49	Ertürk and Ünlü[60], 2018										*																		

TENS: Transcutaneous electrical nerve stimulation.

Validity, reliability, and bias

Funnel plot, Rosenthal's Safe N, and Orwin's Safe N methods were used to demonstrate that the meta-analysis study was reliable and valid and to determine publication bias. The effect sizes of 49 studies examining the effect of non-pharmacological methods on pain in patients undergoing open heart surgery were evaluated according to the funnel scatter plot. In the funnel plot, if the effect sizes of individual studies are inside the funnel lines and symmetrically distributed, it does not cause publication bias; if the effect sizes of individual studies are outside the funnel lines and asymmetrically distributed, it causes publication bias.[38] In line with this information, when Figure 2 is analyzed, it can be said that the effect sizes of the studies are distributed in the graph close to a symmetrical shape (Figure 2).

When the Begg-Mazumdar and Egger tests for the bias indicators of the funnel plot were evaluated, these values were Begg-Mazumdar Kendall's tau=0.016, p=0.885 and Egger: bias=0.759 (95% CI: 0.211 to 2.545), p=0.548. In this case, the p value was greater than 0.05 (p=0.885). These findings indicated that there was no bias. In addition, Rosenthal's fail-safe number data, another test to determine study bias, also supports the data in the funnel plot.

The effect of non-pharmacological methods on pain

In Figure 3, the results of the meta-analysis of 49 studies that examined the effect of non-pharmacological methods on pain in patients undergoing open heart surgery and included in the study are shown with a forest plot. A positive mean effect size value (odds ratio [OR]) of (+3.089) indicates that the treatment effect is in favor of the experimental group. This result showed that the effect size of non-pharmacological methods on pain in patients undergoing open heart surgery was statistically significant with a value of 3.070 (W.A; 2.522-3.736; p<0.001), which was above the OR of +1 (Figure 3). Based on this result, the pain of patients who underwent cardiac surgery with non-pharmacological methods was three times less (OR: 3.089; 95% CI: 2.736-3.488, p<0.001) than those without non-pharmacological methods.

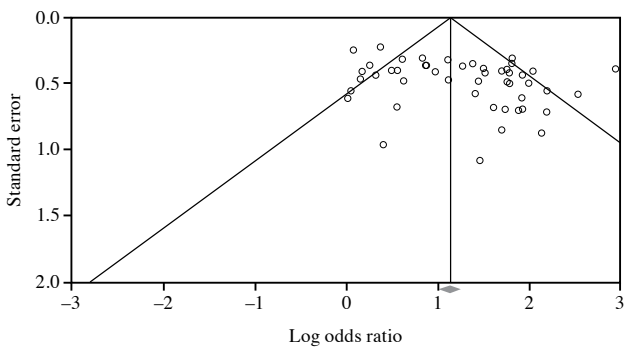

Figure 2. Funnel scatter plot of 48 studies on the pain reducing effect of non-pharmacological methods in patients undergoing open heart surgery.

DISCUSSION

In this systematic review and meta-analysis, the effects of non-pharmacological methods on pain in patients undergoing open heart surgery using data from 49 clinical trials involving 3,097 patients after cardiac surgery were discussed. Cardiac surgeries are one of the most frequently applied surgical treatment methods in the world for reasons such as shortening the recovery period of patients and increasing the quality of life and life span compared to other treatment methods.[39] The pain after open heart surgery adversely affects the quality of life of patients.[39-41] The severity of the patient's pain should be evaluated not according to the size of the operation, but as the patient perceives the pain.[4] The treatment of pain in patients after open heart surgery with non-pharmacological methods has an important place. Although non-pharmacological methods do not replace pharmacological methods in relieving pain, they increase the success of pain treatment. Non-pharmacological methods are practices that can be used as needed, can be easily taught to patients, do not cost much, can be easily applied, and are among the independent roles of the nurse who shows the results immediately.[6,42-44]

Deep breathing and coughing exercises, which are practices that accelerate postoperative recovery, also contribute to reducing pain after open heart surgery. When the studies included in the meta-analysis were examined, deep breathing and coughing exercises were found to be effective in reducing pain when applied alone or together with spirometry and relaxation exercises. In addition, the use of these methods can also contribute to the improvement of lung functions.[43,45-47]

Babamohamadi et al.[43] showed that distraction was an effective nursing intervention in controlling short-term and transient pain. Distraction could be achieved through various techniques including progressive muscle relaxation, meditation and rhythmic breathing (RB), in which patients were asked to close their eyes in a supine position,

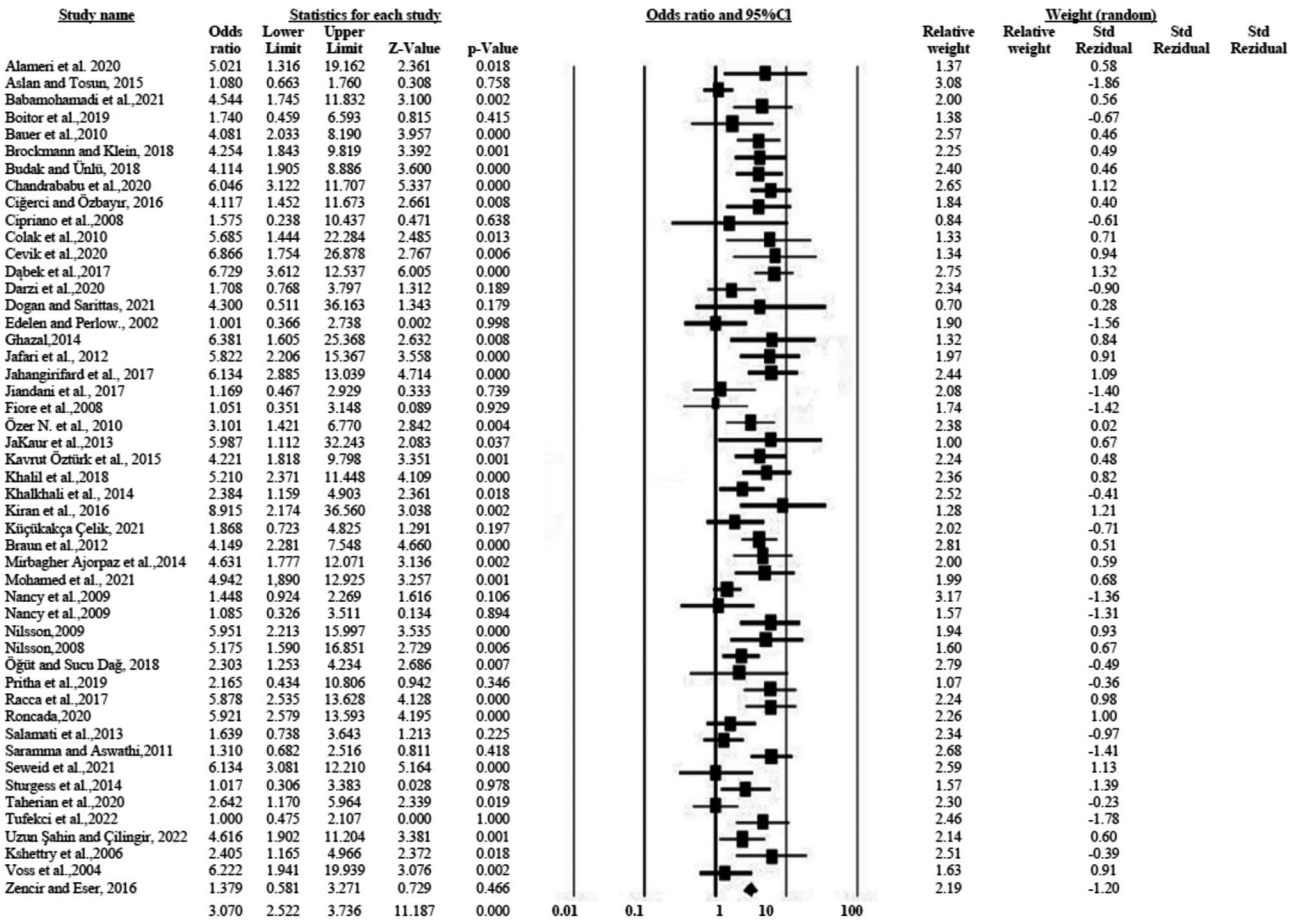

Figure 3. Heterogeneity test results for the effect of non-pharmacologic methods on pain in patients undergoing open heart surgery.

breathe in through the nose, hold their breath and exhale through the mouth counting from 1 to 3. All patients in the intervention group were instructed to focus solely on their breathing while breathing, and the severity of pain after the intervention was found to be significantly lower in the experimental group compared to the control group. The authors concluded that it might help to reduce the number of analgesic use in these patients.

Considering the studies on massage therapy among non-pharmacological methods, massage therapy showed a positive effect on pain in patients who underwent massage therapy. This method is applied in various ways such as hand, foot, extremity and back massage. While massage practices can be applied alone in open heart surgery, there are also studies in which they are used in combination with methods such as patient education, quiet rest time, and relaxation.[5,25,32-34,44,48-53] Alameri et al.,[5] in their study, applied 10-min foot massage to the experimental group by a research nurse within 30 min after taking opioid pain medication, twice in one day, and reported that pain intensity and anxiety significantly reduced in the experimental group compared to the control group. Another study by Boitor et al.[44] randomized patients to two 20-min hand massages (experimental), two 20-min hand holds (active control), or two 20-min rest periods (passive control/standard care) in addition to standard care, and assessed pain intensity, pain discomfort, anxiety, muscle tension, and vital signs before, after, and 30 min after each intervention. The findings showed that a 20-min hand massage in addition to routine postoperative pain management could simultaneously reduce pain intensity, pain discomfort and anxiety by an average of two points on a 0-10 scale.[44] In the study of Bauer et al.,[48] the efficacy and feasibility of massage therapy in relieving pain, tension and anxiety were evaluated in patients undergoing cardiovascular surgery. The patients were randomized to receive massage therapy or a quiet

rest period (control). The authors reported that pain, anxiety and tension significantly reduced in patients receiving massage.

Considering the effects of environmental or emotional methods on pain from the non-pharmacological management used in the studies examined, in Aslan and Tosun's study,[42] the effects of positive environmental experiences on the patient were examined and pain levels were found to be lower in relation to environmental awareness.

With the kinesiotaping method, the respiratory functions of open heart surgery patients can be improved, the pain intensity can be reduced and, therefore, the use of pharmacological methods can be reduced.[10,14]

The music method, which is frequently used among non-pharmacological methods in open heart surgery patients, has various applications before and after surgery. Music, which is a simple, safe and effective method, can reduce anxiety, pain intensity and the amount of analgesics thanks to its physically and psychologically relaxing effect.[18-24]

With TENS, a method of electrical nerve stimulation, patients' respiratory functions and pain can be improved after open heart surgery. Thus, opioid analgesic use may also decrease.[45,53-55]

Acupuncture methods are effective methods in reducing pain after open heart surgery and limiting opioid and non-opioid drug intake.[33,35,36]

In the reflexology method, pain can be reduced by applying pressure and massage to reflex pressure points. Ice massage or Benson relaxation exercises can also be included in these methods.[32,34]

Cold application is among the methods frequently used in thoracic surgeries. The intensity of pain after open heart surgery can be reduced by the application of cold gel packs. In addition, possible pain during exercise can be reduced by applying cold gel packs before deep breathing and coughing exercises or before using a spirometer.[54-57]

Aromatherapy can be applied at different time periods before and after extubation in open heart surgery. Studies have shown that aromatherapy improves vital signs and reduces pain and anxiety.[15-17]

Following open heart disease, the cardiac system is equalized, therapeutic touch, osteopathic manipulative treatment and individual exercise programs appear to increase life skills, accelerate functional recovery, and contribute to pain relief.[26,29-31]

With neurolinguistic programming and guided visualization methods, it can be easier to increase the comfort of patients after open heart surgery, support early recovery, and reduce pain and tension.[25,27,28]

After open heart surgery, patients' pain levels can be reduced by informing them about reducing pain, providing training, and providing follow-up by phone after discharge.[58-60]

The results of the meta-analysis of 49 studies that examined the effect of non-pharmacological methods on pain in patients undergoing open heart surgery and included in the study showed that the effect size of non-pharmacological methods on pain in patients undergoing open heart surgery was statistically significant with a value of 3.070 (W.A; 2.522-3.736; $p<0.001$) and was above the OR of +1. According to this result, non-pharmacological interventions were three times more effective in reducing the severity of pain in patients undergoing cardiac surgery than those without non-pharmacological methods. In this meta-analysis study, it is thought that non-pharmacological methods used in addition to pharmacological methods are effective on patients' quality of life and may reduce opioid use.

Currently, open heart surgery is among the most frequently performed surgeries and severe pain levels are reported by patients after these surgeries. With effective pain control after open heart surgery, patients' recovery is accelerated and their quality of life increases. In addition, with pain control, complications can be prevented, health care expenditure costs can be reduced, and pain can be prevented from becoming chronic. In addition to pharmacological methods, it is of utmost importance to use non-pharmacological methods in pain control.

Nonetheless, there are some limitations to this meta-analysis. The main limitation is the inclusion of studies in only two languages, English and Turkish. Additionally, pain is a patient-reported condition. Pain varies from person to person. Therefore, non-pharmacological methods used to relieve pain are affected by the individual characteristics of the patients. Furthermore, although it was concluded that pharmacological treatments might be effective in relieving postoperative pain after cardiac surgery when combined with non-pharmacological treatments, its effectiveness on pain, which is a subjective condition, could not be clearly stated. The fact that the research (programming and guided images) was not conducted only with randomized-controlled studies and that more studies are needed in this field are among the limitations to our study. Additional

limitations include subjectivity, possible publication bias, and handling of main effects.

However, the main strengths of this meta-analysis include its holistic examination of non-pharmacological pain methods in open heart surgery and its statistical significance. Non-pharmacological pain methods are cost-effective, have few side effects, and are easy to use. Additionally, with the use of non-pharmacological methods, the use of pharmacological methods, particularly opioids, tends to decline.

In conclusion, the use of non-pharmacological methods, as well as pharmacological methods, in pain control in patients undergoing cardiac surgery reduces the probability of pain by three times compared to non-pharmacological methods. Based on our results, using non-pharmacological methods is crucial in relieving patients' pain. Pain is a subjective finding reported by patients. However, it also adversely affects quality of life and recovery. It is, therefore, critical to use non-pharmacological methods to reduce pain in nursing care.

Ethics Committee Approval: As the study was conducted as a meta-analysis study, a literature review model was used. On the basis of the literature review, the approval of the Ethics Committee for research was not obtained, as it did not directly involve an intervention or effect on animals or humans.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: Design, analysis or interpretation, literature search, writing: T.Y., M.O., Ç.A.; Data collection or processing: T.Y., M.O.

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REFERENCES

1. Coppes OJM, Yong RJ, Kaye AD, Urman RD. Patient and surgery-related predictors of acute postoperative pain. Curr Pain Headache Rep 2020;24:12. doi: 10.1007/s11916-020-0844-3.
2. Bektaş N. Kardiyovasküler cerrahi sonrası erken ve geç dönem bakım. In: Çıtlak Sarıtaş S, Bülbüloğlu Kapıkıran G, editörler. Kardiyovasküler ve solunum sistemi hastalıkları, cerrahisi ve bakımı. Ankara: Akademisyen Kitapevi; 2021. s. 167-175.
3. Kakar E, Billar RJ, van Rosmalen J, Klimek M, Takkenberg JJM, Jeekel J. Music intervention to relieve anxiety and pain in adults undergoing cardiac surgery: A systematic review and meta-analysis. Open Heart 2021;8:e001474. doi: 10.1136/openhrt-2020-001474.
4. Reisli R, Akkaya ÖT, Arıcan Ş, Can ÖS, Çetingök H, Güleç MS, et al. Akut postoperatif ağrının farmakolojik tedavisi: Türk Algoloji-Ağrı Derneği klinik uygulama kılavuzu. Agri 2021;33(Suppl 1):1-51. doi: 10.14744/agri.2021.60243.
5. Alameri R, Dean G, Castner J, Volpe E, Elghoneimy Y, Jungquist C. Efficacy of precise foot massage therapy on pain and anxiety following cardiac surgery: Pilot study. Pain Manag Nurs 2020;21:314-22. doi: 10.1016/j.pmn.2019.09.005.
6. Midilli TS, Eşer İ, Yücel Ş. Cerrahi kliniklerinde çalişan hemşirelerin ağri yönetiminde nonfarmakolojik yöntemleri kullanma durumlari ve etkileyen faktörler. Acıbadem Üniversitesi Sağlık Bilimleri Dergisi 2019;1:60-6. doi: 10.31067/0.2018.72.
7. Taupikurrahman M, Sagiran S. Effectiveness of music therapy against decreased pain levels post-heart surgery: Scoping review. Jurnal Aisyah: Jurnal Ilmu Kesehatan 2021;6:433-8. doi: 10.30604/jika.v6i3.584.
8. Çavdar İ, Akyüz N. Ameliyat sonrası ağrı ve yönetimi. In: Akyolcu N, Kanan N, Aksoy G, editörler. Cerrahi hemşireliği I. 4. Baskı. İstanbul: Nobel Tıp Kitapevi; 2022. s. 367-385.
9. Jahangirifard A, Razavi M, Ahmadi ZH, Forozeshfard M. Effect of TENS on postoperative pain and pulmonary function in patients undergoing coronary artery bypass surgery. Pain Manag Nurs 2018;19:408-14. doi: 10.1016/j.pmn.2017.10.018.
10. Jiandani MP, Koradia C, Mehta AA. Effects of kinesiotaping on pain and pulmonary function following open heart surgery: A randomized control trail. J Soc Indian Physiother 2017;1:36-41.
11. Cipriano G Jr, de Camargo Carvalho AC, Bernardelli GF, Tayar Peres PA. Short-term transcutaneous electrical nerve stimulation after cardiac surgery: Effect on pain, pulmonary function and electrical muscle activity. Interact Cardiovasc Thorac Surg 2008;7:539-43. doi: 10.1510/icvts.2007.168542.
12. Ozturk NK, Baki ED, Kavakli AS, Sahin AS, Ayoglu RU, Karaveli A, et al. Comparison of transcutaneous electrical nerve stimulation and parasternal block for postoperative pain management after cardiac surgery. Pain Res Manag 2016;2016:4261949. doi: 10.1155/2016/4261949.
13. Kiran V, Thiruppathi A, Kodhandapani C, Ravi KT. The effect of transcutaneous electrical nerve stimulation on forced vital capacity and pain in patients with median sternotomy. JMSCR 2016;4:10926-33. doi: 10.18535/jmscr/v4i6.41.
14. Brockmann R, Klein HM. Pain-diminishing effects of Kinesio® taping after median sternotomy. Physiother Theory Pract 2018;34:433-41. doi: 10.1080/09593985.2017.1422205.
15. Babatabar Darzi H, Vahedian-Azimi A, Ghasemi S, Ebadi A, Sathyapalan T, Sahebkar A. The effect of aromatherapy with rose and lavender on anxiety, surgical site pain, and extubation time after open-heart surgery: A double-center randomized controlled trial. Phytother Res 2020;34:2675-84. doi: 10.1002/ptr.6698.
16. Khalil N, Ismaeel M, Hassan S, Shawky H. Effects of lavender oil inhalation on sternotomy related pain intensity in open

heart surgery patients in Egypt. Clin Pract 2018;16:1005-10. doi: 10.4172/clinical-practice.1000438.
17. Salamati A, Mashouf S, Sahbaei F, Mojab F. Effects of inhalation of lavender essential oil on open-heart surgery pain. Iran J Pharm Res 2014;13:1257-61.
18. Ciğerci Y, Özbayır T. The effects of music therapy on anxiety, pain and the amount of analgesics following coronary artery surgery. Turk Gogus Kalp Dama 2016;24:44-50.
19. Jafari H, Emami Zeydi A, Khani S, Esmaeili R, Soleimani A. The effects of listening to preferred music on pain intensity after open heart surgery. Iran J Nurs Midwifery Res 2012;17:1-6.
20. Özer N, Karaman Özlü Z, Arslan S, Günes N. Effect of music on postoperative pain and physiologic parameters of patients after open heart surgery. Pain Manag Nurs 2013;14:20-8. doi: 10.1016/j.pmn.2010.05.002.
21. Mirbagher Ajorpaz N, Mohammadi A, Najaran H, Khazaei S. Effect of music on postoperative pain in patients under open heart surgery. Nurs Midwifery Stud 2014;3:e20213. doi: 10.17795/nmsjournal20213.
22. Nilsson U. The effect of music intervention in stress response to cardiac surgery in a randomized clinical trial. Heart Lung 2009;38:201-7. doi: 10.1016/j.hrtlng.2008.07.008.
23. Nilsson U. Soothing music can increase oxytocin levels during bed rest after open-heart surgery: A randomised control trial. J Clin Nurs 2009;18:2153-61. doi: 10.1111/j.1365-2702.2008.02718.x.
24. Voss JA, Good M, Yates B, Baun MM, Thompson A, Hertzog M. Sedative music reduces anxiety and pain during chair rest after open-heart surgery. Pain 2004;112:197-203. doi: 10.1016/j.pain.2004.08.020.
25. Kshettry VR, Carole LF, Henly SJ, Sendelbach S, Kummer B. Complementary alternative medical therapies for heart surgery patients: Feasibility, safety, and impact. Ann Thorac Surg 2006;81:201-5. doi: 10.1016/j.athoracsur.2005.06.016.
26. Sturgess T, Denehy L, Tully E, El-Ansary D. A pilot thoracic exercise programme reduces early (0–6 weeks) sternal pain following open heart surgery. Int J Ther Rehabil 2014;21:110-7.
27. Doğan A, Saritaş S. The effects of neuro-linguistic programming and guided imagery on the pain and comfort after open-heart surgery. J Card Surg 2021;36:2389-97. doi: 10.1111/jocs.15505.
28. Saramma PP, Aswathi AK. Assessing the patients' recall regarding pain and its relief after open heart surgery. NJI 2011;102: B11.
29. Racca V, Bordoni B, Castiglioni P, Modica M, Ferratini M. Osteopathic manipulative treatment improves heart surgery outcomes: A randomized controlled trial. Ann Thorac Surg 2017;104:145-52. doi: 10.1016/j.athoracsur.2016.09.110.
30. Roncada G. Osteopathic treatment leads to significantly greater reductions in chronic thoracic pain after CABG surgery: A randomised controlled trial. J Bodyw Mov Ther 2020;24:202-11. doi: 10.1016/j.jbmt.2020.03.004.
31. Dąbek J, Pyka E, Piotrkowicz J, Stachoń K, Bonek-Wytrych G. Impact of post-hospital cardiac rehabilitation on the quality of life of patients after surgical treatment for coronary artery disease. Kardiochir Torakochirurgia Pol 2017;14:120-6. doi: 10.5114/kitp.2017.68743.
32. Saber Mohamed S, Thabet OF, Sayed ZA, Mohamed RD. Effect of foot reflexology massage versus benson relaxation technique on physiological parameters and pain after open heart surgery. Egypt J Health Care 2021;12:1737-49. doi: 10.21608/ejhc.2021.211188.
33. Taherian T, Shorofi S, Zeydi AE, Charati J, Pouresmail Z, Jafari H. The effects of Hegu point ice massage on post-sternotomy pain in patients undergoing coronary artery bypass grafting: A single–blind, randomized, clinical trial. Adv Integr Med 2019:7. doi: 10.1016/j.aimed.2019.08.001.
34. Uzun Şahin C, Çilingir D. The effects of foot reflexology upon pain, anxiety, and patient satisfaction among patients having undergone open-heart surgery. J Exp Clin Med 2022;39:17-23.
35. Colak MC, Kavakli A, Kilinç A, Rahman A. Postoperative pain and respiratory function in patients treated with electroacupuncture following coronary surgery. Neurosciences (Riyadh) 2010;15:7-10.
36. Pritha L, Valliammal S, Vijayaraghavan R. Effectiveness of acupressure on pain management among mediosternotomy patients. Int J Res Pharm Sci 2019;10:2507-14. doi: 10.26452/ijrps.v10i3.1404.
37. Nahcivan N, Seçginli S. Joanna Briggs. Institute Mastari Critical Appraisal Tools: Psychometric Testing of The Turkish Versions. Presented at the 2nd International Clinical Nursing Research Congress 2015 June 24-27; İstanbul: 2015. p. 1.
38. Borenstein M, Hedges LV, Higgins JPT, Rothstein HR. Introduction to Meta-Analysis. New Jersey: John Wiley & Sons; 2009. Çeviri editörü: Dinçer S. Meta-analize giriş. Ankara: Anı; 2013.
39. Çağlar Tuncer M, Yeşiltepe Oskay Ü. Açık kalp cerrahisinin kadin cinsel fonksiyonuna etkisi ve cinsel danişmanlik. HUHEMFAD 2021;8:341-5.
40. Barzanji A, Zareiyan A, Nezamzadeh M, Mazhari MS. Evaluation of observational and behavioural pain assessment tools in nonverbal intubated critically adult patients after open - heart surgery: A systematic review. Open Access Maced J Med Sci 2019;7:446-57. doi: 10.3889/oamjms.2019.103.
41. Akın E. Klinik ağrı yönetiminde hemşirenin etik yükümlülüğü. Turkiye Klinikleri J Med Ethics 2020;28:128-33. doi: 10.5336/mdethic.2019-66191.
42. Aslan Ö, Tosun B. Cardiovascular surgery patients: Intensive care experiences and associated factors. Asian Nurs Res (Korean Soc Nurs Sci) 2015;9:336-41. doi: 10.1016/j.anr.2015.10.003.
43. Babamohamadi H, Karkeabadi M, Ebrahimian A. The effect of rhythmic breathing on the severity of sternotomy pain after coronary artery bypass graft surgery: A randomized controlled clinical trial. Evid Based Complement Alternat Med 2021;2021:9933876. doi: 10.1155/2021/9933876.
44. Boitor M, Martorella G, Maheu C, Laizner AM, Gélinas C. Does hand massage have sustained effects on pain intensity and pain-related interference in the cardiac surgery critically ill? A randomized controlled trial. Pain Manag Nurs 2019;20:572-9. doi: 10.1016/j.pmn.2019.02.011.
45. Edelen C, Perlow M. A comparison of the effectiveness of an opioid analgesic and a nonpharmacologic intervention

to improve incentive spirometry volumes. Pain Manag Nurs 2002;3:36-42. doi: 10.1053/jpmn.2002.30394.

46. Fiore JF Jr, Chiavegato LD, Denehy L, Paisani DM, Faresin SM. Do directed cough maneuvers improve cough effectiveness in the early period after open heart surgery? Effect of thoracic support and maximal inspiration on cough peak expiratory flow, cough expiratory volume, and thoracic pain. Respir Care 2008;53:1027-34.
47. Zencir G, Eser I. Effects of cold therapy on pain and breathing exercises among median sternotomy patients. Pain Manag Nurs 2016;17:401-10. doi: 10.1016/j.pmn.2016.05.006.
48. Bauer BA, Cutshall SM, Wentworth LJ, Engen D, Messner PK, Wood CM, et al. Effect of massage therapy on pain, anxiety, and tension after cardiac surgery: A randomized study. Complement Ther Clin Pract 2010;16:70-5. doi: 10.1016/j.ctcp.2009.06.012.
49. Chandrababu R, Nayak BS, Pai VB, N R, George LS, Devi ES, et al. Effects of foot massage and patient education in patients undergoing coronary artery bypass graft surgery: A randomized controlled trial. Complement Ther Clin Pract 2020;40:101215. doi: 10.1016/j.ctcp.2020.101215.
50. Ghazal S. Effects of foot and hand massage on pain of open heart surgery patients in intensive care units. Tuj-HLTH [Internet] 2014;36.
51. JaKaur S, Lobo DJ, Latha T. Effectiveness of hand-foot massage on the post operative pain among open heart surgery patients: A randomised control trial. Presented at the 1st Annual Worldwide Nursing Conference (WNC). July 8-9, 2013. Singapore; 2013.
52. Braun LA, Stanguts C, Casanelia L, Spitzer O, Paul E, Vardaxis NJ, et al. Massage therapy for cardiac surgery patients--a randomized trial. J Thorac Cardiovasc Surg 2012;144:1453-9. doi: 10.1016/j.jtcvs.2012.04.027.
53. Albert NM, Gillinov AM, Lytle BW, Feng J, Cwynar R, Blackstone EH. A randomized trial of massage therapy after heart surgery. Heart Lung 2009;38:480-90. doi: 10.1016/j.hrtlng.2009.03.001.
54. Çevik K, İnce S, Pakiş Çetin S, Tetik Ö. Effect of applying cold gel pack to the sternum region on the postoperative pain after open-heart surgery. CBU-SBED: Celal Bayar University-Health Sciences Institute Journal 2020;7:76-80. doi: 10.34087/cbusbed.631665.
55. Khalkhali H, Tanha ZE, Feizi A, Ardabili SS. Effect of applying cold gel pack on the pain associated with deep breathing and coughing after open heart surgery. Iran J Nurs Midwifery Res 2014;19:545-9.
56. Küçükakça Çelik G, Özer N. Effect of cold application on chest incision pain due to deep breathing and cough exercises. Pain Manag Nurs 2021;22:225-31. doi: 10.1016/j.pmn.2020.02.002.
57. Seweid M, Taha N, Ramadan B, Ahmed F. Effect of cold application on incisional pain associated with incentive spirometry after coronary artery bypass graft surgery. Int J Afr Nurs Sci 2021;15:100315. doi: 10.1016/j.ijans.2021.100315.
58. Öğüt S, Sucu Dağ G. Pain characteristics and pain interference among patients undergoing open cardiac surgery. J Perianesth Nurs 2019;34:757-66. doi: 10.1016/j.jopan.2018.10.009.
59. Tüfekçi H, Akansel N, Sivrikaya SK. Pain interference with daily living activities and dependency level of patients undergoing CABG surgery. Pain Manag Nurs 2022;23:180-7. doi: 10.1016/j.pmn.2021.03.002.
60. Ertürk EB, Ünlü H. Effects of pre-operative individualized education on anxiety and pain severity in patients following open-heart surgery. Int J Health Sci (Qassim) 2018;12:26-34.