Pain and sleep after open-heart surgery—inhalation peppermint essence: double-blind randomized clinical trial

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ABSTRACT

Objective The aim of this study was to determine the effect of inhaling peppermint essence on pain relief and sleep quality after open-heart surgery.

Methods In a double-blind randomised clinical trial carried out in Iran in 2020, 64 cardiac patients were selected by convenience sampling and randomly allocated to aromatherapy (n=32) and placebo (n=32) groups. The aromatherapy and control groups received inhaled aromatherapy using peppermint essence and distilled water, respectively. Data gathering tools were the Numeric Pain Rating Scale and St Mary's Hospital Sleep Questionnaire. Data were analysed using an independent t-test, χ^2 test, Mann–Whitney U test and generalised estimating equation analysis.

Results The mean severity of pain in the aromatherapy and placebo groups was 3.22±0.88 and 4.56±0.90, respectively, which was a statistically significant difference (p=0.0001). The mean sleep scores after the intervention on day 1 were 20.10±4.90 and 25.76±6.36 in the aromatherapy and placebo groups, respectively, and 18.63±5.56 and 22.62±5.69, respectively, on day 2. The difference between the two groups was statistically significantly different after the intervention in terms of sleep quality (p<0.05).

Conclusion Aromatherapy attenuated pain and improved sleep quality after open-heart surgery. Peppermint essence aromatherapy is therefore recommended after surgery.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Pain is the most common side effect in the first days after cardiac surgery.
⇒ Patients undergoing surgery can benefit from palliative care and complementary medical treatments.

WHAT THIS STUDY ADDS

⇒ Aromatherapy using peppermint essential oil could significantly increase the sleep quality of patients after cardiac surgery.
⇒ Inhalation of peppermint essential oil with a nebuliser prior to extubation can reduce the severity of pain.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results of the present study may help nurses to consider the use of peppermint oil aromatherapy as an uncomplicated palliative and complementary treatment in the process of caring for patients after cardiac surgery to reduce the severity of pain and improve sleep quality.

INTRODUCTION

Cardiac surgery is a major procedure requiring general anaesthesia and mechanical ventilation support.[1] As such, it can cause significant physical and psychological stress including lack of sleep, pain and fear of death.[2] There is therefore a need for palliative care to be provided to these patients following their surgery. According to various studies, chronic post-sternotomy pain after cardiac surgery occurs in 21–56% of patients.[3 4] Patients undergoing surgery with the use of cardiopulmonary bypass report slightly higher pain intensity than those in whom extracorporeal circulation is not used.[5] There are several possible causes of pain, including sternal malunion, retained pacing wire fragments and chronic inflammation as a result of the presence of sternal wires. A possible aetiological factor is an allergic reaction to nickel in the sternal wires. It is likely that neuropathy caused by intercostal

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nerve damage has an important role in chronic pain after sternotomy.[3] In some cases, chronic pain can be a factor in prolonging hospital stays and results in significant morbidity including psychological distress.[3 4]

Despite the absence of prospective studies on the intensity of pain and the quality of postoperative analgesia following cardiac surgery, palliative care has a critical role. It is important to note that effective pain relief allows patients to feel more comfortable and also helps them to recover more quickly and may reduce the risk of developing certain complications such as pneumonia and blood clots.[3] A patient who is not provided with adequate pain relief after surgery is likely to experience postoperative morbidity, which can adversely affect their recovery.[6] Effective management of acute pain following cardiac surgery may reduce the risk of these complications and prevent the development of chronic pain.[6 7] According to a meta-analysis study, patients with persistent postoperative pain need to receive adequate treatment and follow-up.[4]

There are several systemic sequels of pain including disorders of the respiratory and cardiovascular systems, stimulation of the sympathetic nervous system, and impairments of muscular mobility, general mobility and physical fitness. As well as physical pain, severe pain can have a psychological impact.[3] However, both pain and medications prescribed for treating it can prolong weaning from mechanical ventilation and increase postoperative complications, mortality, length of hospitalisation and healthcare costs. It is possible that non-pharmacological therapies may provide a safer alternative or may be used in conjunction with medications to assist patients in reducing pain after cardiac surgery, improving their comfort level and promoting a healing environment.[3 7]

After cardiac surgery there is an increased risk of some postoperative morbidities, including sleep disturbances.[8] Sleep quality is measured by the feeling of refreshedness and rest after waking up from sleep, which is a sign of good sleep.[9] In a study by Caruana *et al* it was stated that people in intensive care are likely to experience poor quality sleep.[10] A meta-analysis study showed that 76% of hospitalised patients reported poor sleep quality and inadequate sleep duration as a result of their hospitalisation.[11] It has been found that sleep disturbances are associated with poor recovery after surgery.[12] Another study by Hu *et al* showed that postoperative patients experienced disturbed sleep during hospitalisation and up to 6 months after surgery.[13]

Palliative care and complementary medicine treatments such as acupuncture, relaxation techniques, massage and soft manipulation can benefit patients undergoing surgery without burdening the therapeutic plan but, rather, relieving it.[14] Among complementary medicine treatments, particular attention should be given to essential oils, which are both pleasant and inexpensive and can be quite useful. The use of aromatherapy is often combined with other treatments such as massage, which makes it difficult to isolate its effects when applied directly to the skin. Nevertheless, there is some clinical scientific evidence in favour of using aromatherapy with essential oils in various phases of preoperative and postoperative treatment.[15–17]

Aromatherapy appears to be one of the potential methods for reducing postoperative pain, although its effectiveness is unclear.[14] Studies have shown that inhaled essential oils may be used as part of the multidisciplinary treatment for pain, but it is not recommended as the sole pain management after laparoscopy and caesarian section.[16 18]

The mechanism of action of inhaled aromatherapy begins with the absorption of volatile molecules through the nasal mucosa. As odour molecules are converted into chemical signals, they travel towards the olfactory bulb and possibly to other parts of the limbic system, where they interact with the neuropsychological framework to produce characteristic physiological and psychological responses.[19]

One of the aromatic compounds that is widely used in palliative care today is peppermint essential oil. It is well known that peppermint has antispasmodic, analgesic, anti-inflammatory, anti-congestion and antioxidant properties.The three main ingredients of peppermint essential oil are menthol, menthone and menthyl-acetate.[20] Inhaled peppermint essential oil is absorbed systemically through the nasal mucosa and lungs. As soon as the aroma of peppermint is inhaled its molecules are immediately present in the blood and then in the brain and nervous system due to its lipophilic properties, causing physiological and behavioural changes in the individual.[21] In this regard, the study by Akbari *et al* showed that aromatherapy with peppermint essential oil attenuated the pain caused by intravenous catheterisation.[2]

There is evidence that inhaling essential oil may trigger the secretion of endorphin and attenuate pain and anxiety.[22] The study by Mahdavikian *et al* showed that aromatherapy with peppermint essential oils can improve the sleep quality of cardiac patients.[23] Previous studies on other patients have shown its effectiveness on sleep quality.[24–26] A meta-analysis study showed that aromatherapy intervention affected high heterogeneity of the effect size. Thus, future research with stricter controls of the methods and experimental procedures is necessary.[27]

There is no consensus about the effects of aromatherapy with peppermint on pain and sleep after surgery; while some believe in its effectiveness,[15 17] others argue that it is ineffective.[28] It appears that more studies are needed in this area. Therefore, the present study was conducted to investigate the effect of peppermint essential oil as palliative care in reducing pain and improving sleep quality of patients after open-heart surgery. The first hypothesis of the present study was that peppermint essential oil reduces pain in

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patients after open-heart surgery and, second, that it has an effect on improving the sleep quality of patients after open-heart surgery.

METHODS

Study design and participants

This double-blind randomised clinical trial was conducted in 2020 in cardiac patients who were candidates for open-heart surgery. The study design was parallel and the samples were placed in the groups in a ratio of one to one. The patients and the statistical analyst did not know the names and participants' allocation in the groups, and the names of the groups were recorded as A and B by the corresponding author. The participants were recruited from those who were consecutively referred to the cardiac surgery departments of two educational hospitals in Kashan, Iran.

Sampling was performed in a continuous manner and participants were randomly divided into two groups of intervention (n=32) and placebo (n=32) by the first author. Block randomisation (blocks of 4 people) was done using the prepared list from the online randomisation software (https://www.sealedenvelope.com/simple-randomiser/v1/lists) by the corresponding author.

Inclusion criteria included agreement to participate in the study, age >18 years, full postoperative consciousness, no history of allergic reactions to peppermint, no respiratory comorbidity and no cognitive problems. Exclusion criteria included decision to withdraw from the study, having an endotracheal tube for >12 hours, re-intubation, re-sternotomy, unstable haemodynamics, initiation of positive inotropic drugs and use of intra-aortic balloon pump during intervention, and death.

The sample size was calculated based on the results of a former similar study in which the mean scores were 4.84±1.6 and 3.0±2.4 in the control and intervention groups, respectively.[1] Then, with a type I error of 0.05, a type II error of 0.2, S_1 of 1.6, S_2 of 2.4, μ_1 of 4.78 and μ_2 of 3.0, the sample size for each study group was estimated to be 30, so 32 patients were recruited to each group to allow for a 5% dropout rate.

$$n_1 = n_2 = \frac{\left(z_{1-\frac{\alpha}{2}} + z_{1-\beta}\right)^2 (s_1 + s_2)^2}{(\mu_1 - \mu_2)^2} \cong 30$$

Intervention

In this study the intervention was started from the time before the patient was extubated in the intensive care unit and continued until the night of the second day after surgery. The intervention group received seven consecutive phases of peppermint essential oil aromatherapy 30 min before tracheal extubation and continued until the end of the second day after surgery (three times a day; figure 1). Due to the fact that patients undergoing open-heart surgery were discharged from the operating room in the afternoon and their extubation is usually done in the early hours of the night, the first intervention was performed between 19:00 and 21:00 hours.

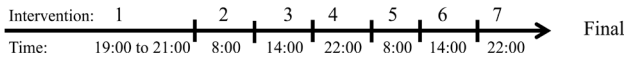

Figure 1 Intervention sequence.

Each time, 0.1 mL of 10% peppermint essential oil plus 10 mL distilled water were infused into the nebuliser of the ventilator (Druger Evita II) and the apparatus was then set on spontaneous mode to deliver a positive end expiratory pressure of 5 mmHg, positive support pressure cm H2o (centimeter H2o) of 7, and 40% oxygen. The heat and moisture exchanger filters of the ventilator were then removed and the apparatus was connected to the patient's tracheal tube for 10 min. The next phases of the intervention were similar to the first except for the use of a nebuliser mask. The placebo group was treated in the same way as the intervention group, but 10 mL of distilled water was used instead of peppermint essential oil.

Peppermint essential oil preparation

The 10% peppermint essential oil was purchased from the Barij-Essence Company, Kashan, Iran and contained limonene (6.03%), cineol (6.34%), menthone (17.7%), isomentone (3.31%), isopolegol (0.15%), menthol (26.66%), polygon (0.21%) and carvone (8.48%).

Instruments

The instruments used in this study included a clinicodemographic information form and a scale for assessing pain. The clinicodemographic information form included questions on patient's age, sex, height, weight, occupation, type and duration of surgery, vital signs (ie, pulse, respiration, systolic and diastolic blood pressure), duration of anaesthesia, duration of endotracheal intubation, duration of being under cardiac pump, medications used in anaesthesia and their dosage, receiving any blood product, and the name of antiemetic medication received after the surgery, if any.

Sleep quality was assessed with the St Mary's Hospital Sleep Questionnaire, which is designed to evaluate the sleep quality of patients admitted to the hospital the previous night.[29] This tool was translated into Persian. The questionnaire contains 14 questions on a 4-point Likert scale, with lower scores indicating better sleep quality. Quantitative content validity was assessed using the Content Validity Ratio (CVR) and Content Validity Index (CVI) and their amounts were estimated as 0.928 and 0.938, respectively. The reliability of the questionnaire was calculated by Cronbach's alpha coefficient (0.92).

Pain was assessed using the Numeric Pain Rating Scale, which is a 10 cm ruler marked from 0 (no pain) to 10 (the highest imaginable pain).[30]

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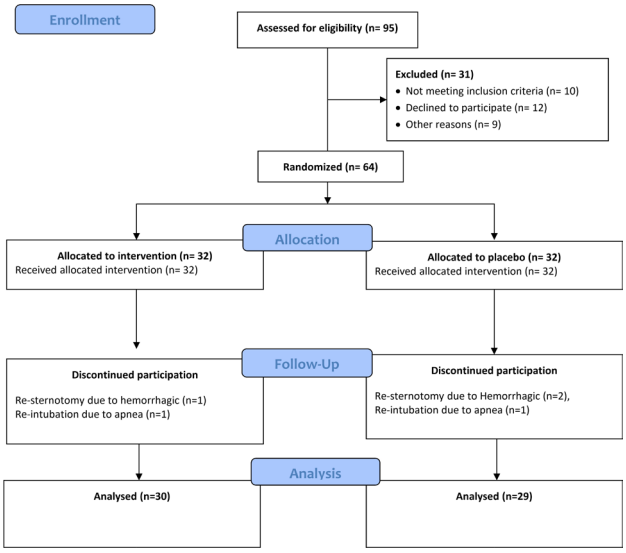

Figure 2 Consort diagram.

Data collection

The clinical demographic information of patients was recorded from the patient file after surgery. To measure the pain of patients in the intervention and placebo groups 30 min after each intervention, patients were asked to record their pain level on the pain reliever, and this pain measurement was done seven times during the study period. Also, in both groups, if the patient experienced any pain during the period of the study, analgesics were prescribed by the doctor and injected by the nurse and the amount was recorded on the clinical data collection form. The sleep quality questionnaire was also completed by the patients in the morning of days 1 and 2 after surgery (figure 2).

Data analysis

Data analysis was performed using the SPSS software version 16.0 (SPSS, Chicago, Illinois, USA). Mean and SD values were used to present quantitative data and frequency and percentages were used to present categorical data. The Kolmogorov–Smirnov test was used to determine whether the quantitative variables had a normal distribution. In order to compare the study groups on the basis of nominal and categorical data, χ^2 tests, Mann–Whitney U tests and independent t-tests were used. To examine variations in pain and sleep quality during consecutive measurements, a generalised estimating equation (GEE) analysis was performed.

RESULTS

Of 95 patients who were assessed for eligibility from June to September, 64 were consecutively recruited. There were no missing data in this study. Two participants from the intervention group and three from the placebo group were excluded during the study and the number of participants in these groups reduced to 30 and 29, respectively (figure 1).

The mean±SD age of participants in the intervention and placebo groups was 61.03±8.16 years and 58.34±8.96 years, respectively. The majority of the placebo group (56.3%) and 43.8% of the intervention group were women. A coronary artery bypass graft was the most common surgery in the intervention and control groups (50% vs 50%). The results of independent t-tests showed a statistically significant difference between the two groups in terms of the amount of morphine ampoules received after surgery in the ICU ward ($p=0.001$). The study groups did not differ significantly regarding their baseline demographic (sex, age, and weight) and clinical characteristics (type of surgery, anaesthesia time (hours), duration of having a tracheal tube, fentanyl citrate ampoules (µg), thiopental ampoules (mg), and duration of being under the CBP device (hours), $p>0.05$; table 1). The results of t-tests showed a statistically significant difference in the mean systolic, diastolic and heart rate between the two groups ($p<0.05$). Also, the results of this test showed a statistical difference between the mean pain scores and sleep quality in the two groups during the measurement times ($p<0.05$), with the mean pain score and sleep quality in the intervention group being significantly lower than in the placebo group (table 2).

GEE analysis was conducted using the backward model to examine the effects of clinicodemographic variables on pain. The results showed that the mean pain score was significantly different between the study groups (coefficient −0.486; $p=0.001$), with the mean pain 2.31 times more in the placebo group than in the intervention group ($e^{-0.486} = 2.11$). Also, as illustrated by the coefficient of the time variable, the pain decreased over time (coefficient −0.032; table 3).

The GEE analysis using the backward model was also conducted to examine the effects of clinicodemographic variables on sleep quality. The results showed that the mean sleep quality was significantly different between the study groups (coefficient −0.121; $p=0.002$), with the mean sleep quality 2.12 times higher in the placebo group than in the intervention group ($e^{-0.121} = 1.98$). Also, as shown by the coefficient of the time variable, sleep quality increased over time (coefficient −0.135; table 4).

DISCUSSION

The results of the present study show that peppermint essence oil aromatherapy can attenuate pain after cardiac surgery. Searching creditable databases including Clinical Key, Cochrane Library, PubMed and Web of Science yielded no studies on the effect of peppermint on the pain caused by cardiac surgery. Some studies have reported the effectiveness of aromatherapy on attenuation of pain from different causes. For example, the study by Akbari *et al*[2] showed that aromatherapy with peppermint essence can reduce pain during intravenous catheterisation in cardiac patients, Heshmati *et al* reported positive effects of peppermint

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Table 1 Comparison of demographic and clinical variables between the intervention and placebo groups

Variables	Group	Mean		P value
Age (years)	Placebo	58.34±8.96		0.23*
	Intervention	61.03±8.16		
Weight (kg)	Placebo	71.27±9.85		0.94*
	Intervention	71.50±13.97		
Anaesthesia time (hours)	Placebo	3.57±0.90		0.12†
	Intervention	3.96±0.85		
Intubation time (hours)	Placebo	3.75±0.89		0.68†
	Intervention	3.88±0.78		
Pump time (min)	Placebo	57.62±21.36		0.05†
	Intervention	69.53±22.53		
Propofol ampoules (mg)	Placebo	15.86±28.31		0.63†
	Intervention	15.37±23.93		
Thiopental ampoules (mg) (OR)	Placebo	134.48±17.82		0.59†
	Intervention	163.33±18.01		
Morphine ampoules (mg)	Placebo	6.27±4.31		0.001†
	Intervention	2.23±2.01		
Pethidine ampoules (mg)	Placebo	9.48±14.47		0.06†
	Intervention	2.83±6.65		
Fentanyl citrate ampoules (µg) (OR)	Placebo	18.41±23.90		0.40†
	Intervention	15.82±9.53		
		Placebo n (%)	**Intervention n (%)**	
Sex	Women	9 (56.3)	7 (43.8)	0.56‡
	Men	20 (46.5)	23 (53.5)	
Type of surgery	CABG	25 (50)	25 (50)	0.61‡
	Valve	2 (33.3)	4 (66.7)	
	Congenital	2 (66.7)	1 (33.3)	

OR: The intervention was performed in the operating room.
*Independent t-test.
†Mann–Whitney test.
‡χ^2 test.
CABG, coronary artery bypass graft.

essence on decreasing pain following appendectomy operations[31] and the study by Sundstrup *et al* also showed that topical menthol acutely reduces pain intensity during the working day in slaughterhouse workers with carpal tunnel syndrome.[32]

To explain this finding, it may be that the analgesic effect of peppermint is due to its main components including carvone, limonene and menthol.[33] The menthol in peppermint affects kappa opioid receptors and soothes the pain in return. In addition, menthol is effective in soothing pain by increasing the stimulation threshold of cells and decreasing synoptic stimulations and transmits.[31] Under pathological situations such as cardiac surgery, menthol activates transient receptor potential cation channel subfamily M member 8 to attenuate mechanical allodynia and thermal hyperalgesia following nerve injury or chemical stimuli. Recent reports have reiterated the requirement of central group II/III metabotropic glutamate receptors (mGluR) with endogenous κ-opioid signalling pathways for menthol analgesia. Additionally, blockage of sodium channels and calcium influx is a determinant step after menthol exposure, suggesting the possibility of menthol for pain management.[34] Another result of the study showed that the average pain score was higher in men. A study by Chia *et al* showed that women consumed significantly less morphine via patient-controlled analgesia than men in the first three postoperative days.[35]

The large volume of literature in this area clearly suggests that men and women differ in their responses to pain, with increased pain sensitivity and risk for clinical pain commonly being observed in women. Emerging evidence suggests that genotype and endogenous opioid function have a causal role in these disparities, and considerable literature implicates sex hormones as factors influencing pain sensitivity. However, the specific modulatory effect of sex hormones on pain among men and women requires more research.[36] Another study stated that gender differences in pain and its relief arise from an interaction of genetic, anatomical, physiological, neuronal,

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Table 2 Comparison of mean pain and sleep quality scores after surgery

Pain		Group	Mean±SD	P value*
2 hours after extubation		Placebo	5.03±1.42	0.0001
		Intervention	3.17±1.48	
Day 1	08:00 hours	Placebo	4.55±1.17	0.0001
		Intervention	3.33±1.18	
	14.00 hours	Placebo	5.03±1.01	0.0001
		Intervention	3.73±0.94	
	22:00 hours	Placebo	4.34±1.42	0.0001
		Intervention	3.27±0.98	
Day 2	08:00 hours	Placebo	4.28±1.43	0.0001
		Intervention	2.93±1.04	
	14:00 hours	Placebo	4.34±1.49	0.0001
		Intervention	2.87±1.35	
	22:00 hours	Placebo	4.34±1.42	0.0001
		Intervention	3.27±0.98	
Total mean score		Placebo	4.56±0.90	0.0001
		Intervention	3.22±0.88	
Sleep				
Day 1		Placebo	25.76±6.36	0.0001
		Intervention	20.10±4.90	
Day 2		Placebo	22.62±5.69	0.009
		Intervention	18.63±5.56	

*Independent t-test.

hormonal, psychological and social factors which modulate pain differently in the sexes.[37]

The results presented in this study show that peppermint essential oils can improve sleep quality in patients undergoing cardiac surgery under inhalation aromatherapy. Our findings are consistent with previous studies. Despite our extensive search in reliable scientific databases, we did not find any published studies regarding the effects of peppermint essential oil on sleep quality of cardiac surgery patients. However, some studies have combined peppermint essential oil with other compounds for use in patients in different disease groups. The results of some studies have indicated the positive effect of inhalation aromatherapy on sleep quality. In this regard, Mahdavikian *et al* showed that aromatherapy with lavender and peppermint essential oils can improve the sleep quality of cardiac patients,[23] and a study by Lillehei and Halcon has also indicated that aromatherapy with peppermint essential oil could be potentially effective in improving sleep quality.[38] Also, in a study by Lisa *et al* on the effects of aromatherapy on insomnia, peppermint essential oil had positive effects on improving insomnia.[24] A study by Jayadharani *et al* also showed that the use of peppermint essential oil can reduce sleep disorders in patients with sleep apnoea and increase sleep quality.[39] The results of a meta-analysis also showed that aromatherapy has a significant effect on improving sleep quality.[25]

To explain the abovementioned results, previous studies have confirmed the relaxing and sedative effects of peppermint essential oil.[24] In other words, this essential oil can decrease fatigue, anxiety, heart rate, respiratory rate and blood pressure, increase the oxygenation of the lungs and brain and improve sleep quality[23] and, in this way, it is able to improve sleep quality of patients after surgery. Since patients experience a high level of stress and pain following surgery after awakening in the critical care department, by removing these factors the sleep quality of the patients could also be improved.

Table 3 Results of generalised estimating equation analysis for examining the effects of clinicodemographic variables on pain

Variable	Coefficient	SE	Wald χ^2	P value
Group (intervention)	−0.486	0.1129	18.516	0.001
Sex (intervention)	0.107	0.0492	4.759	0.029
Time	−0.032	0.0167	3.765	0.052
Intubation time (hours)	0.122	0.0245	24.708	0.001
Diastolic BP (mmHg)	−0.008	0.0023	11.884	0.001
Pulse rate (p/min)	0.005	0.0023	5.782	0.016

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Table 4 Results of generalised estimating equation analysis for examining the effects of clinicodemographic variables on sleep quality

Parameter	Coefficient	SE	Wald χ^2	P value
Group (intervention)	−0.121	0.139	0.751	0.002
Time	−0.135	0.063	4.564	0.033
Age	−0.006	0.002	7.106	0.008
Anaesthesia time (hours)	−0.217	0.033	42.133	0.000
Intubation time (hours)	0.197	0.036	29.334	0.000
Morphine ampoules (mg)	0.013	0.006	4.229	0.040
Fentanyl ampoules	0.002	0.0009	7.051	0.008
Systolic BP (mmHg)	0.007	0.002	7.602	0.006

There were some limitations in this study. First, the possible effects of environmental factors such as light and noise on patients' sleep quality were not considered. Although major attempts were made to control these factors, they could not be completely controlled by the researcher.

CONCLUSION

The results show that inhalation of peppermint essential oil can reduce the pain intensity of patients after open-heart surgery and consequently reduce the use of pain relievers by patients. Also, the use of this herbal product can improve the sleep quality of patients in the first nights after surgery and bring them more comfort. Considering the effect of peppermint essential oil inhalation on pain and sleep quality of patients after open-heart surgery, it can be concluded that this herbal product can be safely used as a complementary treatment in relieving pain and making patients comfortable after heart surgery.

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Contributors IA-F is responsible for the overall content as guarantor. Conceptualization: IA-F, M-RA, MM. Data curation: IA-F, MM, M-SP-A. Formal analysis: MM. Funding acquisition: IA-F, M-RA. Investigation: IA-F, SY, MM. Methodology: IA-F, M-RA. Project administration: M-RA. Resources: IA-F. Software: MM. Supervision: SY, IA-F. Validation: IA-F. Visualization: IA-F, M-RA. Writing - original draft: IA-F, M-RA. Writing - review and editing: IA-F, M-RA, M-SP-A.

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Competing interests None declared.

Patient consent for publication Consent obtained directly from patient(s).

Ethics approval This study was approved by the Ethics Committee of Kashan University of Medical Sciences, Kashan, Iran (approval code: Ir. Kaums. Nuhepm. Rec. 1397.046) and also registered on the Iranian Registry of Clinical Trials (registration code IRCT20100124003146N5). Patients were informed of the study's objectives and procedures, as well as the voluntariness of participation. The patients were assured that their participation in the study would not pose any risk or cost to them, that they would be able to withdraw from the study at their own discretion, and that their withdrawal would not harm their medical care or treatment. Additionally, they were assured that their personal information would be kept confidential. Each participant provided written informed consent.

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REFERENCES

1 Afazel MR, Nadi F, Pour-Abbasi MS, *et al*. The effects of continuous positive airway pressure mask on hemodynamic parameters after open heart surgery: a randomized controlled trial. *Nurs Midwifery Stud* 2017;6:109.
2 Akbari F, Rezaei M, Khatony A. Effect of peppermint essence on the pain and anxiety caused by intravenous catheterization in cardiac patients: a randomized controlled trial. *J Pain Res* 2019;12:2933–9.
3 Zubrzycki M, Liebold A, Skrabal C, *et al*. Assessment and pathophysiology of pain in cardiac surgery. *J Pain Res* 2018;11:1599–611.
4 Guimarães-Pereira L, Reis P, Abelha F, *et al*. Persistent postoperative pain after cardiac surgery: a systematic review with meta-analysis regarding incidence and pain intensity. *Pain* 2017;158:1869–85.
5 Fot EV, Izotova NN, Yudina AS, *et al*. Automated weaning from mechanical ventilation after off-pump coronary artery bypass grafting. *Front Med (Lausanne)* 2017;4:31.
6 Alzahrani T. Pain relief following thoracic surgical procedures: a literature review of the uncommon techniques. *Saudi J Anaesth* 2017;11:327–31.
7 Dabbagh A. Postoperative pain management in adult cardiac surgery. In: Dabbagh A, Esmailian F, Aranki S, eds. *Postoperative critical care for adult cardiac surgical patients*. Cham: Springer International Publishing, 2018: 527–63.
8 Mirmohammadsadeghi A, Jahannama N, Mirmohammadsadeghi M. Sleep quality after coronary artery bypass graft surgery: comparing pulsatile and nonpulsatile pump flow. *J Extra Corpor Technol* 2020;52:314–8.
9 Seid Tegegne S, Fenta Alemnew E. Postoperative poor sleep quality and its associated factors among adult patients: a multicenter cross-sectional study. *Ann Med Surg (Lond)* 2022;74:103273.
10 Caruana N, McKinley S, Elliott R, *et al*. Sleep quality during and after cardiothoracic intensive care and psychological health during recovery. *J Cardiovasc Nurs* 2018;33:E40–9.
11 Burger P, Van den Ende ES, Lukman W, *et al*. Sleep in hospitalized pediatric and adult patients - a systematic review and meta-analysis. *Sleep Med X* 2022;4:100059.
12 Yang PL, Huang GS, Tsai CS, *et al*. Sleep quality and emotional correlates in Taiwanese coronary artery bypass graft patients

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1 week and 1 month after hospital discharge: a repeated descriptive correlational study. *PLoS One* 2015;10:e0136431.
13 Hu X-M, Wei W-T, Huang D-Y, *et al*. Sleep patterns and potential risk factors for disturbed sleep quality in patients after surgery for infective endocarditis. *J Cardiothorac Surg* 2022;17:121.
14 Stea S, Beraudi A, De Pasquale D. Essential oils for complementary treatment of surgical patients: state of the art. *Evid Based Complement Alternat Med* 2014;2014:726341.
15 Meshgin Abadi N, Ramezani Badr F, Mahmoodi K. The use of aromatherapy massage to reduce backpain after percutaneous coronary intervention (PCI): a semi-experimental study. *J Adv Med Biomed Res* 2013;21:24–34.
16 Olapour A, Behaeen K, Akhondzadeh R, *et al*. The effect of inhalation of aromatherapy blend containing lavender essential oil on cesarean postoperative pain. *Anesth Pain Med* 2013;3:203–7.
17 Shahdadi H, Balouchi A, Taheri S, *et al*. Study effect of mint essence on pain, bloat and nausea in patients undergoing appendectomy. *Pharm Lett* 2016;7:193–7.
18 Kopustinskiene DM, Bernatonyte U, Maslii Y, *et al*. Natural herbal non-opioid topical pain relievers—comparison with traditional therapy. *Pharmaceutics* 2022;14:2648.
19 AlMohammed HI, A Alanazi N, Maghrabi EF, *et al*. Role of aromatherapy as a natural complementary and alternative therapy in cardiovascular disease: a comprehensive systematic review. *Evid Based Complement Alternat Med* 2022;2022:4543078.
20 Soleimani M, Kashfi LS, Mirmohamadkhani M, *et al*. The effect of aromatherapy with peppermint essential oil on anxiety of cardiac patients in emergency department: a placebo-controlled study. *Complement Ther Clin Pract* 2022;46:101533.
21 Maghami M, Afazel MR, Azizi-Fini I, *et al*. The effect of aromatherapy with peppermint essential oil on nausea and vomiting after cardiac surgery: a randomized clinical trial. *Complement Ther Clin Pract* 2020;40:101199.
22 Gnatta JR, Kurebayashi LFS, Turrini RNT, *et al*. Aromatherapy and nursing: historical and theoretical conception. *Rev Esc Enferm USP* 2016;50:127–33.
23 Mahdavikian S, Rezaei M, Modarresi M, *et al*. Comparing the effect of aromatherapy with peppermint and lavender on the sleep quality of cardiac patients: a randomized controlled trial. *Sleep Science Practice* 2020;4:10.
24 Blackburn L, Achor S, Allen B, *et al*. The effect of aromatherapy on insomnia and other common symptoms among patients with acute leukemia. *Oncol Nurs Forum* 2017;44:E185–93.
25 Tang Y, Gong M, Qin X, *et al*. The therapeutic effect of aromatherapy on insomnia: a meta-analysis. *J Affect Disord* 2021;288:1–9.
26 Cheong MJ, Kim S, Kim JS, *et al*. A systematic literature review and meta-analysis of the clinical effects of aroma inhalation therapy on sleep problems. *Medicine (Baltimore)* 2021;100:e24652.
27 Kim ME, Jun JH, Hur MH. Effects of aromatherapy on sleep quality: a systematic review and meta-analysis. *J Korean Acad Nurs* 2019;49:655–76.
28 Ou M-C, Lee Y-F, Li C-C, *et al*. The effectiveness of essential oils for patients with neck pain: a randomized controlled study. *J Altern Complement Med* 2014;20:771–9.
29 Ellis BW, Johns MW, Lancaster R, *et al*. The St. Mary's Hospital Sleep Questionnaire: a study of reliability. *Sleep* 1981;4:93–7.
30 Mahboubi M. Mentha spicata as natural analgesia for treatment of pain in osteoarthritis patients. *Complement Ther Clin Pract* 2017;26:1–4.
31 Heshmati A, Dolatian M, Mojab F, *et al*. The effect of peppermint (Mentha piperita) capsules on the severity of primary dysmenorrhea. *J Herbal Med* 2016;6:137–41.
32 Sundstrup E, Jakobsen MD, Brandt M, *et al*. Acute effect of topical menthol on chronic pain in slaughterhouse workers with carpal tunnel syndrome: triple-blind, randomized placebo-controlled trial. *Rehabil Res Pract* 2014;2014:310913.
33 Mahboubi M. *Mentha spicata* L. essential oil, phytochemistry and its effectiveness in flatulence. *J Tradit Complement Med* 2021;11:75–81.
34 Li Z, Zhang H, Wang Y, *et al*. The distinctive role of menthol in pain and analgesia: mechanisms, practices, and advances. *Front Mol Neurosci* 2022;15:1006908.
35 Chia YY, Chow LH, Hung CC, *et al*. Gender and pain upon movement are associated with the requirements for postoperative patient-controlled IV analgesia: a prospective survey of 2,298 Chinese patients. *Can J Anaesth* 2002;49:249–55.
36 Bartley EJ, Fillingim RB. Sex differences in pain: a brief review of clinical and experimental findings. *Br J Anaesth* 2013;111:52–8.
37 Pieretti S, Di Giannuario A, Di Giovannandrea R, *et al*. Gender differences in pain and its relief. *Ann Ist Super Sanita* 2016;52:184–9.
38 Lillehei AS, Halcon LL. A systematic review of the effect of inhaled essential oils on sleep. *J Altern Complement Med* 2014;20:441–51.
39 Jayadharani C, Devi RG, Priya AJ. Effect of peppermint oil among sleep apnea individuals. *JPRI* 2020:98–101.

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