



## Effectiveness of Lemongrass Aromatherapy and The 4-7-8 Breathing Technique on Post Operative Pain after General Anesthesia

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### ABSTRACT

**Introduction:** Postoperative pain is a common clinical problem among patients undergoing surgery with general anesthesia. Compared to regional anesthesia, general anesthesia is associated with a higher intensity of postoperative pain, which may lead to delayed recovery and complications if not optimally managed. In addition to pharmacological therapy, non-pharmacological pain management strategies are increasingly recommended due to their safety, flexibility, and minimal side effects. Lemongrass aromatherapy has been reported to possess antidepressant and analgesic effects, while the 4–7–8 breathing technique is known to promote relaxation and pain control. Combining these interventions may enhance postoperative pain management. **Objective:** This study aimed to determine the effectiveness of a combination of lemongrass aromatherapy and the 4–7–8 breathing technique in reducing pain among patients after general anesthesia. **Methods:** A quasi-experimental study with a pre–post test control group design was conducted at PKU Muhammadiyah Hospital Bantul. The study population consisted of postoperative patients who received general anesthesia. A purposive sampling technique was used to recruit 34 respondents, divided equally into an intervention group (n=17) and a control group (n=17). Pain intensity was measured before and after the intervention. Data were analyzed using the Wilcoxon test for within-group comparisons and the Mann–Whitney test for between-group differences. **Results:** The Wilcoxon test showed a significant reduction in pain intensity in the intervention group (p=0.000) and the control group (p=0.003). The Mann–Whitney test revealed a significant difference in pain reduction between groups (p=0.026), indicating greater effectiveness in the intervention group. **Conclusion:** The combination of lemongrass aromatherapy and the 4–7–8 breathing technique is effective in significantly reducing postoperative pain in patients after general anesthesia.

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## 1. INTRODUCTION

The management of a disease can be done through a process called surgery. Every year, the number of patients undergoing surgery increases. In 2017, there were 140 million patients undergoing surgery in hospitals worldwide. In 2019, this number increased to 148 million patients across all hospitals worldwide. This figure continues to change and increase, as seen in the 2020 data, which shows 234 million patients undergoing surgery (Danial Ramadhan\* & Fitri, 2023). Similarly, in terms of the number of surgeries performed in Indonesia, surgical treatment ranks 11th out of 50 types of treatment, 32% of which are elective surgeries (Nugroheni et al., 2023).

This surgical procedure requires anesthesia to relieve the patient's pain during surgery. The types of anesthesia used in surgical patients are general anesthesia and regional anesthesia. Patients who undergo general anesthesia will experience more post-operative pain than those who undergo regional anesthesia. Post-operative pain that is not properly managed will cause discomfort and ongoing complications (Azizah, 2023). It is because if pain is not properly managed, it can have a negative impact on their health. Improper pain management can lead to serious medical problems, such as endocrine, metabolic, immune, and other systemic disorders, with symptoms such as fever, hypertension, and others. Patients experiencing post-operative pain require further treatment.

Pain management can be performed post-surgery which includes pharmacological and non-pharmacological treatments. Non-pharmacological treatments may include deep breathing relaxation, guided imagery, distraction, or the use of aromatherapy. Aromatherapy can be derived from various plants. Lemongrass aromatherapy is chosen because it contains antidepressant properties that can help alleviate pain in patients. Additionally, lemongrass extract has potential as a sedative in male mice, with efficacy comparable to diazepam (Shintawati, 2019). After testing, lemongrass plants were found to contain active compounds, including alkaloids, flavonoids, saponins, quinones, and tannins. Based on the description of the active compounds above, it can be concluded that lemongrass plants have antibacterial properties (Yuniarti et al., 2022) as aromatherapy to reduce anxiety and pain due to its distinctive and fresh scent (Eva & Destia, 2023).

In addition to aromatherapy, another pain management technique is deep breathing relaxation. The 4-7-8 breathing exercise is a technique that combines breathing and relaxation with timed breathing to reduce dyspnoea, anxiety, and depression (Pandekar & Thangavelu, 2019). Unlike deep breathing relaxation techniques, the 4-7-8 technique has been proven to reduce anxiety, which in turn lowers patients' pain levels. The novelty in this study was the 4-7-8 breathing technique, a relaxation technique to achieve a relaxed state by inhaling for 4 seconds, holding the breath for 7 seconds, and exhaling for 8 seconds (Karangan et al., 2024)

Based on the above information, combining lemongrass aromatherapy with the 4-7-8 breathing exercise is necessary to achieve maximum pain relief for patients. Physiologically, the peripheral nervous system consists of primary nerves that detect tissue damage. This system senses various sensations, such as touch, hot and cold temperatures, pain, and pressure. The receptors that transmit pain signals are called nociceptors, which are activated by mechanical, thermal, or chemical stimuli (Aprilliya L, 2021). In lemongrass aromatherapy, active compounds such as citronellal and geraniol can produce a relaxing effect and modulate the central nervous system (Cui, Li, Wei, Li, He, Yang, Li, et al., 2022). This is also supported by the 4–7–8 breathing

exercise, which activates the vagus nerve to reduce sympathetic nervous system activity (associated with the stress response) and increase parasympathetic nervous system activity (Vierra et al., 2022).

Previous research has shown that the combination of lemongrass aromatherapy and pranayama yoga has a significant effect on reducing dysmenorrhea pain in female students, with a significance value of 0.001 ( $p$ value < 0.05) (A. Anisa, 2023). In another study, the effect of lemongrass aromatherapy had a significance value of 0.000<0.05. Lemongrass aromatherapy was able to reduce pain in mothers during the active phase of labor (G. Anisa et al., 2023). Previous research on deep breathing has been conducted using a quasi-experimental design with pre- and post-tests without controls. Based on the results of the Wilcoxon test, there is an effect of deep breathing relaxation on the intensity of pain in patients after appendectomy surgery ( $p=0.000$ ) (Amir & Nuraeni, 2018). Similarly, deep breathing relaxation techniques have been used in research at Dr. H. Moeloek Provincial Hospital in Tanjung Karang, using accidental sampling and Mann-Whitney U test statistics, with the results showing a significant decrease in the intensity of pain in patients undergoing post-laparotomy surgery ( $p=0.000$ ) (Yuniarti et al., 2022).

The difference from previous studies lies in the independent variables, namely lemongrass aromatherapy and the 4-7-8 breathing exercises for pain therapy in patients undergoing general anesthesia. This combination is considered necessary not only because of the novelty of the therapy but also so that when patients experience pain after general anesthesia, it can be treated as effectively as possible using the appropriate techniques. In addition, the lack of previous studies on combined interventions underscores the importance of this study.

The role of nurses is very much needed in this case. In addition to pharmacological management, nurses can prevent post-operative pain complications by administering non-pharmacological techniques. Based on the background, considering the risks and realities faced by post-operative patients under general anesthesia, it is deemed necessary to conduct research on lemongrass aromatherapy and the 4–7–8 breathing exercises for pain therapy in post-general anesthesia patients.

## 2. METHODS

### Research Design

This study is a quasi-experimental study using a pre-test – post-test control group design, which aims to reveal cause and effect by involving a control group and an intervention group. In this study, the intervention consisted of lemongrass aromatherapy and 4 – 7 – 8 breathing exercises in the intervention group. The control group was administered 4 – 7 – 8 breathing exercises.

### Population and Sample

The population in this study was all post-operative patients at PKU Muhammadiyah Hospital in Bantul. In this study, the researchers used nonprobability sampling, specifically purposive sampling, to select the research sample. Non-probability sampling is a sampling technique in which not all members of the population have an equal chance of being selected as samples. Purposive sampling is a non-random sampling technique in which researchers select samples based

on specific criteria or characteristics that align with the research objectives, enabling them to answer the research questions. The criteria for determining the suitability of the sample for the research objectives were as follows:

- a. Inclusion Criteria
  - 1) Patients willing to be respondents
  - 2) Patients under general anaesthesia
  - 3) Patients aged 17–65 years
  - 4) Patients with a pain scale of 4–6
  - 5) Patients with ASA physical status 1
- b. Exclusion Criteria
  - 1) Experiencing neurological disorders
  - 2) Experiencing drastic hemodynamic changes
  - 3) Experiencing shortness of breath
  - 4) Sample size

The sample size in this study used the Lemeshow formula because the population size was unknown, resulting in 34 respondents with a 95% confidence level.

### **Instrument**

In this study, the tools or instruments included a stopwatch, writing instruments used to record pain measurement results, informed consent forms, Numeric Rating Scale pain measurement sheets, and SOP 4-7-8 breathing exercise sheets. The Numeric Rating Scale (NRS) pain measurement sheet is a widely used pain scale for measuring pain intensity before and after therapeutic intervention, as it is easy to use and document. In the intervention group, aromatherapy with lemongrass essential oil was added, composed of pure essential oil extracted from lemongrass without alcohol, branded Capsen, and certified halal. The device used for aromatherapy administration was a humidifier branded Capsen.

### **Research Procedure**

This research was conducted by the same researcher to minimize bias. Data collection was conducted using a pretest through pain measurement before intervention using the NRS pain scale. Before pain measurement was conducted, respondents were given a brief explanation about the NRS pain scale, lemongrass aromatherapy, and the 4-7-8 breathing exercise in the intervention group. Then, the 4-7-8 breathing exercise intervention was performed for 6 cycles per session over 3 sessions, interspersed with normal breathing for 1 minute per session, and patients also inhaled lemongrass aromatherapy from a humidifier containing 100 ml of water and 5 drops of essential oil. The humidifier was placed approximately 30 cm away or beside the patient's bed for 15 minutes. After that, the researcher administered a post-test by measuring the pain scale using the Numeric Rating Scale (NRS) form at a 15-minute interval. For the control group, only the 4-7-8 breathing exercise was administered. In the sample used, factors that could interfere with the research were experience of pain and anxiety. These two variables could not be controlled.

## Data Analysis

In this study, data processing techniques consisted of editing, coding, tabulating, and data entry techniques on SPSS Statistics 21. Univariate analysis analyzes the characteristics of respondents, including age, gender, and pre and post-pain intensity in the experimental and control groups. Bivariate analysis of data in the Wilcoxon Signed Rank Test research. The Wilcoxon test analyzes the results of paired observations of two data, whether they were different or not. This test was used in each group (intervention and control) to see before and after the intervention. Furthermore, a test was conducted between the intervention group and the control group to compare the two groups using the Mann-Whitney test.

## Ethical Clearance

This research considered several aspects related to research ethics. Respecting Human Dignity. The researcher provided respondents with an informed consent form so they understood the purpose, objectives, and impact of the research. The researcher respected the respondents' decision and gave them full freedom to participate or not in the research without any pressure or coercion from any party. Researchers kept all information provided by respondents confidential, whether obtained directly or from subjective observations. Researchers kept all information informed by respondents either directly or from subjective observations confidential. Balancing Harm and Benefit, researchers consider things that can occur during the research implementation process to prevent risks that can harm the subject. This study also considered patient safety. If persistent pain could not be resolved with non-pharmacological measures, the intervention was discontinued. This research is expected to provide optimal benefits and minimize potential losses or negative impacts for participants. Justice, researchers treated all respondents with respect and fairness because each respondent has equal rights in this study. This study used an experimental and a control group, both of which were given the 4-7-8 breathing exercise intervention. However, the 4-7-8 breathing exercise intervention was only given to the control group, while the intervention group was combined with the provision of lemongrass aroma therapy. An ethical test aimed to maintain the dignity, rights, safety, and well-being of all participants. This document also ensures that research subjects are treated humanely and that the research is conducted without harm or loss, or at least with the minimum possible risk. The ethical test was carried out at PKU Muhammadiyah Bantul Hospital with the ethical number No. 072/EC.KEPK/C/04.25.

## 3. RESULT

This study was conducted at PKU Muhammadiyah Hospital Bantul, in April–May 2025.

**Table 1. Frequency Distribution of Respondents Based on Age (n=34)**

Variable	Range	Group				Total	
		Control		Intervention		N	%
		f	%	f	%		
Age	12-25	2	12%	1	5%	3	9%
	26-45	8	47%	7	41%	15	44%
	46-65	7	41%	9	52%	16	47%

Table 1 shows that in the control group, the majority were in the age range of 26–45 years (8 respondents or 74%). While in the intervention group, the majority were in the age range of 46–65 years (9 respondents or 52%).

Table 2 shows that in the control and intervention group, the majority of the respondents were female (10 respondents or 59%).

Table 3 shows that in the intervention group before lemongrass aroma therapy and 4 - 7 - 8, breathing exercises were administered, the pain scale of all respondents was in the moderate category or as many as 17 people (100%). After giving lemongrass aroma therapy and 4 - 7 - 8 breathing exercises, the pain scale in the mild category was 15 people (88%) and the pain scale in the moderate category was 2 people (22%) with a  $p$  value of 0.00. Whereas in the control group before giving 4 - 7 - 8 breathing exercises the pain scale of all respondents in the moderate category or as many as 17 people (100%). After giving 4 - 7 - 8 breathing exercises, the pain scale in the mild category was 9 people (53%) and the pain scale in the moderate category was 8 people (47%) with a  $p$  value of 0.003.

**Table 2. Frequency Distribution of Respondents Based on Sex (n=34)**

Variable	Category	Group				Total	
		Control		Intervention		N	%
		f	%	f	%		
Sex	L	7	41%	7	41%	14	41%
	P	10	59%	10	59%	20	59%

**Table 3. Distribution of Pain Before and After Treatment in the Intervention Group and Control Group**

Variable	Category	Treatment				$p$ value	Mean Rank
		Pre Test		Post Test			
		f	%	f	%		
Pain Intervention	No Pain (score 0)	0	0	0	0	0,00	8.00
	Mild (score 1–3)	0	0	15	88		
	Moderate (score 4–6)	17	100	2	22		
	Severe (score 7–10)	0	0	0	0		
Pain Control	No Pain (score 0)	0	0	0	0	0,003	5.00
	Mild (score 1–3)	0	0	9	53		
	Moderate (score 4–6)	17	100	8	47		
	Severe (score 7–10)	0	0	0	0		

**Table 4. Differences in Pain in the Intervention and Control Group**

Group	Variable	Mean Rank	Sum of Rank	Asymp. Sig (2-tailed)
Intervention (Lemongrass Aroma Therapy + 478 Breathing Exercise)	Scale of Pain	14,50	246,50	0,026
Control (478 Breathing Exercise)	Scale of Pain	20,50	348,50	

In Table 4, the mean rank data in the intervention group of 14.50 while the control group is 20.50. It identifies that the score in the group that has been given a combination therapy of lemongrass aroma therapy and 4-7-8 breathing exercises or the intervention group has a greater decrease in pain scale than the score of pain scale reduction in the control group. The Mann-Whitney test results showed a significance number of  $\rho=0.026$  ( $p<0.05$ ) which means that there is a significant difference between the control group and the intervention group given a combination of lemongrass aroma therapy and 4-7-8 breathing exercise.

#### 4. DISCUSSION

##### a. Pain Before and After in the Intervention Group

Based on the results of the study of 17 respondents in the intervention group, there was a change in the pain scale of 17 respondents (100%) with a moderate pain scale changing to a mild pain scale in 15 respondents (88%) and remaining at a moderate pain scale in 2 respondents (22%). Although these 2 respondents were still in the moderate pain scale category, there was a decrease in the pain scale from a range of 6 to 4.

The Wilcoxon Signed Rank Test showed a  $p$ value of 0.000 ( $p < 0.05$ ), indicating a significant difference between pain scales before and after the intervention in the intervention group, which included a combination of lemongrass aromatherapy and the 4-7-8 breathing exercise. It aligned a study by (G. Anisa et al., 2023) that lemongrass aromatherapy can reduce pain in mothers during the active phase of labor. Before the intervention, 23 respondents (76.7%) reported severe pain but after the intervention, the majority reported moderate pain, with 22 respondents (73.3%) reporting moderate pain. There was a significant effect of lemongrass aromatherapy, with a significance value of  $0.000 < 0.05$ .

Lemongrass aromatherapy contains active compounds such as citronellal and geraniol, which can provide a relaxing effect and work on the central nervous system, particularly in the Chemoreceptor Trigger Zone (CTZ) and limbic system (Cui et al., 2022). The results of lemongrass aromatherapy research have an effect on the pain scale in post-operative patients because when lemongrass aromatherapy is inhaled, the lemongrass aroma is transmitted to the olfactory center located in the base of the brain. There, neurons recognize and interpret the aroma, then send it to the limbic system, which is then forwarded to the hypothalamus for further processing. The scent of lemongrass stimulates the thalamus to release neurotransmitters such as enkephalin, serotonin, and endorphins, which act as natural analgesics or pain relievers.

In addition, this intervention group was combined with the 4-7-8 breathing exercise, which has been proven to reduce pain levels in post-operative patients. The 4-7-8 technique (inhaling for 4 seconds, holding the breath for 7 seconds, and exhaling slowly for 8 seconds) can stimulate the vagus nerve. Activation of the vagus nerve reduces activity in the sympathetic nervous system (associated with the stress response) and increases activity in the parasympathetic nervous system (Vierra, 2022). This combination resulted in the pain scale of patients in the intervention group changing to the mild category more often than in the control group.

### **b. Pain Before and After in Control Group**

Based on observations of 17 respondents in the control group, it was found that before the 4-7-8 breathing exercise intervention, 17 people (100%) experienced moderate pain with varying pain levels ranging from 4 to 6 on the scale. After being given the 4-7-8 breathing exercise treatment for 10 minutes, there was a change in the pain scale of the respondents. Ten individuals (59%) experienced a decrease in pain intensity from moderate to mild, while seven individuals (41%) remained in the moderate pain category, although there was a decrease from the range of 5 to 4.

The results of statistical testing using the Wilcoxon Signed Rank Test showed a p-value of 0.003 ( $p < 0.05$ ), indicating a significant difference between pain scales before and after administering the 4-7-8 breathing exercise in the control group. It aligns a study by (Zahra et al., 2023) that The 4-7-8 breathing exercise is one of the breathing exercises that involves a structured breathing pattern by counting the rhythm of breaths to train focus and awareness. This exercise can stimulate the activity of the hippocampus, which plays a role in cognitive functions, including memory and concentration. By activating the parasympathetic nervous system, the 4-7-8 breathing exercise technique influences the reduction of physiological stress responses, such as lowering blood pressure, dilating blood vessels, and creating a state of relaxation. This relaxation effect can reduce pain perception by decreasing muscle tension, stabilizing the autonomic nervous system, and improving overall patient comfort.

The effectiveness of the 4-7-8 breathing exercise technique in reducing pain is supported by previous studies showing that the 4-7-8 breathing exercise can improve heart rate variability, and blood pressure, and enhance the body's relaxation response. Activation of the parasympathetic nervous system helps calm the body and reduce pain (Vierra, 2022). In the study, it was observed that the control group was only given 4–7–8 breathing exercises, and 8 respondents remained in the mild pain category. Although there was a decrease in pain levels, it did not drop to the mild category. Several factors influenced this outcome. Age is one factor that affects pain in post-surgical patients.

A study from (Metasari & Sianipar, 2018) also affirmed this finding, that late adulthood to early old age experienced more post-operative pain because, at that age, there is a decline in immune system function and an increased risk of degenerative diseases that can exacerbate pain perception. Thus, age is an important factor that influences pain perception and intensity, with individuals aged 36–55 years tending to experience and be more aware of pain.

### **c. Differences in Pain Between the Intervention and the Control Group**

Based on the results of the study on the effect of lemongrass aromatherapy and the 4-7-8 breathing exercise on respondents' pain using the Mann-Whitney test, a significance value of p-value of 0.026 ( $\alpha < 0.05$ ) was obtained. These results indicated a difference between the intervention group, which received lemongrass aromatherapy and 4-7-8 breathing exercises, and the control group, which only received 4-7-8 breathing exercises, in terms of pain levels. Additionally, the intervention group that

received lemongrass aromatherapy and 4-7-8 breathing exercises had an average score of 14.50, while the control group that only received 4-7-8 breathing exercises had an average score of 20.50, resulting in a difference of 6. This indicated that the combination of lemongrass aromatherapy and 4-7-8 breathing exercises is more effective in reducing post-operative pain in patients.

This difference showed the effectiveness of lemongrass aromatherapy and the 4-7-8 breathing exercises in reducing pain intensity. This combination is one option for non-pharmacological interventions for post-operative patients with moderate pain. When patients inhale lemongrass aromatherapy, they simultaneously perform the breathing exercise: inhaling for 4 seconds, holding their breath for 7 seconds, and exhaling slowly for 8 seconds. As explained earlier, lemongrass aromatherapy contains active compounds such as citronellal and geraniol, which can provide a relaxing effect. The 4-7-8 breathing exercise also stimulates the vagus nerve to reduce the sympathetic nervous system associated with stress. When these two interventions are combined, they can reduce the pain scale of post-operative patients.

This study also showed that lemongrass has a unique aroma, so it is often used as an ingredient in aromatherapy. Tests on lemongrass found that this plant contains various active compounds, such as alkaloids, flavonoids, saponins, quinones, and tannins (Eva & Destia, 2023). Based on the content of these compounds, lemongrass is known to have various properties, including antibacterial, antioxidant, pain relief, joint pain relief, cough and cold remedy, stomach acid reducer, and aromatherapy to help reduce anxiety and pain due to its fresh and distinctive aroma.

In addition, the aroma of lemongrass combined with the 4-7-8 breathing exercise was more effective in reducing pain because the 4-7-8 breathing technique has been proven to increase GABA levels, which was an inhibitory neurotransmitter. Increased GABA helps reduce cortisol and adrenaline levels, which in turn slows heart rate, reduces breathing frequency, and relaxes tense respiratory muscles. This contributed to alleviating anxiety, depression symptoms, and pain (Karangan et al., 2024).

In this study, the differences between age groups were relatively similar. This indicates that bias can be minimized. Pain experience in patients can also influence the occurrence of pain in patients. If patients have previously experienced post-anaesthesia pain, the pain threshold is likely to vary. Anxiety or fear of unknown origin and an individual's inability to control pain or events around them can worsen the perception of pain. However, individuals who believe that they can control the pain they experience tend to feel less anxiety and fear, which in turn can reduce their perception of pain.

There were several limitations to this study, such as the relatively small sample size and quasi-experimental design, which might affect generalization. However, this study contributed to clinical practice and can be applied to patients experiencing post-anaesthesia pain at low cost and safely after general anaesthesia. Recommendations for future research should be expanded to include randomized controlled trials, larger sample sizes, and the exploration of additional outcomes, such as anxiety, patient satisfaction, and physiological indicators.

## 5. CONCLUSION

The pain scale of post-operative patients under general anesthesia before intervention showed that the majority experienced moderate pain (score 4-6). The pain level of post-operative patients in the intervention group after being given a combination of lemongrass aromatherapy and 4-7-8 breathing exercises showed that most respondents' pain scales decreased to the mild pain category (score 1-3). Meanwhile, in the control group, which was only given the 4-7-8 breathing exercise, respondents experienced a decrease in the mild pain category but remained in the moderate pain category, with the pain scale range decreasing. There was an effect of the combination of lemongrass aromatherapy and 4-7-8 breathing exercises on pain in post-operative patients who underwent general anesthesia at PKU Muhammadiyah Hospital Bantul. This study found that clinical trials showed that the combination of lemongrass aromatherapy and the 4-7-8 breathing exercise was more effective than the 4-7-8 breathing exercise alone.

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