

## The effect of combined alternate nostril breathing exercise and lemon aromatherapy inhalation on blood pressure in hypertensive patients: a quasi-experimental study

*Pengaruh Kombinasi Latihan Pernapasan Hidung Bergantian dan Inhalasi Aromaterapi Lemon terhadap Tekanan Darah pada Pasien Hipertensi: Studi Kuasi-Eksperimental*

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### ABSTRACT

**Background:** Hypertension is a non-communicable disease known as a silent killer because it often presents without symptoms until reaching a severe stage. According to WHO (2022), approximately 1.28 billion adults worldwide suffer from hypertension.

**Objective:** This study aimed to determine the effect of alternate nostril breathing exercise (ANBE) combined with lemon aromatherapy inhalation on blood pressure among hypertensive patients in the working area of Puskesmas Jembatan Kecil, Bengkulu City.

**Methods:** This study used a quasi-experimental pre-test and post-test with control group design. A total of 34 respondents were selected using purposive sampling and divided into an intervention group (n=17) and a control group (n=17). The intervention group received ANBE and lemon aromatherapy inhalation twice daily for 4 consecutive days with a duration of 5–15 minutes per session, while the control group received slow deep breathing with the same frequency. Data were analyzed using the Mann-Whitney test.

**Results:** The intervention group showed an average decrease in systolic blood pressure of 17.18 mmHg and diastolic blood pressure of 15.47 mmHg, while the control group experienced decreases of 7.35 mmHg systolic and 6.94 mmHg diastolic. Statistical analysis showed  $p=0.001$  ( $p<0.05$ ), indicating a significant effect of the intervention on reducing blood pressure.

**Conclusion:** The combination of ANBE and lemon aromatherapy inhalation was effective in reducing blood pressure and can be used as an independent non-pharmacological therapy for hypertension.

**Keywords:** alternate nostril breathing exercise, hypertension, lemon aromatherapy

### ABSTRAK

**Latar Belakang:** Hipertensi merupakan penyakit tidak menular yang dikenal sebagai *silent killer* karena sering tidak menimbulkan gejala hingga mencapai tahap berat. Berdasarkan laporan WHO tahun 2022, sekitar 1,28 miliar orang dewasa di dunia mengalami hipertensi.

**Tujuan:** Penelitian ini bertujuan mengetahui pengaruh kombinasi *alternate nostril breathing exercise* (ANBE) dan inhalasi aromaterapi lemon terhadap tekanan darah pada penderita hipertensi di wilayah kerja Puskesmas Jembatan Kecil Kota Bengkulu.

**Metode:** Penelitian menggunakan desain *quasi-experimental pre-test and post-test with control group*. Sebanyak 34 responden dipilih menggunakan *purposive sampling* dan dibagi menjadi kelompok intervensi (n=17) dan kelompok kontrol (n=17). Kelompok intervensi diberikan ANBE dan inhalasi aromaterapi lemon dua kali sehari selama 4 hari berturut-turut dengan durasi 5–15 menit per sesi, sedangkan kelompok kontrol diberikan

*slow deep breathing* dengan frekuensi yang sama. Analisis data menggunakan uji Mann-Whitney.

**Hasil:** Kelompok intervensi mengalami rata-rata penurunan tekanan darah sistolik sebesar 17,18 mmHg dan diastolik 15,47 mmHg, sedangkan kelompok kontrol mengalami penurunan sistolik 7,35 mmHg dan diastolik 6,94 mmHg. Hasil uji statistik menunjukkan  $p=0,001$  ( $p<0,05$ ), sehingga terdapat pengaruh signifikan terhadap penurunan tekanan darah.

**Kesimpulan:** Kombinasi ANBE dan inhalasi aromaterapi lemon efektif menurunkan tekanan darah dan dapat dijadikan terapi nonfarmakologis mandiri pada penderita hipertensi.

**Kata kunci:** *alternate nostril breathing exercise, aromaterapi lemon, hipertensi*

## INTRODUCTION

Hypertension is a common non-communicable disease (NCD) often called a "silent killer" because many individuals are unaware of it until their blood pressure is measured.<sup>1</sup> This global health issue contributes to increasing morbidity, mortality, and healthcare costs. Hypertension is a significant risk factor for various cardiovascular diseases, such as coronary artery disease, heart failure, stroke, and impaired kidney function.<sup>2</sup>

According to the World Health Organisation (WHO), in 2023, about 1.28 billion adults worldwide had high blood pressure, with nearly two-thirds living in low- and middle-income countries. The number has risen from 650 million in 1990 to 1.3 billion in 2023. Hypertension causes approximately 10.8 million deaths and 235 million cases of reduced quality of life each year, making it one of the leading causes of premature death globally.<sup>3</sup>

According to the 2023 Indonesian Health Survey (SKI), hypertension ranked fourth among the leading risk factors for mortality, accounting for 10.2% of deaths. The survey also showed that 30.8% of Indonesians were diagnosed with hypertension. The lowest prevalence was found in Highland Papua (19.9%), while the highest was in Central Kalimantan (40.7%). Nationally, Bengkulu Province ranked 30th, with a prevalence rate of 24.8%, which is below the national average.<sup>4</sup>

According to the Bengkulu Provincial Health Office, the number of hypertension cases in Bengkulu Province has fluctuated in recent years. In 2020, there were 342,172 cases, which rose to 524,184 in 2021, then decreased to 261,621 in 2022. In 2023, Bengkulu City recorded 50,898 hypertension cases across 20 health centres, with the highest numbers at Telaga Dewa (4,248), Jembatan Kecil (4,120), and Kandang (3,177).<sup>5</sup>

Hypertension often results from unhealthy lifestyle habits such as poor diet, stress, smoking, lack of exercise, and obesity. Uncontrollable factors like age and genetics can also influence it. Management generally involves medical treatment and lifestyle changes.<sup>6</sup> One of the effective non-pharmacological methods for controlling blood pressure is the use of breathing relaxation techniques. This exercise helps lower high blood pressure, normalize heart rhythm, and relax tense muscles.<sup>7,8</sup>

The Alternate Nostril Breathing Exercise (ANBE) is effective because it influences the autonomic nervous system and brain activity through the nasal breathing cycle. When one nostril is more active, it stimulates the opposite side of the brain.<sup>9</sup> A study by Permata et al. (2021) at the Telaga Dewa Public Health Centre in Bengkulu City involved 15 participants who practised alternate nostril breathing twice daily for four days. The results showed a significant effect ( $p = 0.001$ ), indicating that this technique can help lower blood pressure in individuals with hypertension.<sup>10,11</sup>

In addition to the ANBE technique, aromatherapy is also an alternative for individuals with hypertension. Aromatherapy works through the olfactory nervous system, stimulating the release of endorphins that help the body relax and stabilize blood pressure.<sup>12,13</sup> Lemon aromatherapy, which contains linalool, is known to calm the

nervous system and promote relaxation, with a positive impact on individuals with hypertension.<sup>14,12</sup>

Previous studies have generally examined alternate nostril breathing exercise and lemon aromatherapy separately in lowering blood pressure among hypertensive patients. This study offers novelty by evaluating the combined effect of both interventions using a quasi-experimental design with a control group. By integrating breathing regulation and aromatherapy simultaneously, this research provides new evidence on a more comprehensive non-pharmacological approach to blood pressure control in hypertensive patients.

This study aims to determine the effects of the alternate nostril breathing exercise technique and lemon aromatherapy inhalation on blood pressure in patients with hypertension in the working area of Jembatan Kecil Public Health Centre, Bengkulu City.

## **METHODS**

### **Study design**

This study was conducted at the Jembatan Kecil Public Health Centre, Bengkulu City, from February 5 to April 1, 2025. The study employed a quantitative approach using a quasi-experimental pre-test and post-test control group design. The research aimed to determine the effect of Alternate Nostril Breathing Exercise (ANBE) combined with lemon aromatherapy on blood pressure among patients with hypertension.

### **Data source and sampling procedure**

Primary data were collected directly from hypertensive patients in the working area of the Jembatan Kecil Public Health Centre. The study population consisted of adults diagnosed with hypertension with blood pressure  $\geq 140/90$  mmHg. Inclusion criteria included patients willing to participate and able to follow the intervention procedures. Exclusion criteria were participants unwilling to complete the intervention and those with medical conditions preventing participation. A purposive sampling technique was used to recruit 34 respondents, who were equally divided into an intervention group (17 participants) and a control group (17 participants).

### **Variables of the study**

The independent variable in this study was the combination of Alternate Nostril Breathing Exercise and lemon aromatherapy inhalation. The dependent variables were systolic and diastolic blood pressure. Potential confounding variables, such as antihypertensive medication use, were controlled by ensuring that all participants continued their prescribed medications without any changes in dosage or type during the intervention period.

### **Measurement and instruments**

Blood pressure measurements were performed using a validated and calibrated Omron digital sphygmomanometer. Systolic and diastolic blood pressure were treated as numerical variables. Measurements were conducted twice during each assessment session (pre-test and post-test), and the average value of the two readings was recorded to improve measurement accuracy.

### **Data collection**

The intervention group received a combination of Alternate Nostril Breathing Exercise and lemon aromatherapy inhalation twice daily for four consecutive days, with each session lasting 5–15 minutes. The control group performed Slow Deep Breathing with the same duration and frequency. Blood pressure measurements were obtained before and after the intervention period by the researchers using the same standardized procedures for all participants.

### Ethical considerations

Ethical approval for this study was obtained from the Ethics Committee of Bengkulu Ministry of Health Polytechnic with approval number KEPK.BKL/21/01/2025. All participants provided informed consent before participation. Participant confidentiality and anonymity were maintained throughout the study process.

### Data analysis

Data analysis was performed using statistical software. Normality testing was conducted using the Shapiro-Wilk test, which indicated that the data were not normally distributed ( $p < 0.05$ ). Therefore, univariate analysis for numerical variables was presented using median, minimum, and maximum values. The Wilcoxon signed-rank test was used for within-group comparisons, while the Mann-Whitney test was applied for between-group comparisons. Statistical significance was determined at a 5% significance level ( $p < 0.05$ ).

## RESULTS

**Table 1. Characteristics of Respondents**

| Variable                                   | Group               |                |
|--------------------------------------------|---------------------|----------------|
|                                            | Intervention (n=17) | Control (n=17) |
| Age                                        |                     |                |
| Min                                        | 38                  | 40             |
| Max                                        | 60                  | 60             |
| Gender                                     |                     |                |
| Male                                       | 8 (47.1%)           | 6 (35.3%)      |
| Female                                     | 9 (52.9%)           | 11 (64.7%)     |
| Education                                  |                     |                |
| Elementary School - Junior High School     | 10 (58.8%)          | 12 (70.6%)     |
| High School                                | 7 (41.2%)           | 5 (29.4%)      |
| Occupation                                 |                     |                |
| Unemployed                                 | 7 (41.2%)           | 4 (23.5%)      |
| Employed                                   | 10 (58.8%)          | 13 (76.5%)     |
| History of Hypertension                    |                     |                |
| > 5 years                                  | 7 (41.2%)           | 9 (52.9%)      |
| ≤ 5 years                                  | 10 (58.8%)          | 8 (47.1%)      |
| Genetic History                            |                     |                |
| No family history                          | 2 (11.8%)           | 1 (5.9%)       |
| Has a family history                       | 15 (88.2%)          | 16 (94.1%)     |
| Smoking History                            |                     |                |
| Non-smoker                                 | 10 (58.8%)          | 12 (70.6%)     |
| Smoker                                     | 7 (41.2%)           | 5 (29.4%)      |
| History of Antihypertensive Medication Use |                     |                |
| > 5 years                                  | 7 (41.2%)           | 9 (52.9%)      |
| ≤ 5 years                                  | 10 (58.8%)          | 8 (47.1%)      |
| Physical Activity                          |                     |                |
| Does not exercise                          | 14 (82.4%)          | 15 (88.2%)     |
| Exercise                                   | 3 (17.6%)           | 2 (11.8%)      |

Table 1 shows that the mean age of participants in the intervention group was  $52.41 \pm 6.76$  years, while the control group had a mean age of  $48.35 \pm 5.77$  years. Participants in both groups were predominantly female. Most respondents had an educational background ranging from elementary to junior high school and were employed.

The majority of participants reported a family history of hypertension, indicating a

potential genetic predisposition. Most respondents were non-smokers and had been using antihypertensive medication. In addition, most participants in both groups reported not engaging in regular physical exercise, which represents a modifiable risk factor for hypertension.

Overall, the distribution of demographic and clinical characteristics between groups appeared comparable.

**Table 2. Distribution of Respondents Based on Blood Pressure Before Treatment in Both Groups**

| Variable                 | Intervention Median (Min–Max) | Control Median (Min–Max) | p-value* |
|--------------------------|-------------------------------|--------------------------|----------|
| Systolic Blood Pressure  | 155 (148–168)                 | 155 (148–180)            | 0.945    |
| Diastolic Blood Pressure | 95 (90–109)                   | 94 (90–105)              | 0.397    |

\*Mann–Whitney Test

As presented in Table 2, there were no statistically significant differences in systolic and diastolic blood pressure between the intervention and control groups before treatment ( $p > 0.05$ ). This finding indicates that both groups had equivalent baseline blood pressure levels, supporting the validity of subsequent comparisons.

**Table 3. Distribution of Respondents Based on Blood Pressure After Treatment in Both Groups**

| Variable                 | Intervention Median (Min–Max) | Control Median (Min–Max) |
|--------------------------|-------------------------------|--------------------------|
| Systolic Blood Pressure  | 140 (135–144)                 | 149 (142–165)            |
| Diastolic Blood Pressure | 80 (75–85)                    | 88 (84–94)               |

Table 3 shows that after treatment, the intervention group had lower median systolic and diastolic blood pressure compared to the control group. The median systolic blood pressure in the intervention group was 140 mmHg, while in the control group it was 149 mmHg. The median diastolic blood pressure in the intervention group was 80 mmHg, whereas in the control group it was 88 mmHg.

**Table 4. Differences in Respondents' Blood Pressure Before and After Treatment in the Intervention Group**

| Variable                                     | N  | Median (Min–Max) | Z      | p-value** |
|----------------------------------------------|----|------------------|--------|-----------|
| Systolic Blood Pressure Before Intervention  | 17 | 155 (148–168)    |        |           |
| Systolic Blood Pressure After Intervention   | 17 | 140 (135–144)    | -3.625 | 0.001     |
| Diastolic Blood Pressure Before Intervention | 17 | 95 (90–109)      |        |           |
| Diastolic Blood Pressure After Intervention  | 17 | 80 (75–85)       | -3.624 | 0.001     |

\*\* Wilcoxon Signed-Rank Test

Table 4 shows the results of the Wilcoxon Signed-Rank Test in the intervention group. There were significant differences in systolic and diastolic blood pressure before and after treatment ( $p < 0.05$ ). The findings indicate that the combination of Alternate Nostril Breathing Exercise and lemon aromatherapy effectively reduced blood pressure among hypertensive patients.

Table 5 demonstrates significant differences in systolic and diastolic blood pressure before and after treatment in the control group ( $p < 0.05$ ). The median systolic blood pressure decreased from 155 mmHg to 149 mmHg, while the median diastolic blood pressure decreased from 94 mmHg to 88 mmHg after the intervention.

**Table 5. Differences in Respondents' Blood Pressure Before and After Treatment in the Control Group**

| Variable                                     | N  | Median (Min–Max) | Z      | p-value*** |
|----------------------------------------------|----|------------------|--------|------------|
| Systolic Blood Pressure Before Intervention  | 17 | 155 (148–180)    |        |            |
| Systolic Blood Pressure After Intervention   | 17 | 149 (142–165)    | -3.629 | 0.001      |
| Diastolic Blood Pressure Before Intervention | 17 | 94 (90–105)      |        |            |
| Diastolic Blood Pressure After Intervention  | 17 | 88 (84–94)       | -3.629 | 0.002      |

\*\*\* Wilcoxon Signed-Rank Test

**Table 6. The Effect of Alternate Nostril Breathing Exercise and Lemon Aromatherapy on Blood Pressure Reduction in Hypertensive Patients**

| Variable                              | N  | Median (Min–Max) | U     | P-value |
|---------------------------------------|----|------------------|-------|---------|
| Systolic Blood Pressure Intervention  | 17 | 16.00 (12-25)    |       |         |
| Systolic Blood Pressure Control       | 17 | 7.00 (4-15)      | 7.000 | 0.001** |
| Diastolic Blood Pressure Intervention | 17 | 15.00 (10-24)    |       |         |
| Diastolic Blood Pressure Control      | 17 | 7.00 (4-12)      | 5.500 | 0.001*  |

\*Mann-Whitney

Table 6 displays the outcomes of the Mann-Whitney statistical test, revealing a p-value of 0.001 ( $p \leq \alpha 0.05$ ). Therefore, it can be inferred that practising alternate nostril breathing combined with lemon aromatherapy significantly influenced SBP and DBP levels among hypertensive individuals residing in the service area of Jembatan Kecil Health Centre, Bengkulu City, in the year 2025

## DISCUSSION

### Effect of Alternate Nostril Breathing and Lemon Aromatherapy on Blood Pressure

This study indicates that the combination of alternate nostril breathing (ANB) and lemon aromatherapy contributes to improved blood pressure regulation in patients with hypertension. These findings may be explained through autonomic, neurophysiological, and psychophysiological mechanisms.

Permata et al. (2021) explained that alternate nostril breathing stabilizes respiratory rhythm and supports autonomic balance. Controlled breathing patterns are associated with reduced sympathetic nervous system activity and enhanced parasympathetic dominance. This physiological shift contributes to cardiovascular relaxation, decreased heart rate, reduced peripheral vascular resistance, and improved hemodynamic stability.<sup>10,15</sup>

Kalaivani et al. (2018) demonstrated that alternate nostril breathing exercises significantly reduced blood pressure among hypertensive patients. Their findings emphasized that slow, rhythmic breathing enhances vagal tone and improves baroreceptor sensitivity. These responses promote vasodilation and reduce cardiac workload, supporting cardiovascular homeostasis.<sup>16</sup>

Similarly, Uğur & Uysal (2020) reported that alternate nostril breathing contributed to blood pressure regulation through modulation of autonomic nervous system activity. The authors highlighted that parasympathetic activation and sympathetic withdrawal are central mechanisms underlying cardiovascular improvement.<sup>17</sup>

Breathing regulation is also closely linked to neural cardiovascular control. Patturahman et al. (2023) described that relaxation-based interventions and adequate

physiological regulation may improve circulatory stability in hypertensive patients. Slow breathing patterns influence neurocardiac interactions, supporting more efficient cardiovascular responses.<sup>18</sup>

Lemon aromatherapy may complement these effects through olfactory-mediated relaxation pathways. Saputra et al. (2024) reported that inhalation of lemon aromatherapy contributed to reductions in blood pressure, suggesting that sensory stimulation plays a role in relaxation and autonomic modulation.<sup>19</sup>

Alfin et al. (2023) demonstrated that lemon aromatherapy significantly reduced blood pressure in elderly patients with hypertension. The study emphasized that the calming properties of lemon essential oil may attenuate stress responses, thereby improving cardiovascular stability.<sup>20</sup>

Comparable findings were reported by Sari (2022), who observed that lemon oil aromatherapy contributed to blood pressure reduction among older adults. The study suggested that bioactive compounds in lemon oil, such as linalool and limonene, may exert anxiolytic and relaxation-enhancing effects.<sup>21</sup>

The combined intervention may therefore produce synergistic effects. ANB primarily acts through respiratory and autonomic regulation, while lemon aromatherapy targets stress reduction and emotional relaxation. Together, these therapies address both physiological and psychological contributors to hypertension.

#### **Comparison with Previous Studies**

The present findings are consistent with earlier studies examining breathing and aromatherapy interventions. Soliman (2020) reported that alternate nostril breathing significantly reduced blood pressure, anxiety, and heart rate among hypertensive patients. The study highlighted the role of controlled respiration in autonomic regulation.<sup>22</sup>

Ramadhan & Prajayanti (2023) similarly found that alternate nostril breathing exercises contributed to improved blood pressure control. Their results reinforced the importance of respiratory modulation as a non-pharmacological strategy.<sup>6</sup>

Uğur & Uysal (2020) further supported these findings by demonstrating that alternate nostril breathing exercises were effective in regulating blood pressure among individuals with hypertension.<sup>17</sup> Evidence supporting lemon aromatherapy has also been documented. Alfin et al. (2023) identified significant antihypertensive effects following lemon aromatherapy administration.<sup>20</sup>

Soeryanto et al. (2024) concluded that lemon aromatherapy effectively reduced blood pressure in hypertensive patients, emphasizing its role as a relaxation-supportive intervention.<sup>23</sup> Handayani & Rohani (2024) similarly reported that lemon aromatherapy contributed to blood pressure stabilization through stress reduction mechanisms.<sup>24</sup>

By integrating ANB and lemon aromatherapy, the current study extends previous evidence and suggests that combining complementary relaxation therapies may enhance cardiovascular outcomes.

#### **Clinical Implications for Nursing Practice**

These findings have important implications for nursing care. Permata et al. (2021) emphasized that alternate nostril breathing is a simple, safe, and cost-effective intervention suitable for patient self-management. Nurses can incorporate ANB into relaxation training, patient education, and hypertension management programs.<sup>10</sup> Patturahman et al. (2023) highlighted the importance of lifestyle and behavioral interventions in maintaining blood pressure stability. Nurses play a critical role in promoting adherence to relaxation techniques and non-pharmacological strategies.<sup>18</sup>

Saputra et al. (2024) described aromatherapy as a non-invasive intervention that may enhance relaxation and psychological comfort. Lemon aromatherapy can be integrated into nursing care to support stress reduction and emotional well-being.<sup>19</sup>

Cahyadi et al. (2024) emphasized the importance of adherence in hypertension management. Complementary therapies such as breathing exercises and aromatherapy may enhance patient engagement and support holistic care.<sup>25</sup>

The combined use of ANB and lemon aromatherapy supports a patient-centered nursing approach addressing both physiological regulation and psychological relaxation.

### Study Limitations

Several limitations should be considered. Variability in medication use, lifestyle behaviors, and adherence to dietary recommendations may have influenced cardiovascular responses. Additionally, the relatively short intervention period limits conclusions regarding long-term sustainability.

Future studies should incorporate longer follow-up durations and tighter control of confounding variables.

### CONCLUSION

This study confirmed that the combination of Alternate Nostril Breathing and lemon aromatherapy effectively reduced systolic and diastolic blood pressure, with greater reductions observed in the intervention group compared to the control group. These findings indicate that the combined with lemon aromatherapy, effectively reduced blood pressure among hypertensive patients in the Jembatan Kecil Public Health Centre area of, Bengkulu City.

In nursing practice, this technique can be applied as a complementary therapy and integrated into patient education and community health promotion programs, as it is simple, safe, and feasible for independent use. Future research should involve larger samples, longer intervention durations, and randomized controlled designs to further strengthen the evidence and examine long-term effects.

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