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Lemon aromatherapy for chemotherapy-induced nausea and vomiting in breast cancer patients

Marta Ulina Simbolon*, Sri Maryuni, Tubagus Erwin

Program Studi Keperawatan, Fakultas Kesehatan, Universitas Mitra Indonesia
Corresponding Author: Marta Ulina Simbolon. Email: simbolonmarta267@gmail.com

Abstract

Background: Chemotherapy-induced nausea and vomiting remain distressing adverse effects of breast cancer treatment and may compromise hydration, nutritional intake, quality of life, and treatment adherence. Lemon aromatherapy is a simple non-pharmacological intervention that may complement standard antiemetic care.
Purpose: To evaluate changes in nausea and vomiting severity following lemon aromatherapy among breast cancer patients undergoing chemotherapy.
Method: This pre-experimental study used a one-group pretest-posttest design. Twenty breast cancer patients receiving chemotherapy were recruited through purposive sampling. Nausea and vomiting severity was measured using a Numeric Rating Scale before and after inhaled lemon aromatherapy administered approximately two hours after chemotherapy for 5-10 minutes. Preintervention and postintervention scores were compared using the Wilcoxon signed-rank test.
Results: The mean nausea and vomiting severity score decreased from 8.15 ± 1.50 before the intervention to 4.00 ± 0.97 afterward. The Wilcoxon signed-rank test showed a statistically significant change between the two assessments ($p < 0.001$).
Conclusion: Nausea and vomiting severity was lower after lemon aromatherapy in this small pre-experimental sample. Lemon aromatherapy may be considered as an adjunct to standard antiemetic care, although controlled studies are needed to establish its independent effect.

Keywords: Breast Cancer; Chemotherapy; Lemon Aromatherapy; Nausea and Vomiting

INTRODUCTION

Breast cancer is the most frequently diagnosed cancer among women and remains a major contributor to cancer-related morbidity and mortality worldwide. Global estimates continue to show a substantial and increasing disease burden, underscoring the need for supportive interventions that improve patients' ability to complete treatment and maintain quality of life (Bray, Laversanne, Sung, Ferlay, Siegel, Soerjomataram, & Jemal, 2024).

Chemotherapy is an essential component of breast cancer management, but chemotherapy-induced nausea and vomiting (CINV) remain common despite modern antiemetic prophylaxis. Prospective studies have shown that nausea, particularly during the delayed phase after chemotherapy, may remain insufficiently controlled and can adversely affect daily functioning and quality of life (Naito, Kai, Ishikawa, Fujita, Uehara, Doihara, Tokunaga, Shimokawa, Ito, & Saeki, 2020; Yeo, Mo, Yip, Yeo, Li, Lau, Lai, Chan, Wong, Pang, Cheung, Chan, Kwok, Suen, & Molassiotis, 2021). Current clinical guidelines therefore emphasize systematic assessment and appropriate pharmacological prevention according to the emetogenic risk of the chemotherapy regimen

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(Herrstedt, Clark-Snow, Ruhlmann, Molassiotis, Olver, Rapoport, Aapro, Dennis, Hesketh, Navari, Schwartzberg, Affronti, Garcia-Del-Barrio, Chan, Celio, Chow, Fleury, Gralla, Giusti, Jahn, Scotté, 2024).

CINV develops through interactions among peripheral gastrointestinal pathways and central neural circuits involving serotonin, dopamine, substance P, and other neurotransmitters. Although pharmacological antiemetics are the foundation of management, some patients continue to experience symptoms and seek complementary approaches that are inexpensive, acceptable, and easy to administer (Zhong, Shahbaz, Teskey, Beever, Kachour, Venketaraman, & Darmani, 2021). Inhaled essential oils stimulate olfactory pathways connected with the limbic system and may influence emotional and physiological responses associated with nausea (Cui, Li, Wei, Li, He, Yang, Li, Duan, Wu, Chen, Chen, Li, Ming, Xiong, Qin, 2022). Citrus essential oils, including lemon oil, contain volatile compounds such as limonene and have been investigated for their calming and symptom-modulating properties (Agarwal, Sebghatollahi, Kamal, Dhyani, Shrivastava, Singh, Sinha, Mahato, Mishra, & Baek, 2022).

Evidence regarding aromatherapy for CINV is promising but heterogeneous. Controlled studies have reported reductions in nausea severity with inhalation aromatherapy, although effects vary according to the essential oil, timing, delivery method, chemotherapy regimen, and outcome measure (Zorba & Ozdemir, 2018; Evans, Malvar, Garretson, Kolovos, & Nelson, 2018; Takasi, Ghanbari, Maroufizadeh, & Parvinroo, 2023; Tabei, Molazem, Rivaz, Ghaem Maghami, & Ahmadloo, 2025). Indonesian studies have also reported lower nausea and vomiting scores following lemon aromatherapy in patients receiving chemotherapy (Hastuti, Nurhayati, Ernawati, Yuliastuti, & Widyastuti, 2021; Sijabat, Tanjung, & Salim, 2024).

Systematic reviews conclude that inhaled aromatherapy may reduce nausea in some cancer populations, but the certainty of evidence remains limited because of small samples, inconsistent protocols, and variable risk of bias (Toniolo, Delaide, & Beloni, 2021; Ahn, Kim, & Kim, 2024; Zhang, Wang, He, Li, & Wang, 2026). This study therefore evaluated changes in nausea and vomiting severity before and after lemon aromatherapy among breast cancer patients undergoing chemotherapy at Dr. H. Abdul Moeloek Regional Hospital, Lampung Province.

RESEARCH METHOD

This quantitative study used a pre-experimental one-group pretest-posttest design. It was conducted in the chemotherapy service at Dr. H. Abdul Moeloek Regional Hospital, Lampung Province, from January 21 to February 3, 2026.

The study population comprised breast cancer patients undergoing chemotherapy. Twenty eligible patients were recruited through purposive sampling according to the study's inclusion and exclusion criteria. The sample-size rationale should be confirmed using the original study protocol and statistical plan.

Nausea and vomiting severity was assessed using a Numeric Rating Scale. Each participant completed a baseline assessment before receiving lemon aromatherapy and a follow-up assessment after the intervention. The intervention was administered approximately two hours after chemotherapy for 5-10 minutes using lemon essential oil applied to an inhalation medium. The exact oil dose, inhalation distance, breathing instructions, treatment setting, and concurrent antiemetic regimen should be confirmed from the original protocol.

Participant characteristics and outcome scores were summarized using descriptive statistics. Because the postintervention score was not normally distributed on the Shapiro-Wilk test ($p = 0.003$), preintervention and postintervention scores were compared using the Wilcoxon signed-rank test. Statistical significance was set at $p < 0.05$.

RESEARCH RESULTS

Table 1. Participant Characteristics (N = 20)

Variable	Results (n/%)
Age (n/%) (Mean±SD)(Range)(Year)	47.30 ± 6.28 (35–57)
<40	2/10.0
≥40	18/90.0
Education Level	

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Junior high school	4/20.0
Senior high school	12/60.0
Higher education	4/20.0
Employment status	
Employed	9/45.0
Unemployed	11/55.0

Table 1 shows that most participants were aged 40 years or older (18 participants, 90.0%). Senior high school was the most frequently reported educational level (12 participants, 60.0%), and 11 participants (55.0%) were unemployed.

Table 2. Nausea and Vomiting Severity Before and After Lemon Aromatherapy (N = 20)

Assessment	Mean ± SD	Range	95% CI	p-value
Pre-intervention	8.15 ± 1.50	5–10	7.45–8.85	
Post-intervention	4.00 ± 0.97	2–5	3.54–4.46	<0.001

Table 2 shows that the mean nausea and vomiting severity score decreased from 8.15 ± 1.50 before lemon aromatherapy to 4.00 ± 0.97 afterward, representing a mean reduction of 4.15 points. The Wilcoxon signed-rank test indicated a statistically significant difference between the preintervention and postintervention scores ($p < 0.001$).

DISCUSSION

The mean nausea and vomiting severity score decreased substantially after lemon aromatherapy, from 8.15 before the intervention to 4.00 afterward. This finding indicates a clinically meaningful change during the observation period; however, the one-group design does not establish that the reduction was caused solely by aromatherapy.

The observed reduction is consistent with previous Indonesian studies reporting decreased chemotherapy-related nausea and vomiting following lemon aromatherapy among patients with cancer. These findings suggest that lemon aromatherapy may be considered a supportive nursing intervention in oncology settings (Hastuti et al., 2021; Sijabat et al., 2024).

International evidence also supports the potential role of inhaled aromatherapy, although the findings have not been entirely consistent. Lower nausea severity has been reported among patients with breast cancer who received aromatherapy compared with those in a control group (Zorba & Ozdemir, 2018). Beneficial effects have also been reported for rose essential oil aromatherapy and *Citrus aurantium* aromatherapy in patients experiencing chemotherapy-induced nausea and vomiting (Takasi et al., 2023; Tabei et al., 2025). In contrast, no significant benefit of ginger aromatherapy was identified among children receiving chemotherapy, indicating that effectiveness may vary according to the study population, essential oil, and intervention protocol (Evans et al., 2018).

The potential mechanism of aromatherapy may involve olfactory stimulation and communication between the olfactory system and limbic structures responsible for emotional responses, autonomic regulation, and symptom perception. Citrus essential oils contain volatile constituents, particularly

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Program Studi Keperawatan, Fakultas Kesehatan, Universitas Mitra Indonesia
Corresponding Author: Marta Ulina Simbolon. Email: simbolonmarta267@gmail.com

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limonene, which may promote relaxation and improve comfort. Nevertheless, the biological pathways through which lemon aroma may influence chemotherapy-induced nausea and vomiting require further investigation (Cui et al., 2022; Agarwal et al., 2022).

The present findings should also be interpreted in relation to systematic evidence. Several inhaled-aromatherapy studies have reported improvements in chemotherapy-induced nausea and vomiting, although methodological limitations remain common (Toniolo et al., 2021). Meta-analytic evidence has indicated an overall benefit of aromatherapy for nausea and combined nausea and vomiting, whereas the evidence for vomiting alone remains less certain (Ahn et al., 2024). Potential benefits have also been reported for acute nausea, but larger studies using standardized intervention protocols are still required (Zhang et al., 2026).

Aromatherapy should be used as a complementary intervention rather than as a replacement for guideline-recommended antiemetic therapy. Randomized trials have demonstrated that contemporary antiemetic combinations, including olanzapine-based regimens, can substantially improve the control of chemotherapy-induced nausea and vomiting (Navari, 2016; Hashimoto, Abe, Tokuyama, Mizutani, Uchitomi, Yamaguchi, Hoshina, Sakata, Takahashi, Nakashima, Nakao, Takei, Zenda, Mizukami, Iwasa, Sakurai, Yamamoto, & Ohe, 2020). Adjunctive interventions should therefore be evaluated while accounting for chemotherapy emetogenicity and the concurrent administration of antiemetic medication.

This study has several limitations. It used a one-group pretest–posttest design without a control group, included only 20 participants from a single hospital, and assessed symptoms over a short observation period. Concurrent antiemetic medication, natural symptom fluctuation, expectancy effects, and differences in chemotherapy regimens may have influenced the postintervention scores. The study also reported mean scores despite using a nonparametric analysis, while the Wilcoxon *Z* statistic and median-based summaries were unavailable. These limitations restrict causal interpretation and limit the generalizability of the findings.

Future studies should employ randomized controlled designs, larger multisite samples, standardized lemon essential oil concentrations and inhalation procedures, validated instruments for chemotherapy-induced nausea and vomiting, and repeated assessments covering both acute and delayed phases. Other supportive interventions, including dietary and acupressure-based approaches, have also produced variable findings, further emphasizing the need for rigorous protocols and clinically meaningful outcome measures (Marx, McCarthy, Ried, McKavanagh, Vitetta, Sali, Lohning, & Isenring, 2017; Crichton, Marshall, Isenring, Lohning, McCarthy, Molassiotis, Bird, Shannon, Koh, McPherson, & Marx, 2024; Chenbing, Huiling, Qianqian, Dan, Guilan, Ling, Lingling, & Weiwei, 2024).

CONCLUSION

Nausea and vomiting severity was lower after lemon aromatherapy among breast cancer patients undergoing chemotherapy, with the mean score decreasing from 8.15 to 4.00 and a statistically significant preintervention-postintervention difference. Lemon aromatherapy may be used as a complementary nursing intervention alongside standard antiemetic treatment. Because the study lacked a control group and included a small sample, the independent effect of the intervention requires confirmation in controlled trials.

SUGGESTION

Future research should use adequately powered randomized controlled designs, clearly report concurrent antiemetic regimens, and standardize the dose, timing, duration, and inhalation technique for lemon aromatherapy. Studies should also assess acute and delayed nausea and vomiting separately, report median and interquartile-range data for nonparametric outcomes, and evaluate patient comfort, treatment adherence, adverse events, and quality of life over multiple chemotherapy cycles.

Marta Ulina Simbolon*, Sri Maryuni, Tubagus Erwin

Program Studi Keperawatan, Fakultas Kesehatan, Universitas Mitra Indonesia
Corresponding Author: Marta Ulina Simbolon. Email: simbolonmarta267@gmail.com

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