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The Efficacy of Fan Therapy to Alleviate Breathlessness among Lung Cancer Patients

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ABSTRACT

Breathlessness is a commonly reported symptom among patients with advanced-stage lung cancer and significantly affects their quality of life. Nowadays, treating breathlessness using standard pharmacological therapies is considered not very effective. Fan therapy, as one of the non-pharmacological approaches, emerges as a way to treat breathlessness. This study aims to examine fan therapy's impact on alleviating breathlessness in lung cancer patients. The research employs a literature review methodology, searching for relevant articles from 2017 to 2022 in databases such as Science Direct, EBSCOhost, Clinical Key Nursing, PubMed, and Google Scholar. Five eligible articles are analyzed descriptively. The findings reveal that 80% of the articles assert the effectiveness of fan therapy in reducing breathlessness in lung cancer patients. Meanwhile, 20% of the articles suggest that fan therapy may have clinical benefits in managing breathlessness. Additionally, it was found that fan therapy can decrease respiratory rates in 60% of the articles and enhance peripheral oxygen saturation in 20% of the articles. Notably, no adverse side effects on patients were reported across all analyzed articles. In conclusion, fan therapy emerges as an economical and safe non-pharmacological intervention for mitigating breathlessness in patients with advanced-stage lung cancer.

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INTRODUCTION

Lung cancer remains the leading cause of cancer-related deaths worldwide. This type of malignancy is characterized by a poor prognosis, with only approximately 20% of patients surviving beyond five years post-diagnosis (Vicidomini, 2023). In 2020, there were 2.21 million new cases and 1.8 million deaths attributed to lung cancer (WHO, 2022), resulting in a death-to-incidence ratio of 0.82. Projections indicate a continual increase in the prevalence of lung cancer, with an estimated 3.8 million new cases and 3.2 million deaths anticipated in 2050 (Sharma, 2022). The substantial occurrence and mortality rates underscore lung cancer as a significant global health concern.

Breathlessness, shortness of breath, or dyspnea is a commonly reported symptom among lung cancer patients. The American Thoracic Society (ATS) defines this condition as a subjective experience with various dimensions related to discomfort in breathing, characterized by varying intensity, dynamic nature, chronicity, and occasional sudden onset, potentially triggering a fear of "drowning" in both patients and their families (Damani et al., 2019; Nemoto et al., 2020). In lung cancer patients, shortness of breath tends to be recurrent and poses a challenge in management (Choratas et al., 2020). Approximately 71.43% of patients with advanced-stage lung cancer are reported to experience shortness of breath (Damani et al., 2019). Another study focused on outpatient care for advanced-stage lung cancer patients found that 31.9% of them reported episodic shortness of breath with a median intensity rating of 7/10 (Julià-Torras et al., 2022). Patients describe this symptom as an increased effort to breathe. The shortness of breath symptoms in lung cancer patients are linked to worsening fatigue, anxiety, appetite loss, and overall well-being (Damani et al., 2019). Furthermore, shortness of breath also negatively impacts overall well-being, hinders

daily activities, interferes with self-care, and reduces the quality of life for lung cancer patients (Damani et al., 2019; Mendoza et al., 2020).

Effective management is essential in alleviating breathlessness in lung cancer patients. Presently, the focus of managing breathlessness in lung cancer patients revolves around treating the underlying disease through methods such as chemotherapy, radiotherapy, surgery, targeted therapy, and immunotherapy. Additionally, efforts are made to address disease-related complications like pleural effusion and administer pharmacological agents to tackle pre-existing comorbidities such as chronic obstructive pulmonary disease (COPD). Opioids and anxiolytics are also employed to modify perception and reduce breathlessness among patients (Feliciano et al., 2021). However, the efficacy of this management strategy could be more effective (Howell, 2021). As a result, non-pharmacological interventions are prioritized as the primary approach for managing breathlessness in lung cancer patients, complementing pharmacological interventions (Hui et al., 2020). One is by directing air toward the face using a fan, also known as fan therapy.

The electric fan is an easily accessible, cost-effective, lightweight, and portable device that does not negatively affect patients when used (Hui et al., 2020). The application of fan therapy has shown promise in relieving breathlessness and enhancing activity tolerance in patients (Morélot-Panzini, 2017). Various mechanisms have been proposed regarding how this intervention effectively reduces patient breathlessness. These mechanisms include facilitating cooling and airflow to the second and third branches of the trigeminal nerve. The reduction in breathlessness is achieved by cooling the nasal mucosa or airways or gently directing air onto the facial skin (Sato et al., 2023). Numerous studies have investigated the effectiveness of fan therapy in diverse patient groups, including those with lung cancer. This literature review aims to identify the evidence supporting the effectiveness of fan therapy in helping lung cancer patients alleviate breathlessness.

METHOD

This study utilizes a literature review methodology to comprehensively examine research articles on the application of fan therapy in lung cancer patients. The literature search was conducted across various databases, including Science Direct, EBSCO-host, ClinicalKey Nursing, PubMed, and Google Scholar, using specific keywords: (lung cancer OR lung malignancy OR lung neoplasm OR lung tumor) AND (hand-held fan therapy OR fan therapy) AND (dyspnea OR shortness of breath OR breathlessness). The inclusion criteria for articles in this review involved studies featuring lung cancer patients or those with lung metastases, experimental research with control groups, randomized control trials (RCTs), systematic reviews, and meta-analyses. Moreover, only articles published between 2017 and 2022 and written in English were considered.

The search was conducted between July 13 and 18, 2022, identifying a total of 998 articles. After screening and applying eligibility criteria, five articles were selected for analysis. These chosen articles underwent a critical review and quality assessment using the Critical Appraisal Skills Programme (CASP) instrument. The analysis was conducted using a descriptive narrative approach.

RESULTS

After selecting five eligible articles, a descriptive analysis was conducted on each. The results of the analysis for each article are presented in Table 1.

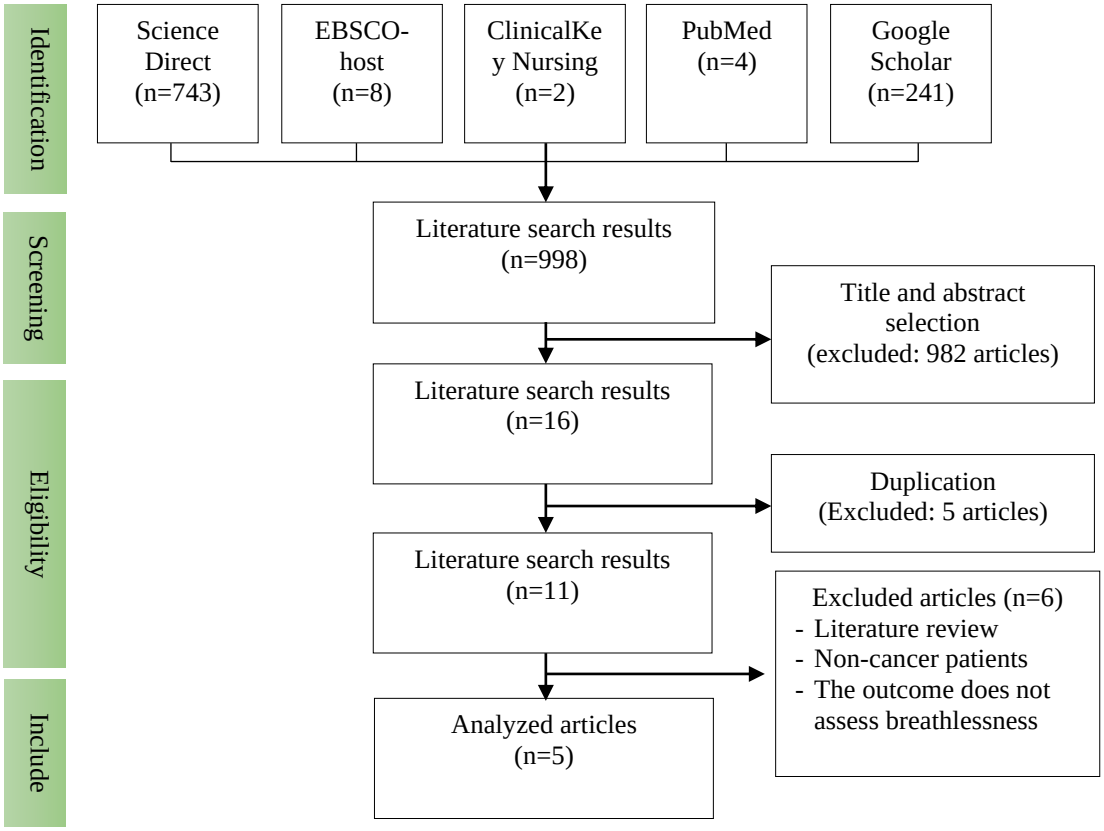

Figure 1. PRISMA flow diagram for literature search

Table 1. Results of the analysis and evaluation of the articles

Author (Year)	Design/ Sample	Variable (and its definition)	Results	Strength and limitation
Kocatepe, Can, & Oruc (2021)	Randomized controlled experimental design N: 96 (47 intervention group, 49 control group)	The intervention and control groups received standard care (oxygen therapy, bronchodilator, semi-Fowler position). Intervention group: practicing the use of a hand-held fan. The fan is held 15 cm from the face for 5 minutes, three times daily (before breakfast, lunch, and dinner) for 14 days. The airflow speed is 4 km/h. Primary outcome: Dyspnea levels were measured using MBS on days 1,7, and 14 post-intervention. Secondary outcomes: vital signs (respiratory rate, pulse rate, peripheral oxygen saturation (SpO2), blood pressure) and quality of life measured using the Functional Assessment of Chronic Illness Therapy–Palliative Care (FACIT-Pal).	- Dyspnea scores from the intervention group on the first, seventh, and fourteenth days after using the hand-held fan were statistically lower than those of the control group ($p<0.01$). Additionally, the dyspnea scores of the experimental group on the first, seventh, and fourteenth days of hand-held fan use were significantly lower than before the fan was used ($p=0.001$). - There was no significant difference in the quality of life scores between the two groups on the first day ($p>0.05$). The quality of life scores in the intervention group was higher than the control group on the 7th and 14th days ($p<0.05$). - On the 14th day of	**Strength:** - The sample demonstrates a 100% effect power on the dyspnea variable, whereas, for the quality of life variable, it is 98.8% - Clearly defined inclusion and exclusion criteria - Detailed explanation of the intervention procedures - No adverse effects were observed in patients as a result of the intervention. **Limitation** - The RCT study was conducted at a single location, and the sample size was small.

Author (Year)	Design/ Sample	Variable (and its definition)	Results	Strength and limitation
			application, the pulse rate was statistically lower in the intervention group compared to the control group. The intervention resulted in a reduction in respiratory rate and an improvement in peripheral oxygen saturation (SpO2) in patients.	
Puspawati, Sitorus, & Herawati (2017)	Open, randomized, controlled, crossover trial design N: 21 (11 intervention group, ten control group)	The intervention and control groups received standard care, including diaphragmatic breathing exercises, oxygen therapy, and pharmacotherapy. For the intervention group, diaphragmatic breathing exercises were supplemented with airflow stimulation from a hand-held fan. The intervention was administered for 5 minutes, twice within two periods. A slightly damp towel was used to clean the patient's face before the intervention. The hand-held fan was small, with three fan blades and an airflow speed of 4 km/h. Primary outcome: the level of dyspnea. Subjective measurement was done using the MBS, while objective measurement involved observing respiratory rate, oxygen saturation, and the use of accessory respiratory muscles. Measurements were taken before and after the intervention.	- The research findings indicate that airflow stimulation from the hand-held fan significantly reduces dyspnea in lung cancer patients (p=0.003). - The study results indicate that airflow stimulation from the hand-held fan can significantly reduce respiratory frequency in lung cancer patients (p=0.008).	**Strength:** - The randomization was done so neither the researchers nor the patients knew the process (double-blinded). - Clearly defined inclusion and exclusion criteria. **Limitation:** - The sample size is small, and there was no effect size analysis on the outcome. - While the intervention procedure has been outlined, it needs more detail and clarity for easy understanding.
Kako et al. (2018).	Parallel-arm, randomized controlled trial N: 40 (20 intervention group, 20 control group)	Intervention group: Fan therapy is administered by directing the airflow from a fan to the entire face area innervated by the second/third branches of the trigeminal nerve. The fan has five blades with dimensions of 37x35.6x84 cm and is directed to one side of the face. The airflow is provided for 5 minutes, and the distance, location, side of the face, intensity,	- The highest proportion of cancer types is lung cancer (55% in the intervention group and 20% in the control group). - There is a significantly more significant decrease in dyspnea levels within the intervention group compared to the control group (p<0.001).	**Strength:** - No adverse effects were identified during the intervention. - The fan-to-face therapy intervention is safe, easy, and cost-effective. - **Limitation:** - The research sample does not consist of 100% lung cancer

Author (Year)	Design/ Sample	Variable (and its definition)	Results	Strength and limitation
		and fan swing are determined according to the patient's preferences. The standing fan is positioned on the floor, starting at the lowest speed and gradually being adjusted to enhance the speed and strength of the airflow. Control Group: Fan therapy was administered to the patient's exposed legs for 5 minutes. The primary outcome is the level of dyspnea measured using the Numeric Rating Scale (NRS) ranging from 0 to 10. Secondary outcomes include changes in facial temperature and other physiological parameters, namely respiratory rate, SpO2 (oxygen saturation), and pulse rate.	- The intervention group shows a significantly more significant reduction in facial temperature compared to the control group (p=0.003) The intervention and control groups showed no significant change in respiratory rate, SpO2, or pulse rate.	patients but somewhat exceeds 50% - The study was conducted at a single location - Blinding was not feasible to be carried out - The intervention procedure is not easily replicable.
Mendoza et al. (2020)	Meta-analysis from RCT N: 139 cancer patients	Fan-to-face therapy vs placebo or other interventions Primary outcome: dyspnea score Secondary outcome: respiration rate	- Pooled analysis indicates a statistically significant reduction in the average dyspnea score change for the fan-to-face therapy group (mean difference=1.81, 95%CI:0.50, 3.12; p<0.00001, I2=93%). - The pooled analysis demonstrates a statistically significant decrease in the mean respiratory rate change (mean difference= -0.91, 95%CI:-1.68, -0.15; p=0.001, I2=81%).	**Strength:** - All the articles analyzed were randomized controlled trials (RCTs). - A combined analysis was conducted on the outcomes of the articles. **Limitation:** - The number of analyzed articles is limited - Some samples do not involve lung cancer.
Qian et al. (2019)	Systematic Review N: 344 (159 cancer patients)	The use of a fan as an intervention	- Six out of ten studies (60%) indicate that fan therapy has clinical benefits in reducing dyspnea or shortness of breath. - Fan therapy is appropriate for use in clinics, hospitals, and healthcare settings. - The duration of fan therapy administration is mentioned in six studies, which are 5 minutes.	**Strength:** - Ninety percent of the analyzed articles were randomized controlled trials (RCTs). **Limitation:** - No pooled analysis was conducted on the outcomes derived from the utilized articles. - Some samples were not related to malignancy and lung cancer.

DISCUSSION

Fan therapy is identified as one of the non-pharmacological methods to alleviate breathlessness, particularly among individuals diagnosed with lung cancer. This literature review determined that fan therapy can reduce breathlessness in patients with lung cancer. This conclusion was drawn from four of the five analyzed research articles, one of which was a systematic review. Besides its effectiveness in alleviating breathlessness, fan therapy was also noted to impact a decrease in respiratory rate and an increase in peripheral oxygen saturation (SpO_2) among lung cancer patients.

The application of fan therapy in lung cancer patients has been found to reduce symptoms of breathlessness (Kako et al., 2018; Kocatepe et al., 2021; Mendoza et al., 2020, 2020; Puspawati et al., 2017). One study has shown that fan therapy effectively alleviates breathlessness on the 1st, 7th, and 14th days when administered to patients (Kocatepe et al., 2021). While the exact mechanism underlying how fan therapy mitigates breathlessness remains uncertain, several proposed mechanisms suggest its ability to cool and facilitate airflow to the second and third branches of the trigeminal nerve. This cooling effect reduces breathlessness by cooling the nasal mucosa or airways and directing air onto the facial skin (Sato et al., 2023). Additionally, fan therapy is believed to act as a distraction and relaxation method, with patients perceiving a decrease in breathlessness when observing the airflow from the fan (Luckett et al., 2017). Another perspective on the efficacy of fan therapy in reducing breathlessness involves a form of "brain manipulation," influencing the brain to believe that the respiratory system functions better than reality. This is attributed to fan therapy's ability to alter the brain's perception of signals from afferent respiratory nerves, supporting psychological and emotional management (Morélot-Panzini, 2017).

Various proposed mechanisms regarding the effect of fan therapy in reducing breathlessness indicate that the alleviation of breathlessness involves biological and psychological factors. This is in line with the understanding that breathlessness is a complex and multidimensional sensation influenced not only by biological factors but also by psychological, social, and environmental factors (Ahmedzai, 2020; Basara et al., 2020; Choratas et al., 2020; Johnston et al., 2023). A study found that psychological factors contribute the most to the intensity of breathlessness, accounting for 14%, followed by biological factors at 10% and social factors at 5% (Basara et al., 2020). This further strengthens the notion that the distraction effect and 'manipulation of brain perception' as psychological approaches within fan therapy can reduce patient breathlessness.

In addition to alleviating breathlessness, fan therapy has been shown to lower the respiratory rate in lung cancer patients. Among five research articles, three suggest that the application of fan therapy contributes to a reduction in the respiratory rate of lung cancer patients (Kocatepe et al., 2021; Mendoza et al., 2020; Puspawati et al., 2017). The underlying physiological effects of fan therapy involve direct stimulation through the trigeminal nerve, nasal mucosa, and nasal and oropharyngeal passages, as well as a cooling effect on facial temperature. These mechanisms are believed to have the potential to improve the ventilation patterns of patients (Mendoza et al., 2020), leading to a subsequent decline in the respiratory rate. Moreover, the potential reduction in respiratory rate may stem from the direct impact of fan therapy on alleviating breathlessness. Increased respiratory exertion commonly arises in patients experiencing breathlessness, leading to a corresponding rise in their respiratory rate. However, when fan therapy is applied, resulting in decreased breathlessness, there is an automatic reduction in respiratory effort, subsequently decreasing the patient's respiratory rate.

Divergent findings were observed in another study, suggesting that fan therapy does not impact the respiratory rate of patients (Kako et al., 2018). This difference may be linked to other factors influencing changes in the respiratory rate, such as the administration of opioids commonly used in palliative care for cancer patients (Hui et al., 2020). Opioids are pharmacological agents with analgesic properties commonly prescribed to manage acute and chronic pain (Webster & Karan, 2020). However, the side effects of opioid use can lead to respiratory depression by acting on μ-opioid receptors (MORs) expressed in brainstem regions involved in respiratory control (Bachmutsky et al., 2020; Furdui et al., 2023). The administration of opioid therapy to cancer patients may potentially induce a placebo effect from fan therapy. Patients receiving fan therapy and opioids may experience a reduced respiratory rate, whereas those receiving fan therapy alone might not observe any alteration in their breathing rate.

Two studies identified peripheral oxygen saturation (SpO_2) as a secondary outcome in fan

therapy patients (Kako et al., 2018; Kocatepe et al., 2021). However, the results from these two studies differ. Kocatepe et al. found that fan therapy could enhance SpO_2 in patients (Kocatepe et al., 2021), while Kako et al. reported that fan therapy did not significantly influence changes in SpO_2 (Kako et al., 2018). These discrepancies may be influenced by various factors, such as differences in the fan therapy administration method, the treatment of the control group, and variations in oxygen therapy given to the patient groups. The type and dosage of oxygen therapy, which may vary for each patient, can significantly impact changes in SpO_2. This is because oxygen therapy is a supportive intervention for end-stage lung cancer patients to address hypoxemia (Lambert et al., 2023; O'Driscoll et al., 2017).

Three of the five examined articles outline the administration techniques for fan therapy. Two studies utilized hand-held fans (Kocatepe et al., 2021; Puspawati et al., 2017), whereas one study employed a standing fan (Kako et al., 2018). In Kocatepe et al.'s study, fan therapy consisted of using a hand-held fan positioned 15 cm away from the face for 5 minutes, three times a day (before breakfast, lunch, and dinner) over 14 days, with an airflow speed of 4 km/h (Kocatepe et al., 2021). Puspawati et al.'s study, which also employed a hand-held fan, delivered fan therapy for 5 minutes twice daily across two sessions using a small-sized fan with three blades and a speed of 4 km/h (Puspawati et al., 2017). Meanwhile, Kako et al.'s study utilized a standing fan placed on the floor with five blades measuring 37x35.6x84 cm. The airflow was directed to one side of the face for 5 minutes, with the distance, location, facial side, intensity, and fan swing adjusted based on patient preferences. The speed and strength of the airflow began at the lowest level and were gradually increased according to patient tolerance (Kako et al., 2018).

Fan therapy emerges as a cost-effective, efficient, and safe evidence-based nursing intervention. Mainly, hand-held fans are economical, easily accessible, lightweight, portable, and do not carry any negative associations for patients (Hui et al., 2020). Moreover, the application of fan therapy is considered relatively safe for patients. Three out of the five articles, which were randomized controlled trials (RCTs), indicated that fan therapy did not lead to side effects and is a safe intervention for individuals with lung cancer (Kako et al., 2018; Kocatepe et al., 2021; Puspawati et al., 2017). Previous studies have also not reported any worsening of physiological outcomes or adverse effects associated with the implementation of fan therapy (Sato et al., 2023).

CONCLUSION

Fan therapy is a non-pharmacological intervention that nurses can utilize to alleviate breathlessness in patients with lung cancer. Beyond its effectiveness, fan therapy is economical, lacks side effects, and is safe for patient application.

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