

Review Article

Fan Therapy for the Treatment of Dyspnea in Adults: A Systematic Review



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Abstract

Context. The use of a handheld or electric fan has been proposed as one component of the complex clinical interventions used in the relief of dyspnea; however, there is a lack of consensus regarding its efficacy.

Objectives. We performed a systematic review to determine the effectiveness of fan therapy for the treatment of dyspnea.

Methods. We searched the Medline, EMBASE, Web of Science, Scopus, CINAHL, PsycInfo, and Cochrane Library databases to identify all fan therapy studies published from January 1, 1946 to September 31, 2018. The search terms included “dyspnea,” “dyspnea,” “dyspneic,” “short of breath,” “shortness of breath,” “breathless,” “breathlessness,” “breathing difficulty,” “labored breathing,” and “fan.” Searches were limited to articles in English or Chinese. The bibliographies of identified articles were also manually searched. Three authors independently assessed papers for inclusion.

Results. Ten of the 92 unique records identified met the inclusion criteria (nine randomized controlled trials and one cohort study). Most studies (80%) were conducted in the hospital setting, and none were double blinded. Nearly half (159 [46%]) of the 344 total subjects had cancer. The most common nonmalignant disease was chronic obstructive pulmonary disease. The most common duration of fan therapy was five minutes. Six studies (60%) reported a significant improvement in dyspnea with fan therapy. There are two ongoing trials being conducted based on a search of trial registries.

Conclusion. Limited direct evidence from randomized controlled trials indicates that fan therapy may effectively alleviate dyspnea. Additional trials are warranted to confirm this finding and explore the use of fan therapy for the treatment of dyspnea in more diverse populations and settings. *J Pain Symptom Manage* 2019;58:481–486. © 2019 American Academy of Hospice and Palliative Medicine. Published by Elsevier Inc. All rights reserved.

Key Words

Dyspnea, fan, cancer, chronic obstructive pulmonary disease, breathlessness, systematic review

Introduction

Dyspnea, or breathlessness, is a subjective experience of breathing discomfort that consists of qualitatively distinct sensations that vary in intensity; it is a common symptom among patients with advanced disease.^{1,2} Dyspnea’s distressing physical

and emotional effects underscore the need for effective interventions.

The use of a handheld or electric fan has been proposed as one component of the complex interventions used in clinical practice for the relief of dyspnea, because its effects—cooling and/or airflow stimulation

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of the skin and the mucosae that are innervated by the second and third branches of the trigeminal nerve, as well as distraction and the promotion of self-efficacy^{3–5}—are believed to have a therapeutic effect on breathing patterns. Fans are a cost-effective, safe, easily obtained, and practical method of producing facial airflow. In 2010, a randomized, controlled, crossover trial demonstrated reduced dyspnea after patients directed a handheld fan toward their faces.⁶ Therefore, multiple clinical guidelines have recommended fan therapy for the management of dyspnea.^{7,8}

To date, there has been only one systematic review of the efficacy of fan therapy, published in 2008.⁹ This Cochrane review of nonpharmacologic interventions for dyspnea in patients with advanced stages of malignant and nonmalignant diseases concluded that there were not enough data to evaluate the efficacy of fan therapy in this setting. Here, we present the results of a new systematic review of literature published over the past 70 years concerning the effectiveness of fan therapy for the relief of dyspnea.

Methods

We searched the Medline, EMBASE, Web of Science, Scopus, CINAHL, PsycInfo, and Cochrane Library electronic databases for literature published from January 1, 1946 to September 31, 2018. We also searched trial registries clinicaltrials.gov, ICTRP, and Cochrane Central for ongoing trials applying the same search strategies, but we only reported the number of those ongoing trials. Search structures, subject headings, and keywords were tailored to each database by a medical research librarian (Y. G.). The following terms were searched: “dyspnea,” “dyspnea,” “dyspneic,” “short of breath,” “shortness of breath,” “breathless,” “breathlessness,” “breathing difficulty,” “labored breathing,” and “fan.” Fan therapy was defined as the use of a handheld or electric fan and excluded the use of an oral nasal mask, nasal cannula, or full-face mask. The search terms were combined by “or” if they represented similar concepts and by “and” if they represented different concepts. The results were restricted to those published in English or Chinese. Studies were included if they met the following inclusion criteria: 1) randomized controlled trial or cohort study in which a fan was used as an intervention; 2) patients aged ≥ 18 years; and 3) dyspnea assessed before and after the intervention. Three reviewers independently screened each study for inclusion, and any disagreements about a particular study were resolved by discussion.

The Cochrane risk of bias assessment tool¹⁰ was used to assess the methodological quality of each included study, including the risk of selection, performance,

detection, attrition, and reporting biases for all outcomes. The following data were extracted from each included study: 1) general information (authors, year of study, geographic location, duration of study, treatment setting [hospital, clinic, or hospice], declared conflicts of interest, and sources of funding); 2) study characteristics (design, number of centers, sample size, follow-up assessments, primary outcome, secondary outcome, and adverse events); 3) patient characteristics (inclusion criteria, exclusion criteria, baseline characteristics, description of therapy, description of the comparator, and etiology of dyspnea); and 4) outcomes. Three reviewers independently evaluated each bias domain and extracted data from each included study using a standardized form, with any disagreements resolved via discussion. Risk of bias within each domain was independently assessed as high, low, or unclear by each reviewer.

The number of records identified, screened, assessed for eligibility, and included in this review were recorded, as were the reasons for excluding identified records. The characteristics (e.g., design, sample size, randomization method, blinding, primary outcome, secondary outcomes, statistical methods, and conclusions) of each study were recorded and summarized.

Because the study methodology and reported outcome measures varied markedly, we decided to focus on describing the studies, their results, and their limitations and on a qualitative synthesis rather than combining the data in a meta-analytic statistical approach.

Results

A total of 95 records was identified (Fig. 1). After excluding three duplicate records, we screened the remaining 92 records for eligibility. Seventy-four studies were excluded because they did not meet the stated inclusion criteria (Fig. 1). Of the remaining 18 full-text articles assessed for eligibility, eight were excluded because of the lack of the use of fan therapy or a lack of dyspnea assessment.

Ten studies and 344 patients were included (Table 1). Nine studies were randomized controlled trials, and one was a single cohort study. Eight of the randomized clinical trials were single-blinded, and one was open-label. Most studies (80%) were performed in an inpatient setting (i.e., hospital or hospice). Patients' ages ranged from 53 to 77 years, and in 159 patients (46%), cancer was the principal cause of dyspnea. The duration of fan therapy (fan-to-face or fan-to-leg) was reported in six studies, all of which used an intervention period of five minutes. The primary outcome of absolute change in dyspnea was recorded in all the studies. However, the method of

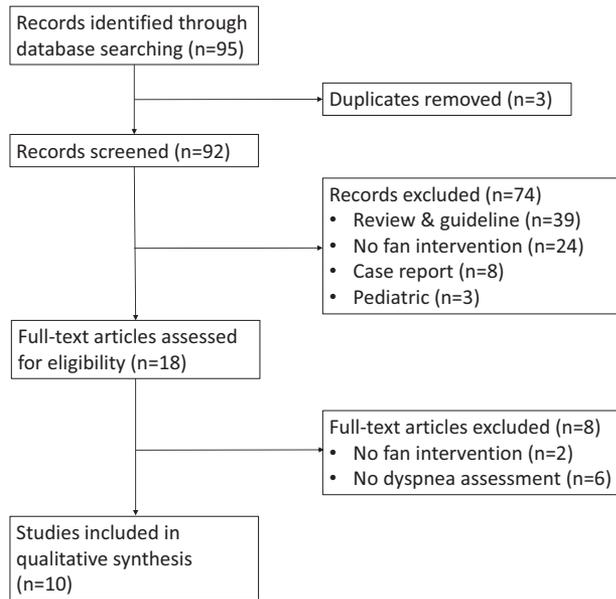


Fig. 1. Study flow chart.

dyspnea assessment varied; five studies used a numeric rating scale, one used a visual analog scale, and four used the Borg scale or modified Borg scale.

The risk of bias for all included studies is summarized in Table 2. Seven of the nine included randomized controlled trials had sufficient information to determine the risk of allocation bias as low risk, the other two randomized controlled trials did not have sufficient information.^{11,12} Although there are eight studies stated single blinding, the blinding process was not complete or verified from the methods provided. There was no blinding in other two studies, a cohort¹³ and a randomized controlled trial.¹⁴ All 10 studies were assessed as high risk of blinding bias. All the studies addressed withdrawals and incomplete

data, and reported the selective outcomes, and were therefore judged as low risk of bias. All the studies, apart from one, a cohort design, were free from other bias and were judged as low risk, whereas the cohort study as high risk.

Six of the 10 included studies determined that the use of a fan was associated with a clinical benefit (Table 3). Galbraith et al.⁶ and Kako et al.¹⁵ both showed that a handheld fan directed at the face reduced the sensation of breathless compared with a fan directed at the leg ($P < 0.05$). In another study, Kako et al.¹⁶ reported relief of dyspnea in patients using the fan to their faces ($P = 0.02$), and also found that one hour was not a sufficient washout period for fan therapy.

Puspawati et al.¹⁷ compared the use of diaphragmatic breathing exercise with airflow from a fan and the use of diaphragmatic breathing exercises alone in 21 hospitalized lung cancer patients. They concluded that the airflow stimulation from a handheld fan decreased the dyspnea sensation and breathing frequency in nonhypoxic lung cancer patients ($P = 0.001$).

Marchetti et al.¹⁸ confirmed the efficacy of fan therapy in 10 outpatients with chronic obstructive pulmonary disease by comparing the fan-to-face and fan-to-leg approaches. The fan-to-face technique resulted in improved exercise performance ($P = 0.03$).

Wong et al.¹² evaluated 30 Chinese inpatients in whom advanced cancer was a principal cause of dyspnea. They applied the symptom scale with fan and accompanied caregivers. They found that fan therapy was effective in alleviating dyspnea in this population ($P = 0.01$).

Four studies^{15–18} failed to demonstrate significant alleviation of dyspnea with the use of fan therapy. Bausewein et al.¹⁹ compared the use of fan therapy with a

Table 1
Characteristics of Included Studies

Study (Reference)	N	Setting	Study Design	Blinding	Cancer-Related	COPD-Related	Age, yrs	Fan Therapy Duration, minutes	KPS
					Dyspnea	Dyspnea			
					n (%)	n (%)	Mean (SD)		Mean (SD)
Bausewein 2010 ¹⁹	70	Hospital	RCT	Single blind	25 (36)	45 (64)	66 (9)	NR	62 (11)
Booth 2016 ¹³	31	Hospital/hospice	Single cohort	Open label	12 (39)	7 (23)	75 (11)	5	NR
Galbraith 2010 ⁶	50	Hospital	RCT	Single blind	11 (22)	26 (52)	71 (33–90)	5	NR
Johnson 2016 ¹⁴	49	Clinic/hospice	RCT	Open label	13 (27)	23 (47)	68 (12) ^a	NR	70 (7)
Kako 2018a ¹⁵	9	Hospital	RCT	Single blind	7 (78)	2 (22)	77 (9)	5	3 ^b
Kako 2018b ¹⁶	40	Hospital	RCT	Single blind	40 (100)	0 (0)	71 (8) ^c	5	42 (11) ^d
Marchetti 2015 ¹⁸	10	Clinic	RCT	Single blind	0 (0)	10 (100)	62 (6)	NR	NR
O'Driscoll 2011 ¹¹	34	Hospital/clinic	RCT	Single blind	0 (0)	34 (100)	67 (9)	NR	NR
Puspawati 2017 ¹⁷	21	Hospital	RCT	Single blind	21 (100)	0 (0)	54 (9)	5	NR
Wong 2017 ¹²	30	Hospital	RCT	Single blind	30 (100)	0 (0)	NR	5	NR
Total	344	—	—	—	159 (46)	147 (43)	—	—	—

COPD = chronic obstructive pulmonary disease; KPS = Karnofsky performance status; RCT = randomized controlled trial; NR = not reported; ECOG = Eastern Cooperative Oncology Group.

^aThe mean age of the control group was 68 years (SD = nine years).

^b(ECOG) performance status was used.

^cThe mean age of the control group was 67 years (SD = 12 years).

^dThe mean KPS of the control group was 43 (SD = 7).

Table 2
Risk of Bias. Methodological Quality of Included Studies

Study (Reference)	Study Design	Allocation	Blinding	Withdrawals, Incomplete Data	Selective Outcome Reporting	Other Issues of Bias
Bausewein 2010 ¹⁹	RCT	Low	High	Low	Low	Low
Booth 2016 ¹³	Single cohort	N/A	High	Low	Low	High
Galbraith 2010 ⁶	RCT	Low	High	Low	Low	Low
Johnson 2016 ¹⁴	RCT	Low	High	Low	Low	Low
Kako 2018a ¹⁵	RCT	Low	High	Low	Low	Low
Kako 2018b ¹⁶	RCT	Low	High	Low	Low	Low
Marchetti 2015 ¹⁸	RCT	Low	High	Low	Low	Low
O'Driscoll 2011 ¹¹	RCT	Unclear	High	Low	Low	Low
Puspawati 2017 ¹⁷	RCT	Low	High	Low	Low	Low
Wong 2017 ¹²	RCT	Unclear	High	Low	Low	Low

RCT = randomized controlled trial; N/A = not applicable.

control treatment and could not demonstrate its effectiveness. Booth et al.¹³ found fan therapy to have a moderate subjective clinical impact in patients with dyspnea at rest, but this effect was not statistically significant. Johnson et al.¹⁴ compared the use of fan therapy with no intervention and confirmed the feasibility of a multisite trial to determine the role of handheld fans as a therapeutic tool in the self-management of chronic shortness of breath but failed to prove the effectiveness of fan therapy. O'Driscoll et al.¹¹ compared the use of air current supplied by an electric fan or mask with an oxygen mask after exercise in nonhypoxemic chronic obstructive pulmonary disease patients; neither the fan nor the oxygen mask had any apparent physical or placebo effect.

There are two ongoing trials using fan as an intervention for dyspnea or breathlessness.^{20,21} All of them are randomized controlled trials.

Discussion

In our systematic review, we found that fan therapy was feasible in clinic, hospice, and hospital settings. Six of nine randomized controlled trials found significant difference in favor of fan therapy. Fan therapy has been recommended for cancer patients with estimated life expectancies from hours to years.⁷ The fan-to-face approach was the most effective in all the studies we reviewed.

One important work with caution is related to the study by Bausewein et al.¹⁹ This is the largest randomized controlled trial and the results did not favor in fan as compared with the wristband as a control. This finding emphasizes the need for more research to better characterize the role of fan therapy in the management of dyspnea.

In the systematic review published in 2008, breathing training, walking aids, chest wall vibration, and neuro-electrical muscle stimulation appeared to be effective nonpharmacologic interventions for relieving breathlessness.⁹ However, these interventions are

inappropriate for patients with poor performance status, or may not be feasible for patients in the home environment. Fan therapy is safe, posing no harm to organs; it creates air flow and cools the surface temperature of the skin, which may be optimal for terminally ill patients at home with limited access to medical devices, and was found to cool the mucosae that are innervated by the second and third branches of the trigeminal nerve in healthy subjects.⁴

In a recently published review article, the effect of airflow for chronic breathlessness relief was examined.²² All the five studies identified in that study are included in our systematic review of 10 studies.

Although there are insufficient available data on which to draw robust conclusions, single cohort study and controlled studies of other nonpharmacologic strategies for relieving dyspnea suggest that fan therapy may be effective for patients with malignant or chronic disease. The comparison of the efficacy of the fan-to-face and fan-to-leg approaches confirmed these mechanisms of dyspnea relief. A cooler temperature alone could be useful for relieving dyspnea, as suggested by the National Comprehensive Cancer Network.⁷ However, only one study in our analysis reported changes in skin temperature before and after fan therapy.¹⁵ The most common treatment duration used in these reviewed studies was five minutes,⁶ but this duration appears to have been selected arbitrarily. To our knowledge, no study has tested the effects of the duration of fan therapy.

The risk of bias of most studies was judged as low in allocation, attrition, and reporting outcomes, and the high risk of bias was only judged in performance, which was due to the natural feature of fan therapy as an intervention. All the trials were single-blinded or open-label, the bias from investigators cannot be eliminated. Although studies with single-blinded setting attempted to blind the participants, the participants cannot be completely blinded to the therapy as the fan is directed at their face or leg, or a placebo wristband or accompanied caregiver was applied as a comparator.

Table 3
Summary of Study Findings

Study (Reference) and Intervention	Absolute Change in Dyspnea		Conclusion
	Mean (SD/Range)	P-value	
Bausewein 2010 ¹⁹			
Fan	-0.6 (2.1) ^a	0.9	The effectiveness of a fan at relieving dyspnea could not be established
A placebo wristband	-0.8 (2.67) ^a		
Booth 2016 ¹³			
Fan	-1.04 ^b	N/A	50% of patients with dyspnea at rest experienced relief using a handheld fan
Galbraith 2010 ⁶			
Fan to face	-7 (1.5 to 14.5) ^c	0.003	A handheld fan to the face reduced dyspnea
Fan to leg	-1.5 (-2 to 7) ^c		
Johnson 2016 ¹⁴			
Fan	-6 (2) ^b	0.853	Confirmed the feasibility of a definitive multisite trial to study the use of a handheld fan as part of the self-management of chronic dyspnea
No intervention	-5 (4) ^b		
Kako 2018a ¹⁵			
No fan	0 ^b	0.02	A fan to the face resulted in relief of dyspnea
Fan to leg	0 ^b		
Fan to face	-0.7 ^b		
Kako 2018b ¹⁶			
Fan to face	-1.35 (-1.85 to -0.84) ^b	0.001	A fan to the face was effective at alleviating dyspnea in terminally ill cancer patients
Fan to leg	-0.1 (-0.53 to 0.33) ^b		
Marchetti 2015 ¹⁸			
Fan to face	5 (0-10) ^a	0.03	A fan to the face improved exercise performance in patients with COPD
Fan to leg	6.5 (0-10) ^a		
O'Driscoll 2011 ¹¹			
Room air	5.1 (1.7) ^a	N/A	A fan had no apparent physical or placebo effect
Electric fan	5.1 (1.7) ^a		
Air mask	5.3 (1.6) ^a		
Oxygen mask	5.1 (1.7) ^a		
Puspawati 2017 ¹⁷			
Fan with diaphragmatic breath exercise	-1.21 (0.56) ^a	0.003	A handheld fan decreased dyspnea in non-hypoxemic, dyspneic lung cancer patients
Diaphragmatic breathing exercise	-0.69 (0.46) ^a		
Wong 2017 ¹²			
Fan	-1.53 ^b	0.01	Fan therapy was effective at alleviating dyspnea in Chinese patients with advanced cancer
Accompanied by caregivers with no fan	-0.13 ^b		

COPD = chronic obstructive pulmonary disease; N/A = not applicable.

^aModified Borg Scale/Borg Scale.

^bNumeric rating scale.

^cVisual Analog Scale.

This review has intrinsic limitations, notably the limited number of studies and the limited quality of those studies (e.g., they did not use pharmacologic strategies or assess the etiology of dyspnea). Moreover, there are some limitations in the design of these randomized controlled trials. Moreover, the potential limitation of vote counting on the number of studies could also be a limitation of a systematic review with small studies bias.²³ There are two clinical trials ongoing on similar topic and hopefully will provide more evidence on the role of fan therapy in the management of dyspnea.

Two important areas of future research include multicenter studies with larger numbers of patients, which may lead to a better assessment of the effectiveness of fan therapy; a better characterization of the cause of dyspnea (e.g., cancer, heart failure, or restrictive or obstructive pulmonary disease); and an appropriate blinding of the intervention. Because of the subjective nature of dyspnea, the lack of existing double-blinded studies is of

concern, and such studies would be an important contribution to this research area.

Conclusion

Limited direct evidence from randomized clinical trials indicates that fan therapy is effective at alleviating dyspnea. Additional trials are warranted to confirm this finding and explore the use of fan therapy for the treatment of dyspnea in more diverse populations and settings. More research is needed to better characterize the role of fan therapy in the management of dyspnea.

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