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Effect of Fan Therapy on dyspnea in patients with chronic respiratory diseases during a 6 MWT: A randomized controlled trial

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1. Introduction

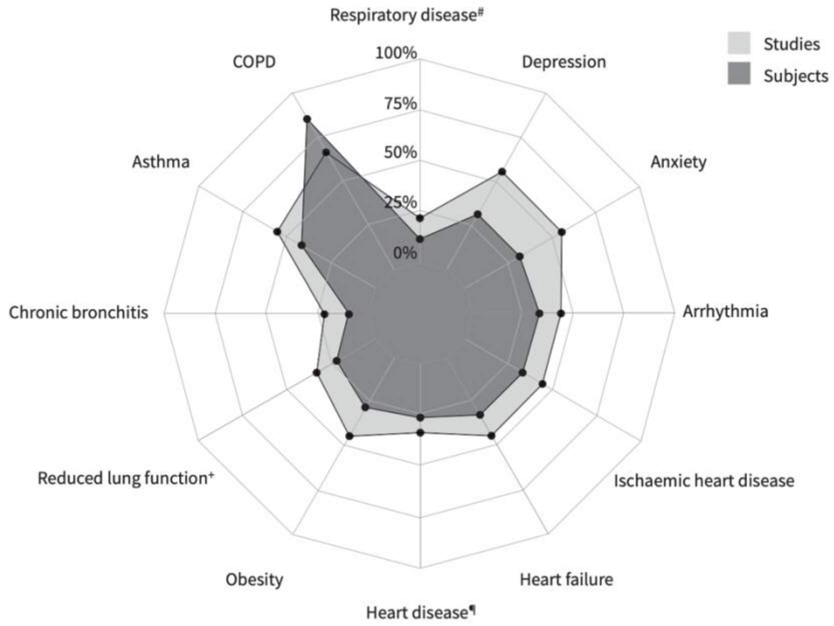
Chronic respiratory diseases are characterized by an affection of the respiratory airways as well as the different structures of the lung (1). These include chronic obstructive pulmonary disease (COPD), asthma, cystic fibrosis, pulmonary fibrosis, lung cancer and many others. Inhalation and exposure to noxious particles like occupational chemicals and dust, environmental air pollution and particularly smoking are the main risk for respiratory illness (2). A 2017 study revealed a prevalence of almost 545 million people in the world affected by chronic respiratory disease (2).

Dyspnea, induced uncomfortable, labored and distressing breathing, is a common symptom in chronic respiratory disease which can result in a major decline of quality of life (3). It is mainly assessed using the modified Medical Research Council (mMRC) breathlessness scale (4). This self-rating questionnaire contributes to assess the degree of functional impairment on daily activities due to breathlessness. The tool is a scale from 0 (breathlessness provoked by strenuous exercise only) to 4 (Incapability of leaving the house or breathless when dressing/undressing)(5).

The prevalence of breathlessness in the general population over 40 years old is 27% (6). It is one of the most frequent complaints leading patients to a general practitioner (7) and to the emergencies with about 4 millions visits per year for respiratory distress (8). For the physicians, diagnosis is a difficult task given the multiple diseases and pathological conditions linked to this symptom (7). As shown on *Fig.1*, there are multiple risk factors, with respiratory diseases being the most important one. Heart troubles, obesity and psychological disorders are also represented as risk factors.

Chronic breathlessness has a major impact on physical activity, potentially causing a vicious cycle with a decline in exercise tolerance and physical conditioning, a reduced health-related quality of life and an increase in morbidity, healthcare needs and mortality (9).

Fig. 1: *Association between underlying breathlessness and underlying conditions. The percentage gets higher the further it is from the center (6)*



Dyspnea has a complex pathophysiological mechanism as it is a subjective experience of respiratory discomfort with qualitative sensations that fluctuate in intensity (10). Breathlessness or dyspnea is defined by a malfunctioning balance between the "demand for breathing and the capacity to satisfy this demand" (8). This means that the neural breathing control from the cortical and medullary command centers does not match the afferent feedback provided by the various sensory receptors in the respiratory system. Furthermore, emerging evidence suggests that dyspnea is a multisystem experience and a complex accumulation of previous expectations, emotional state, experience and perception of internal sensory signals (11). Using neuroimaging techniques (cf. MRI and PET), scientists have been able to visualize the affective and sensorimotor-related brain regions processing breathlessness, such as the insular cortex and the anterior cingulate cortex, which are involved in cognitive, emotional and executive functions (12)(**Fig. 2).** Dyspnea arises from a neuro-mechanical imbalance explained by a mechanical and muscular ventilatory response that falls below the level expected by the central respiratory neuronal command. The contributions of the sensory cortex, the motor cortex and the limbic system (emotional drive) to dyspnea are significant.

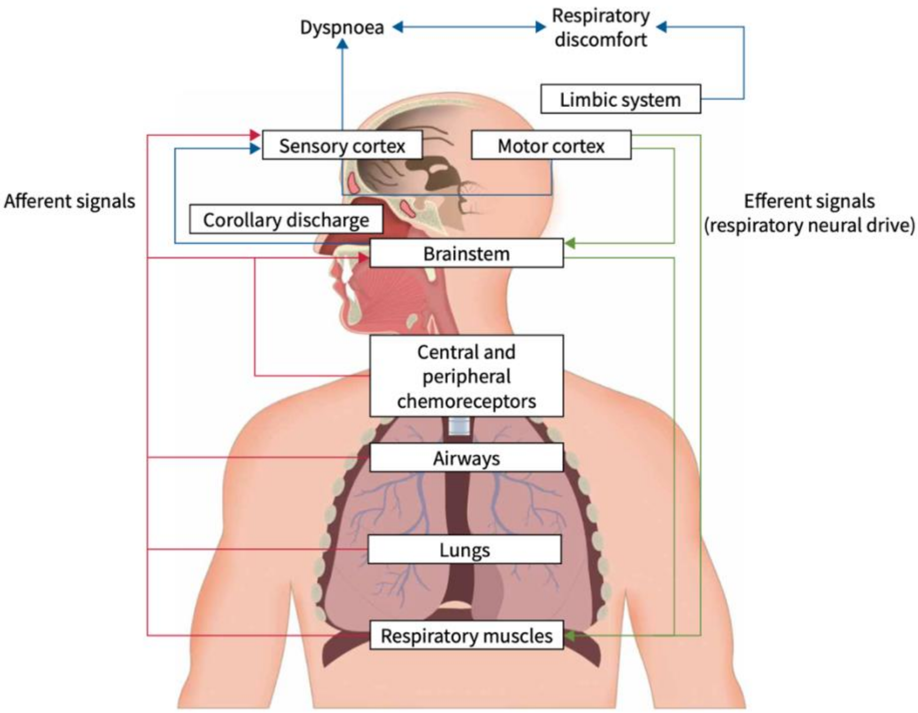


Fig. 2 : *Illustration of the neural mechanisms involved in dyspnea(12)*

To date, there are many different pharmacological treatments to reduce breathlessness, with some focusing on treating the underlying disease. For example, opioids have been proven to be effective in relieving dyspnea (13). However non-pharmacological treatments are also available, such as respiratory techniques, walking aids and position alternation. Two therapies have demonstrated their efficacy in decreasing dyspnea through their central neural effects : inhaled L-menthol and fan therapy (a stream of cool air directed to the face or nose)(9). These therapies act as agonist of TRPM8 channels, which are primarily found in the nasal mucosae and the epithelium of the face, around the nose. More precisely, these channels are located on the olfactive nerve (OGN) and the ophthalmic and maxillary branches of the trigeminal nerve (TGN). TRPM8 channels are activated by sensations of coolness, which alters the afferent feedback to the brain, decreases the central inspiratory neural drive and induces a feeling of improved ventilation (14).

Fan therapy is defined as a the "use of an electric fan blowing on the patient's face"(15). There are several types of fans, including table fan, standing fan, handled fan and portable hanging neck fans (15). This non-pharmacological therapy has proven to be an effective option for relieving dyspnea through its cooling effect on the face (16). It is a practical, harmless, easy, inexpensive, and safe method. It can be used at home as well in hospital settings or clinics, when the patient is seated or lying, and either at rest or during a physical activities like walking or cycling.

There are many studies on the use of fan therapy, but a lot of them have limitations in their design and scientific methods. Additionally, most of the studies explore the use of fans at rest, which does not address the effectiveness of fan therapy during daily physical activities, representing the majority of complains. To assess the impact of chronic respiratory disease on a patient's daily activities, the 6-minutes walking test (6MWT) is a reliable tool, as it reflects the functional exercise capacity (17).

Based on the hypothesis that a fan could reduce dyspnea during physical activity, this study primarily aims to evaluate the effect of fan therapy on breathlessness during daily life efforts through the 6MWT. The secondary aim is to examine whether airflow blowing on the face increases the walking distance and the physical capabilities.

2. Method

2.1 Design of the study

This study is a crossover randomized controlled trial comparing the level of breathlessness in patients with chronic dyspnea during a 6MWT with or without fan therapy (using a portable neck fan).

The research followed the CONSORT guidelines. The project has been approved by the Hospital-Faculty Biomedical Ethics Committee of the Clinique universitaire Saint-Luc, with the Belgian registration number 2013/08MAR/018.

Each patient received an information form describing the survey process and objectives, as well as an informed consent form to sign before inclusion in the study. All data from the subjects participating in the study were kept strictly confidential and protected in accordance with the ethical principles of the Declaration of Helsinki (18).

The recruitment process, which took place at the Clinical universitaire Saint-Luc, was based on the level of chronic dyspnea in the patients. The researcher recruited subjects directly during the pulmonary rehabilitation sessions. The time interval between two tests was a maximum of one week to avoid a significant increase in performance due to the pulmonary revalidation sessions.

2.2 Participants

Within the inclusion criteria, patients with any chronic respiratory diseases had to be in a clinically stable situation for the past month, with no change in respiratory symptoms. Additionally, patients had to be over 18 years old and present a chronic dyspnea with a score of 1 or more on the mMRC scale. A score of 1 means that "*the patient is short of breath when hurrying or walking up a slight hill*" (4).

Exclusion criteria included the inability to give written consent and the presence of any cognitive, cardiovascular (e.g. unstable coronary artery disease or recent myocardial infarction) or peripheral system disorder that might impact walking tolerance and performance.

2.3 Randomization:

In this study, a simple 2-block randomization was used. The subjects were randomized into two groups:

- **Group A:** Participants started with the ventilator-free walking test, followed 2 days later by the ventilator walking test.
- **Group B:** Participants started with the fan walking test and performed the ventilator-free walking test 2 days later.

Each patient was assigned a number using a random number generator (randomizer.org). This number was used to determine the participant's group and the intervention sequence.

A trained physiotherapist was responsible for recruiting the participants and randomly assigning them to one of the two groups. Another one was responsible for having them perform the tests. Given the nature of intervention, it was not possible to blind the experimenter or the patients to the allocation. However, the assessor was blinded.

2.3 Intervention :

- ***Intervention***

The measuring tool used was the 6-minute walking test (6MWT). It is an effort test that provides information about functional, respiratory and cardiac capacity of a patient. Internationally recommended guidelines established by the American Thoracic Society were followed to insure the reliability of the 6MWT (19).

Instruction given to the patient for the 6MWT:

To reduce the risk of bias, every patient received the same instructions from the same experimenter. They were instructed to cover the longest distance possible in six minutes, walking back and forth between two cones (30 meters appart). They were allowed to take a standing break if they felt too exhausted but had to resume walking as soon as they felt better, as the stopwatch would continue running. If their oxygen saturation dropped below 80%, the test would be stopped. During the test, patients were not allowed to speak, and the experimenter could not encourage them.

The fan consists of two mini-fans on either side of the neck. It has the advantage of being lightweight and remains fixed even when walking. For each patient, the ventilator was configured as follows:

- The two mini fans were each positioned 20 cm from the nose on either side of the face.
- The angle of the mini fans was adjusted so that the air current reached the peri-nasal area to activate the TRPM8 receptors of the sub-orbital branch of the trigeminal nerve.
- The propeller speed was set to 1.5 m/s at a temperature of 23.8°C.

For the 6MWT with fan therapy, a portable neck fan (*wearable fan, ANYPOWK, China*) was turned on during the test and the 2-minute recovery period. The portable neck fan was preferred over the hand-held fan for reasons of reproducibility. The distance and angle of the fans in relation to the face were determined beforehand and were therefore identical for each subject.

Fig. 3: *Portable neck fan (wearable fan, ANYPOWK, China) used for this study (20)*

2.4 Outcomes

The primary outcome was the final value of dyspnea experienced by the patients at the end of the 1st and 2nd tests. These two values were compared to determine the effectiveness of ventilation on dyspnea during exercise.

Before each test, patients were asked to rate their level of dyspnea on a modified Borg scale ranging from 0 to 10 (0 = not at all breathless, 10 = maximum breathlessness). At the end of the 6MWT, the patients were asked again to estimate their level of dyspnea on the Borg scale.

The secondary outcomes were :

⇒ **Pulsed oxygen saturation (SpO2):** Patient's saturation was measured before the start of the test at rest, and at 2 minutes, 4 minutes, 6 minutes and 8 minutes (2 minutes after exercise).

⇒ **Heart rate:** Patient's heart rate was also assessed before the start of the test at rest, and at 2 minutes, 4 minutes, 6 minutes and at 8 minutes (2 minutes after exercise). Both pulsed oxygen saturation and heart rate were measured using a portable oxymeter (Nonin, Onyx® Vantage 9590, USA), worn on the finger throughout the test.

⇒ **Distance walked:** The patient walked a 30-meter round trip. At the end of the test, the examiner calculated the total distance walked (in meters) by the patient in 6 minutes.

⇒ **Patient feedback:** After completing both tests, the patient was asked to answer two questions, rating their answer between 0 (totally disagree) and 5 (totally agree):

1) Did you prefer performing the 6MWT with the ventilator? Why or why not?

2) Did you feel any discomfort wearing the ventilator around your neck? If so, what kind ?

2.7 Statistic method:

The sample size was calculated using a power of 80%, a 95% confidence interval, a minimal clinically important difference (MCID) of 2, and a variance of 6.25. This calculation determined a minimum sample size of 25 patients.

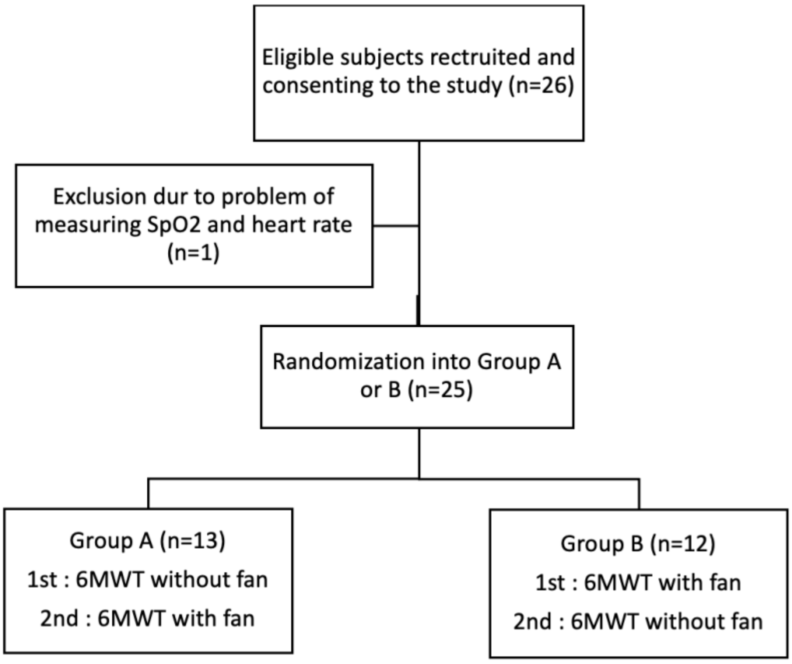
Descriptive analysis was conducted using SPSS 25.0. Data were summarized as either mean and standard deviation (± SD) or median with range (min-max), depending on the distribution's normality. Proportional comparisons were analyzed with the Chi-square test. For continuous data, the paired Student's t-test or the Wilcoxon test was used. The Bland-Altman test assessed the agreement between the 6MWT with and without a fan. Spearman’s Rho correlation test was used to evaluate the relationship between the mMRC score and both the distance traveled and changes in dyspnea. Statistical significance was set at a p-value of less than 0.05.

3. Results

3.1 Characteristics of the Groups

A total of 25 patients with chronic respiratory disease were recruited and separated into two groups of 12 and 13 subjects, homogeneous in gender distribution.

Fig. 4: *Flow diagram of patient recruitment*



The median chronic dyspnea was 2, with a minimum of 1 and a maximum of 3. The main pathology among the patients was COPD.

Table 1: *Characteristics observed among patients*

Characteristics		Subjects (n = 25)
Gender (%)	Women	14 (56)
	Men	11 (44)
Age (years) ± standard deviation (SD)		72 ± 7.2
Weight (kg) ± standard deviation (SD)		69.1 ± 17.7
Height (cm) ± standard deviation (SD)		166 ± 8.1

Pathologies (%)	Lung Cancer	4 (16)
	COPD	14 (56)
	Pulmonary Fibrosis	4 (16)
	Chronic Dyspnea	2 (8)
	Bronchiectasis	1 (4)
Dyspnea (min-max)		2 (1-3)

SD = Standard deviation; COPD = Chronic Obstructive Pulmonary Disease; Min =Minimum; Max = Maximum

3.2 Dyspnea change

The dyspnea at rest was similar before both tests. The results showed a significant lower breathlessness at the end of the 6MWT as well as in the change of dyspnea during the 6MWT with the fan therapy compared to the 6MWT without ($p < 0.001$ for both measures) (Table 2). Only two subjects felt their dyspnea increasing more during the exercise with the fan and two subjects didn't have any change of dyspnea during exercise with and without the fan. When the dyspnea was normalized by the walked distance, the dyspnea was 0.0088 point per meter by the fan.

Table 2 : *Dyspnea measured during the 6MWT with and without fan :*

	Without Fan (Group A+B)	**With Fan** (Group A+B)	p value
Pre-effort dyspnea (pts)	0 (0-5)	1 (0-5)	0.491
Post-effort dyspnea (pts)	4 (0-8)	3 (1-7)	**<0.001**
Evolution of dyspnea (pts)	3 (0-9)	2 (0-6)	**<0.001**
Normalized dyspnea (pts/m)	0.0054 ± 0.0039	0.0088 ± 0.0059	**<0.001**

Pts = points; m = meter

3.3 Distance covered

Table 3 shows the distance walked by the patients at two, four and six minutes and compares the results obtained with and without fan therapy. There was a significant increase of the distance traveled every two minutes in absolute ($p= 0.014$, $p = 0.003$, $p < 0.001$ at 2, 4, and 6 minutes, respectively) and relative value ($p = 0.003$) during the test with fan. The improvement of the covered distance at 6 minutes with the fan therapy was also clinically important.

Table 3: *Distance traveled by the patients without and with fan*

	Without Fan (Group A+B)	**With Fan** (Group A+B)	p value
2 minutes (m)	140 (85-180)	150 (80-200)	**0.014**
4 minutes (m)	280 (150-350)	300 (160-390)	**0.003**
6 minutes (m)	410 (215-535)	450 (235-620)	<**0.001**
6 minutes (% pred)	87.2 ± 15.9	94.8 ± 16.0	**0.003**

m= meter; % (pred)= Percentage of the expected value

3.4 Other variables

There were no differences for all the other cardiorespiratory outcomes between the 6MWT with and without fan except for the change of the heart rate between zero and six minutes ($p = 0.004$)

Table 4 *: Pulsed oxygen saturation (SpO2) and heart rate during the 6 MWT without and with fan*

	Without Fan **(**Group A+B)	**With Fan** (Group A+B)	p value
SpO2 0'	96.4 ± 2.3	95.6 ± 2.9	0.195
SpO2 2'	92.2 ± 3.8	92.9 ± 3.9	0.177
SpO2 4'	91.4 ± 4.1	92.2 ± 4.6	0.127
SpO2 6'	91.9 ± 4.7	91.3 ± 4.5	0.327
SpO2 8'	95.6 ± 2.3	95.2 ± 2.8	0.301
SpO2 0'-6'	-4.9 ± 4.7	-4.3 ± 3.2	**0.440**
SpO2 6'-8'	4.2 ± 3.5	3.9 ± 2.8	**0.662**
HR 0'	89.0 ± 14 .3	87.2 ± 14.7	0.457
HR 2'	96.6 ± 14.4	101.5 ± 13.9	0.062
HR 4'	97.1 ± 13.7	103.5 ± 13.6	0.058
HR 6'	102.1 ± 15.9	106.3 ± 13.2	0.124
HR 8'	91.8 ± 13.6	94.7 ± 13.4	0.166
HR 0'-6'	15.0 ± 15.3	23.0 ± 13.4	**0.004**
HR 6'-8'	-9.3 ± 12.5	-10.5 ± 5.6	**0.775**

' = minutes ; SpO2 = Pulsed oxygen saturation ; HR = Heart Rate

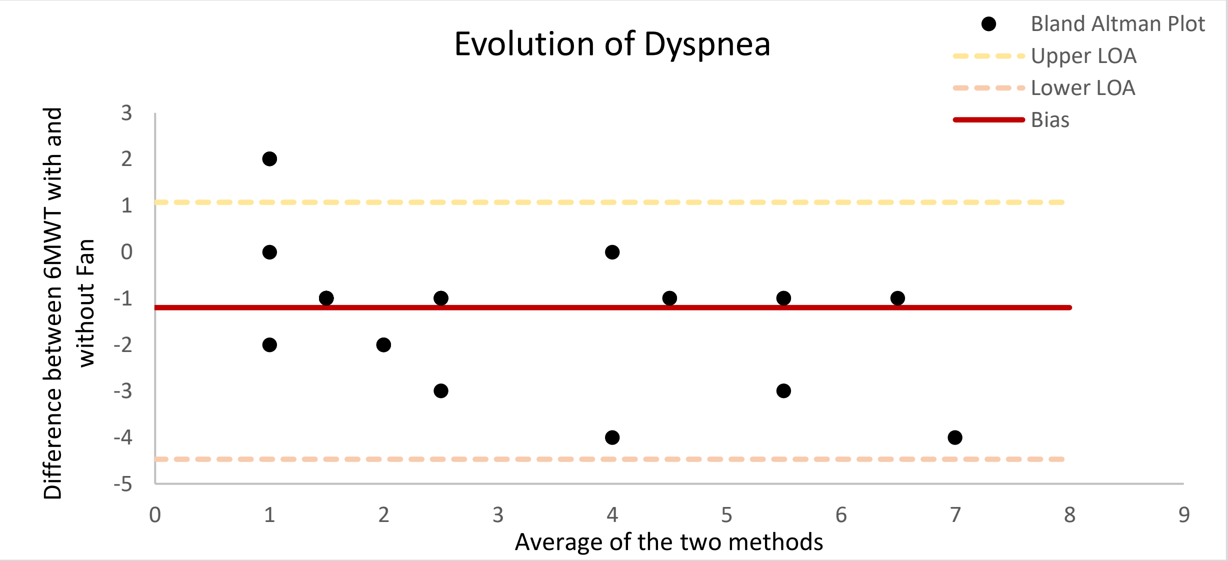
Once the two walking tests were realized, patients were asked if they felt an improvement in dyspnea with the fan compared to none and if there was any discomfort caused by the ventilator during the test. Most patients claimed to feel an improvement of their breathlessness when they had the fan (median = 4). Three patients out of twenty-five felt discomfort while wearing the ventilator, disliking the wind cooling their cheeks.

3.5 Bland-Altman Plot

Evolution of dyspnea

The graphic (Fig. 1) shows a light systematic negative bias (-1) suggesting that the dyspnea during the test with fan is on average 1 unit lower than without fan. Most scatter are within the limits of agreement (LOA), indicating a good agreement between the two methods.

Fig. 5: *Observation of agreement between the change of dyspnea between the 6MWT with and without fan therapy*

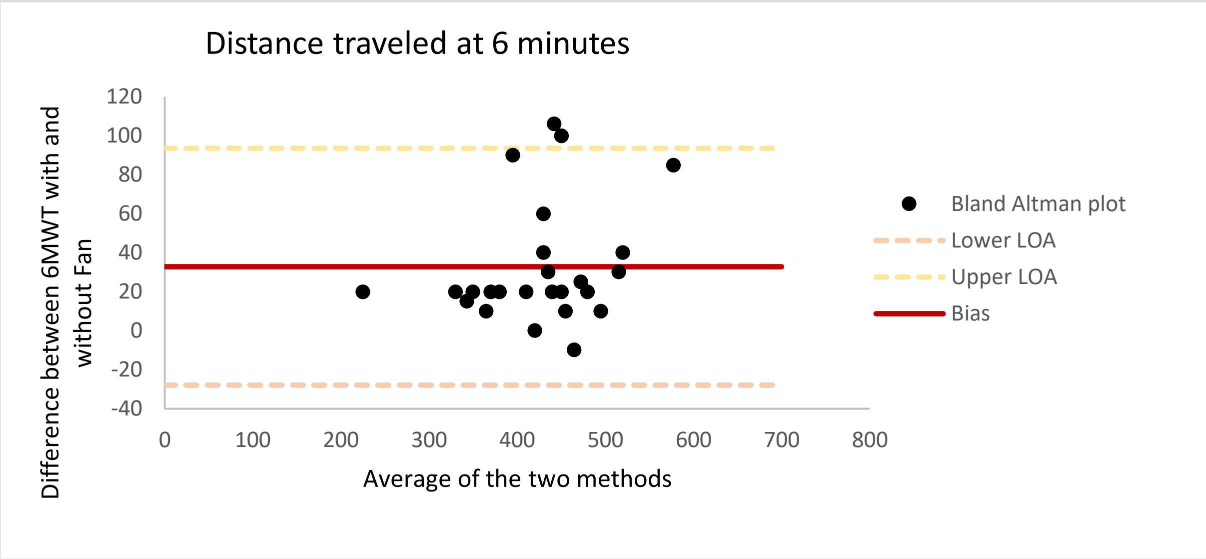


****Upper LOA*** *= Upper Limit Of Agreement;* ***Lower LOA*** *= Lower limit of agreement;* ***Bias*** *= mean of the differences between the two test*

Distance traveled at 6 minutes:

In this Bland-Altman plot (Fig.5), there is a positive bias of 33 units showed by the red line (bias) suggesting that the test with ventilator measured on average 33 meters more than the test without ventilator. Most points are located inside the lower and upper limits of agreements, which indicates a good reliability between the two methods.

Fig. 6: *Observation of agreement between the measure of the distance traveled after 6 minutes between the 6MWT with and without fan therapy*

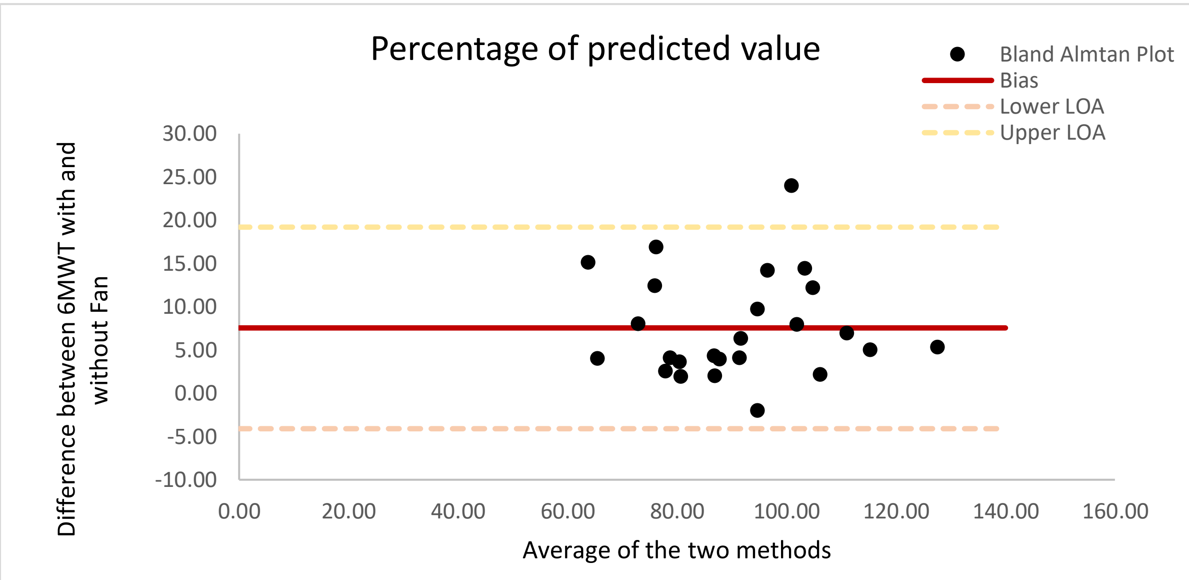


***Upper LOA** = Upper Limit Of Agreement; **Lower LOA** = Lower limit of agreement; **Bias** = mean of the differences between the two test*

Percentage of predicted value:

This graphic shows a positive bias of 8% showing that the results with ventilator are on average 8% higher than those without. Most dots, scattered around the central line are located in between the limits of agreements, showing an acceptable variation between the two methods.

Fig.7: *Observation of agreement between the percentage of the predicted values between the 6MWT with and without fan therapy*



***Upper LOA** = Upper Limit Of Agreement; **Lower LOA** = Lower limit of agreement; **Bias** = mean of the differences between the two test*

3.6 Correlation:

The results showed a negative correlation between the mMRC score and the distance traveled after 6 minutes for both tests (with fan: $\rho = -0.582$; $p = 0.002$/ without fan : $\rho = -0.476$; $p = 0.016$). This suggests that a higher mMRC score is associated with a shorter distance walked during the test. The 6MWT with ventilator presents a higher correlation and statistical difference between the two variables as the 6MWT without ventilator. There is no correlation between the mMRC score and the dyspnea change after 6 minutes.

4. Discussion

The primary objective of this study was to assess the effectiveness of fan therapy in reducing exertion-induced dyspnea in patients with chronic respiratory conditions. Using the 6-minute walking test (6MWT), twice for each patient - once with fan therapy and once without - the study demonstrates a significant decrease in breathlessness at the end of the 6MWT, as well as in the change in dyspnea between 0 and 6 minutes. The results indicate a reduction of one unit in both dyspnea change and shortness of breath at the end of 6 minutes on the modified Borg scale for the Groups A and B when performing the test with the fan ($p < 0.001$). Since the minimal clinically important difference (MCID) for dyspnea is -1 point on the Borg scale (21), this study shows a statistical as well as a clinical improvement in the relief of dyspnea with fan therapy during a 6MWT.

Recent research has consistently demonstrated the effectiveness of fan therapy. A 2019 systematic review, which analyzed six randomized controlled trials, confirmed that this therapy is beneficial specifically for managing dyspnea at rest (16). Therefore, the American College of Chest Physicians and the National Comprehensive Cancer Network have issued clinical guidelines endorsing the use of fan therapy for alleviating dyspnea at rest in palliative care settings (22,23).

However, only a few studies have shown the importance of fan therapy in the management of dyspnea during exercise (24,25). While breathlessness can occur at rest, it is also often exertion-induced, which impacts patients' physical activities (26). The discomfort associated with shortness of breath can discourage patients from continuing with their daily activities and reduce the adherence to pulmonary rehabilitation programs (27), which is the key treatment for chronic pulmonary diseases (28).

In addition to demonstrating the improvement in dyspnea during exercise, this study shows a statistically and clinically significant increase in the distance covered during the 6MWT with the use of a portable ventilator compared to no fan therapy. After six minutes, patients covered a median of 40 meters (absolute value) more with the fan than without, which exceed the MCID for the 6MWT (= between 14 to 30.5 m)(29). These results align with a recent study which also used the modified Borg scale to assess changes in dyspnea during a 6MWT with fan therapy. With the use of a handheld ventilator, there was a reduction of one unit in the dyspnea change and patients increased their distance by a median of 32 meters, both measures meeting the MCID (24). Additionally, Marchetti & al. demonstrated a 34% increase in exercise duration at a constant 50 to 75% maximum workload with a fan directed at the face compared to one directed at the legs (25).

In the current study, there were no significant improvements in the pulsed oxygen saturation and heart rate between the 6MWT with and without fan therapy. These outcomes are supported by Long & al's article, which reported no effect on heart rate or SpO2 during the 6MWT with a ventilator (24).

The fan parameters were established before the trials began, based on existing scientific data. Smith & al.'s highlighted a strong linear correlation between positive air perception and ventilator wind speed (30). Their finding indicated that COPD patients experienced greater comfort with a ventilator at a speed of 1.92 m/s and at 30cm distance from the face (30). However, since the maximum speed of the fan used in our study was 1.5 m/s, it was decided to position the fan closer to the face, at a 20 cm distance. As previously discussed, the activation of the somatosensory cold receptors TRPM8, located on the ophthalmic and maxillary branches of the trigeminal nerve, induces a feeling of improved ventilation by altering afferent feedback to the brain (9). Therefore, maintaining a temperature below 25° (the cold sensitivity threshold of the channels (31)) and directing the airflow toward the face was crucial for this study. Our measurements indicated that at a speed of 1.5 m/s and a 20 cm distance from the face, the fan produced a maximal wind temperature of 23.8°C, which was sufficiently cool to activate the TRPM8 channels. To accommodate individual anatomical differences in facial and neck features, the ventilator's angle was adjusted for each participant. This ensured that the airflow effectively targeted the upper cheeks and areas around the nose, where the second and third branches of the trigeminal nerve are located (14). By ensuring the activation of the trigeminal nerve with cold air, this current study has confirmed the alteration of the patient's breathing pattern, resulting in a decrease of dyspnea and an improvement of exercise.

After having both tests performed, patients were asked to rate their feeling of dyspnea relief while using the fan compared to no use, and the discomfort that it might have induced on a scale from 0 (totally disagree) to 5 (totally agree). The median rating for breathlessness relief was 4, with only three patients reporting a dislike for the cold sensation of the wind on their faces, a secondary effect also noted in another article (32). These results are consistent with those reported by Long & al. showing also a median of 4 for perceived effectiveness of fan therapy during exercises (24). For Khor et al., where despite initial skepticism and uncertainty regarding the efficacy of fan therapy, most patients experienced symptom relief when using a ventilator (33). Furthermore, some patients also reported a relaxation effect accompanied by a sense of security (33) and an improved self-management with a feeling of control on their symptoms (32).

Fan therapy, beyond alleviating dyspnea at rest and during exercise, offers multiple benefits as a tool for managing breathlessness. The use of a portable fan, whether handheld or worn around the neck, is a non-pharmalogical, low-cost, safe and non-invasive technique (34). It presents only minimal side effects like the discomfort of cold wind for some individuals or the potential embarrassment of using it in public (32,34). Evidence have also shown that fan therapy reduces recovery time from exertion-induced dyspnea (32,35). Additionally, the use of cold air is more adequate than oxygen therapy, which is often overprescribed by clinicians for reducing breathlessness in patients with chronic dyspnea, even those who are not hypoxemic (28,36). Finally, according to our knowledge, fan therapy has a significant impact on psychological aspects such as anxiety and depression, which are major comorbidities in patients with chronic respiratory diseases that can reduce social and physical functioning by nearly 25% (27). As mentioned previously, the anterior cingulate cortex and the insular cortex are involved in the response to respiratory stimuli through their cognitive, executive and especially emotional functions (12,27). Therefore, using a ventilator to stimulate these brain regions helps reduce anxiety and depression, thereby improving patients' quality of life (27).

A significant negative correlation was found between the mMRC score and the distance covered during the tests, indicating that as daily life breathing comfort decreases, so does the distance traveled. These results highlight the importance of continuously seeking alternatives to ensure patient have access to physical activities and prevent a decline in functional capacity.

One limitation of this study is that social and psychological aspects were not assessed. As breathlessness is a complex multi-dimensional affection, the chronic respiratory disease alone cannot explain the presence of dyspnea. However, as presented previously, fan therapy has a positive impact on psychological symptoms (27). Also, as it is a daily usable tool, it offers patient a sense of control on their life and it enables them to increase their daily activities, improving their psychological symptoms (32,33). Another limit is the use of a 6-minute walking test to evaluate the effect of cold air on breathlessness. Patients have to walk the longest possible distance without encouragement during this test, which means they are not pushed to their maximum effort capacity. However, the 6MWT is the most suitable test to assess patients' functional capacities, which is the most important as the fan therapy is a tool for daily physical exercise. Studies have confirmed a learning effect in the 6MWT, with an average improvement of 26 meters on the second test (37). Our crossover trial permitted to mitigate this bias, showing that both groups experienced dyspnea relief regardless of whether they started with or without the fan. Moreover, all the patients had previously performed a 6MWT. Additionally, the study was limited by the absence of blinded participants. But blinding patients would be particularly challenging given the nature of the intervention involving the perception of cold air. Finally, the long-term effects of fan therapy were not assessed in this study. It would be beneficial for future research to evaluate the effectiveness of fan therapy during one hour of pulmonary rehabilitation over an extended period.

5. Conclusion

This study aimed to assess the impact of fan therapy on functional exercise capacity and physiological responses in patients with chronic respiratory diseases. This study completed the literature by showing a significant improvement of dyspnea relief and functional capacity while using a ventilator across the face in individuals performing endurance exercise, potentially making it a valuable tool in rehabilitation (key treatment for chronic respiratory diseases) and clinical settings. Additionally, the use of a portable ventilator would help reduce medical expenses associated with the overuse of oxygen and benzodiazepines prescribed to alleviate stress and anxiety caused by dyspnea.

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Abstract

Introduction: Dyspnea, characterized by uncomfortable and distressing breathing, is prevalent in chronic respiratory diseases and arises from a mismatch between respiratory demand and ventilation response. Activating TRPM8 channels through cold sensations on the face has been shown to alleviate dyspnea. This study aims to evaluate the effectiveness of fan therapy during a physical activity in reducing dyspnea and enhancing physical capacity in patients with chronic respiratory conditions.

Method: This study is a crossover randomized controlled trial comparing the level of dyspnea in patients with chronic breathlessness during a 6-minute walking test with and without a portable fan worn around the neck. Patients were randomized to perform two 6MWTs, either beginning with or without the fan, depending on their assigned group.

Results: A total of 25 patients with chronic respiratory disease were recruited and separated into two groups of 12 and 13 subjects, homogeneous in gender distribution. Results showed a significant lower breathlessness at the end of the test as well as in the change of dyspnea during the 6MWT with the fan therapy compared to the 6MWT without ($p < 0.001$ for both measures). There was a significant increase of the distance traveled every two minutes in absolute ($p= 0.014$, $p = 0.003$, $p < 0.001$ at 2, 4, and 6 minutes, respectively) and relative value ($p = 0.003$) during the test with fan.

Conclusion: This study demonstrated a significant improvement in dyspnea relief and functional capacity when using a ventilator across the face in individuals performing endurance exercise, potentially making it a valuable tool in rehabilitation.

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