Title

Review the use of mindfulness and breath retraining on patients with chronic lung disease, inclusive of those with lung cancer

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Introduction

Dyspnea, the subjective experience of breathing discomfort, is a symptom that causes significant distress to patients with chronic lung disease. A complex symptom, dyspnea is a person's perception of the interaction of physiological, psychological, environmental, and social factors. Dyspnea is experienced in chronic diseases ranging from chronic obstructive pulmonary disease (COPD), asthma, and other pulmonary pathology to cancer and heart failure. Creating a substantial burden on the healthcare system, dyspnea affects up to 50% of patients admitted to tertiary care hospitals and a quarter of patients seeking care in an ambulatory setting in the United States (Parshall et al. 2011). In a whole-population survey in Southern Australia the prevalence of breathlessness was 8.9% of all adults and 16.9% for individuals over 65 years old (Bowden et al. n.d.). In patients with chronic lung disease, dyspnea is a predictor of hospitalizations and mortality (Parshall et al. 2011). Dyspnea not only is a negative prognostic factor for patients, but also has a significant impact on their quality of life. The intensity of breathlessness is further magnified by the degree to which the sensation is perceived as unpleasant. Patients can often have anxiety and fear in anticipation of episodes of dyspnea, which can lead to individuals avoiding activities that precipitate the symptoms. Increased dyspnea often leads to inactivity, social isolation, fear, and depression (Ambrosino and Vagheggini 2006). Dyspnea, similar to pain, is an unpleasant sensation that signals to the brain that there is a disturbed physiologic state. The parallels between these two perceptions suggest that mindfulness-based stress reduction therapy (MBSR), which has shown efficacy in treating pain, might also be helpful for treatment of dyspnea. Furthermore chronic pain, anxiety, and depression are prevalent co-morbidities of chronic lung disease that MBSR has shown efficacy in mitigating (Grossman et al. 2004). A review of literature on meditation including mindfulness-based meditation, breathing exercises and breath-retraining exercises was conducted to investigate their effects on patients with chronic lung diseases.

Dyspnea is the most common symptom in patients suffering from COPD (Ambrosino and Vagheggini 2006). As dyspnea escalates with the natural progression of COPD, the increased breathlessness often reaches a point where drugs alone are not enough to alleviate the discomfort. In addition, patients with COPD have been shown to experience significantly increased psychological distress and anxiety compared with the general population (Norweg and Collins 2013). Similarly, patients suffering from other chronic lung diseases including asthma, lung cancer, pulmonary hypertension, and pulmonary fibrosis experience dyspnea as well as psychological distress.

Often when conventional treatments inadequately treat patients, whether it be incomplete relief of symptoms or unwanted side effects, they often turn to other methods to better manage their disease. In the 2012 NIH & National Health Interview Survey of the US population, more than 30 percent of American adults use health care approaches described as complementary, alternative, or integrative (Clarke, Black, and Nahin 2002). The NIH defines complementary medicine as a non-mainstream practice that is used together with conventional medicine, whereas alternative medicine is defined as a practice that is used in place of conventional medicine. Integrative medicine involves bringing the conventional and complementary approaches together in a coordinated way. Used as complementary medicine, breathing exercises, retraining, and mindfulness-based meditation practices are gaining popularity as modalities to treat a number of chronic medical conditions. After supplements the second most commonly used complementary health approach was deep-breathing exercises with 10.9% of the population using them independently or as part of other approaches (Clarke, Black, and Nahin 2002). The same study found that 8.0% of adults were identified as using meditation.

MBSR is a standardized mindfulness-training program initially created in 1979 at the University of Massachusetts by Jon Kabat-Zinn to treat patients with chronic pain (Kabat-Zinn 1982). Kabat-Zinn defines mindfulness as "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of the experience moment by moment" (Kabat-Zinn 2003). The intention behind MBSR was to create a training program that would relieve the suffering of medical patients through mindfulness meditation. MBSR was designed as a complement to medical treatments for patients who were not otherwise responding completely to traditional allopathic treatments. The original stress reduction clinic implemented an 8-week course for outpatient mindfulness education that has been developed into a standardized model that is now taught in a range of professional training programs, which allow mindfulness programs to be offered in a range of settings (Kabat-Zinn 2003). In addition to relieve pain, MBSR has been widely adopted for treating other chronic diseases because of its ability to alleviate psychological and physical suffering in patients with cancer, chronic fatigue, fibromyalgia, rheumatoid arthritis, psoriasis, heart disease, depression & anxiety (Fjorback et al. 2011). The most reproducible impact of the MBSR program is on stress-related disorders, depression and anxiety symptoms (Grossman et al. 2004).

Research indicates that the practice of meditation improves interoception, the sense of one's own physiologic condition, (Slagter et al. 2009) including a lower threshold at which people could detect a change in a resistive respiratory load (Daubenmier et al. 2013). This improved assessment of respiratory load detection supports the idea that mindfulness meditation results in greater respiratory interoceptive awareness. Monitoring of functional brain magnetic resonance imaging (MRIs) in response to mindfulness and relaxation practices has demonstrated an increase in brain activity in areas involved in regulation of pain, which also overlap with dyspnea centers (Zeidan et al. 2011) (Haase et al. 2014). In a study of marines, when subjected to an inspiratory breathing load as an aversive stimulus, the anterior cingulate cortex and right anterior insula registered significant attenuation after mindfulness training (Haase et al. 2014). This demonstrated that mindfulness serves as a way to modulate the brain's response to negative stimuli. Due to this overlap, as well as the interplay of anxiety, other psychological, and environmental factors on the perception of dyspnea, mindfulness may represent a promising intervention in the future management of patients with chronic respiratory illnesses who suffer from dyspnea.

For this article, we conducted a review of the literature pertaining to COPD, lung disease, lung cancer, pulmonary hypertension, pulmonary fibrosis and mindfulness meditation interventions using the MESH terms COPD, lung cancer, pulmonary hypertension, pulmonary fibrosis, Meditation, Mindfulness, & MBSR. The review focused on studies published between 2007 and 2016 in English involving human subjects.

COPD:

To date, there is limited data available on whether mindfulness based practices are beneficial in patients with COPD.

Trials
Our literature search yielded a limited number of trials looking specifically at mindfulness practices in patients with COPD. Two studies to date focus only on mindfulness therapy in patients with COPD.

The first study was a randomized controlled trial (RCT) of 86 patients with COPD from the Veterans Affairs (VA) of the Greater Los Angeles Healthcare System in 2009. Participants were randomized to an 8-week mindfulness-based breathing therapy intervention (n = 44) or a time-matched support group (n = 42). The intervention included the standard 8-week MBSR program with supplemental relaxation response training during the first two weeks. Their weekly sessions included body scan meditations, mindful walking, sitting awareness of breath meditation, mindful-movement, and group discussion. Participants were asked to commit to at least 45 minutes of formal mindfulness practice 6 days of the week at home from recordings to facilitate mindfulness practice at home. Primary outcomes measured included Borg Dyspnea scale following a 6-minute walk test (6MWT) and St. George Respiratory Questionnaire (SGRQ). Secondary outcomes included 5-factor mindfulness questionnaire and perceived stress scale. All measures were administered before randomization and after completion of the program.

The study found no appreciable improvement in perceived dyspnea as measured by the Borg scale after completion of 6MWT despite having sufficient power to detect a difference of 1.4 points in severity. Negligible changes in other measured indicators of quality of life and symptoms were also observed, including 6MWT distance, exacerbation rates, stress & mindfulness assessment questionnaires, and recorded symptom scores in daily diaries. Despite this being a negative study, however, these data are limited in their applicability to the general population as the cohort was derived from a single site of mostly male veterans (85 of 86 participants), which is a group that has higher rates of PTSD and anxiety. There were also high drop out rates of up to 50% in the intervention group with a total of 23 lost to follow up, 14 participants never attending group, 8 participants withdrawing after attending one group, and 1 participant withdrawing after three groups. (Mularski et al. 2009).

The second study, which is two separate papers describing different aspects of the same study, is a pilot study using a RCT of an 8-week mindful meditation intervention tailored for the COPD population with one study measuring breathing parameters and the other examining more qualitative measures of participant experience. The intervention included eight weekly one-hour courses in mindfulness-based meditation that followed the MBSR format. Class sizes ranged from 5-10 participants. Weekly handouts and audio content was provided to the participants for home practice. In order to tailor the course to patients with COPD, they shortened sessions to 60 minutes from the usual MBSR class duration of 2-2.5 hours per class and minimized the focus on breathing, which is a typical practice at the beginning of meditation exercises, because concentration on areas of the body related to illness could potentially be anxiety provoking. Instead, participants were taught body awareness in place of body scans and used spiritual mantras to start the meditation. In addition, Ujjayi breathing, a technique that focuses on diaphragmatic breathing and synchronizing the breath with movements, and QiGong, a meditative movement exercise that coordinates movement, breathing, and meditation, were included. They were also given CDs to facilitate home practice. The control group in this study included a waitlist control group, which received the same intervention after the initial intervention group had completed the course. Data from both the waitlist control group and the regular group were compared to baseline, providing them data from 41 participants.

In the first study, their goal was to assess the feasibility of using MBSR as a treatment for patients with COPD. Their study outcomes included respiratory rate, respiratory variability, expiration time, and synchronization of chest/abdomen movement. They also assessed patients' anxiety sensitivity index scores on the chronic respiratory disease questionnaire (CRQ) and the Freiburg mindfulness inventory (FMI). The results showed that the MBSR intervention group (n = 19) had a significant increase in respiratory rate over time as compared to those randomized to the wait-list group (n = 22) (P = 0.045). Additionally, MBSR intervention group demonstrated a significant decrease in level of mindfulness by FMI score over time as compared to the wait-list group (P = 0.023). These results are surprising because it seems to imply that the intervention group did not benefit from mindfulness practice. However, when they looked specifically at the participants who completed 6 or more classes (n = 12), they did not have a significantly increased respiratory rate compared to the wait-list group. The scales measuring anxiety, dyspnea, fatigue, and CRQ did not change between the groups. The participants who completed 6 or more classes did have significant improvements in emotional function compared to the wait-list control group by the end of the intervention. The authors concluded that despite the lack of outcome success, this study demonstrated that a mindfulness meditation intervention in the COPD population is feasible and acceptable and that trends towards improvement in emotional function were more apparent if participants attended at least 6 classes.

Limitations of study completion include the complexity of the mindfulness meditation intervention and the perceived effects to be apparent after at least 6 classes. This intervention was 8 weeks in duration, and participants were evaluated at 1 week after completion of the class. Another potential issue is that upon initially learning mindfulness, participants have an increased awareness of their sensations of dyspnea and negative emotions. One interesting observation the authors made in this study is that emotional function correlated with class attendance. Participants with higher emotional function were more likely to attend class and high levels of anxiety seemed to be a barrier to participation. There was a dropout rate of 7/19, which is a significant limitation of this study (Chan, Giardino, and Llarson 2015).

Their second paper examined qualitative measures including reflective journaling, phone exit interviews, and CRQ and the Anxiety Sensitivity questionnaire. Weekly journals contained semi-structured forms asking participants to record the number and type of skills within each practice sessions as well as to journal freely to describe their practice. The exit interviews were conducted over the phone and used open-ended question to ask participants to describe their experience with the program, their individual meditation practice, how meditation has impacted their COPD, and how their relationship with themselves and others have changed. An analysis of written and verbal data to identify major themes expressed by participants was categorized into four topics including barriers, learning style, emotional processing, and positive results. Nearly half of the respondents identified barriers or difficulties with developing regular practice of meditation, which included the inability to suspend disbelief, difficulties following through with self-care, and the complexities associated with meditation and mind/body practices such as increased awareness of negative emotions and mind wandering. The paper also identified different types of learning styles, which were categorized as adapting, accepting, and rejecting, and found that the learning styles did not correlate with the participant's ability to use meditation. Participants also reported positive benefits from the meditation practice. 41% said that it helped them in their daily life to reduce shortness of breath, process emotions, and take part in emotionally activating situations. 28% of the participants said that they were able to use meditation to decrease episodic dyspnea. 16% of participants incorporated meditation into their daily life to help with emotional issues. In general, the participants described benefits of meditation as being transformative, improving symptoms, and self-care (Chan and Lehto 2016).

From the current limited literature, it is unclear that mindfulness based practices will change dyspnea or anxiety in patients with COPD. However, they do demonstrate that teaching meditation courses to patients with COPD is feasible. Further larger scale RCTs are needed to better establish benefits of mindfulness based practices in patients with COPD, to help identify which phenotype of patient with COPD would be most likely to benefit, and which specific mindfulness based practices are of the most benefit.

Reviews: Breathing and Relaxation Techniques

While the number of mindfulness specific trials is limited, a few reviews examine the influence of breathing and relaxation techniques for patients with COPD.

A 2013 Systematic review by Norweg et al. on cognitive behavioral strategies for the treatment of COPD was somewhat promising, but inconclusive and ultimately emphasizes the need for further research. This review included 23 RCTs pertaining to COPD and was stratified into meditation, cognitive-behavioral therapy (psychotherapy), breathing exercises, dyspnea self-management education, & distractive auditory stimuli groups. Six studies (n= 298) involved meditative interventions that included yoga, tai chi, qigong, and mindfulness meditation. One of the six studies was Mularski et al's, which was discussed earlier. Of these six studies, two showed a significant decrease in perceived dyspnea by Borg & CRQ scores with Iyengar yoga & Tai-Chi practice (P = 0.07–0.08). An additional study showed within-group effects of decreasing functional burden of dyspnea by the SGRQ following a yogic breathing intervention (P = 0.01). However, three other studies showed no differences in levels of dyspnea with mindfulness-based behavioral therapy or Tai-Chi interventions. These, however, did suffer from several notable limitations, including high drop out rates up to >40% in some cases. Each of these studies was largely heterogeneous and decisive conclusions are limited. Overall, mind-body practices are feasible and are promising for improving the effects of dyspnea and quality of life in COPD, but further larger scale studies are needed to confirm benefits (Norweg and Collins 2013).

Norweg et al also examined seven studies (n = 272) that investigated the effects of slow-breathing exercises on dyspnea, which included biofeedback, pursed-lips breathing (PLB), diaphragmatic breathing and singing. While three of the RCTs found statistically significant differences favoring slow-breathing exercises, three additional studies did not find differences between the treatment and comparison groups though the within-group differences were clinically significant. Yamaguti et al reported that the disabling impact of dyspnea was reduced in the diaphragmatic breathing group compared to the control group (P<0.05). Nield et al reported improved dyspnea at 3 months (P < 0.05) after a 4-week PLB with arterial oxygen saturation (SaO2) biofeedback intervention compared with a control group. Dyspnea reductions in the PLB group were also clinically significant at 4 and 12 weeks. The three studies that found no differences tested exercise training, ventilation feedback training, singing, and respiratory muscle endurance training. Similar to the mind-body practices, small-scale evidence exists to support slow-breathing exercises, but the current data is equivocal and would benefit from larger scale RCTs. PLB is recommended for effective dyspnea relief for advanced lung disease by the American College of Chest physicians.

Another review examined the impact of controlled breathing exercises in patients with COPD on their breathlessness, dyspnea, and quality of life. They reviewed 642 articles and found seven systematic reviews on the effects of breath control exercises. They rated 3 of the reviews as high quality. Through pooled data from these analyses, they concluded that there is evidence that respiratory muscle training has positive benefits on breathlessness, fatigue, and disease-specific quality of life. One of the reviews they evaluated, Gosselink et al, found that inspiratory muscle training showed a significant impact (p<.001) on dyspnea with a summary effect size of -0.45 (95% CI -0.66 to -0.24). Pooled data from nine RCTs they examined showed that disease-specific quality of life (QOL) measured through the chronic respiratory questionnaire had a significant summary effect of 3.8 (p <0.07). With regards to PLB, only one analysis of the ones considered high-quality showed positive effect on reduction of dyspnea. (Borge et al. 2014).

Volpato et al performed a meta-analysis of articles on relaxation techniques with patients with COPD. 25 papers with a pooled sample size of 1426 subjects were reviewed. Relaxation methods investigated progressive muscle relaxation, breathing techniques, diaphragmatic breathing, distraction therapy, yoga, Tai-Chi, and biofeedback. This meta-analysis did not reveal significant effects of the implementation of relaxation techniques for COPD. They were specifically interested in evaluating the effects on forced expiratory volume in 1 second (FEV1), anxiety, depression, and QOL. The effect sizes concerning all the variables examined, while positive, only reached Cohen's small effect. Limitations of these studies include heterogeneity between studies with a number of different variables being examined.

Asthma

MBSR has been shown to have benefits in patients with asthma. Women with COPD often have reactive airways, which suggests a greater potential for efficacy in women with COPD.

In 2012, Pbert et al published a randomized clinical trial on the efficacy of an 8-week MBSR group-based program in improving asthma related quality of life and lung function in adults with mild, moderate, or severe persistent asthma. They concluded that MBSR produced lasting and clinically significant improvements in asthma-related quality of life in patients with persistent asthma, but no improvements in lung function (Pbert et al. 2012). Their intervention involved weekly sessions for 8 weeks lasting 2.5 hours with 83 participants randomized to the standard MBSR intervention (n=42) or an educational control group (n=41). The control group was enrolled in a time-matched course consisting of lectures discussing self-care topics. Inclusion criteria included physician-documented asthma that met criteria for mild, moderate, or severe persistent asthma. The participants were assessed at 10 weeks, 6 months and 12 months after the intervention. At 12 months, participants who had undergone the MBSR course demonstrated clinically significant improvements in the Asthma Quality of Life Questionnaire (AQOL) and 10-item Perceived Stress Scale (PSS). The 12-month AQOL improved in the MBSR group by 0.72 while the control group increased by 0.06 with a differential change of 0.66 (p<.001) where the minimum important change in overall QOL score is 0.5. PSS had improved in the MBSR group decreasing by 4.3 compared with the controls, which increased by 0.2, for a differential change of -4.5 (p=.001). However, no differences were measurable in lung function including peak expiratory flow (PEF) and FEV1. In addition, no significant improvement was seen in asthma control. This seems to suggest that mindfulness training may increase coping resources and improve QOL scores by decreasing stress and reactivity to asthma symptoms without modulating actual lung function. Limitations of this study include a small sample size, potential selection bias as patients from a pulmonary clinic are not representative of general population, and a disproportionate number of Caucasian participants (Pbert et al. 2012).

Other lung pathologies including lung cancer and transplant

Mindfulness has potential benefits in other chronic lung diseases. Similar to COPD, having lung cancer has a significant impact on quality of life because patients experience symptoms including fatigue, cough, pain, dyspnea, weight loss, nausea, anxiety, depression, and difficulty with concentration. Symptom management is one of the most important issues because of the high symptom burden associated with lung cancer (Wells et al. 2007). Often cancer patients turn to complementary and alternative treatments for symptom relief. The frequency of complementary and alternative medicine use among Americans in the general population and those with cancer is similar. In 2002, 11.6% of the general population used deep breathing exercises and 7.6% used meditation (Wells et al. 2007). In comparison, a survey of women with lung cancer showed 11.6% used meditation (Wells et al. 2007). A survey of Australian male cancer patients found that complementary alterative medicine (CAM) was used by 52.9% of the respondents with 15.2% of the respondents using relaxation and meditation techniques. (Klafke et al. 2012).

A study conducted by Wells et al. in 2007 looked at the use of complementary and alternative medicine in female, non-small cell lung cancer patients (N = 189). Participants were surveyed regarding six CAM therapies and symptom management. The purpose of this report was to look at the types of CAM therapies used, the frequency of specific CAM therapies, and look at differences between the women who use CAM therapies and those that do not. Their primary findings were that 44% of the women used CAM therapies with meditation being used by 11.6%. The symptom management questionnaire was used to assess the presence of 8 symptoms including pain, difficulty breathing, fatigue, loss of appetite, weight loss, cough, sleep disturbance, and difficulty concentrating. The most common symptoms that meditation was used to treat was difficulty breathing (10.7%) and pain (9.5%) (Wells et al. 2007). These findings indicate that these patients used meditation despite limited quantitative evidence for its utility, perhaps through personally experiencing benefit in their breathing and pain from meditation.

One thing that can be extrapolated from this data is that while this paper does not measure the actual effectiveness of these CAM therapies, these percentage of patients using meditation to treat difficulty breathing and pain can be seen as a proxy of those patients who perceive benefit to themselves through CAM.

In addition to dyspnea and pain, psychological distress is a major hurdle that lung cancer patients and their partners must overcome. Other forms of cancer have demonstrated benefit from mindfulness practice in regards to psychological distress (Speca et al. 2000). A pilot study by van den Hurk et al. looked to investigate the benefits of MBSR therapy in lung cancer patients and their caregivers. The primary conclusion of this paper is that MBSR is a feasible intervention for lung cancer patients and their partners. The second goal of this paper was to answer if MBSR was effective in reducing psychological distress in lung cancer patients, but the preliminary data showed that there were no significant changes in psychological distress.

Their intervention was slightly modified from the MBSR course, which was developed by Kabat-Zinn, which consisted of eight-week group sessions of 2.5 hours each as well as daily home practice assignments of 45 minutes each. The study population included 19 patients and 16 partners with 84% of their participants attending four or more sessions. To make their intervention more suitable for patients with lung cancer and their partners, they also included a component of psycho-education about grief. Participants were assessed with questionnaires at baseline, after MBSR training, as well as 3 months post training. Assessments used included Hospital Anxiety and Depression Scale, European Organisation for Research and Treatment of Cancer Core Quality of Life Questionnaire for Lung Cancer, Impact of Even Scale, Penn State Worry Questionnaire, Mindful attention and Awareness Scale, Self-Perceived Pressure from Informal Care, and Caregiver Reaction Assessment. Based on these scores, their conclusions were that there were no significant differences in pulmonary symptoms, fatigue, and pain. There was a decrease in the mean score of anxiety and depression, but not a statistically significant change. An important finding regarding the partners was that there was a significant decrease in caregiving being experienced as burdensome after MBSR training.

In addition to quantitative measures, this study also gathered qualitative data regarding the experiences of the participants. Three themes that emerged from their mindfulness course: physical functioning, participation in a group, and participating with a partner. They found that while physical limitations could be a barrier to participation, some participants underestimated their abilities and were surprised by their ability to complete the exercises. The group aspect of the MBSR training seemed to be a positive experience as most participants described feeling more connected and supported. Also, participation with a partner was seen as helpful. Based on this feedback, one primary recommendation was to continue offering MBSR to lung cancer patients and partners in a peer group setting. The authors concluded that although the quantitative measures did not show a difference in psychological distress, qualitative analysis showed that undergoing MBSR instigated a process of change that would be helpful in coping with lung cancer. A major limitation of this study is the small sample size. Since this study lacked a control group, the authors emphasize the need for a RCT to examine the effectiveness of MBSR as an intervention in patients with lung cancer. This study also demonstrates the effectiveness of MBSR based on qualitative data regarding aspects of the patient and caregiver experience that quantitative data does not directly measure (van den Hurk et al. 2015).

Another study was conducted on patients who received solid organ transplants (N = 138) undergoing an MBSR course. 7% of these patients were lung transplant recipients (n = 10). Similar to COPD, solid organ transplants recipients, including lung transplants recipients, are faced with complex health issues making anxiety, depression, and insomnia prevalent among this population. A RCT of solid organ transplant recipients undergoing the MBSR course was performed to evaluate MBSR's impact on anxiety, depression, and sleep. They found that transplant recipients undergoing the MBSR course had reduced anxiety and sleep symptoms compared to the control group (Gross et al. 2010).

This study included patients with a functioning solid-organ transplant who were at least 6 months post-transplant and were medically stable. The intervention was the standard MBSR program (n = 72). In addition to the classes, calls were made by the staff to encourage meditation. MBSR was compared to two control groups, an active health education program as well as a usual care waitlist group that was later re-randomized to MBSR or health education. This study's active control group involving health education based on Lorig et al. 's chronic disease self-management program that allowed them to control for non-specific MBSR elements such as attention from an instructor and support group. Outcome measures included State-Trait Anxiety Inventory, Center for Epidemiological Studies – Depression Scale, Pittsburgh Sleep Quality Index, Short Form – 12 Health Survey, Visual analogue scales for healthy and quality of life, and Mindful Attention Awareness Scale (MAAS).

Findings were that the MBSR group reported less anxiety and fewer sleep disturbances than the health education group. At 1-year post intervention, MBSR was more effective than health education in decreasing anxiety and sleep problems. Also at 1-year, depression symptoms remained reduced from baseline levels in the MBSR group, but not in the Health Education group—but the difference did not reach statistical significance. They found that increased mindfulness measured by MAAS was strongly correlated with improvements in sleep, anxiety, depression, mental health, vitality, and QOL among the participants who completed MBSR. An important finding in this study was that MBSR provided sustained benefits, especially in regards to sleep quality. Secondary outcomes showed that physical health and pain severity were unchanged.

Both transplant patients and patients with chronic lung diseases share the symptoms of anxiety and depression, which showed improvement with MBSR in this study. By identifying no improvement in physical health and pain, this study also raises questions about the limitations of MBSR. However, it should also be noted that this was a pilot study with a number of limitations including that it had a relatively high attrition rate and that it was an unblinded trial using self-reported scales for assessing symptoms as the primary outcome.

Discussion

While mindfulness meditation shows promise as a non-pharmacologic therapy that can improve symptoms experienced by patients with chronic pulmonary diseases, the current research provides limited evidence supporting its effectiveness. From our literature review, studies are small, heterogeneous and plagued with high attrition rates. Few research studies exist examining meditation's impact on pulmonary diseases. Only three studies specifically examine mindfulness meditation's impact on COPD, two of which originate from the same pilot randomized control study. There is a paucity of data on the use of mindfulness in other pulmonary diseases such as pulmonary hypertension and pulmonary fibrosis. Another issue faced in trying to extrapolate conclusions regarding the effectiveness of meditation as an intervention is the heterogeneity of complementary and alternative medicine treatments. While MBSR has a relatively uniform structure across instructors, other mind body practices such as yoga, tai chi, qigong are administered in varying durations, frequencies and intensities. In addition, these mind-body techniques are mostly movement focused compared to mindfulness, which is a combination of practices in stillness and movement.

In addition, the few randomized controlled trials that do exist face the limitation of lacking adequate power. MBSR trials in the pulmonary population have high participant attrition. Previous research has identified that high levels of anxiety and panic produce a barrier to participation in meditation (Delmonte 1988). In patients with COPD, a group known to have increased levels of anxiety, it is understandable that many participants would be hesitant to undergo meditation courses. This hesitance may be due to increased patient anxiety because of a heightened awareness of their internal physical sensations especially related to their dyspnea when they initially practice meditation. Chan et al's study confirmed that emotional function was correlated with class attendance, meaning that patients with more anxiety and depression were less likely to attend class. While in Mularski's study, which saw a 52% dropout rate, a post-study survey showed that barriers experienced by participants who did not complete the study were limitations involving their disease, transportation, or other time commitments. However, about 15% of patients who did not complete the study endorsed that they did not think mind-body practice was going to help. Of the 44 participants assigned to the MBBT intervention, 18% dropped out after one class, which seems to indicate that after exposure to this intervention the participants decided not to return. Future studies will need to take into account this potential barrier to participation and recruitment. Study design could take into account the high dropout rates and attempt to counteract them. For instance studies could recruit a larger number of patients with the expectation of a high dropout rate. Another option could be to devote resources to follow up with participants and encourage attendance. Also patient characteristics need to be investigated to see which may be able to predict which patients are at highest likelihood to benefit from mind-body practices. In treating this patient population, clinicians should be aware of this barrier to participating in mindfulness practices and make adjustments to better accommodate them.

Across different patient populations, the trials reviewed in this paper were unable to identify any measurable physical benefits to mindfulness practice. Mularski et al. found no improvement in respiratory rate, 6MW, dyspnea in patients with COPD who received MBSR. Chan's article identified no improvement in respiratory measures such as rate, expiratory length but rather an increase in respiratory rate was noted. In patients with asthma, Pbert showed no difference in lung function in asthma patients. Lung cancer patients also showed no measurable difference in their pulmonary symptoms, fatigue, and pain after MBSR treatment (van den Hurk et al. 2015). The review papers were inconclusive but some did show some positive benefits on physical symptoms. The meta-analysis of relaxation techniques in patients with COPDs showed no improvements (Volpato et al. 2015). They concluded that while there were some measured differences between the intervention and control group, the effect sizes were too small to be clinically significant. In the review of controlled breathing, they did find that respiratory muscle training had benefits on symptoms of breathlessness. Noreweg's review was inconclusive with 2 of 6 studies demonstrating decreases in perceived dyspnea with meditative relaxation therapies. The quantitative data regarding improvement in quality of life measures is more hopeful for MBSR but still equivocal. Mularski, Valpato, Van Den Hurk show no significant improvement in quality of life measures. Pbert, Grossman, and Borge find improvements. Asthma patients showed improved QOL (Pbert et al. 2012). Transplant patients have measurable benefits in terms of sleep, anxiety, depression, mental health, vitality, and QOL (Gross et al. 2010). 9 RCT on breathing exercises showed that disease specific QOL measured through the CRQ improved (Borge et al. 2014).

Despite equivocal quantitative data on the effectiveness of mindfulness practices, the consensus among the studies is that mindfulness practices have the potential to benefit patients with chronic lung disease. Since many of the RCTs examined were small pilot studies, they reported on the feasibility and safety of MBSR in patients with chronic lung diseases. Across multiple studies, qualitative interview and journal data gathered are consistent with the idea that patients derive benefits from mindfulness practice in ways that are not directly measured quantitatively. In Chan et al, the patients with COPD described benefits of meditation as instigating transformation, improving their symptoms, and improving their skills in self-care (Chan and Lehto 2016). In Gross et al, solid organ transplant patients found mindfulness helped improve sleep quality and decrease other life stressors (Gross et al. 2010). In the study of patients with lung cancer and their partners, MBSR training instigated a process of change resulting in increased awareness and insight into thoughts, feelings, and bodily sensations (van den Hurk et al. 2015). Mindfulness is feasible to practice in patients with chronic lung disease and is a safe intervention. However, definitive conclusions regarding benefits are unable to be drawn based on the current existing literature. Thus, further larger scale studies ensuring inclusion of qualitative data are needed to clarify the benefits derived from mindfulness and which type of patients would most likely benefit.

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