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Evaluation of the Feasibility of a Home-Based TeleYoga Intervention in Participants with Both Chronic Obstructive Pulmonary Disease and Heart Failure

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Abstract

Objective Test the feasibility and clinical outcomes of a home-based video-conferencing yoga intervention in participants diagnosed with both Chronic Obstructive Pulmonary Disease (COPD) and heart failure (HF).

Background

Yoga has potential benefit for symptom relief in participants with COPD and with HF; however, functional impairment and transportation issues can hinder access to typical yoga classes.

Methods

A controlled, non-randomized trial was conducted of an 8-week TeleYoga intervention versus an educational control (information leaflets mailed to participants with one weekly phone call). One-hour TeleYoga classes were implemented twice weekly via multipoint videoconferencing, that connected participants to live classes via an Internet connection to their televisions.

Results

Fourteen participants with COPD and HF took part in the pilot study (7 in the intervention group, 8 in the control). Intervention participants were adherent to classes, able to safely participate, and found the classes enjoyable after the eight-week program. Dyspnea after exercise improved in the intervention group.

Conclusions

Despite their frailty, patients diagnosed with both COPD and HF were able to perform yoga safely in the home setting. TeleYoga was acceptable and adherence was good; however, technical issues were an important hindrance to participation.

Background

Chronic obstructive pulmonary disease (COPD) and heart failure (HF) are costly and burdensome chronic conditions that are increasing in prevalence worldwide.¹⁻³ The conditions often co-exist because of shared risk factors such as age and smoking. The prevalence of COPD in patients with a primary diagnosis of HF is estimated at 40%⁴ while the prevalence of HF in patients with a primary diagnosis of COPD has been estimated at 21%.⁵ The combined diagnosis may not be readily appreciated because of similarities in clinical presentation, patient demographics, and comorbidities.⁶

Both COPD and HF are characterized by symptoms of breathlessness, limited exercise capacity and skeletal muscle myopathy.⁶ The concurrent presence of these conditions can synergistically worsen exertional limitations compared to either diagnosis alone.^{4, 7} Yoga is a logical complementary therapy for patients with COPD and HF because of its emphasis on movement-coordinated breathing and low-impact fitness, both of which are thought to mechanistically improve dyspnea and consequently, physical function.⁸⁻¹⁰ Yoga is included in many pulmonary and cardiac rehabilitation exercises,^{11,12} and the popular media extols the health benefits of yoga for people with chronic medical conditions.¹³

Traditional cardiac and pulmonary rehabilitation provide optimal monitoring and social support. They are focused on endurance and strength training. However, not all patients have insurance coverage for rehabilitation programs, long-term maintenance exercise after rehabilitation is not covered by insurance, and many communities do not have rehabilitation programs available. In addition, transportation to rehabilitation programs can be exhausting for patients with cardiopulmonary disease.

Previous research indicated that yoga was safe and feasible in participants with COPD and in those with HF.^{9,10} In addition, yoga participants had greater improvements in symptoms and functional performance compared to usual care.^{9,10} However, similar to cardiopulmonary rehabilitation, transportation to a central class location was a major barrier for participation in yoga classes in this older chronically-ill population.⁹ Interventions to support participation in exercise-based programs such as yoga are needed for older and socially-isolated adults, including those with chronic cardiopulmonary disease.

Recent advances in multi-point interactive videoconferencing technologies can enable individuals who are geographically isolated to participate in traditional group-based exercise programs from home.^{14,15} The use of videoconferencing has been shown to be an effective tool to provide social support as well as behavioural interventions.^{16,17} Successful implementation of a real-time home-based yoga program, TeleYoga, with live interaction between participants and a yoga teacher may provide convenience and potential for increased participation.

Therefore, the purpose of this study was to determine the feasibility and clinical outcomes of an eight-week home-based yoga program, conducted via simplified multipoint video conferencing in a sample of patients with both COPD and HF. Feasibility was evaluated by adherence, safety, acceptability and technical aspects of the TeleYoga intervention. Clinical outcomes included physical function, quality of life, and symptoms.

Methods

Study Design and Sample

In this quasi-experimental, nonrandomized study, an 8-week intervention of twice-weekly TeleYoga sessions was compared to an attention control group. A

convenience sample of participants diagnosed with both COPD and HF was recruited. Letters describing the study were sent to patients with HF who also had COPD, according to the electronic medical record. Flyers and letters to pulmonary rehabilitation programs from the San Francisco Bay Area were also utilized for recruitment. In addition, participants from previous research studies of COPD and HF were sent recruitment letters. The study was registered with the ClinicalTrials.gov registry (NCT-02078739). Patients were not aware of which group they would be assigned to when they consented to the study (Figure 1). The first seven patients were enrolled in the intervention group and the following eight in the control group.

The study inclusion criteria were that participants: 1) have provider-diagnosed COPD; 2) have provider permission for participation; 3) speak English; 4) be over 40 years old; 5) have NYHA Class I-III systolic or diastolic HF; 6) have access to television and a broadband internet connection; 7) have space to practice yoga at their home; and 8) be willing to have a research assistant connect videoconferencing equipment to their home television. Exclusion criteria included: 1) hospitalization within the 3 months prior to enrollment; 2) cognitive impairment as determined by a score of <3 on the Mini-Cog;¹⁸ or 3) oxygen saturation <85% on 6 liters of nasal oxygen. Written informed consent was obtained from all participants prior to enrollment in the study. The study was approved by the University of California, San Francisco Institutional Review Board (12-08383).

Procedure

Potential participants who met screening criteria when they called the research office in response to recruitment were scheduled for a home visit. The home visit was conducted at baseline and then at eight weeks by one of two registered nurses that served to enroll participants in the study. Pre- and post-

intervention physical assessments, study questionnaires including the Mini-Cog to assess cognition, and installation or pick up of video conferencing equipment was completed for the TeleYoga group during the home visits. Blinding to group assignment did not take place because the nurses were required to install or collect the TeleYoga DocBox during the home visit. Fidelity to data collection and intervention was addressed using a written protocol for data collection and intervention procedures. Participants were given \$75 gift cards to Safeway grocery store at the conclusion of the study.

Participants were given their group assignment during the baseline visit and those assigned to the TeleYoga group were provided a yoga mat, automatic blood pressure cuff, oximeter, and scale. They practiced taking their own blood pressure, weight, heart rate and oxygen saturation levels during the baseline visit so that they could provide these data prior to the start of each yoga class. Participants in the Health Education control group were provided an orientation to the weekly mail and telephone contacts with the intervention nurse during their baseline home visit.

TeleYoga Intervention

Participants reported their vital signs to the TeleYoga nurse before and after each yoga class. They were visually monitored for safety during each session by the TeleYoga nurse via the multipoint videoconferencing system interface. The TeleYoga nurse called each participant on the telephone before and after each TeleYoga session to assess symptoms of HF and COPD. Prior to participating in the TeleYoga study, participants provided contact information regarding their local emergency numbers and a nearby family/friend so that the TeleYoga nurse could activate emergency systems if she judged necessary. If vital signs were unstable (blood pressure less than 90 systolic, heart rate less than 50 beats per minute or

oxygen saturation less than 90%) or if the participant had worsening symptoms of HF or COPD (increased dyspnea from baseline, edema or orthopnea), the participant was stopped from engaging in the yoga class and referred to their health care provider.

TeleYoga classes were offered twice weekly for eight weeks to participants in their homes using video-conferencing (methods previously described).¹⁹ The yoga intervention was provided by the same certified yoga instructor/physical therapy assistant with eight years of experience teaching yoga throughout the study. Video-conferencing equipment was installed in the homes of the intervention group participants during the baseline home visit. The yoga protocol was based on the previously tested yoga programs for COPD^{8,9} and HF,¹⁰ originally developed by a certified Iyengar yoga instructor with expertise in working with individuals living with chronic illness. Briefly, postures included mountain, half down dog, cat, triangle, supported bridge, simple twist, staff, corpse, and cobbler poses, with postures modified as needed to meet the physical ability of each participant. Yoga classes were designed to integrate breathing exercises (slow breathing and extended exhalation breathing), imagery, meditation and relaxation. Classes began with 10 minutes of relaxation followed by approximately 35 minutes of poses and concluded with 15 minutes of meditation and relaxation.

Multipoint videoconferencing via DocBox technology (MicroDesign, Colchester, VT) was used to connect participants to live streamed classes via an Internet connection to their televisions. Participants were instructed to turn on their televisions and then their DocBox, using one simple push button, to initiate the live streaming. A technician managed the live streaming remotely from the DocBox studio once the connection was made. All participants in the TeleYoga group

participated at the same time. They could see the yoga teacher (and vice versa) and received personalized instruction, but could not see each other because of privacy concerns. If participants had questions, they raised their hand and the technician would unmute them to talk with the yoga teacher. The TeleYoga nurse could see all participants and the yoga teacher and was connected by audio to the technician in the DocBox studio.

The DocBox technology was specifically chosen because it was designed for ease of use by older adults who may have no familiarity with technology. It is a hard drive box connected to the participant's television and remotely controlled by a technician. Once set up in the home and then settings adjusted by a technician, the participant turns on the TV and pushes one button on the hard drive box. After that, the remote technician can adjust the picture and sound as needed with no further technical skill required by the participant.

Control

Participants assigned to the attention control group received educational materials in the mail once per week for eight weeks. The TeleYoga nurse called each week for 15-30 minutes to discuss the educational information so as to provide an equal number of phone or mail contacts as in the intervention group. The education materials covered the following topics: evaluating health information, problems sleeping, elder abuse, flu vaccinations, accessing information about complementary and alternative therapies online, accessing information about medications online, depression and a low sodium diet. The control group was designed to require one hour of pre-reading before the nurse phone call and one-half to one hour of nurse telephone contact per week.

Study Feasibility

Adherence rates, safety factors, patient acceptability, and technical issues were used to assess study feasibility. Adherence was measured by the number of sessions attended and time spent in the TeleYoga classes. Safety was measured after each yoga session by: 1) dyspnea intensity and distress using the modified Borg scale,²⁰ 2) heart rate, 3) percent oxygen saturation, and, 4) number of emergency department visits. Participant acceptability was categorized as class enjoyment and class difficulty, assessed after each class using a scale from 0-10 and during a semi-structured exit interview. Qualitative data was collected to assess participant perceptions of the yoga experience and is reported elsewhere.¹⁹

Technical issues experienced by participants, TeleYoga nurse, yoga instructor, and technician during the yoga classes were logged during each class and categorized.

Clinical Outcomes

Outcomes measured were physical function, quality of life (QOL), and symptoms. Physical function was defined as muscle strength and endurance. Strength was tested via upper body (biceps) and lower body (quadriceps) testing using the total number of arm curls using two-pound hand weights and chair stands completed in 30 seconds. Endurance was measured with the home adapted six minute walk test that measured number of feet walked within six minutes.²¹ Validated quality of life (QOL) questionnaires included the St. George's Respiratory Questionnaire that is used for patients with COPD²² and the Kansas City Cardiomyopathy Questionnaire (KCCQ) used for measurement in HF patients.²³ The St. George's Respiratory Questionnaire uses a scale of 0-100 with higher scores indicating more impairment and 4 unit changes signifying clinically important differences.²² The KCCQ uses a scale of 0-100 with higher scores indicating better QOL.

Symptoms of depression, dyspnea, and insomnia were evaluated at baseline and after study completion. Depression was evaluated using the validated Personal Health Questionnaire (PHQ) – 8.²⁴ Scores of 10 and above indicate clinical depression. The PHQ-8 does not include a question related to suicidality as seen in the PHQ-9. Dyspnea was measured using the Dyspnea-12 questionnaire, a well-validated questionnaire used for patients with COPD,²⁵ and dyspnea and distress related to dyspnea was measured using the modified Borg scale²⁰ at the end of the six minute walk. Sleep was measured using the General Sleep Disturbance Scale and has been validated in many populations.^{26,27}

Analysis

All data were analysed using SPSS statistical software version 19.0 (IBM Corp., Armonk, NY). All personal identifiers were deleted and the data was anonymized prior to data analysis. We compared characteristics of the intervention and usual care participant cohorts using Chi square for categorical variables and independent and paired t-test for continuous variables. The frequency distributions of the continuous variables were examined and were found to be approximately normal. Linear mixed modelling was used to analyze clinical outcomes before and after yoga classes. Alpha levels were pre-set at $p < 0.05$ and confidence intervals (CI) were set at 95% with data presented as means $\pm$ standard deviations where appropriate. Since this was a pilot study, we determined effect sizes for future sample size estimates.

Results

Fifteen participants took part in the pilot study with seven from the intervention group and eight from the attention control group (Figure 1). They were recruited from past study participants ($n=2$), Better Breathers groups ($n=5$), response to mailing

(n=4) and referrals from colleagues (n=4). Thirty-two were assessed for eligibility with seventeen excluded for various reasons such as not meeting eligibility criteria or feeling too ill to participate. One attention control group participant dropped out of the study because of scheduling issues. There were no significant differences in baseline characteristics between the intervention and control groups (Table 1). The mean participant age was the early eighth decade (71 ± 8.5) with more females than males (n=10, 66%). The participants were mostly Caucasian and college educated.

Study Feasibility

Adherence to the control group phone call intervention was 100%. Mean attendance was 14.5 (90%) of the yoga classes (out of 16 required classes). All participants attended the entirety of each class with the exception of the youngest participant who left four (of 13 attended) classes early because of personal/family scheduling reasons. Dyspnea intensity and distress related to dyspnea was rated a mean of 1.98 ± 1.52 (scale 0-10) and 0.22 ± 0.62 (scale 0-10) respectively and averaged over all 16 class sessions (Figure 2A). The mean participant heart rate stayed below 90 beats per minute (mean 83.5 ± 14.6) and mean oxygen saturation levels stayed above 90% (mean $95.2\% \pm 3.2$) for all participants in all of the yoga classes (Figure 2B). There were no emergency department visits reported during the eight weeks of class attendance. Class enjoyment was rated a mean of 8.3 ± 2.7 (scale 0-10) with the first class mean rated at 7.5 ± 2.7 and the final class mean of 9.0 ± 2.0 . Mean class difficulty was 3.4 ± 2.6 (scale 0-10) with the first class mean rated at 5.3 ± 3.1 and the final class mean of 2.8 ± 2.5 .

Technical issues were categorized into four groups: Participant-related, nurse-related, yoga teacher-related and IT support technical problems. Thirty-one yoga classes took place over four months. Participant-related problems took place in 14

(45%) classes. Participant issues ranged from problems logging into the class, frozen screens, visual lags, firewall problems, but the most common problem was the login process that occurred in eight (26%) of the 31 classes. Nurse-related problems involved not fully visualizing the participant, delays in logging in, microphone issues, and poor streaming. The yoga-teacher had only one technological problem that involved loss of audio (expired microphone battery). The IT support problems included distracting noises such as echoes and participants hearing other participants. There were only seven (23%) yoga classes without technical issues.

Clinical Outcomes

Upper and lower body muscle strength, as well as the six-minute walk test score, did not significantly improve (Table 2). Following the six-minute walk test, shortness of breath and distress related to dyspnea significantly improved ($p=0.02$, $p=0.03$, respectively) in the intervention group compared to the control group. Quality of life measures improved in both groups, with no significant difference between groups. Although depression did not significantly improve, the overall depression scores in the intervention group improved while depression scores worsened in the control group (effect size -0.385). The overall dyspnea score did not significantly change. The General Sleep Disturbance Scale that measured insomnia improved in the intervention group and worsened in the attention control group. This score was not significant, but had a strong effect size (-0.937).

Discussion

This is the first study to provide preliminary evidence that a TeleYoga intervention may improve symptoms in participants with both COPD and HF who participated in a multipoint videoconference yoga program. More specifically,

participants with COPD and HF were adherent to classes, able to safely participate, and found the classes enjoyable after an eight week home-based yoga program. This pilot study was not powered to demonstrate effectiveness due to limitations of time and funding, and physical function measures did not significantly improve. However, dyspnea after exercise improved in the intervention group. Technical issues were an important hindrance to participation in the TeleYoga classes.

Feasibility in this study was evaluated by adherence, safety, acceptability, and technical aspects of the TeleYoga intervention. The adherence of our participants was high, similar to a study of patients with HF.¹⁰ In a study of yoga for patients with COPD⁹, transportation issues were a significant barrier to participation. We found that internet-based TeleYoga classes accessed at home were well attended in this older population with a dual COPD-HF diagnosis who were highly symptomatic.

Our finding that a yoga program is safe is consistent with prior studies of yoga in separate COPD and HF populations.^{9,10} In a meta-analysis of safety in all available randomized controlled trials of yoga interventions (94 studies), yoga was found to be as safe as usual care with an exercise intervention.²⁸ The authors concluded that recommending yoga to healthy or chronically ill adults should not be discouraged on the basis of safety.

Although technology provides an exciting opportunity for home-based exercise, the authors were unable to find other reports of home-based exercise studies that describe the technical issues in detail. We suspect that many internet-based projects have been conceived but not completed because of the technical barriers involved. We found that the most common technical issue was the log-in process, with delays in connecting to the server and the technical support person who coordinated the audio and visual aspects of the class. In addition we had

ongoing problems with frozen screens, and several participants learned to continue the yoga practice without the full benefit of the teacher's feedback and interaction during class when their screens were frozen. The technical challenges with older, income-restricted adults were related to slow internet access, older age televisions, and lack of basic technical understanding. There is a perception that currently-available, real-time conferencing technology can easily be used for a project such as this. The one-button login process, access to TV rather than computer screen, and remote coordination of all functions after initial login were very attractive features of the DocBox system.^{29,30} However, older home equipment prevented the optimization of the DocBox system and contributed to many unforeseen complications and patient frustrations. Future investigators need to provide fast internet connectivity and up-to-date hardware, including large screens, nonintrusively in the home environment. Because of the technical difficulties with the DocBox technology, a full trial is not planned at this time.

Shortness of breath and distress related to dyspnea significantly improved after the six minute walk, while body strength and six minute walk distance did not improve. Quality of life measures improved in both intervention and control groups. This population tends to be isolated and often homebound, and any social interaction may improve quality of life. Social desirability may have also positively affected outcomes. Although not significant, the strong effect size of the General Sleep Disturbance Scale indicates possible improvement in insomnia for patients in the TeleYoga group, suggesting that sleep quality should be included in future studies of yoga in this population.

Recruitment in this dual diagnosis population is challenging because many patients are cared for in primary care clinics and never reach a specialty practice,

and although they actually have both conditions, they may only have one official diagnosis.³¹ Many patients and providers under-recognize the challenges of a dual diagnosis. Because they are often homebound, we found it was difficult to find patients with both of these diagnoses and communicate with them. The overall frailty of the population may also contribute to recruitment challenges. Although participants were fully engaged with the study, some were limited in their ability to participate because of frailty, and others did not qualify for the study because of frequent exacerbations and poor health. Often these patients are seen by multiple providers from various disciplines and coordination of care and consent for participation can be another challenge to recruitment and enrollment.

Our findings have implications for future research in COPD-HF populations and using home-based interventions. Conducting assessments at home was important in this frail population and minimized missing data. Patients who are unable to attend an in-person intervention are unlikely to be able to attend baseline and follow-up outcomes testing sessions. Future research in this fragile and often homebound population should use assessment tools validated for home use. The home protocol for the six minute walk test cannot be compared with six minute walk results done using the American Thoracic Society guidelines,³² but it has been validated for home use and provides valid within-subject comparisons.²¹ Although the space needed for this six minute walk was only 20 feet, we found that space was sometimes difficult to access in a given subject's home. Clutter issues, small living environments, and short hallways in public apartment buildings required creativity on the part of the outcomes testing personnel. It was therefore important to document clearly the logistics of the baseline test so that the same conditions could be replicated during follow-up testing for valid comparisons. In conducting home-based

research, it is also important to carefully assess resources and evaluate the availability of all required equipment for both outcomes testing and implementation of the intervention. We assumed that patients would have access to basic resources such as extra pillows and blankets to use as bolsters, and chairs, wall, and floor space for yoga practice. This was not always the case, and sometimes interfered with the quality of the yoga intervention.

The Health Education control group intervention provided ongoing interaction and attention from the intervention nurse and was well accepted by the control group participants.¹⁹ The weekly educational materials in the mail and follow-up telephone calls provided value to participants with no impact on well-being.¹⁹ This control intervention can be recommended for other studies of nonpharmacological interventions in this population.

Limitations

We acknowledge there are limitations to this pilot study. The small sample size of homogenous subjects limits generalizability of our findings. The use of convenience sampling means there is a risk of selection bias, and the characteristics of the four participants who declined enrollment in the study could not be compared to the study participants. Reports of vital signs before and after TeleYoga sessions were not observed and there is a possibility they were fabricated to please investigators, although this is thought highly unlikely. The time allotment (“dose”) of the intervention and control intervention was not equal, so although the control was acceptable we recommend that in a full trial the attention provided to participants is balanced between the two groups. The feasibility measures did not include cost estimates, and cost should be considered in future research in this area. Future studies could compare several doses of a yoga intervention to traditional

cardiopulmonary rehabilitation in patients with the dual diagnosis of COPD and heart failure, as this data is not yet available.⁷

Conclusion

Despite their frailty, patients diagnosed with both COPD and HF were able to safely perform yoga in the home setting. Both diagnoses have poor prognoses; however, regardless of how frail or robust they appear, this intervention was well received and had high patient satisfaction. Yoga can be considered a palliative care intervention, as it can be modified for all levels of functional status, and has the potential to improve symptom status. In patients who may have heard that there is “nothing more” that can be done, a complementary therapy such as yoga can provide additional support with minimal safety concerns, even in patients who are receiving maximal therapy for both conditions.

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