A Pilot Study of the Feasibility and Outcomes of Yoga for Lung Cancer Survivors

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Purpose/Objectives: To determine the feasibility of a standardized yoga intervention for survivors of non-small cell lung cancer (NSCLC) and, effects on sleep, mood, salivary cortisol levels, and quality of life (QOL).

Design: This 14-week, one-group, repeated-measures study included a three-week preintervention phase, eight weeks of yoga classes (40 minutes once per week) and home practice, and a three-week postintervention phase. Follow-up occurred at three and six months poststudy.

Setting: A community-based cancer support center in the midwestern United States.

Sample: 7 adults who had completed initial treatment for stages I–IIIa NSCLC.

Methods: A standardized yoga protocol was developed prior to the study by experts in the field. Breathing ease was monitored before, during, and after classes to assess feasibility of movement without compromising respiratory status while doing yoga. Data analysis included descriptive statistics, repeated-measures analysis of variance, and salivary cortisol analysis.

Main Research Variables: Sleep quality, mood, salivary cortisol, and QOL were assessed using the Pittsburgh Sleep Quality Index, Profile of Mood States–Brief, a cortisol measurement, and the Medical Outcomes Survey SF-36®, respectively. Breathing ease was assessed using a dyspnea numeric rating scale as well as observation of participants.

Findings: Participants with varying stages of disease and length of survivorship were able to perform yoga without respiratory distress. Class attendance exceeded 95%, and all practiced at home. Mood, sleep efficiency, and QOL significantly improved; salivary cortisol levels decreased over time.

Conclusions: Yoga was feasible for NSCLC survivors without further compromising breathing with movement. Potential benefits were identified, supporting the need for future clinical trials with larger samples stratified by cancer stage, treatment, and length of survivorship.

Implications for Nursing: Nurses and healthcare providers should consider yoga as a mind-body practice to manage stress, improve mood and sleep, and potentially enhance QOL for NSCLC survivors.

Key Words: lung cancer; yoga; symptoms

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Lung cancer affects almost 400,000 individuals in the United States annually and more than 2 million people worldwide, with increasing prevalence reported (American Cancer Society, 2013; International Agency for Research on Cancer, 2012). Although the five-year survival rate for non-small cell lung cancer (NSCLC) has increased, excessive symptom burden during the survivorship period remains extremely prevalent (Fouladbakhsh & Stommel, 2008, 2010; Podnos, Borneman, Koczywas, Uman, & Ferrell, 2007; Sarna et al., 2008) and is associated with increased stress, poorer functional status, lower quality of life (QOL), and higher mortality (Ferreira et al., 2008; Hansen & Sawatzky, 2008; Sarna, Cooley, & Brown, 2010; Snyder et al., 2008). Emerging evidence strongly suggests benefits of yoga for health promotion and symptom management among those with cancer and other chronic illnesses (Büssing, Ostermann, Lüdtke, & Michalsen, 2012; Carson et al., 2007; Chadwani et al., 2010; Cohen, Wameke, Fouladi, Rodriguez, & Chaoul-Reich, 2004; Donesky-Cuenco, Nguyen, Paul, & Carrieri-Kohlman, 2009; Ulger & Yagli, 2010), although clinical trials are lacking among lung cancer survivors. Research is needed to determine the effectiveness of complementary and alternative medicine (CAM) therapies such as yoga, which may help manage burdensome symptoms that persist over time. This article reports on a pilot study that examined the feasibility of yoga for post-treatment stages I–IIIa NSCLC survivors and the effects of yoga practice on sleep, mood, salivary cortisol levels (as a measure of stress), and QOL.

Literature Review

Lung Cancer and Symptom Burden

Individuals with lung cancer experience a complex array of symptoms that have devastating effects on physical and psychological functioning and may seriously compromise their overall QOL throughout the

survivorship period. Often occurring in clusters, symptoms include sleep problems, distressed mood, fatigue, dyspnea, cough, chest pain, bronchitis, and pneumonia (Brown, Cooley, Chernecky, & Sarna, 2011; Ferrell, Koczywas, Grannis, & Harrington, 2011; Mohan et al., 2007; Yorke, Brettle, & Molassiotis, 2012). Symptom burden is further intensified in this population by late stage of diagnosis, rapid disease progression, treatment side effects, comorbid chronic illness, and lifestyle behaviors that compromise health.

Sleep disturbances, most commonly insomnia, often are reported to occur before cancer treatment and may intensify throughout the illness trajectory, affecting well-being, physical functioning, energy levels, and mood as many as eight years post-treatment (Gooneratne et al., 2007; Otte, Carpenter, Russell, Bigatti, & Champion, 2010; Palesh et al., 2010; Vena et al., 2006; Vena, Parker, Cunningham, Clark, & McMillan, 2004). Individuals with compromised respiratory status and dyspnea, a highly prevalent problem among lung cancer survivors, are particularly affected by sleep disturbances (Cheville et al., 2011; Gaguski, Brandsema, Gernalin, & Martinez, 2010; Thomas, Bausewein, Higginson, & Booth, 2011). Lack of sleep further intensifies stress, negatively affecting mood and breathing distress experienced by patients with lung disease.

Therefore, symptom burden remains a serious and complex problem for NSCLC survivors, with increased focus on the need for evidence-based nonpharmacologic therapies as adjuncts to conventional care (Yorke et al., 2012). Effective combinations of therapies may potentially improve sleep, reduce stress and shortness of breath, and lighten mood, thereby enhancing QOL.

Complementary and Alternative Medicine Use Among Survivors

CAM includes thousands of diverse medical and healthcare treatments, products, and practices that are not considered part of conventional Western medicine. Many of these therapies have existed for millennia within alternative systems of care, such as traditional Chinese and Ayurvedic medicine, and are now being integrated into Western medicine as evidence emerges of the effectiveness of these treatments. The National Center for Complementary and Alternative Medicine has categorized CAM therapies as including mind-body therapies, natural products, manipulative and body-based approaches, energy therapies, and whole systems of alternative care (http://nccam.nih.gov/health/whatiscam).

CAM also may be viewed from a health service perspective, which examines use of CAM provider services (e.g., acupuncture treatment), CAM products (both self- and practitioner-prescribed), and CAM practices (e.g., yoga and Tai Chi, which include movement and meditation) (Fouladbakhsh & Stommel, 2008). Although research on CAM therapies has increased, the vast array of therapies examined across studies makes comparisons on their effectiveness and generalizability of findings difficult. CAM therapy protocols also vary widely, further compromising conclusions that can be drawn about outcomes.

The use of CAM therapies by cancer survivors in the United States is significantly higher than among those without cancer, and has increased in the past several years (39% in 2002, 44% in 2007). This use has been linked to the management of symptoms such as pain, depression, anxiety, and insomnia (Fouladbakhsh & Stommel, 2007, 2008, 2010), with the desire to improve QOL (Gillett, Ientile, Hiscock, Plank, & Martin, 2012; Lu, Tsay, & Sung, 2010). Wells et al. (2007) noted that 44% of the women with NSCLC examined in their study (N = 189) used CAM therapies, with highest use noted for breathing difficulty and pain (55% for both). Other reasons for CAM use by patients with lung cancer include health promotion, increased well-being, illness cure, and relief from treatment side effects (Lövgren, Wilde-Larsson, Hök, Leveälahti, & Tishelman, 2011).

Although research on CAM use in the cancer population has examined a wide array of therapies, studies of use among those with lung cancer have been more limited. Rates of CAM use by lung cancer survivors range from 24%–54%, with an extensive array of therapies reported (Lövgren et al., 2011; Micke et al., 2010; Molassiotis et al., 2006; Wells et al., 2007). Studies have noted the effect of patient beliefs, gender, and race on CAM experiences among patients with lung cancer, and have highlighted the need for improved patient-provider communication to promote effective and safe integration of CAM therapies (Amichai, Grossman, & Richard, 2012; Fouladbakhsh & Stommel, 2008; George, 2012; Lövgren et al., 2011; Molassiotis et al., 2006; Wells et al., 2007). CAM use also is significantly higher among female lung cancer survivors with greater symptom burden (Wells et al., 2007). Studies indicate that individuals with lung cancer use prayer, meditation, herbs, supplements (e.g., green tea, mistletoe, selenium), acupuncture, homeopathy, and massage, with the goal of health promotion, symptom management, improved care, and enhanced QOL (Lövgren et al., 2011; Molassiotis et al., 2006; Wells et al., 2007).

Yoga, a CAM practice, has become more accepted and available in the United States, but is only practiced by a small percentage (4%–5%) of cancer survivors, predominantly those with breast cancer (Fouladbakhsh & Stommel, 2010). The likelihood of women practicing yoga is significantly higher than among men (odds ratio [OR] = 13.5, $p < 0.05$) and is influenced

by symptoms experienced. Cancer survivors with pain had 70% higher odds of using a CAM practice during the preceding year ($p < 0.001$), and survivors with insomnia had significantly increased odds of use ($p < 0.02$) when compared to those without insomnia. Likelihood of yoga practice also was increased among men with depression as compared to men without depression (OR = 4.2 and 3.5, respectively; $p < 0.05$) (Fouladbakhsh & Stommel, 2010).

Potential benefits of yoga also are increasingly recognized by oncology healthcare providers, as noted by inclusion of this practice at integrative cancer centers for health promotion and the management of bothersome symptoms during the cancer trajectory (Hede, 2011). Yoga, as a movement and meditative practice, is gaining increased recognition with the cancer community's initiative to promote exercise for patients and survivors. Systematic review supports the positive effects of exercise interventions, including yoga, on health-related QOL, with significant reductions in sleep disturbances, anxiety, and fatigue (Dhruva et al., 2012; Mishra et al., 2012).

Yoga is defined in the current study as a holistic mind-body CAM practice that includes a coordinated focus on postures and movement (asanas), breathing (pranayama), and meditation (dhyana) to promote relaxation and mindfulness. Benefits of yoga include (a) improved sleep, appetite, and habits; (b) increased sense of peace and tranquility; (c) changes in immune and cardiopulmonary function; and (d) decreased anxiety, fatigue, and pain among those with or without cancer (Büssing et al., 2012; Carrieri-Kohlman et al., 2007; Carson, Carson, Porter, Keefe, & Seewaldt, 2009; Cohen et al., 2004; Galantino, Cannon, Hoelker, Iannaco, & Quinn, 2007; John, Sharma, Sharma, & Kankane, 2007; Ross & Thomas, 2010; Shannahoff-Khalsa, 2005). Meditative practices within yoga are calming, centering, and promote mindfulness, which may reduce fear and anxiety related to a cancer diagnosis and treatment, as well as living with the after-effects of a serious, life-altering illness. These effects may be of particular importance to individuals with lung disease, who may fear increased shortness of breath during exercise and movement. Respiratory benefits of yoga practice have been noted among patients with chronic obstructive pulmonary disease (COPD), emphysema, and asthma (Carrieri-Kohlman et al., 2007; Sharma, 2008), providing preliminary support for this practice among others with respiratory disease.

Symptom management remains problematic for NSCLC survivors and their healthcare providers, with increasing focus on the integration of evidence-based nonpharmacologic CAM therapies as supportive adjuncts to care. Although studies have documented benefits of yoga in the cancer population, data are lacking among individuals with lung cancer. Yoga offers coordinated movement with meditation and breathing exercises, which may be of particular value to those with lung impairment. Therefore, research is needed to more fully understand the effects of yoga and to determine whether this mind-body CAM practice is feasible for those affected by lung cancer.

This 14-week study examined the feasibility and preliminary effects of a standardized yoga intervention on sleep quality, mood, salivary cortisol levels (as a measure of stress), and QOL of NSCLC survivors. Research questions included: (a) Is yoga practice feasible for post-treatment NSCLC survivors with varying stage of disease, comorbidity, and potential respiratory compromise? (b) Does yoga improve sleep, mood, and QOL? and (c) Is salivary cortisol analysis a feasible and potentially informative measure of stress with this study population?

Conceptual Model

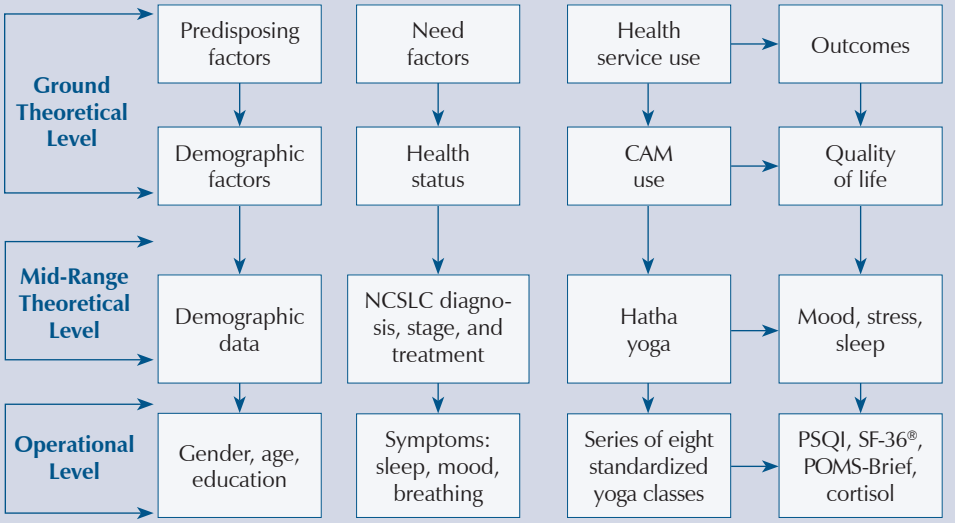
The CAM Healthcare Model (Fouladbakhsh & Stommel, 2007), an extension of Andersen's (1995) Behavioral Model of Health Service Utilization, guided the study. The model proposes that use of CAM practices, such as yoga, is influenced by predisposing factors such as age, gender, and race; enabling factors such as availability and feasibility; and need factors such as breathing ease, cancer stage, comorbidities, and symptoms (see Figure 1). Outcomes in the model include effects on sleep, mood, stress, and QOL. This model has been successfully used in previous research (Fouladbakhsh & Stommel, 2008, 2010) and identifies potential outcomes of specific CAM practices such as yoga.

Methods

Design

This 14-week pilot study used a one-group (intervention only) repeated-measures design, with each participant serving as his or her own control (control by constancy) to examine the feasibility and outcomes of a standardized yoga intervention on sleep, mood, salivary cortisol levels, and QOL. The study included a three-week preintervention phase, an eight-week yoga intervention, a three-week postintervention phase, and two follow-up sessions at three and six months. This design minimized the sample size needed and was selected because of the uncertainty about interest from patients with lung cancer as well as their ability to perform yoga, given potential respiratory compromise in the study population. Even without random assignment of study participants to a separate control group, this design often can provide good causal

evidence for the effectiveness of an intervention (Shadish, Cook, & Campbell, 2002). The collection of multiple observations before, during, and after the intervention allows for the establishment of trend lines (patterns) that, although not necessarily linear, may be orderly and recognizable enough to be extrapolated into the future after the intervention has taken place (Stommel & Wills, 2004). That may suggest continuance of potentially beneficial outcomes related to yoga and, therefore, support more rigorous study.



CAM—complementary and alternative medicine; NCSLC—non-small cell lung cancer; POMS—Profile of Mood States; PSQI—Pittsburgh Sleep Quality Index

Note. Not all direct and indirect relationships are shown.

Figure 1. The CAM Healthcare Model—Yoga Intervention

Sample and Setting

Participants were recruited over a three-week period using study flyers distributed at two outpatient clinics and a cancer support center in a metropolitan community in the midwestern United States. These clinics provide care for patients with cancer at all stages of the cancer trajectory; the community center provides a wide range of social services including support groups for many types of cancer among multi-age individuals and families. Flyers were made available to the lung cancer support group and the general membership. Inclusion criteria included adults aged 18 and older who had completed initial cancer treatment for stages I–IIIa NSCLC and were able to read and write in English. Inclusion criteria were purposefully broad to see which survivors attending the clinics and support groups would choose to enroll, as yoga for lung cancer had not been previously studied in this population. Exclusion criteria included individuals with documented evidence of metastatic disease.

The researchers recognized that symptom reports would vary according to length of survivorship; however, participants served as their own controls and change over time was recorded for comparison. All study sessions were conducted at a well-known and centrally located cancer community center. Because this was a pilot study, initial power analysis was not of primary interest; sample size was affected by the restricted recruitment period, which was necessary because of the study timeline and limited funding. Post-hoc power analysis on the statistically significant findings ($p \leq 0.05$) later indicated the power of the test was in the range of 83%–96%. However, caution must be used in interpreting this finding as a result of the small sample size and study design.

Yoga Intervention and Protocol

The yoga intervention included eight sequential weeks of yoga classes (40 minutes once per week) using a standardized protocol. The protocol was developed by a team of leading yoga and respiratory experts with the American Viniyoga Institute (2014). Viniyoga, a form of hatha yoga, was selected for the protocol because of its focus on health concerns and modifiability according to individual limitations without compromising overall effect (Kraftsow, 1999). The protocol was geared toward individuals with varying degrees of symptom burden, respiratory compromise, and concurrent comorbid conditions (e.g., asthma, emphysema, COPD), which are prevalent in patients with lung cancer. Prior use of viniyoga with respiratory-compromised patients has demonstrated feasibility and effectiveness (Carrieri-Kohlman et al., 2007; Donesky-Cuenco et al., 2009; Sharma, 2008). Numerous hatha yoga traditions exist, with variations in practices (Kepner, Strohmeyer, & Elgelid, 2002), necessitating a standardized approach for research.

The yoga protocol included a series of poses (asanas), breathing exercises (pranayama), and meditative practices (dhyana) that were added to each class in a sequential manner based on level of difficulty. Poses that were practiced included forward and back bends, lateral stretches, and twisting and supine poses with alternative positioning to meet individual needs (e.g., in a chair versus on the mat) (see Table 1). Poses were coordinated with the breath and focused on expansion

of the diaphragm and rib cage, using deep abdominal breathing and breaths to extend exhalation. Specific meditation practices were used to enhance deep abdominal breathing, such as walking meditation and heart-centered meditation. Participants practiced standing and seated positions using yoga mats, and assistive aids such as chairs were available when needed. Home practice, which was recorded on self-report logs, was guided by a yoga manual prepared by the study team and given to each participant. For the study intervention, classes were taught by an experienced yoga teacher trained at the American Viniyoga Institute. The research team was certified in advanced cardiopulmonary resuscitation to maximize participant safety, and at least one RN stayed in the yoga room (unobserved) to monitor participants for potential respiratory distress.

Variables and Measures

Study variables were categorized as follows: (a) predisposing variables: demographic characteristics; (b) enabling variable: feasibility—breathing ease; (c) need variables: cancer stage, respiratory comorbidity, and reported symptoms; and (d) outcome variables: sleep quality, mood, salivary cortisol levels, and QOL. Sleep quality, mood, salivary cortisol (stress measure), and QOL were assessed using the **Pittsburgh Sleep Quality Index (PSQI)**, **Profile of Mood States–Brief (POMS-Brief)**, a salivary cortisol analysis from Salimetrics, and **Medical Outcomes Survey SF-36®**, respectively. Breathing ease was assessed to determine ability (feasibility) of individual participants to do yoga safely, to assess respiratory changes during and after yoga movement, and to promote safety and modification of the yoga protocol (e.g., sitting in chair versus standing) should shortness of breath occur or intensify and create discomfort.

Table 1. Example of Yoga Class Protocol

Component	Type Practiced Every Week	Time Practiced
Poses (asanas)	Forward bends (standing or in a chair) Triangle pose Warrior pose Breath-coordinated spinal movements Spinal twists Back bends	25 minutes
Breathing exercises (pranayama)	Pursed lip breathing Slow abdominal breathing "24/7 breath awareness" Conscious breathing	10 minutes
Meditation (dhyana)	Body scan Walking meditation (mindful walking) Heart-centered meditation	2–4 minutes 3–5 minutes

Note. Poses and meditation are coordinated with the breath. Time is approximated.

The participant information form, developed by the researchers, was completed at the first session and included demographic information such as age, gender, education, marital and employment status, and race. Health information on cancer stage, treatment, symptoms, comorbid conditions, and medication-herb-supplement use also was obtained via the information form.

Sleep quality was measured using the PSQI, a self-rated standardized measure capable of detecting changes in patterns and quality of sleep over time. Nineteen individual items are used to generate seven component scores, with a possible range of subscale scores from 0–3. The sum of the component scores yields a global sleep quality score (range = 0–21), with higher scores indicating worse sleep quality. In studies comparing the psychometric properties of the PSQI in "good" sleepers (i.e., healthy participants) versus "poor" sleepers (e.g., depressed patients, sleep-disordered patients), acceptable measures of internal consistency (Cronbach alpha = 0.83), test-retest reliability (r = 0.85 for global PSQI score across 28 days), and discriminant validity have been documented (Buysse, Reynolds, Monk, Berman, & Kupfer, 2000).

Mood was measured using the POMS-Brief, which uses the same scale as the POMS standard form but includes only 30 items and takes about five minutes to complete. Six dimensions of mood were measured on a five-point intensity scale: tension-anxiety, depression-dejection, anger-hostility, vigor-activity, fatigue-inertia, and confusion-bewilderment. Predictive and construct validity, and a highly satisfactory level of internal consistency at 0.9 or higher, have been documented for the POMS-Brief. Correlation coefficients between the POMS standard and the brief scale have been reported at greater than 0.95, and test-retest reliability ranges from 0.65 (vigor) to 0.74 (depression) (Lorr, McNair, Heuchert, & Droppleman, 2003). For the current study, the total score in the POMS-Brief was used for the analysis.

Stress was assessed using salivary cortisol analysis, which reflects the functioning of the hypothalamic-pituitary-adrenal axis (Dedovic, Duchesne, Andrews, Engert, & Pruessner, 2009; Hellhammer, Wüst, & Kudielka, 2009). Saliva specimens were obtained using the passive-drool method before and after all yoga sessions. Participants refrained from eating and smoking for one hour prior to specimen collection; after rinsing their mouth with water, they released saliva that had pooled in their mouths into collection containers. Specimens were refrigerated within 30 minutes of collection to avoid bacterial growth and

subsequently were stored in a freezer at –80°C until analysis in the biophysical laboratory. Analysis was conducted by a certified technician using a Salimetrics expanded-range, high-sensitivity, salivary cortisol enzyme immunoassay kit. The assay was designed to capture the lower levels of cortisol found in saliva when compared to serum. Intra-assay coefficient of variation ranged from 3.35%–3.65%. Inter-assay coefficient of variation ranged from 3.75%–6.41%. Linearity of dilution tests yielded recovery results from 80%–98%. Sensitivity was found to be less than 0.003 mg/dl.

The SF-36, used as a general survey measure of QOL, has been extensively used in general population studies, policy evaluation, and clinical research. Reliability estimates for the two summary scores for mental and physical health usually exceed 0.9. Content, concurrent, criterion, construct, and predictive validity also have been well established (Ware, 2000). A macro from SAS, version 9.2, was used to calculate the physical and mental QOL scores in the SF-36 subscales.

Breathing ease was determined using a numeric visual analog scale (VAS) before and after yoga classes. The scale has been widely used as a subjective measure of dyspnea intensity and discomfort and served as a guide to determine potential breathing changes (Gift, 1989; Gift & Narsavage, 1998). One or two RNs also remained in the yoga room to discretely observe participants and assess for breathing difficulty (i.e., increased shortness of breath, wheezing, and coughing).

Feasibility was determined by the ability to participate in the yoga class protocol (asanas, pranayama, and dhyana) throughout the intervention phase, frequency of class attendance, number and reason for class absence, and time spent on home practice. Although study participants were reminded to practice at home at the end of each class session, specific instructions on how often to practice and what poses to use were purposely not given so as to determine the choices made by individual participants regarding their yoga practice, providing insight into what individuals preferred. To guide home practice, a yoga manual was given to each participant at the beginning of the intervention. The manual was created by the yoga instructor and the principal investigator and included images of the yoga protocol poses and practices. Images were added to the yoga manual by the study's principal investigator as they were practiced in class. Home practice was measured using a self-report log developed by the researchers to record the poses, meditations, and breathing exercises selected by participants at home. A yoga CD audio-recorded by the yoga instructor was given to each participant at the end of the intervention to guide continuing home use.

Evaluation of the yoga experience was conducted using a written evaluation form developed by the principal investigator, which was completed by each participant at the end of the study. Open-ended questions that focused on the patient's experience during the yoga classes were asked on a paper-and-pencil evaluation form. Examples of included questions are (but are not limited to): (a) What did you like/dislike about the yoga classes? (b) What would you like to see changed with the yoga classes? and (c) Did you benefit from the yoga classes? If so, please describe how? Participants also were asked a series of questions during the phone interviews at three months poststudy and during the in-person meeting at the six-month follow-up session. Subjective feedback in the form of comments voluntarily offered by participants at the time of each yoga class (before and after) also was recorded for evaluative purposes. These evaluation comments were gathered to determine potential changes needed for future studies. No qualitative analysis was conducted with the pilot data, although this is planned for an upcoming randomized, controlled trial.

All measures (questionnaires and biologic sampling) were completed by each participant at each study session during the 14-week period and prior to yoga classes during the intervention phase. Breathing ease was assessed using the VAS at each session and before and after every yoga class during the intervention phase. Additional measures that were taken have been previously reported in the literature (Fouladbakhsh, Davis, & Yarandi, 2013).

Knowledge Translation

Yoga offers potential benefits for symptom management and health promotion and should be considered for integration into cancer care.

Oncology nurses should be aware of evidence-based complementary therapies and promote open dialogue, appropriate decision making, and safe use by patients.

Continued research is needed to more fully understand the biopsychosocial effects of yoga.

Procedures

The study was approved by the institutional review board (IRB) at a Carnegie level 1 classification research university in the midwestern United States. Members of the College of Nursing Yoga and More Research Interest Group completed mandatory IRB research training prior to active involvement in study procedures. The group was created and continues to be directed by the principal investigator, and includes students in nursing and medicine, clinical faculty colleagues, and practicing nurses. All research team members were trained in the

study protocol, data collection, and biologic specimen measurement (Fouladbakhsh, Szczesny, Kowalewski, & Blair, 2013).

Following enrollment, the research team met with participants once per week at the study sessions. The preintervention phase (weeks 1–3) focused solely on baseline data collection, the intervention phase (weeks 4–11) included one 40-minute yoga class per week and data collection, and the postintervention phase (weeks 12–14) included data collection and reports on continuing home practice. Questionnaires and biophysiologic measures were completed weekly throughout the 14-week period. Poststudy follow-up was conducted using phone interviews at three months and in-person interviews at six months.

Data Analysis

The data analysis for this study included descriptive statistics and repeated-measures analysis using SPSS® 19.0 and SAS software to capture within-subjects as well as between-subjects effects. Because this was a relatively short time series (14 measurement occasions), two basic analysis options were conducted. The first was for the survivors who participated in the study to the end. So the researchers would have complete measures, the analysis employed multivariate repeated measures analysis of variance models testing the hypothesis that the slopes of mean changes in the outcome variables differ among the three time segments (preintervention, concurrent intervention, and postintervention periods) (Winer, Brown, & Michels, 1991). The second analysis option, given the likely attrition, included all observations, including participants who did not complete all measurement waves, to make use of pooled time series regression models using a random effects estimator (Liang & Zeger, 1986). In this type of analysis, testing for contrasts in the slopes of consecutive wave intercepts can be used to detect discontinuities in mean outcome changes among the three main observation segments: preintervention, concurrent intervention, and postintervention periods.

Results

Demographic and Health Information

Sixteen individuals responded to the study flyers over the three-week recruitment period, and nine who met eligibility criteria were enrolled. Participants ranged in age from 52–78 years ($\bar{X}$ = 67 years, SD = 6.5) and included three men and six women who had been diagnosed with stages I–IIIa NSCLC. Seven participants successfully completed the entire study. One male participant withdrew and a female participant unexpectedly died before the yoga sessions began. Participants came from a wide geographic area (30–45 minutes average travel time), and attendance exceeded 95%. Infrequent absences were caused by travel issues and minor illness. Most participants were Caucasian (n = 8) of varying ethnicity, and one was African American. The majority was married (n = 7) and had completed some level of college education (n = 6) (see Table 2).

Cancer stage at diagnosis varied across the group, with three participants reporting stage I disease, three reporting stage II, and three reporting stage III NSCLC. Treatment included surgery (thoracotomy or lobectomy) (n = 9), chemotherapy (n = 6), and radiation (n = 4). Comorbid conditions included emphysema, COPD, asthma, osteoarthritis, fibromyalgia, irritable bowel syndrome, headaches, back pain, hypertension, cardiac problems, and anxiety. Three participants reported concurrent chronic respiratory illness. None of the participants currently smoked, although one reported a 40-year history of tobacco use. Reports of dyspnea varied at different times during the study and ranged from mild to moderately severe (2–8) on the 0 (no dyspnea) to 10 (severe dyspnea) VAS. Modifications to the yoga protocol allowed for participation without increase in dyspnea or discomfort with movement and breathing practices. All participants were able to complete the eight-week yoga protocol and practice at home without reports of increased shortness of breath or respiratory distress.

Sleep, Mood, Salivary Cortisol, and Quality of Life

PSQI data indicated that sleep efficiency increased significantly over time ($p < 0.02$), whereas overall sleep quality scores remained the same during the pre- and postintervention phases (PSQI score = 2.43). Sleep duration was 6.25 and 6.13 hours pre- and postintervention, respectively, and sleep latency remained within the normal range both pre- and postintervention ($\bar{X}$ = 21.6 minutes). Use of sleep medications decreased 65% across the intervention period, which may suggest potential improvement in sleep onset and sleep maintenance (sleep disturbance). No changes were noted in number of days of dysfunction from sleepiness.

Mood significantly improved as noted by average change in the POMS-Brief scores over time ($F = 2.93$, $p < 0.002$). That pattern of decline in scores (lower score indicates improvement) continued during the eight-week intervention period and persisted during the postintervention phase. The estimated average score of the POMS-Brief was 37 at yoga session 1 (week 4) and 15 at yoga session 8 (week 11), as noted in Figure 2.

Used as a physiologic measure of stress, salivary cortisol samples were collected at the same time (midmorning) at each study session from all participants

using the passive-drool method. Participants verbalized no complaints about specimen collection, and all were able to complete the task in about five minutes. A decrease in mean salivary cortisol levels for the group was noted (preintervention = 0.3695 mcg/dl, postintervention = 0.1186 mcg/dl), suggesting reduced stress during the intervention period (see Figure 3).

QOL, as measured by the SF-36, showed significant improvement in both the mental and physical subscales. The SF-36 mental subscale scores increased significantly ($F = 2.34$, $p < 0.014$) and remained high over time, indicating improved mood and QOL. A significant concurrent increase in physical health scores ($F = 20.97$, $p < 0.0001$) also was noted (see Figure 4).

Yoga Home Practice and Self-Reports

All participants verbalized that they enjoyed the yoga classes, and all reported an increased sense of calm, relaxation, and ability to handle stressful events that extended outside of class. Four of the participants stated that they were able to use yoga breathing exercises to remain calm during anxiety-filled medical procedures (e.g., blood draws) and with stressful home situations (e.g., care of medically frail spouse). Home practice using the yoga manual was documented in written logs by all of the participants; 33% reported doing yoga daily and 67% reported doing yoga two to three times per week. Positive feedback was received regarding the illustrations and directions provided in the yoga manual. Home practice continued for all five participants who were available for interview at the six-month poststudy session (two participants did not attend this follow-up; therefore, 71% were interviewed and were still practicing). In addition, three participants were practicing in community yoga classes, including the oldest participant who was now able to practice on her mat rather than in a chair.

Limitations

The small sample size and lack of a randomized, controlled design limited generalizability of findings and conclusions that can be drawn about a cause-and-effect relationship between yoga practice and the study outcomes. A once-per-session collection of salivary cortisol, although providing an indication of cortisol changes over time and feasibility in the study population, may be influenced by extraneous factors, unlike a 24-hour diurnal collection. This latter method was not possible for this pilot because of funding restrictions, but is planned for a future clinical trial.

Discussion

The one-group design used for this research was effective in achieving the study aims and identified patterns of change over time, suggesting potential benefits of yoga for NSCLC survivors. This pilot study suggests that patients with lung cancer are interested in yoga and may be able to actively participate in this physically challenging movement practice that includes calming meditation and breathing exercises.

Table 2. Sample Demographics (N = 9)

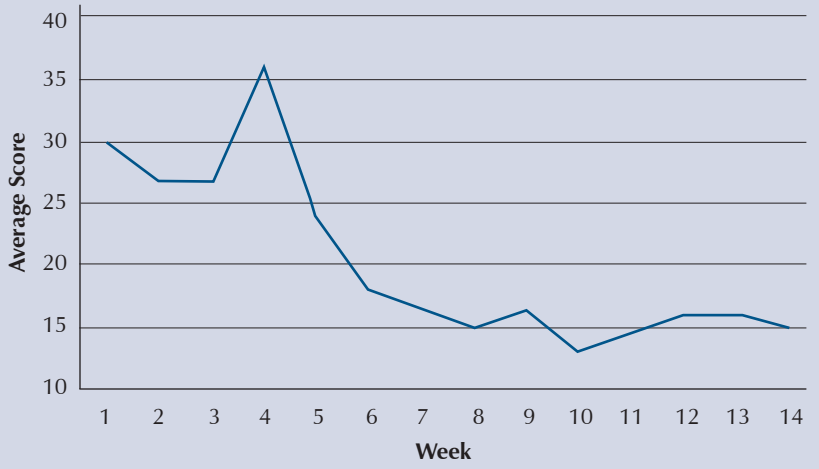
Characteristic	$\bar{X}$	SD	Range
Age (years)	67	6.5	52–78
Participants reporting dyspnea (%)	33	6.25	25–50

Characteristic	n
Gender	
Female	6
Male	3
Race	
Caucasian	8
African American	1
Marital status	
Married	7
Other	2
Education	
High school	2
Some college	6
Missing data	1
Cancer stage	
Ia or Ib	3
IIa or IIb	3
IIIa	3
Cancer treatment (completed)[a]	
Surgery	9
Chemotherapy	6
Radiation	4
Time since diagnosis	
1 year or less	4
2 years	4
3 years	1
Tobacco use	
Nonsmoker	9
History of smoking	1
History of respiratory illness[b]	3

[a] More than one treatment per patient could be selected.
[b] Asthma, chronic obstructive pulmonary disorder, emphysema

Feasibility and Factors Influencing Participation

The current study suggests that yoga is a feasible CAM practice for post-treatment NSCLC survivors who have a complex array of symptoms and concurrent medical conditions and who may benefit from the coordinated yogic components of exercise, breathing, and meditation. Those selecting yoga differed in age, gender, race, and cancer stage, although a larger sample is needed to understand interaction effects between demographic factors, cancer stage, and yoga outcomes. The sample in the current study included more women, which is characteristic of CAM use and yoga, in particular, in the United States (Fouladbakhsh



Note. A significant improvement was noted in POMS-Brief over time. Lower scores indicate an improvement in mood ($F = 2.93$, $p < 0.02$).

Note. Weeks 1–3 were the preintervention phase, weeks 8–11 were the intervention phase, and weeks 12–14 were the postintervention phase.

Figure 2. Average Change in Profile of Mood States–Brief (POMS-Brief) Over Time

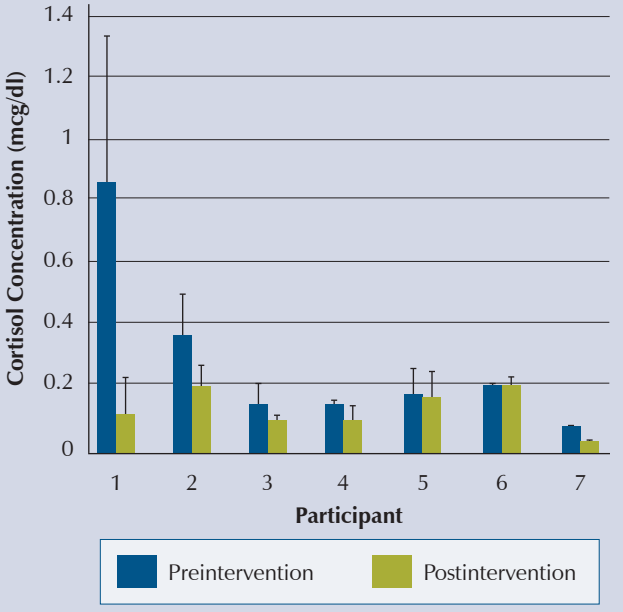
& Stommel, 2007, 2008). The male participant who withdrew stated he did not need yoga because he was "less sick" than the others, highlighting the importance of gender-related factors influencing illness perception, self-care, and symptom management (Fouladbakhsh & Stommel, 2008, 2010).

Among the study sample, dyspnea was a recurrent factor, although it did not interfere with participation in the yoga intervention or home practice. Participants were able to do the poses and breathing exercises without an increase in dyspnea rating and discomfort, suggesting feasibility of yoga for this population. Having a protocol developed with a focus on poses and practices to extend the breath, increase exhalation, reduce stress, and increase relaxation may have enhanced feasibility for lung cancer survivors. In addition, the ability to modify the protocol without compromising the effect allowed participants to practice within their limits (e.g., by sitting in a chair versus on the mat), further enhancing participation feasibility.

Effects on Sleep, Mood, Salivary Cortisol, and Quality of Life

This study supports previous findings in the literature on improved sleep, mood, and QOL with yoga practice in patients with lymphoma or breast cancer (Carson et al., 2009; Chadwani et al., 2010; Cohen et al., 2004; Mustian et al., 2010; Rao et al., 2009; Smith & Pukall, 2009; Speed-Andrews, Stevinson, Belanger, Mirus, & Courneya, 2010; Ulger & Yagli, 2010; Vadiraja et al., 2009). The PSQI was able to capture changes in sleep efficiency, and the decreased use of sleep medication suggests potential improvement in sleep onset and sleep maintenance, both of which require additional study. Whereas yoga has been used for years to promote sleep, additional understanding of the biophysiologic mechanisms is needed and should be closely examined in relationship to use of conventional medications for symptom management.

A steady improvement in the POMS-Brief scores was primarily noted throughout the intervention phase, suggesting that yoga may decrease stress and thereby elevate mood. What is unclear is the role of social support provided by group practice and contact with providers (yoga teacher and research team members) on mood and stress level. Therefore, future work should deconstruct the effects of yoga, providing information on the outcomes of the various yogic components and the influence of group practice. Supporting the mood changes noted, the pattern of decreased salivary cortisol levels with yoga practice over time suggests possible stress reduction. The use of the passive-drool method for saliva collection was well received by the study participants, and subsequent analysis at the biophysical laboratory was efficient and unprob-



Note. A decrease was noted in the level of salivary cortisol concentration over time as depicted for the seven participants who completed the study.

Figure 3. Average Salivary Cortisol Concentrations Pre- and Postintervention

lematic. Inclusion of the cortisol measurement allowed the study team to determine the feasibility of using the passive-drool method, which is important for a future planned clinical trial. Cortisol data, although only suggestive in this pilot, support continued examination in relationship to yoga practice among NSCLC survivors. The use of a 24-hour diurnal salivary cortisol sampling over a three-day period will extend study findings. The necessity of biophysiologic measurement to understand the mechanisms of how yoga affects the mind-body-spirit connection also has been reinforced by this study.

Viewing the data with a wide lens allows researchers to see the potential interactions among all study variables in the current model, with improved sleep and mood and decreased stress all contributing to the bigger picture of enhanced QOL among patients with NSCLC. Future research using a larger sample will allow for statistical analysis of these interaction effects, increasing the understanding of beneficial outcomes and potential risks during the survivorship period. That understanding is necessary if yoga is to successfully complement the symptom management plan and be considered for integration in conventional oncology settings.

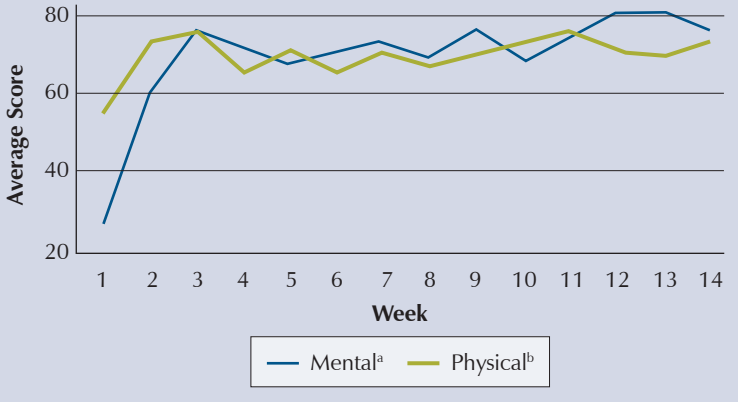
Implications for Future Research

Using a unique methodology to promote research and CAM knowledge among clinicians and students made this pilot study possible. The enthusiasm of the volunteer research team members was unfailing. In addition, the involvement of clinical practitioners, nursing students, and bedside nurses was critical to the success of the research process—from the generation of research questions at the bedside to conducting the study, and to data analysis and publication. Much growth was noted among the students, nurses, and clinical faculty with regard to the research process, data collection, biophysiologic measurement, and yoga philosophy and practice.

The Yoga and More (CAM) research group members continue to work together developing presentations, publications, and research proposals, and they have highlighted the need for creative research involvement. Their desire to become involved in research, coupled with the principal investigator's openness and inclusive approach, promoted learning about yoga and exploration of beliefs about CAM and patient care. This environment provided learning in action and allowed nurses to explore their perceptions and knowledge, which ultimately affect how they care for patients with cancer who choose CAM therapies. In addition, understanding a complex practice such as yoga will allow nurses to provide appropriate and informed guidance for interested cancer survivors.

Also of importance to CAM research is the use of standardized intervention protocols. Yoga, with its many traditions of practice, is very diverse yet beautiful in its simplicity. Advocated as a way of living, yoga includes many variations and thousands of poses and practices, which complicate the research process and clinical application. Nurses need to understand this diversity as they work with patients who seek to practice yoga. Attempts should be made to match the class (tradition) to individual needs. In addition, standardization of yoga research protocols should be developed that do not negatively impact the essence of practice. That will allow comparisons across studies, thereby strengthening research findings.

The protocol developed for this pilot study focused on the potential respiratory problems of those with lung cancer (and concurrent COPD and emphysema) and the difficulties that may occur with exercise and movement. Including a team of experts from the American Viniyoga Institute with experience in chronic respiratory conditions resulted in a protocol that emphasized postures (asanas) and breathing exercises (pranayama) that do not excessively strain breathing and that aimed to slow and deepen the breath. The protocol successfully allowed all participants to practice without compromising breathing. Despite having had thoracic surgery, all participants were able to complete the yoga sessions without discomfort or dyspnea. Modifications built into the standardized yoga protocol allowed for individualization of the poses without compromising overall effect.



[a] $F = 2.34$, $p < 0.014$

[b] $F = 20.97$, $p < 0.0001$

Note. A significant improvement was noted in both physical and mental quality-of-life scores during the intervention, which continued over the post-intervention period.

Note. The yoga intervention took place during weeks 4–11.

Figure 4. Average Change in Physical and Mental Quality of Life as Measured by the Medical Outcomes Survey SF-36®

To enhance consistency across studies, a conceptual model should be used so that factors predicting use of CAM therapies can be identified. The CAM Healthcare Model worked effectively for this study; however, a larger sample is needed to statistically examine direct and indirect predictive relationships among the predisposing, enabling, and need variables, and yoga practice. That will help healthcare providers understand the relationship between predisposing factors such as age, gender, race, and beliefs prompting use of CAM practices such as yoga for health promotion and symptom management. Future studies also should examine the interplay among the individual components of yoga, exploring the physiologic and psychological mechanism affecting outcomes of practice. Deconstructing yoga (i.e., identifying how each component affects the mind-body system, and what "dose" is needed to produce beneficial physiological and psychological outcomes) will illuminate how each component affects the body. Understanding these interaction effects will promote the continued development of yoga protocols based on research evidence and scientific rationale. Large-scale randomized, controlled trials also will shed light on how yoga is similar, and yet different, from other exercise, allowing researchers to determine the unique contributions of both.

Implications for Nursing Practice

Despite respiratory disease and cancer treatment that involved surgery, chemotherapy, and radiation, yoga was possible for this small sample of lung cancer survivors. A standardized protocol that can be uniquely tailored to individual physical limitations, including respiratory compromise, and that builds on a solid theoretical foundation for practice, is essential. This will serve to facilitate yoga practice, maximize benefits while maintaining safety, and promote comparisons across studies. As cancer survivors increasingly recognize the value of exercise and movement, yoga will extend their exercise options. Therefore, fully understanding how yoga affects the body, mind, and spirit, as well as the appropriateness of yoga for diverse groups of individuals across the cancer trajectory, is imperative. As evidence emerges, education also is needed for patients, nurses, physicians, and researchers. In this way, potential benefits may be shared, risks understood, and a place for yoga within health care clearly identified.

Conclusions

The current study suggests that yoga practice is a feasible option for NSCLC survivors at varying stages (I–IIIa) of the illness trajectory, and may offer benefits for symptom management and improved QOL. Additional research with larger sample sizes and strong randomized, controlled designs are warranted to more clearly identify biopsychosocial outcomes, potential risks, and overall effect on QOL. Understanding the interaction effects of the various practice components will extend the science of yoga, allowing providers to appropriately guide those burdened by cancer and other chronic illness. In addition, as so eloquently expressed by participants who "often felt blamed for [their] illness," yoga exemplifies acceptance and nonjudgment, for which they were grateful.

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