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Studien-Review

Wie Yoga Krebskranken hilft

Sowohl während der Therapie als auch nach deren Beendigung profitieren Krebspatienten von einer regelmäßigen Yogapraxis. In einem Review randomisierter, kontrollierter Studien zeigt sich ein klarer Nutzen in verschiedenen Bereichen der Lebensqualität und eine Verbesserung von Fatigue und Stressverarbeitung.

Von Christine Starostzik

Sowohl während der Therapie als auch nach deren Beendigung profitieren Krebspatienten von einer regelmäßigen Yogapraxis.

WINSTON-SALEM. Mithilfe von Yoga können krankheits- und therapiebedingte Symptome bei Krebspatienten verringert werden. Immer mehr Krebszentren informieren über die damit verbundenen Vorteile wie Entspannung und einen besseren Umgang mit der Krankheit.

Auch die Zahl der Studien zu diesem Thema hat in den vergangenen Jahren erheblich zugenommen. Dr. Suzanne Danhauer von der Wake Forest School of Medicine in Winston-Salem und Kollegen haben sich daher einen Überblick über die aktuelle Datenlage verschafft und diese in einem Review zusammengefasst (Cancer 2019; online 1. April).

Insgesamt werteten die Wissenschaftler 29 randomisierte kontrollierte Studien zum Einfluss von Yoga auf das Befinden erwachsener Krebspatienten aus.

Positiver Effekt auf Lebensqualität

In 13 Studien nahmen die Patienten noch während der Behandlung an Yogakursen teil, in zwölf Studien im Anschluss an die Therapiephase, und in vier Studien wurde Yoga entweder während der Behandlungsphase oder danach ausgeübt.

Als Vergleichsgruppen dienten Patienten, die andere Sportarten betrieben, oder solche, die auf einer Warteliste für einen Yogakurs standen beziehungsweise nur die Standardtherapie erhielten. Untersucht wurden die unterschiedlichsten Yogaarten, und auch die Trainingszeiten waren sehr heterogen. Der größte Teil der Studienteilnehmer waren Brustkrebspatientinnen.

In fünf von sechs Studien zeigten sich positive Effekte einer Yogapraxis während der Krebstherapie auf die allgemeine Lebensqualität. Dies betraf vor allem die Bereiche des körperlichen, emotionalen, sozialen und kognitiven Wohlbefindens.

Die Fatigue nahm bei den Krebspatienten in fünf von acht Untersuchungen signifikant ab. In einigen Studien ergaben sich zudem Verbesserungen beim Stressempfinden sowie bei verschiedenen Biomarkern wie proinflammatorischen Zytokinen und Cortisol.

Weniger Biomarker für Stress

Auch im Anschluss an die Behandlungsphase belegt die Mehrzahl der Studien eine signifikante Verbesserung der Lebensqualität in den Yogagruppen gegenüber den Kontrollen. In sieben von zehn Studien konnte die Fatigue reduziert werden. Vier von sechs Untersuchungen ergaben einen besseren Schlaf.

Zusätzlich verbesserten sich durch das Yoga Kognition, Lymphödeme, Vitalität. Auch nahm die Konzentration verschiedener Biomarker für Stress und Entzündungsgeschehen ab. In den Studien mit Patienten sowohl während als auch nach der Krebstherapie ergab sich für die Yogagruppen kein Vorteil bezüglich einer Fatigue, dafür aber hinsichtlich Lebensqualität, Schlaf und Depression.

Allerdings seien Studien mit kombinierten Gruppen wegen der heterogenen Zusammensetzung der Teilnehmer weniger aussagekräftig, wie die Studienautoren um Danhauer bemerken.

Empfehlung an Krebspatienten

In keiner der untersuchten Studien ereigneten sich schwere unerwünschte Ereignisse, die durch Yoga bedingt waren. Angesichts der sicheren Anwendung in Verbindung mit den klar erkennbaren Vorteilen und den relativ geringen Kosten erscheine es sinnvoll, Krebspatienten zu ermuntern, an entsprechenden Programmen teilzunehmen, so das Resümee der Wissenschaftler.

Da verschiedenste Aspekte im Krankheitsverlauf, während der Therapie und auch nach deren Beendigung positiv durch eine regelmäßige Yogapraxis beeinflusst werden können, sollte

Yoga in das Behandlungskonzept von Krebspatienten aufgenommen werden.

Brustkrebs: Abbau von Ängsten durch Yoga

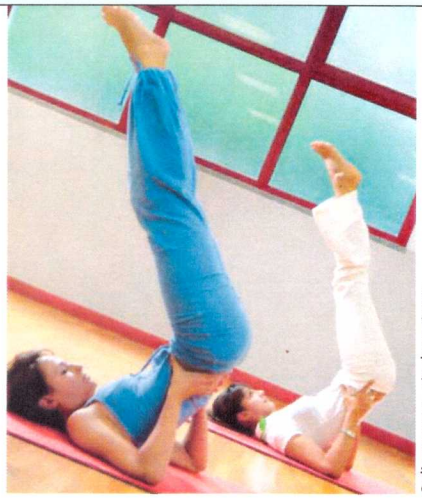
Angst und Depression zählen zu den häufigsten psychologischen Problemen bei Krebspatienten. Kann Yoga, das eine beruhigende und ausgleichende Wirkung besitzt, auch die Ängste, die mit einer Krebserkrankung und deren Therapie einhergehen, abbauen?

Dieser Frage ging die vorliegende Vergleichsstudie nach. Dazu wurden zunächst 98 Patientinnen mit Brustkrebs im Stadium II und III, die sich in ambulanter Behandlung befanden, vor der Primärtherapie in zwei Gruppen randomisiert: Die Patientinnen nahmen entweder täglich mindestens 60 Minuten lang an einer Yoga-Sitzung teil oder es wurde ihnen während ihrer Krankenhausbesuche routinemäßige Supportivtherapie gewährt (Kontrollgruppe).

In die Analyse gingen letztlich nur Frauen ein, die operiert und im Anschluss adjuvant bestrahlt worden waren und sechs Zyklen Chemotherapie erhalten hatten (Yoga: n = 18; Kontrolle: n = 20). Zur Beurteilung des angstabbauenden Effektes wurden Spielbergers „State-Trait-Angst-Inventar" (STAI) zur Erfassung der aktuellen und habituellen Angst sowie eine Symptom-Checkliste verwendet.

Patientinnen, die an dem Yoga-Programm teilnahmen, berichteten gegenüber der Kontrollgruppe insgesamt über weniger Angst. Dabei wurde die subjektiv empfundene Angst als aktueller Zustand (State-Angst) durch das Yoga-Programm nach Operation, während sowie nach Bestrahlung bzw. Chemotherapie signifikant geringer. Die Angst als Eigenschaft (Trait-Angst) war im Vergleich zur Kontrollgruppe sowohl nach Operation als auch nach Bestrahlung bzw. Chemotherapie deutlich abgebaut worden. Des Weiteren konnte während der verschiedenen Stadien der konventionellen Behandlung eine positive Korrelation zwischen State- und Trait-Angst sowie Schwere und Belastung der Therapie-bedingten Symptome festgestellt werden.

Fazit: Die auf Yoga beruhenden Maßnahmen konnten bei Brustkrebspatientinnen die reaktive (State-Angst) wie auch die habituelle Angst (Trait-Angst) effektiv abbauen. Dies könne möglicherweise auf den Stressabbau und die Hilfe zur besseren Bewältigung der Erkrankung während der verschiedenen Stadien der konventionellen Therapie zurückgeführt werden, erklärten die Autoren. **aro**



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Yoga macht nicht nur fit, sondern hilft auch, Stress und Ängste zu überwinden – vor allem während einer Brustkrebserkrankung.

Rao MR et al. Anxiolytic effects of a yoga program in early breast cancer patients undergoing conventional treatment: A randomized controlled trial. **Complement Ther Med** 2009; 17: 1–8.

Ambulant signifikante Symptomkontrolle

Patienten mit metastasierten Krebserkrankungen benötigen Symptomkontrolle und psychosoziale Unterstützung. Was die ambulante Betreuung durch eine onkologische Palliativeinrichtung dabei leisten kann, macht eine kanadische Studie deutlich.

Die prospektive Phase-II-Studie umfasste 150 Patienten mit metastasierter Krebserkrankung, die ambulant an der Oncology Palliative Care Clinic des Princess Margaret Hospital in Toronto betreut wurden. Sie erhielten eine ausgiebige Konsultation von etwa 90–120 Minuten Dauer durch ein Palliativteam, bestehend aus Palliativmediziner, Psychiater, Sozialarbeiter und bei Bedarf anderen Spezialisten. Die weitere Betreuung mittels Telefonkontakten und wenn nötig auch erneuten Sprechstundenbesuchen wurde individuell angepasst.

Im Rahmen der Palliativbetreuung erhielten 66% der Patienten neue Medikamente, 34% wechselten die vorhandene Medikation, 18% stoppten die Einnahme bestimmter Arzneimittel. Weitere Dienste wurden eingeschaltet, vor allem häusliche Pflege (46,7%), palliativmedizinische Betreuung zu Hause (37,3%) und Sozialarbeiter (29,3%). Vor Intervention, nach einer Woche und nach einem Monat bestimmte man mittels ESAS (Edmonton Symptom Assessment Scale) und einer patientenadaptierten FAMCARE (Family Satisfaction with Advanced Cancer Care)-Skala Symptomkontrolle und Patientenzufriedenheit. 123 Patienten füllten die Fragebögen nach einer Woche aus, 88 nach einem Monat.

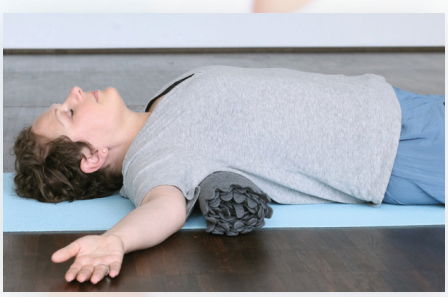
Der ESAS-Distress-Score war an beiden Erhebungszeitpunkten signifikant zurückgegangen. Schmerz, Fatigue, Übelkeit, Depression, Angst, Schläfrigkeit, Appetit, Dyspnoe, Schlaflosigkeit und Obstipation hatten sich signifikant gebessert. Auch im FAMCARE-Score, der die Zufriedenheit der Patienten mit der Intervention widerspiegelt, fand sich eine signifikante Verbesserung.

Fazit: Die ambulante Betreuung durch eine onkologische Palliativeinrichtung wirkt sich positiv auf Symptomkontrolle und Patientenzufriedenheit aus. Die kanadische Arbeitsgruppe unternimmt jetzt eine randomisierte kontrollierte Studie, in der es zusätzlich um den Einfluss einer frühen Palliativintervention auf die Lebensqualität sowohl der Patienten als auch ihrer pflegenden Angehörigen geht. **uwe**

Follwell M et al. Phase II study of an outpatient palliative care intervention in patients with metastatic cancer. **J Clin Oncol** 2009; 27: 206–13.

YOGA UND KREBS

Zur Gesundheit im Interview mit der Yogalehrerin Gaby Kammler



Auf welche Weise kann Yoga bei Krebserkrankungen eingesetzt werden?

Yoga kann die körperliche und emotionale Situation von Menschen, die von einer Krebserkrankung betroffen sind, deutlich verbessern.

Durch gezielte körperliche Übungen wird der Körper kräftiger und beweglicher. Forschungsergebnisse belegen zudem, dass Yoga einen positiven Einfluss auf die Nebenwirkungen von Krebstherapien haben kann.

Setzt man bei Krebserkrankungen spezielle Formen des Yoga ein?

Yogastunden für Menschen mit Krebs sollten nur von erfahrenen und speziell dafür ausgebildeten Yogalehrern angeboten werden. Der Yoga Stil spielt dabei eine eher untergeordnete Rolle. Unsere speziellen Yoga&Krebs Kurse sind auf die besonderen körperlichen und emotionalen Bedürfnisse von Menschen mit einer Krebserkrankung zugeschnitten, dabei werden typische Nebenwirkungen von Krebstherapien berücksichtigt. Die Teilnehmer erlernen neben Entspannungsübungen und kleinen Meditationen, die in dieser lebensverändernden Situation hilfreich sind, auch bestimmte Übungssequenzen, die sie zu Hause fortführen können.

Darf man Yoga in jedem Stadium seiner Krebstherapie machen?

Die Teilnahme an Yoga&Krebs Kursen ist fast in jedem Therapiestadium möglich. Sowohl während der Chemotherapie, während der Bestrahlung oder auch nach Abschluss aller Behandlungen sind diese Stunden gut geeignet. Auch bereits kurze Zeit nach einer Operation und mit einem Port ist eine Teilnahme möglich.

Am meisten schätzen die Teilnehmer unserer Yoga-Kurse, dass sie selbst aktiv dazu beitragen können, dass es ihnen besser geht!

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J Clin Oncol. 2014 Apr 1;32(10):1040-9. doi: 10.1200/JCO.2013.51.8860. Epub 2

Yoga's impact on inflammation, mood, and fatigue in breast cancer survivors: a randomized controlled trial.

Kiecolt-Glaser JK[1], Bennett JM, Andridge R, Peng J, Shapiro CL, Malarkey WB, Emery CF, Layman R, Mrozek EE, Glaser R.

Author information

Abstract

PURPOSE: To evaluate yoga's impact on inflammation, mood, and fatigue.

PATIENTS AND METHODS: A randomized controlled 3-month trial was conducted with two post-treatment assessments of 200 breast cancer survivors assigned to either 12 weeks of 9(minute twice per week hatha yoga classes or a wait-list control. The main outcome measures were lipopolysaccharide-stimulated production of proinflammatory cytokines interleukin-6 (IL- tumor necrosis factor alpha (TNF-α), and interleukin-1β (IL-1β), and scores on the Multidimensional Fatigue Symptom Inventory-Short Form (MFSI-SF), the vitality scale from th Medical Outcomes Study 36-item Short Form (SF-36), and the Center for Epidemiological Studies-Depression (CES-D) scale.

RESULTS: Immediately post-treatment, fatigue was not lower (P > .05) but vitality was higher = .01) in the yoga group compared with the control group. At 3 months post-treatment, fatigue was lower in the yoga group (P = .002), vitality was higher (P = .01), and IL-6 (P = .027), TNF (P = .027), and IL-1β (P = .037) were lower for yoga participants compared with the control group. Groups did not differ on depression at either time (P > .2). Planned secondary analyse showed that the frequency of yoga practice had stronger associations with fatigue at both pos treatment visits (P = .019; P < .001), as well as vitality (P = .016; P = .0045), but not depressi (P > .05) than simple group assignment; more frequent practice produced larger changes. At months post-treatment, increasing yoga practice also led to a decrease in IL-6 (P = .01) and I 1β (P = .03) production but not in TNF-α production (P > .05).

CONCLUSION: Chronic inflammation may fuel declines in physical function leading to frailty disability. If yoga dampens or limits both fatigue and inflammation, then regular practice could have substantial health benefits.

TRIAL REGISTRATION: ClinicalTrials.gov NCT00486525.

PMID: 24470004 PMCID: PMC3965259 DOI: 10.1200/JCO.2013.51.8860

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Psychooncology. 2006 Oct;15(10):891-7.

A pilot study of yoga for breast cancer survivors: physical and psychological benefits.

Culos-Reed SN[1], Carlson LE, Daroux LM, Hately-Aldous S.

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Abstract

BACKGROUND: Physical activity provides a number of physical and psychological benefits to cancer survivors, including lessening the impact of detrimental cancer-related symptoms and treatment side-effects (e.g. fatigue, nausea), and improving overall well-being and quality of life. The purpose of the present pilot study was to examine the physical and psychological benefits afforded by a 7-week yoga program for cancer survivors.

METHOD: Eligible participants (per-screened with PAR-Q/PAR-MED-X) were randomly assigned to either the intervention (n=20) or control group (n=18). All participants completed pre- and post-testing assessments immediately before and after the yoga program, respectively.

RESULTS: The yoga program participants (M age=51.18 (10.33); 92% female) included primarily breast cancer survivors, on average 55.95 (54.39) months post-diagnosis. Significant differences between the intervention and the control group at post-intervention were seen only in psychosocial (i.e. global quality of life, emotional function, and diarrhea) variables (all p's <0.05). There were also trends for group differences, in the hypothesized directions, for the psychosocial variables of emotional irritability, gastrointestinal symptoms, cognitive disorganization, mood disturbance, tension, depression, and confusion (all p's <0.10). Finally, there were also significant improvements in both the program participants and the controls from pre- to post-intervention on a number of physical fitness variables.

CONCLUSIONS: These initial findings suggest that yoga has significant potential and should be further explored as a beneficial physical activity option for cancer survivors. Future research might attempt to include a broader range of participants (e.g. other types of cancer diagnoses, male subjects), a larger sample size, and a longer program duration in an RCT.

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ORIGINAL PAPER

Breathwork: An Additional Treatment Option for Depression and Anxiety?

Lloyd Lalande · Matthew Bambling · Robert King · Roger Lowe

Published online: 1 March 2011

Abstract Breathwork is an increasingly popular experiential approach to psychotherapy based on the use of a specific breathing technique, however, claims of positive mental health outcomes rely on anecdotal clinical evidence. To ascertain the likely efficacy of breathwork this review clarifies the approach and its theoretical assumptions and examines relevant empirical research relating to breathing inhibition, suppression of inner experience, and possible neurological and physiological effects. Additionally, research into mindfulness-based psychotherapy and yoga breathing-based interventions with comparable features to breathwork are examined. Findings suggest qualified support for the key theoretical assumptions of a three component breathwork model, referred to as Integrative Breathwork Therapy (IBT), and its possible utility in the treatment of anxiety and depression. Further research aimed at exploring specific efficacy of this approach for these disorders may yield a useful additional treatment option utilising a different process of change to existing treatments.

Keywords Anxiety · Breathwork · Depression · Mindfulness · Psychotherapy · Respiration · Somatic

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Introduction

Classed as a mind–body, complementary health practice (Sointu 2006), breathwork has achieved a degree of recognition as a form of psychotherapy in Europe (Sudres et al. 1994) and popular interest is likely to grow with rapidly increasing use of alternative and complementary mental health practices, particularly mind–body approaches for depression and anxiety (Elkins et al. 2005). Despite interest in the approach, breathwork has not been subject to empirical investigation which could guide training and clinical practice, or suggest how client change might occur. Currently, there is no universal agreement as to specific components of the technique or the theory defining the approach. Rather than devaluing untested complementary or alternative approaches to mental health, controlled effectiveness studies should be undertaken to examine the evidence for these practices (Norcross 2000). The one study of breathwork attempted to date (Sudres et al. 1994) examined the effectiveness of a standardized ten session intervention with 12 depressed and anxious patients (DSM III-R). Symptom change was assessed pre and post treatment and at 8-week follow-up with ten out of 12 participants achieving clinically significant improvements ($p < 0.5$), which were maintained at follow-up. Results of this study should be interpreted with caution due to the small sample size, lack of a control condition and no examination of process variables thought important in treatment outcome. However, the study provided preliminary evidence for breathwork.

The Breathwork Approach

The breathwork technique described here involves therapists guiding clients through an approximately 1 h process involving the ongoing regulation of breathing, relaxation and application of mindfulness, while the client lies comfortably on their back. A series of 10 weekly or fortnightly sessions is the suggested norm. Apart from providing a rationale for the approach and general support, no additional cognitive or behavioural strategies are required.

The technique that most defines breathwork and differentiates it from other relaxation, meditation and yoga exercises is 'conscious connected breathing.' This technique involves therapists guiding clients in maintaining throughout the session a continuous uninterrupted breathing rhythm with no pauses between transitions of exhale and inhale, with inhalation being active and involving expansion of the upper chest (Dowling 2000; Minett 2004). The lead author's experience with breathwork over the last 20 or so years suggests exhalation should be a transition to complete letting go and relaxation of respiratory muscles. Based on the respiration research literature (Bolton et al. 2004; Bradley 2002), this breathing pattern is comparable to a normal, healthy breathing style which features virtually unbroken rhythmicity and the complete release during exhalation of respiratory muscles active during inhalation. This breathing style differs from that of a normal resting state in that clients are encouraged to adopt an inhalation generally of greater depth, emphasising mobilization of the entire chest. Therapist instructions (Lalande 2007) include statements like "Keep your breathing connected—no gaps or pauses—just a continuous rhythm" and "Just let go on the out-breath."

In addition to guiding clients in maintaining the conscious connected breathing technique described above, therapist support is also provided in maintaining detailed awareness to somatic experience as it unfolds moment-to-moment, and the adoption of an accepting open attitude toward the inner experience taking place. Therapist instructions include, "Focus on the dominate sensation in your body—whatever stands out—study that" and "Whatever is happening right now, just allow it to be there." Throughout the session clients are also encouraged to relax (Dowling 2000; Minett 2004) by remaining alert to the presence of muscular holding-on (tension) in the inner landscape they are observing and releasing the tension they identify. Clients may become aware of pre-existing tension or tension may develop in the form of tightening-up as a defensive response to emerging somatic experience. Relaxation in this approach does not include muscle contractions, hypnotic suggestions, visualization, or counting with breathing used in other approaches to relaxation (e.g. Bernstein et al. 2000). A therapist instruction would be "Any tension you notice—just let it go."

Client experience of breathwork can include novel somatic experiences including increased awareness of tension, energy flows and sensations, along with brief occurrences of heightened arousal including increased emotionality, sadness, frustration and fear (observed clinically as tearfulness or restlessness, for example). It is well accepted that breathing, relaxation and meditative practices can create greater subjective physiological awareness (Schwartz and Schwartz 1996; Smith 1988). Autonomic nervous system effects tend towards overall parasympathetic dominance (relaxation). On completion of a session clients generally report a state of mental clarity, profound relaxation and sense of wellbeing. Anecdotal client reports of change as sessions progress include spontaneous cognitive and behavioural insights, improved interpersonal functioning, and sense of, and desire for, increased authenticity.

The existing breathwork literature (e.g. Dowling 2000; Minett 2004) does not explicitly provide a conceptual model of psychopathology. In this paper we are suggesting that psychopathology from a breathwork model perspective involves the suppression of feelings, sensations and emotions experienced as aversive and inhibition of breathing as a central mechanism through which suppression is achieved. The need for ongoing control and defense against awareness of troubling somatic and psychological experience (necessary to maintain a sense of psychological balance) then results in a habitual, abnormal breathing pattern that becomes a more or less permanent feature of physiological functioning. Breathwork, therefore, assumes a link between the defensive adaptation of inhibited breathing, the presence of unintegrated psychosomatic experience, and the development and maintenance of psychopathology. The approach aims to bring rejected somatic experience into conscious awareness through the removal of breathing inhibitions, and then integrate those experiences into the general flow of consciousness by applying detailed somatic awareness, acceptance and relaxation. The empirical basis for this formulation will be presented in the following sections.

Suppression of Inner Experience and Psychopathology

The suppression of inner experience, which is assumed in breathwork to be detrimental to mental health whether achieved through inhibited breathing or not, has been shown to play a role in the aetiology and persistence of anxiety and depression (Gross 2002; Purdon 1999). Campbell-Sills et al. (2006) also found suppression correlated with poorer recovery from negative affect, increased sympathetic arousal, and decreased parasympathetic responding. The tendency to avoid or control, rather than accept inner experience is suggested as a specific risk

factor in generalised anxiety disorder (Roemer et al. 2005), and has been correlated with diminished positive emotional experiences and life satisfaction, and less frequent positive events on a daily basis (Kashdan et al. 2006). It seems that maintaining the suppression of unwanted thoughts, memories and emotions may also require continuous vigilance to avoid their paradoxical reemergence during post-suppression periods (Campbell-Sills et al. 2006; Dalgleish and Yiend 2006; Wegner 1994; Wenzlaff et al. 1988). A breathwork model that aims to improve wellbeing by replacing suppression of aversive inner experience (through inhibition of breathing) with acceptance and integration of inner experience (by teaching a non-defensive, uninhibited breathing style along with openness to experience) seems to be supported by the above research, especially in the area of depression and anxiety.

Inhibition of Breathing and Psychopathology

Evidence shows that anxiety and expectation related to social and environmental factors leads to the development of inhibited breathing patterns (Fokkema 1999). Additionally, a cognitive orientation toward the environment as unpredictable, uncontrollable, or overwhelming is linked to inhibited breathing characterised by subnormal breathing frequency (Anderson and Chesney 2002). Stressful environments have been found to elicit sustained inhibitory changes to breathing patterns (Anderson 2001) with higher demands on attention producing more inhibition (Denot-Ledunois et al. 1998). Classical conditioning, which has been shown to shape breathing patterns (for a review of influences on breathing, see Shea 1996), may play some role in inhibited breathing developing into a habitual style. As suggest by Anderson and Chesney (2002), in response to the state of hopelessness experienced when facing an uncontrollable environment 'an inhibited breathing pattern would not be merely a transient response to an acute stressor, but a generalized breathing habit conditioned to the assessment that the world is a difficult or dangerous place.'

Inhibited breathing also effects neurological functioning. Given there is little or no reserve of oxygen in the brain it is very sensitive to any changes in level of oxygen present in the blood or changes to blood flow (Erecinska and Silver 2001). Animal models have demonstrated that a slight deficiency of oxygen reaching brain tissue (mild hypoxia) can result if breathing is inhibited, and while energy production via glucose metabolism may remain unaffected, serotonin synthesis is reduced (Erecinska and Silver 2001; Nishikawa et al. 2005). In humans, conditioned suppression of breathing leads to reduced oxygen and high CO_2 levels in the blood which in turn is associated with a tendency toward increased worry and negative affect (Dhokalia et al. 1998). Multiple studies of acute depression have demonstrated decreased frontal cortex metabolism and limbic activation, with the severity of depression linked to larger decreases in metabolism (Post 2000).

It has also been suggested that a biological pathway in which elevations in blood pressure and CO_2 levels resulting from strained breathing perpetuate inhibited breathing once it is established (Fokkema 1999). The physiological evidence suggests a pathway by which inhibited breathing patterns might affect brain metabolism and serotonergic neurotransmission and create a feedback loop involving cognitive, physiological and neurological components that increase risk for major depression (Rosa-Neto et al. 2004). Overall, the evidence discussed above suggests the interaction of psychological and biological mechanisms may perpetuate both inhibited breathing and symptoms of depression or anxiety.

Comparative Psychotherapy Approaches

Rhythmic Breathing-Based Yoga Interventions

Two yoga interventions that utilise rhythmic breathing have shown promise in treating depression (for reviews on yoga for depression and anxiety see, da Silva et al. 2009; Pilkington et al. 2005). Shavasana Yoga teaches slow breathing featuring a two second pause after each inhale and one second pause at the end of each exhale, while relaxing flat on the floor with eyes closed (Khumar et al. 1993). Fifty female subjects suffering from severe depression were assigned to either the yoga treatment comprising of 30 min daily practice over 30 days, or a no-treatment control group. Sixty-four percent of the treatment group experienced significant reduction in depression scores (Zung Depression Self-Rating Scale; Zung 1965) while 44% recovered completely. There was no overall change in the control group at treatment end (Khumar et al. 1993). A randomised controlled trial conducted over 4 weeks compared Sudarshan Kriya Yoga with electro-convulsive therapy (ECT) and tricyclic antidepressant medication (imipramine) as an intervention for depression. The yoga intervention includes a number of breathing techniques involving various degrees of control and forcefulness (Brown and Gerbarg 2005) and was practiced for 45 min once daily for 6 days a week over the 4 week trial period, all groups achieved significant improvement on the Beck Depression Inventory (Beck et al. 1961) and the Hamilton Rating Scale for Depression (Hamilton 1960) with no significant differences between treatments (Janakiramaiah et al. 2000). The two approaches above teach different breathing styles yet both show promise as treatments for depression which suggests that a breathwork

intervention that utilises uninhibited rhythmic breathing as a treatment component would be similarly effective.

Support for Mindfulness as a Component of Breathwork

Fundamental to the breathwork approach under discussion is the sustained self-regulation of attention on breathing and the details of bodily sensations as they arise moment-to-moment along with maintenance of an attitude of acceptance toward inner experience (Dowling 2000; Minett 2004). These are considered key elements that define mindfulness meditation in the psychotherapy literature (Bishop et al. 2004), and components responsible for therapeutic change in Mindfulness-Based Stress Reduction (MBSR; Kabat-Zinn 1990). Therefore, research supporting the effectiveness of mindfulness in MBSR and may also suggest some support for the effectiveness of Breathwork.

Both MBSR and breathwork utilise formal mindfulness practice as a key intervention to create therapeutic change, however, in MBSR mindfulness of breathing is a passive observational process while in breathwork the conscious connected breathing technique described earlier is actively adopted with therapist support as a therapeutic tool. Clients complete a breathwork session in about 1 h which is comparable to the formal meditation practice in MBSR, however, breathwork is not generally administered more than once per week.

Mindfulness interventions are steadily amassing considerable empirical evidence suggesting effectiveness (for reviews, see Allen et al. 2006; Baer 2003; Bishop 2002; Hofmann et al. 2010; King 2006). A rigorous meta-analysis (Grossman et al. 2004) assessing MBSR for a variety of mental health problems yielded a medium effect size for positive outcome on all mental health variables ($d = 0.54$) and physical health variables ($d = 0.53$). A more recent meta-analysis (Hofmann et al. 2010) found effect sizes that indicated MBSR and Mindfulness-Based Cognitive Therapy (Segal et al. 2002) are both effective in reducing depression and anxiety symptoms. More specifically, MBSR is effective in the treatment of generalised anxiety disorder, panic disorder and depression (Kabat-Zinn et al. 1992) with treatment effects maintained at 3-year follow-up (Miller et al. 1995). MBSR has also been found to reduce ruminative thinking with reductions in rumination accounting for reductions in depression and anxiety related maladaptive cognitive content and affective symptoms (Ramel et al. 2004). Rumination predicts the onset of depressive disorders, anxiety symptoms and mixed anxiety-depression (Nolen-Hoeksema 2000) and also predicts greater depression and anxiety and longer duration of negative feelings (Leahy 2002).

The mechanisms by which mindfulness meditation brings about change are suggested to include: exposure type processes; relaxation; an increased capacity for emotional regulation and processing; and a changed relationship to ones thoughts, feelings and sensations (Baer 2003; Bishop et al. 2004; Hayes and Feldman 2004; Shapiro et al. 2006). Given the first two of these mechanisms are formally utilised in a standardized breathwork approach and the second two are consistent with anecdotal reports of client experience, and in light of our current understanding of mindfulness practice as an effective component of therapeutic interventions for depression and anxiety, the application of mindfulness in the breathwork approach should also contribute to therapeutic outcomes.

Breathwork, while including mindfulness in the approach is distinctly different in that it uses respiratory regulation. Mindfulness, as described in the psychotherapy literature sited above, does not involve therapist guided, moment-to-moment support in maintaining a continuous cyclic breathing rhythm with active inhalation and complete release of respiratory muscles on exhalation—described as a healthy, natural breathing style in the respiration literature (Bolton et al. 2004; Bradley 2002). In other words, mindfulness does not actively focus on achieving and maintaining an uninhibited breathing pattern on a moment-to-moment basis. The modification of habitual inhibited breathing patterns is not addressed directly in mindfulness. The respiratory regulation component of breathwork not only substantially increases awareness of somatic phenomena, it actually elicits deeply buried somatic experience to which mindfulness can then be applied. Breathwork is not so much a mindfulness-based practice as it is a respiration-based practice that utilizes mindfulness as an essential component in the process of integrating somatic material the respiratory component makes available to conscious awareness.

Neurological Effects of Meditation and Breathwork

Research into the neurological effects of meditation also suggests therapeutic utility as a component of breathwork. A well established characteristic of meditation is increased alpha and theta activity, with increased alpha activity shown to relate to higher serotonin activation (Anderer et al. 2000; Thorleifsdotttir et al. 1989), while Kjaer et al. (2002) found theta activity during meditation related to a 65% increase in dopamine release. During meditation overall cerebral blood flow also increases (Cahn and Polich 2006) which may play a role in these changes. Meditation is thought to modulate behavioural states related to arousal, attention, mood, and motivation at least partly through serotonergic innervation (Mesulam 2000). Additional support for this proposition comes from EEG studies

suggesting meditators are better able to regulate intensity of emotional arousal (Aftanas and Golosheikin 2005). The well established link between meditation and increased alpha and theta brain wave activity suggests another possible pathway by which breathwork might create therapeutic neurological changes.

Total Relaxation as a Component of Breathwork

Relaxation techniques are known to alleviate distress, anxiety and depression, increase positive mood states (Jain et al. 2007; Luebbert et al. 2001; Stetter and Kupper 2002), and increase EEG theta brain wave activity, which is associated with reduced central nervous system arousal (Jacobs and Friedman 2004). Relaxation in breathwork is concerned with not only relaxation in a general sense, but also with developing awareness of, and skill in releasing, holding-on at the most subtle levels, especially while experiencing challenging inner experiences. Breathwork aims to develop the cognitive skills of focusing, passivity and receptivity Smith (1988) suggests relaxation techniques promote. Smith (1988) describes *focussing* as 'the ability to identify, differentiate, maintain attention on, and return attention to simple stimuli for an extended period,' *passivity* as 'the ability to stop unnecessary goal-directed and analytic activity' and *receptivity* as 'the ability to tolerate and accept experiences that may be uncertain, unfamiliar, or paradoxical.' This suggests relaxation in breathwork may reduce arousal levels through a repeated exposure-like process, while teaching a relaxation response to provocative inner experience. In addition, it suggests developing a sense of safety with a psychological process characterised by complete letting-go, defencelessness and surrender to experience.

Conclusion

There is empirical support for the idea that sustained inhibited breathing patterns can develop in response to stressful environments. Research also suggests inhibited breathing lowers brain oxygen and reduces serotonin synthesis with consequent increase in depressive symptomology. Further, a feedback loop involving cognitive, physiological and neurological components may perpetuate inhibited breathing and symptoms of depression and anxiety. In addition to the encouraging results from the breathwork study by Sudres et al. (1994) noted in the introduction, there is empirical support for yoga breathing-based interventions in treating depression, and meditation-based approaches demonstrate efficacy in the treatment of depression and anxiety. Neurological and behavioural self-regulatory changes associated with meditation are also related to positive mental health outcomes. This review has identified empirical evidence that suggests support for a standardized breathwork approach based on three core components that together promote somatic integration; the conscious connected breathing pattern, mindfulness, and relaxation. There is qualified support for the key theoretical assumptions of breathwork and its possible utility in the treatment of anxiety and depression. Given no standardized breathwork approach exists for research purposes (e.g. manualization, training) or clinical practice, and to differentiate this breathwork approach from others, and to highlight its aim of integration, this model can be referred to as Integrative Breathwork Therapy (IBT). There is sufficient evidence to conclude a case to undertake efficacy research into IBT particularly relating to depression and anxiety.

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Multicenter, randomized controlled trial of yoga for sleep quality among cancer survivors.

Mustian KM[1], Sprod LK, Janelsins M, Peppone LJ, Palesh OG, Chandwani K, Reddy PS, Melnik MK, Heckler C, Morrow GR.

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Abstract

PURPOSE: Thirty percent to 90% of cancer survivors report impaired sleep quality post-treatment, which can be severe enough to increase morbidity and mortality. Lifestyle interventions, such as exercise, are recommended in conjunction with drugs and cognitive behavioral therapy for the treatment of impaired sleep. Preliminary evidence indicates that yoga-a mind-body practice and form of exercise-may improve sleep among cancer survivors. The primary aim of this randomized, controlled clinical trial was to determine the efficacy of a standardized yoga intervention compared with standard care for improving global sleep quality (primary outcome) among post-treatment cancer survivors.

PATIENTS AND METHODS: In all, 410 survivors suffering from moderate or greater sleep disruption between 2 and 24 months after surgery, chemotherapy, and/or radiation therapy were randomly assigned to standard care or standard care plus the 4-week yoga intervention. The yoga intervention used the Yoga for Cancer Survivors (YOCAS) program consisting of pranayama (breathing exercises), 16 Gentle Hatha and Restorative yoga asanas (postures), and meditation. Participants attended two 75-minute sessions per week. Sleep quality was assessed by using the Pittsburgh Sleep Quality Index and actigraphy pre- and postintervention.

RESULTS: In all, 410 survivors were accrued (96% female; mean age, 54 years; 75% had breast cancer). Yoga participants demonstrated greater improvements in global sleep quality and, secondarily, subjective sleep quality, daytime dysfunction, wake after sleep onset, sleep efficiency, and medication use at postintervention (all $P \leq .05$) compared with standard care participants.

CONCLUSION: Yoga, specifically the YOCAS program, is a useful treatment for improving sleep quality and reducing sleep medication use among cancer survivors.

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The effects of yoga and self-esteem on menopausal symptoms and quality of life in breast cancer survivors—A secondary analysis of a randomized controlled trial

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ABSTRACT

Objectives: Previous research has found that yoga can enhance quality of life and ease menopausal symptoms of breast cancer survivors. The study examined whether self-esteem mediated the effects of yoga on quality of life, fatigue and menopausal symptoms, utilizing validated outcome measures.
Study design: This is a secondary analysis of a randomized controlled trial comparing the effects of yoga with those of usual care in 40 breast cancer survivors who suffered from menopausal symptoms. All participants completed all 3 assessments (week 0, week 12, and week 24) and provided full data.
Main outcome measures: Outcomes were measured using self-rating instruments. Mediation analyses were performed using SPSS.
Results: Self-esteem mediated the effect of yoga on total menopausal symptoms ($B = -2.11$, 95% BCI [−5.40 to −0.37]), psychological menopausal symptoms ($B = -0.94$, 95% BCI [−2.30 to −0.01]), and urogenital menopausal symptoms ($B = -0.66$, 95% BCI [−1.65 to −0.15]), quality of life ($B = 8.04$, 95% BCI [3.15–17.03]), social well-being ($B = 1.80$, 95% BCI [0.54–4.21]), emotional well-being ($B = 1.62$, 95% BCI [0.70–3.34]), functional well-being ($B = 1.84$, 95% BCI [0.59–4.13]), and fatigue ($B = 4.34$, 95% BCI [1.28–9.55]). Self-esteem had no effect on somatovegetative menopausal symptoms ($B = -0.50$, 95% BCI n.s.) or on physical well-being ($B = 0.79$, 95% BCI n.s.).
Conclusions: Findings support the assumption that self-esteem plays a vital role in the beneficial effect of yoga and that yoga can have long-term benefits for women diagnosed with breast cancer and undergoing menopausal transition.

1. Introduction

Breast cancer is the most frequently diagnosed cancer in women worldwide. Treatment advances have led to improved survival rates and more women reaching menopause [1]. Climacteric symptoms tend to be more intense in breast cancer survivors, especially in those taking aromatase inhibitors [2,3]. As estrogen-based treatments are usually contraindicated, there is a need for alternative strategies.

Yoga can serve as one such alternative or complementary intervention for menopausal complaints. It has a positive effect on breast cancer patients in general and also on breast cancer survivors undergoing menopausal transition in particular [4,5]. It can influence somatovegetative, psychological, and urogenital menopausal symptoms as well as fatigue, quality of life, and menopausal symptoms in general [6]. Therefore, treatment of menopausal symptoms with yoga is evidence based. However, the mechanisms of action remain unclear.

One explanation for those mechanisms involves the psychological aspects of menopause management. Self-esteem for example refers to the way we evaluate ourselves. Women with higher self-esteem are more resilient to stress and possess more resources to cope with demands [7,8]. Reduced self-esteem might put survivors at a higher risk of negative outcomes like depression or negative health in general

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and reduced quality of life [9,10]. At the menopausal transition women often report loss of self-esteem and there seems to be a linear association between high self-esteem and fewer menopausal symptoms [9]. Therefore it is valuable to strengthen womeńs self-esteem in order to diminish any negative consequences of the menopausal transition. Research has demonstrated that physical activity, including yoga, positively influences self-esteem in menopausal women, even in the long run [11,12]. This process may account for the mechanisms through which yoga alleviates menopausal symptoms: yoga enhances self-esteem and self-esteem, in turn, decreases menopausal symptoms and fatigue, and increases quality of life.

Therefore, we hypothesized that the beneficial effect of yoga on menopausal symptoms in general, and more specifically somatovegetative, psychological, and urogenital menopausal symptoms as well as fatigue and quality of life, is mediated by self-esteem. To test this assumption, we performed a secondary analysis of data from a randomized controlled trial that compared the effects of yoga with those of usual care in 40 breast cancer survivors who suffered from menopausal symptoms.

2. Methods

2.1. Design

This is a secondary mediator analysis based on an open-label, randomized controlled clinical trial that has been published previously [6]. It was conducted at the Department of Gynecology Certified Breast Center at Malteser Hospital St. Anna (Duisburg, Germany) and approved by the Ethics Committee of the University of Duisburg-Essen (approval number 13-5421-BO).

2.2. Participants

Participants were recruited from the Department of Gynecology Certified Breast Center at Malteser Hospital St. Anna by the study physician. To be included, women had to be aged 30–65 years, to have been treated for nonmetastatic breast cancer (International Union Against Cancer stages I–III) and to have completed surgical (breast-conserving surgery, mastectomy, simultaneous breast reconstruction), radiotherapeutic, and/or chemotherapeutic treatment. Women had to suffer from at least mild menopausal symptoms, indicated by a score of at least 5 on the Menopause Rating Scale (MRS). Physical inability to do yoga, regular yoga practice within the last year, psychosis, participation or planned participation in other clinical trials, (planned) surgical interventions during the previous three months, and (planned) hormone-replacement therapy were exclusion criteria. If women were on a stable dose of antiestrogen medication, nonhormonal treatment, or antidepressant medication, they were not excluded from the trial.

2.3. Randomization

Women were randomly allocated either to yoga and meditation or to usual care. They were stratified by the intake of antiestrogen medication during the study period (two strata: no intake and intake) by block randomization with randomly varying block lengths. A biometrician who was not involved in patient recruitment or assessment was in charge used Random Allocation Software [13] for randomization and secured the randomization list with a password. Sealed, sequentially numbered envelopes containing the treatment assignments were prepared by the biometrician and opened after written informed consent − in the form of a prepared consent form that had to be signed by the patient − had been obtained and baseline assessment had been done, beginning with the lowest number.

2.4. Interventions

2.4.1. Yoga and meditation

The yoga group received weekly traditional Hatha yoga sessions that included meditation. Those yoga sessions were 90 min long and based on the teachings of Sivananda Saraswati [14]. Yoga took place over a period of 3 months. The meditation was derived from the Karma Kagyu school of Tibetan Buddhism according to Lama Ole Nydah. A certified Hatha yoga instructor led the classes. She also was a direct student of Lama Ole Nydahl. Each class started with the corpse pose and was followed by breathing techniques and a series of sun salutations (a flowing sequence of yoga postures). Afterwards a couple of yoga postures and/or meditation practices were performed. Not all practices were included in each class. Practices were adapted to the womeńs possibilities and needs. Classes ended with guided relaxation in the corpse pose. 5–10 min of lectures on yoga (yogic theories on the physiological and psychological effects of the postures, breathing techniques, and meditation and on the nature of the mind) and/or Buddhist philosophy (Buddhist theories on cause and effect and on negative emotions) complemented the classes. Participants were encouraged to practice daily at home, although no minimum practice time was required. Women were introduced to all exercises before home practice, in class.

2.4.2. Usual care

Participants in the usual care group did not participate in any study intervention for the first 24 weeks of the trial. After 24 weeks they were offered the same yoga classes as the intervention group.

2.5. Measures

All measures in their German versions were captured at three time points: week 0, 12, and 24.

2.5.1. Self-esteem

Self-esteem was measured using the SES scale from Rosenberg [15]. It includes ten items that can be answered on a four-point scale, ranging from *strongly agree* to *strongly disagree*; an example item is “On the whole, I am satisfied with myself”. For mediation analyses, self-esteem at week 12 was used.

2.5.2. Menopausal symptoms

Menopausal symptoms were assessed as *total symptoms*, *somatovegetative symptoms, psychological symptoms,* and *urogenital symptoms* using the Menopause Rating Scale score (MRS) [16,17]. Higher scores indicate more severe symptoms. For mediation analyses, menopausal symptoms at week 24 were used. Total menopausal symptoms was the primary outcome.

2.5.3. Breast cancer specific quality of life

We evaluated breast cancer specific quality of life using the Functional Assessment of Cancer Therapy-Breast (FACT-B) [18], which evaluates overall quality of life, physical well-being, social well-being, emotional well-being, and functional well-being. Higher scores indicate better quality of life. For mediation analyses, breast cancer specific quality of life at week 24 was used.

2.5.4. Fatigue

Fatigue was assessed using the Functional Assessment of Chronic Illness Therapy-Fatigue (FACIT-F) [19]. Higher scores indicate less fatigue. For mediation analyses, fatigue at week 24 was used.

All adverse events that occurred during the study period were recorded.

2.6. Sample size calculation and statistical analysis

A sample size calculation was made a priori. As a cutoff value to evaluate the efficacy of a treatment for menopausal symptoms compared with no specific treatment, a group difference of 7 points on the MRS total score is suggested. Assuming a standard deviation of 7.1, a 2-sided, level 5% *t*-test requires 36 participants to detect a 7-point difference between groups with a statistical power of 80% [20]. Accounting for a maximum of 10% dropouts, we planned to include 40 patients.

The analyses were conducted on all patients who participated in the study (N = 40). To estimate baseline differences in self-esteem, paired *t*-tests were conducted. Mediation analyses were performed following the procedure recommended by Hayes [21], using the "Process" macro for SPSS. Bootstrapping drawing 1000 samples and 95% confidence intervals (CI) were applied. All analyses were performed using the Statistical Package for Social Sciences software (IBM SPSS Statistics for Windows, release 22.0; IBM Corporation, Armonk, NY).

3. Results

40 women were enrolled in the study after they provided informed consent (see Fig. 1 for participant flow diagram and Table 1 for a brief overview of the participants' demographic characteristics; for a detailed sample description see the previous report [6]). Every woman completed all 3 assessments and provided full data. Hence there was no missing data. Mean age (standard deviation) was 49.2 ± 5.9 years, and the mean time since surgery was 28.1 ± 18.3 months. Most women currently received antiestrogen medication (90%). No woman used antidepressant medication or made use of any nonhormonal treatment for her menopausal symptoms. There were no baseline differences between the two groups.

Women in the yoga group attended a mean of 9.7 ± 2.3 (80.8%) yoga classes and practiced at home for 35.3 ± 27.9 min per week. Correlations between study variables are shown in Table 2.

Mediation analyses showed that self-esteem mediated the effect between yoga and eight out of ten relevant outcomes (see Table 3): total menopausal symptoms, psychological menopausal symptoms, and urogenital menopausal symptoms, quality of life, social well-being, emotional well-being, functional well-being, and fatigue. The effects on physical well-being, and somatovegetative menopausal symptoms were not mediated by self-esteem. The direct effects of yoga on the different outcomes were not significant (all CI include zero).

There were no serious adverse events.

4. Discussion

The present study examined the mediational effects of self-esteem for yoga on different menopause-related symptoms in a sample of breast cancer survivors enrolled in a randomized controlled yoga trial. Research has demonstrated that yoga has a positive effect on menopausal symptoms [22,23]. However, the underlying mechanisms remained unclear. This analysis indicates that self-esteem plays a vital role in the effects of yoga on menopause-related outcomes. The effect of yoga on total menopausal symptoms, psychological menopausal symptoms, and urogenital menopausal symptoms, quality of life, social well-being, emotional well-being, functional well-being, and fatigue was mediated by self-esteem. No mediation was found for physical well-being or somatovegetative menopausal symptoms.

Interestingly, when testing for mediations none of the direct effects of yoga on the different outcomes was significant. This indicates a complete mediation of the effects of yoga on the different outcomes by self-esteem, i.e. self-esteem seems to be the main mechanism of action of yoga in alleviating menopausal symptoms in breast cancer survivors. A strong relationship between positive attitude towards oneself and the severity of menopausal symptoms has been found before. Women who are satisfied with their appearance and perceive themselves as attractive have less severe menopausal symptoms than those who do not [24]. Likewise, low self-confidence and low self-esteem are associated with more severe menopausal symptoms [9,25]. It has been previously shown that yoga can increase self-esteem in female students [26], sedentary adults [27], women with abdominal obesity [28], and breast cancer survivors [29]. Moreover, there are hints that yoga also improves self-esteem in menopausal women without a history of breast cancer [30]. Increases in self-worth during a yoga intervention are associated with decreases in menopausal symptoms [10]. Yoga's influence on psychological constructs related to self-esteem such as body satisfaction and self-objectification have been discussed as potential mechanisms of yoga's effects on well-being, especially in women [31]. Given the strong association of self-esteem with menopausal symptoms [9] on the one hand and the effect of yoga on self-esteem [29,30], the pathway shown in this study is appears to be valid.

However, there are additional underlying processes imaginable that need to be evaluated. Besides psychological modes of action like the path involving self-esteem, yoga might also have an impact on biological processes which influence menopause-related outcomes. For example, it has been shown that yoga lowers blood pressure and influences other biological and behavioral cardiovascular risk factors [32–34]. This in turn might affect the degree of vasomotor menopausal symptoms. Furthermore, it might be that yoga positively influences cortisol levels, which in turn increase well-being and quality of life [35], or that yoga inhibits the production of proinflammatory cytokines interleukin-6, which in turn leads to decreased fatigue [36]. Those biological processes were not within the scope of the present study. Further research needs to evaluate other possible mechanisms, taking biological as well as psychological processes into account.

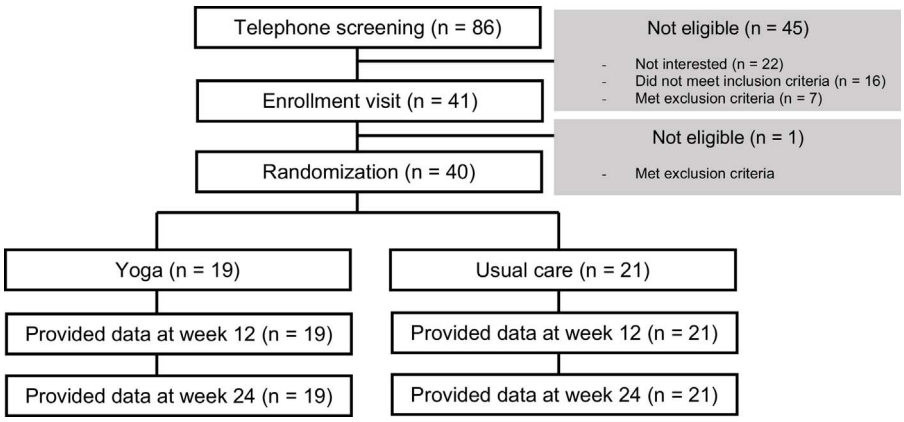

Fig. 1. Participant flow diagram.

Table 1
Demographic characteristics.

	Yoga (n = 19)	Usual Care (n = 21)	Total (n = 40)
Age: mean ± SD	48.3 ± 4.8	50.0 ± 6.7	49.2 ± 5.9
Height: mean ± SD, cm	169.9 ± 7.3	170.2 ± 5.4	170.1 ± 6.3
Weight: mean ± SD, kg	69.8 ± 11.9	74.3 ± 17.0	72.2 ± 17.8
Marital status			
Married	13	17	30
Living together	2	4	6
Single	1	0	1
Divorced	3	0	3
No. of children: mean ± SD	1.6 ± 0.9	1.1 ± 1.2	1.4 ± 1.1
Education (%)			
No qualification	1 (5.3)	0 (0)	1 (2.5)
Secondary modern school: "Hauptschule" qualification	1 (5.3)	3 (14.3)	4 (10)
High school: "Realschule" qualification	3 (15.8)	8 (38.1)	11 (27.5)
A level: "Abitur"	8 (42.1)	3 (14.3)	11 (27.5)
University degree	5 (26.3)	6 (28.6)	11 (27.5)
Other	1 (5.3)	1 (4.8)	2 (5)
Employment			
Full time	6 (31.6)	6 (28.6)	12 (30)
Part time	10 (52.6)	5 (23.8)	15 (37.5)
Home keeper	1 (5.3)	4 (19)	5 (12.5)
Retired	0 (0)	1 (4.8)	1 (5.3)
Disabled	2 (10.5)	2 (9.5)	4 (10)
Unemployed	0 (0)	3 (14.3)	3 (7.5)
Cancer stage: n (%)			
I	11 (57.9)	12 (57.1)	23 (57.5)
II	7 (36.8)	7 (33.3)	14 (35)
III	1 (5.3)	2 (9.5)	3 (7.5)
Time since diagnosis: mean ± SD, mo	26.7 14.0	33.6 19.4	30.3 17.2
Time since surgery: Mean ± SD, mo	24.6 15.1	31.2 20.7	28.1 18.3
Current antihormonal therapy: n (%)			
Yes	17 (89.5)	19 (90.5)	36 (90)
No	2 (10.5)	2 (9.5)	4 (10)
Prior chemotherapy: n (%)			
Yes	13 (68.4)	16 (76.2)	29 (72.5)
No	6 (31.6)	5 (23.8)	11 (27.5)
Prior radiotherapy: n (%)			
Yes	17 (89.5)	19 (90.5)	36 (90)
No	2 (10.5)	2 (9.5)	4 (10)

Note. SD = standard deviation.

The results of this study have to be interpreted in light of some limitations. Due to the nature of the study, no blinding of participants and therapists was possible. Furthermore, there was no long-term follow-up beyond 24 weeks and a selection bias is possible. The small sample size is another limitation.

To conclude, self-esteem may play a vital role within the process of yoga influencing quality of life and menopausal symptoms, but further research is necessary to fully understand the underlying mechanisms.

Table 2
Correlations between study variables.

		1	2	3	4	5	6	7	8	9	10	11	12
1	Group[a]												
2	Self-Esteem[b]	0.01											
3	Self-Esteem[c]	0.43**	0.62***										
4	Total quality of life[d]	0.32*	0.29	0.55***									
5	Physical well-being[d]	0.38*	0.14	0.32*	0.82***								
6	Social well-being[d]	0.25	0.18	.50**	0.65***	0.35*							
7	Emotional well-being[d]	0.25	0.38*	0.55***	0.75***	0.46**	0.36*						
8	Functional well-being[d]	0.19	0.25	0.45**	0.90***	0.76***	0.56***	0.66***					
9	Fatigue[d]	0.31	0.19	0.49**	0.84***	0.86***	0.45**	0.62***	0.81***				
10	Total menopausal symptoms[d]	−0.37*	−0.07	−0.40*	−0.76***	−0.77***	−0.26	−0.60***	−0.74***	−0.80***			
11	Somatovegetative menopausal symptoms[d]	−0.26	−0.01	−0.26	−0.68***	−0.68***	−0.19	−0.51**	−0.65***	−0.72***	0.88***		
12	Psychological menopausal symptoms[d]	−0.34*	−0.06	−0.39*	−0.80***	−0.76***	−0.38*	−0.66***	−0.73***	−0.82***	0.90***	0.75***	
13	Urogenital menopausal symptoms[d]	−0.33*	−0.12	−0.37*	−0.40*	−0.47**	−0.06	−0.33*	−0.46**	−0.46**	0.74***	0.48**	0.48**

Note. $N = 40$; [a] Yoga = 1, usual care = 0; [b] = time point one; [c] = time point two; [d] = time point three.
*$p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 3
Results of the mediation analyses: effects of group mediated by self-esteem on the different outcomes.

			95% BCI		
	B	*SD B*	lower 2,5%	upper 2,5%	
total quality of life	8.04	3.24	3.15	17.03	*
physical well-being	0.79	0.71	−0.15	2.89	n.s.
social well-being	1.80	0.85	0.54	4.21	*
emotional well-being	1.62	0.63	0.70	3.34	*
functional well-being	1.84	0.85	0.59	4.13	*
fatigue	4.34	2.05	1.28	9.55	*
total menopausal symptoms	−2.11	1.25	−5.40	−0.37	*
somatovegetative menopausal symptoms	−0.50	0.56	−2.06	0.37	n.s.
psychological menopausal symptoms	−0.94	0.61	−2.30	−0.01	*
urogenital menopausal symptoms	−0.66	0.38	−1.65	−0.15	*

Note. $N = 40$; BCI = bootstrapping confidence interval; if the confidence interval does not include zero, the effect is significant; B = mean of unstandardized estimators of 1000 bootstrapping samples; *SD B* = standard deviation of *B;* Yoga was coded as "1" and usual care as "0", therefore a positive, significant B-value indicates a mediation effect between yoga and outcomes.

Contributors

AKK, lead author, analyzed and interpreted the data.
SR, co-author, conceived, designed, and performed the experiments.
RL, co-author, conceived, designed, and performed the experiments.
SK, co-author, conceived, designed, and performed the experiments.
GD, co-author, conceived and designed the experiments.
JL, co-author, conceived and designed the experiments.
HC, co-author, conceived, designed, and performed the experiments.

Conflict of interest

The authors declare that they have no conflict of interest.

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Ethical approval

This is a secondary analysis of results from a clinical trial conducted at the Department of Gynecology Certified Breast Center at Malteser Hospital St. Anna (Duisburg, Germany) and approved by the Ethics Committee of the University of Duisburg-Essen (approval number 13–5421-BO).

Provenance and peer review

This article has undergone peer review.

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Yoga for symptom management in oncology: A review of the evidence base and future directions for research

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Abstract

Because yoga is increasingly recognized as a complementary approach to cancer symptom management, patients/survivors and providers need to understand its potential benefits and limitations both during and after treatment. The authors reviewed randomized controlled trials (RCTs) of yoga conducted at these points in the cancer continuum (N = 29; n = 13 during treatment, n = 12 post-treatment, and n = 4 with mixed samples). Findings both during and after treatment demonstrated the efficacy of yoga to improve overall quality of life (QOL), with improvement in subdomains of QOL varying across studies. Fatigue was the most commonly measured outcome, and most RCTs conducted during or after cancer treatment reported improvements in fatigue. Results also suggested that yoga can improve stress/distress during treatment and post-treatment disturbances in sleep and cognition. Several RCTs provided evidence that yoga may improve biomarkers of stress, inflammation, and immune function. Outcomes with limited or mixed findings (eg, anxiety, depression, pain, cancer-specific symptoms, such as lymphedema) and positive psychological outcomes (such as benefit-finding and life satisfaction) warrant further study. Important future directions for yoga research in oncology include: enrolling participants with cancer types other than breast, standardizing self-report assessments, increasing the use of active control groups and objective measures, and addressing the heterogeneity of yoga interventions, which vary in type, key components (movement, meditation, breathing), dose, and delivery mode.

Keywords: anxiety; cancer; depression; fatigue; mind-body; quality of life; sleep; symptoms; yoga.

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Yoga and Self-Reported Cognitive Problems in Breast Cancer Survivors: A Randomized Controlled Trial

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Abstract

Objectives—Cancer survivors often report cognitive problems. Furthermore, decreases in physical activity typically occur over the course of cancer treatment. Although physical activity benefits cognitive function in non-cancer populations, evidence linking physical activity to cognitive function in cancer survivors is limited. In our recent randomized controlled trial, breast cancer survivors who received a yoga intervention had lower fatigue and inflammation following the trial compared to a wait-list control group. This secondary analysis of the parent trial addressed yoga's impact on cognitive complaints.

Methods—Post-treatment stage 0 – IIIA breast cancer survivors (N = 200) were randomized to a 12-week twice-weekly Hatha yoga intervention or a wait-list control group. Participants reported cognitive complaints using the Breast Cancer Prevention Trial (BCPT) Cognitive Problems scale at baseline, immediately post-intervention, and 3-month follow-up.

Results—Cognitive complaints did not differ significantly between groups immediately post-intervention (p = .250). However, at the 3-month follow-up, yoga participants' BCPT Cognitive Problems scores were an average of 23% lower than wait-list participants' scores (p = .003). These group differences in cognitive complaints remained after controlling for psychological distress, fatigue, and sleep quality. Consistent with the primary results, those who practiced yoga more

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frequently reported significantly fewer cognitive problems at the 3-month follow-up than those who practiced less frequently ($p < 0.001$).

Conclusions—These findings suggest that yoga can effectively reduce breast cancer survivors' cognitive complaints, and prompt further research on mind-body and physical activity interventions for improving cancer-related cognitive problems.

Keywords

cancer; oncology; cognition; yoga; physical activity

Background

Breast cancer survivors commonly experience cognitive impairment during survivorship [1, 2]. Accumulating evidence suggests that cancer and its treatment can negatively impact neuropsychological test performance [3-5], although these findings are not without controversy [1, 6]. Cancer-related neuropsychological problems appear to dissipate over time; however, for a subset of cancer survivors, mild impairment may persist over the long-term in several focused cognitive domains, such as verbal ability [6].

In addition to poorer neuropsychological test performance, survivors often report cognitive problems [7]. Although subjective cognitive dysfunction is consistently associated with psychological distress [7, 8], the relationships between subjective and objective cognitive function is less clear. Cross-sectional studies indicate that cognitive complaints may parallel neuropsychological test performance in some domains. For example, breast cancer survivors who reported more memory problems had lower scores on a standardized verbal memory task than those who reported fewer memory problems [9]. On the other hand, breast cancer survivors who just stopped adjuvant endocrine therapy (e.g., tamoxifen or aromatase inhibitors) continued to report cognitive problems over the following year, despite improvement in objective neuropsychological test scores [10]. Whether or not perceptions are mirrored by objective neuropsychological measures, perceived cognitive dysfunction can be disruptive to cancer survivors. For example, one year after cancer treatment, women with more cognitive complaints had lower quality of life scores than those with fewer cognitive complaints [11]. Accordingly, subjective cognitive problems are bothersome for some cancer survivors.

Physical activity benefits cognitive function in non-cancer populations [12, 13], but evidence linking physical activity to cognitive complaints in cancer survivors is limited. Significant de-conditioning and decreases in physical activity typically occur over the course of cancer treatment [14, 15]. Consequently, cognitive complaints among cancer survivors may be at least partially linked to decreased physical activity. A recent meta-analysis concluded that physical activity interventions improved cancer survivors' overall quality of life, but did not consistently affect their perceived cognitive problems [16]. However, several limitations of the meta-analysis precluded strong conclusions, including the small sample sizes of many studies, as well as the relatively limited number of trials that reported cognitive outcomes. Taken together, these findings suggest that further research is necessary to determine whether physical activity impacts cognitive function for cancer survivors.

Yoga is a particularly appealing exercise intervention for improving cognitive function in breast cancer survivors. With gentle physical activity, breathing practices, and meditation, yoga can be easily adapted for breast cancer survivors who may be experiencing common physical symptoms like pain or fatigue [17]. Indeed, recent randomized controlled trials (RCTs) demonstrated that cancer survivors derived both physical and psychological benefits from yoga [17-19]. In addition, healthy college-aged females performed better on a working memory and inhibitory control task immediately following a yoga practice session compared to a baseline or aerobic exercise session [20]. Yoga can also reduce inflammation [19], one proposed mechanism that may contribute to breast cancer survivors' cognitive symptoms [21-23].

Several meta-analyses suggest that yoga improves cancer survivors' fatigue, distress, and quality of life [24-26], but yoga's impact on cognitive function following cancer treatment is unclear. Indeed, a recent meta-analysis of randomized controlled yoga trials for breast cancer survivors concluded that there was insufficient evidence to evaluate yoga's cognitive effects, because too few trials reported cognitive outcomes [27]. Studies with larger samples of post-treatment breast cancer survivors, appropriate covariates, and supporting adherence data are necessary to evaluate whether yoga decreases subjective cognitive problems. In our recent RCT, a brief yoga intervention reduced fatigue and inflammation compared to a wait-list control group [19]. In the current paper, we report secondary analyses that examined whether yoga also affected self-reported cognitive complaints.

Methods

Participants

Female stage 0 - IIIA breast cancer survivors (N = 200) were recruited from breast cancer physicians and clinics, community announcements, and breast cancer groups and events for an RCT investigating yoga's effects on inflammation, fatigue, and depression from 2007 to 2012 (ClinicalTrials.gov identifier: NCT00486525). The sample size was calculated to ensure adequate (80%) power to detect differences in these primary endpoints, requiring 85 participants per group and assuming a 15% attrition rate [19]. Participants' cancer stage at diagnosis was determined using medical records. Women were eligible for the study if they had completed breast cancer treatment (except for tamoxifen/aromatase inhibitors) between 2 months and 3 years previously. Women were ineligible if they engaged in over 5 hours of vigorous physical activity per week, if they had a prior history of any other cancer (except basal or squamous cell skin cancer), or if they suffered from major medical conditions such as anemia, diabetes, multiple sclerosis, chronic obstructive pulmonary disease, symptomatic ischemic heart disease, uncontrolled hypertension, or liver or kidney failure. Women were also excluded if they had severe cognitive impairment (e.g., dementia, Alzheimer's disease), or abused alcohol or drugs. Those who reported current yoga practice or prior yoga practice exceeding three months were also excluded. The recruitment and randomization procedures have been described in detail in the primary RCT paper [19]. The institutional review board approved this study, and each participant provided informed consent.

Procedures

Participants completed a variety of self-report measures (described below) during study visits at the Clinical Research Center. Following a baseline study visit, a data manager (who had no participant contact) used an online randomization program to assign participants to a 12-week Hatha yoga intervention (n = 100) or a wait-list control condition (n = 100). Immediately post-intervention and at the 3-month follow-up, participants completed additional questionnaires and provided fasting morning blood samples. Participants were asked not to share their group assignment with the study personnel during study visits.

Trained yoga instructors delivered the yoga intervention, which outlined poses for the 24, twice-weekly, 90-minute sessions (see [19] for detailed information on the yoga protocol). Each of the 25 yoga groups (i.e., cohorts) included between 4 and 20 participants. Sessions were audiotaped, and raters assessed 50% of the tapes for protocol drift. To maximize adherence, yoga instructors called women who missed a class to discuss missed material and to assess barriers for participation. Participants received pamphlets that detailed the poses and breathing exercises from class, and were encouraged to practice at home. Women were also given a commercial yoga video for cancer survivors as a home practice aide. Although instructors did not give specific instructions or requirements for the length of home practice, they gave suggestions for ways to complete the poses at home. Women in the yoga condition used weekly logs to record their combined yoga class and home practice time during the 12-week intervention period; the combined total was used to calculate their average daily minutes spent practicing yoga during the intervention period. Instructors also encouraged yoga participants to continue to practice yoga after the 12-week intervention period ended. However, participants did not log their yoga practice during the follow-up period. Wait-list control participants were told to continue normal activities and refrain from beginning any yoga practice; all participants reported adhering to this guideline. After their 3-month follow-up, women in the wait-list group were offered the option to participate in the yoga classes.

Measures

Self-reported cognitive problems—Participants rated how much they were bothered by cognitive symptoms (i.e., forgetfulness, difficulty concentrating, and being easily distracted) in the past 4 weeks (0 “not at all” to 4 “extremely”) as part of the Breast Cancer Prevention Trial (BCPT) Symptom Checklist [28]. The BCPT Symptom Checklist contains several subscales, and factor analytic studies from 4 samples demonstrated that the 3-item BCPT Cognitive Problems Scale is psychometrically and conceptually appropriate for evaluating cognitive symptoms [29]. The individual item scores were averaged to index cognitive problems, with higher scores indicating more cognitive complaints. The scale demonstrates good internal consistency and discriminant validity [28]; Cronbach’s alpha in our sample was .91 at baseline, .91 at the post-intervention visit, and .93 at the 3-month follow-up.

Covariates—In our primary trial, yoga improved sleep quality and fatigue [19]. In addition, prior research has demonstrated that cognitive complaints are linked to depressive symptoms, anxiety symptoms, and fatigue [7, 29]. Accordingly, we assessed depressive

symptoms, anxiety symptoms, fatigue, and sleep quality in order to account for the possibility that they could be responsible for yoga-related differences in self-reported cognitive function.

Women reported current levels of depressive symptoms using the Center for Epidemiological Studies Depression Scale (CES-D), a valid, reliable, and widely-used measure of depressive symptoms [30]. Anxiety symptoms were measured with the Beck Anxiety Inventory (BAI), which has well-established internal consistency and test-retest reliability [31]. Participants rated sleep quality and disturbances using the Pittsburgh Sleep Quality Index (PSQI), which has been used extensively in sleep assessment [32]; higher scores reflect poorer sleep quality. Participants reported vitality in the last month using the Medical Outcomes Study Short Form Health Survey (SF-36) Energy Scale [33], which provided a measure of general energy without assessing the overlapping construct of cognitive fatigue. Higher scores indicate greater vitality and thus lower fatigue.

Inflammation—As part of the parent RCT, fasting blood samples were assayed for lipopolysaccharide (LPS)-stimulated production of interleukin-6 (IL-6), interleukin-1β (IL-1β), and tumor necrosis factor alpha (TNF-α). LPS-stimulated cytokines were measured from isolated peripheral blood mononuclear cells according to Meso Scale Discovery kit instructions (see [19] for detailed methods).

General activity level—At each study visit, the Community Health Activities Model Program for Seniors (CHAMPS) questionnaire was used to assess the average frequency and duration of participants' engagement in various physical activities in the last month [34, 35]. For each participant, weekly hours spent engaging in activities of moderate-to-high intensity were calculated.

Statistical analyses

In preliminary analyses, we tested for baseline between-group differences in cognitive complaints using an independent samples t-test. In primary analyses, linear mixed models tested whether self-reported cognitive function differed between groups following the intervention. Intervention group, visit, the group by visit interaction, and baseline cognitive complaints were entered as predictors of post-intervention cognitive complaints. To account for repeated post-intervention assessments of each participant and the yoga class cohorts (resulting in partially nested data), subject and intervention cohort were included as random effects. Significant group by visit interactions were decomposed using planned contrasts that tested whether cognitive complaints differed for the yoga and wait-list groups both immediately post-intervention and at the 3-month follow-up. A second set of planned contrasts tested the effect of visit within each group, addressing whether cognitive complaints changed significantly from the immediate post-intervention to 3-month follow-up visits for each group.

We conducted two sets of ancillary analyses. First, we examined whether potential confounds could account for yoga's effect on cognitive function. To accomplish this goal, we simultaneously included levels of depression, anxiety, fatigue, and sleep quality in the

primary model [7, 19, 29]. Because these variables were measured at each study visit, they were included as time-varying covariates.

The second set of ancillary analyses examined whether women who practiced yoga more frequently derived more benefit from the intervention. To test this hypothesis, we repeated the primary analyses and replaced intervention group with the participants' average minutes of yoga practice per day, which included time spent practicing in class and at home during the intervention. Significant practice by visit interactions were decomposed using planned contrasts that tested the effect of yoga practice at each post-intervention visit. To examine whether yoga practice was associated with change in cognitive complaints over time, a second set of planned contrasts tested the effect of visit at no yoga practice (wait-list participants, 0 minutes per day), lower frequency yoga practice (25^{th} percentile, 18 minutes per day), and higher frequency yoga practice (75^{th} percentile, 29 minutes per day).

Given prior research linking inflammation, physical activity, and cognitive function [13, 20], we also explored the possibility that inflammation mediated yoga's effect on cognitive complaints. The parent RCT demonstrated that women in the yoga group had lower levels of LPS-stimulated IL-6, IL-1β, and TNF-α than women in the wait-list control group at the 3-month follow-up [19]. Levels of LPS-stimulated IL-6, IL-1β, and TNF-α did not differ between yoga and waitlist groups immediately post-intervention. In exploratory analyses, we tested whether levels of inflammation were associated with cognitive complaints. We tested this possibility in two ways. First, we added each inflammatory marker separately to the primary model individually as a time-varying covariate. These analyses allowed us to examine whether inflammation significantly predicted cognitive complaints. Next, we calculated changes in LPS-stimulated cytokines by subtracting 3-month follow-up values from baseline values; we investigated whether changes in inflammation predicted cognitive problems scores at the 3-month follow-up (controlling for baseline cognitive complaints). Levels of LPS-stimulated IL-6, IL-1β, and TNF-α were natural log-transformed to reduce skew.

Finally, to gain information about participants' activity level during the follow-up period, we conducted a post-hoc exploratory analysis to test the effect of group on moderate-to-high physical activity levels following the intervention. To do so, we repeated the primary analyses and replaced the cognitive complaints variable with the activity level outcome variable while controlling for baseline activity levels.

Results

Sample description

Demographic and baseline characteristics of the sample are presented in Table 1. Participants were primarily employed (68.5%), Caucasian (88.5%), post-menopausal (81%) women. On average, participants were 10.9 (± 7.9 *SD*) months post-treatment, with the exception of hormonal therapy. Demographic and disease-related characteristics did not differ significantly between groups. Four women (two in the yoga group and two in the waitlist group) experienced a recurrence of their breast cancer during study enrollment. Importantly, BCPT Cognitive Problems Scale scores did not differ significantly between the

two groups at baseline ($t(198) = -.45$, $p = 0.654$). On average, participants reported slight-to-moderate bother from cognitive symptoms, which is consistent with previous reports using the BCPT Cognitive Problems Scale [28].

Protocol adherence

Of the 200 women in the initial sample, 186 provided post-intervention data across the wait-list (n = 90) and yoga (n =96) groups. Women who did not provide post-intervention data were more likely to be separated or divorced compared to women who provided data ($X^2 = 8.28$, $p = .041$). Other demographic characteristics did not differ significantly between women who provided post-intervention data and those who did not (ps > .100). However, women who dropped out of the study had higher anxiety symptoms ($t(198) = 2.57$, $p = .011$) and worse sleep quality ($t(197) = 1.94$, $p = .053$), as well as slightly more cognitive complaints ($t(198) = 1.68$, $p = .094$) at baseline than those who completed the intervention.

On average, women who received the yoga intervention attended 18.13 (± 4.52 *SD*) of 24 classes (75.4%), and reported 24.69 (± 10.62 *SD*) minutes per day of yoga practice during the 12-week intervention. None of the wait-list control participants reported practicing yoga over the course of the intervention.

Primary analyses

Table 2 summarizes the results from the primary linear mixed model, which tested group differences in cognitive complaints over time. The group by visit interaction was a significant predictor of self-reported cognitive problems, suggesting that change in cognitive complaints differed for yoga versus wait-list groups ($F(1, 176) = 4.11$, $p = .044$; see Table 2 and Figure 1A). The first set of planned contrasts tested group differences at each time point (see Table 3). Cognitive complaints did not differ significantly between yoga ($M = 1.15$) and wait-list ($M = 1.26$) groups immediately following the intervention ($t(86) = 1.16$, $p = .250$). However, at the 3-month follow-up visit, yoga participants ($M = 1.03$) reported 23% fewer cognitive problems than wait-list participants ($M = 1.34$; $t(88) = -3.02$, $p = .003$). A second set of contrasts tested the effect of visit within each group. For the control group, cognitive complaints did not differ significantly from immediately post-intervention to the 3-month follow-up visits ($t(175) = 1.06$, $p = .291$). However, cognitive complaints improved over time in the yoga group, although this effect approached significance ($t(177) = -1.82$, $p = .071$).

Ancillary analyses

In secondary analyses, we adjusted for the concurrent effects of depression, anxiety, fatigue, and sleep quality (see Table 2). The results of the primary analysis remained the same, albeit slightly weaker; the group by visit interaction approached significance with all of the covariates included ($F(1, 173) = 3.08$, $p = .081$). Planned contrasts reflected the primary results. Specifically, cognitive complaints did not differ significantly between groups immediately following the intervention ($t(97) = -.18$, $p = .858$). However, yoga participants tended to report fewer cognitive problems than wait-list participants at the 3-month follow-up ($t(101) = -1.89$, $p = .062$). For the control group, cognitive complaints did not differ significantly from immediately post-intervention to 3-month follow-up ($t(171) = .66$, $p = .$

511). However, cognitive complaints decreased from immediately post-intervention to 3-month follow-up for women in the yoga group, although again this effect was trending towards significance ($t(173) = -1.84$, $p = .068$).

Analyses that examined the effect of yoga practice on self-reported cognitive function bolstered the primary analyses examining the assigned intervention group (see Figure 1B). The yoga practice by visit interaction was significant ($F(1, 174) = 8.81$, $p = .003$). Follow-up tests revealed that the effect of yoga practice frequency on cognitive function was not significant immediately following the intervention ($b = -.003 \pm .003$ SE, $t(126) = -1.02$, $p = .308$). However, women who spent more time practicing yoga during the course of the trial reported significantly fewer cognitive problems at the 3-month follow-up visit than those who practiced yoga less frequently ($b = -.01 \pm .003$ SE; $t(127) = -3.79$, $p < 0.001$). A second set of contrasts examined the effect of visit on cognitive complaints for those with different levels of yoga practice. Among women who spent no time practicing yoga (i.e., wait-list controls, 0 minutes per day), cognitive complaints did not change significantly from immediately post-intervention ($M = 1.25$) to the 3-month follow-up ($M = 1.34$; $t(175) = 1.53$, $p = .128$). Similarly, those with lower yoga practice frequency (i.e., 25th percentile, 18 minutes per day) did not report significant changes from immediately post-intervention ($M = 1.19$) to the 3-month follow-up ($M = 1.11$; $t(176) = -1.54$, $p = .125$). However, among women with higher yoga practice frequency (i.e., 75th percentile, 29 minutes per day), cognitive complaints decreased significantly from immediately post-intervention ($M = 1.15$) to the 3-month follow-up ($M = 0.97$; $t(175) = -2.58$, $p = .011$). Adjusting for depression, anxiety, sleep quality, and fatigue did not change the results.

Exploratory analyses

Yoga decreased inflammation in the parent RCT; accordingly, we examined whether changes in inflammation contributed to group differences in cognitive complaints. We added each inflammatory marker to the primary model as a time-varying covariate; IL-6, IL-1β, and TNF-α levels were not significant predictors of cognitive complaints (ps > .369). Changes in IL-6, IL-1β, and TNF-α levels from baseline to 3-month follow-up did not significantly predict cognitive complaints at the 3-month follow-up (ps > .474).

We also examined whether general physical activity levels as measured by the CHAMPS differed between groups following the intervention. The main effect of group predicting moderate-to-high intensity activity hours was significant ($F(1, 78) = 5.69$, $p = .019$), and the group by visit interaction was not significant ($p = .751$). Immediately post-intervention, yoga participants ($M = 6.60$) tended to report greater moderate-intensity activity hours compared to wait-list participants ($M = 5.23$), and this effect approached significance ($t(145) = 1.83$, $p = .068$). At the 3-month follow-up, yoga participants ($M = 6.80$) reported significantly greater moderate-to-high intensity activity hours than wait-list participants ($M = 5.17$, $t(148) = 2.17$, $p = .032$).

Conclusions

On average, breast cancer survivors who received a brief yoga intervention had 23% lower self-reported cognitive problems scores than wait-list participants at the 3-month follow-up

visit. Among women in the intervention group, those who practiced yoga more frequently during the intervention had larger decreases in cognitive complaints than those who practiced less frequently, suggesting that components of yoga were beneficial. The current findings suggest that yoga may be useful for reducing cognitive complaints in breast cancer survivors.

These results extend the current literature on cognitive function, yoga, and breast cancer survivorship in an important new direction. RCTs and meta-analyses have demonstrated that yoga reduces common behavioral symptoms for breast cancer survivors, such as psychological distress, fatigue, and sleep disturbances [17-19, 25, 26]. However, limited research has addressed yoga's effect on perceived cognitive problems, another important aspect of cancer survivors' well-being [27]. With good adherence (above 90%), inclusion of relevant covariates (i.e., psychological distress), and supporting yoga practice frequency data, this study addresses limitations of the few yoga intervention trials reporting cognitive outcomes. Importantly, group differences in cognitive complaints remained even after controlling for psychological distress, fatigue, and sleep quality, which are often related to perceived cognitive problems [7, 8]. Indeed, our results indicated that lower distress and fatigue may have contributed to yoga's beneficial effect on cognitive function, but could not entirely explain it.

In this study, group differences in cognitive complaints were significant at the 3-month follow-up, but not immediately following the intervention. This pattern is consistent with the primary outcomes of this trial; yoga participants had significantly lower LPS-stimulated IL-6, IL-1β, and TNF-α, and fatigue than waitlist participants at the 3-month follow-up, but group differences were not significant immediately post-intervention. One possibility is that women may have continued to practice yoga beyond the intervention period, accruing its positive effects on physical, emotional, and cognitive well-being over time. Although women reported their at-home and in-class yoga practice during the intervention, we did not ask participants to track their yoga activities following the 12-week intervention period, a limitation of this study. However, participants reported their participation in other activities at each study visit, including the 3-month follow-up visit. Compared to waitlist participants, yoga participants reported more hours of moderate-to-high intensity activity both immediately post-intervention and at the 3-month follow-up. These data suggest that women who received the yoga intervention sustained greater overall physical activity levels over time, which could have produced the cognitive benefits that were evident at the 3-month follow-up. Future RCTs may be strengthened by including follow-up periods, and continuing to measure participants' yoga practice after the intervention ends.

There are several plausible mechanisms through which yoga may reduce breast cancer survivors' cognitive complaints. Prior research suggests that inflammation contributes to breast cancer survivors' cognitive symptoms [21-23]. However, reductions in the inflammatory markers studied here did not explain yoga-related changes in cognitive complaints in the current study, which suggests that yoga likely affected cognitive complaints through other pathways. Physical activity can benefit cognitive function by increasing cerebral blood flow, neurogenesis, and neurotrophic factors that support neuronal health [37]. In addition, yoga may decrease cognitive complaints by reducing negative

performance expectations. For example, women who received chemotherapy and were reminded about its negative cognitive effects performed more poorly on a subsequent memory task and reported more cognitive problems than those who did not receive such reminders [38]. Breathing exercises and meditation during yoga may help to focus attention to the present moment; emerging research suggests that mindfulness can impact cognitive function [39]. Accordingly, yoga may reduce perceived cognitive deficits by increasing physical fitness and/or mindfulness. Finally, it is possible that yoga participants' expectations of the intervention's benefits may have influenced their likelihood to engage in practice or perceive cognitive improvement. Comparing yoga to other physical activity interventions in future trials would help to further assess yoga's utility in improving post-treatment cognitive problems, as well as the mechanisms through which yoga affects cognitive function.

Women in our study reported relatively low levels of cognitive problems; on average, they were "slightly" or "moderately" bothered by forgetfulness, difficulty concentrating, and distractibility. These data are consistent with breast cancer survivors' reports in other studies [28, 40]. Those who dropped out of the intervention reported slightly more cognitive problems and fatigue [19] than those who completed the trial. Consequently, our results may actually underestimate the true effect of yoga on cognitive function, one limitation. Alternatively, yoga may be less feasible for those with the greatest fatigue and self-reported cognitive problems. Of note, women who dropped out of the study represent a small percentage of the overall sample; the trial had excellent retention, with an attrition rate of less than 10%. In addition, because we did not assess objective measures of cognitive function, these data cannot address whether yoga benefits objective cognitive performance, another limitation. Although future trials that examine neuropsychological test performance would help to answer whether yoga also affects objective cognitive function, it is also important to note that better subjective cognitive function could substantially improve quality of life [9, 11].

Given the improved efficacy of cancer treatments, long-term health and quality of life following cancer is increasingly important. Breast cancer survivors often report and experience cognitive problems following cancer treatment, and perceived cognitive dysfunction may continue even after neuropsychological test performance improves [10]. These findings suggest that yoga can effectively reduce breast cancer survivors' cognitive complaints, and prompt researchers to further explore mind-body and physical activity interventions for improving cancer-related cognitive problems.

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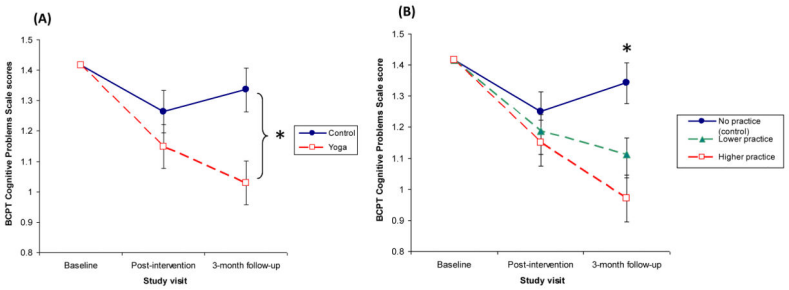

Figure 1.

(A) BCPT Cognitive Problems Scale scores at baseline, immediately post-intervention, and 3 months post-intervention in yoga and control groups. The plot shows estimated marginal means (± SE) from a linear mixed model adjusting for baseline BCPT Cognitive Problems Scale scores. Yoga participants reported significantly fewer cognitive problems at the 3-month follow-up visit compared to wait-list control participants (* indicates significant group contrast, $p < .05$). **(B)** BCPT Cognitive Problems Scale scores at baseline, immediately post-intervention, and 3-month follow-up based on yoga practice frequency. The plot shows estimated marginal means (± SE) from a linear mixed model adjusting for baseline BCPT Cognitive Problems Scale scores at no yoga practice (wait-list participants, 0 minutes per day), lower frequency yoga practice (25^{th} percentile, 18 minutes per day), and higher frequency yoga practice (75^{th} percentile, 29 minutes per day). At 3-month follow-up, those who practiced yoga more frequently reported fewer cognitive problems than those who practiced less frequently (* indicates significant slope of yoga practice, $p < .05$).

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Table 1

Demographic and baseline characteristics of total sample.

	Total sample (n = 200)				Yoga (n = 100)				Wait-list (n = 100)			
Variable	**n**	**%**	***M***	**(*SD*)**	**n**	**%**	***M***	**(*SD*)**	**n**	**%**	***M***	**(*SD*)**
Age (years)			51.6	(9.2)			51.8	(9.8)			51.3	(8.7)
BMI (kg/m^2)			27.8	(5.7)			27.9	(5.3)			27.6	(6.0)
BCPT cognitive problems			1.5	(1.0)			1.5	(1.0)			1.4	(1.0)
CES-D depressive symptoms			10.7	(8.2)			10.2	(8.2)			11.2	(8.2)
BAI anxiety symptoms			10.1	(7.1)			9.8	(7.2)			10.33	(7.1)
SF-36 vitality			46.5	(20.6)			48.6	(20.2)			44.4	(20.9)
PSQ sleep quality			7.5	(3.5)			7.9	(3.9)			7.2	(3.1)
CHAMPS moderate-to-high intensity activity, hrs/week			6.3	(5.8)			6.8	(6.3)			5.8	(5.1)
Race/Ethnicity												
White	176	88.5			88	88			88	88		
Black	18	9			8	8			10	10		
Asian	5	2.5			3	3			2	2		
Marital Status												
Single	26	13			18	18			8	8		
Married	140	70			68	68			72	72		
Separated/divorced	29	14.5			14	14			15	15		
Widowed	5	2.5			0	0			5	5		
Education level												
High school or less	12	6			5	5			7	7		
Some college	49	24.5			27	27			22	22		
College graduate	62	31			29	29			33	33		
Postgraduate	77	38.5			39	39			38	38		
Employment status												
Employed	137	68.5			71	71			66	66		
Unemployed	35	17.5			15	15			20	20		
Retired	28	14			14	14			14	14		
Income level ($)												

Variable	Total sample (n = 200)				Yoga (n = 100)				Wait-list (n = 100)			
	n	**%**	***M***	**(*SD*)**	**n**	**%**	***M***	**(*SD*)**	**n**	**%**	***M***	**(*SD*)**
0 – 25,000	10	5.5			3	3			7	7		
25,000 – 50,000	33	18			18	18			15	15		
50,000 – 75,000	35	19.1			17	17			18	18		
75,000-100,000	46	25.1			23	23			23	23		
>100,000	59	32.2			30	30			29	29		
No report	17	8			9	9			8	8		
Type of treatment												
Surgery only	26	13			13	13			13	13		
Surgery plus radiation	52	26			28	28			24	24		
Surgery plus chemotherapy	46	23			23	23			23	23		
Surgery plus radiation plus chemotherapy	76	38			36	36			40	40		
Cancer stage at diagnosis												
0	18	9			9	9			9	9		
I	89	44.5			46	46			43	43		
IIA	52	26			27	27			25	25		
IIB	23	11.5			10	10			13	13		
IIIA	18	9			8	8			10	10		
Tamoxifen/aromatase inhibitor use	143	71.5			72	72			71	71		
Postmenopausal	153	81			76	76			77	77		
Time since diagnosis (months)			17.3	(8.1)			16.3	(7.5)			18.3	(8.5)
Time since treatment (months)			10.9	(7.9)			9.9	(7.1)			11.8	(8.5)

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Table 2

F-tests for all predictors of BCPT Cognitive Problems Scale scores at the post-intervention visits in primary and ancillary analyses.

Effect	*F*	DF	*P*
Primary model			
Baseline cognitive complaints	243.73	1, 183	**<.001**
Visit*	.27	1, 176	.608
Group	5.60	1, 55	**.022**
Visit × Group	4.11	1, 176	**.044**
Ancillary model			
Baseline cognitive complaints	159.77	1, 198	**<.001**
Visit	.66	1, 172	.417
Group	1.42	1, 59	.238
Visit × Group	3.08	1, 173	.081
Depressive symptoms	5.78	1, 347	**.017**
Anxiety symptoms	8.32	1, 351	.004
Fatigue	11.43	1, 323	.001
Sleep quality	.507	1, 343	.477

*Immediate post-intervention visit versus 3-month follow-up visit.

Table 3

Contrasts comparing cognitive complaints across groups and over time from the primary linear mixed effects model.

Contrast	Mean Differences in BCPT Cognitive Scale scores			
	Mean Difference	SE	95% CI	*p*
Comparing groups				
Yoga vs. wait-list immediately post-intervention	.12	.10	−.08 to .32	.250
Yoga vs. wait-list at 3-month follow-up	.31	.10	.11 to .51	**.003**
Comparing visits				
Immediately post-intervention to 3-month follow-up in yoga group	.07	.07	−.06 to .20	.291
Immediately post-intervention to 3-month follow-up in wait-list control group	.12	.07	−.01 to .25	.071