



Published in final edited form as:

*Cancer*. 2019 June 15; 125(12): 1979–1989. doi:10.1002/cncr.31979.

## Yoga for Symptom Management in Oncology: A Review of the Evidence Base and Future Directions for Research

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### Abstract

As 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. We 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, n=4 with mixed samples). Findings both during and after treatment demonstrated 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 additionally suggest that yoga can improve stress/distress during treatment and post-treatment disturbances in sleep and cognition. A number of RCTs showed evidence that yoga may improve biomarkers of stress, inflammation, and immune function. Outcomes with limited or mixed findings (e.g., anxiety, depression, pain, cancer-specific symptoms such as lymphedema, 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 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.

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**Conflict of Interest:** None

**Precis:**

Randomized controlled trials conducted both during and after cancer treatment provide evidence for the efficacy of yoga to improve quality of life and fatigue. Yoga has potential to improve additional cancer-related symptoms (e.g., sleep, depression, anxiety, distress, cognition) and biomarkers of stress and inflammation/immunity, but further research is needed.

**Keywords**

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

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**Introduction**

Cancer is one of the most common causes of morbidity and mortality, with approximately 14 million new cases and nearly 9 million cancer deaths annually worldwide.<sup>1</sup> Psychosocial and biomedical sequelae of cancer and its treatment include distress (e.g., depression, anxiety, fear of recurrence), fatigue, sleep disturbance, pain, nausea/vomiting, cognitive difficulties, immunosuppression, and cardiotoxicity.<sup>2–6</sup> Symptom burden is higher in adults with cancer than non-cancer patients and is associated with decreased functioning, increased disability, and poor quality of life (QOL).<sup>2,4,7–9</sup> In some cases, cancer-related sequelae resolve; however, persistent and late effects leave many survivors with long-term symptom management needs.<sup>3,10–13</sup>

Yoga is increasingly recognized as a complementary approach to diminishing the onset and severity of cancer-related symptoms and/or treating such symptoms.<sup>14</sup> Research has demonstrated feasibility and acceptability of yoga among cancer patients undergoing treatment and those who have transitioned out of the medical setting.<sup>15–17</sup> Most NCI-designated comprehensive cancer centers now include information about yoga on their websites (87%) and offer on-site yoga instruction (69%).<sup>18</sup> A population-based study of adults in the US found that approximately 10% of cancer survivors have ever tried yoga, 5.5% in the past year.<sup>19</sup> Reasons for use of yoga among cancer survivors include: relaxation; coping with cancer-related distress; taking an active, positive role in their cancer recovery; managing non-cancer conditions (e.g., cardiovascular disease, arthritis); and increasing energy, physical activity, immunity, and overall wellness.<sup>20–22</sup>

Cancer survivors turn to complementary therapies such as yoga to enhance recovery and wellness and are particularly likely to approach yoga as a complementary option based on recommendations from healthcare providers.<sup>19</sup> Establishing the efficacy of yoga for cancer symptom management is therefore critical for appropriate supportive cancer care and survivorship planning. Patients/survivors and providers need to understand the potential benefits and limitations of yoga at each point in the cancer continuum from diagnosis through long-term survivorship. Thus, the current review examines evidence for use of yoga both *during and after* cancer treatment.

## Methods

We searched CINAHL, MEDLINE, PsycINFO, and PubMed using the terms yoga, cancer, and related Medical Subject Headings (e.g., neoplasm). We ascertained additional reports from reference lists of identified articles. Inclusion criteria were: (1) randomized controlled trial (RCT) of yoga, including yoga postures or breathing techniques; (2) sample including adults with current/past cancer, regardless of treatment status; and (3) published quantitative results in peer-reviewed journals in English through December 2017. Trials were excluded if they: (1) delivered meditation only; (2) taught yoga as part of a multimodal program (e.g., mindfulness-based stress reduction); or (3) were designed primarily to evaluate feasibility and/or acceptability.

## Results

### Study Characteristics

We identified 29 RCTs (see Table 1): 13 were conducted during treatment (23 publications), 12 after treatment was completed (20 publications), and 4 included participants both during and after treatment. Only four studies included an active comparison group, such as supportive counseling, stretching, or physical activity control groups, and the others used a waitlist method or usual care control groups. Samples predominantly included women with breast cancer. Of 13 RCTs conducted during treatment, all but one were with women with breast cancer, with five conducted during radiotherapy only, five during chemotherapy only, and three across both radiotherapy and chemotherapy.

Yoga interventions varied considerably in the components taught. With the exception of a single study focused only on yogic breathing,<sup>23</sup> most studies conducted during treatment involved multi-component protocols (i.e., movement/postures, breathing, and meditation) based on several different yoga types (1 each: Anusara, Eischens, Iyengar, Tibetan, Yoga in Daily Life; 2 Bali; 5 Vivekananda Yoga Anusandhana Samsthana). Yoga was typically delivered in a group format, though individual instruction occurred in 1 study by design<sup>24</sup> and in 2 studies due to patients' schedules.<sup>25,26</sup> Dose varied widely, with classes lasting up to 90 minutes and occurring from 1 to 6 days/week over 1 to 8 weeks. Further, most prescribed home practice.<sup>24–33</sup> For the post-treatment yoga studies, interventions were designed as gentle stretching and strengthening exercises, including breathing techniques (Pranayama), postures (asanas), meditation and relaxation. Sessions were group-based and used a variety of yoga styles: Hatha<sup>34–39</sup> (n=4), Iyengar<sup>38,40</sup> (n=2), gentle/Restorative<sup>41,42</sup> (n=2), and Satyananda<sup>43</sup> (n=1). Dose varied widely, with length of programs varying from 4 weeks to 6 months, with classes offered 1–3 times weekly, and each class lasting from 60–120 minutes. Home-based practice was encouraged across most studies. For the combined sample studies, the yoga intervention involved 7–12 weekly group classes (2 Hatha yoga, 1 Restorative yoga, 1 Tibetan yoga),<sup>44–47</sup> and home practice was encouraged in two of these studies.<sup>46,47</sup>

Intervention adherence (class attendance or practice outside of class) and its reporting were inconsistent. Among studies conducted during treatment, several did not report or only partially reported adherence.<sup>23,24,27,29,30,32</sup> Some studies reported the mean number of

classes attended (e.g., 5.5 of 8 possible classes)<sup>31,33</sup> and mean hours of home practice (e.g., 2.25 per week).<sup>31</sup> Others reported adherence ranging up to 81% of participants attending all classes<sup>48</sup> and 100% engaging in 5–7 days of home practice per week.<sup>29</sup> Among studies conducted post-treatment, reporting of program adherence also varied (n=10 reported some measure of adherence). Studies that reported average attendance saw as high as 97% attendance, with a self-reported home practice adherence of 86%. In contrast, one study reported 61% average adherence (across 14 yoga participants). In a 6-month intervention, average attendance at facility-based classes was 19.6 times, and home practice was reported as 55.8 times on average.<sup>35</sup> Among the four studies with combined samples, all reported on adherence, either percentage of classes attended<sup>45,49</sup> and/or mean number of classes attended (i.e., mean-9.7 of 12 classes).<sup>45–47</sup>

## Outcomes

Table 2 provides an overview of outcomes assessed and statistical significance of between-group main effects, broken down by self-reported measure of physical function, objective physical measures (fitness, actigraphy, biomarkers), and self-reported measures of psychological and cognitive outcomes. Table 3 provides a summary of the outcome categories and findings across studies.

## Summary of Findings

**During Cancer Treatment.**—RCTs of yoga conducted during cancer treatment most commonly measured fatigue (n=8), anxiety (n=8), depression (n=7), and QOL (n=6). For QOL, 5 of 6 studies demonstrated favorable effects of yoga on global<sup>50</sup> and domain-specific (physical,<sup>26,28</sup> emotional,<sup>30,51</sup> social,<sup>51</sup> cognitive<sup>30</sup>) measures, but studies also reported non-significant findings (global,<sup>32</sup> social,<sup>52</sup> role function,<sup>52</sup> mental,<sup>26</sup> functional,<sup>51</sup> physical<sup>51</sup>). Consistent findings, albeit among a small number of studies, included improved distress (n=2), perceived stress (n=3), and various biomarker levels (e.g., pro-inflammatory cytokines, cortisol; n=4). Three trials reported improvements in psychosocial outcomes such as benefit finding and spirituality. No RCTs conducted during treatment measured physical fitness or cognitive outcomes.

Two examples of methodologically strong studies conducted during cancer treatment stated that they were sufficiently powered to detect differences in pre-specified primary outcomes (power analyses reported) and included both active and usual care control groups.<sup>25,28</sup> A study conducted by Chandwani and colleagues (2014)<sup>23</sup> reported that their primary outcomes were the Physical Component Score (PCS) and Mental Component Score (MCS) from the Medical Outcomes Study 36-Item Short-Form Survey (SF-36) QOL measure at 1 month post-radiotherapy. Statistically significantly greater increases from baseline were observed in PCS scores for the yoga group compared with the wait-list control group. There were no significant effects of yoga as compared to the active stretching control group or for the MCS. Secondary outcomes included significantly steeper cortisol slopes in the yoga group as compared to both control groups, suggesting positive effects of yoga on the stress hormone cortisol. In addition, the PCS Physical Functioning subscale also showed a statistically and clinically significant difference for yoga as compared to the active stretching control group at the primary time point. Moderator analyses further indicated that the

efficacy of yoga for improving MCS was more pronounced for women with elevated sleep disturbances and depressive symptoms at the start of radiotherapy.<sup>53</sup>

Another study by Chaoul and colleagues (2018) stated primary outcomes were self-reported sleep disturbances (Pittsburgh Sleep Quality Index) and fatigue (Brief Fatigue Inventory) one-week after the intervention.<sup>25</sup> There were no group differences noted in total sleep disturbances or fatigue levels over time. Yet, significant differences were detected between yoga and both control groups (i.e., active stretching, usual care) for a subscale of the sleep disturbances measure (daily disturbances). Subgroup analyses revealed that patients who practiced yoga at least 2 times a week self-reported better sleep, as also supported by an objective measure of sleep (i.e., actigraphy) at 3 and 6 months after the intervention compared with those who did not practice and with those in the usual care control group.

**After Cancer Treatment.**—The most commonly assessed category of outcomes in RCTs conducted after completion of cancer treatment was physical, which included fatigue, sleep, and physical fitness. Overall, fatigue (n=10) was the most studied individual outcome, showing improvement in 7 studies. Sleep demonstrated improvement in 5 of 7 studies, including one using objective, actigraphy-based measurement.<sup>42</sup> Only 1 of 5 studies reported significant between-group effects of yoga on physical fitness.<sup>37</sup> Nonetheless, this finding is particularly noteworthy considering that it was the only post-treatment RCT to use physical exercise as the control group.

Other commonly assessed outcomes were QOL and depression (each n=5). QOL measures varied, but commonly included cancer-specific measures, such as the Functional Assessment of Cancer Therapy and European Organization for Research and Treatment of Cancer questionnaires. Of the 5 studies that examined QOL, 4 reported between group improvements in various domains (global QOL,<sup>54</sup> emotional function (n=2),<sup>34,54</sup> decreased diarrhea,<sup>54</sup> QOL sub-scale of symptoms,<sup>43</sup> FACT-B QOL total,<sup>34</sup> social<sup>34</sup> and functional well-being),<sup>34</sup> though one study (which examined breast cancer-related QOL) was limited to subgroup analysis based on attendance.<sup>27</sup> Of these 5 studies, nonsignificant findings were also reported for a number of QOL domains including physical well-being<sup>35,38</sup> or function,<sup>54</sup> social well-being<sup>35,38</sup> or function,<sup>54</sup> emotional well-being,<sup>35,38</sup> cognitive function,<sup>54</sup> role function<sup>54</sup> and functional well-being.<sup>35,38</sup>

Finally, a range of additional outcomes improved following yoga including cognition (e.g., memory difficulties, cognitive disorganization, cognitive complaints), lymphedema, vitality/vigor, and biomarkers (e.g., inflammation, stress/cortisol). However, the findings were limited to 2–3 studies for each outcome. Unlike RCTs conducted during treatment, post-treatment studies rarely assessed anxiety.

**Combined Samples.**—In studies enrolling patients during the active phase of treatment and once treatment ended, fatigue was again the most common outcome (n=4).<sup>45–47,49</sup> However, none of the RCTs found a significant effect of yoga on fatigue. For QOL, sleep, and depression, 2 of 3 studies (for each outcome) reported significant effects of yoga. In fact, for the 3 studies that measured QOL, there were significant group differences for mental health QOL in one study,<sup>45</sup> and for general health-related QOL, social well-being,

emotional well-being, functional well-being, and physical well-being in another study<sup>34</sup> for at least one time point. Two studies found significant group differences for social well-being.<sup>46,47</sup> For two studies, findings were nonsignificant for physical health QOL, general health related-QOL, and a number of the QOL domains (emotional, functional, and physical well-being);<sup>45,46</sup> social well-being was nonsignificant in one of these studies.<sup>45</sup> Other outcomes were less commonly studied in combined samples; in fact, none of the combined sample RCTs assessed pain, perceived stress, or objectively measured physical outcomes.

### Adverse Event Reporting

Of the studies conducted during cancer treatment, 6 mentioned that there were no adverse events related to the study intervention, and 7 did not include adverse event reporting. Of the post-treatment studies, 7 mentioned adverse events or safety reporting. Of these, events likely attributed to the yoga interventions were described in 3 and included transient muscle soreness, unilateral hip pain, back spasms, recurrence of chronic back and/or shoulder problems.<sup>34,36,40</sup> In addition, Mustian and colleagues systematically reported on all unexpected, serious, life-threatening and fatal adverse events during the study period and did not attribute the single serious adverse event that occurred to the yoga intervention.<sup>42</sup> Of the combined studies, 2 included adverse event reporting and two did not. One study stated that no adverse events were reported.<sup>45</sup> Cramer et al. reported seven total minor adverse events (e.g., muscle soreness, minor vertigo), with six that recovered without treatment.<sup>34,47</sup> One person who experienced hip pain recovered after treatment with analgesic drugs.

### Discussion

The popularity of yoga with cancer patients is reflected in the existing evidence base and the number of trials that have examined the effects of yoga in oncology. Twenty-nine RCTs of yoga for adults with cancer were identified including 13 conducted during cancer treatment, 12 in patients who had completed cancer treatment, and 4 trials that included a combined sample. Results from RCTs conducted during and after treatment consistently found improvements in multiple domains of QOL, fatigue, sleep, psychological outcomes, and biomarkers. Studies of yoga after treatment also found benefits for a range of other self-reported outcomes. The four studies that included both patients on and off treatment had less consistent findings, with none reporting improvements in fatigue and two each reporting improved QOL domains, sleep, and depression.

Examining the number of positive versus negative outcomes for those undergoing cancer treatment reveals clear benefits in terms of QOL, fatigue, and perceived stress, with less consistent but supportive evidence for other psychosocial outcomes like benefit finding and spirituality. There were mixed findings for sleep, anxiety, and depression. Four out of four studies also found improvements in biomarkers that included cortisol regulation and inflammatory markers. One of the limitations in these studies is that they do not necessarily target one symptom at the start of the trial. Rather, they tend to focus more on a buffering model – diminishing the onset of multiple symptoms associated with treatment. Many patients will go through treatment experiencing few side effects while others struggle from the outset. If studies conducted in patients undergoing treatment used a population expected

to develop more symptoms or patients who had already developed side effects, perhaps the benefits of yoga would be magnified.

Post-treatment studies showed consistent support for yoga in improving fatigue, sleep, and multiple QOL domains, as well as a number of biomarkers. Additional measures assessed physical fitness/functional ability outcomes, unique to the post-treatment studies. Given the opportunity for the body physiologically to “make gains” post-treatment, and the American Cancer Society’s recommendation for continued physical activity and fitness post-treatment, the potential for yoga as a type of physical activity that improves fitness outcomes, such as aerobic capacity, strength, and flexibility, is important.<sup>37,39,54–56</sup> In addition, given the prevalence of comorbidities, (e.g., heart disease) in cancer survivorship, understanding the benefits of yoga as a “body-mind medicine” should be further explored.

In spite of the well-established relationship between cancer diagnosis and distress, which frequently persists after treatment, post-treatment studies did not have a substantial focus on psychosocial well-being.<sup>57,58</sup> Two studies found improvements in depression, while only one study demonstrated an improvement in anxiety.<sup>34,57,58</sup> Finally, the association between physical and psychological outcomes is often captured with global QOL measures. Overall, the issue of using QOL measures to understand specific constructs (physical or psychological) is a potential limitation. It is done to provide a comprehensive measure that reduces subject burden; however, use of a global QOL measure may obscure important nuances that would be captured using a more symptom-specific measure. In addition, for the most part, these studies did not target specific elevated symptoms, with the exception of some studies examining chronic fatigue and sleep disturbances. Similar to the studies of patients undergoing active treatment, examining the benefits of yoga to treat a specific condition will yield greater understanding of the specificity of yoga at treating targeted conditions.

Studies that evaluated yoga interventions in a sample that combined those who were during treatment *and* post-treatment reported less robust findings compared to studies with a more homogeneous sample. These weaker findings are likely due to the increased heterogeneity of the outcomes at study entry, making significant between-group findings more difficult. In fact, when Moadel et al. conducted subanalyses of their sample, focusing only on women who were *not* on treatment at the start of the trial, the findings were clearly stronger.<sup>46</sup> This finding suggests that future efficacy studies should focus on specific populations and times during the cancer care trajectory.

Measures used in the studies during and after treatment were quite varied, making comparison across measures difficult. The use of Patient-Reported Outcomes Measurement Information System (PROMIS) measures in future trials would greatly facilitate comparisons and would also lend toward comparison with legacy measures via Prosetta Stone.<sup>59</sup> Further, many of the measures used in these studies rely on self-report, which can capture important subjective responses to the intervention. However, increasing the use of objective measures such as physical fitness, costs and health care utilization, and biological outcomes is important to improve the reliability of the data and our understanding of the breadth of changes that result from yoga participation. It is noteworthy that a number of

clinical trials assessed biomarkers, with findings suggesting that yoga may improve outcomes such as stress hormone regulation, inflammation, and immune function.

Importantly, none of the trials documented any serious adverse events associated with yoga, with only some minor adverse events reported (e.g., muscle soreness).<sup>34,36,40</sup> Minor adverse events were only reported in three post-treatment and one trial that combined active and post-treatment patients. One way these adverse events may be mitigated in future studies could be by reducing the intensity of movements taught during active treatment. Other studies specifically reported that there were no adverse events related to the intervention, although it was not clear in many publications if there were no adverse events or if adverse events were just not assessed. It is important for future trials to systematically assess and report on all adverse events because relying on spontaneous reports from participants may highly underestimate the frequency of these events.

Adverse events are an extremely important consideration because any side effects or risk profile needs to be weighed against the possible benefits. In the case of yoga, the high safety profile combined with benefits for both subjective and objective outcomes and the relatively low cost suggests it is appropriate to encourage patients to participate in yoga programs to reduce symptoms and improve multiple aspects of QOL during and after treatment. However, even if cost is not a barrier, for many patients accessing yoga classes can be a challenge.

Investigators have explored the feasibility of methodological innovations to increase the reach of yoga to more heterogeneous populations (e.g., other cancer types, rural residence). Some of these new methods include incorporating caregivers, implementing yoga in the clinical setting, offering yoga in community settings, and using technology.<sup>60–64</sup> Use of these approaches could address barriers to participation such as accessibility, travel distance, and dissemination (e.g., increased treatment fidelity).<sup>65</sup> Since there is now evidence supporting the efficacy of yoga, it is increasingly important to investigate the effectiveness of these approaches and other intervention elements that may facilitate the eventual translation of yoga to practice (e.g., low cost, takes limited time, is manualized, self-sustaining).<sup>66</sup> Further, future research could also examine if programs placing a greater emphasis on relaxation and meditation during active treatment may lead to greater improvements in mental health and sleep disturbances.<sup>67</sup>

## Limitations

A number of limitations arise when examining yoga and cancer research. As with other areas of research, a “file drawer” effect, where negative trials tend to not get published, may occur. However, as is seen in Table 3, a number of trials published non-significant findings. As many of these trials had small sample sizes they may have been underpowered and future large scale trials are needed. Further, this review was heavily weighted with studies of yoga for breast cancer and generally high functioning populations. However, trials of yoga with other types of cancer, including ovarian, prostate, colorectal, brain, and blood and advanced lung cancer, are emerging, and findings may be different for a more heterogeneous group of cancer survivors.<sup>47,60–62,68,69</sup> Another inherent challenge is that most studies used different kinds of yoga. Even though there may be consistency in the components such as

incorporating movements, breathing exercises, and relaxation and meditation practices, the specific practices, intensity, frequency, and duration often vary substantially. Reporting yoga protocols, similar to published reports of clinical trial protocols in exercise, for example, would further our understanding of the effects of yoga. Unfortunately, most studies also did not report the details on their teacher training and whether teachers had experience specifically in oncology populations. However, a well-trained yoga therapist, for which there is now an accreditation (<http://www.iayt.org/>) and more to come, should be able to work with vulnerable patients to ensure utmost safety and efficacy. In addition, the “dose” of yoga varied tremendously between studies including the number of classes, length of each class, and frequency of practice. A methodological limitation was that most of the studies did not include active control groups, making it challenging to know if it was yoga per se conferring the benefits. However, the studies that did include active control groups such as stretching or exercise did report outcomes favoring the yoga group. Future work comparing the efficacy and/or non-inferiority of yoga in comparison to other active interventions, such as traditional physical activity, would also be beneficial and could be examined within practical behavioral trial frameworks. Finally, treatment fidelity is often missing from studies making it difficult to know if what was supposed to be taught to the patients was actually taught. More recent trials, especially studies with financial support, include quality control procedures to ensure appropriate delivery of all components.

## Conclusion

Despite these limitations, there is sufficient evidence to support the benefits of yoga for patients while they are undergoing cancer treatment and when they move out of the medical setting and into survivorship. Yoga improves multiple aspects of QOL, cancer-specific symptoms, psychological outcomes, and important biomarkers such as stress hormone regulation, immune function, and inflammatory markers. As a low-cost and safe intervention, yoga should be provided alongside the standard of care to help improve multiple aspects of cancer patients’ adjustment to cancer and its treatment. In many trials, the evidence supports what we would expect - that outcomes are best for those who engage in yoga more often.<sup>25,36,46</sup> Future research should focus on better understanding the factors that facilitate engaging in yoga and strategies for overcoming the barriers.

## Acknowledgements:

Research reported in this publication was supported by the National Cancer Institute (Dr. Addington is supported by training grant CA193193) and National Center for Complementary & Integrative Health (Dr. Sohl is supported under Award Number K01AT008219) of the National Institutes of Health. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. Partial funding for Dr. Cohen was provided by the Richard E. Haynes Distinguished Professorship for Clinical Cancer Prevention at The University of Texas MD Anderson Cancer Center. Partial funding for Dr. Van Puymbroeck was provided by the Roy Distinguished Professorship in Health Innovation Research at Clemson University.

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Table 1.

## Study Characteristics

Study	Publication	N <sup>a</sup>	Cancer Type(s) (Stages)	Cancer Treatment(s)	Control(s)
During Treatment					
1	Banerjee, 2007 <sup>27</sup>	68	Breast (II–III)	C, R	SC
2	Rao, 2007; 2008a; 2008b; 2009; 2015; 2017a <sup>50,70–74</sup>	98	Breast (II–III)	C, R, S	SC
3	Vadiraja, 2009a, b, c <sup>30,52,75</sup>	88	Breast (I–III)	R	SC
4	Chandwani, 2010 <sup>26</sup>	61	Breast (0–III)	R	WL
5	Kovacic, 2011a, 2011b, 2013 <sup>29,76,77</sup>	32	Breast (I–II)	C, R, S	UC
6	Chandwani, 2014 <sup>28</sup> ; Ratcliff, 2016 <sup>53</sup>	163	Breast (0–III)	R	ST, WL
7	Taso, 2014 <sup>48</sup>	60	Breast (I–III)	C	UC
8	Chakrabarty, 2015 <sup>23</sup>	160	Breast (I–III)	R	UC
9	Lancot, 2016 <sup>31</sup>	101	Breast (I–III)	C	WL
10	Lotzke, 2016 <sup>32</sup>	92	Breast (I–III)	C	PE
11	Anestin, 2017 <sup>33</sup>	82	Breast (I–III)	C	WL
12	Ben Josef, 2017 <sup>51</sup>	68	Prostate (I–II)	R	UC
13	Chaoul, 2018 <sup>25</sup>	227	Breast (I–III)	C	ST, UC
Post-Treatment					
14	Culos-Reed, 2006 <sup>54</sup>	38	Mixed (I–III)		WL
15	Carson, 2009 <sup>78</sup>	37	Breast (I–II)		WL
16	Banasik, 2011 <sup>38</sup>	18	Breast (II–IV)		WL
17	Littman, 2012 <sup>35</sup>	63	Breast (0–III)		WL
18	Bower, 2012 <sup>40</sup> ; 2014 <sup>79</sup>	31	Breast (0–II)		HE
19	Mustian, 2013 <sup>42</sup>	410	Mixed (0–IV)		WL
20	Peppone, 2015 <sup>b<sub>80</sub></sup>	167	Breast (0–III)		WL
21	Sprod, 2015 <sup>b<sub>81</sub></sup>	97	Mixed (0–IV)		WL
22	Janelins, 2016 <sup>b<sub>82</sub></sup>	328	Mixed (0–IV)		WL
23	Kiecolt-Glaser, 2014 <sup>36</sup> ; Derry, 2015 <sup>83</sup>	200	Breast (0–IIIA)		WL
24	Loudon, 2014 <sup>43</sup> ; 2016 <sup>55</sup>	28	Breast (0–III)		WL
25	Cramer, 2015 <sup>34</sup>	40	Breast (I–III)		WL
26	Hughes, 2015 <sup>37</sup> ; Parma, 2015 <sup>84</sup>	94	Breast (NR)		PE <sup>c</sup>
27	Taylor, 2018 <sup>41</sup>	33	Breast (I–III)		WL
28	Rao, 2017b <sup>85</sup> ; Vadiraja, 2017 <sup>86</sup>	91	Breast (IV)		SC
Combined (During and Post-Treatment)					
29	Cohen, 2004 <sup>49</sup>	39	Lymphoma (I–IV)	C	WL
30	Moadel, 2007 <sup>46</sup>	164	Breast (I–IV)	C, H, R	WL
31	Danhauer, 2009 <sup>45</sup>	44	Breast (0–IV)	C, R	WL

Study	Publication	N <sup>a</sup>	Cancer Type(s) (Stages)	Cancer Treatment(s)	Control(s)
32	Cramer, 2016 <sup>47</sup>	54	Colorectal (I–III)	C	WL

*Note.* First author only is listed. C=chemotherapy, H=hormonal treatment, S=surgery, R=radiation therapy, NR=not reported, HE=health education, PE=physical exercise, SC=supportive counseling, ST=stretching, UC=usual care, WL=waitlist.

<sup>a</sup>Reflects total sample enrolled/randomized even if fewer were analyzed.

<sup>b</sup>Secondary analysis of subgroup from Mustian et al, 2013.

<sup>c</sup>2 PE comparison groups.

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Outcomes of RCTs of Yoga in Cancer

Table 2.

Treatment Status / Study Number	Quality of Life	Physical (Self-Report)				Physical (Objective)			Psychological / Cognitive					
		Fatigue	Pain	Sleep	Other <sup>a</sup>	Physical Fitness	Actigraphy	Biomarkers	Anxiety	Depression	Distress	Perceived Stress	Other <sup>b</sup>	Cognition
During Treatment														
1								x	x					
2	x				x			x	x					
3	x	x		x				x	x	x			x	
4	x	NS		NS					NS				x	
5									x					
6	x	x		NS				x	NS					x
7		x							NS					
8		x												
9									NS					
10	NS	NS							NS					NS
11				NS					NS					
12	x	x		NS										
13		NS						x						
Post-Treatment														
14	x						x		NS				NS	
15		x	x		x									
16	NS	x							NS					
17	NS	NS							NS					
18		x		NS			x		NS				NS	
19							x							
20			x											
21		x					x							
22														x
23		x					x		NS					x

Treatment Status / Study Number	Quality of Life		Physical (Self-Report)				Physical (Objective)				Psychological / Cognitive				
	Fatigue	Pain	Sleep	Other <sup>a</sup>	Physical Fitness	Actigraphy	Biomarkers	Anxiety	Depression	Distress	Perceived Stress	Other <sup>b</sup>	Cognition		
24	NS	NS		x	NS							x			
25	x			x				NS	NS						
26					x		NS								
27	NS		NS					x			NS				
28	x		x	x			x						x		
Combined During/Post-Treatment															
29	NS		x					NS	NS				NS		
30	NS									NS			NS		
31	NS		NS						x						
32	NS		x	NS				x							

Note: x,  $p < .05$  (significant benefit in favor of yoga group); NS=non-significant; blank cells indicate outcome not measured.

<sup>a</sup>Includes general symptoms (intensity/frequency), prostate symptoms, nausea/vomiting, dyspnea, menopausal symptoms, lymphedema, and vigor/vitality.

<sup>b</sup>Includes benefit-finding, intrusive/avoidant thoughts, life satisfaction, mindfulness, spirituality, and affect.

**Table 3.**

## Summary of Findings

Outcome	During Treatment		Post-Treatment		Combined	
	n Significant	n NS	n Significant	n NS	n Significant	n NS
Quality of Life	5	1	3	2	2	1
Physical – Self-Reported						
Fatigue	5	3	7	3	0	4
Pain	1	0	2	1	NA	
Sleep	2	2	4	2	2	1
Other <sup>a</sup>	2	2	9	0	0	1
Physical – Objective						
Physical Fitness	NA		1	4	NA	
Actigraphy	1	0	1	0	NA	
Biomarkers	4	0	3	2	NA	
Psychological/Cognitive						
Anxiety	4	4	0	1	1	1
Depression	3	4	2	3	2	1
Distress	2	0	NA		0	1
Perceived Stress	3	0	1	3	NA	
Other <sup>b</sup>	3	1	1	0	0	2
Cognition	NA		2	1	NA	

*Note.* Table summarizes between-group main effects. n=number of studies; NA=not applicable (outcome not included).

<sup>a</sup>Includes general symptoms (intensity/frequency), prostate symptoms, nausea/vomiting, dyspnea, menopausal symptoms, lymphedema, and vigor/vitality.

<sup>b</sup>Includes benefit-finding, intrusive/avoidant thoughts, life satisfaction, mindfulness, spirituality, and affect.