



Published in final edited form as:

*Brain Behav Immun Integr.* 2023 July ; 3: . doi:10.1016/j.bbii.2023.100019.

## A quality improvement study on the feasibility and potential benefits of a yogic breathing program for cancer survivors and caregivers during treatment in a lodging facility

Christina M. Alford<sup>a</sup>, Amy E. Wahlquist<sup>b</sup>, Katherine R. Sterba<sup>b</sup>, Graham W. Warren<sup>c</sup>, Sundaravadivel Balasubramanian<sup>c,d,\*</sup>

<sup>a</sup>Hollings Cancer Center's South Carolina Cancer Health Equity Consortium Fellow, University of South Carolina, Columbia, SC, USA

<sup>b</sup>Department of Public Health Sciences

<sup>c</sup>Department of Radiation Oncology, Hollings Cancer Center, Medical University of South Carolina, Charleston, SC 29425, USA

<sup>d</sup>PranaScience Institute, Mount Pleasant, SC 29464, USA

### Abstract

**Background:** Complementary and integrative health approaches with a focus on relieving side effects of cancer treatment are popular among cancer patients. Previous studies have investigated the combined effects of yoga postures, breathing, and meditation, but the specific effects of the breathing component are under-reported. Our previous studies indicate that yogic breathing can improve salivary biomarker expression related to stress, immune response, and tumor suppression. We aim to assess the acceptability and feasibility of a yogic breathing program in cancer patients and caregivers during the treatment period.

**Methods:** In this quality improvement study, we designed a 20-minute yogic breathing regimen and introduced them to all-site cancer patients and their caregivers during the cancer treatment period at a lodging facility, Hope Lodge in Charleston, SC. All interested participants were included as there were no eligibility criteria set for the study. The availability of the class was advertised via intercom, displays, and word of mouth. Participants were taught five different breathing exercises, and after completion of the exercises in a single session, a self-reported

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\*Corresponding author at: Department of Radiation Oncology, Hollings Cancer Center, Medical University of South Carolina, Charleston, SC 29425, USA. [balasubr@musc.edu](mailto:balasubr@musc.edu) (S. Balasubramanian).

#### Declaration of Competing Interest

SB is the Founder & CEO of PranaScience Institute, a small business entity involved in teaching and research of breathing exercises.

#### CRediT authorship contribution statement

**C.M. Alford:** Funding acquisition, Writing – original draft. **A.E. Wahlquist:** Data curation, Formal analysis, Writing – review & editing. **K.R. Sterba:** Conceptualization, Writing – review & editing. **G.W. Warren:** Conceptualization, Methodology, Funding acquisition. **S. Balasubramanian:** Conceptualization, Funding acquisition, Methodology, Project administration, Writing – review & editing.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.bbii.2023.100019.

quality improvement questionnaire was administered assessing sociodemographic/clinical factors, expectations about the session, and ratings of satisfaction with the session.

**Results:** During the nine months of the data collection period, 52 participants provided feedback of which patients and caregivers were almost equal numbers. Participants' perception of intervention acceptance, symptom management, satisfaction with the sessions, and future needs for practice indicate that the yogic breathing sessions help improve some of the key symptoms of cancer experience such as stress.

**Conclusion:** Findings indicate that yogic breathing is acceptable to patients and caregivers and may help alleviate some of the side effects resulting from cancer treatment, and the intervention is feasible at lodging facilities during treatment. Currently, the yogic breathing sessions are conducted on a weekly basis by Hope Lodge volunteers trained by the study team.

## Introduction

Currently there are over 15.5 million Americans living with a history of cancer in the U.S (ACS, 2019). This progress is due to advances made over time with early detection and treatment. However, patients undergoing cancer treatment often experience adverse side effects, such as fatigue, pain, depression, stress, loss of appetite, and sleep disturbances among other cancer site-specific symptoms. Symptom management approaches are critically needed to manage these side effects and improve patient quality of life (QoL) (ACS, 2019). A cancer diagnosis can cause a great deal of stress for patients affecting all dimensions of their life (Linden et al., 2012). Leading up to treatment, they can be overwhelmed with fears such as, fear of the future, the unknown, change, and death (Loughan et al., 2021; Sun et al., 2019). All these factors significantly contribute to a reduced QoL for a cancer survivor. Getting stress under control is critical because stress has been associated with negative health outcomes (Danhauer et al., 2017). Chronic stress can cause patients to give up habits that help prevent cancer such as healthy eating and exercise. Extensive evidence is available suggesting that chronic stress can promote cancer growth and progression (Chaoul et al., 2014).

Not only are patients affected by their diagnosis, but the people caring for them are significantly impacted as well (Northouse et al., 2012). After treatment, patients are often in need of support from caregivers who are the primary source of social and emotional support for patients. They also play an essential role in how well the patient manages their illness. A review done on 192 articles identified over 200 problems related to the responsibilities of a caregiver indicates that the caregivers experienced physical and psychological problems like anxiety, depression, fatigue, and sleep disturbances (Stenberg et al., 2010; Tan et al., 2020; Lutgendorf and Laudenslager, 2009). A study done on 299 cancer patients and their caregivers added to existing evidence that there is a moderately strong and significant relationship between patient emotional health-related QoL and caregiver mood state (Douglas et al., 2016). Because of the critical role the caregiver plays in impacting patient outcomes, it is critical to address the concerns of both patients and their caregivers.

Complementary therapies have become increasingly popular among cancer patients (Guerra-Martin et al., 2021). These practices can be used alongside conventional medicine to

relieve the side effects of cancer treatment. They have also been suggested to improve QoL (Greenlee et al., 2017). The combined use of evidence-based complementary therapies and mainstream medicine is termed integrative medicine (IM). On average, 50% of cancer patients have used IM during their treatment process, and these numbers are on the rise (Witt and Cardoso, 2016). These approaches can be appealing due to their simplicity and use of non-pharmacological, bio-behavioral methods, and lifestyle modifications (Latte-Naor and Mao, 2019). There have been studies to provide evidence that IM interventions have the potential to cause a reduction in cancer-related symptoms and this seems to be the case across all therapy modalities including radiation, chemotherapy, and surgery (Witt et al., 2017).

One of the most commonly reported and growing complementary practices in the U.S. is yoga (Zhang et al., 2021). Yoga (meaning *union* from the root word *okka* in the Tamil language), is a discipline of ancient Eastern origin that incorporates ethics, lifestyle, breath control, meditation, and physical postures to achieve a sense of balance with the mind, body, and spirit (Sengupta, 2012; Woodyard, 2011). Many studies have reported positive mental effects of yoga in the healthy general population (Hendriks et al., 2017). A review of ten studies compared the effects of yoga to typical exercises and found yoga to be just as effective in improving fatigue, pain, and sleep (Stan et al., 2016). A review of randomized controlled studies indicates yoga reduces long-term anxiety during and after cancer treatment, improves mood and depressive thoughts during radiation therapy and chemotherapy, and improves QoL (Buffart et al., 2012).

The ancient *Yoga* tradition as described in Siddha literature consists of eight major paths including the widely known physical postures (*Asana*), breathing regulation (*Pranayama*), and meditation (*Dhyana*) (Somasundaram, 2002; Thirumoolar; Satchidananda, 2015). *Pranayama* is the practice of regulated breathing also known as yogic breathing (YB) (Somasundaram, 2002; Shrivastava et al., 2015; Subbarayappa, 1997; Brems et al., 2016). While there have been multiple studies focusing on the combined effects of yoga postures, breathing, and meditation in cancer, only a few studies have evaluated individual components. To our knowledge, only one previous study (Dhruva et al., 2012) has examined pranayama as an intervention for cancer patients undergoing chemotherapy. This study found yoga breathing to be a feasible intervention in those patients receiving chemotherapy (Dhruva et al., 2012). Other studies have suggested that the practice of *pranayama* creates a relaxed state by enhancing parasympathetic tone in normal individuals (Mourya et al., 2009; Jerath et al., 2006; Gerritsen and Band, 2018). We recently reported that yogic breathing stimulated measurable biomarkers in saliva including tumor suppressors and immune mediators (Balasubramanian et al., 2015a, 2015b). In addition, stress-related pro-inflammatory cytokine levels in saliva are reduced upon yogic breathing in normal subjects (Twal et al., 2016). *Pranayama* exercises are relatively easy to practice virtually by everyone including those who are limited by physical ability and fitness (Narayanan et al., 2021). However, it is not currently provided in lodging facilities such as Hope Lodge for cancer patients and caregivers. In this quality improvement study, we explored whether it is possible to provide weekly classes of yogic breathing in this setting, and the participants' acceptability of yogic breathing as a supportive care intervention to help reduce the side effects associated with cancer treatment during the active treatment period.

## Methods

This is a quality improvement study and no personally identifiable information was collected from the participants and does not require a review by an institutional review board (NIH Regulation and Policy. SubPartA, 2023). The study team has been offering yogic breathing classes on a voluntary basis since the year 2014 at the American Cancer Society - Carol Grotnes Belk Campus Charleston Hope Lodge and conducted this survey among voluntary participants to evaluate the yogic breathing service. Hope Lodge provides temporary housing free of charge to cancer patients and caregivers with a view to reducing the travel burden during cancer treatment (ACS Hope Lodge website. Accessed February 27, 2023). Along with housing, the lodge offers supportive programs to improve the community support networks, access to cancer information and resources, and services designed to improve healing for both patients and caregivers.

Anyone staying at the facility is welcome to attend the weekly yogic breathing classes. The guests are informed of the yogic breathing classes during the initial orientation about the facility and via fliers with details about the class, a display near the front desk and notice board, and intercom announcements prior to the beginning of every session. Classes are taught once a week on Wednesdays for 20 min (11.30–11.50 am). The certified yoga instructor first gives the participants an overview of the purpose of conducting the class, including what previous research studies have shown and the potential benefits of yogic breathing exercises without any religious connotations. Then the instructor provides a demonstration and verbal instructions for five different breathing exercises consecutively. A brief description of the typical yogic breathing exercises used in weekly sessions is provided in Table 1 (Balasubramanian, 2019). Participants were encouraged to practice the breathing exercises and were provided with verbal information on freely available online exercises (Balasubramanian, 2015) by the instructor to facilitate the continued practice of yogic breathing. After completion of the exercises, a voluntary survey containing ten questions and a space for additional comments (Fig. 1) was collected from participants who wished to complete it. These surveys did not ask for any personally identifiable information and contained questions on sociodemographic (e.g., age, gender) clinical characteristics (cancer type of the patients), perceived and experienced benefits of yogic breathing (improved stress, mood, pain, eating and other), whether participant planned to continue yogic breathing, and asked for suggestions to improve the class in the comments section. The survey was collected only once from a participant after a single session of practice. This study contains the survey data collected during a period of nine months (between September 2015 and June 2016).

## Data analysis

Descriptive statistics including frequencies, percentages, means, and standard deviations, as appropriate, were used to describe the patients and caregivers as well as the perceived and experienced benefits of yogic breathing.

## Results

During the nine-month data collection period, there were 52 participants that provided feedback using the questionnaire. The majority of participants were caregivers (50%), followed by patients (46%), Hope Lodge volunteers (2%), and the unreported category (2%). The majority (67%) of them were females, males constituted 32%, and unreported were 1%. Age for the participants ranged from 20 to 84 with a mean (standard deviations) age of 58.6 ( $\pm 12.8$ ). There were 17 different types of cancers affecting participants in this study with head and neck cancer (HNC) being reported most frequently followed by breast and brain cancers (Fig. 2).

As shown in Fig. 3, the most commonly reported expectations for participants were that the class would decrease their stress ( $n = 45$ , 86.5%) and improve their mood ( $n = 28$ , 53.8%). Twenty-five percent ( $n = 13$ ) believed the class would decrease pain, and 17.3% ( $n = 9$ ) believed the class would improve appetite. Similar numbers of participants expecting improvements in stress, mood, and pain reported experiencing these improvements (84.6%, 67.3%, and 23.1%, respectively). Only 3 (5.8%) participants reported the class improved their appetite. Other reported expectations in response to open-ended questions included that the program would improve breathing ( $n = 4$ , 7.7%), help them relax ( $n = 4$ , 7.7%), or improve sleep ( $n = 3$ , 5.8%). Two participants expected the program to improve saliva production, and one expected decreased tightness in shoulders and that it would help them think more clearly. There are more than one expectation from several of the participants.

All participants were very (90%) or somewhat (10%) satisfied with the class, and the majority were comfortable with the length of the session (83% reported length was just right, and 17% felt it was too short). Most participants (83%) said they would continue doing the exercises at home, 15% of them mentioned “Maybe” they will continue the practice at home, and 2% did not provide any response to this question. Participants indicated that they would be very (46%), somewhat (40%), a little (8%), not at all (2%), interested in participating in a longer program if offered at a convenient location; and 4% of them did not provide any response to this question. Other open-ended comments from the participants are included as Supplementary Table.

Together our results indicate that the Yogic breathing sessions can be conducted in as little as 20 min in a facility hosting cancer patients and caregivers. Improvements in several domains that the participants expected seem to be experienced by the end of the session. There were no adverse effects reported by any of the participants in these sessions ever since the program was started. It is also understood that improvements in the program could include providing these classes on a regular basis in convenient locations with more advertisements, including printed and online materials to make learning and continued practice easy.

## Discussion

While accumulating evidence suggests that Yoga intervention could be beneficial in cancer survivorship (Guerra-Martin et al., 2021), there have been only a few studies done solely on

breathing exercises (Dhruva et al., 2012). Although the classical yoga texts (Thirumoolar; Satchidananda, 2012) do not favor the practice of one subtype of yoga over the other, in the popular yoga culture, breathing exercises are only a minor component, and that culture has trickled into yoga regimens for cancer patients too. For instance, a 60-minute yoga regimen for breast cancer survivorship contains 40 min of physical postures (asana), 10 min altogether for meditation and breathing exercises, and 10 min of deep relaxation (Taso et al., 2014). The practice of such a posture-based yoga regimen has several barriers for cancer patients including lack of interest, insufficient education about the benefits of yoga, class location, symptom severity restricting the practice, time constraints, financial resources, and experiencing physical limitations to perform postural yoga (Desai et al., 2021). Yogic breathing exercises could circumvent these difficulties by reducing the practice time to anywhere from 5 to 25 min, relieving space constraints for practice as they can be practiced by sitting on a chair for example, enabling easy learning, and not physically demanding to practice even for people with chronic conditions (Satchidananda, 2015; Balasubramanian et al., 2015b; Balasubramanian, 2020; Holland et al., 2012). In addition, we showed that yogic breathing can stimulate salivary expression of tumor suppressors and reduce inflammatory molecules (Balasubramanian et al., 2015b). However, the concept of yogic breathing is quite new to the population at least in the current location. Our goal was to evaluate if these yogic breathing exercises could be delivered effectively and to learn about the participants' perception of how these exercises may reduce their symptoms. To the best of our knowledge, this is the first-ever quality improvement study to evaluate the yogic breathing sessions for cancer patients and caregivers provided at a lodging facility during the treatment period. This study examined 1) if we could conduct yogic breathing exercises at a specialized lodging facility for cancer patients and their caregivers during cancer treatment, 2) the acceptability of a brief 20-minute class to learn and practice breathing exercises, and 3) any needed changes for a yogic breathing program for future large trials as an intervention to reduce the side effects of cancer treatment. The participants of this study were either cancer patients receiving treatment or their caregivers. Occasionally the staff/volunteers from the lodging facility participated in these sessions which suggests that yogic breathing could be useful in workplace wellness as well.

The 20-minute length was chosen based on our earlier studies (Balasubramanian et al., 2015b; Twal et al., 2016) where we found the expression of salivary proteins in response to a breathing exercise, and also based on the traditional Pranayama literature (Thirumoolar; Balasubramanian, 2017). The 20-minute duration for yogic breathing practice as perceived by the participants in the present study seems to be appropriate and can range from 15 to 30 min.

The feasibility of yogic breathing was previously demonstrated in cancer patients receiving chemotherapy in a university hospital setting (Dhruva et al., 2012). In this study, we tested yogic breathing in a lodging facility and opened it to all including all-site cancer patients and their caregivers; occasionally, staff working in the facility also attended the sessions. We found that program delivery was feasible in this residential setting for cancer patients and that both patients and caregivers were able to participate and engage in brief classes. There are over 30 locations that run Hope Lodge throughout the USA (ACS Hope Lodge website. Accessed February 27, 2023). It is possible to replicate the current yogic breathing offering

to all the facilities. Currently available virtual learning tools might aid in disseminating the practice to all Hope Lodge locations.

The majority of participants expected improvements in stress, pain, and mood from yogic breathing and experienced improvements in these areas. However, in the case of appetite, the expectations were not met at high rates which could be because the responses were collected after a single session, and longer practice is often necessary to observe sustained improvements. It is possible that this finding is related to the cancer site or treatment type as about half of the participants expecting to improve their appetites had a form of HNC, and these patients may have experienced a reduction of salivary secretion and loss of taste, which may decrease appetite.

Participants also listed a broad range of other expected benefits from yogic breathing including help with sleep, relaxation, increased saliva production, breathing, shoulder tightness, and clearer thinking. Overall, participants rated the class very favorably and most planned to continue exercises at home and were interested in a longer program if held at a convenient location. Comments made by the participants suggest that providing take-home material on the yogic breathing exercises and better advertisement within the Hope Lodge facility could be ways to improve the class. Many studies reported that yoga improved fatigue, stress, sleep, mood, pain, and/or overall QoL (Yagli and Ulger, 2015; Dobos et al., 2015; Rao et al., 2017; Nejati et al., 2016; McCall et al., 2015; Hughes et al., 2015; Ben-Josef et al., 2016, 2017; Carr et al., 2016). Future trials should consider those suggestions to include more advertising, and possibly peer navigators to inform other residents about the benefits of the class. To our knowledge, only one previous study (Dhruva et al., 2012) tested *pranayama* as a single intervention to alleviate the symptoms of cancer patients receiving chemotherapy. This study also believed *pranayama* had the potential to be a simple and effective intervention for cancer patients undergoing treatment. The present study had no specifications on what type of treatment cancer patients were receiving, and caregivers were also included as participants. However, similar results in regards to yogic breathing improving the side effects of cancer treatment were found. Results from this study were used to design the ongoing clinical trial to test yogic breathing intervention to relieve the symptoms and side effects of breast cancer patients that just completed their radiation therapy (Balasubramanian, 2021).

### Limitations of the study

This is a quality improvement study with small sample size and the participant response is based on a single session of yogic breathing practice. The data, including the expectations, and experience about the session, were collected after the delivery of a single yogic breathing session as opposed to a long-term intervention could be another limitation. Normally the Yoga interventions are tested at 12 weeks and longer (Stan et al., 2016; Schmidt et al., 2013). Also, the evaluation of the effects of the session on symptom management did not use standardized measures on symptoms as it would deem this study as a clinical trial. In our ongoing full clinical trial (Balasubramanian, 2021) we use such standardized instruments for symptoms and quality of life. Another limitation is that our sample population is not a good representation of the distribution of the cancer types among

different races, genders, and ethnicities. The lack of follow-ups to determine the number of repeated attendees is another limitation. While the quality improvement scope of the study was aligned with our goal to examine the feasibility and acceptance of yogic breathing, larger full-scale clinical trials are needed to better characterize participants' experiences.

## Conclusion

The results of this quality improvement study suggest that yogic breathing exercises could be feasible at supportive care facilities, and patients and caregivers would like to continue with similar practices. Our data provide preliminary evidence that yogic breathing could be effective in reducing some of the side effects of cancer treatment, which could be used to improve the quality of life of cancer patients and caregivers.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

## Acknowledgements

We thank Mr. Christopher Campbell for reading, and editing the manuscript. Support by Ms. Sundi Herring, staff, volunteers, and participants at the Hope Lodge, Charleston, SC is gratefully acknowledged.

## Financial support

CMA is a fellow of the Summer Undergraduate Research Training Program at the South Carolina Cancer Health Equity Consortium funded through NIH/NCI: R25 CA193088 (Program Director: Dr. Marvella Ford, Medical University of South Carolina). SB is funded through NIH STTR (1R41CA254557 to PranaScience Institute), and GWW is funded through AHRQ R01 (R01HS024533).

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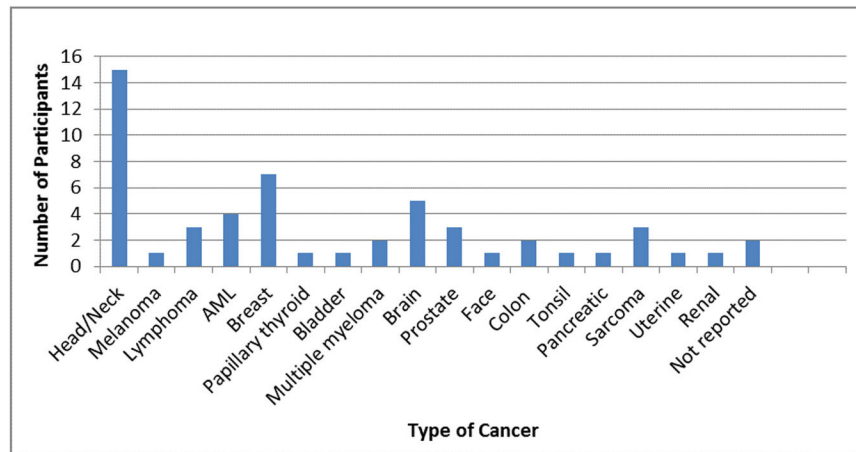
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**Yogic Breathing Class**  
**Instructor: Dr. Sundar Balasubramanian**  
**Classes conducted at Hope Lodge, Wednesdays 11.30 AM to 11.50 AM**

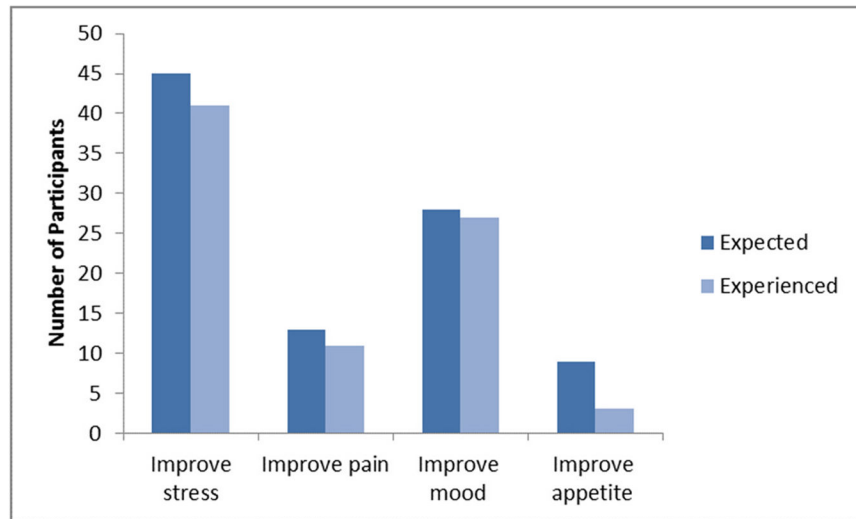
Please complete the following voluntary questions. Your anonymous responses will be used to help improve the class.

1. Please check the option that best describes you:  Cancer Patient  
 Caregiver (Family member or friend)
2. What is your age? \_\_\_\_\_
3. What is your gender?  Male  Female
4. What type of cancer do you or your loved one have? \_\_\_\_\_
5. What expectations DID YOU HAVE for this class? (Check all that apply.)
  - Improve stress
  - Improve pain
  - Improve mood
  - Improve appetite
  - Other (please describe): \_\_\_\_\_
6. What did this class DO for you? (Check all that apply.)
  - Improve stress
  - Improve pain
  - Improve mood
  - Improve appetite
  - Other (please describe): \_\_\_\_\_
7. Please rate your overall satisfaction with the class. (Check one option.)
  - Very satisfied  Somewhat satisfied  A little satisfied  Not at all satisfied
8. Please rate your satisfaction with the length of the class. (Check one option.)
  - Too short  Too long  Just the right amount of time
9. Do you plan to continue doing these exercises when you go home? (Circle one)
  - Yes  Maybe  No
10. How interested would you be in participating in a longer program if it were offered to you at a convenient location?
  - Very interested  Somewhat interested  A little interested  Not at all interested
11. Please offer suggestions about anything we can do to improve this class.  
 \_\_\_\_\_  
 \_\_\_\_\_

**Fig. 1.** Quality improvement questionnaire. The 11 item questionnaire was designed to collect non-identifiable responses from the participants.



**Fig. 2.** Types of cancer reported by participants. In some cases the caregivers reported the cancer type of the corresponding patients. In some cases the cancer type was not reported. AML = acute myeloid leukemia.



**Fig. 3.** Expected and experienced improvements in stress, mood, pain, and appetite by participants.

**Table 1**

Details of yogic breathing exercises provided to cancer patients and caregivers in a 20-minute in-person group session.

Name of the exercise	Exercise description	Length of time practiced
Breath awareness, and deep breathing	Introducing how to become aware of the breathing and engaging the abdomen for deep and slow breathing through the nostrils	1–2 min
Humming	Deep inhalation followed by humming sound during exhalation.	2 min
Alternate nostril breathing	Inhaling through one nostril and exhaling through the other; alternating inhalation and exhalation in each nostril.	3 min
Thirumoolar Pranayamam	Inhalation, breath-hold, and exhalation at a ratio of 1:4:2. Inhalation is done through the left nostril and exhalation is through the right nostril.	5 min
Ocean sound breathing	Producing the sighing sound with the closed mouth during deep inhalation and exhalation	2 min

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