The Effects of Pranayama or Deep Breathing Exercises on Fatigue and Sleep Quality in Women Receiving Radiation Therapy for Breast Cancer

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OBJECTIVES: To evaluate the effects of pranayama and deep breathing exercises on fatigue and sleep quality in women undergoing radiation therapy for breast cancer.

SAMPLE & SETTING: This randomized controlled study was conducted on the outpatient radiation oncology unit of a hospital with 20 patients each in pranayama, deep breathing, and standard care groups (N = 60).

METHODS & VARIABLES: The Piper Fatigue Scale and the Pittsburgh Sleep Quality Index were used to evaluate the participants' fatigue and sleep quality.

RESULTS: The control group showed a significant increase in fatigue levels at the end of radiation therapy compared to the beginning. Sleep quality was improved only in the pranayama group.

IMPLICATIONS FOR NURSING: Pranayama can be learned easily, can be performed anywhere, and does not require any equipment, making it a convenient exercise for patients. Oncology nurses can take the lead in suggesting pranayama for symptom management.

KEYWORDS fatigue; sleep quality; pranayama; deep breathing exercises; symptom management
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Breast cancer is the most common cancer in women worldwide (Ferlay et al., 2021). Radiation therapy is a local treatment method applied after surgery and/or after chemotherapy, and is an important component of breast cancer treatment that minimizes the possibility of recurrence and increases the likelihood of progression-free survival (Leonardi et al., 2016). However, side effects of radiation therapy can have a negative impact on patient quality of life. Fatigue is one of the most common symptoms that emerges as a side effect of radiation therapy at the beginning of treatment as well as during and after treatment, depending on previous treatments (e.g., surgery, chemotherapy) (Abrahams et al., 2016; Hauth et al., 2021; Hofsø et al., 2013; LaRiviere et al., 2020; Xiao & Torres, 2019). Patients may experience decreased quality of sleep as another side effect of radiation therapy (Abrahams et al., 2016; Hofsø et al., 2013; Milton et al., 2022; Rades et al., 2021). In addition, studies have demonstrated that fatigue and sleep quality are related to each other, with fatigue negatively affecting sleep quality (Fox et al., 2020; Imanian et al., 2019; Sanei et al., 2021). Interventions aimed at improving sleep quality may also affect fatigue (Dun et al., 2022; Momayyezi et al., 2021). In this context, nonpharmacologic approaches are recommended and may be effective in preventing or reducing fatigue and improving sleep quality. These interventions may include exercise, patient education, cognitive behavioral therapies, mind–body techniques, acupuncture, acupressure, yoga, and relaxation exercises (Bennett et al., 2016; Dean, 2022; Halemani et al., 2021; Lyman et al., 2018; Takemura et al., 2020; Tarrasch et al., 2018).

Among nonpharmacologic approaches is deep breathing, a relaxation technique that involves slowing down the breathing rate and focusing on inhaling and exhaling. The aim of deep breathing is to help individuals relax by focusing on their breath and increasing parasympathetic activity by taking slow breaths in and out (Jerath et al., 2019; Mulhaeriah et al., 2018; Yokogawa et al., 2018). Pranayama consists of yoga-based breathing techniques that aim to directly and consciously regulate one or more respiratory functions (Saoji et al., 2019). The calm and soothing breathing techniques in pranayama (e.g., nadi shodhana, Bhramari pranayama) reduce sympathetic stimulus and increase parasympathetic activity (Dhruva et al., 2012; Peterson et al., 2017; Sharma et al., 2014; Sinha et al., 2013). Pranayama is similar to deep breathing exercises in terms of breathing regulation. However, it differs by slowing or accelerating the breathing rate, manipulating the nostrils (i.e., nadi shodhana), making humming sounds (i.e., Bhramari) (Jagadeesan et al., 2022; Ushamohan et al., 2023), and holding the breath (Peterson et al., 2017; Sharma et al., 2014). There is evidence that pranayama can reduce fatigue in patients undergoing chemotherapy (Dhruva et al., 2012), improve sleep quality in patients with COVID-19 (Jagadeesan et al., 2022), reduce blood pressure in individuals with hypertension (Thanalakshmi et al., 2020), and improve respiratory function, as well as reduce anxiety and stress (Jayawardena et al., 2020). One study evaluated the effects of pranayama on radiation therapy–induced fatigue (Chakrabarty et al., 2015), but, to the authors' knowledge, no study has evaluated its effectiveness on radiation therapy–induced sleep quality.

It has been recommended that studies with active control groups should be conducted to aid in the interpretation of findings related to pranayama from previous studies (Danhauer et al., 2019). It is thought that pranayama may reduce fatigue and improve sleep quality in patients receiving radiation therapy.

The hypotheses of this study were as follows: (a) Pranayama is effective for improving fatigue in patients receiving radiation therapy for breast cancer; (b) pranayama is effective for improving sleep quality in patients receiving radiation therapy for breast cancer; (c) deep breathing exercises are effective for improving sleep quality in patients receiving radiation therapy for breast cancer; and (d) deep breathing exercises are effective for improving fatigue in patients receiving radiation therapy for breast cancer.

Methods

Study Design

The study was designed as a randomized controlled prospective parallel three-group trial (control, pranayama, and deep breathing exercise groups) and was registered at ClinicalTrials.gov (identifier: NCT04441827). The study was conducted between June 2017 and January 2019 in accordance with the principles of the CONSORT (Consolidated Standards of Reporting Trials) guidelines (see Figure 1).

Study Setting

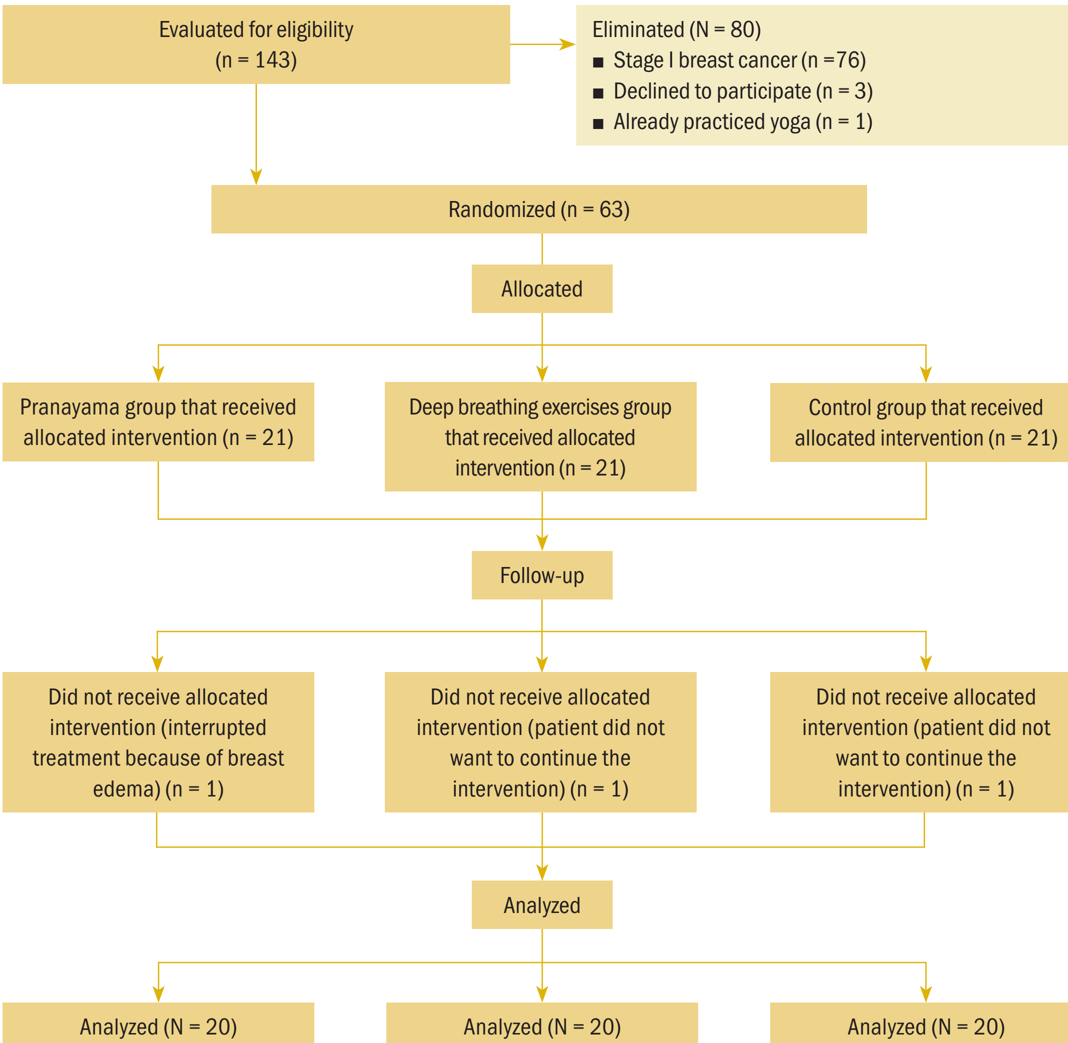
This research was conducted on the outpatient radiation therapy unit of a private hospital. Before the radiation therapy was administered, all patients in the groups were invited to participate in the study and were provided with information about the study. The patients received outpatient radiation therapy treatment for 25 days (five consecutive weeks, excluding weekends), during which the researchers followed the patients.

Study Sample

G*Power software was used to analyze the sample size. Because there was no similar study, the effect size of the study was aimed to be medium ($f = 0.2$) to calculate the sample size. Based on 80% power and 95% confidence level, it was calculated that the sample size should be 21 patients per group, totaling 63 patients. One participant from the pranayama group (interrupted treatment because of breast edema), one from the deep breathing exercise group (chose to discontinue participation), and one from the control group (chose to discontinue participation) were eliminated during the research process. Therefore, a post hoc power analysis was performed to determine the power of the study. Because repeated measurement was used in the study, based on the effect size ($f = 0.35$), 80% power, and 95% confidence level, the power of the study was found to be 98%–99% in the analysis based on the mean scores of the Pittsburgh Sleep Quality Index (PSQI) reported by patients. The inclusion criteria included the following: being literate, speaking Turkish, being aged 18 years or older, having received chemotherapy, having had breast-conserving surgery or modified radical mastectomy, planning to undergo radiation therapy to the chest wall and/or breast and lymphatic region, having a stage II–III breast cancer diagnosis (according to tumor diameter, node, and metastasis), having a hemoglobin level of 10 gm/dl or greater, scoring 0–1 on the Eastern Cooperative Oncology Group's Performance Status Scale, being an outpatient on the radiation therapy unit, and agreeing to participate in the study.

The exclusion criteria included the following: taking opioids, sedative drugs, or sleep medications; receiving any pharmacologic or nonpharmacologic

FIGURE 1. CONSORT Flow Diagram



CONSORT— Consolidated Standards of Reporting Trials

intervention for fatigue or insomnia; and regularly practicing yoga, pranayama, or deep breathing exercises.

Randomization

The participants were randomly assigned by a statistician to one of three groups (control, pranayama, deep breathing exercise) using a random numbers table (www.random.org). According to the randomization list, closed envelopes in which the participant group was written inside the envelope and the sequence number was written on the envelope were used. A total of 143 patients volunteered to participate in the study and were evaluated for eligibility according to the inclusion criteria. Out of these, 80 patients were excluded because the patient was diagnosed with stage I breast cancer (n = 76), already practiced yoga (n = 1), or declined to participate in the study (n = 3). The 63 patients who met the inclusion criteria were invited to participate in the study, written and verbal consent was obtained, and they were assigned to groups according to the randomization list. Finally, the study was concluded with 20 patients in each group (N = 60) after three patients chose to not participate for various reasons. Blinding could not be performed because of the nature of the study's intervention. Permission was obtained from the ethics committee of a university, and written and verbal consent was obtained from the participants. All three groups received the same medical care during the study.

Data Collection Tools

Piper Fatigue Scale: The Piper Fatigue Scale (PFS) was used to assess fatigue in patients with breast cancer (Amarsheda & Bhise, 2022). The scale is composed of 22 items and four subdimensions: behavioral/severity (6 items), affective meaning (5 items), sensory (5 items), and cognitive/mood (6 items). Each item is scored on a scale ranging from 0 to 10, with higher scores indicating higher levels of perceived fatigue. Subdimension scores are calculated by adding the scores of the items within each subdimension and dividing by the total number of items. The total fatigue score is obtained by adding the item scores and dividing by the total number of items. The standardized alpha for the entire scale (N = 22 items) is 0.97 (Piper et al., 1998). Can and Durna (2001) performed the Turkish validation and reliability of the scale and determined a Cronbach's alpha of 0.94. In this study, the Cronbach's alpha of the scale was 0.98. The PFS total score was discussed in this study in relation to the literature, but the subdimensions were not analyzed.

PSQI: The PSQI is a self-report screening and assessment tool that provides detailed information on sleep quality and the type and severity of sleep disorder the patient experienced in the past month. The PSQI is a 19-item scale that assesses subjective sleep quality, latency, duration, habitual sleep efficiency, disturbances, use of sleep medications, and daytime dysfunction across seven subcomponents. Each response is scored on a scale of 0–3 based on symptom frequency (0 if the symptom has not occurred in the past month; 1 if it has occurred less than once a week; 2 if it has occurred twice a week; and 3 if it has occurred three or more times a week). In the survey's sleep quality assessment, responses are scored using the following scale: 0 = very good, 1 = fairly good, 2 = fairly bad, and 3 =

FIGURE 2. Yoga-Based Breathing Exercises (Pranayama)

Step 1
Focusing on breathing (1 minute): Sitting in a chair with the body and head upright, eyes closed, hands folded on top of each other on the stomach, and shoulders relaxed, deep and slow breaths are taken. The body is relaxed by focusing on inhalation and exhalation.

Step 2
Nadi shodhana breathing (3 minutes): The right side of the nostril is closed with the thumb or ring finger while the body and head are upright, the muscles are relaxed, and the eyes are closed while sitting on a chair. A deep breath is taken in slowly through the left nostril and the breath is held in. After that, the left nostril is closed with the thumb or ring finger while opening the right nostril simultaneously, and the breath is exhaled slowly through the right nostril. After breath is taken in deeply and slowly through the right nostril, the right nostril is closed and the breath is exhaled slowly through the left nostril. This process is then repeated.

Step 3
Sheetali breathing (3 minutes): Sitting on a chair with the body and head upright, muscles relaxed, and eyes closed, roll the tongue up, forming a tube. A breath is taken in slowly through the tongue as if sucking water (making an "s" sound). After breathing in, the tongue is placed in the mouth, the mouth is closed, and the tongue is relaxed. By holding the breath, the freshness of the breath is felt in the brain and throughout the whole body before exhaling through the nose. If the tongue cannot be rolled up, the mouth is opened, the tip of the tongue is touched to the roof of the mouth, and teeth are closed. Breath is taken in slowly through the teeth as if sucking water (making an "s" sound). After the inhalation, the mouth is closed, and the tongue is relaxed. By holding the breath, the freshness of the breath is felt in the brain and throughout the whole body before breathing out through the nose.

Step 4
Bhramari breathing (2 minutes): While sitting comfortably with an upright body and head, muscles are relaxed, and the eyes are closed. The ears are closed gently with the index fingers, creating light pressure, with the elbows pointing down, and a breath is taken in through the nose. When the breath is released through the nose, make a smooth, continuous humming sound. This sound is created via the back palate.

Step 5
Focusing on breathing (1 minute): Sitting in a chair with the body and head upright, eyes closed, hands folded on top of each other on the stomach, and shoulders relaxed, deep and slow breaths are taken. The body is relaxed by focusing on inhalation and exhalation.

Note. Based on information from Chakrabarty et al., 2015; Dhruva et al., 2012.

FIGURE 3. Deep Breathing Exercises

Step 1
Focusing on breathing (1 minute): Sitting in a chair with the body and head upright, eyes closed, hands folded on top of each other on the stomach, and shoulders relaxed, deep and slow breaths are taken. The body is relaxed by focusing on inhalation and exhalation.

Step 2
Chest breath (3 minutes): While sitting with a straight body and head, the left hand on the chest and the right hand on the belly, breath is taken in and out slowly through the nose, and the chest is expanded with breath. The expanded chest is felt by the hand on the chest. As the breath is released slowly, the hand feels the chest goes down.

Step 3
Diaphragmatic breath (3 minutes): While sitting with a straight body and head, both hands are put on the stomach and a breath is taken in and released slowly and deeply through the nose. While breathing, the belly is expanded as slowly as possible, which is felt by the hand. While exhaling slowly through the nose, the hand feels the belly go down.

Step 4
Pursed lip breathing (2 minutes): While sitting with an upright body and head, both hands are folded on top of each other on the stomach, and a breath is taken in slowly through the nose as if smelling a flower. While breathing, the stomach is expanded as slowly as possible, which is felt by the hands. After that, the lips are pursed as if wanting to gently blow out a candle, and breath is released through the mouth very slowly. While exhaling, the stomach is pulled in, which is felt by the hands on the stomach.

Step 5
Focusing on breathing (1 minute): Sitting in a chair with the body and head upright, eyes closed, hands folded on top of each other on the stomach, and shoulders relaxed, deep and slow breaths are taken. The body is relaxed by focusing on inhalation and exhalation.

Note. Based on information from Kim & Kim, 2005; Yokogawa et al., 2018.

very bad. The resulting global score ranges from 0 to 21, with higher scores indicating poor sleep quality and greater levels of sleep disturbance. A total sleep score of 5 or higher indicates clinically significant poor sleep quality (Buysse et al., 1989). The psychometric evaluation of the PSQI in patients with cancer has provided evidence for internal consistency, reliability, and construct validity (Beck et al., 2004; Mollayeva et al., 2016). The Turkish validation and reliability of the index were performed by Ağargün et al. (1996). In the current study, the scale's Cronbach's alpha was 0.8. Subdimensions were not analyzed, and the study used the total PSQI score.

Data Collection

The researcher conducted face-to-face interviews with patients on their first admission to the radiation therapy unit. Patients who met the inclusion criteria were included in the study, and data were collected through these interviews. Two measurements were taken using the PFS and PSQI before starting radiation therapy (preintervention) and the day the radiation therapy sessions ended (postintervention, 25th session).

Interventions

Research was conducted using three parallel groups: the pranayama group, the deep breathing exercise group as the active control group, and the control group without intervention. A special room was set up on the radiation therapy unit for all exercises. The researcher explained and demonstrated the exercises to the individual participants according to the protocols in Figures 2 and 3. The researcher observed the participants and guided them to perform the exercises correctly, providing feedback on their performance. The first few training sessions lasted about 30–45 minutes. Participants in the pranayama and deep breathing exercise groups were guided by the researcher with their respective exercises for 10 minutes after every radiation therapy session. Because the 10-minute daily pranayama and deep breathing exercise protocols were conducted in this study, the researcher told the participants not to perform the breathing exercises at home. The participants' verbal assurance that they did not perform the exercises at home was taken as the primary confirmation. Patients were allocated to groups based on the randomization table. The specific interventions were then carried out according to the groups to which they were assigned. The pranayama group was administered a protocol of pranayama exercises based on the literature. Before developing the protocol, the first researcher underwent certified training in yoga-based breathing exercises and had been an oncology nurse for 30 years. The pranayama protocol for the group was created by taking three types of yoga-based breathing exercises (nadi shodhana, Sheetali, and Bhramari), which demonstrated effectiveness in reducing fatigue in patients who received radiation therapy in a previous study (Chakrabarty et al., 2015). Pranayama exercises differ from exercises used in the deep breathing active control group in aspects such as manipulation of the nostrils, chanting or humming sounds, and holding the breath (Saoji et al., 2019).

Pranayama group: Before starting radiation therapy, participants were trained by the researcher on how to perform the exercises using the written educational material, which included the pranayama exercises. After each radiation therapy session, participants performed the breathing exercises with the researcher in a quiet room with two sofas and a chair on the radiation therapy unit. Throughout all 25 sessions, the researcher supervised and guided the participants in performing the pranayama exercises according to the protocol. Each participant was instructed by the researcher on the timing and sequence of each breathing exercise. This ensured that each pranayama exercise was performed accurately and for the desired duration.

TABLE 1. Demographic Characteristics of Study Participants (N = 60)

	Control Group (N = 20)		Pranayama Group (N = 20)		Deep Breathing Group (N = 20)			
Characteristic	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	Test[a]	p
Age (years)	50.3	12.07	53	12.2	50.5	10.07	0.376	0.688
Characteristic		n		n		n	Test[b]	p
Education level							3.244	0.518
Primary school		5		2		5		
High school		3		2		4		
Bachelor's degree or higher		12		16		11		
Employment status[c]							0.784	0.676
Unemployed		18		17		16		
Employed		2		3		4		
Hormone treatment							1.866	0.393
No		12		15		11		
Yes		8		5		9		
Lives alone[c]							1.111	0.574
No		19		18		17		
Yes		1		2		3		
Marriage status							4.773	0.092
Married		14		18		12		
Single		6		2		8		
Surgical treatment							4.019	0.134
Modified radical mastectomy		12		10		16		
Breast-conserving surgery		8		10		4		

[a] Variance analysis (F)
[b] Chi-square
[c] During treatment
Note. Summary statistics were presented as mean and SD for variance analysis.

TABLE 2. Comparison of PFS Mean Scores of Patients Before and After Radiation Therapy (N = 60)

	Control Group (N = 20)		Pranayama Group (N = 20)		Deep Breathing Group (N = 20)		Test Statistics[a]	
PFS Score	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	Test	p
Preintervention	3.1	1.92	3.45	1.73	2.76	1.86	0.723	0.49
Postintervention	4.02	2.41	3.51	1.79	2.91	1.91	1.478	0.237
Test Statistics	Test[b]	p	Test[b]	p	Test[b]	p		
Intragroup comparison	4.193	0.045	0.014	0.905	0.117	0.733	–	–

[a] Intergroup comparisons using the Kruskal–Wallis test of the pre- and postintervention measurements
[b] Wilcoxon signed-rank test
PFS—Piper Fatigue Scale
Note. PFS scores range from 0 to 10, with higher scores indicating higher levels of perceived fatigue.

Deep breathing exercise group: The aim of this group was to form an active control group for the pranayama group by performing deep breathing exercises similar to those in the pranayama group but without pranayama exercises. The participants received training from the researcher along with written material on the deep breathing exercises before radiation therapy. After each radiation therapy session, the participants performed the deep breathing exercises with the researcher in a quiet room with two sofas and a chair on the radiation therapy unit. Throughout all 25 sessions, the participants were instructed to do the breathing exercises with their eyes closed, focusing on their breath. The researcher informed the participants about the timing and performance of each breathing exercise during the intervention. Therefore, each deep breathing exercise was performed one-on-one in accordance with the protocol, accompanied by the researcher who provided supervision and ensured that the exercises were performed correctly and for the desired period of time.

Control group: The patients in the control group received standard care without any additional pharmacologic or nonpharmacologic interventions aimed at improving sleep quality or reducing fatigue symptoms during their time on the outpatient radiation therapy unit. After completion of radiation therapy treatment, final measurements were taken and the participants in the control group were informed about breathing exercises. Patients who expressed an interest in learning were also taught how to do the breathing exercises.

The participants in the pranayama and deep breathing exercise groups did not report any adverse events during or after the exercises.

Statistical Analysis

IBM SPSS Statistics, version 25.0, was used to analyze the data. Descriptive statistics were calculated for categorical and continuous variables. When the parametric test prerequisites were not met, the Kruskal–Wallis test was used to compare more than two independent groups, and the Wilcoxon signed-rank test was used to compare two dependent groups. Relationships between categorical variables were analyzed with chi-square tests. The level of statistical significance was set at $p < 0.05$. The groups were given codes to avoid researcher bias. Until the statistical analyses were concluded, the researchers did not know which code belonged to which group.

Results

There was no statistically significant difference between the experimental groups and the control group in terms of sociodemographic and clinical characteristics ($p > 0.05$) (see Table 1).

The pre- and postintervention scores for the PFS were determined as $\bar{X} = 3.1$ (SD = 1.92) and $\bar{X} = 4.02$ (SD = 2.41) in the control group; $\bar{X} = 3.45$ (SD = 1.73) and $\bar{X} = 3.51$ (SD = 1.79) in the pranayama group; and $\bar{X} = 2.76$ (SD = 1.86) and $\bar{X} = 2.91$ (SD = 1.91) in the deep breathing exercise group, respectively. In the intragroup comparison, there was a significant increase in the PFS score in the control group ($p < 0.05$). Within-group comparison of pre- and postintervention PFS scores showed no significant difference in the pranayama and deep breathing exercise groups ($p > 0.05$). Between-group comparison also revealed no significant difference in preintervention ($p = 0.49$) and postintervention ($p = 0.237$) PFS scores among the control, deep breathing exercise, and pranayama groups (see Table 2).

TABLE 3. Comparison of PSQI Scores of Patients Before and After Radiation Therapy (N = 60)								
	Control Group (N = 20)		Pranayama Group (N = 20)		Deep Breathing Group (N = 20)		Test Statistics[a]	
PSQI Score	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	Test	p
Preintervention	6.9	4.1	8.5	3.99	7.8	4.19	0.767	0.469
Postintervention	8.15	3.66	6.9	3.67	7.65	3.91	0.563	0.572
Test Statistics	Test[b]	p	Test[b]	p	Test[b]	p		
Intragroup comparison	2.41	0.126	4.102	0.042	0.035	0.8533	–	–

[a] Intergroup comparisons using the Kruskal–Wallis test of the pre- and postintervention measurements
[b] Wilcoxon signed-rank test
PSQI—Pittsburgh Sleep Quality Index
Note. A total sleep score of 5 or higher on the PSQI indicates clinically significant poor sleep quality.

The pre- and postintervention PSQI scores were found to be $\bar{X}$ = 6.9 (SD = 4.1) and $\bar{X}$ = 8.15 (SD = 3.66) in the control group; $\bar{X}$ = 8.5 (SD = 3.99) and $\bar{X}$ = 6.9 (SD = 3.67) in the pranayama group; and $\bar{X}$ = 7.8 (SD = 4.19) and $\bar{X}$ = 7.65 (SD = 3.91) in the deep breathing exercise group, respectively. Intragroup comparison showed a statistically significant difference in pre- and postintervention PSQI scores of the pranayama group ($p = 0.042$), but no difference was found in the control and deep breathing exercise groups ($p > 0.05$). There was no significant difference in preintervention ($p = 0.469$) and postintervention ($p = 0.572$) PSQI scores between the control, deep breathing exercise, and pranayama groups in intergroup comparison (see Table 3).

Discussion

Fatigue and insomnia are common and concerning symptoms in patients receiving radiation therapy. This study revealed that although fatigue from radiation therapy increased in the control group, there was no change in fatigue in the pranayama group or the deep breathing exercise group. In this study, fatigue (0.92-point increase on the PFS) increased in the control group at the end of radiation therapy compared to before radiation therapy. Fatigue remained constant in the pranayama group (0.06-point increase on the PFS). The deep breathing exercise group experienced a minimal increase in fatigue (0.15 points on the PFS) compared to the control group. Similar to the current study, a prospective study by Donovan et al. (2004) focusing on patients with breast cancer who received radiation therapy found that fatigue, assessed with the PFS, was 3.8 at the beginning of radiation therapy treatment and 4.2 at the end of radiation therapy treatment.

In the current study, although the PFS score in the control group was higher at postintervention compared to preintervention more than the PFS score in the pranayama group and in the deep breathing exercise group, no significant difference was found in the PFS score in the intergroup comparison. A study conducted by Kim and Kim (2005) found that performing relaxation breathing exercises while a CD played recorded commands for 30 minutes a day for 10 weeks was effective in reducing fatigue in patients who underwent hematopoietic stem cell transplantation. Compared to previous studies, the daily duration of pranayama was shorter in the current study. Chakrabarty et al. (2015) found that pranayama exercise performed in the yoga room of the hospital was effective in reducing fatigue in patients with breast cancer undergoing radiation therapy; these patients performed pranayama twice a day five days a week for six weeks (18 minutes in the morning and 18 minutes in the evening). Similarly, in a study by Mulhaeriah et al. (2018), patients performed pranayama exercises for 60 minutes daily. In contrast, the current study conducted pranayama for only 10 minutes a day on the radiation therapy unit. Therefore, it is recommended to conduct studies comparing the effects of different durations and frequencies of pranayama exercises for patients with cancer.

Sleep quality is known to be negatively affected by radiation therapy. Sanei et al. (2021) reported that patients with breast cancer who received radiation therapy had a higher PSQI score (8.54 points) compared to women without cancer (6.56 points). However, in the current study, it was observed that sleep quality improved after radiation therapy (6.9 points) in the pranayama group when compared to the measurements taken before radiation therapy (8.5

points). Although limited, some studies have demonstrated the effectiveness of breathing exercises, such as yoga-based breathing, in reducing sleep disorders in patients with cancer undergoing chemotherapy (Dhruva et al., 2012). Additional research is needed to investigate the impact of pranayama and deep breathing exercises on sleep quality in patients with cancer undergoing radiation therapy. Starreveld et al. (2021) investigated the correlation between sleep quality and fatigue in survivors of non-Hodgkin lymphoma and found that fatigue was related to subjective sleep quality and daily dysfunction, which are factors of sleep quality. Similar to findings from Starreveld et al. (2021), the current study found that pranayama improved sleep quality at the end of radiation therapy compared to before radiation therapy. Additional research is needed to examine the effect of pranayama on sleep quality in patients undergoing radiation therapy.

In this study, it was observed that after patients performed pranayama for 10 minutes a day for 25 days, the total PSQI score decreased from 8.5 points to 6.9 points (–1.6 points), indicating an improvement in sleep quality compared to preintervention. In a study by Seok and Jun (2016), the total PSQI score was found to be 8.3 points in patients receiving radiation therapy for breast and gynecologic cancers. In a study conducted by Garrett et al. (2011), the total PSQI score was 7.3 points in patients with breast cancer undergoing radiation therapy. Jagadeesan et al. (2022) conducted a study on the sleep quality of Bhramari pranayama for patients with COVID-19 in home isolation and found that performing 20 minutes of Bhramari pranayama twice a day for 15 consecutive days reduced the PSQI score from 11.02 points to 7.92 points, indicating an improvement in sleep quality. Compared to previous studies, the current study used a shorter daily duration of pranayama. However, it was still found to be effective in improving sleep quality when compared to the control group. Future studies could explore the effects of pranayama and other breathing exercises with varying durations to determine the optimal length of time needed to improve sleep quality.

In previous studies, it has been observed that there are differences in the intervention, duration, and frequency of breathing exercises (minimum of 10 minutes versus maximum of 60 minutes) (Chakrabarty et al., 2015; Dhruva et al., 2012; Jagadeesan et al., 2022; Kim & Kim, 2005; Starreveld et al., 2021). As demonstrated in this study, low-dose pranayama may affect sleep quality, but a higher pranayama dose may be more effective for sleep quality (Dhruva et al., 2012) and fatigue (Chakrabarty et al., 2015) in patients receiving radiation therapy. In future studies, the effects of different pranayama doses on fatigue and sleep quality can be evaluated. In addition, it is believed that the short duration and ease of learning are important factors in patients' adoption of these exercises. Patients with cancer may prefer deep breathing exercises that do not require physical or mental strain rather than longer, more strenuous exercises because of their long and challenging treatments. Therefore, in future studies, it may be recommended to evaluate the impact of ease and duration of prescribed exercise on patient adherence.

In addition, this study's population consisted of only women. It has been shown that yoga may be effective in reducing fatigue and symptoms in men with prostate cancer receiving radiation therapy (Ben-Josef et al., 2017). However, to the authors' knowledge, there is no literature evaluating the effects of pranayama or deep breathing exercises on fatigue, sleep quality, or other symptoms in patients with prostate cancer receiving radiation therapy. It is recommended to conduct studies evaluating the effects of pranayama or deep breathing exercises on fatigue and sleep quality in patients with different types of cancer and in male populations receiving radiation therapy.

Pranayama and other breathing exercises can be done individually or in groups, at any time or place, making them a convenient and low-stress activity for individuals experiencing fatigue and insomnia (Chakrabarty et al., 2015; Dhruva et al., 2012; Peterson et al., 2017). As a result, the participants reported finding pranayama and breathing exercises easy to learn and expressed an interest in continuing to do the exercises in the future. In addition, this study did not require any special equipment other than a quiet environment and a chair for the intervention, and no side effects were reported during or after the exercises.

KNOWLEDGE TRANSLATION

- Pranayama and deep breathing exercises for patients with breast cancer undergoing radiation therapy can reduce fatigue and improve sleep quality.
- Clinical settings can easily integrate pranayama as a symptom management technique.
- Oncology nurses should practice breathing exercises with patients with cancer.

Limitations

There are several limitations to consider in this study. This study was carried out in a single health center and included only women undergoing radiation therapy for breast cancer. The breathing exercises were performed for 10 minutes in 25 sessions. To ensure adherence to the protocol, participants were instructed not to do the exercises at home. However, the study relied on self-reporting to confirm adherence, which may not be entirely accurate. The use of subjective self-reporting scales to evaluate fatigue and sleep quality may have also introduced bias because participants may have been fatigued while completing the questionnaires. In addition, the study was conducted without blinding and the researcher had more interaction with the experimental groups, which could have influenced subjective well-being. Further research with longer-term interventions and larger, more diverse samples is needed to confirm the effectiveness of pranayama and deep breathing exercises in reducing fatigue and improving sleep quality in patients with cancer undergoing radiation therapy.

Implications for Nursing

Pranayama and deep breathing exercises can be effective in reducing fatigue commonly experienced before, during, and after radiation therapy. These exercises are easy to learn and implement, do not require any equipment, can be performed in any location at any time, and are cost free. Patients with cancer can also perform these exercises at home. However, patients need to be supported in learning and incorporating these exercises into their daily activities and making them a habit. This includes teaching the exercises, facilitating their integration into daily activities, and supporting patients in making them a regular part of their routine. In this context, oncology nurses have the important role of integrating these exercises into patient care and supporting patients to increase their regular use of these exercises at home. In this regard, additional studies are recommended to promote the use of pranayama and deep breathing exercises for preventing and reducing fatigue, improving sleep quality, encouraging patients to perform the exercises, increasing their adherence to exercise, and facilitating these interventions' use in clinics.

Conclusion

This study investigated the impact of a 10-minute daily practice of pranayama and deep breathing exercises on fatigue and sleep quality in women with breast cancer undergoing radiation therapy. The results showed that the pranayama group experienced improved sleep quality at the end of radiation therapy, whereas the control and deep breathing exercise groups had worsened sleep quality. This study is believed to be the first to investigate the effects of short-term breathing exercises on fatigue and sleep quality in patients undergoing radiation therapy. Additional research could involve longer-term interventions to determine whether the benefits of pranayama and deep breathing exercises increase with continued practice over time.

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