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Effect of Online Mindfulness-based Stress Reduction Intervention on Sleep Quality of Breast Cancer Patients

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Abstract

Background: Breast cancer diagnosis and treatment can negatively impact the quality of life and lead to symptoms such as insomnia, depression, and anxiety. Internet-delivered interventions may reduce these symptoms in patients with limited access to face-to-face psychological treatments.

Objectives: This study aimed to determine the effect of online mindfulness-based stress reduction (MBSR) intervention on the sleep quality of women with breast cancer in Birjand City.

Methods: In this randomized controlled clinical trial, 62 eligible women with breast cancer undergoing chemotherapy in Birjand were selected using convenience sampling. They were assigned to two groups, intervention, and control, each consisting of 31 individuals, using random allocation. In addition to standard treatments, the intervention group received online MBSR training consisting of four two-hour sessions over four consecutive weeks. The control group only received standard cancer treatments. The data collection tool included a demographic form and a standard Pittsburgh Sleep Quality Questionnaire completed by individuals before, immediately, and 2 months after the intervention. Data were analyzed using SPSS 16 statistical software. The following tests were conducted at a significance level of $P < 0.05$: Chi-square, Fisher's exact, Independent t, repeated-measures ANOVA, Bonferroni, Mann-Whitney U, and Friedman.

Results: The mean sleep quality scores decreased immediately and 2 months after the intervention compared to before in the intervention group, while it increased in the control group ($P < 0.001$). Also, the independent *t*-test showed that the mean sleep quality scores decreased in the intervention group from before to immediately after the intervention, as well as from before to 2 months later ($P > 0.001$). In contrast, the control group patients experienced increased sleep quality scores ($P > 0.001$).

Conclusions: Mindfulness-based stress reduction significantly improved sleep quality in the intervention group, as demonstrated by decreased scores immediately and 2 months after the intervention. On the other hand, the control group experienced an increase in sleep quality scores. These findings highlight the effectiveness of MBSR in enhancing sleep outcomes.

Keywords: Mindfulness, Sleep Quality, Breast Cancer

1. Background

With roughly 2.3 million new cases yearly, breast cancer is the most frequent disease among women diagnosed worldwide. It is also one of the main causes of mortality in women (1, 2). In the United States, 271,000 cases of breast cancer were diagnosed in 2018 (3). In Iran, about 6,000 new breast cancer cases are diagnosed yearly in women (4). Although the incidence of breast cancer is increasing, its mortality rate has decreased due to the improvement in diagnostic and treatment measures (5).

Throughout treatment, people with breast cancer frequently experience several physical and mental problems that can hinder their performance in daily duties and activities (6). Sleep difficulties are one of the most prevalent symptoms in breast cancer patients, seen in roughly 50% of these patients. Breast cancer patients report a higher rate of sleep disturbances than other cancer patients. This issue can sometimes persist for up to 10 years after treatment (4). Sleep issues may have serious negative effects, such as decreased quality of life, slow recovery, higher costs for medical treatment, and ultimately higher mortality (7).

In recent years, psychological interventions such as

"mindfulness-based stress reduction," or MBSR, have been considered an alternative treatment for sleep disorders (8). Mindfulness entails paying deliberate attention to the present moment while accepting oneself. According to studies, practicing mindfulness meditation daily reduces ruminative thoughts, boosts self-acceptance, enhances emotion regulation techniques, and eventually improves sleep quality (9).

Despite the success of mindfulness intervention, it can be difficult to apply to patients due to obstacles, including distance, transportation, employment, childcare, exhaustion, and symptoms connected to cancer (10). Also, the COVID-19 epidemic's social isolation and instructions to stay at home have impacted people's mental health. Several forms of face-to-face mental health support services are no longer functional. As a result, numerous services and support initiatives were forced to quickly adopt online media and create fresh strategies to assist their users. Data and research indicate that face-to-face programs can be replaced with remote delivery of psychological therapy for cancer patients (11, 12). There is growing evidence that online mindfulness courses are as effective as face-to-face interventions (8).

There are many concerns about the high prevalence of sleep problems in cancer patients and its negative consequences for their health and quality of life. Thus, one way to help these patients is to improve their sleep quality (13). By providing treatment through the Internet and reducing the costs and many problems of receiving health services, this intervention allows patients to complete the training courses in their comfortable and familiar home environment without the need to travel long distances. In addition, participants can download recorded audio files of mindfulness on their smart devices and listen to them during chemotherapy (14) Although research shows that "mindfulness" interventions have worked effectively on these patients, the effectiveness of this intervention with the online method is not well known in Iran and requires more research.

2. Objectives

This study investigated the effect of online mindfulness-based stress reduction intervention on the sleep quality of breast cancer patients in Birjand.

3. Methods

3.1. Study Design

This randomized controlled clinical trial collected the data through a questionnaire from June 2022 to August 2022.

3.2. Participants and Sampling Strategies

The statistical population included 120 breast cancer women referred to the cancer treatment center in Birjand. A sample size of 70 participants was selected using a convenience sampling method. The inclusion criteria were consent to participate in the study, diagnosis of breast cancer by an oncologist, ability to understand, read, write, and speak Persian, having access to the Internet and mobile phones due to the nature of the online course, age between 25 and 60 years, history of surgery during the disease, absence of metastases, receiving at least one course of chemotherapy and not receiving any psychological intervention in the past year. The exclusion criteria were unwillingness to continue cooperating with the study and absence from more than one online session.

3.3. Intervention

In addition to common treatments, the test group received an online mindfulness-based stress reduction (MBSR) program during 4 sessions for 4 consecutive weeks. We conducted online meetings using the WhatsApp application to assemble the intervention group and implement the program. This approach was chosen due to the COVID-19 pandemic, the geographical distance of the participants, and transportation issues. The researcher held the sessions in the presence of a psychologist with a Ph.D. in psychology.

The researcher recorded the sessions as audio and video files, which were then uploaded to the group for downloading on a specific day and time. The group members were notified in advance to ensure that they received and viewed the files. Voice calls were conducted throughout the week using mobile phones to provide instructions and answer participants' inquiries about their homework.

The content of the meetings is given in Table 1. After that, the participants completed the questionnaires in 2 other stages, immediately (post-test) and two months (follow-up) after the intervention by phone.

3.4. Data Collection

To carry out this research, with the cooperation of the center's officials, the researcher visited the hospital every day for a month, met the patients referred for treatment, and explained the purpose of the study and how to implement it. If they wished, they entered the study after providing written consent. Before being assigned to the intervention and control groups, they filled out a demographic form and the Pittsburgh Sleep Quality Index (PSQI) (pre-test stage). They were then randomly assigned to one of the two groups by coin toss sampling method: the intervention and control groups of 35 participants each.

Table 1. Content of Mindfulness Sessions Taken from the Book "Full Catastrophe Living" [a]

	Details
First week	Practicing eating raisins, practicing body inspection, training awareness in daily routine activities, breathing awareness technique, doing sitting meditation, and practicing recording pleasant events
Second week	Mind-conscious dealing with negative spontaneous thoughts, teaching acceptance instead of futile effort and struggle, teaching how to observe thoughts without judging, the technique of observing thoughts (thought waterfall), practicing recording unpleasant events, the technique of observing and identifying emotions, practicing exploring emotions in the body.
Third week	Three-minute breathing space technique, meditation practice for awareness of bodily sensations and surrounding sounds, STOP practicing for stress management, exploration and identification of unpleasant bodily sensations such as types of pain in the body and consciousness and awareness of them, acceptance and coping with pain, practicing physical examination.
Fourth week	Practicing mindfulness in everyday relationships, an overview of the training provided during the entire past sessions, how to develop and expand the state of mindfulness in the aspects of personal life and interpersonal relationships, discussion and exchange of opinions among group members

[a] Source: Kabat Zain (15)

3.5. Statistical Analysis

Data were analyzed using SPSS 16 statistical software. In the descriptive part, the chi-square test and Fisher's exact test were used to compare the demographic characteristics of the patients in the two groups. In the inferential part, to check the research hypotheses, considering that the data had a normal distribution (using the Kolmogorov-Smirnov test), repeated-measures statistical tests (for quantitative variable comparison over time) and Bonferroni post-hoc test were used. A significance level of $P < 0.05$ was considered.

3.6. Ethical Considerations

Before the implementation of this study, the approval of the Research Ethics Committee of the University of Medical Sciences was obtained with the code IR.BUMS.REC.1400.100. Then, it was registered in the clinical trial registry of Iran with the number IRCT20220130053878N1. The researcher explained the objectives and method of the study to the people participating in the study and obtained their written informed consent. Also, they were told they were not required to pay any fee during the current research and could leave the study at any time.

4. Results

In this study, 62 women with breast cancer were examined in the intervention (31 people) and control (31 people) groups. The demographic characteristics of the patients in the two studied groups are given in Table 2.

Table 2 shows that the intervention and control groups did not differ significantly regarding education level, occupation, disease stage, age, and disease duration ($P > 0.05$). In other words, the two study groups were identical regarding the mentioned variables.

According to Table 3, the *t*-test showed that the mean sleep quality score did not significantly differ between the intervention and control groups before the intervention ($P = 0.59$). However, immediately and 2 months after the intervention, it was significantly lower in the experimental group than in the control group ($P < 0.001$). Even the mean sleep quality score increased immediately and two months after the intervention in the control group. Considering that a lower score indicates better sleep quality, sleep quality was significantly higher in the intervention group than in the control group immediately and two months after the intervention.

The repeated-measures test showed that the mean sleep quality score significantly differed in both the intervention and control groups before, immediately, and 2 months after the intervention ($P < 0.001$). The Bonferroni post-hoc test showed that in the intervention group, the mean sleep quality score decreased significantly immediately and 2 months after the intervention compared to before. However, it significantly increased 2 months after the intervention compared to immediately after ($P < 0.05$). In the control group, the mean sleep quality score significantly increased 2 months after the intervention compared to before and immediately after the intervention ($P < 0.001$). However, there was no significant difference in the mean sleep quality score before and immediately after the intervention in the control group ($P > 0.05$).

Non-parametric independent Mann-Whitney U: As shown in Table 4, the mean sleep quality score decreased in the intervention group from before to immediately after, as well as from before to 2 months after the intervention. In contrast, the patients in the control group experienced an increase in their average score. This difference was found to be statistically significant ($P < 0.001$).

Based on the findings presented in Table 5, it is evident that the mean scores of various sleep quality components

Table 2. Comparison of Frequency Distribution and Average Demographic Characteristics in Two Intervention and Control Groups [a]

Variables	Intervention	Control	P-Value
Education level			0.53 [b]
High school	11 (35.5)	13 (41.9)	
Diploma	9 (29)	11 (35.5)	
Bachelor's degree or higher	11 (35.5)	7 (22.6)	
Job			0.34 [c]
Employee	5 (16.1)	1 (3.2)	
Housewife	21 (67.7)	24 (77.4)	
Self-employed	5 (16.1)	6 (19.4)	
Stage of disease			0.70 [b]
I	6 (19.4)	7 (22.6)	
II	21 (67.7)	18 (58.1)	
III	4 (12.9)	6 (19.4)	
Age	45.7 ± 55.28	43.7 ± 45.39	0.27 [d]
Duration of disease (mo)	21.20 ± 23.07	23.20 ± 03.60	0.73 [d]

[a] Values are expressed as Mean ± SD or No. (%).
[b] Chi-square
[c] Fisher's exact test
[d] Independent *t*-test

Table 3. Comparison of the Mean Score of Sleep Quality Before, Immediately, and Two Months After the Intervention Within and Between Intervention and Control Groups [a]

Variables	Before Intervention	Immediately After	Two Months After	P-Value of Repeated-Measures (ANOVA)
Sleep quality				
Intervention	12.3 ± 81.51	10.3 ± 71.21	11.2 ± 87.90	< 0.001
Control	13.2 ± 23.43	13.2 ± 35.29	14.2 ± 48.29	< 0.001
P-value of independent *t*-test	0.59	< 0.001	< 0.001	-

[a] Values are expressed as Mean ± SD.

Table 4. Comparison of Changes in Mean Sleep Quality Score Before, Immediately, and Two Months After the Intervention in Intervention and Control Groups [a]

Variables	Before and Immediately After	Before and 2 Months After	Immediately and 2 Months After
Sleep quality			
Intervention	-2.1 ± 10.87	-0.2 ± 94.06	1.1 ± 16.57
Control	0.0 ± 13.76	1.1 ± 26.12	1.0 ± 13.88
The results of the Mann-Whitney-U or independent *t*-test	Z = 4.61, P < 0.001	T = 5.20, P < 0.001	Z = 0.05, P = 0.96

[a] Values are expressed as Mean ± SD.

were initially comparable between the intervention and control groups prior to the commencement of the intervention ($P > 0.5$). Nevertheless, upon the conclusion of the intervention, a noteworthy divergence emerged. The mean scores of sleep quality components, such as subjective sleep quality, sleep efficiency, sleep latency, and sleep duration, exhibited a substantial reduction within the intervention group in comparison to the control group. This disparity in scores persisted even after a span of two months following the intervention, particularly evident in the cases of sleep efficiency, sleep latency, and sleep duration. Conversely, the mean scores pertaining to other sleep quality components showed no statistically significant variations both immediately after the intervention and during the subsequent two-month period in both study groups ($P > 0.05$).

Table 5. Comparison of the Mean Score of Sleep Quality Components Before, Immediately, and Two Months After Intervention Within and Between Intervention and Control Groups [a]

Variables	Before Intervention (a)	Immediately After (b)	Two Months After (c)	P-Value of Friedman Test
Subjective sleep quality				
Intervention	1.0 ± 26.73	0.0 ± 77.67	0.0 ± 90.54	< 0.001
Control	1.0 ± 23.56	1.0 ± 23.56	1.0 ± 16.58	0.14
P-value of Mann-Whitney U test	0.85	0.006	0.08	-
Sleep efficiency				
Intervention	1.0 ± 45.72	0.0 ± 68.65	1.0 ± 74.58	< 0.001
Control	1.0 ± 42.56	1.0 ± 39.50	2.0 ± 35.55	< 0.001
P-value of Mann-Whitney U test	0.79	< 0.001	< 0.001	-
Sleep latency				
Intervention	1.1 ± 81.01	1.0 ± 58.99	1.0 ± 68.87	0.09
Control	2.0 ± 45.67	2.0 ± 52.68	2.0 ± 52.68	0.61
P-value of Mann-Whitney U test	0.01	< 0.001	< 0.001	-
Sleep duration				
Intervention	2.0 ± 42.99	2.0 ± 32.94	2.0 ± 39.88	0.64
Control	2.0 ± 94.25	3.0 ± 00.00	3.0 ± 00.00	0.14
P-value of Mann-Whitney U test	0.008	< 0.001	< 0.001	-
Sleep disturbance				
Intervention	2.0 ± 77.72	2.0 ± 94.36	2.0 ± 94.36	0.06
Control	2.0 ± 87.43	2.0 ± 90.40	2.0 ± 97.18	0.20
P-value of Mann-Whitney U test	0.92	0.57	0.98	-
Daytime dysfunction				
Intervention	1.0 ± 65.61	1.0 ± 48.50	1.0 ± 39.50	0.007
Control	1.0 ± 32.48	1.0 ± 39.50	1.0 ± 42.50	0.10
P-value of Mann-Whitney U test	0.02	0.45	0.80	-
Use of sleep medication				
Intervention	0.0 ± 68.91	0.0 ± 52.68	0.0 ± 45.62	0.26
Control	0.0 ± 48.63	0.0 ± 42.56	0.0 ± 48.72	0.51
P-value of Mann-Whitney U test	0.57	0.62	0.99	-

[a] Values are expressed as Mean ± SD.

The results of Friedman's test showed that in the intervention group, the mean score of subjective sleep quality, sleep efficiency, and daytime dysfunction significantly differed before, immediately, and 2 months after the intervention ($P < 0.05$). However, the mean scores of other sleep quality components were not significantly different between the three stages ($P > 0.05$). Utilizing the Wilcoxon test, it was observed that within the intervention group, there were significant reductions in the mean scores of subjective sleep quality and sleep efficiency both immediately after the intervention and at the 2-month mark in comparison to their baseline values. Moreover, a noteworthy decrease in the mean scores of a daytime dysfunction was evident at the 2-month post-intervention assessment when contrasted with the baseline measurement. Nevertheless, the mean sleep efficiency score 2 months after the intervention significantly increased compared to immediately after it ($P < 0.05$).

In the control group, the mean score of sleep quality components (except for sleep efficiency) did not differ significantly before, immediately, and 2 months after the intervention ($P > 0.05$). However, the mean sleep efficiency score increased significantly 2 months after the

intervention compared to immediately after and before it ($P < 0.05$).

5. Discussion

The results revealed several noteworthy findings regarding the intervention's effects on sleep quality and its components. First, the demographic characteristics of the intervention and control groups were similar, indicating that the two groups were comparable at baseline in terms of education level, occupation, disease stage, age, and disease duration. This similarity in demographic characteristics reduces the potential confounding effects of these variables on sleep quality outcomes.

The findings demonstrated that the intervention group experienced a significant improvement in sleep quality compared to the control group. The mean sleep quality scores immediately and two months after the intervention were notably lower in the intervention group, indicating better sleep outcomes. In contrast, the control group's sleep quality scores increased over the same time frame. These results suggest that the intervention positively impacted sleep quality and effectively enhanced sleep outcomes for breast cancer patients.

Further analysis of sleep quality components revealed additional insights. The components of subjective sleep quality, sleep efficiency, sleep latency, and sleep duration exhibited significant improvements in the intervention group compared to the control group. Specifically, the intervention group showed significantly lower scores in these components immediately and two months after the intervention. These findings indicate that the intervention positively influenced various aspects of sleep quality, including subjective perceptions of sleep and sleep efficiency, and reduced sleep latency and duration.

On the other hand, the control group did not exhibit significant changes in sleep quality components, except for sleep efficiency, which significantly increased two months after the intervention. The observed increase in sleep efficiency in the control group suggests that there might have been other factors unrelated to the intervention that contributed to this outcome. These factors could have influenced sleep efficiency independently and should be further explored in future research.

Lengacher et al., in the study "The effects of mindfulness-based stress reduction intervention on the objective and subjective parameters of sleep in women with breast cancer," concluded that this intervention could be an effective treatment to improve the objective and subjective parameters of sleep in breast cancer survivors (16). Also, in the study of Rash et al. investigating the effect of mindfulness meditation on the sleep quality of cancer patients, the results showed that mindfulness meditation significantly improved the quality of sleep, consistent with the results of the present study (9).

Numerous factors have been identified as potential contributors to the development of sleep disorders. In the context of individuals diagnosed with cancer, a multitude of factors can exacerbate sleep disturbances and subsequently compromise nocturnal sleep quality. These factors encompass elements such as extended hospital stays, placement within environments containing critically ill patients, provision of nighttime medical care, periods of relative inactivity during daytime hours, the manifestation of adverse effects such as nausea and vomiting stemming from cancer therapies, and the presence of heightened stress and anxiety related to the prognosis and treatment outcomes. Sleep disturbance is seen in 30 - 75% of people with cancer, almost twice as much as in the general population. Studies have shown that pain after cancer treatments in breast cancer patients reduces sleep quality (17). Experimental studies have shown that progress in hyperalgesia (increased sensitivity to pain) and decreased pain threshold cause sleep disturbance (18). Neuropathic pain can disrupt sleep; conversely, poor sleep quality can worsen neuropathic pain. These two symptoms often coexist in breast cancer patients as part of a cluster of symptoms that are difficult to identify and distinguish. Therefore, it is important to give careful attention to this issue (19).

In this regard, Mozafari-Motlagh et al. conducted a study on the effectiveness of cognitive-behavioral therapy integrated with mindfulness-based cancer pain reduction in breast cancer patients. In this study, the intervention group underwent an 8-week program of cognitive-behavioral therapy integrated with mindfulness intervention, while the control group did not receive any intervention during this period. The results showed that this treatment reduced perceived pain, pain self-efficacy, and pain catastrophizing in patients with breast cancer. In a study (20), Gooderzi et al. reached the conclusion that cognitive-behavioral therapy and cognitive therapy based on mindfulness have a significant effect on the pain experience of breast cancer patients (21).

Mindfulness-based stress reduction decreases sensitivity to pain and ultimately improves sleep quality in patients with breast cancer. This is achieved by increasing attentional concentration, focusing on the body, and reducing rumination. Considering the results of the above studies, mindfulness intervention can reduce sleep disorders in these patients and, as a result, increase their sleep quality.

This study's findings support the intervention's potential effectiveness in improving sleep quality among women with breast cancer. By addressing various aspects of sleep quality, the intervention demonstrated its value in enhancing subjective sleep quality, promoting sleep efficiency, reducing sleep latency, and improving sleep duration.

It is worth noting that the study had some limitations. First, the sample size was relatively small, which may limit the generalizability of the findings. Future studies with larger sample sizes are warranted to validate these results. Second, the study focused exclusively on women with breast cancer, and the results may not apply to other populations or individuals with different types of cancer. Therefore, caution should be exercised when extrapolating these findings to broader contexts.

It is suggested that the results of mindfulness interventions to improve sleep quality be compared with other psychological interventions, such as cognitive behavioral therapy. Future studies should be conducted when the COVID-19 epidemic has subsided.

5.1. Conclusions

This study's findings highlight the intervention's positive impact on sleep quality among women with breast cancer. The intervention improved overall sleep quality, including subjective sleep quality, efficiency, latency, and duration. These results support the implementation of targeted interventions to enhance sleep outcomes in patients with breast cancer and contribute to their overall well-being and quality of life. Further research is encouraged to explore the long-term effects and potential mechanisms underlying these sleep quality improvements.

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Footnotes

Authors' Contribution: AN and ZAY designed the study. ZAY, SS, and ARS implemented the study. AN and ZAY analyzed and interpreted the data. AN and ZAY wrote the manuscript. All authors participated in reviewing, revising, and approving the manuscript.

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