Original Article

A comparison between effects of sudoku and mandala painting on anxiety of breast cancer patients undergoing chemotherapy

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Abstract

Introduction: Once diagnosed with breast cancer, many women may experience psychological complications, such as anxiety. The grueling treatments that such patients may undergo, for example, chemotherapy, not only cause specific complications for them but also increase their anxiety level. A technique to manage these psychological consequences in patients with breast cancer is to play Sudoku or do Mandala painting. **Purpose:** This study aimed to compare the effects of Sudoku and Mandala painting on the anxiety level of patients with breast cancer undergoing chemotherapy. **Methodology:** This randomized clinical trial was conducted on 70 patients with breast cancer in Arak, Iran. The patients who met the inclusion criteria were selected through purposive sampling, and then they were assigned to one of the Mandala painting or Sudoku groups using block randomization. The data were collected using a demographics form and the Spielberger State-Trait Anxiety Inventory (STAI). All participants in both groups completed the research questionnaires before the intervention. The obtained data were analyzed using descriptive and inferential statistics in SPSS-26. **Results:** The results indicated that there was a significant difference between the pre-test and post-test anxiety scores in both Sudoku and Mandala painting groups ($P = 0.0001$). The difference between the pre-test and post-test mean anxiety scores was 6.09 ± 4.02 in the Sudoku group and 48.93 ± 13.8 in the Mandala painting group. The results of the inter-group comparison also showed a significant difference between the two groups in post-test mean anxiety score ($P = 0.0001$), proving that Mandala painting was more effective in reducing the anxiety of patients. **Conclusion:** Mandala painting was more effective than Sudoku in reducing the anxiety level of patients with breast cancer. It can be hence concluded that Mandala painting can be used as a relaxing art therapy technique in these patients.

Keywords: Anxiety, breast cancer, chemotherapy, Mandala painting, Sudoku

Introduction

Breast cancer accounts for about one-third of all common female cancers and is also the second most common cancer after lung cancer and the most common cause of death among women.[1] The incidence of breast cancer is on the rise among Iranian women as it accounts for 79% of the most common cancers affecting Iranian women. There are more than 52,000 women with breast cancer in Iran, whose number is annually increased by more than 10,000.[2] The prognosis of breast cancer varies depending on the type of cancer, clinical stage, and age. The 5-year survival rate of patients with breast cancer has also been reported to range between 80% and 90% in the United Kingdom and the United States.[3]

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Once diagnosed with breast cancer, many women may experience psychological complications, such as stress and anxiety. The grueling treatments that such patients may undergo, for example, chemotherapy or surgical procedures, can not only cause certain complications for them but also increase their anxiety level.[4] The results of a study demonstrated that 39%, 45%, and 14% of patients with breast cancer experience high, moderate, and mild anxiety, respectively.[5] Some studies have reported that more than 80% of patients with breast cancer experience anxiety during chemotherapy.[6] If anxiety is not followed up and treated during the course of treatment, it may progress into chronic anxiety, which can harm the recovery of patients. Identifying and measuring the anxiety level during treatment can help planning and implementing proper treatment programs as well as complementary and nursing care.[5]

Complementary and alternative therapies have received greater attention in recent years and are widely being used along with pharmacotherapy. Non-pharmacological treatments are generally used as supportive and even alternative therapies in many medical centers around the world.[7] Using games is among the most important and helpful methods of treatment. There are many types of games including games with playthings or brain-training games. According to researchers, being enjoyable is the most important feature of games,[8] and as a result, playing games is one of the best ways to reduce mental problems and achieve emotional balance.[9]

Previous studies have shown that game-based interventions can effectively reduce anxiety.[5] Research has also demonstrated that brain-training games trigger the release of dopamine, which improves a person's mood and promotes optimism while boosting concentration and memory. One of the most important effects of brain-training games is reducing anxiety and stress. Such games can lower mental stress, helping players feel calmer and better.[10] Brain-training games can cause evident effects on the mind at any age; people of different ages, from children to the elderly, can play brain-training games. Playing games is one of the ways that can help anxious people have a healthy life. Playing games removes barriers to the mental development of individuals and reinforces their physical strength for a healthy life. It is also a good way to practice feeling relaxed.[11] Playing Sudoku is one of the hobbies that can greatly improve both physical and mental health.[12]

Sudoku is among the best brain-training games. Scientists believe that solving Sudoku puzzles helps humans activate their brain, feel entertained, avoid negative thoughts, and maintain and increase peace of mind. In addition, when people face challenging issues in their lives, this game can also help them strengthen brain networks and cognitive abilities and achieve peace of mind by engaging different parts of the brain in finding a suitable solution. Today, Sudoku is one of the most popular entertainments in different countries, and it is also available as an application program.[13] The results of a study showed that playing Sudoku can help calm down and get rid of negative thoughts.[14] The findings of Johari also indicated that playing Sudoku reduced the stress and anxiety level of cancer patients.[15]

As a painting technique and an art therapy method, Mandala painting is another way to help people cope with stress.[16] This technique helps individuals increase their awareness; adapt to symptoms of illness, stress, and traumatic experiences; and improve their cognitive abilities by creating works of art.[17] Mandala painting enhances creativity and is an ideal way for meditation.[18] Since psychiatrists have confirmed the positive effects of Mandala images on anxiety, cancer patients admitted to cancer treatment centers are recommended to attend Mandala therapy workshops to overcome their anxiety and stress.[17] Muthard *et al.* (2016)[19] reported the effectiveness of Mandala painting in reducing anxiety and stress.

According to Carl Gustav Jung, Mandala painting can actually organize and regulate mental chaos. Jung employed this method for treating his patients and argued that anxiety can make a person unable to do anything and make it difficult for them to cope with daily life.[18] The results of Bell *et al.*[20] showed that Mandala art therapy can potentially minimize mild anxiety.

The literature review revealed that a few studies have compared the effects of Sudoku and Mandala painting on the anxiety level of breast cancer patients undergoing chemotherapy. However, it is of great importance to develop interventions to reduce the anxiety of patients during treatment, especially patients who fight cancer as a fatal disease. This study hence aimed to compare the effects of Sudoku and Mandala painting on the anxiety level of patients with breast cancer undergoing chemotherapy in the Outpatient Chemotherapy Ward of Khansari Hospital in Arak, Iran.

Methodology

Study design

This study was a randomized clinical trial with two experimental groups.

Study sample and setting

This study was conducted on 70 patients with breast cancer who met the inclusion criteria in Khansari Hospital of Arak, a city located in the center of Iran, in 2020. The inclusion criteria were being in the 18–65 age range, being definitely diagnosed with breast cancer based on medical records, attending the second to fifth sessions of chemotherapy, receiving no concomitant radiotherapy treatment, having no history of taking anxiolytics for a month, being aware of affliction with breast cancer, not using complementary medicine products, such as herbal teas that may have calming and anxiety-reducing effects, having no history of taking anxiolytics or anti-depressants, having no previous experience of playing Sudoku or doing Mandala painting, and having no history of mental disorders based on patient file. The exclusion criteria were reluctance to continue the study and incidence of any problems related to breast cancer that made it impossible for the patient to continue playing Sudoku or doing Mandala painting. After examining the status of patients based

on the inclusion and exclusion criteria, a total of 70 patients were selected and assigned to the Sudoku group (group A) and Mandala painting group (group B) using block randomization in MATLAB.

Sample size

The sample size was calculated based on the findings of Xiao-Mei *et al.*[21] Assuming an alpha (α) of 5%, a confidence interval of 95%, and a test power (1-β) of 80%, the sample size was calculated as 28 for each group. After considering an attrition rate of 20%, the final sample size was determined to be 35 for each group.

$$N = \frac{(z1-\frac{\alpha}{2}+z1-B)2\times(S_1^2+S_2^2)}{(\mu1-\mu2)2}$$

α = 0.05, β = 0.2, α = 0.05, β = 0., μ1 = 42.35, S1 = 6.09, μ2 = 37.77, S2 = 5.96, N1 = N2 = 35

Data collection tools

The required data were collected using a demographics form and the Spielberger State-Trait Anxiety Inventory (STAI).

Demographics form: This form consisted of questions about the age, marital status, place of residence, level of education, income level, and disease status of the participants.

State-Trait Anxiety Inventory (STAI): Developed by Spielberger, the STAI is a 20-item inventory with four choices (not at all, somewhat, moderately so, and very much so). The minimum and maximum scores are 20 and 80, respectively. The scores are interpreted as follows: 31: mild anxiety, 32–42: moderate to low anxiety, 43–54: moderate to high anxiety, 55–64: relatively high anxiety, 65–75: high anxiety, and 76+: very high anxiety.[22] The results of Monesi Toosi *et al.*[23] (2015) showed that the concurrent validity of the Farsi version of the STAI and its original version was 0.16, which was statistically significant at 0.0001. The factor analysis results also demonstrated that this inventory includes two factors that together explained 35.14% of the variance. Moreover, Monesi Toosi *et al.* (2015)[23] reported a Cronbach's alpha of 0.90 for the STAI.

Intervention

Before the intervention, playing Sudoku and doing Mandala painting were explained to the participants. In addition, participants in both groups were asked to fill out the demographics form and the STAI before the intervention. Then a Sudoku puzzle with a pencil and eraser was given to participants in Group A to solve during their chemotherapy. The Sudoku puzzle was a 9×9 grid divided into nine 3×3 sub-grids. Some cells were filled with default numbers, and the patients were asked to complete the puzzle following three rules:

Rule 1: Each row must contain the numbers from 1 to 9, without repetitions.

Rule 2: Each column must contain the numbers from 1 to 9, without repetitions.

Rule 3: Each 3×3 box can only contain the numbers from 1 to 9 once [59].

The participants in group B were provided with a simple Mandala painting pattern along with a box of 12-color crayons and an eraser to complete during their chemotherapy. At the end of the chemotherapy, which lasted for about 2 hours, the participants were asked to fill out the STAI once again.

Data analysis

The obtained data were coded and entered into SPSS-26. Then, they were analyzed using descriptive statistics including frequency, frequency percentage, mean, and standard deviation and were reported in tables and diagrams. Qualitative data were also analyzed using inferential statistics, including Chi-square test and Fisher's exact test. In addition, independent and paired t-tests or their non-parametric equivalents, that is, the Mann–Whitney U test and the Wilcoxon signed-rank test, were employed to compare mean values. Analysis of covariance (ANCOVA) was also used to confirm the hypotheses.

Ethical considerations

This research project was approved by the Research Council and the Ethics in Research Committee of Arak University of Medical Sciences (registration code: IR.ARAKMU.REC.1400.258). The research team committed themselves to complying with the ethical principles stipulated by the Ministry of Health and Medical Education at all stages of the study. The participants were assured that their personal information would be kept confidential and their medical data would be only used for research purposes. Moreover, all participants were briefed on the research objectives and procedures, and their informed written consent was obtained before they entered the study.

Results

Demographics

The mean age of participants was 45.23 ± 9.59 years old, with a minimum and maximum of 25 and 59, respectively. The data showed that 49 participants (70%) were married, 7 participants (10%) were single, and 14 participants (20%) were widowed. In terms of level of education, 29 participants (41.4%) had a university degree, 17 participants (24.3%) had failed to get a high school diploma, 12 participants (17.1%) had a high school diploma, and 12 participants (17.1%) had a junior high school completion certificate. The data also indicated that 47 participants (67.1%) were housewives, nine participants (12.9%) were employees, nine participants (12.9%) were unemployed, and five participants (7.1%) were self-employed. In terms of the number of children, 22 participants (31.4%) had two children, 20 participants (28.6%) had three or more children, 15 participants (21.4%) had no child, and 13 participants (18.6%)

had only one child. The results demonstrated that 54 participants (77.1%) had no underlying disease, four (5.7%) and two (2.9%) participants were afflicted with hypertension and diabetes mellitus, respectively, and 10 participants (14.3%) had other underlying diseases. Moreover, 17 participants (24.3%) had a history of regular exercise and six participants (8.6%) were smokers. The data showed that 28 (40%), 15 (21.4%), 14 (20%), and 13 (18.6%) participants were undergoing the fourth, fifth, third, and second rounds of their chemotherapy, respectively. Based on demographic data, a total of 66 participants (94.3%) were covered by an insurance company and 13 participants (18.6%) were female breadwinners. In terms of place of residence, 58 participants (82.9%) lived in urban areas and 12 participants (17.1%) lived in rural areas. The data also showed that 62 participants (88.6%) were living with their families and 8 participants (11.4%) were living alone. Finally, the mean income of participants was 73285714.29 ± 56259528.75 million IRR, with a minimum and maximum of 10 and 45 million IRR, respectively. The data indicated that there was no significant difference between the participants in group A and group B in demographic variables [Table 1].

Anxiety

According to Table 2, the pre-test mean anxiety score was 57.57 ± 8.64 in group A and 59.68 ± 7.02 in group B. The results of the Mann–Whitney U test showed no significant difference between the two groups in this regard ($P = 0.301$). The post-test mean anxiety score was 53.54 ± 8.52 and 46.2 ± 7.89 in group A and group B, respectively, indicating a statistically significant difference between the two groups ($P = 0.0001$). The Wilcoxon signed-rank test also demonstrated that the reduction in the mean anxiety score in both the Sudoku group (group A) (from 57.57 ± 8.64 to 53.54 ± 8.52) and the Mandala painting group (group B) (from 59.68 ± 7.02 to 46.2 ± 7.89) was statistically significant ($P = 0.0001$).

Table 1: Demographic information of participants in both experimental groups

Variables		Mandala painting		Sudoku		*P*
		Percentage	Frequency	Percentage	Frequency	
Marital status	Single	71.4	25	68.6	24	*P*=0.865*
	Married	11.4	4	8.6	3	
	Widowed	17.1	6	22.9	8	
Number of children	No child	17.1	6	25.7	9	*P*=0.517*
	One child	14.3	5	22.9	8	
	Two children	34.3	12	28.6	10	
	Three or more children	34.3	12	22.9	8	
Educational attainment	Guidance school	17.1	6	17.1	6	*P*=0.518**
	Failed high school diploma	25.7	9	22.9	8	
	High school diploma	22.9	8	11.4	4	
	University degree	34.3	12	48.6	17	
Chemotherapy round	Second	22.9	8	14.3	5	*P*=0.790**
	Third	17.1	6	22.9	8	
	Fourth	40	14	40	14	
	Fifth	20	7	22.9	8	
Job status	Employee	11.4	4	14.3	5	*P*=0.863*
	Self-employed	5.7	2	8.7	3	
	Housewife	71.4	25	62.9	22	
	Unemployed	11.4	4	14.3	5	
History of underlying diseases	Hypertension	5.7	2	5.7	2	*P*=0.593*
	Diabetes mellitus	2.9	1	2.9	1	
	No disease	71.4	25	82.9	29	
	Other diseases	20	7	8.6	3	
Age		Standard deviation	Mean	Standard deviation	Mean	*P*=0.837***
		9.32	45.51	9.98	44.94	

*Fisher's exact test, **Chi-square, ***Mann–Whitney *U* test

Table 2: Pretest and posttest mean anxiety scores in the Sudoku and Mandala painting groups

Anxiety		Pretest		Posttest		Mean difference		Wilcoxon signed-rank test	
		Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Statistic	Sig.
Sudoku		8.64	57.57	8.52	53.54	6.09	4.02	−3.328	0.001
Mandala painting		7.02	59.68	7.89	46.2	8.93	13.48	−4.985	0.001
Mann–Whitney *U* test	Statistic	524.5		309					
	Sig.	0.301		0.0001					

Table 3 presents the results of Fisher's exact test. The results showed that there was no significant difference between the Sudoku group and the Mandala painting group in the pre-test levels of anxiety ($P = 0.227$), whereas a significant difference was found between them in anxiety levels after the intervention ($P = 0.0003$). All participants in the Sudoku group experienced medium-to-low to high levels of anxiety before the intervention, whereas one participant exhibited mild, three medium-to-low, eight medium-to-high, 20 relatively high, and three high levels of anxiety immediately after the intervention. All participants in the Mandala painting group experienced medium-to-low to high levels of anxiety before the intervention, whereas one participant exhibited mild; 14 medium-to-low; 10 medium-to-high; and ten, 14, ten, and ten relatively high levels of anxiety immediately after the intervention. As shown in the table below, Mandala painting was more effective than Sudoku in reducing the anxiety level of the participants.

Discussion

This purpose-based study aimed to compare the effects of Sudoku and Mandala painting on the anxiety level of 70 patients with breast cancer undergoing chemotherapy. The study results showed that there was a significant difference between the pre-test and post-test anxiety scores in the Sudoku group. Grabbe *et al.*[24] studied the effects of Sudoku on the active memory performance in adults and reported that there was a relationship between the performance of participants in Sudoku and their memory performance as those who played Sudoku more exhibited a more active memory. The findings of Bellens *et al.*[25] also showed the positive effects of a video game-based cognitive intervention on the anxiety of breast cancer survivors. These results were consistent with the findings of this study.

The results also indicated that there was a significant difference between the pre-test and post-test anxiety scores in the Mandala painting group. Yakar *et al.*[26] investigated the effects of Mandala painting on the anxiety of 12 cancer patients in a study with a pre-test–post-test design. The participants attended an art therapy intervention using Mandala painting once a week for 8 weeks. Their results showed that the anxiety scores of the participants significantly decreased after the intervention. The findings of Gürcan and Atay (2021).[27] also demonstrated the effectiveness of Mandala painting in reducing psychological symptoms, anxiety, and depression in adolescents with cancer. These results were consistent with the findings of this study.

All participants in the Sudoku group experienced medium-to-low to high levels of anxiety before the intervention, whereas one participant exhibited mild, three medium-to-low, eight medium-to-high, 20 relatively high, and three high levels of anxiety immediately after the intervention. All participants in the Mandala painting group experienced medium-to-low to high levels of anxiety before the intervention, whereas one participant exhibited mild, 14 medium-to-low, ten medium-to-high, and ten relatively high levels of anxiety immediately after the intervention. These figures indicate that Mandala painting was more effective than Sudoku in reducing the anxiety level of the participants.

Ghamari *et al.* (2019) studied the effect of Mandala painting on the anxiety level of adolescents in a test group and two comparison groups. Participants in the test group, first comparison group, and second comparison group were asked to engage in painting a Mandala pattern for 20 min, painting a checkered page for 20 min, and painting anything they wanted for 20 min. The results showed that there was a significant difference between the three groups in the post-test mean anxiety scores. All three techniques managed to reduce the anxiety level of participants. However, Mandala painting was more effective than the other two methods in this regard.[28] This was consistent with the findings of this study. Nevertheless, Ramdaniati *et al.* (2016)[29] reported that play therapy was more effective than art therapy in reducing the anxiety level of the participants in their study, which is not consistent with the findings of this study.

Table 3: Comparison of the pretest and posttest frequency distribution of anxiety levels in the two groups

	Group	Pretest		Posttest	
		Percentage	Frequency	Percentage	Frequency
Sudoku	Mild	0	0	2.9	1
	Moderate to low	5.7	2	8.6	3
	Moderate to high	17.1	6	22.9	8
	Relatively high	54.3	19	57.1	20
	High	22.9	8	8.6	3
	Very high	0	0	0	0
Mandala painting	Mild	0	0	2.9	1
	Moderate to low	5.7	2	40	14
	Moderate to high	5.7	2	28.6	10
	Relatively high	45.7	16	28.6	10
	High	42.9	15	0	0
	Very high	0	0	0	0
Statistic		Fisher exact=4/368		Fisher exact=13/619	
Sig.		*P*=0/227		*P*=0/003	

Conclusion

Both Sudoku and Mandala painting managed to reduce the anxiety level of patients with breast cancer in this study. However, Mandala painting was more effective than Sudoku in this regard. It can be hence concluded that Mandala painting can be used as a relaxing art therapy technique in these patients. In addition, Mandala painting is recommended to be employed as a therapeutic tool to reduce the anxiety level of patients.

Limitations

One of the limitations in this study was that the participants were selected from patients with breast cancer who were undergoing chemotherapy. Therefore, this sample cannot well represent all people who suffer from anxiety disorders. In addition, since a self-reporting tool was employed in this study for measuring the anxiety level of the participants, their responses may not be absolutely reliable. This study investigated the effects of Sudoku and Mandala painting only on the anxiety level of patients with breast cancer, but their effects on other unpleasant inconveniences and problems of these patients, such as fear, were not measured.

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Conflicts of interest

There are no conflicts of interest.

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