

The effectiveness of deep breathing exercises in reducing the anxiety among the patients undergoing proton therapy at apollo proton cancer Centre

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Abstract

Background: Anxiety is a common psychological response among patients undergoing proton therapy due to cancer diagnosis, immobilization, repeated imaging, and remaining alone during treatment. Uncontrolled anxiety may affect treatment compliance and patient well-being. Deep breathing exercises are a simple, non-pharmacological nursing intervention that may reduce anxiety.

Aim: To evaluate the effectiveness of deep breathing exercises in reducing anxiety among patients undergoing proton therapy at Apollo Proton Cancer Centre, Chennai.

Methods: A quantitative, quasi-experimental pre-test-post-test control group design was used. Sixty patients undergoing proton therapy were recruited through purposive sampling and allocated into an experimental group (n = 30) and a control group (n = 30). Baseline anxiety was assessed using a modified Anxiety Assessment Scale based on the Hospital Anxiety and Depression Scale-Anxiety (HADS-A). The experimental group received a 20-minute demonstration of deep breathing exercises and practised them twice daily for three consecutive days and once again 30 minutes before proton therapy. The control group received routine nursing care. Post-test anxiety was assessed immediately before treatment. Descriptive and inferential statistics, including paired and independent *t*-tests, were used for analysis.

Results: The experimental group's mean anxiety score significantly decreased from 13 ± 3 to 6 ± 1 , whereas the control group's post-test mean score was 16 ± 2 . A highly significant difference was observed between the groups ($t = -24.49$, $p < 0.001$). Following the intervention, 90% of patients in the experimental group had normal anxiety levels.

Conclusion: Deep breathing exercises significantly reduced anxiety among patients undergoing proton therapy. This simple, safe, non-invasive, and cost-effective intervention can be incorporated into routine oncology nursing practice to improve patients' psychological well-being and treatment experience.

Keywords: Proton therapy; Anxiety; Deep breathing exercises; Oncology nursing; Radiation therapy; Non-pharmacological intervention

1. Introduction

Cancer is a major global health concern, and radiation therapy is an essential treatment modality. Proton therapy is an advanced form of radiation therapy that uses proton beams to precisely target tumors while minimizing radiation

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exposure to surrounding healthy tissues. The treatment involves careful assessment, imaging, treatment planning, patient immobilization, and image-guided radiation delivery to ensure accuracy.

Despite its benefits, patients undergoing proton therapy often experience anxiety related to cancer diagnosis, treatment procedures, immobilization, repeated imaging, and remaining alone in the treatment room during radiation delivery. Anxiety may affect patient cooperation, treatment adherence, and overall well-being. Nurses play a vital role in identifying anxiety and providing appropriate education, emotional support, and psychosocial interventions to improve the treatment experience.

Aruna et al. (2019) reported that most patients undergoing radiation therapy experienced mild to moderate anxiety, with a significant positive correlation between anxiety and depression ($r = 0.721$, $p < 0.05$). These findings highlight the need for effective nursing interventions to reduce psychological distress. However, evidence on anxiety among patients undergoing proton therapy remains limited. Therefore, this study aims to assess anxiety among patients receiving proton therapy and generate evidence to support nursing interventions that enhance psychological well-being and quality of care.

2. Review of Literature

Naregal et al. (2014) conducted a descriptive study to assess the level of anxiety among cancer patients and to determine its association with selected socio-demographic variables. A purposive sampling technique was used to recruit cancer patients admitted to Krishna Hospital. The findings revealed that 74% of the patients experienced moderate anxiety, while 24% had severe anxiety. However, no significant association was found between the level of anxiety and the selected socio-demographic variables.

Fernandes (2015) conducted a study to assess anxiety and depression among patients with head and neck cancer and to evaluate the effectiveness of nurse-led interventions. Thirty patients aged above 18 years admitted to Pravara Rural Hospital were included in the study. The interventions comprised patient education, reinforcement through educational pamphlets, oral and mouth care, breathing exercises, counselling, and spiritual care. Post-intervention assessment demonstrated a significant reduction in anxiety and depression from moderate to mild levels. The study also found a significant association between depression and selected socio-demographic variables, including occupation, cancer treatment, and treatment compliance. Furthermore, a positive relationship was observed between anxiety and depression. The findings concluded that nurse-led interventions are effective in reducing anxiety and depression and should be incorporated into routine cancer care.

Hayama et al. (2012) conducted a randomized controlled study to evaluate the effect of a deep breathing intervention on tension-anxiety and fatigue among Japanese women with gynecological cancer undergoing adjuvant chemotherapy. Twenty-three patients were randomly assigned to intervention ($n = 11$) and control ($n = 12$) groups. The intervention group practiced a 10-minute deep breathing program consisting of abdominal breathing, thoracic breathing, and breathing with raised arms. Anxiety and fatigue were assessed before and after chemotherapy using the Profile of Mood States-Short Form (Japanese version) and the Cancer Fatigue Scale. The results showed that patients in the intervention group experienced greater reductions in tension-anxiety and fatigue compared to the control group, indicating that deep breathing is an effective non-pharmacological intervention for alleviating psychological distress in patients undergoing chemotherapy.

Objectives

- To assess the level of anxiety among patient who will undergo proton therapy in both experimental and control group.
- To administer deep breathing exercise in experimental group
- To reassess the level of anxiety among patient who underwent proton therapy in both experimental and control group.

Hypothesis

- Research Hypothesis

There is a significant reduction in the level of anxiety after performing deep breathing exercises among patient underwent proton therapy

3. Methodology

3.1. Research Approach: Quantitative Approach

- Research Design: Quasi-experimental pre-test–post-test control group design
- Variables:
 - Independent Variable: Deep Breathing Exercises
 - Dependent Variable: Level of Anxiety
- Study Place (Setting): Apollo Proton Cancer Centre.
- Study Duration: 6 months (Aug 2025 – Jan 2026)
- Study Population: Patient who will undergo proton therapy

$$n = (2(Z_{\alpha/2} + Z_{\beta})^2 \sigma^2) / d^2$$

n = sample size per group

$Z_{\alpha/2} = 1.96$ (95% confidence level)

$Z_{\beta} = 0.84$ (80% power)

σ = Standard deviation from the pilot study

d = Expected difference (effect size) between the groups

Sample: 60 (Experimental Group = 30 & Control Group = 30)

Sampling Method: Non – Probability Purposive Sampling Method

3.2. Inclusive Criteria

Patient who will undergo proton therapy (a) between age group of 20 years to 65 years, (b) for first time with physical fitness to perform deep breathing exercises

3.3. Exclusive Criteria

Patient undergoing proton therapy (a) who Not willing to participate in the study, (b) Not fit to perform deep breathing exercises, (c) Has psychiatric problem

3.4. Data Collection Tool

Section A: Demographic Details

Section B: Modified Anxiety Assessment Scale (developed based on the Hospital Anxiety and Depression Scale–Anxiety [HADS-A])

Table 1 Modified Anxiety Assessment Scale

S.No	Questions	Never (0)	Sometimes (1)	Frequently (2)	Always (3)
1	I am feeling anxious and nervous about the therapy.				
2	I am unable to stop or control my worry about the outcome of the therapy.				
3	I constantly seek reassurance from others about a positive outcome of the therapy.				
4	I am feeling worried about being alone in a closed room during therapy.				

5	I am feeling anxious about the immobilization of body parts during therapy.				
6	I become easily annoyed or irritable.				
7	I am having trouble relaxing.				

Score	Interpretation
0-7	Normal (No anxiety)
8-10	Mild anxiety (Borderline abnormal)
11-14	Moderate anxiety (Abnormal)
15-21	Severe anxiety (Abnormal)

3.5. Method of Data Collection

Following approval from the Institutional Ethics Committee, data collection was commenced. Eligible participants who met the inclusion criteria were recruited using purposive sampling. The purpose of the study was explained to all participants, and written informed consent was obtained prior to enrolment.

After recruitment, participants were alternately assigned to the experimental and control groups until the required sample size of 30 participants in each group was achieved. Baseline anxiety was assessed in both groups using the modified anxiety assessment scale before the initiation of proton therapy.

Participants in the experimental group received a 20-minute demonstration of deep breathing exercises by the principal investigator. The demonstration included explanation, supervised practice, and reinforcement to ensure correct performance of the breathing technique. Participants were instructed to practise the deep breathing exercises twice daily for three consecutive days before the scheduled proton therapy session and to perform one additional session 30 minutes before undergoing proton therapy.

Participants in the control group received routine nursing care without the deep breathing intervention. Following completion of the intervention period, anxiety levels were reassessed in both the experimental and control groups immediately before the proton therapy session using the same modified anxiety assessment scale.

3.6. Data Analysis & Interpretation

Data were analyzed in accordance with the objectives of the study and the formulated hypotheses. Both descriptive and inferential statistics were used for data analysis.

Table 2 Demographic Data

Demographic Variable		Control Group		Experimental Group	
		No	%	No	%
Age	20-34	7	24	5	17
	35-49	2	6	8	27
	50-65	21	70	17	56
Gender	Male	24	80	14	47
	Female	6	20	16	53
Education	School	9	30	9	30
	UG	16	53	21	70
	PG	5	17	0	0

Treatment Part	Abdomen	2	6	3	10
	Back	2	6	2	6
	Head & Neck	16	54	13	43
	pelvis	5	17	5	17
	Thoracic	5	17	7	24
History of Surgery	Yes	24	80	18	60
	No	6	20	12	40
History of Medical Treatment	Yes	12	40	8	27
	No	18	60	22	73

Table – 2 shows the distribution of sample according to socio demographic variable with frequency and percentage.

Table 3 Pre and Post Test Anxiety Score Distribution in Experimental and Control Group

Level of Anxiety	Control Group				Experimental Group			
	Pre Test		Post Test		Pre Test		Post Test	
	No.	%	No.	%	No.	%	No.	%
Normal	0	0	0	0	2	6	27	90
Boarder Line Anxiety	7	24	1	3	7	24	3	10
Moderate Anxiety	12	40	8	27	12	40	0	0
Severe Anxiety	11	36	21	70	9	30	0	0

Table 3 shows the distribution of anxiety levels among patients in the control and experimental groups during the pre-test and post-test. In the control group, during the pre-test, 7 (24%) participants had borderline anxiety, 12 (40%) had moderate anxiety, and 11 (36%) had severe anxiety. In the post-test, 1 (3%) participant had borderline anxiety, 8 (27%) had moderate anxiety, and 21 (70%) had severe anxiety. In the experimental group, during the pre-test, 2 (6%) participants had normal anxiety, 7 (24%) had borderline anxiety, 12 (40%) had moderate anxiety, and 9 (30%) had severe anxiety. Following the intervention, the majority of participants, 27 (90%), had normal anxiety, while 3 (10%) had borderline anxiety, and none had moderate or severe anxiety. This is clearly represented in Figure 1.

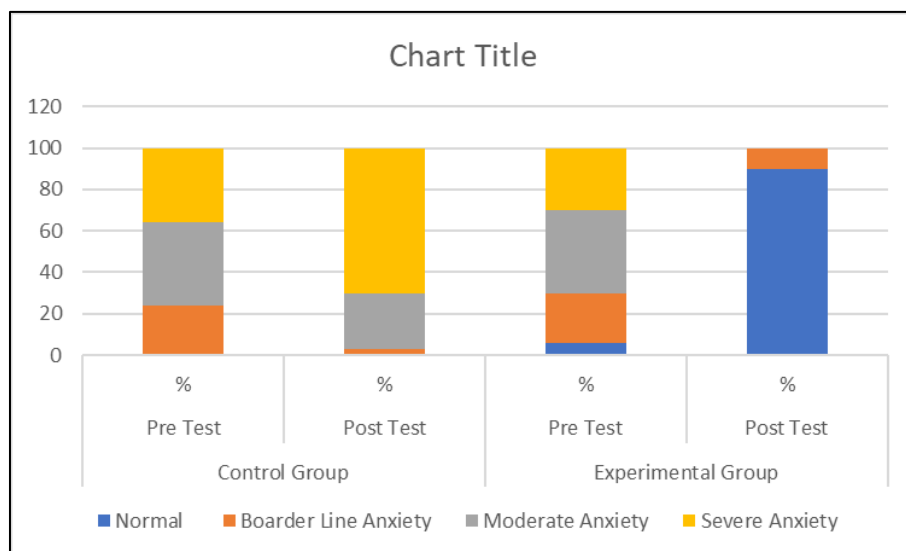


Figure 1 Pre and Post Test Anxiety Score Distribution in Experimental and Control Group

Table 4 Effectiveness of Deep Breathing Exercises in Experimental Group Using Paired t Test

Paired t Test						
Group	Pre Test		Post Test		t value	p value
	Mean	Standard Deviation	Mean	Standard Deviation		
Experimental	13	3	6	1	-2.045	<0.001
Control	13	3	16	2		

Table 4 shows the comparison of pre-test and post-test anxiety scores in the experimental group using the paired t-test. The mean anxiety score decreased from 13 ± 3 in the pre-test to 6 ± 1 in the post-test. The paired t-test demonstrated a statistically significant reduction in anxiety following the deep breathing exercises ($t = -2.045$, $p < 0.05$).

Table 5 Comparison of Post-test Anxiety Scores Between the Experimental and Control Groups Using the Independent t-Test

Group	Post-test Mean $\pm$ SD	n	t value	p value
Experimental	6.00 ± 1.00	30	-24.49	<0.001
Control	16.00 ± 2.00	30		

Table 5 shows that the post-test mean anxiety score in the experimental group was 6.00 ± 1.00 , whereas the control group had a mean anxiety score of 16.00 ± 2.00 . The independent t-test revealed a highly statistically significant difference between the two groups ($t(58) = -24.49$, $p < 0.001$), indicating that deep breathing exercises were effective in reducing anxiety among patients undergoing proton therapy.

4. Discussion

The present study demonstrated that deep breathing exercises significantly reduced anxiety among patients undergoing proton therapy. The mean anxiety score in the experimental group decreased from 13 ± 3 during the pre-test to 6 ± 1 during the post-test. The paired t-test showed a statistically significant reduction in anxiety ($t = -2.045$, $p < 0.001$). Furthermore, the independent t-test revealed a statistically significant difference in post-test anxiety scores between the experimental and control groups ($t = -24.49$, $p < 0.001$), indicating the effectiveness of the intervention.

Therefore, the research hypothesis (H_1) stating that there is a significant reduction in the level of anxiety after performing deep breathing exercises among patients undergoing proton therapy was accepted, and the corresponding null hypothesis (H_0) was rejected.

The findings are consistent with those of Hayama et al. (2012), who reported that deep breathing exercises significantly reduced anxiety among patients undergoing chemotherapy, and Fernandes (2015), who demonstrated that nurse-led interventions, including breathing exercises, effectively reduced anxiety among patients with cancer. These findings suggest that deep breathing exercises are a simple, safe, and effective non-pharmacological nursing intervention that can be incorporated into routine care for patients undergoing proton therapy.

5. Conclusion

The present study concluded that deep breathing exercises were effective in reducing anxiety among patients undergoing proton therapy. A significant reduction in post-test anxiety scores was observed in the experimental group compared with the control group, indicating the beneficial effect of the intervention. Deep breathing exercises are a simple, safe, non-invasive, and cost-effective nursing intervention that can be incorporated into routine nursing care to promote the psychological well-being of patients undergoing proton therapy.

Recommendations

Deep breathing exercises may be incorporated into routine nursing care for patients undergoing proton therapy to reduce treatment-related anxiety.

Similar studies may be conducted with a larger sample size and in multiple proton or radiation therapy centres to improve the generalizability of the findings.

Future research may compare the effectiveness of deep breathing exercises with other non-pharmacological interventions, such as guided imagery, music therapy, or mindfulness-based relaxation techniques.

Long-term follow-up studies are recommended to evaluate the sustained effects of deep breathing exercises on anxiety and quality of life.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Statement of ethical approval

The study was approved by the Institutional Ethics Committee – Bio Medical Research, Apollo Hospitals, Chennai, (Ref: IEC-BMR App No.: APH-C-S-005/07-25) before the commencement of data collection.

Statement of informed consent

Written informed consent was obtained from all participants prior to their enrolment in the study. Participation was entirely voluntary, and participants were informed of their right to withdraw from the study at any stage without affecting their treatment. Confidentiality and anonymity of all participant information were maintained throughout the study in accordance with institutional ethical guidelines and the principles of the Declaration of Helsinki.

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