Effect of Progressive Muscle Relaxation Technique on Fatigue and Sleep Quality among Colorectal Cancer Patients Undergoing Chemotherapy

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Abstract

Background: Fatigue and poor sleep quality are considered ones of the most prevalent side effects among colorectal cancer patients undergoing chemotherapy. Progressive muscle relaxation technique is a cognitive-behavioral therapy that can help to decrease these effects. **Aim of the study**: Determine the effect of progressive muscle relaxation technique on fatigue and sleep quality among colorectal cancer patients undergoing chemotherapy. **Research design**: A quasi experimental research design was utilized in this study. **Setting**: The inpatient medical oncology department at Damanhour Oncology Center, affiliated to the Specialized Medical Centers, Ministry of Health, El-Beheira Governorate, Egypt. **Subjects**: A purposive sample of 130 adult patients of both sex with colorectal cancer undergoing chemotherapy. **Tools of data collection**: Three tools were used: **Tool (I):** Demographic and Clinical Data Structured Interview Schedule, **Tool (II):** Fatigue Assessment Scale, **Tool (III):** The Groningen Sleep Quality Scale. **Results**: The study showed that there was a highly statistically significant difference between both control and study groups concerning their total fatigue level and total sleep quality score in 1st and 2nd evaluations ($p < 0.001$*). **Conclusion**: Progressive Muscle Relaxation Technique significantly decreases fatigue level and improves sleep quality among colorectal cancer patients undergoing chemotherapy. **Recommendations**: Incorporate progressive muscle relaxation technique into the routine nursing care for colorectal cancer patients undergoing chemotherapy. In-service training programs for all nurses in oncology departments about the benefits, demonstration, and utilization of progressive muscle relaxation technique for patients undergoing chemotherapy.

Keywords Chemotherapy, Colorectal Cancer patients, Fatigue, Progressive Muscle Relaxation Technique, and Sleep Quality.

Introduction

Colorectal Cancer (CRC) in recent years has become a major global issue due to its rising incidence rate, resulting in significant morbidity and mortality worldwide. Globally, CRC ranks as the second deadliest cancer and third most common cancer. The International Agency for Research on Cancer (IARC) in 2022, estimated that there were 1.92 million (9.6%) new cases of CRC worldwide **(International Agency for Research on Cancer, 2022**). In Egypt, according to the Global Cancer Observatory (GCO) reports in 2022,

estimated that the incidence and mortality rate of CRC were 6.4% and 3.4% respectively. Also, the incidence rate of CRC per 100,000 for males and female were 6.6% & 6.3% respectively **(Global Cancer Observatory, 2022).** Numerous genetic, environmental, lifestyle, and physiological variables can contribute to the development of CRC which includes a variety of molecularly heterogeneous disorders **(Ashique et al., 2024).**

Due to limited screening and vague early symptoms, colorectal cancer is often diagnosed at an advanced stage. Some lower gastrointestinal symptoms suggesting CRC include rectal bleeding, abdominal pain or mass, altered bowel habits, weight loss, anemia, fatigue, nausea, vomiting, and some emergency conditions such as bowel obstruction or perforation **(Han et al., 2020; Sawicki et al., 2021).**

Colorectal cancer is commonly treated through a multimodal approach such as surgery, radiotherapy, and chemotherapy **(Fadlallah et al., 2024).** Chemotherapy is one of the most effective modalities for colorectal cancer, often used alone or alongside other treatments. It works by targeting rapidly dividing cancer cells and disrupting their growth **(Han et al., 2020; Devi & Sharma, 2019).** While advancements in CRC treatment have increased survival rates, chemotherapy has therapeutic as well as toxic effects**.** These adverse effects of chemotherapy rely on the medications used, dosage, length of the course, and the unique characteristics of each patient **(Raisa & Marhaendraputro, 2019).**

Many side effects such as fatigue, nausea, vomiting, sleep disturbance, discomfort, anxiety, and hair loss, are common among patients undergoing chemotherapy course. Fatigue and poor sleep quality are two of the most common complaints among those patients **(Horio et al., 2022; Smith et al., 2020; Tsai et al., 2022).**

Fatigue is one of the most disturbing and distressing side effects for most CRC patients. It greatly affects patients cognitively and emotionally before, during, and for months or years after chemotherapy. Several studies illustrated that about 80- 90 % of cancer patients treated with chemotherapy reported fatigue **(Kim et al., 2020; Wesselink et al., 2020).**

Chemotherapy, in particular, has been associated with disturbed sleep that occurs in up to 90% of cancer patients after diagnosis or during treatment. As well, CRC patients experience sleep disturbances in varying ranges of severity. Some studies show that 30%–60% of CRC patients present with a sleep disorder. Colorectal cancer patients frequently experience poor sleep quality, which may be due to chemotherapy treatment and its side effects **(Legg et al., 2022).**

Fatigue and poor sleep coexist and have an impact on every aspect of CRC patients' lives. As a result comprehensive care which including both pharmacological and non-pharmacological approaches are utilized in the treatment of fatigue and sleep disturbances **(Momayyezi et al., 2021).** The non-pharmacological treatments rely on exercise, nutrition, rest, and the use of alternative interventions such as mindfulness, meditation, yoga, massage, acupressure, reflexology, and Progressive Muscle Relaxation

Technique (PMRT) **(Dean, 2022; Tsai et al., 2022).**

Progressive Muscle Relaxation Technique is a cognitive-behavioral therapy that was developed by Dr. Edmund Jacobson in the 1930s. He discovered that muscles could be effectively relaxed by tensing them briefly, then releasing the tension. In PMRT, patients deliberately contract a specific muscle group for five to seven seconds, then relax it for 10-20 seconds, focusing on the contrast between tension and relaxation. This awareness of the physical sensation of relaxation is a key benefit of the technique **(Sarı et al., 2024; Rady et al., 2020).**

Progressive Muscle Relaxation Technique is a simple, cost-effective, non-invasive technique that patients can easily learn and practice at home or in clinical settings **(Sawale & Patil, 2023).** Also, PMRT offers numerous benefits, including reduced sympathetic nervous system activity leading to lower heart rate, respiratory rate, and blood pressure. It also helps regulate the peripheral and central nervous systems, thereby decreasing stress, anxiety, and fatigue, while improving sleep quality and overall health outcomes and quality of life of CRC patients **(Rosdiana & Cahyati, 2019).**

Significance of the study:

Researches specifically examining the effects of PMRT on fatigue and sleep quality in cancer patients remains limited. However, many studies in different fields such as cardiac rehabilitation, dialysis, psychiatry, and radiotherapy, have demonstrated that PMRT significantly enhances health outcomes in cancer patients by alleviating symptoms such as pain, nausea, vomiting, psychological distress, anxiety, and depression **(Tan et al., 2022; Jaya, & Thakur, 2020; Mohammed et al., 2020**) Therefore, the current study was conducted to determine the effect of progressive muscle relaxation technique on fatigue and sleep quality among colorectal cancer patients undergoing chemotherapy.

Aim Of The Study

This study aimed to determine the effect of progressive muscle relaxation technique on fatigue and sleep quality among colorectal cancer patients undergoing chemotherapy.

Research hypotheses:

- H0: Colorectal cancer patients who practice progressive muscle relaxation technique exhibit the same level of fatigue and sleep quality as the control group.
- H1: Colorectal cancer patients who practice progressive muscle relaxation technique exhibit less fatigue than those who did not practice it.
- H2: Colorectal cancer patients who practice progressive muscle relaxation technique exhibit better sleep quality than those who did not practice it.

Subjects And Methods

Study design:

A quasi experimental research design was utilized in this study.

Study Setting:

This study was conducted at the inpatient medical oncology department at Damanhour Oncology Center, affiliated to the Specialized Medical Centers, Ministry of Health, El-Beheira Governorate, Egypt.

Subjects

A purposive sample of 130 adult patients of both sex with colorectal cancer undergoing chemotherapy were included in the study and they were assigned into two equal groups (control and study). **They were selected according to the following inclusion criteria:**

- Adults aged 20 ≤ 60 years.
- Accepting to participate in the study.
- Scheduled for chemotherapy sessions for 3 consecutive days at least one month ago.
- Able to communicate verbally.
- Free from uncontrolled medical conditions (heart diseases, uncontrolled hypertension, and musculoskeletal disorders).
- Not taking sleep medications.
- Not previously practiced PMRT or other relaxation techniques.

Sample size:

The sample size was estimated based on the **Epi info 7 program** using the following parameters:

- Population size: 180 for three months.
- Expected frequency: 50%
- Confidence coefficient: 95%
- The margin of error:5%
- Minimum sample size: 123
- Sample size:130

Tools of data collection

Three tools were used for data collection.

Tool (I): " Demographic and Clinical Data Structured Interview Schedule "

This tool was developed by the researchers based on recent and relevant literature **(Akin & Kas Guner, 2019; De Paolis et al., 2019; Imanian et al., 2019)**. It was divided into two parts:

Part1:Demographic Data: It included eight items related to demographic data which were age, gender, area of residence, marital status, level of education, occupation, smoking habits, and caffeine consumption.

Part 2: Clinical Data: It included data regarding presence of associated diseases, colorectal cancer site, chemotherapy protocol type, the onset of chemotherapy sessions, and the type of previous colorectal surgery. These data were obtained from the medical record and confirmed by interviewing the patients.

Tool II: " Fatigue Assessment Scale ".

This tool was developed by **(Krupp et al., 1989 ; Michielsen et al.,2003 ; Yildirim & Ergin, 2013)** It was adapted by the researchers to assess the patient's fatigue level. It consisted of five dimensions with 23 sub-items as follows The first dimension; general fatigue (five sub-items), second dimension; physical fatigue (four sub-items), third dimension; mental fatigue(five sub-items), fourth dimension; the effect of fatigue on activities of daily living (eight sub-items) and fifth dimension; fatigue severity analog scale, which ranged from (0-10).

Scoring system:

Responses of each item in the first four dimensions (22 items) were scored on a five-point Likert scale ranged from 1 (never), 2 (very little), 3 (sometime), 4 (often), and 5 (always). The total score of them was 110. The global fatigue score was calculated by summing the total score of the first 22 items which equal (110) and item number 23 equal (10). So total score was 120. The total score was transformed into percent and categorized as the following:

- 1% < 33.3% mild fatigue.
- 33.3% < 66.6% moderate fatigue.
- 66.6 % - 100% severe fatigue.

Tool III: "The Groningen Sleep Quality Scale":

This tool was developed by **(Meijman et al., 1988)** and was adapted by the researcher and translated into Arabic. It was used to measure sleep quality during each last night of the three days and contained eleven items.

Scoring system:

Responses to each item were scored by yes equal (1) or no equal (0). The total score (11) was transformed into percent and categorized as the following:

- 66.6%- 100% poor sleep.
- 33.3% ≤ 66.6% fair sleep.
- ≤ 33.3% good sleep.

Method:

The study was accomplished according to the following steps:

Approval

- The researchers training certificate received from Complementary Medicine of the Arab African Union in Cairo, after special training for the performance of PMRT before implementation on the patients.
- An official letter was obtained from the Dean of the Faculty of Nursing, Damanhour University, and was directed to the director of Damanhour Oncology Center in El–Behira governorate and the Specialized Medical Centers, Ministry of Health to obtain permission to conduct the study after explaining the purpose of the study.

Tools of the study:

- Tool I was developed by the researchers based on recent and relevant literature.
- Tool II and tool III were adapted by the researchers.

1. Content validity:

The study tools were tested for content validity by a jury of five experts in the field of Medical-Surgical Nursing, at the Faculty of Nursing, Damanhour University. Accordingly, some modifications were done.

2. Pilot study:

A pilot study was carried out on 10% (13 patients) to assess the clarity, feasibility, and applicability of the tools. The necessary modifications were done accordingly. Data obtained was excluded from the current study.

3. The tools reliability:

The reliability of the tools (II and III) was tested using Cronbach's alpha test, the reliability coefficient was 0.859% and 0.744% respectively which is considered good reliability.

Data collection:

The researchers interviewed each patient individually (both groups control & study) in the previously mentioned setting to collect the needed data related to personal and clinical data by using tool I and pretest assessment of fatigue by using tool II and sleep quality by using tool III.

For the control group:

- The control group received routine oncology center care which was measuring vital signs & given prescribed chemotherapy drugs and other routine medications. Data was collected first from the control group to prevent data contamination.

For the study group:

- The researchers met each patient in the morning shift during the infusion of preparation medications before the

chemotherapy drug according to the hospital routine protocol.

- The technique was carried out in the room that well-ventilated, quiet, with sufficient light, ambient temperature, and a comfortable bed with curtains to provide the patient's privacy.
- The patient was asked to wear comfortable clothes; empty bowel and bladder, have a light meal, and sit down in a comfortable position with his hands on his thigh and feet flat on the floor or extended on the bed while practicing the technique.
- The researchers demonstrated each step of the PMRT for each patient in the study group with a picture and video and then asked the patient to re-demonstrate it until he/she can master it.
- Patients were asked to close his/her eyes, focus on breathing, and take deep breaths. Repeat 3-5 cycles of deep breathing (as patient tolerance).
- Then, the patient was instructed to voluntarily tense and release the big muscle groups systematically from head to toe.
- Starting with facial muscles: for eyes: close the eyes very tightly, frown nose, hold for 5-10 seconds, and then slowly release while counting for 10. For mouth: pursed the lips when yawning, holding for 5-10 seconds and then slowly releasing while counting for 10.
- For neck and shoulder muscles: shrug the shoulders up towards the ears, holding for 5-10 seconds, and then let them drop down as far as possible while counting for 10.
- For two arms and hands: tighten biceps by drawing the forearm up towards the shoulder, while clenching the fist, holding for 5-10 seconds, and then slowly releasing while counting for 10.
- For chest and abdominal muscles: tensing the chest by taking a deep breath, filling up the lungs and chest with air, holding for 5-10 seconds, and then slowly releasing while counting for 10. For the abdomen, suck the abdomen in, holding for 5-10 seconds, and then slowly release while counting for 10.
- For two legs: squeeze thigh muscles by pulling the toes upwards to stretch the calf muscle, hold them for 5-10 seconds, and then slowly release while counting for 10.
- For feet: pointing toes away from the head, squeeze tightly for 5-10 seconds, and then release. Then flex feet in, pointing toes up towards the head, hold for 5-10 seconds, and then slowly release while counting for 10.
- The patient ends the technique by taking 3-5 deep breaths, returning to normal status, and ensuring the patient is calm and comfortable.
- Each patients in the study group performed PMRT sessions for 15- 20 minutes three times per day (morning- evening- night) shifts in the presence of the researchers for three consecutive days in the inpatient medical oncology department (total 9 sessions).
- The researchers explain each step of the PMRT for patient care givers with a picture and video.
- After discharge, the researchers makes phone calls to the patient or family member to encourage the performance of the technique according to patient tolerance using the media provided by the researcher a minimum of three times a week (once / day).

- Evaluation was carried out for both groups two times by using tools (II

and III). The first evaluation was done in the inpatient room before the patient was discharged on the 3rd day of the chemotherapy session. The second evaluation was done after two weeks before the initiation of the next chemotherapy session in the inpatient room.

- Data was collected in a period of six months from September 2024 to February 2025.

Ethical Consideration

- Approval from the Ethical Research Committee of the Faculty of Nursing, at Damanhour University was obtained before conducting the study (**Approval No. 99-a) on 18/4/2024**.
- An official letter of approval from the Scientific Research Ethics Committee of MOHP was obtained after sending permission from the Damanhour Oncology Center in El–Behira governorate and the Specialized Medical Centers, Egypt (**Approval No. 3-2024/9) on 19/9/2024.**
- Informed consent was obtained from each patient in both groups before data collection and after providing an appropriate explanation about the aim of the study.
- Confidentiality of data was maintained.
- Patients' privacy was respected and anonymity was asserted.
- The patients were assured that their participation was voluntary and had the right to withdraw from the study at any moment without any negative impact.

Statistical Analysis

- After data were collected it was revised, coded, and fed to statistical software IBM SPSS version 22. The given graphs were constructed using Microsoft Excel software.
- All statistical analysis was done using two-tailed tests and an alpha error of 0.05. P value less than or equal to 0.05 was considered to be statistically significant.

The used tests were:

- Chi-square test: For categorical variables, to compare between different groups.
- Fisher's Exact Test: Correction for chi-square when more than 20% of the cells have an expected count of less than 5.
- Student t-test: For normally distributed quantitative variables, to compare between two studied groups.
- ANOVA with repeated measures: For normally distributed quantitative variables, to compare between more than two periods or stages and Post Hoc Test (adjusted Bonferroni) for pairwise comparisons.
- Mann Whitney test: For abnormally distributed quantitative variables, to compare between two studied groups.
- Pearson coefficient: To correlate between two normally distributed quantitative variables.

Results

Table (1) illustrates the frequency distribution of the studied patients in both groups regarding their demographic data. Concerning patients' age, it was found that the mean age of patients in both control and study groups was 46.23±9.77 and 46.0±10.66 respectively. Regarding gender, it was noticed that more than half (61.5% and 58.5%) of patients in the control and study groups respectively were male. Regarding to area of residence, more than half (60% and 58.5%) of patients in the control and study groups respectively were living in

rural areas. Corresponding to marital status, 69.2% and 60% of patients in the control and study groups respectively were married.

Table (2) illustrates the frequency distribution of the studied patients in both groups regarding their clinical data. Concerning associated diseases, it was found that around one-third (33.8% and 38.5%) of patients in control and study groups respectively had associated disease, (20% and 15.4%) of patients in control and study groups respectively had diabetes mellitus, while (13.8% and 26.2%) of patients in control and study groups respectively had hypertension. Regarding colorectal cancer sites, the table shows that (44.6% and 56.9%) of patients in control and study groups respectively had ascending colon cancer, while rectum cancer represented (46.2% and 30.8%) of patients in control and study groups respectively. Concerning chemotherapy protocol type, this table conveys that the majority (81.5% and 86.2%) of patients in both control and study groups respectively use the folfox protocol.

Table (3) shows the percentage distribution of the studied patients in both groups regarding their total fatigue level score before and after PMRT. The table revealed that the highest fatigue level in both control and study groups pre was moderate fatigue and represented (55.4% and 53.8%) respectively. Where the total mean score of fatigue for patients in the control and study groups pre was 61.57 ± 16.12 and 61.42± 14.19 respectively. While in the 2nd evaluation the total mean score in the control group were increased to 72.86 ± 9.95, but in the study group the total mean score were decreased to 41.57 ± 7.30, with highly statistically significant difference between both control and study groups in relation to their total fatigue level in 1st and 2nd evaluations ($p < 0.001$*).

Table (4) Shows the percentage distribution of the studied patients in both groups regarding their total sleep quality score before and after PMRT. It revealed that the poor sleep pre was (38.5% and 35.4%) in both control and study groups respectively, comparing to the good sleep pre was (12.3% and 18.5%) in both control and study groups respectively. Where the total mean score of sleep quality for patients in the control and study groups pre was 6.66 ± 2.92 and 6.65± 2.99 respectively. While in the 2nd evaluation the total mean score in the control group were increased to 8.05 ± 2.58, but in the study group the total mean score were decreased to 3.65 ± 2.27. There was a highly statistically significant difference between the control and study groups in relation to their total sleep quality score in 1st and 2nd evaluations ($p < 0.001$*).

Table (5) illustrates the correlation between total fatigue level and total sleep quality. It revealed that, there was a highly statistically significant correlation between the total fatigue level and total sleep quality for patients in the control and study groups in pre ($p <0.001$*).

Also, there was a highly statistically significant correlation between the total fatigue level and total sleep quality in the 1st and 2nd evaluations for patients in the control group ($p <0.001$*), while in the study group, there was a statistically significant correlation ($p= 0.002$*).

Table (1): Frequency distribution of the studied patients in both groups regarding their demographic data.

Demographic Data	Control group (n = 65)		Study group (n = 65)		Test of Sig.	P
	No.	%	No.	%		
Age (years)						
- <30	4	6.2	6	9.2		
- 30 – <40	14	21.5	13	20.0	χ^2= 0.566	0.904
- 40 – <50	19	29.2	17	26.2		
- ≤ 60	28	43.1	29	44.6		
- Mean ± SD.	46.23 ± 9.77		46.0 ± 10.66		t= 0.129	0.898
Gender						
- Male	40	61.5	38	58.5	χ^2= 0.128	0.720
- Female	25	38.5	27	41.5		
Area of residence						
- Rural	39	60.0	38	58.5	χ^2= 0.032	0.858
- Urban	26	40.0	27	41.5		
Marital status						
- Single	14	21.5	19	29.2		
- Married	45	69.2	39	60.0	FET= 1.640	0.663
- Widowed	6	9.2	7	10.8		
Level of education						
- Illiterate	17	26.2	15	23.1		
- Primary	13	20.0	15	23.1	FET= 4.520	0.630
- Preparatory	2	3.1	4	6.2		
- Technical/Diploma	21	32.3	20	30.8		
- University	12	18.5	11	16.9		
Occupation						
- Not working	14	21.5	21	32.3		
- Manual	17	26.2	14	21.5		
- Housewife	20	30.8	17	26.2	χ^2= 2.434	0.657
- Employee	13	20.0	11	16.9		
- Retired	1	1.5	2	3.1		
Smoking habits						
- No	61	93.8	63	96.9	χ^2= 0.699	0.680
- Yes	4	6.2	2	3.1		
Caffeine consumption						
- No	33	50.8	36	55.4	χ^2= 0.278	0.598
- Yes	32	49.2	29	44.6		

SD: Standard deviation χ^2: Chi square test. U: Mann Whitney test. FET : Fisher's Exact Test. p: p value for comparing between the two studied groups.

Table (2): Frequency distribution of the studied patients in both groups regarding their clinical data.

Clinical Data	Control group (n = 65)		Study group (n = 65)		χ^2	p
	No.	%	No.	%		
Associated diseases						
No	43	66.2	40	61.5		
Yes	22	33.8	25	38.5		
If yes specify #						
• Hypertension	9	13.8	17	26.2	0.300	0.584
• Diabetes mellitus	13	20.0	10	15.4		
• cardiopulmonary diseases	3	4.6	14	21.5		
• Liver diseases	5	7.7	4	6.2		
• Gastrointestinal diseases	3	4.6	2	3.1		
Colorectal cancer site#						
• Ascending colon	29	44.6	37	56.9		
• Transverse colon	22	33.8	27	41.5		
• Descending colon	26	40.0	20	30.8		
• Sigmoid colon	25	38.5	17	26.2		
• Rectum	30	46.2	20	30.8		
Chemotherapy protocol type						
• Folfox protocol	53	81.5	56	86.2	0.511	0.475
• Folfiri protocol	12	18.5	9	13.8		
The beginning of chemotherapy sessions						
• 1 month to < 3 months	17	26.2	17	26.2	2.394	0.495
• 3 months < 6 months	22	33.8	29	44.6		
• 6 months to <1 year	17	26.2	14	21.5		
• 1 year to < 5 years	9	13.8	5	7.7		
Previous colorectal surgery						
• No	23	35.4	15	23.1	2.380	0.123
• Yes	42	64.6	50	76.9		
	(n = 42)		(n = 50)			
Type of previous surgery#						
• Colostomy	20	47.6	26	52.0		
• Ileostomy	5	11.9	8	16.0		
• Hemicolectomy	24	57.1	19	38.0		
• Segmoidectomy	5	11.9	9	18.0		
• Low anterior resection	8	19.0	9	18.0		

χ^2: Chi square test *: Statistically significant at $p \leq 0.05$
#: More than one answer.

Table (3): Percentage distribution of the studied patients in both groups regarding their total fatigue level score before and after PMRT.

Total fatigue level score	Control group (n = 65)						Study group (n = 65)						Test of sig. (p_1)	Test of sig. (p_2)	Test of sig. (p_3)
	Pre		1st Post		2nd Post		Pre		1st Post		2nd Post				
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%			
Mild fatigue (23 – 55)	24	36.9	16	24.6	2	3.1	26	40.0	51	78.5	63	96.9	FET= 0.261	FET= 39.182	FET= 138.884
Moderate fatigue (56 – 87)	36	55.4	46	70.8	59	90.8	35	53.8	14	21.5	2	3.1	0.926	<.001*	<.001*
Severe fatigue (88 – 120)	5	7.7	3	4.6	4	6.2	4	6.2	0	0.0	0	0.0			
Total score (23 – 120) Mean ± SD.	61.57 ± 16.12		65.49 ± 12.93		72.86 ± 9.95		61.42 ± 14.19		47.78 ± 8.54		41.57 ± 7.30		t= 0.058 0.954	t= 9.211 <.001*	t= 20.438 <.001*

Table (4)Percentage distribution of the studied patients in both groups regarding their total sleep quality score before and after PMRT.

Sleep quality	Control group (n = 65)						Study group (n = 65)						Test of sig. (p_1)	Test of sig. (p_2)	Test of sig. (p_3)
	Pre		1st Post		2nd Post		Pre		1st Post		2nd Post				
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%			
Poor sleep (8-11)	25	38.5	37	56.9	41	63.1	23	35.4	9	13.8	2	3.1	χ^2= 0.948 0.623	χ^2= 33.564 <0.001*	χ^2= 59.595 <0.001*
Fair sleep (4-7)	32	49.2	23	35.4	19	29.2	30	46.2	28	43.1	28	43.1			
Good sleep (0-3)	8	12.3	5	7.7	5	7.7	12	18.5	28	43.1	35	53.8			
Total score (0-11) Mean ± SD.	6.66 ± 2.92		7.75 ± 2.69		8.05 ± 2.58		6.65 ± 2.99		4.45 ± 2.72		3.65 ± 2.27		U= 2090.50 0.918	U= 833.50 <0.001*	U= 467.50* <0.001*

χ^2: Chi square test **U:** Mann Whitney test ***:** Statistically significant at $p \leq 0.05$

<0.001*: highly statistically significant

Table (5): Correlation between total fatigue level and total sleep quality.

Variable	Correlation coefficient	Control group (n = 65)			Study group (n = 65)		
		Pre	1st Post	2nd Post	Pre	1st Post	2nd Post
Total fatigue level and total sleep quality	R	0.610	0.518	0.506	0.531	0.377	0.548
	P	<0.001*	<0.001*	<0.001*	<0.001*	0.002*	0.002*

r: Pearson coefficient *: Statistically significant at $p \leq 0.05$
<0.001*: highly statistically significant

Discussion

Colorectal cancer becoming more widespread all over the world. Chemotherapy can be used as a first-line or second-line treatment for colorectal cancer although it may be used alone or combined with other modalities. Chemotherapy-related side effects are common in CRC patients and significantly affect their health-related quality of life. Patients with colorectal cancer receiving chemotherapy frequently experience fatigue and sleep disturbance **(Jagieła et al., 2021).**

Efficient fatigue management may be essential for improving the quality of sleep and overall health of CRC patients and vice versa **(Legg et al., 2022).** Among non-pharmacological management, the progressive muscle relaxation technique has been the most widely used to control or alleviate chemotherapy side effects among cancer patients including Fatigue and sleep disturbances **(Tian et al., 2020).**

The results of the present study revealed that there were no statistically significant differences were noticed between the control and study groups about their demographic and clinical data. This indicates that there were no extraneous variables that affected the results. Further, there were no statistically significant differences between the control and study groups about their total fatigue score and total sleep quality score before PMRT. This might be due to the patients undergoing chemotherapy experienced side effects that can increase fatigue and sleep problems. Also, chemotherapy had interconnected alterations in muscle, neurotransmitters, neuroendocrine, immune, and cytokines that contribute to fatigue and sleep quality **(White, 2022).**

As regards total fatigue level score after PMRT, the current results showed that the total mean score of fatigue in the control group were increased, but in the study group the total mean score were decreased after performance of PMRT, with highly statistically significant differences between both groups in 1st and 2nd evaluations. From the researcher's point of view, any exercise performed regularly and under the supervision of a professionals reduces fatigue by helping the body regulate energy use. These results are consistent with the results of **(Loh et al., 2022)** who revealed that the fatigue levels of cancer participants who received PMR training were significantly lower than those of the participants in the control group at all time points.

This finding is also supported by a systematic review and meta-analysis conducted by **(Wang et al., 2024)** who reported that there was a highly significant difference in improving cancer-related fatigue and suggested that PMR may relieve cancer-related fatigue by improving progressive muscle atrophy and muscle metabolic disorders associated with cancer and its treatment. Additionally, **(Huddar et al., 2023)** found reduced fatigue levels in cancer survivors when assessed immediately and post five days after performing PMRT with a significant difference between the studied groups.

On the other hand, the finding of the current study is contradicted by the results of **(Genç & Oğuz, 2024)** who reported that there wasn't a statistically significant difference in fatigue levels pre and post-intervention and stated that PMRT was not an effective approach in decreasing chemotherapy-related fatigue in the study group patients with breast cancer and receiving chemotherapy. This

difference between the present study and the latter one may be related to the design of the intervention, duration, and frequency of relaxation, number of training sessions, tools used to measure sleep quality, sample size, inclusion, and exclusion criteria.

Regarding total sleep quality score after PMRT, that the total mean score of sleep quality in the control group were increased, but in the study group the total mean score were decreased after performance of PMRT, with highly statistically significant differences between both groups in 1st and 2nd evaluations. This finding may be explained by, the possibility of progressive muscle relaxation technique which improves the quality of sleep by ensuring muscular relaxation, promoting circulation, and relaxing the body. Also, this technique enables physical and mental relaxation and lowers the metabolic rate by decreasing sympathetic nervous system activities and increasing the parasympathetic nervous system **(Yona & Dahlia, 2020).** Furthermore, PMRT promotes the release of endorphins, which can help alleviate pain and fatigue, making it easier to transition into sleep **(Harorani, et al., 2020).**

These results were consistent with the study by **Sarı et al. (2024)** who found lower global sleep scores in the study group after performing PMRT among cancer patients undergoing chemotherapy. Similar results were found in studies conducted by **Wang et al., (2025)** marked lower sleep quality scores across all dimensions compared to the control group in postoperative colon cancer patients. Also, **Hakverir & Gündogdu, (2024)** exhibited a significantly lower global sleep score in the study group after performing PMRT when compared to the control group among hemodialysis patients and reported that exercises performed twice daily and for an extended period could yield more effective results on patients sleep quality. Further, the results were supported by **Kahreh et al., (2024)** who reported that the patients who practiced Jacobson relaxation technique could significantly improve their sleep quality score in the study about cancer patients undergoing chemotherapy.

As regards the correlation between total fatigue level and total sleep quality, the current study showed that there was a statistically significant positive correlation between the total fatigue level and total sleep quality before PMRT & in 1st and 2nd evaluations for patients in both groups. This could be explained by how fatigue and sleep disturbances interact with the Hypothalamic-Pituitary-Adrenal (HPA) axis, leading to disruptions in the body's natural circadian rhythm. As a result, cancer functions as a stressor on the HPA axis, causing consistently elevated cortisol levels rather than the normal fluctuations that occur with morning peaks and nighttime lows. As cortisol plays a critical role in regulating the sleep-wake cycle, persistently elevated levels particularly during the evening may impair sleep initiation and contribute to increased nighttime fatigue **(Dean, 2022).**

As a result, it makes sense that there would be a correlation between fatigue and sleep quality since fatigued participants have trouble falling asleep, which lowers the quality of their sleep, particularly in healthcare environments. Another explanation for this finding could be that less fatigue leads to better sleep quality.

This finding was supported by **Rajendran et al., (2020)** Who reported that there was a significant positive fair correlation between sleep quality index score and fatigue score. Additionally, the results of **Kılıç & Parlar Kılıç, (2023)** reported that after performing PMRT the total score of the sleep quality and the fatigue score decreased among rheumatoid arthritis patients in the intervention group. Also, supported by **Legg et al., (2022)** who stated that there was a significant association between worse sleep quality and worse fatigue in CRC participants, and added that sleep quality had positive correlations with fatigue in cancer patients.

Hence, notable effect of PMRT on fatigue and sleep problems among colorectal cancer patients undergoing chemotherapy. Oncology nurses should have an important role in assessing, planning, and implementing effective methods of PMRT after creating a body of knowledge about PMRT, and using it in practice to achieve desired outcomes for cancer patients.

Limitations of the study:

- Some difficulties were encountered by the researcher during the process of data collection where some patients coming after more than two weeks due to their medical status. So, sessions couldn't be on the same schedule and were excluded from the study.
- Five patients in the study group neglected to complete the technique at home. So, they were excluded from the study subjects.

Conclusion

Based on the study findings it can be concluded that colorectal cancer patients undergoing chemotherapy who practiced progressive muscle relaxation technique have decreased fatigue level and improved sleep quality than those who received only routine nursing care as the total fatigue level and total sleep quality score were decreased in 1st and 2nd evaluations than before PMRT. Also, the correlation between the total fatigue level and total sleep quality was statistically significant in pre, 1st and 2nd evaluations.

Recommendations

Based on the findings of the current study the following recommendations can be suggested:

- **Recommendation for patients:**
- Conducting on-going practical sessions about how to re-demonstrate PMRT for cancer patients with illustrated booklets and media for clarification of the technique.
- **Recommendation for nurses:**
- Progressive muscle relaxation should be incorporated into the routine nursing care for CRC patients undergoing chemotherapy
- **Recommendations for administration:**
- Ongoing regular in-service training programs should be provided for all nurses in oncology departments about the benefits, demonstration, and utilization of PMRT.
- Availability of manual instruction of PMRT should be provided for all nurses and all patients in the oncology department.

- **Recommendations for further studies:**
- Replication of the present study under different circumstances with large sample and other setting is recommended to validate the results and greater generalization of the results.
- Exploration of the effect of PMRT on the management of the different

cancer treatment side effects such as peripheral neuropathy, pain, anxiety, and dyspnea.

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