

Original

Assessment of Sleep Quality Improvement Associated with Simple Progressive Muscle Relaxation in Patients with Cancer

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Abstract

Purpose: Approximately 30-70% of patients with cancer reportedly experience insomnia-induced pain. Progressive muscle relaxation (PMR) is a widely used relaxation technique to help people experiencing insomnia. However, PMR involves an added burden for patients with cancer as their disease progresses. Therefore, the authors created a simple PMR. This study assessed improvement in sleep quality associated with simple PMR for patients with cancer.

Methods: Patients with cancer hospitalized for treatment underwent one day of intervention with PMR and one control day. The measurement indicators were the Japanese version of the Pittsburgh Sleep Quality Index, the Oguri-Shirakawa-Azumi Sleep Inventory MA Version (OSA), and interviews.

Results: The analysis included ten participants with a mean age of 58 years. Scores for OSA sleepiness on rising ($P=0.003$) and sleep initiation/maintenance ($P=0.012$) differed significantly between the PMR and control days. A content analysis of the interview recordings extracted four major classifications, such as “my sleep quality improved” and “my sleep quantity improved.”

Conclusions: The results suggest that even a single session of simple PMR may improve sleep in patients with cancer, such as with falling asleep and maintaining sleep.

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1. Introduction

In 2019, approximately 17 million people worldwide were newly diagnosed with cancer, which has increased annually.¹ Many patients with cancer experience mental and physical pain,² including pain induced by insomnia,³⁻⁵ which affects 30-70% of patients with cancer.⁶⁻¹¹ Chronic, persistent insomnia triggers malaise^{8,12} and reduces the patient's quality of life (QOL).^{13,14} Further, insomnia has been linked to depression,^{9,15} anxiety,⁷ and reduced immunity.¹⁵ Therefore, helping patients with cancer obtain good-quality sleep is crucial for maintaining and improving their QOL.

Progressive muscle relaxation (PMR), developed by Dr. Edmund Jacobson, is a relaxation technique that combines repeated, systematic tension and relaxation of muscles with breathing techniques.¹⁶ Bernstein and Borkovec combined the 108 muscles and muscle groups of Jacobson's technique and reduced it to 16, making it more usable.¹⁶ The 16-muscle PMR technique developed by Bernstein and Borkovec is widely used.¹⁶

Multiple studies have demonstrated that PMR is effective for improving pain,¹⁷ nausea and/or vomiting,¹⁸⁻²⁰ fatigue,²¹ anxiety,²²⁻²⁴ depression,²⁴ and QOL^{22,23} among patients with cancer. The sleep-related effects of PMR have been identified in studies conducted with patients who have undergone lung resection,²⁵ those with chronic obstructive pulmonary disease,²⁶ those with cancer undergoing chemotherapy,²⁷ pregnant women,²⁸ and healthy individuals.²⁹ Other studies have combined PMR for patients with cancer with other techniques, such

as cognitive behavioral therapy.³⁰⁻³³ However, the 16-muscle PMR involves an added burden for patients with cancer as their disease progresses.³⁴ Therefore, the authors created a simple 7-muscle PMR,³⁵ its effects on sleep in patients with cancer have not been clarified.

PMR is simple to learn and provides an easy feeling of relaxation.¹⁶ Therefore, assessing PMR-associated improvement in sleep quality among patients with cancer could lead to the application of PMR for patients with cancer suffering from insomnia. This could help maintain or improve their QOL. Thus, this study assessed improvement in sleep quality associated with simple PMR for patients with cancer.

2. Methods

2.1. Participants

2.1.1. Inclusion criteria

Participants comprised Japanese patients aged ≥ 20 years who were hospitalized in departments of gastroenterological surgery or radiology. They had obtained permission from their attending physician and head ward nurse to participate. Further, they had been notified of having cancer, insomnia, stable physical symptoms, and a stable mental state. Additionally, they self-reported having the required strength and desire to perform PMR.

2.1.2. Participant selection procedure

2.1.2.1. Head ward nurses were asked to list patients who met the inclusion criteria. Permission to undergo the study intervention was granted by attending physicians via the head ward nurses.

2.1.2.2. A ward nurse who was not a researcher was asked to confirm the participant's intention to receive an explanation of the study.

2.1.2.3. If a participant granted permission to receive an explanation of the study, a researcher visited the participant and explained the study using a form. If the participant provided consent, the participant signed a consent form and was enrolled as a study participant. The researcher also confirmed that the participant met the inclusion criteria.

2.2. Data collection period

We collected data from August to November 2021.

2.3. Intervention procedure (see Fig. 1)

2.3.1. Participants were assigned to Group A or B in the order they provided consent. Group A underwent one PMR day followed by one control day. Group B underwent one control day followed by one PMR day. There was only one simple PMR intervention for patients with cancer because previous research³⁴ indicated that it is difficult for patients with cancer to continue PMR for 30 minutes. The reasons for this include disease progression and treatment side effects. Therefore, a single, 15-minute intervention was considered to lead to clinical use as the intervention potentially improved sleep.

	Day 1	Day 2	Day 3
(Assignment)			
Group A	●	○	
Group B	○	●	
(Instruments)			
PSQI	◎		
OSA (the following morning)		◎	◎
Semi-structured interview			◎

Fig. 1 Study protocol

●: PMR day, ○: Control day, ◎: Assessment day

PMR: Progressive Muscle Relaxation

PSQI: The Japanese version of Pittsburgh Sleep Quality Index

OSA: OSA sleep inventory MA version

2.3.2. On the first day of the study, researchers explained to participants the PMR procedure, how it is performed, and key points, followed by a PMR demonstration. Participants assumed a supine position in bed and performed PMR with a portable CD player (with earphones). PMR was performed according to a simplified PMR CD created by the authors (Prem Promotions Inc., Tokyo, Japan).³⁵ PMR involves a method that repeats the tension and relaxation of the skeletal muscles of 16 muscle groups (forearms/upper arms, lower legs/thighs, buttocks, lower back, abdomen, chest, shoulders, neck [back neck, right neck, left neck, front neck], face [forehead/around the eyes/mandible]). The duration of method is approximately 30 minutes.¹⁶ However, the simple PMR created by the authors repeats the tension and relaxation of the skeletal muscles of seven muscle groups (forearms/upper arms, lower legs/thighs, chest, shoulders, face [forehead/around the eyes/mandible]). It takes approximately 15 minutes. The 7-muscle PMR content and procedure were as follows: breathing techniques → muscle tension and relaxation (forearms/upper arms, lower legs/thighs, chest, shoulders, face [forehead/around the eyes/mandible]) → breathing techniques.

2.3.3. PMR was performed for approximately 15 minutes during the one-hour period, ranging from at least one hour after dinner to bedtime (7:30-8:30 PM).

2.3.4. Participants who were using hypnotics were told to continue taking them as normal.

2.4. Instruments

2.4.1. Basic participant characteristics

Through interviews with patients with cancer, we obtained information regarding their sex, age, diagnosis, major symptoms, treatment, and medication.

2.4.2. Japanese version of the Pittsburgh Sleep Quality Index

The Japanese version of the Pittsburgh Sleep Quality Index (PSQI)—a Japanese translation of a questionnaire developed and standardized at the University of Pittsburgh to assess sleep quality—has been proved to be

reliable (Cronbach's $\alpha=0.77$) and valid.^{36,37} The PSQI comprises 18 questions about sleep habits and quality in the previous month assessed with a Likert scale. The index comprises seven factors: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction. Each factor is scored from 0 to 3, with these scores summed to yield a total PSQI score of 0-21. A higher score represents more disordered sleep.

2.4.3. Oguri-Shirakawa-Azumi Sleep Inventory MA Version

The Oguri-Shirakawa-Azumi Sleep Inventory MA Version (OSA sleep inventory MA version; OSA), developed by Yamamoto, Tanaka, Takase, Yamazaki, Azumi and Shirakawa,³⁸ is a subjective scale measuring the sense of sleep. It assesses introspection regarding sleep upon waking, primarily among middle-aged and older adults. The inventory comprises 16 questions across five factors: four questions on sleepiness on rising; five questions on sleep initiation/maintenance; two questions on frequent dreaming; three questions on refreshment; two questions on sleep duration.³⁸ Questions for each of these five factors are assessed on a four-point Likert scale. With permission from Shirakawa,³⁸ we used an OSA sleep introspection score conversion sheet to score the questions. A higher score represents a better sense of sleep.

2.4.4. Interview guide-based semi-structured interviews (opinions regarding the effects of PMR on sleep)

On the final day of the study, interviews were conducted based on an interview guide for roughly 10-15 minutes. The interview guide included content such as physical condition, feelings, and sleep status before and after PMR. Interviews were recorded with a digital voice recorder with the participants' permission.

2.5. Measurement timing and frequency

The measurements were implemented as follows. First, the PSQI was conducted once on the first day of the study. Second, the OSA was conducted twice—the mornings following the PMR and control days, respectively. Finally, semi-structured interviews were conducted once on the third day of the study.

2.6. Analysis

For the PSQI, scores for the individual factors of sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbance, use of sleeping medication, and daytime dysfunction (0-3 each) were added to yield a total PSQI score. For the OSA scores, the PMR and control days were compared via a Mann-Whitney U test. Statistical analysis was performed with IBM SPSS Statistics ver. 26.0, with $p < 0.05$ considered significant.

Verbatim interview transcripts were analyzed via content analysis. These verbatim transcripts were used to identify contexts that described the effects of PMR on sleep; these contexts were defined as record units. If a single context contained words describing different

effects, these effects were divided by type, and the context was treated as multiple record units. Moreover, codes were created to avoid changing the meanings of the record units. The abstraction levels of the coded record units were increased based on similarities in their meanings. Subsequently, the coded record units were classified. Throughout the analysis process, the collaborators discussed their analyses until they reached a consensus to ensure reliability.

2.7. Ethical considerations

This study was conducted with the approval of the Gunma University Institutional Review Board (Approval No. HS2018-258). Participants received written and oral explanations of the import and methods of the study, including the following: the voluntary nature of their participation and their freedom to withdraw during the study; anonymization of data obtained in the study; protection of privacy; the possibility of obtaining a sense of relaxation from participating in the study; potential disadvantages and methods for dealing with them should they arise. The intervention was performed after the participants had signed the consent form.

3. Results

3.1. Participant characteristics (see Table 1)

Out of a total of 12 individuals, two withdrew from the study due to feeling unwell. Thus, 10 participants were involved in the final analysis—five men and five women, with a mean age of 58.0 years (standard deviation=13.2 years). Symptoms included pain and nausea in five and two participants, respectively. Treatment comprised radiotherapy for six participants, chemotherapy for two participants, and chemoradiotherapy for two participants. Of the 10 participants, seven had a total PSQI score of seven or greater and had a poor sleep assessment (cases A, B, C, D, F, G, and I). The PSQI total score was highest in case I, who experienced nausea during chemoradiotherapy, followed by case B, who experienced pain during radiation therapy, and case F, who was undergoing chemotherapy.

3.2. Assessments of sleep

3.2.1. OSA scores (see Table 2)

Sleepiness on rising ($p=0.003$) and sleep initiation/maintenance ($p=0.012$) differed significantly between the PMR and control days.

3.2.2. Interview results and participants' opinions of the effects of PMR on sleep (see Table 3)

Content analysis yielded 51 record units, 44 codes, 10 minor classifications, and 4 major classifications. The four major classifications were as follows: "my sleep quality improved"; "my sleep quantity improved"; "I have a sense of mental and physical calmness"; "PMR does not seem to affect my sleep."

Table 1 Participant characteristics

Case	Gender	Diagnosis	Symptoms	Treatment	PSQI total score
A	Male	Prostate cancer	None	Radiotherapy	7
B	Female	Colorectal cancer	Pain	Radiotherapy	14
C	Female	Cholangiocarcinoma	Pain	Chemotherapy	7
D	Male	Esophageal cancer	Pain	Radiotherapy	9
E	Female	Cervical cancer	Nausea	Chemoradiotherapy	4
F	Female	Pancreatic cancer	None	Chemotherapy	12
G	Male	Pharyngeal cancer	Pain	Radiotherapy	9
H	Male	Pelvic chondrosarcoma	Pain	Radiotherapy	3
I	Female	Cervical cancer	Nausea	Chemoradiotherapy	17
J	Male	Colorectal cancer	Numbness	Radiotherapy	4

PSQI: Japanese version of Pittsburgh Sleep Quality Index

Table 2 OSA scores on the PMR day and the control day

	PMR day n=10 Median (range)	Control day n=10 Median (range)	P Value
Sleepiness on rising	21.0 (10–35)	15.0 (0–29)	0.003 **
Sleep initiation/maintenance	18.0 (0–32)	11.0 (0–32)	0.012 *
Frequent dreaming	29.0 (8–32)	23.5 (8–32)	0.355
Refreshment	21.5 (11–34)	21.0 (0–34)	0.082
Sleep duration	20.0 (9–34)	20.0 (0–34)	0.925

OSA: OSA sleep inventory MA version PMR: Progressive Muscle Relaxation ** $P < 0.01$. * $P < 0.05$.
The Mann-Whitney U test was used.

Table 3 Participants' opinions of the effects of PMR on sleep

Number of codes (), n=10

Major classification	Minor classification	Examples of participants' opinions
My sleep quality improved (21)	I can fall asleep easily	I went to bed right away. I was watching TV, and it was 9:00 PM. I think I fell asleep before 10:00 PM. (Case: E)
	I have a deep sleep	I feel like I slept rather soundly yesterday. (Case: F)
	I feel refreshed when I wake up	I slept well and thought, 'Oh, I'm up', so I feel like I woke up feeling pretty good. (Case: E)
My sleep quantity improved (7)	I feel extended sleep	I usually wake up before 4:00 AM, but I slept until about 5:00, so I felt like even 1 hour makes a difference. (Case: I)
	I wake up less frequently during the night	I usually go to the bathroom more often, but I felt like I didn't go as many times. (Case: B)
I have a sense of mental and physical calmness (9)	I feel relaxed	I felt more relaxed than usual. (Case: G)
	I feel comfortable	I feel like my body has been a little less tense. (Case: F)
	My body feels warm	My body felt warm. Normally, I am always oversensitive to the cold. That's why I felt that my blood circulation was good. (Case: C)
PMR does not seem to affect my sleep (7)	I feel no change in sleep	To be honest, I don't think I fell asleep much differently from usual. (Case: G)
	I don't know whether PMR will help me sleep if I only do it once	

PMR: Progressive Muscle Relaxation

4. Discussion

4.1. Assessment of sleep in patients with cancer

The participants' total PSQI score at baseline was 3–17, signifying that they assessed their sleep quality as poor. This result aligns with the previous finding that patients with cancer have poor sleep quality.^{8,11} Previous studies have also found that sleep disorder in patients with cancer is affected by chemotherapy,^{4,5} radiotherapy,⁶ and symptoms such as pain.¹¹ This study's participants were affected by radiotherapy and chemotherapy and experienced symptoms such as pain. The study's findings suggest that the participants' poor assessments of their sleep quality were affected by their treatment and symp-

toms.

4.2. Assessments of the effects of simple PMR on sleep in patients with cancer

Scores for the OSA factors of sleepiness on rising and sleep initiation/maintenance were significantly higher on the PMR day than on the control day. Further, participants provided the following positive opinions regarding the effects of PMR on sleep: "My sleep quality improved"; "My sleep quantity improved"; "I have a sense of mental and physical calmness." These results were similar to previous studies indicating that sleep disorder improved following PMR.^{21,27} Other studies have demonstrated that systolic blood pressure, diastolic blood

pressure, and heart rate decreased following PMR.^{19,39} PMR provides a sense of relaxation through the repeated intentional tensing and relaxing of skeletal muscles.¹⁶ The improvement in sleep quality observed in this study was likely due to a state of parasympathetic dominance. Additionally, the PMR CD which we created and used in the intervention was a simplified version of a PMR session that lasted only 15 minutes (Prem Promotions Inc., Tokyo, Japan). Nevertheless, even simplified PMR was found to improve sleep quality for patients with cancer.

However, as seen in the major classification (“PMR does not seem to affect my sleep”) and its minor classifications (“I feel no change in sleep” and “I don’t know whether PMR will help me sleep if I only do it once”), participants also voiced negative opinions. Case G stated that, after implementing PMR, “[He] felt more relaxed than usual” but that “To be honest, [he does not] think [he] fell asleep much differently from usual.” They did not feel the effects of PMR on sleep. Previous studies reported that sleep quality improved when PMR was performed for five days²⁷ or three months.²¹ The lack of effects on sleep may have been at least partially due to the brevity of the PMR intervention time.

4.3. Nursing support with PMR to improve sleep quality in patients with cancer

Patients with cancer experience physical, mental, social, and spiritual anguish,³ causing them immense stress.⁴⁰ Consequently, patients with cancer are presumed to be in a state of tension in which the sympathetic nervous system is constantly predominant.

In our study, participants performed PMR only once for roughly 15 minutes. However, even with only this simple PMR intervention, patients with cancer gave scores on sleepiness on rising and sleep initiation/maintenance that were significantly higher on the PMR day than after the control day. Moreover, the participants voiced affirmative opinions: “My sleep quality improved” and “My sleep quantity improved.” Cases B and I, whose PSQI total scores were particularly high and sleep assessments were poor, also expressed that their sleep quantity improved.

These results suggest that the application of PMR can improve sleep quality for patients with cancer who are troubled by insomnia. Another affirmative opinion voiced by participants was “I have a sense of mental and physical calmness.” Cases F, whose PSQI total scores were high and sleep assessments were poor, stated as follows: “I feel like my body has been a little less tense.” This opinion suggests that PMR gives patients with cancer a sense of relaxation. By incorporating PMR sessions into their lives, patients with cancer may reduce their tension and sleep better.

Nevertheless, participants also voiced a negative opinion: PMR does not seem to affect my sleep. Performing PMR daily can provide a relaxation response.¹⁶ This finding suggests that obtaining sleep-related effects from PMR requires patients with cancer to practice it consistently. However, PMR involves an added burden for patients with cancer as their disease progresses.³⁴

Enabling patients with cancer to continue PMR by reducing their burden may require developing PMR techniques that can be performed within a short period.

5. Conclusion

This study assessed improvements in sleep quality associated with simple PMR for patients with cancer. Patients with cancer had poor sleep ratings before the intervention. OSA sleepiness on rising ($P = 0.003$) and sleep initiation/maintenance ($p = 0.012$) significantly improved with just one PMR session. The interview survey also revealed additional effects of PMR. The results suggest that even a single session of simple PMR may improve sleep, such as falling asleep and maintaining sleep, in patients with cancer. This study will help establish a simple and sustainable PMR technique in clinical practice.

6. Study limitations and future research directions

This study’s small sample size and the absence of a washout period may prevent its results from being generalizable. Future studies should include larger sample sizes and establish a washout period to enable a proper assessment of the effects of PMR on sleep in patients with cancer.

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Declaration of Competing Interest

The authors declare no conflict of interest.

References

1. Global Burden of Disease 2019/Cancer Collaboration. Cancer incidence, mortality, years of life lost, years lived with disability, and disability-adjusted life years for 29 cancer groups from 2010 to 2019: A systematic analysis for the global burden of disease Study 2019. *JAMA oncology* 2022; 8: 420-444.
2. Dong ST, Butow PN, Costa DS, et al. Symptom clusters in patients with advanced cancer: a systematic review of observational studies. *J Pain Symptom Manage* 2014; 48: 411-450.
3. Hsu HT, Lin KC, Wu LM, et al. Symptom cluster trajectories during chemotherapy in breast cancer outpatients. *J Pain Symptom Manage* 2017; 53: 1017-1025.
4. Kuo HH, Chiu MJ, Liao WC, et al. Quality of sleep and related factors during chemotherapy in patients with stage I/II breast cancer. *J Formos Med Assoc* 2006; 105: 64-69.
5. Liu L, Fiorentino L, Natarajan L, et al. Pretreatment symptom cluster in breast cancer patients is associated with worse

- sleep, fatigue and depression during chemotherapy. *Psychooncology* 2009; 18: 187-194.
6. Savard J, Ivers H, Savard MH, Morin CM. Cancer treatments and their side effects are associated with aggravation of insomnia: results of a longitudinal study. *Cancer* 2015; 121: 1703-1711.
 7. Gibbins J, McCoubrie R, Kendrick AH, et al. Sleep-wake disturbances in patients with advanced cancer and their family carers. *J Pain Symptom Manage* 2009; 38: 860-870.
 8. Humpel N, Iverson DC. Sleep quality, fatigue and physical activity following a cancer diagnosis. *Eur J Cancer Care* 2010; 19: 761-768.
 9. Mansano-Schlosser TC, Ceolim MF, Valerio TD. Poor sleep quality, depression and hope before breast cancer surgery. *Appl Nurs Res* 2017; 34: 7-11.
 10. Al Maqbali M, Al Sinani M, Alsayed A, et al. Prevalence of sleep disturbance in patients with cancer: A systematic review and meta-analysis. *Clin Nurs Res* 2022; 31: 1107-1123.
 11. Savard J, Morin C. Insomnia in the context of cancer: a review of a neglected problem. *J Clin Oncol* 2001; 19: 895-908.
 12. Beck SL, Dudley WN, Barsevick A. Pain, sleep disturbance, and fatigue in patients with cancer using a mediation model to test a symptom cluster. *Oncol Nurs Forum* 2005; 32: 542-E48-E55.
 13. Brian DG, Qian L. Sleep disturbance among Chinese breast cancer survivors living in the USA. *Support Care Cancer* 2018; 26: 1695-1698.
 14. Jong ND, Couetens AM, Abu-Saad HH, et al. Fatigue in patients with breast cancer receiving adjuvant chemotherapy: a review of the literature. *Cancer Nurs* 2002; 25: 283-297.
 15. Irwin M, Smith TL, Gillin JC. Electroencephalographic sleep and natural killer activity in depressed patients and control subjects. *Psychosom Med* 1992; 54: 10-21.
 16. Snyder M, Pestka E, Bly C. Progressive Muscle Relaxation. In: Snyder M, Lindquist R (eds). *Complementary / Alternative Therapies in Nursing* 4th ed. New York: Springer Publishing Company, 2002: 310-319.
 17. Kwekkeboom KL, Wanta B, Bumpus M. Individual difference variables and the effects of progressive muscle relaxation and analgesic imagery interventions on cancer pain. *Journal Pain Symptom Manage* 2008; 36: 604-615.
 18. Molassiotis A. A pilot study of the use of progressive muscle relaxation training in the management of post-chemotherapy nausea and vomiting. *Eur J Cancer Care* 2000; 9: 230-234.
 19. Molassiotis A, Yung HP, Yam BMC, et al. The effectiveness of progressive muscle relaxation training in managing chemotherapy-induced nausea and vomiting in chinese breast cancer patients: a randomised controlled trial. *Support Cancer Care* 2002; 10: 237-246.
 20. Tian X, Tang RY, Xu LL, et al. Progressive muscle relaxation is effective in preventing and alleviating of chemotherapy-induced nausea and vomiting among cancer patients: A systematic review of six randomized controlled trials. *Support Care Cancer* 2020; 28: 4051-4058.
 21. Demiralp M, Oflaz F, Komuruc S. Effects of relaxation training on sleep quality and fatigue in patients with breast cancer undergoing adjuvant chemotherapy. *J Clin Nurs* 2010; 19: 1073-1083.
 22. Cheung YL, Molassiotis A, Chang AM. A pilot study on the effect of progressive muscle relaxation training of patients after stoma surgery. *Eur J Cancer Care* 2001; 10: 107-114.
 23. Cheung YL, Molassiotis A, Chang AM. The effect of progressive muscle relaxation training on anxiety and quality of life after stoma surgery in colorectal cancer patients. *Psychooncology* 2003; 12: 254-266.
 24. Sloman R. Relaxation and imagery for anxiety and depression control in community patients with advanced cancer. *Cancer Nurs* 2002; 25: 432-435.
 25. Aksu NT, Erdogan A, Ozgur N. Effects of progressive muscle relaxation training on sleep and quality of life in patients with pulmonary resection. *Sleep Breath* 2018; 22: 695-702.
 26. Chegeni PS, Gholami M, Azargoon A, et al. The effect of progressive muscle relaxation on the management of fatigue and quality of sleep in patients with chronic obstructive pulmonary disease: A randomized controlled clinical trial. *Complement Ther Clin Pract* 2018; 31: 64-70.
 27. Harorani M, Davodabady F, Farahani Z, et al. The effect of Benson's relaxation response on sleep quality and anorexia in cancer patients undergoing chemotherapy: A randomized controlled trial. *Complement Ther Med* 2020; 50:102344.
 28. Tan XYJ, Choong SYX, Cheng LJ, et al. Relaxation interventions for improving sleep outcomes in perinatal women: A systematic review and meta-analysis of randomized controlled trials. *Midwifery* 2021; 103:103151.
 29. Means MK, Lichstein KL, Epperson MT, et al. Relaxation therapy for insomnia: nighttime and day time effects. *Behav Res Ther* 2000; 38: 665-678.
 30. Kwekkeboom KL, Abbott-Anderson K, Wanta B. Feasibility of a patient-controlled cognitive-behavioral intervention for pain, fatigue, and sleep disturbance in cancer. *Oncol Nurs Forum* 2010; 37: E151-159.
 31. Kwekkeboom KL, Abbott-Anderson K, Cherwin C, et al. Pilot randomized controlled trial of a patient-controlled cognitive-behavioral intervention for the pain, fatigue, and sleep disturbance symptom cluster in cancer. *J Pain Symptom Manage* 2012; 44: 810-822.
 32. Rumble ME, Keefe FJ, Edinger JD, et al. A pilot study investigating the utility of the cognitive-behavioral model of insomnia in early stage lung cancer patients. *J Pain Symptom Manage* 2005; 30: 160-169.
 33. Smeit R, Deck R, Conta-Marx B. Sleep management training for cancer patients with insomnia. *Support Care Cancer* 2004; 12: 176-183.
 34. Kondo Y, Koitabashi K, Kaneko Y. Experiences of difficulty that patients with cancer faced in the learning process of progressive muscle relaxation. *Jpn J Nurs Sci* 2009; 6: 123-132.
 35. Kondo Y, Koitabashi K, Kaneko Y, et al. Development of simplified progressive muscle relaxation method and efficacy of its application to Cancer Patient. *J Jpn Soc Nurs Res* 2011; 34: 87-93 (in Japanese).
 36. Doi Y, Minowa M, Uchiyama M, et al. Psychometric assessment of subjective sleep quality using the Japanese version of the Pittsburgh Sleep Quality Index (PSQI-J) in psychiatric disordered and control subjects. *Psychiatry Res* 2000; 97: 165-172.
 37. Doi Y, Minowa M, Okawa M, et al. Development of the Japanese version of the Pittsburgh Sleep Quality Index. *Jpn J Psych Treatm* 1998; 13: 755-763 (in Japanese).
 38. Yamamoto Y, Tanaka H, Takase M, et al. Standardization of revised version of OSA sleep inventory for middle age and aged. *Brain Science and Mental Disorders* 1999; 10: 401-409 (in Japanese).
 39. Kim KJ, Na YK, Hong HS. Effects of progressive muscle relaxation therapy in colorectal cancer patients. *West J Nurs Res* 2016; 38: 959-973.
 40. Stacker T, Kober KM, Dunn L, et al. Associations between demographic, clinical, and symptom characteristics and stress in oncology patients receiving chemotherapy. *Cancer Nurs* 2023; 46: E62-E69.