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The Effect of Light on Quality of Sleep and Life in Breast Cancer Patients

Meme Kanseri Hastalarında Işığın Uyku ve Yaşam Kalitesine Etkisi

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Abstract

Objective: This study conducted to evaluate the effect of white spectrum light on sleep and life quality in breast cancer patients who received radiotherapy.

Materials and Methods: The sample of this randomized controlled study consisted of patients with low sleep quality who did not report pain, fatigue, depression and anxiety. Research data were collected using by Individual Identification Feature Form, Sleep and Light Application Follow up Form, Beck Depression scale, Beck Anxiety scale, The European Organization for Research and Treatment of Cancer Quality-of-Life Questionnaire (EORTC QLQ) C-30, Pittsburg Sleep Quality index (PSQI) and Numerical Pain Rating scale. Patients who met the sampling selection criteria (n=23) were randomized in to the intervention and control groups. The control group patients were rested while the intervention group was applied to 10.000 lux white light/30 min/day in a week. Sleep and life quality of both groups of patients were assessed twice as before the radiotherapy and on the eighth day of radiotherapy.

Results: The mean PSQI score of both groups was greater than five points at the first assessment performed before radiotherapy, on the eighth day of radiotherapy it was below five points. In the second assessment intervention group's PSQI mean score was lower compared with the control group [(intervention group=5.0±2.32, control group=6.50±3.26), (U=85.000, p=0.260)]. In the study, while the EORTC QLQ C-30 functional subscale score increased in the second assessment according to the first assessment in the intervention and control groups, the symptom subscale score decreased and there was no change in the global health score.

Conclusion: In this study, it was determined that white light does not affect on sleep and quality of life in patients with breast cancer who received radiotherapy.

Keywords: Radiotherapy, sleep quality, quality of life, bright white light

Öz

Amaç: Bu araştırma radyoterapi uygulanan meme kanserli hastalarda beyaz ışığın uyku ve yaşam kalitesine etkisini değerlendirmek amacıyla yapıldı.

Gereç ve Yöntem: Randomize-kontrollü bu araştırmanın örneklemini ağrı, yorgunluk, depresyon ve anksiyete bildirmeyen, uyku kalitesi düşük hastalar oluşturdu. Araştırma verileri; Birey Tanıtıcı Özellikler Formu, Uyku ve Işık Uygulama Takip Formu, Beck Depresyon ölçeği, Beck Anksiyete ölçeği, Avrupa Kanser Araştırma ve Tedavi Organizasyonu Yaşam Kalitesi Anketi (EORTC QLQ) C-30, Pittsburgh Uyku Kalitesi indeksi (PUKI), Sayısal Ağrı Değerlendirme skalası kullanılarak toplandı. Örneklem seçim ölçütlerine uyan hastalar (n=23) uygulama ve kontrol gruplarına randomizasyonu yapıldı. Uygulama grubuna 10,000 lux beyaz ışık/30 dakika/gün bir hafta süresince uygulanırken, kontrol grubunun istirahatı sağlandı. Her iki grup hastanın uyku ve yaşam kalitesi radyoterapiden önce ve radyoterapinin 8. gününde iki kez değerlendirildi.

Bulgular: Radyoterapiye başlamadan önce ilk değerlendirmede her iki grubun ortalama PUKI puanı beşin üzerindeyken, radyoterapinin sekizinci gününde beş puanın altındaydı. İkinci değerlendirmede uygulama grubunun PUKI ortalama puanı kontrol grubuna göre daha düşüktü [(uygulama grubu=5,0±2,32, kontrol grubu=6,50±3,26), (U=85,000, p=0,260)]. Araştırmada uygulama ve kontrol gruplarında birinci değerlendirmeye göre ikinci değerlendirmede EORTC QLQ C-30 fonksiyonel alt boyut skoru artarken, semptom alt boyut skoru düştü, global sağlık skorunda bir değişiklik olmadı.

Sonuç: Bu araştırmada radyoterapi uygulanan meme kanserli hastalarda beyaz ışığın uyku ve yaşam kalitesine etkisinin olmadığı belirlendi.

Anahtar Kelimeler: Radyoterapi, uyku kalitesi, yaşam kalitesi, parlak beyaz ışık

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Introduction

Cancer is a leading cause of morbidity and mortality worldwide, with substantial and growing financial and quality of life burden for patients, their families, and society (1). Cancer and its treatments can negatively impact patients and their relatives on multiple physical, psychosocial and emotional dimensions of well-being and overall quality of life as patients experience treatment-induced toxicities such as neurocognitive dysfunction, fatigue, pain, and sleep impairments (1,2). Approximately one-third of cancer patients experience sleep disturbances caused by pain, anxiety, hot flashes, night sweats, gastrointestinal and genitourinary changes, breathing problems, fatigue, the psychological impact of the malignancy, treatments, and hospitalization (3-6). Sleep disturbances were significantly more common and more severe among long-term breast cancer survivors (65%) compared to women without cancer (7).

Alterations in sleep patterns are endemic among cancer patients, yet sleep problems are rarely assessed in a typical patient evaluation (4). Sleep deprivation is associated with a decline in cognitive function, inability to engage in work or recreational activities, loss of hedonic capacity, alterations to immune and neuroendocrine function, and a sharp decline in the quality of life (3,4). Therefore, it is recommended that healthcare professionals should comprehensively assess sleep patterns in patients (6). Pharmacological, cognitive-behavioral therapies, physiological/circadian therapies, stimulus control and sleep hygiene, are included in the management of sleep disorders in cancer patients (4,6,8-11).

Exposure to bright white light suppresses the production of melatonin and helps regulate circadian rhythms (12). Therefore, afternoon or evening melatonin administration is expected to shift circadian rhythms to an earlier time, thus, correcting a pathological phase delay (13). Previous studies suggested that bright white light reduces sleep disruption and waking up early, shortens the transition phase from light to deep sleep, and reduces the number of naps in a day (10,14). Akyar and Akdemir (15) found that a 10.000 lux light therapy had a positive impact on the sleep quality in older patients. Neikrug et al. (16) suggested that morning administration of bright white light may protect women from experiencing circadian rhythm deterioration during chemotherapy. Therefore, sleep disorders cause many problems in oncology patients, which should be assessed and cured. Healthcare professionals, particularly nurses, can use light as a non-pharmacological intervention to reduce sleep disorders in oncology patients and help them sleep better. This study aims to determine the impact of light on sleep quality and quality of life in breast cancer patients as a non-pharmacological method with fewer side effects and lower costs.

Materials and Methods

Study Design

This is a randomized, controlled intervention study to assess the effect of bright white light on sleep and quality of life in breast cancer patients who received radiotherapy.

Study Setting and Population

This study was conducted in the Radiation Oncology Center of a Hospital in Eskişehir between November 1, 2016 and September 30, 2017. The research universe consisted of breast cancer patients who received radiotherapy in the radiation oncology service during the research period. The study sample included patients who met the inclusion criteria within the study universe.

Inclusion criteria: This criterion included patients between 18 and 74 years of age who could read and write, were conscious, did no night shift work, and had bad sleep quality [the Pittsburg Sleep Quality index (PSQI) score was more than 5]. These patients did not report any pain (0 points on the Numerical Pain Assessment scale), fatigue, depression (less than 13 points on the Beck Depression inventory), and anxiety (less than 8 points from the Beck Anxiety inventory). Moreover, these patients did not perceive light, had natural/contact lens and did not any change their medication protocol within the last three months.

Outcome Measures

Research data was collected at two-time points (on the first day of the radiotherapy and the eighth day of the radiotherapy) using observation, interview, and assessment methods. The personal introduction form, sleep, and light monitoring form, Beck Depression inventory, Beck Anxiety inventory, The European Organization for Research and Treatment of Cancer Quality-of-Life Questionnaire-30 (EORTC QLQ C-30), the PSQI, the Numeric Pain Assessment scale, light source, and a lux meter were used to collect data.

Personal introduction form: This form was prepared based on literature, which includes patients' socio-demographic characteristics, information regarding disease and its treatment (3,5,6,14,15,17).

Sleep and light monitoring form: This form was developed based on previous studies and included questions regarding the information on the features of the patients' bedrooms (temperature, light, sound) and the side effects of the light (having dry, itchy and burning eyes, redness on face and arms, skin sensitivity, nervousness, headache, nausea, and vomiting, body temperature) (6,18).

Pittsburg Sleep Quality index: This index was developed in 1988. The reliability and validity study of the scale in the Turkish population was carried out by Ağargün et al. (19) in 1996. The scale consists of seven components. Each item in the scale was scored between 0 and 3. The range of overall PSQI score varied between 0 and 21. Sleep quality is evaluated as poor in those with an overall score of more than 5 and fine in those with an overall score of 5 or lower.

The European Organization for Research and Treatment of Cancer Quality-of-Life Questionnaire C-30: The questionnaire developed by EORTC, and the EORTC QLQ C-30 Version 3.0 is a quality of life questionnaire commonly used for cancer patients all over the world. An item analysis was carried out to determine the relationship among the scale items. A strong relationship was found with a Cronbach alpha value of r=0.9014. EORTC QLQ C-30 Quality-of-Life Questionnaire contains 30 questions and three headings like general well-being, functional difficulties, and symptom control. The questions, 28 out of

30, were designed with a 4-point Likert scale and answers of the questions are made up of none: 1, very less: 2, fairly: 3, and much: 4. By the 29th and 30th questions of the scale, the patients were asked to assess their well-being and general quality of life, respectively with a 7-point Likert scale (1: too bad and 7: perfect) questions 29 and 30, inquired about general well-being. Higher scores in functional and general well-being subscales and a lower score in symptoms are associated with higher quality of life (20).

The Numeric Pain Assessment scale: This is a self-assessment scale for patients to assess the severity of pain. The numeric rating scale utilizes a linear scale from 0-10, with 0 representing "no pain" and ten being indicative of "pain as bad as you can imagine" (21).

The Beck Anxiety inventory: It was created in 1988 to assess the severity of anxiety in individuals. The Turkish reliability and validity studies were performed as described by Ulusoy et al. (22) in 1998 using a self-rated anxiety scale also asking for physiological symptoms. It is a 21-item self-report instrument that measures symptoms of anxiety using a 4-point Likert-type scale (0-3). The test has a maximum of 63 points. The total score of 0-7 is considered as a minimal level of anxiety, 8-15 is mild anxiety, 16-25 is moderate anxiety, and 26-63 is severe anxiety. Higher scores reflect higher levels of anxiety.

The Beck Depression inventory: It was developed in 1967. It is a 21 item self-report, a questionnaire, wherein the patients are asked to choose the statement that best describes their attitude towards the item. Each item had four response options, and the answers were scored on a scale value of 0 (neutral) to 3 (the most severe). The statements included in this scale were self-reports of depression patients who underwent treatment. The maximum total score was 63. A total score of 0-13 is considered minimal range (no depression), 14-24 is moderate, and 25-63 indicates severe depression. The validity and reliability study of the Turkish version of the scale was conducted by Hisli (23).

Light source: Exposure to bright white light (2000-3000 lux) for 1-2 hours is sufficient to regulate the circadian rhythm for eliminating sleep disorders and improving sleep quality (14,15,24,25). A high lumen bright white light box with 220v 85-105w was used in the patients' environment.

Lux meter: It is a portable, practical device used to measure the amount of light for a 10.000 lux standard light therapy regime for the patients.

Intervention

After establishing they met the inclusion criteria, patients were systematically assigned into two groups of A and B by using a simple randomization method. The research data was collected through the following steps.

1. On the first day, the patients were asked to fill out a "Personal Introduction Form", "The Sleep and Light Monitoring Form", "The Beck Depression inventory", "The Beck Anxiety inventory", "EORTC QLQ C-30", "PSQI", and "The Numeric Pain Assessment scale". The sleep and quality of life and the comorbidity of patients were assessed, and the patients who met the sampling selection criteria were randomly assigned to intervention and control groups.
2. The intervention group patients were accepted in a room organized for the inclusion of light in the radiation oncology. A television set was placed in the room to prevent the patients' eyes from direct light. The bright white light box was placed on a table located in front of the patient, and a lux meter was used to measure the light intensity and to calculate the distance between the patient and the light source. For seven days, the patients were exposed to a 10.000 lux bright white light for 30 minutes a day before their radiotherapy sessions in the afternoon, and they filled "Sleep and Light Tracking Form" on the day of each session.
3. The control group patients were rested before their daily radiotherapy session and filled "Sleep and Light Monitoring Form."
4. On the eighth day, all the patients in both of the groups filled "EORTC QLQ C-30", "PSQI" and "Numeric Pain Assessment scale."

Statistical Analysis

Data were analyzed by using IBM SPSS Statistics 21.0 program. All analyses were performed by using statistical methods to explain the hypotheses of the study with expressing the continuous data as mean ± standard deviation and the categorical data as a percentage (%). Normality of the data was analyzed by using the Shapiro Wilk's test. Mann-Whitney U tests were used for data series consisting of independent measurements or scoring and Wilcoxon signed ranks test was used for dependent variables. Significance level set at $p<0.05$.

Ethical Considerations

This study was approved by Eskişehir Osmangazi University Ethical Committee (approval date/number: October 25, 2016/80558721/216). After giving written and verbal information, all study subjects gave written consent. They were informed that if they did not want to continue, they can leave the study without stating a reason.

Results

Socio-demographic and clinical characteristics of the sample: All breast cancer patients (n=78) who received radiotherapy within a year were reached for the research, and 29.4% of patients (n=23) were found to have low sleep quality. All patients who had low sleep quality were female, and the mean age of the participants was 51.21±2.07 years. Of the patients, 82.6% were married, and 52.2% were primary school graduates. Regarding the income level, 78.3% of the patients expressed that their income met their expenses. Among them, 39.1% had chronic disease and 65.2% had stage 2 (Table 1). All patients in the intervention group adapted to the bright white light intervention and no side effect was observed.

Pittsburg Sleep Quality index scores of the sample: While the PSQI mean score of each group were greater than five points according to the first assessment performed before radiotherapy (PSQI; intervention=9.54±4.84, control=8.50±3.47), PSQI mean score decreased in both of groups in the second assessment (PSQI; intervention=5.0±2.32, control=6.50±3.26), (Table 2). However, the researchers found a change between the first and the second assessment values. PSQI mean score was lower in the intervention group compared with the control group in the second measurement (U=85.000, p=0.260) (Table 2).

The European Organization for Research and Treatment of Cancer Quality-of-Life Questionnaire C-30 subscale scores of the sample: It was determined that the mean score of the functional subscale of intervention and control groups be greater in the second assessment compared with the first assessment. Moreover, the mean score of symptom subscale decreased in both of groups in the second assessment while no difference was found for the mean score of global well-being (Table 2). Although no significant difference was found among the groups for the mean score of functional subscale, the symptom subscale or the global-wellbeing subscale, the mean score of the symptom subscale was higher, and the mean scores of the functional subscale and global well-being subscale were lower in the intervention group compared with the control group [Scores in the functional subscale: (First assessment: U=63.500, p=0.880); (Second assessment: U=81.500, p=0.347)], [Scores in the symptom subscale: (First assessment: U=70.500, p=0.786), (Second assessment: U=72.000, p=0.740)], [Scores in the global wellbeing subscale: (First assessment: U=62.000, p=0.833), (Second assessment: U=62.000, p=0.833)] (Table 2).

Table 1. Distrubution of socio-demographic and disease characteristics

Characteristics	Groups					
	Intervention		Control		Total	
	Mean ± SEM		Mean ± SEM		Mean ± SEM	
Age (year)	53.36±2.35		49.25±3.33		51.21±2.07	
	n	%	n	%	n	%
Educational status						
Literate	2	8.7	2	8.7	4	17.4
Primary school	7	30.4	5	21.7	12	52.2
Secondary school	1	4.3	3	13	4	17.4
High school	1	4.3	2	8.7	3	13
Marital status						
Married	9	39.1	10	43.5	19	82.6
Single	2	8.7	2	8.7	4	17.4
Income levels						
Income less than expenses	4	17.4	1	4.3	5	21.7
Income equal to expenses	7	30.4	11	47.8	18	78.3
Income more than expenses	0	0	0	0	0	0
Caregiver						
Yes	6	26.1	9	39.1	15	65.2
No	5	21.7	3	13	8	34.8
Chronic disease						
Yes	5	21.7	4	17.4	9	39.1
No	6	26.1	8	34.8	14	60.9
Stage						
1	1	4.3	2	8.7	3	13
2	7	30.4	8	34.8	15	65.2
3	2	8.7	1	4.3	3	13
4	1	4.3	1	4.3	3	8.7

SEM: Slow eye movements

Discussion

Breast cancer and its treatment can cause insomnia. 29.4% breast cancer patients who did not report any pain, fatigue, anxiety, and depression and received radiotherapy had low sleep quality in this study. Studies indicate that sleep quality of breast cancer patients is affected by the type of treatment, comorbid situation, symptom burden, and emotional status (7,17,26-30). Patients tended to report higher levels of sleep disturbances in response to chemotherapy, hormonal therapy, and surgical treatment (17,26). Moreover, fluctuations in sleep quality could be observed particularly within a year after the treatment (31). Although studies on the evaluation of sleep patterns of patients during radiotherapy are very limited, they generally focus on the evaluations on different cancer types before the initiation of radiotherapy (10,28,32-34). In two previous studies, it was reported that breast cancer patients experienced substantial sleep disorders before their radiotherapy sessions, which were mainly based on the progression of the disease, prior treatments and psychotherapy symptoms (28,35). Miaskowski et al. (34) found that a third to a half of the sample, comprising various cancer patients including breast cancer patients were experiencing clinically significant levels of sleep disturbance before radiotherapy; however, they suggested that these disruptions in circadian rhythms were associated with increased levels of fatigue, increased levels of depressive symptoms, decreased levels of function, and decreased quality of life. Furlow (36) stated that the role of radiation therapy in sleep disturbance is complex and probably varies depending on the cancer type, radiation target fields, treatment history, and patient factors while in another study it was determined that radiation therapy, particularly to the brain, can interfere with patients' circadian rhythms and rapid eye movement sleep (10). Thus, our findings corroborate previous studies. Studies suggested that sleep disorders in patients increase according to their symptoms, emotional status, and radiation areas. The sampling group in our study consisted of patients who did not report any emotion such as pain, fatigue, anxiety or depression, which can be associated with a low ratio of sleep quality. Another finding of our study is also supporting that situation; a reduction in symptom burden was determined while an improvement in functional and global well-being in all patients, and an increase in sleep quality were found in the second assessment compared with the first assessment.

In the meta-analysis of the sleep disorders of cancer patients, it was found that interventions were only 13% of the total studies reviewed. The most common interventions tested were formal or investigator-generated behavioral treatments for insomnia. Other interventions included mostly non-pharmacotherapy interventions such as acupuncture, yoga, relaxation, and exercise (37). In our study, the impact of light therapy as a physiological treatment was examined on the sleep quality, and it was determined that 10.000 lux bright white light therapy not significantly affect on sleep quality. Bright white

light is often used in the treatment of circadian rhythm and management of sleep disorders in different populations (10,12,14,15). Karami et al. (38) suggested that an increase in melatonin serum levels in older patients who were exposed to scheduled daylight in the morning and evening improved sleepiness, fatigue, and subjective general health, especially anxiety and insomnia. Neikrug et al. (16) suggested that the morning administration of 1500 lux bright white light may protect women from experiencing circadian rhythm deterioration during chemotherapy. Although a heterogeneous sample was used in a previously conducted systematic review, evidence of the efficacy of bright white light was so limited that no conclusions about them could be reached (39). The research results differ from the literature which was associated with the afternoon light intervention and small sample size.

In our study, no significant effects of a 10.000 lux light were found on the quality of life. A reduction in symptom burden and increase in functional and global well-being of the patients in both groups on the 8th day the radiotherapy was observed. In another study, although overall fatigue improved with bright white light treatment was not supported, the lack of deterioration in total fatigue scores suggested that bright morning light may be a useful intervention during chemotherapy for breast cancer (40). Jeste et al. (41) did not report a reduced score of the quality of life in breast cancer patients by preventing fatigue through bright white light compared with the dim red light. In another study with a sample consisting of multiple sclerosis patients, a low-cost, noninvasive treatment option was investigated whether supplemental exposure to 10.000 lux bright white light reduces fatigue (42). Thus, phototherapy together with treadmill training prevented an increase in subcutaneous fat and improved the quality of life in postmenopausal women (43). Limited studies are available that examine the impact of light on the quality of life were in a limited number. Therefore, we suggest that future studies should examine the impact of light on symptom management and quality of life of the breast cancer patients.

Conclusion

This study is randomized controlled study examining the impact of light on sleep and quality of life of breast cancer patients who received radiotherapy. Research findings have limited the validity of the results obtained from the PSQI and EORTC-C30, of which the validity and reliability were conducted based on self-report of patients. The discussion section is limited as there were not many studies examining the impact of light

Table 2. Distribution of Pittsburg Sleep Quality index, European Organization for Research and Treatment of Cancer scores according to groups

Scales	Assesment	Intervention		Control		U p
		n	Mean ± SD	n	Mean ± SD	
PSQI	First	11	9.54±4.84	12	8.50±3.47	67.000 1.000
	Second	11	5.00±2.32	12	6.50±3.26	85.000 0.260
	Z	-2.587		-2.508		-
	p	0.010		0.012		-
EORTC subscales						
Functional subscore	First	11	70.50±22.72	12	68.14±23.10	63.500 0.880
	Second	11	77.57±8.22	12	79.62±17.82	81.500 0.347
	Z	-0.819		-2.398		-
	p	0.413		0.016		-
Symptom subscore	First	11	27.97±16.47	12	35.47±29.41	70.500 0.786
	Second	11	14.91±10.92	12	23.93±23.02	72.000 0.740
	Z	-2.818		-2.670		-
	p	0.005		0.008		-
Global health subscore	First	11	64.39±19.03	12	59.02±31.07	62.000 0.833
	Second	11	64.39±19.03	12	59.02±31.07	62.000 0.833
	Z	0.00		0.000		-
	p	0 1.000		1.000		-

EORTC: European Organization for Research and Treatment of Cancer, SD: Standard deviation, PSQI: Pittsburg Sleep Quality index, Z: Wilcoxon signed-ranks test, U: Mann-Whitney U test

on the quality of life of the breast cancer patients. Therefore, it is suggested that further studies should also focus on the quality of life and include a wide population of sampling group, use objective measurement devices like actigraphy to deeply analyze sleep quality and sleep disorders associated with the circadian rhythm disorders.

Ethics

Ethics Committee Approval: This study was approved by Eskişehir Osmangazi University Clinical Research Ethics Committee (approval date/number: October 25, 2016/80558721/216).
Informed Consent: After giving written and verbal information, all study subjects gave written consent.
Peer-review: Internally peer-reviewed.

Authorship Contributions

Concept: A.Ö., E.M., E.Ç., Design: A.Ö., N.K., G.B.A., Data Collection or Processing: E.Ö., Ö.K., A.Ö., E.M., Analysis or Interpretation: A.Ö., E.Ç., Literature Search: G.B.A., N.K., Writing: A.Ö., Ö.K.
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References

1. Pierre PJ, Grandner MA, Garland SN, Henry E, Jean-Louis G, Burish TG. Self-reported memory problems in adult-onset cancer survivors: effects of cardiovascular disease and insomnia. Sleep Medicine 2015;16:845-9.
2. Zhang Q, Yao D, Yang J, Zhou Y. Factors ınfluencing sleep disturbances among spouse caregivers of cancer patients in Northeast China. PLoS One 201;9:e108614.
3. Palesh OG, Roscoe JA, Mustian KM, Roth T, Savard J, Ancoli-Israel S, Heckler C, Purnell JQ, Janelsins MC, Morrow GR. Prevelence, demographics, and psychological associations of sleep disruption in patients with cancer: University of Rochester Cancer Centre-Community Clinical Oncology Program. J Clin Oncol 2010;28:292-8.
4. Graci G. Pathogenesis and manangement of cancer-related insomnia. J Support Oncol 2005;3:349-59.
5. Passik SD, Whitcomb LA, Kirsh KL, Theobald DE. An unsuccesful attemot to develop a single-ıtem screen for insomnia in cancer patients. J Pain Symptom Manage 2003;25:284-7.
6. National Cancer Instıtute. Sleep Disorders-for health professionals (PDQ®). Available from http://www.cancer.gov/about-cancer/treatment/side-effects/sleep-disorders-hp-pdq#section/_10. [Cited 14 July 2015].
7. Otte JL, Carpenter JS, Russel KM, Bigatti S, Champion VL. Prevalence, severity and correlates of sleep-wakr disturbances in long-term breast cancer survivors. J Pain Symptom Manage 2010;39:535-47.
8. Berger AM, Kuhn BR, Farr LA, Lynch JC, Agrawal S, Chamberlain J, Von Essen SG. Behavioral therapy intervention trial to ımprove sleep quality and cancer related fatigue. Psychooncology 2009;18:634-46.
9. Savard J, Morin CM. Insomnia in the contex of cancer: A review of a neglected problem. J Clin Oncol 2001;19:895-908.
10. Delsigne J. Managing sleep disorders in cancer patients. Oncolog 2013:58:2.
11. National Sleep Foundation. Insomnia. Available from http://sleepfoundation.org/insomnia/content/treatment. [Cited 2015 14 July]
12. Gammack JK. Light therapy for ınsomnia in older adults. Clin Geriatr Med 2008;24:139-49, viii.
13. Erdinç O, Tuncel D, Aslan K, Demir CF. Circadian rhythm sleep-wake disorders. Treatment guide for sleep disorders 2014:56.
14. Sloane PD, Williams SC, Mithcell CM, Preisser JS, Wood W, Barrick L, Hickman SE, Gill SK, Connell BR, Edinger J, Zimmerman S. High-ıntensity enviromental light in dementia: effect on sleep and activity. J Am Geriatr Soc 2007;55:1524-33. Epub 2007 Aug 21.
15. Akyar I, Akdemir N. The effect of light therapy on the sleep quality of the elderly: An intervention study. Australian Journal of Advanced Nursing 2014;31:31-8.
16. Neikrug AB, Rissling M, Trofimenko V, Liu L, Natarajan L, Lawton S, Parker BA, Ancoli-Israel S. Bright light therapy protects women from circadian rhythm desynchronization during chemotherapy for breast cancer. Behav Sleep Med 2012;10:202-16.
17. Bauml J, Chen L, Chen J, Boyer J, Kalos M, Li SQ, DeMichele A, Mao JJ. Arthralgia among women taking aromatese inhibitors: is there a shared inflammatory mechanism with co-morbid fatigue and insomnia. Breast Cancer Research 2015;17:89.
18. Labbate LA, Lafer B, Thibault A, Sachs GS. Side effects induced by bright light treatment for seasonal affective disorder. J Clin Psych 1994:55;189-91.
19. Ağargün MY, Kara H, Anlar Ö. The validity and reliability of the Pittsburgh quality index. Türk Psikiyatri Dergisi 1996:7;107-15.
20. Beşer N, Öz F. Anxiety-depression levels and quality of life patients with lymphoma who are curing chemotherapy. Cumhuriyet University Journal of Nursing 2003;7:47-58.
21. Aslan FE. Pain assessment methods. Cumhuriyet University Journal of Nursing 2002;6:9-16.
22. Ulusoy M, Şahin N, Erkmen H. Turkish version of Beck Anxiety Inventory: psychometric properties. Journal of Cognitive Psychotherapy 1998;2:163-72.
23. Hisli N. A study on the validity of the Beck Depression Inventory. Psikoloji Dergisi 1988;22:118-26.
24. Sun JL, Wu SC, Chang LI, Chiou JF, Chou PL, Lin CC. The relationship between light exposure and sleep, fatigue, and depression in cancer outpatients: test of the mediating effect. Cancer Nurs 2014;37:382-90.
25. Ho SC, Wong TKS, Tang PL, Pang SMC. Nonpharmacologic sleep promotion: bright light exposure. Complementary Therapies in Nursing and Midwifery 2002;8:130-5.
26. Costa AR, Fontes F, Pereira S, Gonçalves M, Azevedo A, Lunet N. Impact of breast cancer treatments on sleep distrubances- A systematic review. The Breast 2014;23:697-709.
27. Ancoli-Israel S, Liu L, Rissling M, Natarajan L, Neikrug AB, Palmer BW, Mills PJ, Parker BA, Sadler GR, Maglione J. Sleep, fatigue, depression and circadian activity rhythms in women with breast cancer before and after treatment: A 1-year longitudinal study. Support Care Cancer 2014;22:2535-45.
28. Onselen CV, Dunn LB, Lee K, Dodd M, Koetters T, West C, Paul SM, Aouizerat BE, Wara W, Swift P, Miaskowski C. Relationship between mood disturbance and sleep quality in oncology outpatients at the initiation of radiation therapy. Eur J Oncol Nurs 2010;14:373-9.
29. Mansano-Schlosser TC, Ceolim MF. Association between poor clinical prognosis and sleep duration among breast cancer patients. Rev. Latino-Am. Enfermagen 2017;25:e2899.

30. Liu L, Rissling M, Natarajan L, Fiorentino L, Mills PJ, Dimsdale JE, Sadler GR, Parker BA, Ancoli-Israel S. The longitudinal relationship between fatigue and sleep in breast cancer patiets undergoing chemotherapy. Sleep 2012;35:237-45.
31. Otte JL, Davis L, Carpenter JS, Rand KL, Skaar TC, Weaver M, Chernyak Y, Zhong X, Igega C, Landis C. Sleep disorders in breast cancer survivors. Support Care Cancer 2016;24:4197-205.
32. Miaskowski C, Lee KA. Pain, fatigue, and sleep disturbances in oncology outpatients receiving radiation therapy for bone metastasis: A pilot study. Journal of Pain and Symptom Management 1999;17:320-32.
33. Reyes-Gibby CC, Chan W, Abbruzzese JL, Xiong HQ, Ho L, Evans DB, Varadhachary G, Bhat S, Wolf RA, Crane C. Patterns of self-reported symptoms in pacreatic cancer patients receiving chemoradiation. J Pain Symptom Manage 2007;34:244-52.
34. Miaskowski C, Lee K, Dunn L, Dodd M, Aouizerat BE, West C, Paul SM, Cooper B, Wara W, Swift P. Sleep-wake circadian activity rhythm parameters and fatigue in oncology patients prior to the initation of radiation therapy. Cancer Nurs 2011;34:255-68.
35. Lopez E, Torre-Lugue A, Lozo A, Alvarez J, Buela-Casal G. Assesment of sleep disturbances in patients with cancer: Cross-sectional study in a radiotherapy department. Eur J Oncol Nurs 2016;20:71-6.
36. Furlow B. Sleep disorders in cancer radiation therapy: Little understood, often undetected and important. Oncology Nurse Advisor. 2016. http://www.oncologynurseadvisor.com/side-effect-management/sleep-is-an-important-consideration-for-cancer-patients/article/507903/2/. Accessed 14 October 2017.
37. Otte JL, Carpenter JS, Manchanda S, Rand KL, Skaar TC, Weaver M, Chernyak Y, Zhong X, Igega C, Landis C. Systematic review of sleep disorders in cancer patients: can the prevelance of sleep disorders be ascertained? Cancer Med 2015;4:183-200.
38. Karami Z, Golmohammadı R, Heıdarıpahlavıan A, Poorolajal J, Heidarimoghadam R. Effect of daylight on melatonin and subjective general health factors in elderly people. Iran J Public Health 2016:45;636-43.
39. Montgomery P, Dennis J. A systematic review of non-pharmacological therapies for sleep problems in later life. Sleep Medicine Reviews 2004;8:47-62.
40. Ancoli-Israel S, Rissling M, Neikrug A, Trofimenko V, Natarajan L, Parker BA, Lawton S, Desan P, Liu L. Light treatment prevents fatigue in women undergoing chemotherapy for breast cancer. Support Care Cancer 2012;20:1211-9.
41. Jeste N, Liu L, Rissling M, Trofimenko V, Natarajan L, Parker BA, Ancoli-Israel S. Prevention of quality of life deterioration with light therapy is associated with changes in fatigue in women with breast cancer undergoing chemotherapy. Qual Life Res 2013;22:1239-44.
42. Mateen FJ, Manalo NC, Grundy SJ, Houghton MA, Hotan GC, Erickson H, Videnovic A. Light therapy for multıpl sclerosis-associated fatigue: Study protocol for a randomized controlled trial. Medicine (Baltimore) 2017;96:e8037.
43. Paolillo FR, Borghi-Silva A, Arena R, Parizotto NA, Kurachi C, Bagnato VS. Effects of phototherapy plus physical training on matabolic profile and quality of life in postmenopausal women. J Cosmet Laser Ther 2017;19:364-72.