Original Article

Sleep Quality and Cancer-Related Fatigue in Patients with Cancer

Mahdieh Momayyezi1, Hossein Fallahzadeh1, Fatemeh Farzaneh2, Mohammad Momayyezi3

1Department of Biostatistics and Epidemiology, Center for Healthcare Data Modeling, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
2Deparment of Biostatistics and Epidemiology, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran
3Shahid Sadoughi Teaching Hospital, Shahid Sadoughi University of Medical Sciences, Yazd, Iran

Abstract

Introduction: Sleep problems and fatigue are common symptoms reported by cancer patients. In this study, the researchers used a specialized tool to measure fatigue in cancer patients and its relationship with sleep quality in Yazd, Iran.

Methods: This descriptive correlational study included 149 cancer patients (age range: over 18 years) referred to Shahid Sadoughi Hospital in Yazd, Iran. Data were collected by the Pittsburgh Sleep Quality Index (PSQI) and Cancer-Related Fatigue Questionnaire. A PSQI score of ≥5 indicated a poor sleep. Data were analyzed using SPSS Statistics for Windows, version 13.0 (SPSS Inc., Chicago, IL, USA), Pearson’s correlation, t test, analysis of variance (ANOVA), and linear regression.

Results: The mean (SD) PSQI score of patients was 13 (4.85) out of 21. About 69.3% of patients had a poor sleep quality. While the mean (SD) of sleep duration was 5.57 (0.54) hours, it was 69.44 (46.58) minutes for sleep latency. Also, with increasing the mean of sleep quality, the mean of fatigue significantly increased (P<0.001, R=0.63).

Conclusion: According to the results, there was a relationship between the sleep quality and fatigue in cancer patients, so that patients with better sleep quality had less fatigue.

Introduction

Sufficient sleep is an effective element in physical and mental health.1 A good sleep provides physical restoration through anabolic functions such as protein and tissue synthesis.2 Over the recent years, researchers and specialists have paid more attention to the relationship between sleep and cancer.3,5

Cancer has been considered one of the major public health threats for public health systems in the world.6 Patients with cancer may experience various problems such as sleep problems, fatigue, depression, anxiety, worries and treatment problems. Sleep disorders in patients with cancer are approximately double than general population (12.25% in the general population and 30-50% in oncology patients).7

Sleep disorders include a range of symptoms such as waking early in the morning, daytime sleepiness, waking up and having trouble getting back to sleep and difficulty falling asleep.7 Approximately, 20-70% of breast cancer patients suffer of insomnia.9 Tag Eldin et al., reported that short sleep duration, decrease of sleep efficiency, sleep latency was significantly more in patients with cancer compared to healthy people.10 Chen et al., indicated that patients with cancer and their intimate partners have poor sleep quality.11 Indeed, recent scientific evidence shows that a correct assessment of sleep disorders in cancer patients suggested interesting therapeutic views in the treatment of cancer patients.12

In the other hand, cancer-related fatigue (CRF) is common problem in the cancer patients. But little is known of its relationship with mental health, pain and sleep in the cancer patients.13 The majority of cancer patients experience moderate to severe CRF during primary treatments. In addition, CRF may continue in cancer survivors for months and years after treatment. CRF can be effective in quality of life.14 Porro et al., showed Quality of life and fatigue was as the predictors of return to work in women with breast cancer.15

Fatigue in cancer patients differs from fatigue in non-patients. CRF has a wide range of symptoms, including persistent and distressing physical, emotional, and/or cognitive weakness, tiredness, and lack of energy. In this type of fatigue, the patient feels tired without doing any specific activity. There is a hypothesis regarding this type of fatigue indicating that it often does not get better by sleeping or resting.16 On the contrary, it is hypothesized
that this fatigue will improve automatically with improved sleep problems.\textsuperscript{14} For example, napping during the day can improve fatigue. On the other hand, napping during the day can increase fatigue during the next day by reducing nighttime sleep.

Although fatigue is one of the most common symptoms in cancer patients, but little information is available on the relationship between fatigue and sleep quality. Limited studies have been conducted in Iran on the relationship between fatigue and sleep quality in adults with cancer, and most have examined fatigue and sleep quality separately. Imanian et al., examined the association between fatigue and sleep in breast cancer patients. They used the Brief Fatigue Inventory (BFI) questionnaire to assess fatigue. BFI is a general questionnaire that does not focus on a specific disease.\textsuperscript{17} It is also worth mentioning that a fatigue questionnaire for cancer patients was designed for the Iranian population in 2017, and its validity and reliability were reviewed and confirmed.\textsuperscript{18}

If there is a significant relationship between fatigue and sleep quality, doctors can improve fatigue by adjusting the sleep rhythm and reducing sleep disorders in cancer patients. Therefore, following the improvement of fatigue, treatment tolerance increases, and mood disorders and depression improve. Due to the lack of studies on the relationship between fatigue and sleep quality in cancer patients, researchers decided to use a specialized tool to measure fatigue in cancer patients and its relationship with sleep quality.

Materials and Methods

This study is a descriptive study that conducted in Yazd province in 2017 to examine the correlation between sleep quality and fatigue in hospitalized patients with cancers aged 18 years and older who referred to the Shahid Sadoughi Hospital in Yazd, Iran. The sample size was determined to be 141, based on a confidence interval (CI) of 95\% and standard deviation of 4.25 based on a similar study\textsuperscript{19} and error estimation of the mean of 0.7, which was increased to 150 to account for potential missing cases. Sampling was conducted based on the convenience sampling method.

The inclusion criteria for the patients were comprised of age ≥18 years, diagnosis of cancer via doctor's approval, start the treatment process and consent to participate in this study. Also, patients who had not responded to all questions and non-native people were excluded from this study.

The data were collected by the questionnaire. The first part of the questionnaire was related to the demographic variables (age, educational level, job type, etc) and disease-related variables (the type of cancer, duration of cancer and methods of treatment).

The quantity and quality of sleep during the past month (four weeks) was measured with Pittsburgh Sleep Quality Index (PSQI). PSQI is a self-report questionnaire developed by researchers at the University of Pittsburgh.\textsuperscript{20} PSQI had 19 questions in 7 components included subjective sleep quality; sleep latency, that is the amount of time that it takes to fall asleep; sleep duration; habitual sleep efficiency, that is the percentage of the actual hours of sleep divided by the hours spent in bed; sleep disturbances; use of sleeping medications; and daytime dysfunction.

The score range of each question was from 0 to 3 points; with a total score range from 0 to 21. A PSQI score of ≥ 5 identified as poor sleepers.\textsuperscript{21} The reliability and validity of the questionnaire have been confirmed in Backhaus et al., study with a Cronbach's alpha of 0.85 and intra-class correlation coefficient (ICC) of 0.87.\textsuperscript{20} In addition, ICC was 0.87 in Khorrarei-Rad et al., study that conducted on breast cancer patients receiving chemotherapy.\textsuperscript{4} The reliability of the questionnaire also confirmed in this study with a Cronbach's alpha of 0.82.

Also, fatigue was measured with CRF questionnaire that designed by Momayyezi et al.\textsuperscript{18} This questionnaire had 24 questions in three dimensions including daily activities and general problems (10 questions), sleep problems (9 questions), and mental states and emotions (5 questions). A 4-point Likert-type range was used for scaling (0 = never, 1 = sometime, 2 = usually, and 3 = always) with a total score range from 0 to 72. The higher score shows more fatigue in person. The reliability and validity of the questionnaire have been confirmed in Momayyezi et al., study. Face validity is evaluated by patients and content validity is evaluated by a panel of experts. The reliability of the questionnaire was confirmed using Cronbach’s alpha coefficient and Test-retest. Cronbach’s alpha coefficient for fatigue questionnaire was 0.95. For assessing repeatability (Test-retest), the questionnaire was completed by 40 patients. After 4 weeks, the questionnaire was completed again by the same patients. Then ICC calculated. According their results ICC was 0.92 for the total questionnaire. Cronbach's alpha coefficient (\(\alpha = 0.93\)) and Test re-test (ICC = 0.92) were used to assess the reliability of the questionnaire. Construct validity was confirmed by performing factor analysis.\textsuperscript{18}

The researchers referred to Shahid Sadoughi Hospital in Yazd city for sampling. According to the inclusion criteria, 150 patients with cancer aged 18 years and older who referred to the Shahid Sadoughi Hospital in Yazd entered the study. Initially, Researchers explained the aim of the study to patients. Questionnaires were completed by patients. But, if they were not able to complete, questions were completed by the researcher by face-to-face interview and responses were recorded.

After reviewing the questionnaires, one questionnaire was deleted due to deficiencies in completing the information, and then the information of 149 patients was included in the statistical software.

Data were analyzed using SPSS Statistics for Windows, version 13.0 (SPSS Inc., Chicago, IL, USA). The mean of fatigue based on more than two groups was evaluated.
using ANOVA test. The Tukey test was used when researchers need to determine if the interaction among three or more variables is mutually statistically significant. T-test was used to compare the mean of sleep quality based on gender. Pearson’s correlation was calculated for the assessment of the correlation between variables. In all the statistical analyses, P value of less than 0.05 was considered significant.

Multiple linear regression analysis was also performed to examine the significance of the relevant variables in explaining the variances of the fatigue. The strategy for entering the variables into the regression model was that first each variable entered the linear regression separately (simple linear regression), then the variables with p-value less than 0.2 entered the multiple linear regression. Participation in the study was also voluntary.

Results
In this study, sleep quality was assessed in patients with cancer aged 18 years and older in Yazd. The mean (SD) age of the patients was 55.03 (9.38) years. Most of the patients were male (60.4%) with less than a high school diploma (68.5%). The results showed that the mean (SD) duration of cancer was 12.45 (10.94) months; 27.6% had intestine and colorectal cancer and 20.1% had breast cancer, and 30.9% of patients were treated by all three usual methods (chemotherapy, radiotherapy, and surgery) (Table 1).

The mean (SD) PSQI score was 13 (4.85) of the total score 21. Considering a cut-off point of 5, 69.3% of patients had poor sleep quality. The mean (SD) of the PSQI components were as follows: Subjective sleep quality 1.95 (0.86), Sleep efficiency 1.26 (0.28), Daytime dysfunction 1.59 (1.01), Sleep disturbances 1.98 (0.62), Sleep duration 1.52 (1.07), Sleep latency 2.43 (0.75) and use of sleeping medications 2.25 (1.04) of the total score 3 for each item of PSQI components. Therefore, sleep latency and use of sleeping medications had the highest mean and sleep efficiency had the lowest mean. Also, sleep efficiency in most of the patients (58.1%) was more than 85%.

The frequency of sleep disturbance reported by patients with a frequency of 3 times a week was as follows: waking during the night or in the early morning (48.7%), feeling too hot (24%), having pain (20%), feeling too cold (19.3%), having bad dreams (15.3%), and coughing or snoring (10%), waking up to urinate (9.3%) and waking up due to difficulty breathing (6.7%). With respect to subjective sleep quality, 39.3% of patients rated their sleep quality as fairly good, 26.2% fairly bad and 34.5% very bad. In addition, 21% of the patients reported that keeping up enough enthusiasm to get things done was “a very big problem,” 21.8% reported that it was “somewhat of a problem”, 36.3% reported that it was “only a very slight problem” and 21% reported that they had no problem at all.

The mean (SD) sleep duration in patients was 5.57 (0.54) hours. Sleep duration was in the range of 2-12 hours in participants. The results showed 11.3% of patients slept more than 7 hours, 18.5% between 6-7 hours, 34.7% between 5-6 hours, and 35.5% less than 5 hours during the night. The mean (SD) sleep latency in patients was 69.44 (46.58) minutes. Sleep latency range was between 6-180 minutes. Also, 2.4% of patients took less than 15 minutes, 8.9% between 16-30 minutes, 31.5% between 31-60 minutes and 57.2% higher than 60 minutes to fall asleep after going to bed. The results showed 13.8% of patients only had not taken sleep medicines during the past month. According to the results, 3.4% less than once a week, 25.9% once or twice a week and 56.9% three or more times a week had taken sleep medicines during the

| Table 1. Frequency of socio-demographic and clinical characteristics (N = 149) |
|-----------------|-----------------|
| Variables       | N (%)           |
| Gender          |                 |
| Women           | 59 (39.6)       |
| Men             | 90 (60.4)       |
| Economic status |                 |
| Bad             | 75 (50.3)       |
| Moderate        | 62 (41.6)       |
| Good            | 12 (8.1)        |
| Educational level|                 |
| Illiterate      | 28 (18.8)       |
| Less than diploma | 102 (68.5)  |
| Diploma         | 9 (6)           |
| University education | 10 (6.7) |
| Job             |                 |
| Employer        | 3 (2)           |
| Worker          | 57 (38.3)       |
| Self-employed   | 27 (18.1)       |
| Emeritus        | 4 (2.7)         |
| Unemployed      | 58 (38.9)       |
| Type of treatment|                |
| Chemotherapy    | 48 (32.2)       |
| Chemotherapy and radiotherapy | 2 (1.3) |
| Chemotherapy and surgery | 53 (35.6) |
| Chemotherapy, radiotherapy, and surgery | 46 (30.9) |
| Type of cancer  |                 |
| Liver           | 10 (6.7)        |
| Leukemia and lymphatic | 24 (16.1)   |
| Intestine and colorectal | 41 (27.6)  |
| Breast          | 30 (20.1)       |
| Lung            | 5 (3.4)         |
| Esophagus and stomach | 17 (11.4) |
| Bladder         | 9 (6)           |
| Ovarian         | 7 (4.7)         |
| Skin            | 4 (2.7)         |
| Prostate        | 2 (1.3)         |
past month.

Based on the Tukey test, the mean of sleep quality and all components were significantly worse in patients who had a worse economic situation (F = 7.67, P = 0.001) (Table 2). Also, the mean of sleep quality was higher in patients with colorectal cancer and lung cancer than other types of cancer (F = 3.21, P = 0.002) (Table 3). In addition, overall sleep quality, sleep latency, daytime dysfunction, sleep efficiency, sleep duration and subjective sleep quality were significantly worse in patients who were treated by all three methods (chemotherapy, radiotherapy, surgery) than patients who didn’t received all three methods (Table 4).

Table 2. Mean of Pittsburgh Sleep Quality Index (PSQI) and fatigue based on socio-demographic

| Variable               | Sleep quality | Fatigue          |
|------------------------|---------------|------------------|
|                        | Mean (SD)     | P value          | Mean (SD)     | P value          |
| Gender                 |               |                  |               |                  |
| Women                  | 11.11 (3.96)  | 0.230            | 51.02 (16.9)  | 0.0060           |
| Men                    | 12.05 (4.03)  | 0.001b           | 59.8 (16.3)   | <0.001b          |
| Economic status        | 0.001b        | 0.001b           | 13.05 (3.83)  | 61 (15.3)        |
| Bad                    | 10.2 (3.74)   | 0.001b           | 49.7 (16.6)   | <0.001b          |
| Moderate               | 11 (3.97)     | 0.21c            | 46.11 (12.8)  | 0.01c            |
| Good                   | 11.10 (4.17)  | 0.21c            | 59.5 (16.05)  | 0.01c            |
| Educational level      |               |                  |               |                  |
| Illiterate             | 12.18 (3.77)  | 0.050            | 57.9 (17.4)   | 0.0060           |
| Less than diploma      | 9.44 (3.43)   | 0.050            | 42.4 (11.2)   | 0.0060           |
| Diploma                | 12.22 (5.11)  | 0.050            | 45.8 (12.7)   | 0.0060           |
| University education   | 10.66 (5.68)  | 0.050            | 46.5 (0.7)    | 0.0060           |
| Job                    | 12.3 (1.73)   | 0.050            | 62.1 (15.2)   | 0.0060           |
| Employer               | 12.4 (4.89)   | 0.050            | 58.7 (18.7)   | 0.0060           |
| Self-employed          | 12.18 (3.77)  | 0.050            | 57.9 (17.4)   | 0.0060           |
| Emeritus               | 10.25 (1.89)  | 0.050            | 43 (10.4)     | 0.0060           |
| Unemployed             | 10.95 (3.85)  | 0.050            | 50.5 (16.7)   | 0.0060           |

*Independent t test; ANOVA; Statistically significant.

The results showed that the mean (SD) of fatigue was 53.44 (16.61) (of the total score of 72). The mean (SD) dimensions of fatigue were as follows: daily activities and general problems was 24.93 (9.1) (of the total score of 44), the mean (SD) of sleep problems was 16.79 (6.9) (of the total score of 36), and the mean (SD) of mental states and emotions was 11.53 (3.2) (of the total score of 20). The Pearson correlation coefficient showed a significant positive relationship between sleep quality and fatigue; so that the mean of fatigue was significantly increased with increasing the mean of sleep quality and fatigue; so that the mean of fatigue was significantly increased with increasing the mean of sleep quality (P < 0.001, R = 0.63).

There were significant differences between the total mean of fatigue and gender, job, educational level and economic status (Table 2). The results showed that patients with a high school diploma had significantly fewer fatigue than patients with lower education (F = 3.66, P = 0.01). In terms of the occupation, workers had a higher score of fatigue than other jobs (F = 3.79, P = 0.006). Also, the mean of fatigue was significantly worse in patients who had a worse economic situation (F = 11.67, P < 0.001). The mean of fatigue was significantly higher in men than women (P = 0.006). The mean of fatigue was higher in patients with colorectal cancer than other types of cancer (F = 5.83,

Table 3. Mean of Pittsburgh Sleep Quality Index (PSQI) and fatigue based on type of cancer

| Type of cancer       | Sleep quality | Fatigue | P value |
|----------------------|---------------|---------|---------|
|                      | Mean (SD)     | Mean (SD) |        |
| Liver                | 12.8 (4.2)    | 59.6 (7.8) |        |
| Leukemia and lymphatic| 13.2 (4.3)    | 54.6 (13.2) |        |
| Intestine and colorectal| 16.2 (4.9)  | 67.4 (15.9) |        |
| Breast               | 13.1 (3.6)    | 43.6 (14.7) |        |
| Lung                 | 14.7 (4.3)    | 59.2 (21.1) | <0.001 |
| Esophagus and stomach| 8.8 (5.1)     | 61.2 (11.4) | <0.001 |
| Bladder              | 11.3 (5.2)    | 46.6 (18.3) |        |
| Ovarian              | 8.1 (2.1)     | 41.6 (17.9) |        |
| Skin                 | 12 (4.08)     | 40 (8.5)   |        |
| Prostate             | 11.5 (0.7)    | 43 (5.6)   |        |

ANNOVA; *Statistically significant.

Table 4. Mean of components of Pittsburgh Sleep Quality Index (PSQI) based on the type of treatment

| Variables               | Mean (SD) | P value |
|-------------------------|-----------|---------|
|                        | Chemotherapy | Chemotherapy, radiotherapy and surgery | Chemotherapy & Surgery | Chemotherapy & Radiotherapy |       |
| Sleep latency (min)     | 2.5 (0.78)  | 2.7 (0.51)  | 2.11 (0.83)  | 2.5 (0.7)  | 0.005*  |
| Daytime dysfunction     | 1.82 (0.93) | 2.12 (0.88) | 1.04 (0.01) | 2.0 (0.00) | <0.001* |
| Sleep disturbances      | 1.87 (0.6)  | 2.13 (0.67) | 1.95 (0.59) | 2.0 (0.00) | 0.32    |
| Sleep efficiency        | 0.95 (0.1)  | 1.15 (0.28) | 0.83 (0.39) | 0.7 (0.3)  | 0.008*  |
| Sleep duration (h)      | 2.17 (0.9)  | 2.22 (0.89) | 1.45 (0.04) | 2.0 (0.00) | 0.001*  |
| Use of sleeping medications | 2.3 (1.11)   | 2.35 (0.98) | 2.11 (1.07) | 2.0 (0.00) | 0.75    |
| Subjective sleep quality| 2.02 (0.83) | 2.21 (0.84) | 1.66 (0.84) | 1.5 (0.7)  | 0.02*   |
| Overall sleep quality score| 13.65 (4.47)| 14.65 (4.8) | 11.12 (4.3) | 12.5 (2.12) | 0.01*   |

*ANOVA; *Statistically significant.
Sleep quality and fatigue in cancer patients
Journal of Caring Sciences, 2021, Volume 10, Issue 3

There was no significant difference between the mean of fatigue and treatment method. In addition, the results showed a significant relationship between all PSQI components and the mean of fatigue (Table 5). The mean score of fatigue was higher in patients who used sleeping medications more than 3 times per week, patients with very bad subjective sleep quality and sleep efficiency of less than 65%, and patients who had sleep duration of less than 5 hours and sleep latency of higher than 60 minutes. In addition, the mean of fatigue increased with increase of the sleep disturbances and daytime dysfunctions (Table 5).

In the present study, linear regression analysis was used to assess the significance of the sleep quality and other variables in explaining the variances of fatigue. According to the multiple linear regressions, the variables included in the model explained 54% of the variance in the fatigue, but only the sleep quality and duration of cancer were significant in the model (P < 0.001) (Table 6).

Discussion
The results showed that 69.3% of cancer patients had poor sleep quality based on the cut-off point of PSQI. Also, the overall prevalence of poor sleep quality was 78% in Al Maqbali et al., study, 77.3% in Wu et al., study and 64% George et al., study which is consistent with the present study. The stress associated with cancer diagnosis and treatment process leads to the release of pro-inflammatory cytokines and this partly explains the high incidence of sleep problems in cancer patients.

Khorrami-Rad et al., indicated that the mean (SD) of sleep quality was 11.73 (3.73) in patients with breast cancer and according to the cut-off point, 50% of patients had poor sleep quality. The mean score of sleep quality in patients with cancer was 9.22 in Oman and 6.51 in five sites in Nebraska and South Dakota in Omaha (USA). In addition, the total score of PSQI in breast cancer patients undergoing chemotherapy in the USA was 7.31. A part of this difference is due to differences in geographic regions, genetic differences, the type of cancer and another part due to differences in type of study and data collection tools and sample size.

It seems that admission in hospital, hospitalization in a room with a severely sick person, receive nursing care during the night, rest and inactivity during the day, have complications such as nausea and vomiting, stress and worry about treatment outcomes and many other factors decrease the patient's sleep quality during the night. Sleep disturbance is seen in 30-75% of people with cancer and is almost twice than the general population. In this study, the most common sleep disturbances in patients were waking up in the middle of the night or early morning, feeling too hot during sleep and having pain. According to Khorrami-Rad et al., study, waking up in the middle of the night or early morning was common sleep disturbances.

In current study, the mean of time to fall asleep after going to bed was higher than 60 minutes. Khorrami-Rad et al., also reported difficulty initiating sleep in women with cancer. In confirmation of this finding, Kuo et al., reported that the most sleep problems in patients with breast cancer were difficulty initiating sleep. Similar studies showed difficulty initiating sleep was more common in people with cancer than healthy people. It

### Table 5: Frequency of components of Pittsburgh Sleep Quality Index (PSQI) and mean of fatigue

| Sleep quality parameters | N (%) | Mean (SD) | P value |
|--------------------------|-------|-----------|---------|
| Subjective sleep quality |       |           |         |
| Very good                | -     | -         |         |
| Fairly good              | 39.3  | 46.65 (13.5) | <0.001* |
| Fairly bad               | 26.2  | 52.55 (11.04) |       |
| Very bad                 | 34.5  | 70.6 (14.08)  |         |
| Sleep efficiency         |       |           |         |
| > 85%                    | 58.1  | 49.7 (14.6)   |         |
| 75-84%                   | 16.4  | 59.6 (16.9)   | <0.001* |
| 65-74%                   | 10.7  | 68.38 (7.4)   |         |
| <65%                     | 14.8  | 74.06 (13.6)  |         |
| Daytime dysfunction      |       |           |         |
| Never                    | 17.7  | 59.77 (20.05) |       |
| < 1 times per week       | 25.8  | 51.13 (13.07) | <0.001* |
| 1-2 times per week       | 35.5  | 54.12 (15.8)  |         |
| ≥3 times per week        | 21    | 70.3 (14.3)   |         |
| Sleep disturbances       |       |           |         |
| 0                        | -     | -         |         |
| 1-9                      | 34.2  | 45.38 (13.37)| <0.001* |
| 10-18                    | 55    | 59.75 (14.84)|         |
| 19-27                    | 10.8  | 74.76 (13.7)  |         |
| Sleep duration (h)       |       |           |         |
| >7                       | 11.3  | 50 (17.3)    |         |
| 6-7                      | 18.5  | 51.19 (15.55)| <0.001* |
| 5-6                      | 34.7  | 58.5 (12.93)  |         |
| <5                       | 35.5  | 69 (14.61)   |         |
| Sleep latency (min)      |       |           |         |
| <15                      | 2.4   | 48.85 (15.23)|         |
| 16-30                    | 8.9   | 45.55 (13.94)| <0.001* |
| 31-60                    | 31.5  | 53.66 (14.63)|         |
| ≥60                      | 57.2  | 70.46 (11.99)|         |
| Use of sleeping medications |     |           |         |
| Never                    | 13.8  | 54.88 (16.06)|         |
| < 1 times per week       | 3.4   | 44.25 (11.5) | <0.001* |
| 1-2 times per week       | 25.9  | 43.65 (9.2) |         |
| ≥3 times per week        | 56.9  | 64.77 (16.2) |         |
| Overall sleep quality score |     |           |         |
| Good                     | 30.7  | 47.2 (18.5)  | 0.02** |
| Poor                     | 69.3  | 57.48 (17.3) |         |

*ANOVA; †Independent t test; ‡Statistically significant.
seems that the long-term rest and nap during the day are the causes of difficulty initiating sleep in cancer patients.

The mean of sleep duration during the night was nearly 5 hours. Considering that the proper sleep duration is 7-8 hours for adults, nighttime sleep duration in this study was low. In confirmation of this finding, Khorrami-Rad et al., and Lee et al., reported insufficient sleep duration was one of the major problems in people with cancer. Lack of activity in the hospital causes timely naps during the day and reduces nighttime sleep. Also, the use of corticosteroids (such as dexamethasone) in cancer patients leads to insomnia. These drugs may affect the sleep stages. Huang et al., in their study reported that cortisol-containing diets and their fluctuations in the body are associated with sleep duration, efficiency, latency and daytime dysfunction. In current study, the mean sleep quality score decreased with increasing duration of the disease. This reflects the improvement in sleep quality with increasing in the duration of the disease which is consistent with Park et al., study.

The results showed that the mean of fatigue was lower in patients with better sleep quality. The results of a study suggested that the incidence and severity of sleep disorders had a significant relationship with fatigue; also CRF was the strong predictor of sleep quality. Beverly et al., recommended that doctors must be treat sleep disorders to relieve cancer related fatigue. In the Loh et al., study, the prevalence of sleep disturbance was 40%. In addition, 63% of cancer patients who had sleep disturbances had CRF. Sleep disorder was associated with pain, fatigue, and depression but after multivariate analysis, only fatigue was significantly associated with the sleep disorder. In the Schreier et al., study were moderate correlations among sleep disturbance and fatigue.

Studies have shown physical activity and cognitive behavioral therapy were effective for the management of CRF and sleep disturbance in cancer patients. Lin et al., in their study examined the effect of yoga therapy on CRF and sleep in cancer survivors. They showed yoga therapy was effective for treating CRF among cancer survivors. In addition, 22% to 37% of the improvements in CRF from yoga therapy result from improvements in sleep quality. Other studies also showed a positive effect of the exercise intervention on improving sleep quality and fatigue. Some studies have also examined the impact of psychological interventions. Gabra and Hashem concluded that sleep disorders and prevalence of some psychiatric disorders such as depression, anxiety, obsession, sensitivity and etc. can disrupt the treatment of cancer patients.

The limitations of this study are self-completed questionnaires. It is suggested that future studies use of diagnostic tests such as objective measures to confirm sleep disorders and also, assess the impact of interventions on improving fatigue in sleep disorders.

### Conclusion

According to the results, there is a relationship between the quality of sleep and fatigue in cancer patients, so patients with better sleep quality had less fatigue. In this study, nearly 70% of patients with cancer had poor sleep quality. Therefore, it is essential to create an environment in which sleep disorder factors are minimized such as reduce noise, turn off lights or reduce the amount of light, set the room temperature, cleanliness of the equipment and the location of the patient’s sleep, use the blanket to keep the heat, put the pillows in available place, give the soft and loose clothes to patients, empty the bladder and bowel before sleep, increase fluid and fiber intake during the day and reduce it at night. Doctors can also use sleeping medications to help relieve sleep disorders in cancer patients. Nursing interventions are effective in identifying symptoms. Physical fatigue can be improved by improving physical activity and mental fatigue can be improved by psychosocial interventions.

### Research Highlights

#### What is the current knowledge?

So far, no study in Iran has examined the relationship between sleep quality and fatigue in adults with cancer.

#### What is new here?

There is a relationship between the quality of sleep and fatigue in cancer patients. In this study, nearly 70% of patients with cancer had poor sleep quality. In the present study, the mean sleep quality score decreased with increasing duration of the disease. The mean of sleep quality was higher in patients with colorectal cancer and lung cancer than other types of cancer. The overall sleep quality, sleep latency, daytime dysfunction, sleep efficiency, sleep duration and subjective sleep quality were significantly worse in patients who were treated by all three methods (chemotherapy, radiotherapy, surgery) than patients who received other treatments methods.
Acknowledgments
The researchers are grateful to the research center for healthcare data modeling that collaborated with this research.

Ethical Issues
Before completing the questionnaire, researchers explained the aim of the study to participants. In addition, participation in the study was voluntary. This article has a license from the research ethics committees of Shahid Sadoughi University of Medical Sciences (Reference number: IR.SSU.SPH.REC.1394.114).

Conflict of Interest
The authors declare that there is no conflict of interest.

Authors’ Contributions
MM: Conception and design; FF, MM: Acquisition of data; HF: Analysis and interpretation of data; MM, HF, FF, MM: Drafting the article; MM, HF, FF, MM: Review of article and find approval.

Reference
1. Alfonsi V, Scarpelli S, D’Atri A, Stella G, De Gennaro L. Later school start time: the impact of sleep on academic performance and health in the adolescent population. Int J Environ Res Public Health. 2020; 17(7): 2574. doi: 10.3390/ijerph17072574
2. Erickson VS, Westlake CA, Dracup KA, Woo MA, Hage A. Sleep disturbance symptoms in patients with heart failure. AACN Clin Issues. 2003; 14(4): 477-87. doi: 10.1097/00044046-200311000-00009
3. Heckman CJ, Kloss JD, Feskanich D, Culnane E, Schernhammer ES. Associations among rotating night shift work, sleep and skin cancer in Nurses’ Health Study II participants. Occup Environ Med. 2017; 74(3): 169-75. doi: 10.1136/omed-2016-103783
4. Khorrami-Rad A, Noroozi M, Ahmari Tehran H, Rahmani A. Quality of sleep and related factors in breast cancer patients receiving chemotherapy in Qom 2011. Iranian Quarterly Journal of Breast Disease. 2012; 4(4): 51-60. [Persian].
5. Liu R, Wu S, Zhang B, Guo M, Zhang Y. The association between sleep duration and prostate cancer: a systematic review and meta-analysis. Medicine (Baltimore). 2020; 99(28): e21180. doi: 10.1097/md.0000000000021180
6. Marshall AD, Pawlotsky JM, Lazarus JV, Aghemo A, Dore GJ, Grebely J. The removal of DAA restrictions in Europe - one step closer to eliminating HCV as a major public health threat. J Hepatol. 2018; 69(5): 1188-96. doi: 10.1016/j.jhep.2018.06.016
7. Langford DJ, Lee K, Miaskowski C. Sleep disturbance interventions in oncology patients and family caregivers: a comprehensive review and meta-analysis. Sleep Med Rev. 2012; 16(5): 397-414. doi: 10.1016/j.smrv.2011.07.002
8. Wang J, Janson C, Lindberg E, Holm M, Gislason T, Benediktsdottir B, et al. Dampness and mold at home and at work and onset of insomnia symptoms, snoring and excessive daytime sleepiness. Environ Int. 2020; 139: 105691. doi: 10.1016/j.envint.2020.105691
9. Trudel-Fitzgerald C, Zhou ES, Poole EM, Zhang X, Michels KB, Eliassen AH, et al. Sleep and survival among women with breast cancer: 30 years of follow-up within the Nurses’ Health Study. Br J Cancer. 2017; 116(9): 1239-46. doi: 10.1038/bjc.2017.85
10. Tag Eldin ES, Younis SG, Aziz L, Eldin AT, Erfan ST. Evaluation of sleep pattern disorders in breast cancer patients receiving adjuvant treatment (chemotherapy and/or radiotherapy) using polysomnography. J BUON. 2019; 24(2): 529-34.
11. Chen Q, Terhorst L, Lowery-Allison A, Cheng H, Tsang A, Layshock M, et al. Sleep problems in advanced cancer patients and their caregivers: who is disturbing whom? J Behav Med. 2020; 43(4): 614-22. doi: 10.1007/s10865-019-00088-3
12. Mogavero MP, DelRosso LM, Fanfulla F, Brunì O, Ferri R. Sleep disorders and cancer: state of the art and future perspectives. Sleep Med Rev. 2021; 56: 101409. doi: 10.1016/j.smrv.2020.101409
13. Ho RT, Kwan TT, Cheung IK, Chan CK, Lo PH, Yip PS, et al. Association of fatigue with perceived stress in Chinese women with early stage breast cancer awaiting adjuvant radiotherapy. Stress Health. 2015; 31(3): 214-21. doi: 10.1002/smi.2548
14. Lin PJ, Kleckner IR, Loh KP, Inglis JE, Peppeone LJ, Janselins MC, et al. Influence of yoga on cancer-related fatigue and on mediational relationships between changes in sleep and cancer-related fatigue: a nationwide, multicenter randomized controlled trial of yoga in cancer survivors. Integr Cancer Ther. 2019; 18: 1534735419855134. doi: 10.1177/1534735419855134
15. Porro B, Michel A, Zimindohoué C, Bertrand P, Monrigal E, Trentini F, et al. Quality of life, fatigue and changes therein as predictors of return to work during breast cancer treatment. Scand J Caring Sci. 2019; 33(2): 467-77. doi: 10.1111/scs.12646
16. Fox RS, Ancoli-Israel S, Roesch SC, Merz EL, Mills SD, Wells KJ, et al. Sleep disturbance and cancer-related fatigue symptom cluster in breast cancer patients undergoing chemotherapy, Support Care Cancer. 2020; 28(2): 845-55. doi: 10.1007/s00520-019-04834-w
17. Imanian M, Imanian M, Karimyar M. Sleep quality and fatigue among breast cancer patients undergoing chemotherapy. Int J Hematol Oncol Stem Cell Res. 2019; 13(4): 196-200.
18. Momayyezi M, Fallahzadeh H, Farzaneh F, Momayyezi M. Iranian version of cancer-related fatigue questionnaire: construction and validation. Zahedan J Res Med Sci. 2018; 20(12): e69187. doi: 10.5812/jzrms.69187
19. Graves JK, Jacob E. Pain, coping, and sleep in children and adolescents with sickle cell disease. J Child Adolesc Psychiatr Nurs. 2014; 27(3): 109-20. doi: 10.1111/jcap.12077
20. Buyssse DJ, Reynolds CF, 3rd, Monk TH, Berman SR, Kupper DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989; 28(2): 193-213. doi: 10.1016/0165-1781(89)90047-4
21. Backhaus J, Junghanns K, Broocks A, Riemann D, Hohagen F. Test-retest reliability and validity of the Pittsburgh Sleep Quality Index in primary insomnia. J Psychosom Res. 2002; 53(3): 737-40. doi: 10.1016/s0022-3999(02)00330-6
22. Al Maqbali M, Hughes C, Gracey J, Rankin J, Dunwoody L, Hage E, Trentini F , et al. Quality of life, fatigue and changes therein as predictors of return to work during breast cancer treatment. Scand J Caring Sci. 2019; 33(2): 467-77. doi: 10.1111/scs.12646
23. Wu LM, Amidì A, Valdimarsdottir H, Ancoli-Israel S, Liu

Journal of Caring Sciences, 2021, Volume 10, Issue 3 | 151
L, Winkel G, et al. The effect of systematic light exposure on sleep in a mixed group of fatigued cancer survivors. J Clin Sleep Med. 2018; 14(1): 31-9. doi: 10.5664/jcsm.6874
24. George GC, Iwuanyanwu EC, Anderson KO, Yusuf A, Zinner RG, Piha-Paul SA, et al. Sleep quality and its association with fatigue, symptom burden, and mood in patients with advanced cancer in a clinic for early-phase oncology clinical trials. Cancer. 2016; 122(21): 3401-9. doi: 10.1002/cncr.30182
25. Weber D, O’Brien K. Cancer and cancer-related fatigue and the interrelationships with depression, stress, and inflammation. J Evid Based Complementary Altern Med. 2017; 22(3): 502-12. doi: 10.1177/2156587216676122
26. Berger AM, Kupzyk KA, Djallalova DM, Cowan KH. Breast Cancer Collaborative Registry informs understanding of factors predicting sleep quality. Support Care Cancer. 2019; 27(4): 1365-73. doi: 10.1007/s00520-018-4417-5
27. Kuo HH, Chiu MJ, Liao WC, Hwang SL. Quality of sleep and related factors during chemotherapy in patients with stage I/II breast cancer. J Formos Med Assoc. 2006; 105(1): 64-9. doi: 10.1096/jfma.06-50110-8
28. Zemestani M, Hasannejad L, Nejadian A. Comparison of quality of life, sleep quality and social adjustment of cancerous patients with intact individual in Ahvaz city. Stud Med Sci. 2013; 24(7): 471-82. [Persian].
29. Lee K, Cho M, Miaskowski C, Dodd M. Impaired sleep and rhythms in persons with cancer. Sleep Med Rev. 2004; 8(3): 199-212. doi: 10.1016/j.smrv.2003.10.001
30. Huang T, Poole EM, Vetter C, Rexrode KM, Kubzansky LD, Schernhammer E, et al. Habitual sleep quality and diurnal rhythms of salivary cortisol and dehydroepiandrosterone in postmenopausal women. Psychoneuroendocrinology. 2017; 84: 172-80. doi: 10.1016/j.psyneuen.2017.07.484
31. Park JH, Lee SJ, Gwak JI, Shin JY, Lee JK. Sleep quality of breast cancer patients receiving chemotherapy in the outpatients setting. Korean J Fam Med. 2010; 31(10): 778-85. doi: 10.4082/kjfm.2010.31.10.778
32. Momayyezi M, Fallahzadeh H, Farzaneh F, Momayyezi M. Sleep quality and disturbances in children and adolescents with cancers: a cross-sectional study. Int J Pediatr. 2018; 6(4): 7529-42. doi: 10.22038/ijp.2018.28729.2509
33. Beverly CM, Naughton MJ, Pennell ML, Foraker RE, Young G, Hale L, et al. Change in longitudinal trends in sleep quality and duration following breast cancer diagnosis: results from the Women’s Health Initiative. NPJ Breast Cancer. 2018; 4: 15. doi: 10.1038/s41552-018-0065-7
34. Loh KP, Zittel J, Kadambi S, Pandya C, Xu H, Flannery M, et al. Elucidating the associations between sleep disturbance and depression, fatigue, and pain in older adults with cancer. J Geriatr Oncol. 2018; 9(5): 464-8. doi: 10.1016/j.jgo.2018.02.006
35. Schreier AM, Johnson LA, Vohra NA, Muzaffar M, Kyle B. Post-treatment symptoms of pain, anxiety, sleep disturbance, and fatigue in breast cancer survivors. Pain Manag Nurs. 2019; 20(2): 146-51. doi: 10.1016/j.pmn.2018.09.005
36. Sundberg K, Wengström Y, Blomberg K, Hälleberg-Nyman M, Frank C, Langius-Eklöf A. Early detection and management of symptoms using an interactive smartphone application (Interaktor) during radiotherapy for prostate cancer. Support Care Cancer. 2017; 25(7): 2195-204. doi: 10.1007/s00520-017-3625-8
37. Uhm KE, Yoo JS, Chung SH, Lee JD, Lee I, Kim JI, et al. Effects of exercise intervention in breast cancer patients: is mobile health (mHealth) with pedometer more effective than conventional program using brochure? Breast Cancer Res Treat. 2017; 161(3): 443-52. doi: 10.1007/s10549-016-4065-8
38. Golshani G, Pirnia B. Comparison of mindfulness-based cognitive therapy (MBCT) with acceptance and commitment therapy (ACT) on the severity of fatigue, improvement of sleep quality and resilience in a patient with prostate cancer: a single-case experimental study. Int J Cancer Manag. 2019; 12(2): e88416. doi: 10.5812/ijcm.88416
39. Gabra RH, Hashem DF. Sleep disorders and their relationship to other psychiatric disorders in women with breast cancer: a case-control study. Middle East Curr Psychiatry. 2021; 28(1): 10. doi: 10.1186/s43045-021-00090-z