Title Page

Fatigue and Sleep Disturbance in Arabic Cancer Patients Following Completion of Therapy: Prevalence, Correlates and Association with Quality of Life

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Background: Fatigue and sleep disturbance are two of the most common and distressing cancer symptoms that negatively affect quality of life.

Objective: To assess the prevalence of, and factors contributing to, fatigue and sleep disturbance in Arabic-speaking cancer patients in Oman following completion of their cancer treatment.

Methods: A cross-sectional and descriptive correlational design was used. Data were collected using the Pittsburgh Sleep Quality Index (PSQI >5), the Functional Assessment of Cancer Therapy- Fatigue (FACT-F $\leq$ 34) and the Functional Assessment of Cancer Therapy – General.

Results: Of the 369 patients that participated, 77.5% (n=286) reported clinically-significant fatigue, and 78% (n=288) reported poor sleep. Fatigue ($P<.05$) was significantly associated with age, cancer site, months since diagnosis, type of treatment received, and comorbidity. Those experiencing fatigue and poor sleep had the lowest quality of life among the cancer patients studied.

Conclusion: Fatigue and sleep disturbance are significant problems for the Arabic patients diagnosed with cancer. Both fatigue and sleep disturbance should be routinely assessed in the case of such patients.

Implications for Practice: Routine assessments of fatigue and sleep disturbance are recommended so that appropriate interventions and treatment management plans can be introduced to reduce fatigue and improve sleep quality among patients with cancer.

Introduction

Cancer is a major life stressor that can affect the physiological, psychological and physical state of the person diagnosed. The cancer journey can involve pain, weakness and fatigue, and can reduce functioning in terms of active daily living. The World Health Organization estimates that there were 24.5 million cases of newly-diagnosed cancer, and over 9.6 million deaths in 2017. [1] The number of new cancer diagnoses is expected to rise in the next two decades by about 70% globally. [2] In Oman, more than 1,615 patients were diagnosed with cancer in 2015. [3]

In a review of 37 research articles, Wu and Harden [4] identified that fatigue, depression, sleep disturbance and pain symptoms were experienced by more than one-third of cancer survivors after treatment. The prevalence of cancer-related fatigue is estimated at between 50% and 92%. [5] Fatigue has been shown to negatively affect daily activity levels and quality of life (QoL). [6,7] Jones et al. [8] reported that fatigue is also associated with high levels of disability.

In the current study, three definitions were adopted. First, Cella et al.[9] defined fatigue as '…a subjective state of overwhelming and sustained exhaustion and decreased capacity for physical and mental work that is not relieved by rest'. Second, Buysse [10] defined sleep health as '…a multidimensional pattern of sleep-wakefulness, adapted to individual, social, and environmental demands, that promotes physical and mental well-being'. Last, Cella [11] described QoL as '…the extent to which one's usual or expected physical, emotional, and social well-being are affected by a medical condition or its treatment'.

Fatigue may occur during treatment for cancer; it typically increases during radiation therapy[12], chemotherapy [13] and biological therapy.[14] In addition, even after completion of primary treatment, fatigue persists in more than 50% to 65% of patients, for months or even years.[15,16] It is important to

study the incidence of fatigue in various populations to establish cultural variations and to establish normative data in specific populations.

Patients diagnosed with cancer often experience sleep disturbance, particularly insomnia. Sleep disturbance affects between 50% to 75% of cancer patients.[17] It has also been linked to the likelihood of cancer recurrence [18,19] and may result in poor healing, [20] decreased cognitive functioning,[21] and reduced work activity.[22] In addition, sleep disturbance in cancer patients can negatively impact their health-related QoL, which includes physical and psychological functioning.[23,24]

Rationale of the Study

In the Omani population, there are no published data on the prevalence of fatigue, sleep disturbance and/or altered QoL in cancer patients. In addition, the Gulf countries that have the same culture and share the same language (Arabic) have not published studies that address fatigue and sleep disturbance in cancer patients. Omani cancer patients share the same values, culture and beliefs as patients living in many other Arabic countries; however, most studies on fatigue, sleep disturbance and QoL have been conducted in Western cultures. The subjective nature of patients' reported assessments of their symptoms might be different in Arabic countries. This study focused on the prevalence of fatigue, sleep, and QoL within an Arabic culture to provide prevalence information with regard to fatigue, sleep disturbance, and QoL within Arabic-speaking cancer patients in Oman.

Study Aims

The aims of this study were to (1) assess the prevalence of, and factors contributing to, fatigue and sleep disturbance in Arabic-speaking cancer patients in Oman following completion of their cancer treatment, and (2) assess their fatigue in relation to sleep disturbance, health-related QoL, demographics and treatment characteristics.

Methods

Study Design and Sample

A quantitative design incorporating a cross-sectional survey was used. Participants were recruited from the National Oncology Centre's outpatient clinic from November 2017 to January 2019. The inclusion criteria for participating in the study were: adult patients above 18 years of age; able to speak and write in Arabic; no known psychiatric or neurological disorders that could interfere with study participation (such as schizophrenia or Parkinson's disease); diagnosed with any type of cancer; and completed surgical intervention, chemotherapy and/or radiotherapy treatment at least one month prior to recruitment, but during the last 12 months. Exclusion criteria included being less than 18 years of age, currently undergoing chemotherapy or radiotherapy treatment, or newly diagnosed with cancer.

Instrument Used

Demographic data and treatment characteristics were collected from patients. The study used three instruments to measure fatigue, sleep disturbance, and QoL.

Fatigue

The Functional Assessment of Cancer Therapy-Fatigue subscale (FACT-F), consisting of 13-items, assesses self-reported fatigue in the previous seven days.[25] The response options from the 5-point Likert scale for each item range from 0 to 4. The total score of the FACT-F ranges from 0 to 52. A higher score indicates less or no fatigue, whereas a lower score indicates more fatigue. Van Belle et al. [26] identified the cut-off point of the FACT-F value as 34 for a diagnosis of fatigue in patients with cancer, with a score equal to or less than 34 indicating clinically-significant fatigue. The original FACT-F showed strong internal consistency (*coefficient alpha* 0.93-0.95) and good stability (*test-retest* r =0.87).[25] The Arabic version of FACT-F showed very good internal consistency (Cronbach's α = .94). [27]

Quality of Life

The Functional Assessment of Cancer Therapy-General (FACT-G) version 4 [28,29] measures QoL using 27-items that are divided into four domains: physical well-being (PWB) (7-items); social/family well-being (SWB) (7-items); emotional well-being (EWB) (6-items); and functional well-being (FWB) (7-items). Each sub-scale score can be calculated separately if more than 50% of the items are answered. The response options from the 5-point Likert scale for each item range from 0 to 4. The total score is calculated by summing all individuals' sub-scales (PWB+SWB+EWB+FWB); the total score can range from 0 to 108. A higher score indicates a good level of QoL, whereas a lower score indicates a reduced level of QoL. The Cronbach's α value of the Arabic version of FACT-G is .92. [27]

Sleep Quality

The Pittsburgh Sleep Quality Index (PSQI) was used to assess sleep quality over the previous month.[30] The PSQI consists of 19-items categorized into seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications and daytime dysfunction. The score of each of the seven components can range from 0 to 3. The global score of the PSQI is calculated by summing the seven components, which can range from 0 to 21, with higher scores indicating poor sleep quality in the previous month. If the global score was more than five, then the participants were classified as experiencing poorer sleep; if the score was less than or equal to five, they were classified as experiencing good sleep. The PSQI has acceptable reliability in terms of Arabic cancer patients (Cronbach's $\alpha = .77$).[31]

Data Analysis

The data were entered into the Statistical Package for the Social Science (SPSS), version 25. In order to address the research questions, descriptive statistics were calculated in the form of means, standard deviations, standard errors, frequency, and percentages for all the scales, sub-scales and participant variables. Independent *t*-test and chi-squares (or Fisher's exact test) were used to test whether or not the

levels of fatigue, sleep quality and QoL differed in terms of demographics and treatment characteristics.

Two separate logistic regressions were conducted. The first was to identify the association of (demographic, treatment characteristic, PSQI seven components, and FACT-G subscales) factors that predict significant fatigue in patients (FACT-F ≤34) diagnosed with cancer. The second was to identify the predicting variables of 'poorer sleep' (PSQI >5) using the demographic, treatment characteristic, FACT-F, and FACT-G sub-scales variables. The Hosmer-Lemeshow test was applied to assess the model's goodness-of-fit test. $P<.05$ was considered to be statistically significant for all analyses.

Ethical Considerations

Ethical permission was sought initially from the Nursing and Health Research Institute Filter Committee at Ulster University. As the research was conducted in the National Oncology Centre of the Royal Hospital in Oman, ethical approval was also sought from the Ministry of Health in Oman via the Research and Ethical Review and Approval Committee in the Directorate General of Planning and Studies at the Ministry of Health (MoH/DGPS/CSP/PROPOSAL_ APPROVED/31/2017).

Results

Demographic and Treatment Characteristics

Of the 400 patients eligible to participate, 369 participants completed and returned valid questionnaire booklets, giving a response rate of 92.2%. Thirty-one patients were not included in the study; thirteen did not return the questionnaire booklet, eleven declined to participate, and seven did not complete enough of the questionnaire booklet for their responses to be included.

The majority of the participants were female (66.4%, n=245), and the largest age group was 41-50 years of age (25.7%, n=95), followed by 31-40 years (22.8%, n=84). Approximately three-quarters of

the participants were married 74% (n=273), with single participants accounting for 10.8% (n=40) (Table 1).

The most frequent cancer sites were breast 37.7% (n=139) and colorectal (14.6%, n=54). The tumor stages ranged from 1 to 4 and unspecified; most participants had stage II cancers (39.3% n=145). Furthermore, 42.5% (n=157) of the participants had been diagnosed within the previous year, whereas 34.4% (n=127) were diagnosed 12 to 24 months previously. Most participants, (63.4%, n=234), had received both chemotherapy and radiotherapy. More than half (52.3% n=193) of the participants did not have previous medical problems.

Prevalence of Fatigue

In the total group, the mean fatigue score was 22.70 (SD. 12.99, 0-52). Of the 369 patients, 286 (77.5%) experienced clinically-significant fatigue (FACT-F $\leq$ 34) and 83 (22.5%) were not fatigued. There were significant differences in fatigue by age (χ^2 (4, N=369) =14.399, p=.006) with the highest proportion of fatigue found among participants aged between 51 and 60 (22.7% vs. 13.3%), and among those over 60 (24.1% vs. 10.8%) compared with the non-fatigue groups. There were also significant differences in fatigue (χ^2 (9, N=369) =18.276, p=0.032) according to cancer site; participants with colorectal, lung, gastrointestinal, brain, gynecological, and lymphoma were more likely to have fatigue compared to non-fatigue groups.

Fatigue differed significantly in relation to the number of months since diagnosis (χ^2 (8, N=369) =8.65, p=.034); participants diagnosed with cancer within the previous twelve months were more likely to have fatigue (46.2% vs. 31.2%). There were significant differences in cases of fatigue according to the type of treatment (χ^2 (2, N=369) =10.791, p=.005) with the highest proportion of fatigue found among participants treated with both chemotherapy and radiotherapy (67.8% vs. 48.2%) compared to the non-fatigue groups. Fatigue was more prevalent among patients with asthma (2.8% vs. 0%), anemia (4.5%

vs. 0%), hypertension/heart failure (18.2% vs. 10.8%), diabetes/heart diseases (18.9% vs. 7.2%), and others (3.8% vs. 2.4%) when compared to non-fatigue groups. There were no differences in fatigue according to gender (p=.41), marital status (p=.26), education level (p=.56), employment status (p=.15) and stage of cancer (p=.60).

Participants with fatigue reported lower mean scores of the QoL scale and sub-scales compared to non-fatigue patients (Table 2). In addition, in the fatigue groups (M=10.23, SD=3.99), the level of PSQI was lower compared to that in the non-fatigue groups (M=5.76, SD=2.95), t (177.758) =11.15, p<.05, indicating that fatigue is related to poor sleep. Among the seven sub-scales of the PSQI, there were six significantly associated with worse fatigue: subjective sleep quality, sleep latency, habitual sleep efficiency, sleep disturbances, use of sleep medications and daytime dysfunction. Only sleep duration was not statistically significantly associated with fatigue (P=.06).

Prevalence of Sleep Disturbance

The mean PSQI score was 9.22 (SD, 4.2, ranging from 1 to 20) and the prevalence of poorer sleep among participants was 78% (n=288) using a cut-off score of 5, which is the clinically significant indication of poorer sleep. There were no differences in reporting poor sleep according to gender (p=.36), age (p=.14), education level (p=.77), employment status (p=.36), stage of cancer (p=.15) and time since diagnosis (p=.78). Marital status had a significant influence on the poor sleep group χ^2 (2, N=369) =8.583, p=.014, with a higher prevalence of married (74.3% vs. 72.8%) and divorced/separated/widowed (17% vs. 8.6%) participants being identified as poorer sleepers compared to the good sleepers group. Finally, significant effects on sleep were associated with cancer site (χ^2 (9, N=369) =17.163, p=.04), with poorer sleep associated with colorectal, stomach, lung, gastrointestinal, brain, lymphoma and gynecological cancers.

There were significant differences observed in patients receiving both chemotherapy and radiotherapy (66.7% vs. 51.9%) compared with other treatments (χ^2 (2, N=369) =10.044, *p*=.007) who reported poor sleep. Participants with asthma, anemia, hypertension/heart failure, diabetes/heart diseases and other comorbidities were more likely to report poor sleep (χ^2 (6, N=369) =24.961, *p*=.001) compared to good sleepers.

Participants with poorer sleep had significantly lower fatigue scores (M=19.4, SD=14.2) than good sleepers (M=34.38, SD=11.63), t (10.41) =367, p<0.05), indicating that poor sleepers had reported more fatigue. The poorer sleep had significantly lower mean scores for QoL (M=64.64, SD=16.9) as well as PWB (M=10.1, SD=7.61), EWB (M=14.08, SD=5.47) and FWB (M=18.28, SD=5.42) compared to good sleeper groups (p<.05). Only the SWB subscale demonstrated no significant difference between the two sleep quality groups (Table 3).

Predictive Factors for Fatigue

All the variables were selected to form a logistic regression model. Twelve independent variables were significantly associated with fatigue (Table 4). The strongest predictor of fatigue was the number of months since diagnosis; those with fewer than 12 months were 10.9 times more likely to suffer fatigue (95% CI:1.369-86.820; *p*=.024). The second predictor of fatigue was employment status; employed participants were 9.6 times more likely to suffer fatigue (95% CI: 1.583-58.934; *p*=.014). Participants with sleep latency or sleep disturbance issues were 3.5 times (95% CI: 1.715-7.309; *p*=.001) and 2.7 times (95% CI: 1.079-6.820; *p*=.034) respectively, to be more likely to experience fatigue. Social and family well-being also significantly predicted fatigue, as participants were twice as likely to exhibit fatigue if they had social problems.

Predictive Factors for Poor Sleepers

All the variables were selected to form a logistic regression model. Four independent variables were significantly associated with sleep disturbances (Table 5). The strongest predictor of sleep disturbances was age; those between 18 and 30 years of age were 10 times more likely to have sleep disturbances than was revealed in the case of other variables (95% CI:1.093-93.091; p=.042). The other predictors were single marital status and PWB. The fatigue scale mean significantly predicted poor sleepers (aOR: 0.929, CI; 0.887-0.974).

Discussion

To the best of our knowledge, this is the first study to examine the prevalence of fatigue, sleep disturbance and QoL among Arabic cancer patients in Oman following treatment. The main findings indicate that over 77% of the patients in this study experienced clinically-significant fatigue. These results are higher than those found in previous studies reporting post-treatment fatigue in diverse cancer populations, with rates varying from 39% in the Netherlands [32] to 60% in the United States,[33] a difference that may be partially explained by the majority of participants (63.4%) having received combined chemotherapy and radiotherapy. This is consistent with other studies which have found that survivors treated with combined radiotherapy and chemotherapy are at higher risk of increased fatigue.[8,34] Boer et al.[35] suggested that combined radiotherapy and chemotherapy was more toxic than chemotherapy alone.

The prevalence of fatigue in Arabic cancer patients in Oman was influenced by age, with fatigue being significantly more prevalent in patients over the age of 51. Previous research also indicated that older patients with cancer report more fatigue than younger patients.[36,37] Giacalone et al. [38] suggested that elderly people who have survived cancer, but who live with comorbidity conditions, may have an increased prevalence of fatigue. In our study, 67.6% (119/176) of participants over the age of 51 years reported comorbidities; moreover, comorbidities (asthma, anemia, hypertension/heart failure and

diabetes/heart diseases) were significantly associated with the increased prevalence of fatigue. There may be unique features of certain types of cancer and cancer treatment strategies that increase the probability of experiencing fatigue. In the current study, participants diagnosed with colorectal, gastrointestinal, lymphoma and gynecological cancers reported a significantly greater prevalence of fatigue compared with individuals with other cancers. Other studies have similarly found that fatigue varies by cancer type.[39,40] This may be attributable to the type of cancer treatment and management.

The findings of the current study demonstrate decreased fatigue over time following a diagnosis; participants diagnosed with cancer within the previous twelve months were more likely to have fatigue than those with a diagnosis of a year or longer. Wang et al.[41] and Matias et al. [42] have indicated that fatigue decreases after the second year from diagnosis. Persistent fatigue in cancer survivors might be linked to chronic inflammatory processes. [43]

Fatigue has deleterious effects on QoL, as the patients feel tired and lack the energy to perform daily activities. The results of this study indicate a significant association between fatigue and all the mean scores of the QoL scale, and the PSQI subscales and global score. Participants with fatigue report lower levels of QoL and increased sleep disturbance. Previous studies have indicated the direct influence of fatigue in lowering QoL and causing disturbed sleep on the part of patients diagnosed with cancer.[44–46] Therefore, this work supports the findings from previous studies in different populations.

Sleep Disturbance

The mean global PSQI score in the current study was 9.18 (SD=3), similar to findings within other populations, including in Danish (7.01(SD=3.89) [47] and Iranian (8.97(SD=2.96) samples. [48] The prevalence of sleep disturbances (PSQI >5) was 78%, which is higher than the findings by George et al. [44] who reported sleep difficulty as 64% (total sample size n=256), but comparable to the estimates

by Wu et al., [49] who reported the percentage of sleep difficulty in cancer survivors as 77.3% (total sample size n=44); both studies were conducted in United States.

Poor sleep quality was significantly higher in patients who received both chemotherapy and radiation therapy in their primary treatment. Moreover, comorbidities had a significant impact on sleep. Many factors can contribute to sleep difficulties such as chemotherapy, radiation therapy and comorbidities.[50,51] There are a number of demographic and treatment characteristic variables previously reported as being associated with an increased rate of sleep disturbance such as gender, age, education level, employment status, cancer site, stage of cancer and time since diagnosis; [17,52,53] however, in this study, these variables were not statistically significantly associated with sleep disturbance. There may be unique features of sample characteristics between studies, for example certain types of cancer and cancer treatment strategies, that increase the association of sleep disturbance with different variables.

This study has found that poor sleepers had low overall QoL and that fatigue has a significant effect on sleep disturbance. A similar result was reported by Van Leeuwen et al., [24] George et al.,[44]and Dickerson et al.,[49]. Sleep disturbance appears to contribute to fatigue. Understanding the underlying causes of both fatigue and sleep disturbance is essential for improving interventions that can help to reduce the symptoms and improve the QoL of cancer survivors.

In this study, time, specifically the first 12 months after a diagnosis, was the most robust predictor of fatigue. Moreover, it was found that fatigue was predicted by all QoL subscales; physical, social/family, emotional and functional well-being. These findings are in line with other research describing the prediction of fatigue in association with similar variables.[23,55] In the present study, marital status (single), the PWB subscale and fatigue predicted sleep disturbance. Otte et al. [56] documented that sleep disturbance was less likely to occur in individuals who were married. This may be because single patients (unmarried) may have less social and emotional support, thus leading to

loneliness and poor sleep.[57,58] However, the family structure in Oman is different from that found in many other countries; around 60% consist of an extended family cohabitating, such as a single person living with parents, grandparents, brothers, sisters, and sometimes married brothers with children all living in the same home with a grandparent or in an adjacent house.[59] Further study is required to identify the factors that affect sleep disturbance among single patients with cancer. Our results suggest that poor sleep quality and fatigue could impede the ability of cancer patients to function in daily life.

Limitations

The study has a number of limitations. The study utilized a cross-sectional design, and therefore findings represent fatigue, sleep disturbance and QoL at one point in time. The study relied on the participants' self-reporting, without any objective metrics to support the self-reports. The inclusion criteria might have contributed to selection bias because only participants who had completed surgical intervention, chemotherapy and/or radiotherapy treatment, either at least one month prior to recruitment or during the previous 12 months, were included. Another study limitation was sample heterogeneity, as different types and stages of cancer, with different treatments and types of management were included. Nevertheless, it is important to acknowledge that this study has explored fatigue and sleep disturbance in most types of cancer, which can provide a direction for investigating a specific type of cancer in future research.

Finally, the study design does not provide data regarding fatigue and sleep disturbance present prior to the diagnosis of cancer. It would be important for further research to include a longitudinal study to identify the prevalence of fatigue and sleep disturbance before, during and after the treatment of cancer.

Implications for Practice

More than 75% of the participants in this study reported significant fatigue, but most healthcare professionals in Oman do not assess fatigue on a regular basis. This study provides evidence that cancer patients in Oman experience clinically-significant fatigue that is similar to cancer patients' experience elsewhere, making it advisable for healthcare professionals to conduct regular assessments of fatigue and provide appropriate management. In this study, approximately 75% of the participants were considered to be poor sleepers, with a resulting negative effect on QoL. Routine fatigue and sleep disturbance assessments in the clinical settings of Oman might identify patients in need of management strategies to reduce fatigue and improve sleep quality.

Conclusion

This is the first study to provide evidence of the prevalence of fatigue and sleep disturbance among Omani Arabic cancer patients. Fatigue and sleep disturbance were significantly related to decreased quality of life for this patient group. Appropriate management for fatigue and sleep disturbance in Arabic cancer patients is needed.

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Table 1: Demographic and Clinical Characteristic of Participants with Fatigue and Sleep Disturbance Scores:

			Non-fatigued (FACT-F > 34) (n=83) (22.5%)		Fatigued (FACT-F ≤ 34) (n=286) (77.5%)				Poor Sleeper (PSQI > 5) n=288 (78%)		Good Sleeper (PSQI ≤ 5) n=81 (22%)			
	n	%	n	%	n	%	(*df*) χ^2	*P*	n	%	n	%	(*df*) χ^2	*P*
Gender							(1) 0.531	.41					(1).834	.361
Male	124	33.6	31	37.3%	93	32.5%			93	32.3%	31	38.3%		
Female	245	66.4	52	62.7%	193	67.5%			195	67.7%	50	61.7%		
Age							(4)14.399	.006					(4)6.793	.147
18-30	36	9.8	10	12%	26	9.1%			26	9%	10	12.3%		
31-40	84	22.8	23	27.7%	61	21.3%			60	20.8%	24	29.6%		
41-50	95	25.7	30	36.1%	65	22.7%			72	25%	23	28.4%		
51-60	76	20.6	11	13.3%	65	22.7%			64	22.2%	12	14.8%		
More than 60	78	21.1	9	10.8%	69	24.1%			66	22.9%	12	14.8%		
Marital Status							(2)2.625	.269					(2)8.583	.014
Married	273	74	62	74.7%	211	73.8%			214	74.3%	59	72.8%		
Single	40	10.8	12	14.5%	28	9.8%			25	8.7%	15	18.5%		
Divorced/ Separated /widowed	56	15.2	9	10.8%	47	16.4%			49	17%	7	8.6%		
Education Level							(3)2.03	.566					(3)1.130	.77
None	75	20.3	15	18.1%	60	21%			61	21.2%	14	17.3%		
Basic Education	89	24.1	17	20.5%	72	25.2%			69	24%	20	24.7%		
Secondary Education	104	28.2	28	33.7%	76	26.6%			78	27.1%	26	32.1%		
Degree	101	27.4	23	27.7%	78	27.3%			80	27.8%	21	25.9%		
Employment Stats							(2)1.558	.159					(2)1.998	.368
Employed	125	33.9	24	28.9%	101	35.3%			99	34.4%	26	32.1%		
Retired	71	19.2	19	22.9%	52	18.2%			51	17.7%	20	24.7%		
Unemployed	173	46.9	40	48.2%	133	46.5%			138	47.9%	35	43.2%		
Cancer Site							(9)18.276	.032					(9)17.163	.046
Breast	139	37.7	42	50.6%	97	33.9%			102	35.4%	37	45.7%		

Colorectal	54	14.6	9	10.8%	45	15.7%			46	16%	8	9.9%		
Stomach	18	4.9	6	7.2%	12	4.2%			16	5.6%	2	2.5%		
Others	29	7.9	8	9.6%	21	7.3%			19	6.6%	10	12.3%		
Lung	20	5.4	1	1.2%	19	6.6%			19	6.6%	1	1.2%		
Gastrointestinal	19	5.1	2	2.4%	17	5.9%			17	5.9%	2	2.5%		
Brain	19	5.1	2	2.4%	17	5.9%			17	5.9%	2	2.5%		
lymphoma	20	5.4	3	3.6%	17	5.9%			16	5.6%	4	4.9%		
Gynaecological	24	6.5	2	2.4%	22	7.7%			19	6.6%	5	6.2%		
Urinary	27	7.3	8	9.6%	19	6.6%			17	5.9%	10	12.3%		
Stage							(4)2.717	.606					(4)6.667	.155
One	34	9.2	11	13.3%	23	8%			25	8.7%	9	11.1%		
Two	145	39.3	29	34.9%	116	40.6%			107	37.2%	38	46.9%		
Three	107	29	25	30.1%	82	28.7%			87	30.2%	20	24.7%		
Four	72	19.5	15	18.1%	57	19.9%			62	86.1%	10	13.9%		
Unspecified	11	3	3	3.6%	8	2.8%			7	2.4%	4	4.9%		
Month Since Diagnosis							(3)8.65	.034					(3)1.067	.785
< 12 months	157	42.5	26	31.3%	132	46.2%			122	42.4%	36	44.4%		
12-24 months	127	34.4	29	34.9%	97	33.9%			102	35.4%	24	29.6%		
25-36 months	52	14.1	17	20.5%	35	12.2%			39	13.5%	13	16%		
> 36 months	33	8.9	11	13.3%	22	7.7%			25	8.7%	8	9.9%		
Type of Treatment Finished							(2)10.791	.005					(2)10.044	.007
Chemo and Radio	234	63.4	40	48.2%	194	67.8%			192	66.7%	42	51.9%		
Chemotherapy	122	33.1	39	47%	82	28.7%			89	30.9%	32	39.5%		
Radiotherapy	13	3.5	4	4.8%	10	3.5%			7	2.4%	7	8.6%		
Comorbidities							(6)23.153	.001					(6)24.961	<.001
None	193	52.3	61	73.5%	132	46.2%			133	46.2%	60	74.1%		
Asthma	8	2.2	0	0%	8	2.8%			8	2.8%	0	0.0%		
Anemia	13	3.5	0	0%	13	4.5%			13	4.5%	0	0.0%		
Diabetes	21	5.7	5	6%	16	5.6%			16	5.6%	5	6.2%		
Hypertensive/ Heart Failure	61	16.5	9	10.8%	52	18.2%			51	17.7%	10	12.3%		
Diabetes/Heart diseases	60	16.3	6	7.2%	54	18.9%			56	19.4%	4	4.9%		
Others	13	3.5	2	2.4%	11	3.8%			11	3.8%	2	2.5%		

Table 2: The Effect of Fatigue Versus no Fatigue on Scores for the FACT-G Subscale and PSQI Subscales

	Non-fatigued (FACT-F > 34) (n=83)		Fatigued (FACT-F ≤ 34) (n=286)				
	Mean	SD	Mean	SD	*t*	*df*	*p*
C1: Subjective sleep quality	.66	.65	1.5	.96	-9.199	196	<.001[a]
C2: Sleep latency	1.18	.86	2	.84	-7.725	367	<.001
C3: Sleep duration	1	.88	1.2	.81	-1.891	367	.06
C4: Habitual sleep efficiency	.67	1.03	1.05	1.07	-2.821	367	.005
C5: Sleep disturbances	1.31	.54	1.76	.66	-6.243	159	<.001[a]
C6: Use of sleep medications	.34	.65	1.13	1.08	-8.311	225	<.001[a]
C7: Daytime dysfunction	.59	.64	1.6	.86	-11.563	175	<.001[a]
PSQI Global score	5.76	2.95	10.23	3.99	11.16	178	<.001[a]
Physical well-being	21.24	5.7	9.48	7	-15.67	161	<.001[a]
Social well-being	23.95	5.14	21.95	4.24	-3.61	367	<.001[a]
Emotional well-being	20.81	2.68	13.6	5.29	-16.8	273	<.001[a]
Functional well-being	23.78	5.17	17.98	5.29	-8.96	136	<.001[a]
Overall Quality of Life	89.78	11.48	63.01	15.51	-17.17	177	<.001[a]

[a] 'Equal variances not assumed' raw was used for interpreting the result (assumption of homogeneity of variance violated).

Table 3 The Effect of Sleep Versus Poor Sleep on Scores for FACT-G Subscale and FACT-F

	Good Sleeper (PSQI ≤ 5) n=81		Poor Sleeper (PSQI > 5) n=288				
	Mean	SD	Mean	SD	*t*	*df*	*p*
FACT-F	34.38	11.63	19.41	11.37	10.41	367	<.001
FACT-G	84.64	15.1	64.64	16.9	10.25	141.37	<.001[a]
Physical well-being	19.32	6.65	10.1	7.61	9.89	367	<.001
Social well-being	23.2	5.52	22.17	4.19	1.82	367	.069
Emotional well-being	19.26	4.51	14.08	5.47	8.68	152.54	<.001[a]
Functional well-being	22.85	5.68	18.28	5.42	6.64	367	<.001

[a] 'Equal variances not assumed' raw was used for interpreting the result (assumption of homogeneity of variance violated).

Table 4: Logistic Regression Results for Predictors of Fatigue (FACT-F ≤ 34) Odds Ratio (95% CI):

Variable	Total	Non-fatigued (FACT-F > 34) (n=83) (22.5%)	Fatigued (FACT-F ≤ 34) (n=286) (77.5%)		
		n%	n%	OR (95% CI)	*p* value
Gender					
Male	124(33.6)	31(37.3)	93(32.5)	**.144(.026-.788)**	**.025**
Age					
18-30	36(9.8)	10(12)	26(9.1)	**.022(.001-.899)**	**.044**
Employment Stats					
Employed	125(33.9)	24(28.9)	101(35.3)	**9.658(1.583-58.934)**	**.014**
Month Since Diagnosis					
< 12 months	157(42.5)	132(46.2)	26(31.3)	**10.902(1.369-86.82)**	**.024**
Type of Treatment Finished					
Chemotherapy	122(33.1)	39(47)	82(28.7)	**.05(.005-.532)**	**.013**
Physical WB	Mean (SD)	21.24(5.70)	9.48(7.00)	**.855(.784-.933)**	**<.001**
Social/Family WB	Mean (SD)	23.95(5.14)	21.95(4.24)	**1.216(1.059-1.397)**	**.006**
Emotional WB	Mean (SD)	20.81(2.68)	13.60(5.29)	**0.773(.661-.904)**	**.001**
Functional WB	Mean (SD)	23.78(5.17)	17.98(5.29)	**0.808(.703-.929)**	**.003**
C2 Sleep latency	Mean (SD)	1.18(.86)	2.00(.84)	**3.541(1.715-7.309)**	**.001**
C3 Sleep duration	Mean (SD)	1.00(.88)	1.20(.81)	**0.343(.139-.845)**	**.02**
C5 Sleep disturbances	Mean (SD)	1.31(.54)	1.76(.66)	**2.713(1.079-6.82)**	**.034**

a Variable(s) entered on step 1: Gender, Age, Marital Status, Education Level, Employment Stats, Cancer Site, Stage, Month Since Diagnosis, Type of Treatment Finished, comorbidities, Physical WB, Social/Family WB, Emotional WB, Functional WB, C1 Subjective sleep quality, C2 Sleep latency, C3 Sleep duration, C4 Habitual sleep efficiency, C5 Sleep disturbances, C6 Sleep medication , C7 Daytime functioning.

Table 5: Logistic Regression Results for Predictors of Poor Sleeper (PSQI >5) Odds Ratio (95% CI):

Variable	Total	Good Sleeper (PSQI ≤ 5) n=81	Poor Sleeper (PSQI > 5) n=288		
Age		n%	n%	OR (95% CI)	*p* value
18-30	36(9.8)	10(12.3)	26(9)	**10.09(1.09-93.09)**	**.04**
Marital Status					
Single	40(10.8)	15(18.5)	25(8.7)	**.09(.01-.59)**	**.01**
Physical WB	Mean (SD)	19.32(6.65)	10.1(7.61)	**.93(.87-.99)**	**.02**
FACT-F	Mean (SD)	34.38(11.63)	19.41(11.37)	**.93(.89-.97)**	**< .001**
Variable(s) entered on step 1: Gender, Age, Marital Status, Education Level, Employment Stats, Cancer Site, Stage, Month Since Diagnosis, Type of Treatment Finished, comorbidities, Physical WB, Social/Family WB, Emotional WB, Functional WB, Fatigue Subscale.					