Prospective evaluation of the prevalence and severity of fatigue in patients with prostate cancer undergoing radical external beam radiotherapy and neoadjuvant hormone therapy

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Objective: *To prospectively evaluate the prevalence and severity of fatigue and its impact on quality of life (QOL) during and after radical external beam radiotherapy (RT) for prostate cancer.*

Method and materials: *Twenty-eight men with prostate cancer undergoing RT over 6-8 consecutive weeks were prospectively accrued. The Brief Fatigue Inventory (BFI), a validated fatigue assessment tool, was administered at five time points: baseline (week 1), middle of RT (week 3-4), end of RT (last week of RT), and follow-up (median 6.5 weeks after RT). The BFI contained nine questions, each using 0-10 ratings to quantify fatigue severity and interference with six QOL domains. The prevalence of moderate-severe fatigue was plotted as a function of time. Mean sum and subscale scores at each time point were compared to baseline scores using Wilcoxon tests. Linear regression analyses were performed to assess associations between fatigue scores and age, tumor and treatment characteristics.*

Results: *The median age was 69 years (range 57-84), Gleason score 7 (range 6-10), and presenting PSA 9.0 ng/mL (range 2.5 ng/mL-103.0 ng/mL). Patients were treated once daily to a median dose of 74 Gy (range 60 Gy-78 Gy) over a median of 37 fractions (range 30-39). Hormone therapy was used in all patients (median duration 12.2 months). The prevalence of moderate-severe present fatigue increased from 7% at baseline to 8% at mid-RT and 32% at RT completion. Compared to baseline (mean score 11.5), fatigue increased significantly mid-RT (mean score 14.6, $p = 0.03$) and peaked at the end of RT (mean score 23.5, $p = 0.001$). Fatigue significantly interfered with walking ability, normal work, daily chores, and enjoyment of life only at the end of RT. After RT completion, fatigue improved but remained higher compared to baseline at 6.5 weeks of follow-up (mean score 15.0, $p = 0.02$). On linear regression analysis, age, Gleason score, PSA, T-stage, hormone therapy duration, RT dose and fractions were not significantly associated with mean fatigue scores.*

Conclusion: *Patients undergoing 6-8 weeks of RT experienced significant fatigue adversely affecting QOL persisting after therapy completion. Since walking ability was not affected until the end of RT, a walking exercise intervention to combat fatigue is likely feasible and is being investigated.*

Key Words: fatigue, prostate cancer, radiation therapy, function, quality of life

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Introduction

Cancer-related fatigue, defined by the National Comprehensive Cancer Network as "a common, persistent, and subjective sense of tiredness related to cancer or to treatment for cancer,"[1] is a significant problem that adversely affects patients' function and quality of life (QOL).[1-5] A National Institute of Health conference on cancer-related symptom management recommends research focus on the incidence, severity and duration of fatigue in subgroups within the cancer population receiving different therapies.[6] To date, several fatigue assessment tools are available.[5-8] Of these, the Brief Fatigue Inventory (BFI) has been demonstrated to be a valid and reliable self-report instrument that allows for rapid assessment of fatigue severity in cancer patients.[8]

The aim of this study is to prospectively examine the prevalence and severity of fatigue and its impact on function and QOL using the BFI in a cohort of patients with prostate cancer undergoing external beam radiotherapy (RT) with curative intent.

Methods

With institutional ethics review approval, 28 consecutive patients receiving radical external beam radiotherapy (RT) at the British Columbia Cancer Agency, Vancouver Island Centre from October 1-December 31, 2004 were offered participation in this study. All patients who were offered the study agreed to participate. After providing informed consent, patients completed the BFI at five time points: baseline (week 1), mid-RT (week 3-5), end of RT (last week of RT), and at follow-up (median 6.5 weeks after RT). The BFI consisted of nine questions (total score 0-90) to quantify fatigue severity and interference with six QOL domains: general activity, mood, walking ability, normal work and daily chores, relations with other people, and enjoyment of life, Figure 1. For each question, a 0 – 10 numeric rating was used with 0 representing no fatigue or interference and 10 representing the worst level of fatigue or complete interference. Fatigue severity was further categorized as: none or no fatigue (0), mild (1-3), moderate (4-6) or severe (7-10). These categories correspond to the statistically determined cutoff between 6 and 7 for severe fatigue and between 3 and 4 for moderate fatigue reported by Mendoza et al.[8]

Patient, tumor, and treatment characteristics examined included patient age at diagnosis, T-stage, presenting PSA level, Gleason score, type and duration of hormone therapy (HT), number of RT fractions, number of RT fields, and total RT dose.

Please circle the number that describes your fatigue (tiredness, weariness):

Q1	Right Now:	0	1	2	3	4	5	6	7	8	9	10
Q2	During the past week:	0	1	2	3	4	5	6	7	8	9	10
Q3	Describe your WORST level of fatigue during the past week	0 No fatigue	1	2	3	4	5	6	7	8	9	10 As bad as you can imagine

Please circle the number that describes how much, during the past week, fatigue has interfered with your:

Q4	General activity	0	1	2	3	4	5	6	7	8	9	10
Q5	Mood	0	1	2	3	4	5	6	7	8	9	10
Q6	Walking ability	0	1	2	3	4	5	6	7	8	9	10
Q7	Normal work, daily chores	0	1	2	3	4	5	6	7	8	9	10
Q8	Relations with other people	0	1	2	3	4	5	6	7	8	9	10
Q9	Enjoyment of life	0 Does not interfere	1	2	3	4	5	6	7	8	9	10 Completely interferes

Figure 1. Brief fatigue inventory.

TABLE 1. **Patient, tumor, and treatment characteristics**

	n	%
Age (years)		
Median 69 (range 57-84)		
50 – 59	1	4
60 – 69	15	53
70 – 79	11	39
80 – 89	1	4
T Stage		
1	1	4
2	13	46
3	9	32
4	1	4
Unknown	4	14
Presenting PSA level (ng/mL)		
Median 9.0 (range 2.5-103)		
≤ 4	2	7
5-10	15	54
11-20	3	11
> 20	8	28
Gleason score		
Median 7 (range 6-10)		
6	5	18
7	14	50
8-10	9	32
Hormone therapy duration		
Median 12.2 months (range 9.1-20.5)		
< 12 months	7	25
≥ 12 months	20	71
Unknown	1	4
# of RT fields		
4	9	32
5	19	68
# of RT fractions		
Median 37 (range 30-39)		
30	1	4
35	9	32
37	16	57
39	2	7
Total RT dose (Gy)		
Median 74 (range 60-78)		
60	2	7
70	9	32
74	15	54
78	2	7

RT = radiotherapy

Statistical analysis

Differences in the mean total BFI score between baseline and each subsequent time point were examined using the Wilcoxon test, a nonparametric test designed to detect differences in two related samples comprising of data that follow nonsymmetrical distribution. Differences in the mean individual scores for each BFI variable between baseline and each time point were also examined. Linear regression analysis was conducted to examine relationships between patient, tumor, and treatment factors and total fatigue scores. The level of statistical significance was established at $P \leq 0.05$. All statistical tests were performed using SPSS 11.0.1 (SPSS Inc., Chicago, IL).

Results

Table 1 presents the patient, tumor, and treatment characteristics of the study cohort. The median age was 69 years (range 57–84 years). The majority of patients had stage T2 and T3 tumors (46% and 32%, respectively). The median Gleason score at diagnosis was 7 (range 6–10) and the median PSA level at diagnosis was 9.0 ng/mL (range 2.5–103.0 ng/mL).

Hormone therapy

All patients in this series received hormone therapy. The median duration of HT was 12.2 months (range 8.6-20.5 months). Eleven patients received Lupron and Flutamide, seven received Lupron, Flutamide, and Casodex, three received Zoladex and Flutamide, three received Zoladex, Flutamide, and Casodex, two received Lupron only, one received Zoladex only, and one received Casodex, Zoladex, Suprefact, and Flutamide. HT was delivered over a 6 to 8-month course prior to RT and the majority of patients continued with HT while receiving external beam RT.

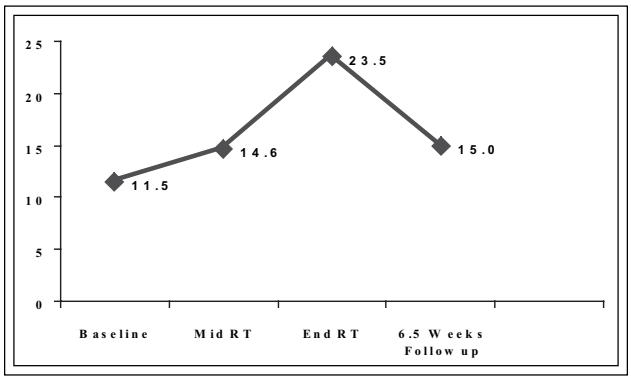

Figure 2. Mean brief fatigue inventory sum scores over time.

TABLE 2. **Prevalence and severity of fatigue over time**

	Time point			
	Baseline	**Mid RT**	**End RT**	**Follow-up (Median 6.5 weeks after RT)**
Present fatigue (Q1)				
None	54	43	29	19
Mild	39	46	39	50
Moderate	7	4	14	11
Severe	0	4	18	4
Unknown	0	4	0	7.0
Fatigue in past week (Q2)				
None	32	18	18	29
Mild	54	64	50	50
Moderate	14	11	11	11
Severe	0	4	21	4
Unknown	0	4	0	7
Worst fatigue during past week (Q3)				
None	32	18	14	25
Mild	46	50	39	47
Moderate	11	14	18	14
Severe	11	14	29	7
Unknown	0	4	0	7

Data reported as % of patients

Radiation therapy

External beam RT was delivered once daily using 18 MV photons targeting the prostate and periprostatic tissues in all patients. Five-field and four-field beam arrangements were used in 68% and 32% of patients, respectively. The median total dose was 74 Gy (range 60 Gy-78 Gy) over a median of 37 fractions (range 30–39).

Mean total fatigue scores

Changes in the mean total fatigue score over time are depicted in Figure 2. Compared to baseline (mean total score 11.5), BFI scores significantly increased during RT (mean total score 14.6, p = 0.03) and at the end of RT (mean total score 23.5, p = 0.001). After RT completion, fatigue improved at 6.5 weeks of follow-up but remained higher compared to baseline (mean score 15.0, p= 0.02).

TABLE 3. **Comparisons of mean fatigue scores over time with mean baseline scores**

	Fatigue level (Q1-3)		**General activity (Q4)**		**Mood (Q5)**		**Walking ability (Q6)**		**Normal work (Q7)**	
	Mean	**p**	**Mean**	**p**	**Mean**	**p**	**Mean**	**p**	**Mean**	**p**
Baseline	5.0	_	0.8	_	1.0	_	1.6	_	1.4	_
Mid RT	6.0	0.04	1.6	0.02	1.3	0.11	1.8	0.39	1.4	0.28
End RT	9.6	0.001	2.6	0.003	2.3	0.003	2.9	0.04	2.8	0.007
6.5 weeks follow-up	6.5	0.009	1.5	0.07	1.0	0.38	1.8	0.19	1.7	0.07

All p values are Wilcoxon comparisons with the mean baseline scores

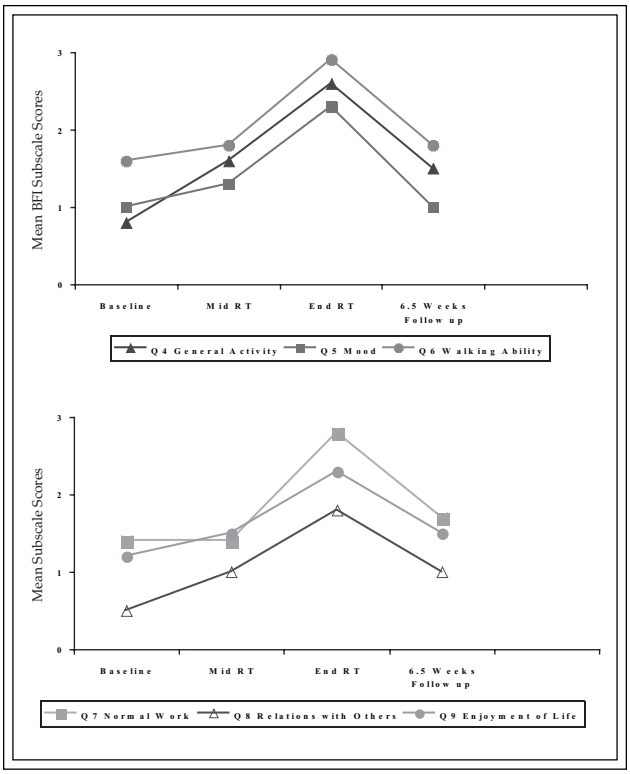

Figure 3. Mean brief fatigue inventory subscale scores over time.

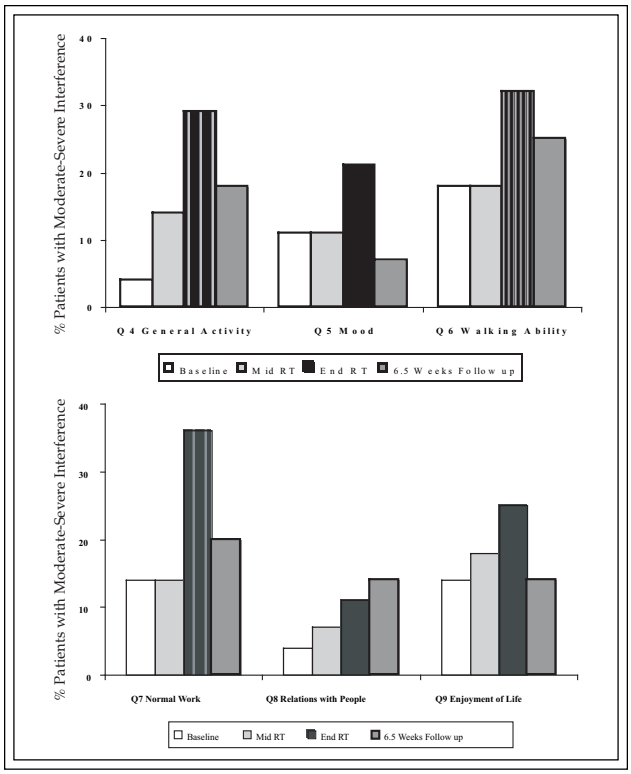

Figure 4. Prevalence of moderate-severe interference with quality of life over time.

Prevalence and severity of fatigue

Patient responses quantifying their total fatigue at present, in the past week, and worst fatigue during the past week are summarized in Table 2. At baseline, 54% of patients reported no present fatigue, 39% reported only mild fatigue, 7% reported moderate fatigue, and no patient reported severe fatigue. The prevalence of any present fatigue increased from 46% at baseline to 71% at the end of RT, and remained high at 64% at 6.5 weeks of follow-up. The prevalence of "fatigue in the past week" and "worst fatigue during the past week" were consistently greater at each time point compared to "present fatigue." In the rating of "worst fatigue during the past week", moderate-severe fatigue was reported by 22% of patients at baseline, increasing to 47% of patients at the end of RT, and 21% at follow up.

Relations with others (Q8)		**Enjoyment of life (Q9)**		**Total score (Q1-9)**	
Mean	**p**	**Mean**	**p**	**Mean**	**p**
0.5	_	1.2	_	11.5	_
1.0	0.01	1.5	0.01	14.6	0.03
1.8	0.003	2.3	0.003	23.5	0.001
1.0	0.05	1.5	0.05	15.0	0.02

Analysis of function and QOL subscales

Examination of the individual BFI subscale scores reveals that fatigue's interference with general activity, mood, walking ability, normal work, relation with others, and enjoyment of life all followed similar time trends peaking at the end of RT, and improving at a median of 6.5 weeks of follow-up, Figure 3.

Comparisons of each subscale scores with the baseline scores are presented in Table 3. Compared to baseline, the overall fatigue level (Q1-3) and the mean total BFI score (Q1-9) were significantly higher at mid-RT and at the end of RT. These scores improved by 6.5 weeks of follow-up, but not to the same levels as baseline ($p = 0.009$ and $p = 0.03$, respectively). In the analysis of fatigue interference with QOL, significant interference with general activity and relations with others were observed at mid RT and at

the end of RT ($p < 0.05$). Significant interference with mood ($p = 0.003$), walking ability ($p = 0.04$), normal work ($p = 0.007$), and enjoyment of life ($p = 0.04$) were observed only at the end of RT, Table 3. The majority of these QOL measures returned to levels similar to baseline at follow up ($p > 0.05$).

Figure 4 summarizes the prevalence of moderate to severe interference with QOL for each subscale over time. The proportion of patients in whom fatigue exerted moderate to severe interference with these six QOL measures increased from 4%–18% at baseline to 11%–36% at the end of RT. The prevalence of moderate to severe interference in these subscales declined at a median of 6.5 weeks after RT but, with the exception of mood, were still higher compared to baseline.

Linear regression analysis

On linear regression analysis, the total BFI scores at baseline, during RT, end of RT and at follow-up were not significantly associated with patient age, T-stage, Gleason score, presenting PSA level, type and duration of HT, number of RT fractions, number of RT fields and total RT dose (all $p > 0.05$).

Discussion

This prospective study confirmed that fatigue is a prevalent problem among patients with prostate cancer receiving radical external beam RT. Over the 6-8 week course of RT, the majority of patients experienced significant increases in fatigue that adversely interfered with different QOL domains reflected by the BFI scores. By the end of RT, 71% of patients reported some degree of fatigue. Although there was some improvement observed on follow-up at a median of 6.5 weeks after RT, the majority of patients still reported fatigue. Fatigue significantly interfered with general activity and relations with other people throughout RT and with walking ability, mood, normal work and enjoyment of life only at the end of RT. While the proportion of patients reporting some adverse effects on QOL from fatigue throughout RT was high, severe adverse effects were less common. After the completion of RT, significant improvements in all QOL domains were observed, except for relations with other people, which improved only slightly and not to baseline levels. We examined fatigue scores at each time point in relation to patient, tumor and treatment characteristics. None of these factors were statistically significant in the linear regression analyses.

Since HT alone or in conjunction with RT may contribute to fatigue, we attempted to evaluate the role of HT on fatigue by examining the duration of HT in the linear regression analysis. This yielded non-significant results. In terms of timing of HT, we note that patients receiving HT in this study were uniformly treated with a 6 to 8-month course of HT prior to RT and the majority continued with HT while receiving external beam RT. There was thus little variation in timing of HT relative to RT. This observation, along with the observation that HT duration was not significant in the regression analysis, support the suggestion that fatigue and its fluctuations over time in this patient cohort are more likely related to the effects of RT rather than HT.

There are few studies focusing on fatigue and QOL in patients with prostate cancer undergoing RT with which to compare our results. In a prospective study similar to the present analysis, investigators at the Veteran Affairs (VA) Medical Center in Houston evaluated fatigue in 36 patients with localized prostate cancer receiving 7-8 weeks of RT.[9] Patients completed the Piper Fatigue Scale consisting of 22 questions, each using a 0-10 rating system, and the Functional Assessment of Cancer Therapy for Prostate (FACT-P),[10] with 46 questions assessing QOL at baseline, middle of RT, completion of RT and at 4-5 weeks follow-up. The proportion of patients reporting fatigue increased from 8% at baseline to 25% at RT completion.[9] By 4-5 weeks of follow-up, while there was some improvement in fatigue, the level of fatigue did not return to baseline levels, a finding consistent with the current analysis. In a subsequent report with longer follow-up, these authors also found that the level of fatigue did not return to baseline at 12 to 24 months after RT.[11] In the VA Medical Center study, the FACT-P results indicate that there were no significant decreases in QOL during RT.[9, 10] This finding differed from our study which found that fatigue significantly interfered with QOL, particularly at the end of RT. While similar RT treatment protocols and data collection time points were used in both studies, the use of hormone therapy was not specified in the VA Medical Center study. Differences in assessment scales may also affect the observed results. Unlike the BFI, the Piper scale does not categorize fatigue severity. Also, the BFI assessed fatigue interference on various QOL parameters rather than general QOL. Due to these sources of variations, direct comparisons between the VA Medical Centre and the present study are limited.

Janda et al examined fatigue and QOL in 43 patients receiving conformal RT with or without HT for T1-T3 prostate cancer.[12] Using the European Organization for Research and Treatment of Cancer (EORTC QLQ-C30) instrument, these authors found

that patients experienced significantly increased fatigue by the completion of RT, which returned to baseline levels by 6 weeks after RT. With respect to QOL, role functioning and emotional functioning significantly decreased from baseline levels at the completion of RT but improved to baseline levels at 6 weeks post-RT.[12]

In a study by Maliski et al of 147 men with prostate cancer,[13] the predictors of fatigue after treatment for prostate cancer were examined using the RAND 36-item Health Survey[14] and the University of California, Los Angeles Prostate Cancer Index.[15] This study found that patients who reported fatigued at follow-up were more likely to be non-white, married, unemployed, and have comorbid conditions compared to patients who did not report fatigue.[13] In addition, patients who had lower baseline energy scores and lower role-emotional functioning scores were more likely to experience significant increases in fatigue at follow-up.[13]

Fatigue among cancer patients has been described by Magnusson et al to encompass three distinct stages characterized by a sense of physical loss, decreases in physical activity, social activity and QOL, and an action stage.[16] In the action stage, patients have reported using self-help measures such as walking, enjoying music and resting to alleviate fatigue.[16] Several measures, including information provision and exercise, have been prospectively studied for their effect in reducing fatigue in patients receiving RT and HT for prostate cancer. In a randomized controlled trial of 152 patients who received radical RT for prostate cancer, patients who were given specific information on what to expect during RT experienced fewer sleeping problems and less fatigue compared to patients who only received general information.[17] In another trial of 65 men receiving radical RT at a prescribed dose of 50 Gy-52 Gy in 20 fractions, patients who completed moderate-intensity walking exercises did not experience a significant increase in fatigue during or after RT.[18] In comparison, men who were advised to rest experienced significant increased fatigue by the end of RT.[18] Additionally, there was a significant improvement in the physical functioning of the exercise group compared to the control group.[18] The results of this trial suggest that aerobic exercise is helpful in combating fatigue during RT. However, its applicability to patient populations undergoing longer courses of RT remains to be tested. In the present study where the duration of RT was 6-8 weeks, it is noted that fatigue did not significantly interfere with walking ability until the end of RT. This raises the suggestion that a walking exercise program to combat fatigue during RT may well be feasible and warrants investigation.

While the current analysis did not evaluate sexual function in relation to fatigue and physical activity, a recent study from the University of Miami suggests that prostate cancer patients who underwent external beam RT had significantly greater sexual function as physical activity increased.[19] This finding highlights the importance of incorporating measures of sexual function in future studies of activity and quality of life after RT for patients with prostate cancer.

Finally, in a recent randomized trial evaluating the role of resistance exercise in reducing fatigue among prostate cancer patients receiving HT, subjects who participated in a 12-week resistance exercise program three times a week experienced less fatigue and interference with activities of daily living and QOL compared to subjects in the non-exercise control group.[20] Thus, both aerobic and resistance exercises appear to have potential benefits in reducing fatigue and improving QOL in prostate cancer patients, although continued study in this area specific to patients undergoing protracted courses of RT is needed.

Conclusion

The BFI may be used to assess fatigue severity and its interference with QOL in prostate cancer patients undergoing radical RT. Patients undergoing 6-8 weeks of RT experienced significant fatigue adversely affecting QOL. Since walking ability was not affected until the end of RT, a walking exercise intervention to combat fatigue is likely feasible and will be investigated. □

References

1. Mock V, Atkinson A, Barsevick A et al. National Comprehensive Cancer Network (NCCN) practice guidelines for cancer-related fatigue. *Oncology* 2000;14:151-161.
2. Stone P, Ream E, Richardson A et al. Cancer-related fatigue – a difference of opinion? Results of a multicentre survey of health care professionals, patients and caregivers. *Eur J Cancer Care* 2003;12:20-27.
3. Cella D, Lai J, Chang C, Peterman A, Slavin M. Fatigue in cancer patients compared with fatigue in the general United States population. *Cancer* 2002;94:528-538.
4. Servaes P, Verhagen C, Bleijenberg G. Fatigue in cancer patients during and after treatment: prevalence, correlates and interventions. *Eur J Cancer* 2002;38:27-43.

5. Stasi R, Abriani L, Beccaglia P, Terzoli E, Amadori S. Cancer-related fatigue: evolving concepts in evaluation and treatment. *Cancer* 2003;98:1786-1801.
6. Patrick DL, Ferketich SL, Frame PS et al. National Institutes of Health State-of-the-Science Panel Conference Statement: Symptom Management in Cancer: Pain, Depression, and Fatigue, July 15-17, 2002. *J Natl Cancer Inst* 2002; 95:1110-1117.
7. Piper BF. Fatigue in cancer patients: current perspective on measurement and management. Fifth National Conference of Cancer Nursing. Monograph on Nursing Management of Common Problems: State of the Arts; 1988; Arlington (VA). New York: American Cancer Society; 1988.
8. Mendoza TR, Wang XS, Cleeland CS et al. The rapid assessment of fatigue severity in cancer patients. *Cancer* 1999;85:1186-1196.
9. Monga U, Kerrigan AJ, Thornby J, Monga TN. Prospective study of fatigue in localized prostate cancer patients undergoing radiotherapy. *Radiat Oncol Invest* 1999;7:178-185.
10. Esper P, Mo F, Chodak G, Sinner M, Cella D, Pienta KJ. Measuring quality of life in men with prostate cancer using the functional assessment of cancer therapy-prostate instrument. *Urology* 1997;50:920-928.
11. Monga U, Kerrigan AJ, Thornby J, Monga TN, Zimmerman KP. Longitudinal Study of quality of life in patients with localized prostate cancer undergoing radiotherapy. *J Rehabil Res Dev* 2005;42:391-400.
12. Janda M, Gerstner N, Obermair A et al. Quality of life changes during conformal radiation therapy for prostate carcinoma. *Cancer* 2000;89:1322-1328.
13. Maliski SL, Kwan L, Orecklin JR, Saigal CS, Litwin MS. Predictors of fatigue after treatment for prostate cancer. *Urology* 2005;65:101-108.
14. Hays R, Sherbourne C, Mazel R. The RAND 36-item Health Survey 1.0. *Health Econ* 1993;2:217-227.
15. Litwin M, Hays R, Fink A, Ganz PA, Leake B, Brook RH. The UCLA Prostate Cancer Index: development, reliability, and validity of a health-related quality of life measure. *Med Care* 1998;36:1002-1112.
16. Magnusson K, Moller A, Ekman T, Wallgren A. A qualitative study to explore the experience of fatigue in cancer patients. *Eur J Cancer Care* 1999;8:224-232.
17. Kim Y, Roscoe JA, Morrow GR. The effects of information and negative affect on severity of side effects from radiation therapy for prostate cancer. *Support Care Cancer* 2002;10:416-421.
18. Windsor PM, Nicol KF, Potter J. A randomized, controlled trial of aerobic exercise for treatment-related fatigue in men receiving radical external beam radiotherapy for localized prostate carcinoma. *Cancer* 2004;101:550-557.
19. Dahn JR, Penedo FJ, Molton I, Lopez L, Schneiderman N, Antoni MH. Physical activity and sexual functioning after radiotherapy for prostate cancer: beneficial effects for patients undergoing external beam radiotherapy. *Urology* 2005;65:953-958.
20. Segal RJ, Reid RD, Courneya KS et al. Resistance exercise in men rreceiving androgen deprivation therapy for prostate cancer. *J Clin Oncol* 2003;21:1653-1659.