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ORIGINAL ARTICLE

Anxiety, depression, and pain: differences by primary cancer

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Abstract
Goals of work Disease-related cancer pain is a multidimensional phenomenon. Psychological factors that may alter pain perception in cancer patients have not been well studied. The study purpose was to explore differences in pain, anxiety, and depression by type of primary cancer.
Patients and methods In a cross-sectional study of consecutive patients (80% male, mean age 60.5±11.5 years) undergoing radiation treatment for head/neck (HNC, n=93), lung (LC, n=146), or prostate (PC, n=63) cancers, patients reported pain quality, pattern, and intensity with the McGill Pain Questionnaire. They also completed the State Trait Anxiety Inventory, Center for Epidemiologic Studies Depression Scale, and Coping Strategies Questionnaire. Comparative statistics, correlation coefficients, and multivariate regression analysis were performed.
Main results Worst pain intensity was significantly greater in LC subjects compared to HNC (p<0.05) and PC (p<0.001). Pain quality ratings were significantly greater for individuals with LC compared to PC (p<0.05), and the regression analyses indicated that pain quality ratings were partially predicted by having LC. Depression levels approached clinical significance and were greatest for individuals with LC. Catastrophizing was correlated with high levels of depression (p<0.01) and anxiety (p<0.01).
Conclusions Individuals with cancer undergoing radiation treatment experienced clinically significant levels of unrelieved cancer pain despite standard pain management. Pain intensity and quality ratings were greatest for LC individuals and may contribute to symptoms of depression. Catastrophizing may contribute to psychological factors which may impact the pain experience. Tailored treatments that meet cancer patients' psychosocial and medical needs may result in improved pain management and functional ability.

Keywords Cancer · Pain · Anxiety · Depression · Coping

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Introduction

Pain is commonly associated with cancer, as it is the presenting symptom in 20% to 50% of all cancer patients and is significant in 75% to 90% of patients with advanced or terminal cancer [9, 31, 40]. Cancer-related pain may be associated with the disease and/or treatment and is a multidimensional phenomenon, consisting of physiologic, sensory, affective, cognitive, and behavioral components [1, 51, 55]. Cancer pain during and following treatment has been correlated with increased morbidity, reduced performance status, increased anxiety and depression, and diminished quality of life [5, 12, 40].

Cancer pain has adverse effects upon patients' psychological well-being. Zaza and Baine [57] performed a systematic review in which they found a strong association

between cancer pain and psychological distress, manifested as mood disturbance, anxiety, and depression. Worsening pain leads to increased psychological distress, and the effect is evident across the cancer disease spectrum [28]. Because cancer patients have a disease with demonstrable organic pathology, psychological factors tend to be viewed as being of secondary importance [50]. Pain perception has been extensively studied in acute and non-cancer chronic pain but has received relatively little attention in the cancer pain literature [49, 50]. However, substantial evidence suggests that psychological factors play an important role in modulating pain experience even for cancer patients [28].

Cancer and its treatment can affect physical and psychosocial well-being, placing people with cancer at risk of depressive mood during and following cancer treatment [11] and may be associated with sleep dysfunction and fatigue [15]. The predisposition to depression among cancer patients is compounded by the cancer-related pain and can contribute to significant psychological stressors during and after cancer treatment.

Psychosocial contributors such as coping and social support may further impact the pain experience associated with cancer. Catastrophizing as a coping strategy has been the most studied and has become one of the most important psychological predictors of the pain experience [48, 54]. Catastrophizing has been associated with increased pain behaviors [29], increased use of health care services [17], and use of pain medication [25].

Psychological factors that may alter pain perception in cancer patients have not been well studied. Most of the literature is retrospective or cross-sectional in design, and investigators have evaluated psychological factors following cancer treatment, thereby studying the impact of treatment upon psychological status. Furthermore, since many studies evaluating the psychosocial impact of cancer pain have assessed quality of life measures and symptom clusters, limited research has been conducted using focused psychological evaluation [14, 15]. Consequently, the aim of this study was to evaluate differences in pain, anxiety, and depression in patients undergoing treatment for lung, head/neck (HNC), or prostate cancer. A secondary aim was to explore relationships between coping strategies and psychological factors by type of primary cancer.

Patients and methods

Study design

This was a cross-sectional study of 302 consecutive, consenting subjects undergoing treatment for cancers of the lung, head and/or neck, or prostate. The study was approved by the Human Subjects Committee at the University of Washington for initial data collection and by the University of Illinois at Chicago for ongoing data analysis.

Patients

Individuals were recruited from the Radiation Oncology Clinic at the University of Washington Medical Center and other institutions in the Puget Sound area. Eligible subjects: (1) had a diagnosis of lung, head and/or neck, or prostate cancer; (2) were undergoing radiation therapy for treatment of cancer; (3) had disease- or treatment-related cancer pain during the week prior to enrolling in the study; and (4) spoke and read English. Subjects were excluded if they: (1) had pain for less than 1 month after surgery and were pain-free prior to entry into the study or (2) were physically or mentally unable to complete study procedures. Mental competence was evaluated using the Mini-Mental State (MMSE) [16], in which individuals scoring 20 or less on the MMSE would be excluded. However, no subjects were excluded due to this criterion.

Study procedures

Potential subjects who met the study criteria were invited to participate. A total of 1,064 consecutive subjects were approached in person at the University of Washington Radiation Oncology Clinic or by their providers at an outside clinic. Subjects approached at outside clinics were first mailed introductory letters by their oncologists. It was determined that 536 subjects did not meet inclusion criteria. Of the eligible subjects, 103 subjects refused, and 425 subjects agreed to participate. Most subjects who did not participate stated they were too ill or stressed or did not have sufficient time to complete study procedures, given their transportation arrangements to and from the clinic. Using list-wise deletion procedures, we retained 302 subjects with complete data for this analysis. Subject fatigue and lack of time to complete all instruments were the main reasons for missing data.

As required for investigations involving human subjects, informed consent was obtained, and then participants underwent an in-person interview in which the following data were collected.

1. Demographic data included self-reported patient characteristics as well as medical record disease characteristics abstracted by the research team.
2. Pain quality (pain rating index [PRI] scores), pattern and intensity were measured with the McGill Pain Questionnaire (MPQ) [34], a pain assessment tool in which the patient marks areas of pain on a body outline drawing, circles words to describe pain quality and

pattern, writes narrative text to indicate activities that increase or reduce the pain, and selects pain severity indicators. Pain intensity was rated on a 0–5 categorical scale (0 = none, 1 = mild, 2 = discomforting, 3 = distressing, 4 = horrible, 5 = excruciating). PRI scores were calculated by categorizing descriptive sensory pain words from the MPQ into sensory (maximum = 42), affective (maximum = 14), evaluative (maximum = 5), miscellaneous (maximum = 17), and total (maximum = 78) scores. Also, the number of words chosen (NWC) was tabulated according to Melzack's instructions [34].

3. The adequacy of analgesic prescription was estimated by calculating a pain management index (PMI) as suggested by Cleeland [7, 9]. The worst pain level score (0–3 categorical scale: 0 = none, 1 = mild, 2 = moderate, 3 = severe pain) was subtracted from the analgesics step score (0–3 categorical scale: 0 = none, 1 = step 1 drugs, 2 = step 2 drugs, 3 = step 3 drugs) to produce a PMI score. A negative PMI score indicated inadequate analgesic prescription (undertreatment of pain) and 0 or positive PMI scores indicated satisfactory analgesics.
4. State and trait anxiety was measured with the State and Trait Anxiety Inventory (STAI) [47]. The STAI consists of two separate 20-item, self-report scales for measuring state and trait anxiety. Each of these anxiety measures is scored with a minimum of 20 and a maximum of 80 and has demonstrated good psychometric properties [47].
5. Depression was measured with the Center for Epidemiologic Studies Depression Scale (CES-D) [42]. The CES-D is a valid and reliable 20-item instrument used for measuring depression in the general population. This scale gives depression a rating of 0 to 60.
6. Coping strategies were measured with the eight subscales of the Coping Strategies Questionnaire [44], a valid and reliable tool in the cancer population. Coping strategies are categorized as six types of cognitive coping strategies (diverting attention, reinterpreting pain sensations, coping self-statements, ignoring pain sensations, praying or hoping, and catastrophizing) and two behavioral coping strategies (increasing activity level and increasing pain behavior). Each of the 49 coping strategies is rated on a 0–6 scale. In addition, the ability to completely control pain and completely decrease pain items are each rated on a 0–6 scale.

Statistical analysis

Data were exported into SPSS Version 15.0 (Chicago, IL, USA) for analysis. Descriptive statistics were generated for demographic data, pain, anxiety, depression, and coping characteristics. One-way analysis of variance (ANOVA) was used to evaluate differences in pain, anxiety, and depression by type of primary cancer. Pearson correlation coefficients (r) were used to explore relationships between psychological factors and coping strategies in cancer patients. Using linear regression methods, a multivariate analysis was performed to evaluate the effect of predictors upon the dependent variables: (1) NWC; (2) pain rating index total (PRI-T); and (3) total pain intensity score (present pain + worst pain + least pain intensities). Statistical significance was set a priori at $p<0.05$.

Results

Descriptive statistics

Patients had a diagnosis of lung ($n=146$, 48.3%), head/neck ($n=93$, 30.8%), or prostate ($n=63$, 20.9%) cancers. The mean age of the sample was 59.6±11.3 years, and 76.8% were male. Additional demographic data are presented in Table 1.

At diagnosis, 80.8%, 55.9%, and 31.7% of subjects had stage III or IV cancer of the lung, HNC, or prostate, respectively. Surgical procedures had been performed on 33.6%, 68.8%, and 39.7% of lung, HNC, and prostate cancer patients prior to radiation therapy. Concomitant chemotherapy was administered to 54.1% of patients with lung cancer, 24.7% with head and/or neck cancer, and 58.7% with prostate cancer. A greater proportion of lung cancer subjects reported the origin of pain to be associated with the primary tumor (45.9%), compared to HNC (17.2%; $\chi^2(1)=20.8$, $p<0.001$) and prostate patients (15.9%; $\chi^2(1)=20.9$, $p<0.001$). In contrast, the majority of HNC (58.1%, $\chi^2(1)=29.4$, $p<0.001$) and prostate patients (49.2%, $\chi^2(1)=15.2$, $p<0.001$) attributed their origin of pain to treatment, compared to individuals with lung cancer (24.7%). Further disease characteristics are detailed in Table 1.

Pain comparisons by primary cancer

Present pain intensity was greatest in HNC subjects (1.5±1.0), followed by individuals with lung (1.3±1.0) and then prostate cancer (1.0±0.9). The difference in present pain intensity by type of cancer was statistically significant ($F(2)=3.9$; $p<0.05$) and was statistically greater in subjects with HNC compared to those with prostate cancer ($p<0.005$; Fig. 1). Worst pain levels were high, and differences by cancer type were statistically significant ($F(2)=8.1$, $p<0.001$). Worst pain was significantly greater in lung cancer subjects (3.4±1.2) compared to individuals with HNC (3.0±1.3; $p<0.05$) and prostate cancer (2.7±1.3; $p<$

Table 1 Demographic and disease characteristics by type of primary cancer (N=302)

Variable	Lung cancer (N=146) n (%)	Head/neck cancer (N=93) n (%)	Prostate cancer (N=63) n (%)
Gender			
Male	101 (69.2)	68 (73.1)	63 (100)
Female	45 (30.8)	25 (26.9)	0 (0)
Age (mean±SD)	61.2±10.4	53.9±12.0	64.4±8.7
Education			
≤High school	81 (55.5)	44 (47.3)	18 (28.6)
Some College	65 (44.5)	48 (51.6)	44 (69.8)
Ethnicity			
Caucasian	129 (88.4)	84 (90.3)	56 (88.9)
Other	17 (11.6)	9 (9.7)	7 (11.1)
Cancer stage (at diagnosis)			
Stage I	16 (11.0)	20 (21.5)	17 (27.0)
Stage II	7 (4.8)	18 (19.4)	23 (36.5)
Stage III	63 (43.2)	14 (15.1)	11 (17.5)
Stage IV	55 (37.7)	38 (40.9)	9 (14.3)
Treatment			
Surgical Procedure	49 (33.6)	64 (68.8)	25 (39.7)
Chemotherapy	79 (54.1)	23 (24.7)	37 (58.7)
Radiation Therapy	146 (100)	93 (100)	63 (100)
Origin of Pain (self-report)			
Tumor-related	67 (45.9)	16 (17.2)	10 (15.9)
Treatment-related	36 (24.7)	54 (58.1)	31 (49.2)
Both	18 (12.3)	18 (19.4)	4 (6.3)
Unknown	7 (4.8)	1 (1.1)	6 (9.5)

SD standard deviation

0.001). Least pain intensity within the previous week was minimal, with no significant differences when comparing the cancer groups.

All five PRI scores were greatest for individuals with lung cancer. There were statistically significant differences in sensory, affective, evaluative, and total PRI scores by type of cancer (Tables 2 and 3). Sensory, affective, and total PRI scores were significantly greater in individuals with lung cancer compared to those with prostate cancer ($p<$ 0.05 for sensory, affective, and total scores). The evaluative PRI score was significantly greater in lung cancer subjects compared to those with HNC ($p<0.05$) and prostate cancer ($p<0.05$). There were no significant differences in miscellaneous PRI scores among the three cancer groups.

The NWC was determined by adding the number of categories for which pain words were chosen (maximum = 20). The overall mean NWC was 6.0±4.3 (median = 6.0) words for all subjects. There was a statistically significant difference in mean NWC score by cancer type (Tables 2 and 3). NWC was greatest for lung cancer subjects, followed by HNC and then prostate cancer, with a significantly greater number of words chosen by individuals with lung cancer compared to those with prostate cancer ($p<0.05$).

The MPQ pain pattern was stratified into the three categories based upon the periodicity of the pain. Overall, a larger proportion of individuals reported rhythmic, periodic, and intermittent pain patterns (66.2%), followed by a continuous, steady, and/or constant pain pattern (50.0%), and then brief, momentary, and/or transient pain (36.8%). There was a statistically significant difference in group 1 pain pattern (continuous, steady, constant) by type of cancer (Tables 2 and 3). The group 1 pain pattern was greatest in individuals with HNC (58.1%), followed by lung (50.0%) and prostate cancer (38.1%) and was significantly greater in individuals with HNC compared to prostate cancer ($p<$ 0.05). Group 2 (rhythmic, periodic, and intermittent) and group 3 (brief, momentary, and transient) pain patterns were similar for all three cancer groups. The mean pain pattern score (maximum = 6) was 2.9±1.4 (median = 3.0), with no significant differences among the three cancer groups.

Based on Cleeland's PMI, 79.8% of cancer patients were taking analgesic medication satisfactory for their pain intensity levels, while 19.5% were taking prescriptions that represented undertreatment for the level of their pain intensity (Tables 2 and 3). There were no significant differences in PMI scores among the cancer groups.

Comparisons of psychological factors by primary cancer

Psychological factors are detailed in Table 4. Overall, depression levels approached clinical significance and were greatest for individuals with lung cancer, followed by HNC, and then prostate cancer. The difference was statistically significant between lung and prostate cancer patients only ($p<0.05$). The mean values for trait- and state-anxiety

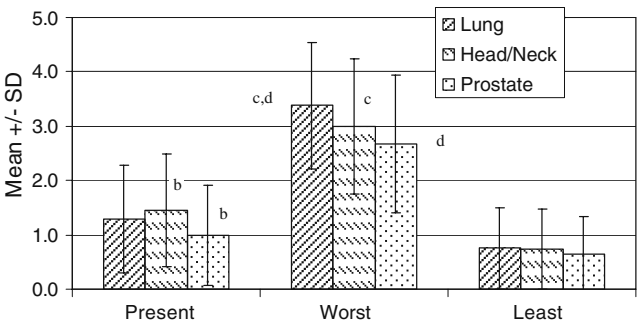

Fig. 1 Mean values of pain intensity by primary cancer. Pain intensity categorized as: none (*0*), mild (*1*), discomforting (*2*), distressing (*3*), horrible (*4*), and excruciating (*5*). [b]$p<0.005$, head/neck cancer compared to prostate cancer. [c]$p<0.05$, lung cancer compared to head/neck cancer. [d]$p<0.001$, lung cancer compared to prostate cancer

Table 2 Pain characteristics by type of primary cancer

Variable	Lung cancer (N=146)		Head/neck cancer (N=93)		Prostate cancer (N=63)		Test statistic
	Mean±SD	Median (min, max)	Mean±SD	Median (min, max)	Mean±SD	Median (min, max)	$F(2)$
Pain rating index scores							
Sensory (maximum=42)	10.4±7.8*	10.0 (0, 35)	8.7±6.9	7.0 (0, 26)	7.7±6.6*	6.0 (0, 22)	$F(2)=3.5$, $p<0.05$
Affective (maximum=14)	1.5±2.1*	0.5 (0, 10)	0.9±1.6	0.0 (0, 8)	0.8±1.7*	0.0 (0, 9)	$F(2)=4.1$, $p<0.05$
Evaluative (maximum=5)	1.6±1.7*,**	1.0 (0, 5)	1.2±1.4**	1.0 (0, 5)	1.2±1.4*	1.0 (0, 5)	$F(2)=3.5$, $p<0.05$
Miscellaneous (maximum=17)	2.7±2.9	2.0 (0, 12)	1.9±2.7	1.0 (0, 15)	2.2±3.2	1.0 (0, 14)	$F(2)=2.3$, p=NS
Total (maximum=78)	16.1±12.4*	15.0 (0, 56)	12.6±10.5	10.0 (0, 52)	11.8±11.0*	8.0 (0, 41)	$F(2)=4.3$, $p<0.05$
Number of pain words chosen	6.7±4.4**	7.0 (0, 19)	5.0±4.4**	5.0 (0, 20)	5.6±4.0	4.0 (0, 15)	$F(2)=3.8$, $p<.05$
Total pain pattern score	3.0±1.4	3.9 (0, 6)	3.0±1.4	3.0 (0, 6)	2.6±1.4	3.0 (0, 6)	$F(2)=1.9$, p=NS

SD standard deviation, *NS* not significant, $F(2)$ ANOVA F values with two degrees of freedom

*$p<0.05$ lung cancer compared to prostate cancer; **$p<0.05$, lung cancer compared to head/neck cancer

indicated mild to moderate levels of anxiety. There were no significant differences in state- or trait-anxiety levels among the cancer groups.

The most common types of coping strategies were coping self-statements (mean 3.6±1.3), followed by praying/hoping (mean 3.1±1.6), and the behavioral strategy of increasing pain behavior (3.0±1.0). The least-used strategies were catastrophizing (1.1±1.2) and reinterpreting pain sensations (1.3±1.3). Cancer subjects reported moderate levels of having complete control over pain (3.6±1.5) and being able to completely decrease pain (3.5±1.5). There were no statistically significant differences in any of the coping strategies amongst cancer groups.

Correlation statistics

Correlation statistics were performed between coping strategies and the psychological factors (depression, trait anxiety, and state anxiety) for each of the cancer groups. In all three cancer groups, catastrophizing was correlated with high levels of depression ($p<0.01$, Table 5), state anxiety ($p<0.01$, Table 6) and trait anxiety ($p<0.01$, Table 7). Furthermore, the ability to control pain was inversely related to depression (lung, HNC $p<0.01$; prostate $p<0.05$), state anxiety (lung, prostate $p<0.01$; HNC $p<0.05$), and trait anxiety (lung, prostate $p<0.01$; HNC $p<0.05$) in all cancer groups. In addition, in HNC cancer subjects, reinterpreting pain, using active coping strategies, and inability to decrease pain were associated with increased state anxiety levels ($p<0.05$). Finally, in individuals with lung cancer, praying/hoping was related to depression ($p<0.05$), and the ability to decrease pain was inversely related to depression ($p<0.01$), trait anxiety ($p<0.05$), and state anxiety ($p<0.01$).

Multivariate regression analysis

A multivariate regression analysis was performed to evaluate contributors to sensory pain quality and intensity in cancer patients, and the results are presented in Table 8. In the first model, the dependent variable NWC (intercept =

Table 3 Pain characteristics by type of primary cancer

	Lung cancer (N=146) n (%)	Head/neck cancer (N=93) n (%)	Prostate cancer (N=63) n (%)	Test statistic $\chi^2(2)$
Pain pattern				
Group 1 (continuous, steady, constant)	73 (50.0)	54 (58.1)*	24 (38.1)*	$\chi^2(2)=6.0$, $p=0.05$
Group 2 (rhythmic, periodic, intermittent)	98 (67.1)	57 (61.3)	45 (71.4)	$\chi^2(2)=1.8$, p=NS
Group 3 (brief, momentary, transient)	58 (39.7)	30 (32.3)	23 (36.5)	$\chi^2(2)=1.4$, p=NS
Pain management index				
Adequate analgesics	126 (86.3)	71 (76.3)	44 (69.8)	$\chi^2(2)=1.6$, p=NS
Inadequate analgesics	20 (13.7)	21 (22.6)	18 (28.6)	$\chi^2(2)=1.9$, p=NS

*$p<0.05$, head/neck cancer compared to prostate cancer

$\chi^2(2)$=Chi-square values with two degrees of freedom

Table 4 Psychological factors by type of primary cancer

Variable	Lung cancer (N=146) Mean±SD	Head/neck cancer (N=93) Mean±SD	Prostate cancer (N=63) Mean±SD	Test statistic $F(2)$
State anxiety (range 20–80)	40.7±12.3	40.6±13.7	37.8±13.4	$F(2)=1.2$, p=NS
Trait anxiety (range 20–80)	37.8±11.1	37.2±10.8	36.5±11.6	$F(2)=0.3$, p=NS
Depression (range 0–60)	16.5±10.5[a]	14.3±10.4	12.3±9.4[a]	$F(2)=3.4$, $p<0.05$
Coping strategies (range 0–6)				
Diverting attention	3.0±1.3	2.6±1.4	2.7±1.3	$F(2)=2.7$, p=NS
Reinterpreting	1.4±1.4	1.1±1.1	1.2±1.2	$F(2)=1.7$, p=NS
Coping self-statements	3.7±1.3	3.5±1.3	3.7±1.3	F(2)=0.9, p=NS
Ignoring	2.3±1.5	2.3±1.3	2.3±1.4	F(2)=0.1, p=NS
Praying/hoping	3.1±1.6	3.0±1.6	3.0±1.5	F(2)=0.4, p=NS
Catastrophizing	1.2±1.3	1.0±1.1	0.9±1.0	F(2)=2.3, p=NS
Increasing activity level	2.8±1.2	2.6±1.1	2.7±1.3	F(2)=0.8, p=NS
Increasing pain behavior	3.0±1.0	2.8±1.0	3.1±1.0	F(2)=1.5, p=NS
Complete control over pain (range 0–6)	3.7±1.5	3.5±1.3	3.6±1.6	F(2)=0.4, p=NS
Complete decrease in pain (range 0–6)	3.6±1.5	3.4±1.4	3.6±1.4	F(2)=1.0, p=NS

SD standard deviation, $F(2)$ ANOVA F values with two degrees of freedom

*$p<0.05$ lung cancer compared to prostate cancer

1.472) was predicted by state anxiety (β=0.062, p=0.014), depression (β=0.068, p=0.032), female gender (β=−0.271, p=0.026), using more coping strategies (β=.016, p=0.004), and having lung cancer (β=1.185, p=0.015). In the second model, PRI-T (intercept = −2.992) was predicted by state anxiety (β=0.186, p=0.007), depression (β=0.201, p=0.020), using more coping strategies (β=0.042, p=0.006), and having lung cancer (β=2.991, p=0.022). In a third model, the total pain intensity (intercept = 8.594) was predicted by using more coping strategies (β=0.018, p=0.002) and being unable to decrease pain (β=−0.620, p=0.000). None of the pain quality measures were predicted by cancer stage.

Discussion

In this study, we sought to evaluate differences in sensory pain and psychological factors in individuals with cancer- and/or treatment-related pain undergoing radiation therapy for lung, head/neck, or prostate cancer. Overall, we found high levels of worst pain intensity in all cancer groups, despite standard pain management. Lung cancer patients reported the highest levels of pain intensity, greater pain quality ratings, and higher mean depression scores compared to individuals with HNC or prostate cancer. Furthermore, catastrophizing was related to depression, state- and trait-anxiety in all cancer patients.

Table 5 Correlations between coping strategies and depression by primary cancer

Coping strategy	Lung cancer (N=146)	Head/neck cancer (N=93)	Prostate cancer (N=63)
Diverting attention	−0.02	0.04	−0.13
Reinterpreting	0.04	0.10	−0.04
Coping self-statements	−0.16	−0.06	−0.02
Ignoring	−0.09	−0.07	−0.15
Praying/hoping	0.21*	0.10	0.14
Catastrophizing	0.58**	0.57**	0.49**
Increasing activity level	−0.06	0.20	−0.13
Increasing pain behavior	0.11	0.15	−0.17

*$p<0.05$; **$p<0.01$

Table 6 Correlations between coping strategies and state anxiety by primary cancer

Coping strategy	Lung cancer (N=146)	Head/neck cancer (N=93)	Prostate cancer (N=63)
Diverting attention	−0.01	0.20	−0.02
Reinterpreting	0.02	0.22*	0.01
Coping self-statements	−0.15	0.03	−0.06
Ignoring	−0.11	0.03	−0.14
Praying/hoping	0.09	0.20	0.11
Catastrophizing	0.50**	0.55**	0.54**
Increasing activity level	−0.09	0.23*	−0.15
Increasing pain behavior	−0.03	0.05	−0.15

*$p<0.05$; **$p<0.01$

Table 7 Correlations between coping strategies and trait anxiety by primary cancer

Coping strategy	Lung cancer (N=146)	Head/neck cancer (N=93)	Prostate cancer (N=63)
Diverting attention	0.01	0.08	−0.05
Reinterpreting	0.01	0.12	−0.09
Coping self-statements	−0.09	−0.07	−0.12
Ignoring	−0.06	−0.02	−0.20
Praying/hoping	0.15	0.07	0.09
Catastrophizing	0.56*	0.58*	0.59*
Increasing activity level	0.02	0.12	−0.21
Increasing pain behavior	0.01	−0.02	−0.21

*p<0.01

In our sample, approximately 80% of lung cancer patients presented with advanced (stage III or IV) disease at diagnosis. In the other cancer groups, 56% of HNC patients and 32% of prostate cancer patients had advanced disease. A greater proportion of lung cancer patients reported tumor-related pain, while the majority of HNC and prostate cancer patients found their origin of pain to be treatment-related.

While present pain intensity levels were low, increased levels of worst pain within the previous week were clinically significant and were greatest in individuals with lung cancer. These findings are consistent with previous studies [2, 9, 10] and suggest that worst cancer pain is severe and not adequately controlled. High levels of worst pain have been associated with the presence of breakthrough or functional pain [4, 5] and neuropathic pain [23, 53] and may substantially compromise function [5, 32, 41] and increase patient distress [5].

It is estimated that about 55% of outpatients with metastatic cancer have disease-related pain [9]. Despite international guidelines for management of cancer-related pain [26], undertreatment of cancer pain remains a significant problem. Multicenter studies indicate that 40–80% of patients with cancer pain are not prescribed analgesics appropriate to the severity of their pain, with additional patients not receiving sufficient dosing of the analgesic prescribed [8, 9, 12]. In our sample, the PMI scores suggested that 20% of cancer patients were not prescribed adequate analgesics. Subjects in this study received variable types and doses of analgesics, reflecting differences in provider preferences regarding pain management approaches. Consequently, the extent of pain control may have varied in this population.

Several factors can contribute to the undertreatment of pain. Patients may be reluctant to report pain or may refuse treatment with opioid drugs for fear of addiction or concerns related to side effects of medications [6, 10, 37]. Furthermore, patients and some health care providers anticipate pain and may believe that pain is an inevitable part of cancer and cancer treatment [10, 37, 38]. Alternatively, health care providers may place priority on curing the illness, therefore placing less emphasis on managing symptoms associated with the disease [10, 38].

Pain quality was measured with the five PRI scores as well as the NWC score, all from the MPQ. Compared to other studies of individuals with cancer pain [13, 20, 56], our population reported similar PRI and NWC scores. In our study, sensory pain accounted for a greater proportion of the total PRI, as has been reported previously [13], and the pain quality scores were comparable to samples with nociceptive pain [53].

Pain quality ratings (PRI and NWC) were greater in lung cancer patients compared to individuals with HNC or

Table 8 Multivariate regression analysis

Dependent variable	Predictor	Beta	SE of beta	p value
NWC	Intercept	1.472	1.215	
	State anxiety	0.062	0.025	0.014
	Depression	0.068	0.032	0.032
	Gender	−1.271	0.567	0.026
	Coping strategies	0.016	0.006	0.004
	Lung cancer	1.185	0.483	0.015
PRI-T	Intercept	−2.992	2.743	
	State anxiety	0.186	0.069	0.007
	Depression	0.201	0.086	0.020
	Coping strategies	0.042	0.015	0.006
	Lung cancer	2.991	1.299	0.022
Pain intensity total score	Intercept	8.594	0.887	
	Coping strategies	0.018	0.006	0.002
	Ability to decrease pain	−0.620	0.169	0.000

NWC number of pain words chosen, *PRI-T* pain rating score total

prostate cancer. Furthermore, the results of the regression analyses indicate that PRI-T and NWC were at least partially predicted by having a diagnosis of lung cancer. These findings suggest that lung cancer patients undergoing radiation therapy may exhibit greater levels of disease- or treatment-related nociceptive and neuropathic pain.

Depression is a common but not universal reaction to cancer [19, 43]. Depression is frequently underdiagnosed and undertreated in patients with cancer [33] and contributes to the pain experience. With the CES-D, a self-report questionnaire, a total score ≥16 is highly associated with clinical depression and is generally used as an indication of it [36]. In our sample, lung cancer patients reported mean depression scores that may indicate symptoms of depression approaching a diagnosis of depression. Furthermore, feelings of worry and anxiety have been described in cancer populations [30] and may also contribute to the presentation of pain. In our sample, mean values of anxiety suggested moderate state anxiety levels in lung and HNC patients, and the multivariate regression revealed that depression and state anxiety contributed to the pain quality ratings.

The multidimensionality of cancer pain has been demonstrated by reports of the relationship between pain and psychological factors, such as depression and anxiety. In a systematic review by Zaza and Bain [57], the authors found a strong association between pain and psychological distress in cancer patients. Furthermore, cancer patients with pain have been more likely than pain-free subjects to experience high levels of depression and anxiety, other cancer symptoms and lower quality of life [18, 24, 35, 46]. These reports support literature that cancer pain is not fundamentally different from chronic nonmalignant pain [3, 45, 50].

In our study, we found that coping strategies were associated with pain intensity and quality. In addition, there was a significant relationship between catastrophizing and the psychological factors of depression and state- and trait-anxiety in all cancer patients. In studies of subjects with cancer pain, catastrophizing has been linked to increased pain intensity, anxiety, and depression [3, 25, 54, 57]. Furthermore, ineffective coping mechanisms and inability to control pain have been found to relate to functional interference [27, 39] and inappropriate health behaviors in cancer patients [21, 22]. These results suggest that pain coping interventions to include pain control may reduce psychological distress (particularly catastrophizing) and pain among individuals with cancer.

Our study has several limitations. First, the cross-sectional design does not allow for inferring a causal link between pain and psychological factors. Longitudinal and intervention research is needed to: (1) assess the influence of pain throughout cancer treatment and its impact upon quality of life and (2) identify whether a change in psychosocial factors occurs throughout treatment and how this may relate to the pain experience. Second, while this study was conducted with a sample of patients having lung, HNC, or prostate cancer, these findings need to be replicated with larger and more varied samples to determine whether the findings can be generalized to other cancer populations, particularly to minority populations with cancer since our sample was predominately Caucasian. Third, due to our study design, our sample included subjects who underwent different cancer treatments and were at different stages of the course of radiation treatment. Therefore, we were unable to determine which cancer treatment(s) may have contributed to the pain experience. It is also unknown what effect persistent disease- and/or treatment-related pain may have had upon the composite pain reports. Furthermore, the relationship between psychological factors and coping was correlational, so further studies are needed to explore the direction of the relationship that may result in specific interventions to strengthen coping. Finally, pain and psychological scores may be due to a third independent factor that has not been assessed in this study, such as social support, self-efficacy, or mood.

The study findings have implications for assessment and management of pain associated with cancer treatment. Unrelieved cancer pain may lead to a more negative pain experience to include psychological impact and catastrophizing about pain experiences. Negative cognitions about pain have been identified as important factors influencing patients' adjustment to disease [3, 48, 52]. Consequently, health care practitioners should include assessment of pain, psychological factors, and coping into their routine patient assessment prior to cancer treatment to provide appropriate care and make necessary multidisciplinary referrals. Similarly, in individuals who exhibit high pain levels, clinicians should consider the psychological impact of the pain experience.

In summary, the results of our study suggest that individuals with lung, HNC, and prostate cancer undergoing radiation treatment experience clinically significant levels of unrelieved cancer pain, despite standard pain management. Pain intensity and quality ratings were greatest for lung cancer patients and may contribute to symptoms of depression. In addition, catastrophizing may contribute to psychological factors which may impact the pain experience. Tailored treatments that meet cancer patients' psychosocial as well as medical needs may result in improved pain management and functional ability.

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References

1. Ahles TA, Blanchard EB, Ruckdeschel JC (1983) The multidimensional nature of cancer-related pain. Pain 17:277–288
2. Berry DL, Wilkie DJ, Huang HY, Blumenstein BA (1999) Cancer pain and common pain: a comparison of patient-reported intensities. Oncol Nurs Forum 26:721–726
3. Bishop SR, Warr D (2003) Coping, catastrophizing and chronic pain in breast cancer. J Behav Med 26:265–281
4. Bruera E, Schoeller T, Wenk R, MacEachern T, Marcelino S, Hanson J, Suarez-Almazor M (1995) A prospective multicenter assessment of the Edmonton staging system for cancer pain. J Pain Symptom Manage 10:348–355
5. Caraceni A, Portenoy RK (1999) An international survey of cancer pain characteristics and syndromes. IASP Task Force on Cancer Pain. International Association for the Study of Pain. Pain 82:263–274
6. Cleary JF (2000) Cancer pain management. Cancer Control 7:120–131
7. Cleeland C (1991) Research in cancer pain. What we know and what we need to know. Cancer 67:823–827
8. Cleeland CS, Gonin R, Baez L, Loehrer P, Pandya KJ (1997) Pain and treatment of pain in minority patients with cancer. The Eastern Cooperative Oncology Group Minority Outpatient Pain Study. Ann Intern Med 127:813–816
9. Cleeland CS, Gonin R, Hatfield AK, Edmonson JH, Blum RH, Stewart JA, Pandya KJ (1994) Pain and its treatment in outpatients with metastatic cancer. The N Engl J Med 330:592–596
10. Cohen E, Botti M, Hanna B, Leach S, Boyd S, Robbins J (2008) Pain beliefs and pain management of oncology patients. Cancer Nurs 31:E1–E8
11. de Leeuw JR, de Graeff A, Ros WJ, Blijham GH, Hordijk GJ, Winnubst JA (2000) Prediction of depressive symptomatology after treatment of head and neck cancer: the influence of pre-treatment physical and depressive symptoms, coping, and social support. Head Neck 22:799–807
12. Di Maio M, Gridelli C, Gallo C, Manzione L, Brancaccio L, Barbera S, Robbiati SF, Ianniello GP, Ferrau F, Piazza E, Frontini L, Rosetti F, Carrozza F, Bearz A, Spatafora M, Adamo V, Isa L, Iaffaioli RV, Di Salvo E, Perrone F (2004) Prevalence and management of pain in Italian patients with advanced non-small-cell lung cancer. Br J Cancer 90:2288–2296
13. Dobratz MC (2001) Patterns of advanced cancer pain in home hospice patients. Cancer Nurs 24:294–299
14. Epstein JB, Beaumont JL, Gwede CK, Murphy B, Garden AS, Meredith R, Le QT, Brizel D, Isitt J, Cella D (2007) Longitudinal evaluation of the oral mucositis weekly questionnaire-head and neck cancer, a patient-reported outcomes questionnaire. Cancer 109:1914–1922
15. Epstein JB, Elad S, Eliav E, Jurevic R, Benoliel R (2007) Orofacial pain in cancer: part II—clinical perspectives and management. J Dent Res 86:506–518
16. Folstein MF, Folstein SE, McHugh PR (1975) Mini-mental state. A practical method for grading the cognitive state of patients for the clinician. J Psychiatr Res 12:189–198
17. Gil KM, Thompson RJ Jr, Keith BR, Tota-Faucette M, Noll S, Kinney TR (1993) Sickle cell disease pain in children and adolescents: change in pain frequency and coping strategies over time. J Pediatr psychol 18:621–637
18. Glover J, Dibble SL, Dodd MJ, Miaskowski C (1995) Mood states of oncology outpatients: does pain make a difference? J Pain Symptom Manage 10:120–128
19. Godding PR, McAnulty RD, Wittrock DA, Britt DM, Khansur T (1995) Predictors of depression among male cancer patients. J Nerv Ment Dis 183:95–98
20. Graham C, Bond SS, Gerkovich MM, Cook MR (1980) Use of the McGill pain questionnaire in the assessment of cancer pain: replicability and consistency. Pain 8:377–387
21. Grassi L, Rossi E, Sabato S, Cruciani G, Zambelli M (2004) Diagnostic criteria for psychosomatic research and psychosocial variables in breast cancer patients. Psychosomatics 45:483–491
22. Grassi L, Rosti G (1996) Psychiatric and psychosocial concomitants of abnormal illness behaviour in patients with cancer. Psychother Psychosom 65:246–252
23. Grond S, Zech D, Diefenbach C, Radbruch L, Lehmann KA (1996) Assessment of cancer pain: a prospective evaluation in 2266 cancer patients referred to a pain service. Pain 64:107–114
24. Henoch I, Bergman B, Gustafsson M, Gaston-Johansson F, Danielson E (2007) The impact of symptoms, coping capacity, and social support on quality of life experience over time in patients with lung cancer. J Pain Symptom Manage 34:370–379
25. Jacobsen PB, Butler RW (1996) Relation of cognitive coping and catastrophizing to acute pain and analgesic use following breast cancer surgery. J Behav Med 19:17–29
26. Jadad AR, Browman GP (1995) The WHO analgesic ladder for cancer pain management. Stepping up the quality of its evaluation. JAMA 274:1870–1873
27. Jensen MP, Turner JA, Romano JM, Karoly P (1991) Coping with chronic pain: a critical review of the literature. Pain 47:249–283
28. Keefe FJ, Abernethy AP, Campbell LC (2005) Psychological approaches to understanding and treating disease-related pain. Annu Rev Psychol 56:601–630
29. Keefe FJ, Lefebvre JC, Egert JR, Affleck G, Sullivan MJ, Caldwell DS (2000) The relationship of gender to pain, pain behavior, and disability in osteoarthritis patients: the role of catastrophizing. Pain 87:325–334
30. Langius A, Bjorvell H, Lind MG (1993) Oral- and pharyngeal-cancer patients' perceived symptoms and health. Cancer Nurs 16:214–221
31. Lesage P, Portenoy RK (1999) Trends in cancer pain management. Cancer Control 6:136–145
32. Li KK, Harris K, Hadi S, Chow E (2007) What should be the optimal cut points for mild, moderate, and severe pain? J Palliat Med 10:1338–1346
33. McDaniel JS, Musselman DL, Porter MR, Reed DA, Nemeroff CB (1995) Depression in patients with cancer. Diagnosis, biology, and treatment. Arch Gen Psychiatry 52:89–99
34. Melzack R (1975) The McGill Pain Questionnaire: major properties and scoring methods. Pain 1:277–299
35. Miaskowski C, Dibble SL (1995) The problem of pain in outpatients with breast cancer. Oncol Nurs Forum 22:791–797
36. Orme JG, Reis J, Herz EJ (1986) Factorial and discriminant validity of the Center for Epidemiological Studies Depression (CES-D) scale. J Clin Psychol 42:28–33
37. Paice JA, Toy C, Shott S (1998) Barriers to cancer pain relief: fear of tolerance and addiction. J Pain Symptom Manage 16:1–9
38. Pargeon KL, Hailey BJ (1999) Barriers to effective cancer pain management: a review of the literature. J Pain Symptom Manage 18:358–368
39. Porcelli P, Tulipani C, Maiello E, Cilenti G, Todarello O (2007) Alexithymia, coping, and illness behavior correlates of pain experience in cancer patients. Psychooncology 16:644–650
40. Portenoy RK (1989) Cancer pain. Epidemiology and syndromes. Cancer 63:2298–2307

41. Portenoy RK, Miransky J, Thaler HT, Hornung J, Bianchi C, Cibas-Kong I, Feldhamer E, Lewis F, Matamoros I, Sugar MZ et al (1992) Pain in ambulatory patients with lung or colon cancer. Prevalence, characteristics, and effect. Cancer 70:1616–1624
42. Radloff LS (1977) The CES-D Scale: a self-report depression scale for research in a general population. Appl Psychol Meas 1:385–401
43. Reich M (2008) Depression and cancer: recent data on clinical issues, research challenges and treatment approaches. Curr Opin Oncol 20:353–359
44. Rosenstiel AK, Keefe FJ (1983) The use of coping strategies in chronic low back pain patients: relationship to patient characteristics and current adjustment. Pain 17:33–44
45. Sist TC, Florio GA, Miner MF, Lema MJ, Zevon MA (1998) The relationship between depression and pain language in cancer and chronic non-cancer pain patients. J Pain Symptom Manage 15:350–358
46. Spiegel D, Sands S, Koopman C (1994) Pain and depression in patients with cancer. Cancer 74:2570–2578
47. Spielberger CG, Gorsuch F, Luchene R (1971) STAI Manual for the S-T-A-I-(self-evaluation questionnaire). Consulting Psychologist, Palo Alto
48. Sullivan MJ, Thorn B, Haythornthwaite JA, Keefe F, Martin M, Bradley LA, Lefebvre JC (2001) Theoretical perspectives on the relation between catastrophizing and pain. The Clin J Pain 17:52–64
49. Turk DC, Feldman CS (1992) Noninvasive approaches to pain control in terminal illness: the contribution of psychological variables. The Hosp J 8:1–23
50. Turk DC, Fernandez E (1990) On the putative uniqueness of cancer pain: do psychological principles apply? Behav Res Ther 28:1–13
51. Turk DC, Kerns RD (1983) Conceptual issues in the assessment of clinical pain. Int J Psychiatry Med 13:57–68
52. Turner JA, Jensen MP, Romano JM (2000) Do beliefs, coping, and catastrophizing independently predict functioning in patients with chronic pain? Pain 85:115–125
53. Wilkie DJ, Huang HY, Reilly N, Cain KC (2001) Nociceptive and neuropathic pain in patients with lung cancer: a comparison of pain quality descriptors. J Pain Symptom Manage 22:899–910
54. Wilkie DJ, Keefe FJ (1991) Coping strategies of patients with lung cancer-related pain. The Clin J Pain 7:292–299
55. Wilkie DJ, Keefe FJ, Dodd MJ, Copp LA (1992) Behavior of patients with lung cancer: description and associations with oncologic and pain variables. Pain 51:231–240
56. Wilkie DJ, Savedra MC, Holzemer WL, Tesler MD, Paul SM (1990) Use of the McGill Pain Questionnaire to measure pain: a meta-analysis. Nurs Res 39:36–41
57. Zaza C, Baine N (2002) Cancer pain and psychosocial factors: a critical review of the literature. J Pain Symptom Manage 24:526–542