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Exploration of the Relationships Between Stress and Distinct Pain and Sleep Disturbance Profiles in Patients Undergoing Chemotherapy

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Abstract

Background: Unrelieved pain and sleep disturbance are common symptoms in oncology patients. Increased stress may be an underlying cause for both symptoms.

Objectives: Purposes were to identify subgroups of outpatients with distinct pain AND sleep disturbance profiles and evaluate for differences among these subgroups in demographic and clinical characteristics. Differences in global stress, cancer-specific stress, and cumulative life stress, as well as resilience and coping were evaluated.

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Methods: Patients (n=1343) completed self-report questionnaires for demographic and clinical characteristics and stress, resilience, and coping. Latent profile analysis was used to identify subgroups of patients with distinct pain AND sleep disturbance profiles. Differences among the subgroups were determined using parametric and nonparametric tests.

Results: Three distinct profiles were identified (i.e., No Pain+Moderate Sleep Disturbance (SD) (27.6%), Moderate Pain+Moderate SD (38.6%), Severe Pain+High SD (33.8%)). Compared to the other two classes, Severe Pain+High SD class was younger, had fewer years of education, was more likely to be female, more likely to live alone, less likely to be employed, and had a higher level of comorbidity. This class had the highest stress scores and were more likely to report higher rates of adverse childhood experiences.

Conclusions: Over 70% of our sample reported clinically meaningful levels of both symptoms and 33.8% reported relatively high rates of adverse childhood experiences.

Implications for Practice: Clinicians need to perform routine assessments, particularly of adverse childhood experiences, and initiate appropriate referrals.

Introduction

Unrelieved pain and sleep disturbance are two of the most common symptoms reported by oncology patients.[1] In a 2007 systematic review, that spanned 40 years of research,[2] 64% of patients with advanced stage disease; 59% of patients receiving cancer treatment; and 33% of survivors reported moderate to severe pain. Of note, in a subsequent review, published ten years later,[3] these prevalence rates were essentially unchanged (i.e., 66.4% of patients with metastatic or terminal disease, 55% during active treatment, 39.3% after curative treatment). In our most recent study of 1343 oncology patients receiving chemotherapy,[4] 72.5% of them reported pain. Of the 972 patients with pain, 21.5% reported only noncancer pain, 37.0% only cancer pain, and 41.5% both cancer and noncancer pain. Across these three pain groups, worst pain scores were in the moderate to severe range. These findings suggest that unrelieved pain remains a significant problem for oncology patients.

Similar to pain, sleep disturbance often goes unrecognized, is under-treated,[5, 6] and has numerous negative effects on oncology patients.[7] Of note, compared to the general population,[8] rates of insomnia are nearly three times higher in patients with cancer. While both symptoms are common, no studies have evaluated for inter-individual variability in the co-occurrence of pain and sleep disturbance in oncology patients undergoing chemotherapy.

One potential etiology for the occurrence of both pain and sleep disturbance is stress. A cancer diagnosis and associated treatments are perceived by patients as stressful or even traumatic experiences.[9, 10] For example, in one study of 85 oncology patients who sought psychosocial support services,[9] 60% of the sample endorsed clinical levels of post-traumatic stress disorder (PTSD) symptoms and 34% met the cutoff score for a diagnosis of probable PTSD. In this study, PTSD symptoms, sleep disturbance, pain intensity, and pain interference were positively correlated with each other. Controlling for metastatic disease, race, and type of cancer, sleep disturbance mediated the relationship between PTSD symptoms and pain intensity. The authors concluded that the relationships among PTSD

symptoms, pain intensity, and pain interference could be explained by co-occurring sleep disturbance.

These findings are supported by a recent review that suggests that in the general population a bidirectional relationship exists between stress and sleep.[11] Both acute and chronic stress have a negative impact on human sleep architecture that results in disruptions in sleep. However, a large amount of inter-individual variability exists in patients' responses to stress, as well as its impact on sleep. As noted in this review,[11] early life stressors contribute to the development of various types of sleep disorders in adult life.

Equally important is the relationship between stress and pain. Physiological responses to both stress and pain involve activation of common biological pathways including the hypothalamic-pituitary-adrenal (HPA) axis.[12] Of note, repeated and/or long-term exposure to various types of stress, as well as the emotional reactions to various stressors (e.g., depression, anxiety), can contribute to changes in pain processing (i.e., stress-induced hyperalgesia) and/or the exacerbation of chronic pain.[13] However, little is known about the relationships between various types of stress (i.e., global, cancer-specific, cumulative life stress) and the co-occurrence of pain and sleep disturbance in oncology patients.

Cancer patients demonstrate variable responses to stress that could be potentially explained by differences in personality or utilization of different coping mechanisms. A widely used definition of coping introduced by Lazarus and Folkman states that it involves "constantly changing cognitive and behavioral efforts to manage specific external and/or internal demands that are appraised as taxing or exceeding the resources of the person."[14] Coping strategies are generally divided in two categories; namely: engaging (adaptive or problem-focused) and disengaging (maladaptive or emotion-focused). Very limited data are available on the relationships between sleep disturbance and different coping styles. In one study of 55 men with cancer,[15] higher use of avoidance coping was associated with more severe sleep disturbance. In another longitudinal study of breast and prostate cancer patients undergoing radiation therapy,[16] the use of avoidance coping strategies was associated with worse sleep trajectories. However, in the male patients, the use of approach coping strategies predicted better sleep. Similar to sleep disturbance, limited information is available on the relationships between pain and coping behaviors in oncology patients. In one study of 162 patients with ovarian cancer,[17] higher pain distress and consequences scores were associated with a higher number of attempted coping strategies, as well as with the use of the strategies that involved expressing emotions and seeking emotional support.

Given the large amount of inter-individual variability in patients' symptom experiences, person-centered analytic approaches can be used to identify patients at increased risk for a higher symptom burden. We used this approach to evaluate for subgroups of patients with distinct pain[18] or sleep disturbance[19] profiles over two consecutive cycles of chemotherapy. In this paper, we extend our findings by modeling the two symptoms together. The purposes of this study, in a sample of oncology outpatients undergoing chemotherapy, were to identify subgroups of patients with distinct pain AND sleep disturbance profiles and to evaluate for differences among these subgroups in demographic and clinical characteristics. In addition, we evaluated for differences in global stress, cancer-specific stress, and cumulative life

stress, as well as resilience and coping. We hypothesized that patients with the worst pain and sleep disturbance profiles would report higher levels of all three types of stress, lower levels of resilience, and increased use of disengagement coping strategies.

Methods

Patients and Settings

This longitudinal study, described in detail elsewhere,[20] evaluated the symptom experience of oncology outpatients receiving chemotherapy. Eligible patients were ≥18 years of age; had a diagnosis of breast, gastrointestinal, gynecological, or lung cancer; had received chemotherapy within the preceding four weeks; were scheduled to receive at least two additional cycles of chemotherapy; were able to read, write, and understand English; and gave written informed consent. Patients were recruited from two Comprehensive Cancer Centers, one Veteran's Affairs hospital, and four community-based oncology programs. A total of 2234 patients were approached and 1343 consented to participate (60.1% response rate). The major reason for refusal was being overwhelmed with their cancer treatment.

Instruments

Demographic and clinical characteristics—A demographic questionnaire obtained information on age, gender, ethnicity, marital status, living arrangements, education, employment status, and income. In addition, patients completed the Karnofsky Performance Status (KPS) scale,[21] the Alcohol Use Disorders Identification Test (AUDIT),[22] and the Self-Administered Comorbidity Questionnaire (SCQ).[23] The SCQ evaluates the occurrence, impact of, and treatment for 13 common medical conditions. MAX2 score was used to evaluate the toxicity of the chemotherapy regimen.[24] Medical records were reviewed for disease and treatment characteristics.

Pain and sleep disturbance measures—Worst pain severity was assessed using the Brief Pain Inventory (BPI).[25] Patients were asked to indicate whether they were generally bothered by pain (yes/no). If they were generally bothered by pain, they rated their worst pain severity in the past 24 hours using a 0 (no pain) to 10 (worst pain imaginable) numeric rating scale (NRS). A mean BPI pain interference score was calculated.

The 21-item General Sleep Disturbance Scale (GSDS) was designed to assess the quality of sleep in the past week. Each item was rated on a 0 (never) to 7 (everyday) NRS. The GSDS total score is the sum of the 21 items that can range from 0 (no disturbance) to 147 (extreme sleep disturbance). Higher total scores indicate higher levels of sleep disturbance with a GSDS total score of ≥43 indicating a clinically meaningful level of sleep disturbance.[26] In this study, its Cronbach's alpha was 0.83.

Stress, Resilience, and Coping Measures—The 14-item Perceived Stress Scale (PSS) was used as a measure of global perceived stress according to the degree that life circumstances are appraised as stressful over the course of the previous week.[27] Total PSS scores can range from 0 to 56. In this study, its Cronbach's alpha was 0.85.

The 22-item Impact of Event Scale-Revised (IES-R) was used to measure cancer-related distress.[28, 29] Patients rated each item based on how distressing each potential difficulty was for them during the past week "with respect to their cancer and its treatment". Three subscales evaluate levels of intrusion, avoidance, and hyperarousal perceived by the patient. The total score can range from 0 to 88. Sum scores of ≥24 indicated clinically meaningful post traumatic symptomatology and scores of ≥33 indicate probable PTSD.[30] In this study, the Cronbach's alpha for the IES-R total score was 0.92.

The 30-item Life Stressor Checklist-Revised (LSC-R) is an index of lifetime trauma exposure (e.g., death of a loved one, sexual assault).[31] The LSC–R assesses whether each stressful event occurred, at what ages the events occurred, how many times each event occurred, how dangerous the event was, and whether the individual had an intense emotional reaction to the event(s). The total LSC–R score is obtained by summing the total number of events endorsed (range of 0 to 30). If the patient endorsed an event, the patient was asked to indicate how much that stressor affected their life in the past year, from 1 (not at all) to 5 (extremely). These responses were averaged to yield a mean "Affected" score. In addition, a PTSD sum score was created based on the number of positively endorsed items (out of 21) that reflect the DSM-IV PTSD Criteria A for having experienced a traumatic event. The LSC-R has demonstrated good to moderate test–retest reliability and good criterion-related validity with diverse populations.[32–35]

The 10-item Connor-Davidson Resilience Scale (CDRS) evaluates a patient's personal ability to handle adversity (e.g., "I am able to adapt when changes occur").[36, 37] Total scores range from 0 to 40, with higher scores indicative of higher self-perceived resilience. The normative adult mean score in the United States is 31.8 (±5.4),[37, 38] with an estimated minimal clinically important difference of 2.7.[39] In this study, its Cronbach's alpha was 0.90.

The 28-item Brief Cope scale was designed to assess a broad range of coping responses among adults.[40, 41] Higher scores indicate greater use of the various coping strategies by the patients. In total, 14 dimensions were evaluated using this instrument (with their respective Cronbach's alphas), namely: self-distraction (0.46), active coping (0.75), denial (0.72), substance use (0.87), use of emotional support (0.77), use of instrumental support (0.77), behavioral disengagement (0.57), venting (0.65), positive reframing (0.79), planning (0.74), humor (0.83), acceptance (0.68), religion (0.92), and self-blame (0.73). Each dimension was evaluated using two items. The Brief Cope has well established validity and reliability in oncology patients.[42, 43]

Study Procedures

The study was approved by the Committee on Human Research at the University of California, San Francisco and by the Institutional Review Board at each of the study sites. Eligible patients were approached by a research staff member in the infusion unit to discuss participation in the study. Written informed consent was obtained from all patients. Depending on the length of their chemotherapy cycles, patients completed questionnaires in their homes, a total of six times over two cycles of chemotherapy (i.e., prior to chemotherapy administration (i.e., recovery from previous CTX cycle), approximately 1

week after chemotherapy administration (i.e., acute symptoms), approximately 2 weeks after chemotherapy administration (i.e., potential nadir)).

Data Analysis

Latent profile analysis (LPA) was used to identify subgroups of patients with distinct worst pain AND sleep disturbance profiles. Before performing the LPA, patients who reported the occurrence of pain for ≤1 of the six assessments were identified and labeled as the "None" class (n=371, 27.6%). Then, the LPA was performed on the remaining 972 patients. This LPA was done with the combined set of variables over time (i.e., using the worst pain intensity and GSDS scores obtained during the six assessments in a single LPA). This approach provides a profile description of these two symptoms with two profiles over time. The LPA was done using Mplus version 8.4.[44]

In order to incorporate expected correlations among the repeated measures of the same variable and cross-correlations of the series of the two variables (i.e., worst pain and GSDS scores), we included covariance parameters among measures at the same occasion and those that were one or two occasions apart. Covariances of each variable with the other at the same assessments were included in the model. Autoregressive covariances were estimated with a lag of two with the same measures and with a lag of one for each variable's series with the other variable. We limited the covariance structure to a lag of two to accommodate the expected reduction in the correlations that would be introduced by two chemotherapy cycles within each set of three measurement occasions and to reduce model complexity.[45] Model fit was evaluated to identify the solution that best characterized the observed latent class structure with the Bayesian Information Criterion, Vuong-Lo-Mendell-Rubin likelihood ratio test (VLRM), entropy, and latent class percentages that were large enough to be reliable.[44] Missing data were accommodated for with the use of the Expectation-Maximization (EM) algorithm.[46]

Data were analyzed using SPSS version 27 (IBM Corporation, Armonk, NY). Descriptive statistics and frequency distributions were calculated for demographic and clinical characteristics. Differences among the worst pain AND sleep disturbance classes in demographic and clinical characteristics and stress, resilience and coping scores were evaluated using parametric and nonparametric tests. A p-value of <0.05 was considered statistically significant. Post hoc contrasts were done using a Bonferroni corrected p-value of $<.017$ (.05/3 possible pairwise comparisons).

Results

Latent Profile Analysis

The 371 patients (27.6%) who had ≤1 occurrence of pain and an average GSDS score of 43.0 over the six assessments were classified as the No Pain and Moderate Sleep Disturbance Class (No P+Moderate SD). For the remaining 972 patients whose data were entered into the LPA, the 2-class solution was selected because the BIC for that solution was lower than the BIC for the 1-class solution. In addition, the VLMR was significant for the 2-class solution, indicating that two classes fit the data better than one classes. Although the

BIC was smaller for the 3-class than for the 2-class solution, the VLMR was not significant for the 3-class solution, indicating that too many classes were extracted.

The Figure displays the trajectories of worst pain and sleep disturbance for the three classes. These classes were named based on clinically meaningful cutpoints for worst pain and GSDS scores. Of the 1343 patients in this study, 27.6% were in the No P+Moderate SD, 38.6% in the Moderate Pain and Moderate Sleep Disturbance (Both Moderate), and 33.8% in the Severe Pain and High Sleep Disturbance (Both High) classes.

Differences in Demographic and Clinical Characteristics

Compared to the other two classes, the Both High class was younger, had fewer years of education, was more likely to be female, less likely to be married or partnered, more likely to live alone, less likely to be employed, less likely to exercise on a regular basis, and more likely to self-report a diagnosis of depression (Table 2). Among the three classes, significant differences were found in annual household income and KPS scores (No P+Moderate SD > Both Moderate > Both High), as well as number of comorbid conditions, SCQ scores, and self-reported diagnosis of back pain (No P+Moderate SD < Both Moderate < Both High). Compared to the No P+Moderate SD class, the other two classes were more likely to self-report diagnoses of osteoarthritis and rheumatoid arthritis. Compared to the No P+Moderate SD class, the Both High class had a higher body mass index and were more likely to self-report heart disease and anemia.

Differences in Stress and Resilience Measures

Compared to the other two classes, Both High class had higher PSS, IES-R subscale and total scores, and lower CDRS scores (Table 3). Among the three classes, significant differences were found in LSC-R total, affected sum, and PTSD scores (No P+Moderate SD < Both Moderate < Both High).

Differences in the Occurrence of Life Stressors

For the interpersonal violence, abuse, and neglect stressors, compared to the other two classes, the Both High class reported higher occurrence rates for: family violence in childhood, emotional abuse, physical abuse at ≥16 years of age, and both items for forced touch and forced sex (Table 4). In terms of the other stressors, compared to the No P+Moderate SD class, the other two classes, reported higher occurrence rates for seen serious accident and family member in jail. Among the three classes, significant differences were found in the occurrence of serious money problems and having a serious physical or mental illness not related to cancer (No P+Moderate SD < Both Moderate < Both High).

Differences in the Effect of Life Stressors

Compared to the other two classes, the Both High class reported higher effected scores for: parents being separated or divorced, themselves being separated or divorced, and having an abortion or miscarriage (Table 5). Compared to the No P+Moderate SD class, the Both High class reported higher effected scores for: forced to touch at ≥16 years of age, been in a serious disaster, and had a serious accident or injury. Compared to the Both Moderate class, the Both High class reported higher effected scores for: emotional abuse, forced to touch

at <16 years of age, serious money problems, caring for someone with a severe physical or mental handicap, and sudden death of someone close.

Differences in Coping Strategies

As shown in Table 6, compared to the other two classes, the Both High class reported higher scores for: denial, venting, substance use, behavioral disengagement, and self-blame. Compared to the No P+Moderate SD class, the other two classes reported higher scores for religion.

Discussion

This study is the first to use LPA to identify distinct pain AND sleep disturbance profiles in oncology patients receiving chemotherapy and evaluate for associations with measures of global, cancer-specific, and cumulative life stress, as well as resilience and the use of engagement and disengagement coping strategies. Our a priori hypothesis was supported in that patients in the Both High class reported the highest stress scores, the lowest resilience scores, and higher use of most of the disengagement coping strategies. While in our previous studies of the individual symptoms, four distinct profiles for pain (i.e., none, mild, moderate, and severe)[18] and three distinct profiles for sleep disturbance (i.e., low, high, and very high)[19] were identified, when the joint LPA was done, three distinct profiles were identified. While the exact reasons for the different number of profiles are not readily apparent, some findings warrant consideration. First, regardless of whether the patients reported pain, all of the patients were classified as having sleep disturbance scores that were above the clinically meaningful cutpoint for the GSDS. As expected, patients in the Both High class, that constituted a third of the sample, had GSDS total scores that were equivalent to those reported by shift workers[47] and mothers and fathers of newborn infants.[48] Our finding that over 70% of our patients reported clinically meaningful levels of both symptoms is consistent with previous reports of co-occurrence rates of between 40% and 80% for patients with chronic non-cancer pain.[49] In terms of causality, recent evidence suggests that a bidirectional relationship exists between these two symptoms and that they exacerbate each other.[50]

One of the goals of this study was to identify modifiable and non-modifiable risk factors for a worse symptom profile, as well as the relationships among stress, resilience, and coping and these profiles. Table 7 provides a synthesis of the findings by comparing the Both Moderate and Both High profiles to the NoP+Moderate SD profile. The remainder of the Discussion places these findings in the context of the extant literature.

Demographic and Clinical Characteristics

The majority of the demographic risk factors were associated with membership in the Both High class. Compared to the other two classes, the Both High class was significantly younger, more likely to be female, less likely to be married/partnered, more likely to live alone, less likely to be employed, had a lower annual household income, and was less likely to exercise on a regular basis. Our findings regarding the association between younger age and higher levels of sleep disturbance[51, 52] and pain[53] are consistent with previous reports

that investigated individual symptoms in oncology patients. In terms of gender differences, findings for both sleep disturbance[54, 55] and pain[56] are inconclusive in both oncology patients and the general population. However, as noted in one review,[57] women appear to be at increased risk for insomnia that is attributed to fluctuations in sex steroid hormones.

A cancer diagnosis and associated treatments, as well as co-occurring symptoms like pain and sleep disturbance, are known to have negative effects on patients' ability to work and on their financial status.[58] Undoubtedly, these challenging financial situations contribute to increased stress that may create a viscous cycle of increased pain, difficulty sleeping, and perceptions of increased stress. This vicious cycle may be exacerbated by the lack of social support which is known to exacerbate pain[59] and sleep disturbance.[60]

Compared to the No P+Moderate SD class, the clinical characteristics that were common to the other two classes included: a higher number of comorbidities, a higher comorbidity burden, and receipt of a higher number cancer treatments, as well as a lower functional status. These findings are consistent with studies of sleep disturbance[61, 62] and pain[63,64] as single symptoms. In terms of specific comorbid conditions, it is not surprising given the bidirectional relationship between pain and sleep disturbance,[49] that patients in the two worst classes reported higher occurrence rates for osteoarthritis, rheumatoid arthritis and back pain. These findings suggest that oncology clinicians need to assess for and manage both cancer and non-cancer related pain.

It should be noted that 31.6% of the patients in the Both High class self-reported a diagnosis of depression. This finding is interesting given the fact that recent work suggests that insomnia may be the result of the malfunctioning of emotional regulation.[57] The authors suggest that extrinsic and intrinsic "sleep permissive" and "wake promoting" conditions co-determine whether an individual transitions into sleep. For example, unrelieved pain, anxiety, and stress, as well as depressive symptoms may promote wakefulness rather than sleep. This hypothesis warrants careful consideration in oncology patients who report an average of 14 co-occurring symptoms.[65]

Stress

Our evaluation of stress included measures of global, cancer-specific, and cumulative life stress. Of particular importance to this discussion and not well studied on oncology patients is the relationships between sleep disturbance and pain in the context of stress, particularly PTSD[66, 67] and adverse childhood experiences (ACEs).[68–70] As noted in one review,[68] at least 1 out of every 10 people seeking medical care has experienced an ACE and the trauma associated with this experience contributes to an increased risk for common medical conditions.

Patients in the Both High class had average IES-R total scores that indicate clinically meaningful post traumatic symptomatology and 28.2% of these patients had scores of ≥33 which indicates probable PTSD. As noted in Table 3, these patients had the highest scores for all of the stress measures and resilience scores that were below the normative score for the United States. In terms of the occurrence (Table 4) and effect (Table 5) of specific stressors, patients in the Both High class reported some of the highest occurrence rates for

ACEs including: family violence in childhood (29.9%), as well as physical abuse (18.8%), forced touching (18.6%) and forced sex (8.3%) at or before the age of 16. Our findings are consistent with a systematic review that found positive associations between the occurrence of ACEs and a number of sleep disorders in adulthood.[69] While the exact mechanism(s) for this association is not completely understood, recent hypotheses suggest that stress: causes dysregulation in circadian rhythms; increases neuronal activity in the brain; results in elevated levels of corticotrophin releasing hormone; and/or results in a failure to learn proper sleep habits. In terms of ACEs and pain, a growing body of pre-clinical and clinical literature suggests that early life stress can result in long term changes in brain functioning and nociceptor processing that results in increased pain sensitivity and higher susceptibility to the development of chronic pain.[70]

Coping

In our previous study with the same sample,[71] we reported that the use of disengagement coping strategies was associated with higher levels of cancer-related stress. While not studied in relationship to the co-occurrence of pain and sleep disturbance, patients in the Both High class reported the highest use of all of the disengagement coping strategies (i.e., venting, substance use, behavioral disengagement, self-blame), except for self-distraction. While the relationships between sleep disturbance and the use of various coping strategies has not been examined in oncology patients, in a study of ovarian cancer patients who reported a mean pain score of 5.5 on a 0 to 10 NRS, the most frequently used coping strategies were planning and actively managing pain. This finding is congruent with the higher use of planning in our Both High class.

Implications for Clinical Practice

Given that over 70% of our patients reported clinically meaningful levels of both pain and sleep disturbance, as well as high levels of stress, including high occurrence rates for ACEs, and the more frequent use of disengagement coping strategies, numerous opportunities exist to improve these patients' care. First and foremost, clinicians need to assess for the co-occurrence of pain and sleep disturbance. In terms of a routine ACE assessment, professionals express concern that asking these intimate types of questions will upset the patient or erode trust. However, in a study of over 400,000 patients,[72] the routine use of an instrument like the Adverse Child Experience Questionnaire did not evoke any complaints. In many cases, patients expressed gratitude for being able to discuss these traumatic events for the first time. In the context of a busy oncology clinic, if patients do report ACEs, clinicians need to express empathy and schedule another appointment with the patient to develop a plan for management or referral to a mental health professional.

In terms of the management of co-occurring pain and sleep disturbance, clinicians need to perform a comprehensive evaluation of the current use and effectiveness of pharmacologic and non-pharmacologic interventions for these symptoms. As noted in one review,[49] cognitive behavioral interventions are demonstrating efficacy for both of these symptoms.

Limitations and Directions for Future Research

Several limitations warrant consideration. Given that this sample was relatively homogenous in terms of education and socioeconomic status, future studies need to determine the impact of additional social determinants of health (e.g., neighborhood, ethnic diversity) on the severity of both symptoms and levels of all three types of stress. While the LSC-R does not create a score for total number of ACEs the patient experiences, given the positive associations between the absolute number of ACEs and the development of sleep disorders[69] and chronic pain [70], future studies need to perform this evaluation in oncology patients. Finally, the mechanisms that underlie the co-occurrence of pain and sleep disturbance warrant careful evaluation.

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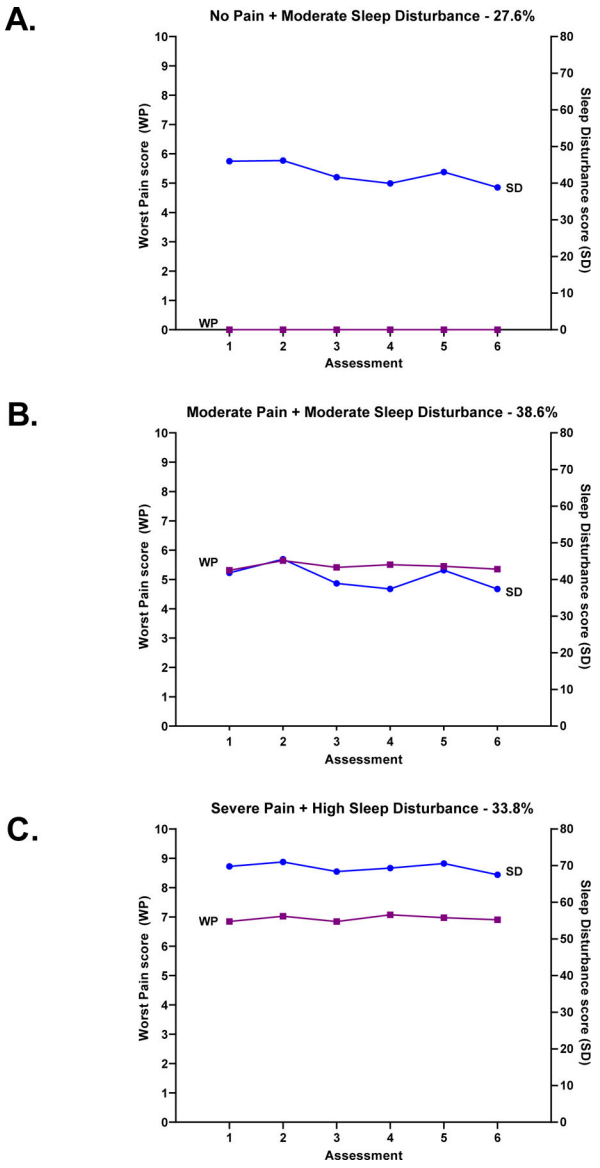

Figure.

Trajectories of worst pain (WP) and sleep disturbance (SD) for the three latent classes. The numbers on the x-axis indicated the assessments of pain (i.e., rating of worst pain on a 0 to 10 numeric rating scale) and sleep disturbance (i.e., General Sleep Disturbance Scale scores) that were done prior to the administration of chemotherapy (i.e., assessments 1 and 4), in the week following the administration of chemotherapy (i.e., assessments 2 and 5), and two weeks after the administration of chemotherapy (i.e., assessments 3 and 6).

Table 1.

Latent Profile Solutions and Fit Indices for One through Three Classes for the Worst Pain and Sleep Disturbance Scores

Model	LL	AIC	BIC	Entropy	VLMR
1 Class	−28982.27	58080.53	58363.53	n/a	n/a
2 Class[a]	−28605.68	57353.36	57699.80	0.75	753.17[b]
3 Class	−28436.49	57040.97	57450.84	0.78	ns

Baseline entropy and VLMR are not applicable for the one-class solution

[a]The 2-class solution was selected because the BIC for that solution was lower than the BIC for the enrollment (1-class) solution. In addition, the VLMR was significant for the 2-class solution, indicating that two classes fit the data better than one classes. Although the BIC was smaller for the 3-class than for the 2-class solution, the VLMR was not significant for the 3-class solution, indicating that too many classes were extracted.

[b]$p < .00005$

Abbreviations: AIC, Akaike Information Criterion; BIC, Bayesian Information Criterion; LL, log-likelihood; n/a, not applicable; ns, not significant; VLMR, Vuong-Lo-Mendell-Rubin likelihood ratio test for the K vs. K-1 model.

Table 2.

Differences in Demographic and Clinical Characteristics Among the Worst Pain and Sleep Disturbance Latent Classes at Enrollment

Characteristic	No Pain + Moderate Sleep Disturbance (0) 27.6% (n=371)	Moderate Pain + Moderate Sleep Disturbance (1) 38.6% (n=519)	Severe Pain + High Sleep Disturbance (2) 33.8% (n=453)	Statistics
	Mean (SD)	Mean (SD)	Mean (SD)	
Age (years)	58.2 (11.9)	58.5 (12.5)	54.8 (12.3)	F = 12.72, p <.001 0 and 1 > 2
Education (years)	16.7 (3.2)	16.3 (3.0)	15.7 (2.9)	F = 9.49 p <.001 0 and 1 > 2
Body mass index (kg/m^2)	25.5 (5.5)	26.0 (5.3)	26.9 (6.2)	F= 5.99 p = .003 0 < 2
Alcohol Use Disorders Identification Test score	3.0 (2.0)	2.8 (2.4)	3.1 (2.9)	F = 1.23, p = .293
Karnofsky Performance Status score	84.8 (11.5)	81.1 (11.9)	74.7 (12.1)	F = 74.66 p <.001 0 > 1 > 2
Number of comorbid conditions	1.9 (1.1)	2.4 (1.5)	2.8 (1.5)	F = 42.69 p <.001 0 < 1 < 2
Self-administered Comorbidity Questionnaire score	4.3 (2.4)	5.4 (3.0)	6.6 (3.6)	F = 57.59 p <.001 0 < 1 < 2
Time since diagnosis (years)	1.7 (3.2)	2.3 (4.2)	1.9 (3.9)	KW = 6.30, p = .043 0 < 1
Time since diagnosis (years, median)	0.40	0.44	0.42	
Number of prior cancer treatments	1.3 (1.3)	1.7 (1.6)	1.7 (1.5)	F = 8.43 p <.001 0 < 1 and 2
Number of metastatic sites including lymph node involvement[a]	1.1 (1.2)	1.4 (1.3)	1.2 (1.3)	F = 4.85 p = .008 0 < 1
Number of metastatic sites excluding lymph node involvement	0.7 (0.9)	0.9 (1.1)	0.8 (1.1)	F = 4.66 p = .010 0 < 1
MAX2 score	0.17 (0.08)	0.17 (0.08)	0.18 (0.08)	F = 1.35, p = .261
	% (n)	% (n)	% (n)	
Gender (% female)	71.9 (266)	76.7 (398)	83.9 (380)	X^2 = 17.56, p <.001 0 and 1 < 2
Self-reported ethnicity White Asian or Pacific Islander Black Hispanic, Mixed, or Other	 70.5 (260) 12.5 (46) 6.8 (25) 10.3 (38)	 68.2 (347) 15.3 (78) 8.1 (41) 8.4 (43)	 70.1 (314) 9.8 (44) 6.5 (29) 13.6 (61)	X^2 = 12.88, p = .045 NS 1 > 2 NS 1 < 2

Characteristic	No Pain + Moderate Sleep Disturbance (0) 27.6% (n=371)	Moderate Pain + Moderate Sleep Disturbance (1) 38.6% (n=519)	Severe Pain + High Sleep Disturbance (2) 33.8% (n=453)	Statistics
	Mean (SD)	Mean (SD)	Mean (SD)	
Married or partnered (% yes)	69.6 (256)	67.2 (344)	57.2 (254)	X^2 = 16.05, p <.001 0 and 1 > 2
Lives alone (% yes)	18.8 (69)	18.1 (93)	27.4 (122)	X^2 = 14.29, p = .001 0 and 1 < 2
Currently employed (% yes)	42.2 (154)	36.1 (186)	28.1 (126)	X^2 = 18.06, p <.001 0 and 1 > 2
Annual household income Less than $30,000 + $30,000 to $70,000 $70,000 to $100,000 Greater than $100,000	 9.7 (32) 17.0 (56) 19.7 (65) 53.6 (177)	 14.4 (66) 26.5 (121) 17.7 (81) 41.4 (189)	 29.7(123) 18.6 (77) 13.8 (57) 37.9 (157)	KW = 40.39, p <.001 0 >1 > 2
Child care responsibilities (% yes)	22.0 (80)	18.8 (95)	25.8 (115)	X^2 = 6.70, p = .035 1 < 2
Elder care responsibilities (% yes)	6.2 (21)	9.1 (42)	8.1 (34)	X^2 = 2.25, p = .324
Past or current history of smoking (% yes)	30.2 (110)	37.7 (193)	36.9 (164)	X^2 = 5.86, p = .053
Exercise on a regular basis (% yes)	77.7 (283)	71.6 (363)	64.0 (283)	X^2 = 18.44, p <.001 0 and 1 > 2
Specific comorbid conditions				
Heart disease	3.2 (12)	5.6 (29)	7.9 (36)	X^2 = 8.41, p = .015 0 < 2
High blood pressure	29.1 (108)	30.3 (157)	31.1 (141)	X^2 = 0.39, p = .822
Lung disease	9.4 (35)	11.8 (61)	12.6 (57)	X^2 = 2.11, p = .348
Diabetes	7.0 (26)	10.0 (52)	9.7 (44)	X^2 = 2.70, p = .259
Ulcer or stomach disease	3.0 (11)	4.2 (22)	7.1 (32)	X^2 = 8.10, p = .017
Kidney disease	0.8 (3)	1.3 (7)	2.0 (9)	X^2 = 2.06, p = .358
Liver disease	5.4 (20)	8.1 (42)	5.5 (25)	X^2 = 3.65, p = .162
Anemia or blood disease	8.4 (31)	11.8 (61)	15.9 (72)	X^2 = 10.98, p = .004 0 < 2
Depression	10.5 (39)	14.5 (75)	31.6 (143)	X^2 = 70.43, p <.001 0 and 1 < 2
Osteoarthritis	5.9 (22)	14.1 (73)	15.2 (69)	X^2 = 19.17, p <.001 0 < 1 and 2

Characteristic	No Pain + Moderate Sleep Disturbance (0) 27.6% (n=371)	Moderate Pain + Moderate Sleep Disturbance (1) 38.6% (n=519)	Severe Pain + High Sleep Disturbance (2) 33.8% (n=453)	Statistics
	Mean (SD)	Mean (SD)	Mean (SD)	
Back pain	7.3 (27)	28.3 (147)	38.0 (172)	X^2 = 103.35, p <.001 0 < 1 < 2
Rheumatoid arthritis	0.8 (3)	4.2 (22)	4.0 (18)	X^2 = 9.53, p = .009 0 < 1 and 2
Cancer diagnosis				
Breast cancer	38.5 (143)	38.5 (200)	43.5 (197)	
Gastrointestinal cancer	35.6 (132)	30.1 (156)	27.4 (124)	X^2 = 12.28, p = .056
Gynecological cancer	13.2 (49)	19.5 (101)	18.3 (83)	
Lung cancer	12.7 (47)	11.9 (62)	10.8 (49)	
Prior cancer treatment				
No prior treatment	29.2 (105)	25.0 (125)	21.3 (95)	X^2 = 13.63, p = .034 0 > 2
Only surgery, CTX, or RT	44.0 (158)	40.7 (204)	42.0 (187)	NS
Surgery and CTX, or surgery and RT, or CTX and RT	15.3 (55)	22.0 (110)	21.1 (94)	0 < 1
Surgery and CTX and RT	11.4 (41)	12.4 (62)	15.5 (69)	NS
Metastatic sites				
No metastasis	34.8 (126)	28.5 (147)	34.8 (155)	
Only lymph node metastasis	22.4 (81)	22.7 (117)	21.1 (94)	X^2 = 6.84, p = .336
Only metastatic disease in other sites	19.1 (69)	22.3 (115)	21.5 (96)	
Metastatic disease in lymph nodes and other sites	23.8 (86)	26.6 (137)	22.6 (101)	
CTX regimen				
Only CTX	73.5 (263)	64.6 (330)	73.8 (329)	X^2 =12.36, p=0.015 0 and 2 > 1
Only targeted therapy	2.5 (9)	3.7 (19)	2.5 (11)	NS
Both CTX and targeted therapy	24.0 (86)	31.7 (162)	23.8 (106)	0 and 2 < 1
Cycle length				
14-day cycle	45.5 (166)	40.7 (210)	40.9 (182)	KW = 2.74, p = .255
21-day cycle	48.2 (176)	51.0 (263)	52.1 (232)	
28-day cycle	6.3 (23)	8.3 (43)	7.0 (31)	
Emetogenicity of the CTX regimen				
Minimal/low	14.8 (54)	22.5 (116)	20.0 (89)	KW = 12.30, p = .002 0 > 1 and 2
Moderate	60.8 (222)	59.7 (308)	62.8 (280)	
High	24.4 (89)	17.8 (92)	17.3 (77)	
Antiemetic regimen				
None	6.7 (24)	7.9 (40)	6.4 (28)	
Steroid alone or serotonin receptor antagonist alone	18.5 (66)	20.4 (103)	22.0 (96)	X^2 = 5.62, p = .468
Serotonin receptor antagonist and steroid	48.3 (172)	49.6 (250)	45.0 (196)	
NK-1 receptor antagonist and two other antiemetics	26.4 (94)	22.0 (111)	26.6 (116)	

[a]Total number of metastatic sites evaluated was 9.

[+]Reference group

Abbreviations: CTX, chemotherapy; kg, kilograms; KW, Kruskal Wallis; m^2, meters squared; n/a, not applicable; NK-1, neurokinin-1; NS, not significant; pw, pairwise; RT, radiation therapy; SD, standard deviation.

Table 3.

Differences in Stress and Resilience Measures Among the Worst Pain and Sleep Disturbance Latent Classes at Enrollment

Measures[a]	No Pain + Moderate Sleep Disturbance (0) 27.6% (n=371)	Moderate Pain + Moderate Sleep Disturbance (1) 38.6% (n=519)	Severe Pain + High Sleep Disturbance (2) 33.8% (n=453)	Statistics
	Mean (SD)	Mean (SD)	Mean (SD)	
PSS total score (range 0 to 56)	16.0 (7.9)	16.7 (7.0)	22.5 (8.1)	F=93.03, p<0.001 0 and 1 < 2
IES-R total score (≥24)	15.5 (10.6)	14.9 (9.9)	25.7 (15.1)	F=110.14, p<0.001 0 and 1 < 2
IES-R intrusion	0.7 (0.6)	0.7 (0.5)	1.3 (0.8)	F=111.65, p<0.001 0 and 1 < 2
IES-R avoidance	0.9 (0.6)	0.8 (0.6)	1.1 (0.7)	F=26.36, p<0.001 0 and 1 < 2
IES-R hyperarousal	0.5 (0.5)	0.4 (0.4)	1.1 (0.8)	F=148.40, p<0.001 0 and 1 < 2
LSC-R total score (range 0 to 30)	4.8 (3.2)	5.8 (3.6)	7.3 (4.5)	F=33.36, p<0.001 0 < 1 < 2
LSC-R affected sum (range 0 to 150)	8.3 (7.2)	10.6 (9.4)	16.1 (13.2)	F=47.66, p<0.001 0 < 1 < 2
LSC-R PTSD sum (range 0 to 21)	2.1 (2.3)	2.8 (2.7)	4.2 (3.6)	F=42.00, p<0.001 0 < 1 < 2
CDRS total score (range 0 to 40)	31.1 (6.3)	30.5 (6.2)	28.8 (6.5)	F=13.89, p<0.001 0 and 1 > 2

Abbreviations: CDRS, Connor Davidson Resilience Scale; IES-R, Impact of Event Scale – Revised; LSC-R, Life Stressor Checklist-Revised; PSS, Perceived Stress Scale; PTSD, post traumatic stress disorder; SD, standard deviation.

[a]Clinically meaningful cutoff scores or range of scores

Table 4.

Differences among the Worst Pain and Sleep Disturbance Latent Classes in the Percentage of Patients Exposed to Specific Stressors

Stressful Life Event	No Pain + Moderate Sleep Disturbance (0) 27.6% (n=371)	Moderate Pain + Moderate Sleep Disturbance (1) 38.6% (n=519)	Severe Pain + High Sleep Disturbance (2) 33.8% (n=453)	Statistics
	% (n)	% (n)	% (n)	
Interpersonal Violence, Abuse, and Neglect Stressors				
Family violence in childhood	19.0 (49)	21.6 (91)	29.9 (103)	X^2=11.39, p=.003 0 and 1 < 2
Emotional abuse	17.1 (44)	17.5 (75)	30.3 (105)	X^2=22.65, p<.001 0 and 1 < 2
Physical neglect	1.5 (4)	4.7 (20)	7.5 (26)	X^2=11.42, p=.003 0 < 2
Sexual harassment	8.5 (22)	17.7 (74)	26.1 (90)	X^2=31.07, p<.001 0 < 1 < 2
Physical abuse - <16 years	10.0 (26)	13.3 (56)	18.8 (65)	X^2=9.94, p=.007 0 < 2
Physical abuse - ≥16 years	10.0 (26)	11.7 (49)	18.3 (63)	X^2=10.78, p=.005 0 and 1 < 2
Forced to touch - <16 years	6.2 (16)	9.1 (38)	18.6 (65)	X^2=26.41, p<.001 0 and 1 < 2
Forced to touch - ≥16 years	2.3 (6)	4.1 (17)	11.2 (39)	X^2=25.22, p<.001 0 and 1 < 2
Forced sex - <16 years	1.6 (4)	2.9 (12)	8.3 (29)	X^2=19.79, p<.001 0 and 1 < 2
Forced sex - ≥16 years	3.5 (9)	4.1 (17)	11.4 (40)	X^2=22.06, p<.001 0 and 1 < 2
Other Stressors				
Been in a serious disaster	34.4 (87)	43.0 (183)	43.0 (151)	X^2=5.84, p=.054
Seen serious accident	22.7 (58)	36.1 (154)	35.9 (126)	X^2=15.31, p<.001 0 < 1 and 2
Had serious accident or injury	18.8 (48)	23.4 (98)	29.2 (102)	X^2=9.07, p=.011 0 < 2
Jail (family member)	13.6 (35)	22.9 (97)	22.9 (80)	X^2=10.37, p=.006 0 < 1 and 2
Jail (self)	5.4 (14)	6.8 (29)	7.7 (27)	X^2=1.26, p=.532
Foster care or put up for adoption	1.9 (5)	1.9 (8)	3.4 (12)	X^2=2.38, p=.305
Separated/divorced (parents)	18.6 (48)	18.7 (80)	27.7 (97)	X^2=11.10, p=.004 0 and 1 < 2
Separated/divorced (self)	34.2 (89)	35.8 (153)	37.8 (132)	X^2=0.86, p=.652
Serious money problems	11.2 (29)	18.1 (77)	28.7 (100)	X^2=30.07, p<.001 0 < 1 < 2
Had serious physical or mental illness (not cancer)	10.4 (27)	18.0 (77)	26.4 (93)	X^2=25.43, p<.001 0 < 1 < 2
Abortion or miscarriage	43.3 (81)	45.2 (150)	43.7 (129)	X^2=0.22, p=.898

Stressful Life Event	No Pain + Moderate Sleep Disturbance (0) 27.6% (n=371)	Moderate Pain + Moderate Sleep Disturbance (1) 38.6% (n=519)	Severe Pain + High Sleep Disturbance (2) 33.8% (n=453)	Statistics
	% (n)	% (n)	% (n)	
Interpersonal Violence, Abuse, and Neglect Stressors				
Separated from child	0.8 (2)	1.7 (7)	3.6 (12)	X^2=5.98, p=.050
Care for child with handicap	3.2 (8)	4.6 (19)	3.6 (12)	X^2=1.01, p=.604
Care for someone with severe physical or mental handicap	19.9 (51)	22.5 (94)	30.0 (103)	X^2=9.45, p=.009 0 < 2
Death of someone close (sudden)	45.9 (117)	48.3 (204)	53.2 (182)	X^2=3.44, p=.179
Death of someone close (not sudden)	79.4 (200)	76.2 (317)	82.2 (282)	X^2=4.13, p=.127
Seen robbery/mugging	20.9 (54)	20.9 (89)	24.1 (84)	X^2=1.38, p=.503
Been robbed/mugged	24.4 (63)	25.8 (109)	29.3 (101)	X^2=2.02, p=.364

Table 5.

Differences Among the Worst Pain and Sleep Disturbance Latent Classes in the Effect of Stressors on Life in the Past Year

Stressful Life Event[a]	No Pain + Moderate Sleep Disturbance (0)	Moderate Pain + Moderate Sleep Disturbance (1)	Severe Pain + High Sleep Disturbance (2)	Statistics
	Mean (SD)	Mean (SD)	Mean (SD)	
Interpersonal Violence, Abuse, and Neglect Stressors				
Family violence in childhood	1.6 (1.1)	1.9 (1.2)	2.0 (1.2)	KW=5.13, p=.077
Emotional abuse	2.4 (1.4)	2.3 (1.3)	2.9 (1.3)	KW=7.86, p=.020 1 < 2
Physical neglect	2.8 (2.1)	2.7 (1.3)	2.9 (1.3)	KW=0.25, p=.884
Sexual harassment	1.5 (1.2)	1.5 (1.0)	1.5 (0.9)	KW=1.70, p=.428
Physical abuse - <16 years	1.7 (1.1)	1.9 (1.3)	2.1 (1.3)	KW=3.40, p=.182
Physical abuse - ≥16 years	1.7 (1.2)	1.7 (1.0)	2.1 (1.3)	KW=3.98, p=.136
Forced to touch - <16 years	1.6 (1.3)	1.6 (1.0)	2.4 (1.4)	KW=12.29, p=.002 1 < 2
Forced to touch - ≥16 years	1.0 (0.0)	1.7 (1.2)	2.2 (1.3)	KW=7.99, p=.018 0 < 2
Forced sex - <16 years	2.0 (1.2)	1.6 (0.8)	2.2 (1.5)	KW=0.59, p=.747
Forced sex - ≥16 years	1.6 (1.3)	1.5 (0.9)	1.9 (1.3)	KW=1.81, p=.406
Other Stressors				
Been in a serious disaster	1.2 (0.7)	1.3 (0.8)	1.5 (0.8)	KW=9.83, p=.007 0 < 2
Seen serious accident	1.3 (0.6)	1.4 (0.8)	1.6 (1.0)	KW=4.73, p=.094
Had serious accident or injury	1.2 (0.6)	1.6 (1.0)	1.8 (1.1)	KW=15.18, p<.001 0 < 2
Jail (family member)	1.6 (1.0)	1.8 (1.4)	2.1 (1.4)	KW=3.47, p=.177
Jail (self)	1.2 (0.6)	1.8 (1.1)	2.0 (1.5)	KW=3.17, p=.205
Foster care or put up for adoption	2.2 (1.6)	2.3 (1.9)	2.4 (1.2)	KW=0.42, p=.811
Separated/divorced (parents)	1.5 (1.0)	1.6 (1.0)	2.0 (1.2)	KW=9.28, p=.010 0 and 1 < 2
Separated/divorced (self)	1.9 (1.3)	1.9 (1.2)	2.4 (1.5)	KW=10.07, p=.007 0 and 1 < 2
Serious money problems	2.5 (1.7)	2.3 (1.6)	3.1 (1.7)	KW=12.56, p=.002 1 < 2
Had serious physical or mental illness (not cancer)	2.0 (1.2)	2.4 (1.4)	2.7 (1.3)	KW=6.58, p=.037 no significant pairwise contrasts
Abortion or miscarriage	1.3 (0.7)	1.4 (0.9)	1.8 (1.2)	KW=13.79, p=.001 0 and 1 < 2
Separated from child	1.0 (---)	2.9 (1.1)	3.0 (1.9)	KW=1.56, p=.458
Care for child with handicap	4.0 (1.6)	3.2 (1.3)	2.9 (1.3)	KW=3.38, p=.0185
Care for someone with severe physical or mental handicap	2.5 (1.4)	2.2 (1.3)	2.9 (1.6)	KW=9.03, p=.011 1 < 2

Stressful Life Event[a]	No Pain + Moderate Sleep Disturbance (0)	Moderate Pain + Moderate Sleep Disturbance (1)	Severe Pain + High Sleep Disturbance (2)	Statistics
	Mean (SD)	Mean (SD)	Mean (SD)	
Death of someone close (sudden)	2.0 (1.2)	2.0 (1.3)	2.4 (1.4)	KW=8.25, p=.016 1 < 2
Death of someone close (not sudden)	1.9 (1.1)	2.0 (1.2)	2.5 (1.4)	KW=29.01, p<.001 0 and 1 < 2
Seen robbery/mugging	1.2 (0.4)	1.6 (1.0)	1.7 (1.2)	KW=9.32, p=.009 0 < 1 and 2
Been robbed/mugged	1.4 (0.9)	1.7 (1.1)	1.7 (1.2)	KW=4.18, p=.124

Abbreviation: SD, standard deviation.

*Range = 1 “not at all” to 5 “extremely”

[a]These data are reported for those patients who reported the occurrence of the stressor (see Table 4)

Table 6.

Differences Among the Worst Pain and Sleep Disturbance Latent Classes in the Brief COPE Subscale Scores

Subscale [a]	No Pain + Moderate Sleep Disturbance (0) 27.6% (n=371)	Moderate Pain + Moderate Sleep Disturbance (1) 38.6% (n=519)	Severe Pain + High Sleep Disturbance (2) 33.8% (n=453)	Statistics
	Mean (SD)	Mean (SD)	Mean (SD)	
Engagement coping strategies				
Active coping	6.0 (1.7)	6.1 (1.6)	5.9 (1.6)	F=1.27, p=.282
Planning	5.2 (1.8)	5.2 (1.8)	5.5 (1.7)	F=4.16, p=.016 0 < 2
Positive reframing	5.3 (2.0)	5.5 (1.9)	5.5 (1.9)	F=1.20, p=.303
Acceptance	6.7 (1.4)	6.8 (1.3)	6.6 (1.4)	F=1.92, p=.146
Humor	4.3 (2.0)	4.2 (1.9)	4.5 (2.0)	F=3.10, p=.045 1 < 2
Religion	4.7 (2.3)	5.1 (2.3)	5.2 (2.3)	F=5.07, p=.006 0 < 1 and 2
Using emotional support	6.4 (1.7)	6.3 (1.6)	6.3 (1.6)	F=0.23, p=.793
Using instrumental support	5.3 (1.8)	5.3 (1.8)	5.4 (1.7)	F=1.62, p=.199
Disengagement coping strategies				
Self-distraction	5.4 (1.8)	5.4 (1.7)	5.6 (1.5)	F=1.71, p=.181
Denial	2.5 (1.0)	2.4 (0.9)	2.7 (1.3)	F=8.79, p<.001 0 and 1 < 2
Venting	3.8 (1.6)	3.8 (1.6)	4.3 (1.7)	F=13.44, p<.001 0 and 1 < 2
Substance use	2.1 (0.5)	2.2 (0.7)	2.4 (0.9)	F=9.73, p<.001 0 and 1 < 2
Behavioral disengagement	2.2 (0.6)	2.1 (0.6)	2.4 (1.0)	F=21.13, p<.001 0 and 1 < 2
Self-blame	2.6 (1.0)	2.6 (1.0)	3.3 (1.5)	F=42.89, p<.001 0 and 1 < 2

Abbreviation: SD, standard deviation.

[a] Each item was rate on a 4-point Likert scale that ranged from 1 (“I haven’t been doing this at all”) to 4 (“I have been doing this a lot”). Each coping strategy is evaluated using 2 items. Scores can range from 2 to 8 with higher scores indicating greater use of each of the coping strategies.

Table 7.

Characteristics Associated With Membership in the Worst Pain and Sleep Disturbance Latent Classes

Characteristic[a]	Moderate Pain + Moderate Sleep Disturbance	Severe Pain + High Sleep Disturbance
Demographic Characteristics		
More likely to be younger		■
Fewer years of education		■
More likely to be female		■
Less likely to be married or partnered		■
More likely to live alone		■
Less likely to be employed		■
More likely to have a lower annual household income	■	■
Less likely to exercise on a regular basis		■
Clinical Characteristics		
Higher body mass index		■
Lower functional status (KPS score)	■	■
Higher number of comorbidities	■	■
Higher comorbidity burden (SCQ score)	■	■
Longer time since cancer diagnosis	■	
Higher number of prior cancer treatments	■	■
Higher number of metastatic sites including lymph node involvement	■	
Higher number of metastatic sites excluding lymph node involvement	■	
More likely to self-report heart disease		■
More likely to self-report anemia or blood disease		■
More likely to self-report depression		■
More likely to self-report osteoarthritis	■	■
More likely to self-report back pain	■	■
More likely to self-report rheumatoid arthritis	■	■
Less likely to have received no prior cancer treatment		■
More likely to have received surgery and CTX, or surgery and RT, or CTX and RT	■	
More likely to have received CTX and targeted therapy	■	
Stress Characteristics		
Higher Perceived Stress Scale score		■
Higher Impact of Event Scale-Revised total score		■
Higher Impact of Event Scale-Revised intrusion score		■
Higher Impact of Event Scale-Revised avoidance score		■
Higher Impact of Event Scale-Revised hyperarousal score		■
Higher Life Stressor Checklist-Revised total score	■	■
Higher Life Stressor Checklist-Revised affected sum score	■	■

Characteristic[a]	Moderate Pain + Moderate Sleep Disturbance	Severe Pain + High Sleep Disturbance
Higher Life Stressor Checklist-Revised PTDS sum score	■	■
Lower Connor Davidson Resilience Scale total score		■
Higher Occurrence of Life Stressors		
Family violence in childhood		■
Emotional abuse		■
Physical neglect		■
Sexual harassment	■	■
Physical abuse - <16 years		■
Physical abuse - ≥16 years		■
Forced to touch – <16 years		■
Forced to touch – ≥16 years		■
Forced sex – <16 years		■
Forced sex – ≥16 years		■
Seen serious accident	■	■
Had serious accident or injury		■
Jail (family member)	■	■
Separated/divorced (parents)		■
Serious money problems	■	■
Had serious physical or mental illness (not cancer)	■	■
Care for someone with severe physical or mental handicap		■
Higher Effect of Life Stressors		
Forced to touch - ≥16 years		■
Been in serious disaster		■
Had serious accident or injury		■
Separated/divorced (parents)		■
Separated/divorced (self)		■
Abortion or miscarriage		■
Death of someone close (not sudden)		■
Seen robbery or mugging	■	■
Use of Coping Strategies		
Higher use of planning		■
Higher use of religion	■	■
Higher use of denial		■
Higher use of venting		■
Higher use of substances		■
Higher use of behavioral disengagement		■
Higher use of self-blame		■

[a] Comparisons done with the No Pain and Moderate Sleep Disturbance classes

Abbreviations: CTX, chemotherapy; KPS, Karnofsky Performance Statue; PTSD, post-traumatic stress disorder; RT, radiation therapy.