

Symptom clusters among multiethnic groups of cancer patients with pain

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ABSTRACT

Objective: Considering recent inconsistent findings on ethnic differences in cancer pain experience, there is a need to clarify the association of ethnicity to cancer pain experience through diverse approaches. However, there currently exist only a small number of studies on ethnic differences in cancer pain experience in general, and few symptom cluster studies specifically related to ethnic differences in cancer pain experience. The purpose of this study was to cluster cancer patients who reported similar cancer pain experience, and to determine ethnic differences in the clusters.

Method: This was a secondary analysis of the data from a larger Internet study on cancer pain experience of four major ethnic groups of cancer patients in the United States. Only 388 subjects who responded to the questions on cancer pain, cancer symptoms, and functional status were included for this secondary analysis. The data were analyzed using hierarchical cluster analysis and multinomial logistic analysis.

Results: A three-cluster solution was adopted: 1) Cluster 1 with low pain, low symptoms, and high functional status, 2) Cluster 2 with moderate pain, low symptoms, and moderate functional status, and 3) Cluster 3 with high pain, moderate symptoms, and low functional status. In Cluster 2, there were ethnic difference in the cancer pain and functional status scores; Asian Americans reported lower pain scores than did other ethnic groups, and African Americans had higher functional status scores than did other ethnic groups. In Cluster 3, there were ethnic difference in the symptom scores ($p < 0.05$); African Americans reported higher symptom scores than did whites.

Significance of results: The results of this study add an important piece of information on ethnic differences in symptom clusters. This study suggests further national scope studies on clustering multiethnic groups of cancer patients by cancer pain experience.

KEYWORDS: Cancer, Oncology, Pain, Symptom Cluster, Ethnicity

INTRODUCTION

Despite an increasing number of studies on symptom clusters in oncology, the symptom cluster research has been critiqued in many aspects from conceptualization to interpretation of the findings (Kirkova et al., 2010; Molassiotis et al., 2010). Here, symptom clusters mean subgroups of symptoms (≥ 2) that are

associated with each other and occur simultaneously, and for which the grouping happens with predictability rather than by chance (Tsai et al., 2010). Some researchers claim that the symptom cluster concept is old, and that its clinical importance is not known (Kirkova et al., 2010; Molassiotis et al., 2010). On the other hand, it is also pointed out that symptom cluster research is still in its infancy, and a standard definition of a symptom cluster and a consensus on the data need to be developed with further work (Kirkova et al., 2010; Molassiotis et al., 2010). In addition, there are concerns about conceptual and

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methodological clarity in symptom cluster research (e.g., the required number of symptoms to form a cluster, the most appropriate statistical method, the cutoff points for symptom severity, the necessity of homogenous samples) (Kirkova et al., 2010; Molasiotis et al., 2010). In general, symptom cluster research in oncology needs further work in most aspects of its research process.

One of the areas in symptom cluster research that need further works is incorporation of ethnic differences in symptom clusters. Recently, with an increasing number of studies on diverse ethnic groups of cancer patients, researchers reported symptom clusters among different ethnic groups (Fu et al., 2009; Tsai et al., 2010). For example, Tsai et al. (2010) identified five symptom clusters among Taiwanese cancer patients through an exploratory factor analysis: loss of energy, poor intake, autonomic dysfunction, aerodigestive impairment, and pain complex. Fu et al. (2009) indicated that, compared with other ethnic groups, Hispanic breast cancer patients were more likely to report chemotherapy-related symptoms ($p < 0.05$) and pain-related symptoms ($p < 0.05$).

Considering recent inconsistent findings on ethnic differences in cancer pain experience (Laliberte, 2003; Edrington et al., 2004; Miaskowski, 2004), there is a need to clarify the association of ethnicity to cancer pain experience through diverse approaches. This kind of clustering of cancer patients who report similar cancer pain experience and finding ethnic differences in the clusters could provide an answer for the association of ethnicity to cancer pain experience. However, there currently exist only a small number of studies on ethnic differences in cancer pain experience in general, and few symptom cluster studies specifically related to ethnic differences in cancer pain experience (Laliberte, 2003; Rustøen et al., 2003; Edrington et al., 2004; Miaskowski, 2004; Fu et al., 2009; Tsai et al., 2010).

In symptom cluster research, researchers have identified symptom clusters, or cancer patients who reported similar symptom experience with a specific symptom cluster (Miaskowski et al., 2006). Usually, the first clustering method has been used, but this raises an issue because it does not help distinguish cancer patient subgroups by symptom severity scores or different patterns of symptom severity across subgroups (Miaskowski, 2006; Dodd et al., 2010). There are several studies that adopted the latter approach of clustering (Trask & Griffith, 2004; Bender et al., 2005; Glaus et al., 2006; Ferreira et al., 2008; Gwede et al., 2008; Maliski et al., 2008; Pud et al., 2008; Dodd et al., 2010). In the latter approach, clustering is done according to the type of cancer, its treatment, and specific symptoms, and it helps identify cancer patient subgroups at risk who need interventions

(Trask & Griffith, 2004; Bender et al., 2005; Glaus et al., 2006; Miaskowski et al., 2006; Ferreira et al., 2008; Gwede et al., 2008; Maliski et al., 2008; Pud et al., 2008).

The purpose of the study reported in this article was to cluster cancer patients who reported similar cancer pain experience, and to determine ethnic differences in the clusters. By doing this, we aimed to identify a cluster group at high risk who would need more help in cancer pain management, while determining ethnic differences in the clusters. This clustering approach could determine subgroups of cancer patients from multiethnic groups with similar pain experience, and help identify groups of cancer patients who are at low, moderate, and high risk of pain who may need different cancer pain management strategies (Trask & Griffith, 2004; Bender et al., 2005; Glaus et al., 2006; Miaskowski et al., 2006; Ferreira et al., 2008; Gwede et al., 2008; Maliski et al., 2008; Pud et al., 2008).

This was a secondary analysis of the quantitative data from a larger study that explored cancer pain experience of four major ethnic groups of cancer patients in the United States (Hispanics, non-Hispanic [N-H] whites, N-H African Americans, and N-H Asian Americans). Cancer patients simultaneously experience pain with other symptoms, functional status changes, and other challenges that can diminish their quality of life across all states and time (Dodd et al., 2001). Also, studies have reported significant correlations of cancer pain intensity to psychological and physical symptoms (Poulos et al., 2001). Therefore, in this analysis, cancer pain experience was viewed as a multidimensional subjective experience that accompanies changes in symptoms and functional status, and the clusters by cancer pain experience were determined based on the three scores (cancer pain, symptom, and functional status scores).

The secondary analysis reported in this article was conducted with assumptions from a feminist perspective. Although this study included both men and women, a feminist perspective was taken because it could guide disclosures of ethnic minority men's marginalized experience as well as women's hidden experience (Im, 2010). A basic assumption made for this analysis was: inadequate cancer pain management results from their constant interactions with their environment (Hall & Stevens, 1991). For example, ethnic minority cancer patients in a clinical setting, regardless of their gender, may feel difficulty in expressing their pain to white healthcare providers, and fail to receive adequate pain management (Ramer et al., 1999). In this case, their inadequate management of cancer pain could be from their interactions with their environment rather than from

their biological differences in cancer pain experience. Therefore, it is assumed that ethnic differences in cancer pain experience may not only come from purely biological differences, but also from environmental influences. Also, using a feminist perspective, ethnicity and other contextual factors were viewed as significant variables that influenced and/or were influenced by cancer patients' interactions with their environments, subsequently influencing cancer patients' pain experience. In other words, the study's focus on ethnic differences in cancer pain experience is from this feminist perspective that emphasizes the contextual influences on cancer pain experience. Finally, in the original study, the patients' self-reports of their cancer pain experience were used as the sole source of the data; feminists trust people's own descriptions of their experience (Hall & Stevens, 1991). Therefore, in this secondary analysis, we relied on the patients' self-report data on cancer pain experience as accurate and reliable sources.

METHODS

This was a secondary analysis of the quantitative data from 480 cancer patients in the United States, which was a part of a larger study (Im et al., 2007) that aimed at developing a decision support system for cancer pain management. The Institutional Review Board of the institution where the researchers were affiliated approved the study.

Setting and Participants

The participants from the larger study (480 cancer patients) were recruited by making study announcements through Internet and community settings; volunteers who agreed to participate by visiting the project web site and who met the inclusion criteria were recruited. All participants were at least 18 years of age and could read and write English, and had self-reported ethnic identity of Hispanic, N-H White, N-H African American, or N-H Asian American. In the original study, there was no inclusion criterion related to cancer pain, because gender and ethnic differences in the overall prevalence of cancer pain experience was the focus of the study. In this secondary analysis, only 388 participants were included; 92 participants who lacked data on cancer pain scores, symptoms scores, and functional status scores were excluded because distributions of these scores were essential for a cluster analysis. Sample size was predetermined because this was a secondary analysis. The minimum number of cases for a cluster analysis was $\geq 2^k$ cases (k = the total number of variables), preferably 5×2^k (Formann, 1984). Therefore, the sample size was large enough to perform this secondary analysis. The

participants included 87 Hispanics, 146 N-H whites, 80 N-H African Americans and 75 N-H Asian Americans. Approximately 80.2% of the participants were female, and approximately 19.8% were male. Their average age was 50.9 years old ($SD = 12.4$). Sixty-eight percent had combined treatments for their cancer, and 17% had chemotherapy only. Characteristics of the participants can be found in Tables 1 and 2.

Instruments

Background Characteristics

To measure background characteristics, five questions on age, gender, education, employment status, and family income were used. In addition to a question about the participant's country of birth, self-reported ethnicity was identified using the ethnic identity question required in the National Institute of Health's guideline. Self-reported health status was measured by participants' rating of their own general health. To identify their access to healthcare, one question asked where they usually went when they were sick or needed advice about their health. Four items about cancer status (primary cancer site, stage of cancer, previous medical treatment, and use of pain medication) were also used.

Self-Reported Cancer Pain Experience

The Brief Pain Inventory-Short Form (BPI-SF), one of the multidimensional cancer pain assessment tools, was used to measure the self-reported cancer pain experience during the past week. The BPI-SF consists of four items related to pain intensity and seven items related to pain interference with function. The BPI-SF pain scores were determined by adding four items on the intensity of pain using a numeric rating scale (0 = no pain to 10 = pain), with seven items on interference in the participants' life caused by pain, using another numeric rating scale (0 = does not interfere to 10 = completely interferes). The range of the total scores was 0–110, with a higher score indicating more severe pain. Cronbach's α of the original version of the BPI ranged from 0.77 to 0.91 (Cleeland & Ryan, 1994). Validity and reliability of the BPI-SF have also been established across different cultures and languages (Saxena et al., 1997; Ger et al., 1999; Radbruch et al., 1999). Cronbach's α of the BPI-SF in this study was 0.96.

Symptoms Accompanying Cancer Pain

The Memorial Symptom Assessment Scale-Short Form (MSAS-SF) (Chang et al., 2000) was used to measure the past week's experience of 32 symptoms commonly associated with cancer in two dimensions: 1) severity and 2) distress. The severity of each

Table 1. Characteristics of the participants (N = 388)

Characteristics	Cluster 1 n (%)	Cluster 2 n (%)	Cluster 3 n (%)	Total n (%)	F or χ^2	p value
<i>Gender</i>						
Female	129 (76.3)	154 (83.2)	28 (82.4)	311 (80.2)	2.77	0.25
Male	40 (23.7)	31 (16.8)	6 (17.6)	77 (19.8)		
Age (yrs)(Mean \pm SD)	52.6 \pm 13.0	49.7 \pm 11.6	48.2 \pm 13.0	50.9 \pm 12.4	3.34	0.04
<i>Ethnicity</i>						
Hispanic	33 (19.5)	44 (23.8)	10 (29.4)	87 (22.4)	13.22	0.04
N-H White	56 (33.1)	80 (43.2)	10 (29.4)	146 (37.6)		
N-H African	47 (27.8)	28 (15.1)	5 (14.7)	80 (20.6)		
N-H Asian	33 (19.5)	33 (17.8)	9 (26.5)	75 (19.3)		
<i>Education</i>						
\leq Middle school	17 (10.1)	15 (8.1)	3 (8.8)	35 (9.0)	2.01	0.73
High school	38 (22.5)	53 (28.6)	8 (23.5)	99 (25.5)		
\geq College	114 (67.5)	117 (63.2)	23 (67.6)	254 (65.5)		
<i>Employment</i>						
Yes	93 (55.0)	64 (34.6)	5 (14.7)	162 (41.8)	26.37	0.00
No	76 (45.0)	121 (65.4)	29 (85.3)	226 (58.2)		
<i>Family income</i>						
Insufficient	31 (18.3)	63 (34.0)	15 (44.1)	109 (28.1)	33.72	0.00
Somewhat insufficient	33 (19.5)	54 (29.2)	12 (35.3)	99 (25.5)		
Sufficient	105 (62.2)	68 (36.8)	7 (20.6)	180 (46.4)		
<i>Born in US</i>						
Yes	120 (71.0)	139 (75.1)	20 (58.8)	279 (71.9)	3.90	0.14
No	49 (29.0)	46 (24.9)	14 (41.2)	109 (28.1)		
<i>Self-reported health</i>						
Unhealthy	20 (11.8)	84 (45.4)	27 (79.4)	131 (33.8)	91.64	0.00
Don't know	18 (10.7)	30 (16.2)	1 (2.9)	49 (12.6)		
Healthy	131 (77.5)	71 (38.4)	6 (17.6)	208 (53.6)		
<i>Regular access to health service</i>						
Yes	164 (97.0)	170 (91.9)	31 (91.2)	365 (94.1)	4.76	0.09
No	5 (3.0)	15 (8.1)	3 (8.8)	23 (5.9)		
Total	169 (100.0)	185 (100.0)	34 (100.0)	388 (100.0)		

symptom was scored from 0 to 4 ranging from “no symptoms” to “very much.” Distress was rated on a five point (0–4) Likert scale (not at all = 0, a little bit = 1, somewhat = 2, quite a bit = 3, and very much = 4). The MSAS-SF included the global distress index (GDI) (4 psychological symptoms, and 6 physical symptoms), the physical symptom distress score (PHYS) (12 prevalent physical symptoms), and the psychologic symptom distress score (PSYCH) (6 prevalent psychological symptoms). The number of symptoms is derived from screening for the presence of 32 symptoms. The MSAS-SF score was determined by averaging the ratings of the 32 distress symptoms (range, 0.8–4.0). Cronbach's α of the MSAS-SF ranged from 0.76 to 0.87, and the validity and reliability of MSAS-SF had been established among ethnically diverse populations (Chang et al., 2000). Cronbach's α of the MSAS-SF in this study was 0.92.

Functional Status

The Functional Assessment of Cancer Therapy Scale (FACT-G) consists of 33 items with five

domains assessing physical well-being, social and family well-being, relationship with the physician, emotional well-being, and functional well-being during the past week (Cella et al., 1993). The response to 28 of the items ranged from 0 (not at all) to 4 (very much). There are five subcategories: physical well-being (PWB)(seven items), social/family well-being (SFWB)(seven items), relationship with doctor (RWD)(two items), emotional well-being (EWB)(five items) and functional well-being (FWB)(seven items). The FACT-G score was determined by adding the ratings of 28 items (possible range, 0–112). Cronbach's α of the FACT-G was 0.92 (Cella et al., 1993) and the validity and reliability of the FACT-G have been established across diverse ethnic populations (Mullin et al., 2000; Yu et al., 2000). Chronbach's α of the FACT-G in this study was 0.89.

Data Collection Procedures

For the original study, a project web site had been established and published on an independent,

Table 2. Cancer-related characteristics of the patients in the three clusters

Characteristics	Cluster 1 n (%)	Cluster 2 n (%)	Cluster 3 n (%)	Total n (%)	χ^2	p-value
<i>Cancer site</i>						
Breast	81 (47.9)	71 (38.4)	11 (32.4)	163 (42.0)	6.92	0.55
Gastrointestinal	16 (9.5)	18 (9.7)	4 (11.8)	38 (9.8)		
Female reproductive organs	14 (8.3)	19 (10.3)	3 (8.8)	36 (9.3)		
Lung	11 (6.5)	14 (7.6)	1 (2.9)	26 (6.7)		
Other	47 (27.8)	63 (34.1)	15 (44.1)	125 (32.2)		
<i>Cancer treatment</i>						
Chemotherapy only	29 (17.2)	27 (14.6)	8 (23.5)	64 (16.5)	6.19	0.40
Surgery only	16 (9.5)	17 (9.2)	2 (5.9)	35 (9.0)		
Combined	108 (63.9)	132 (71.4)	23 (67.6)	263 (67.8)		
Others	16 (9.5)	9 (4.9)	1 (2.9)	26 (6.7)		
<i>Cancer Stage</i>						
0	12 (7.1)	7 (3.8)	0 (0.0)	19 (4.9)	13.50	0.20
I	34 (20.1)	27 (14.6)	4 (11.8)	65 (16.8)		
II	42 (24.9)	48 (25.9)	9 (26.5)	99 (25.5)		
III	21 (12.4)	34 (18.4)	5 (14.7)	60 (15.5)		
IV	22 (13.0)	27 (14.6)	10 (29.4)	59 (15.2)		
Unknown	38 (22.5)	42 (22.7)	6 (17.6)	86 (22.2)		
<i>Use of pain medication</i>						
Yes	39 (23.1)	92 (49.7)	24 (70.6)	155 (39.9)	40.74	0.00
No	130 (76.9)	93 (50.3)	10 (29.4)	233 (60.1)		
Total	169 (100.0)	185 (100.0)	34 (100.0)	388 (100.0)		

dedicated web server that conformed to the Health Insurance Portability and Accountability Act (HIPAA) and SysAdmin, Audit, Network, Security (SANS)/Federal Bureau of Investigation (FBI) recommendations. When a potential participant visited the project web site, informed consent was obtained by asking the participant to click the “I agree to participate” button on the project web site after giving the general purpose of the study on the opening page. After this, participants were asked questions on specific diagnoses, cancer therapies, and medications. Upon request, pen and pencil questionnaires were provided by mail to the community consultants, who distributed the questionnaires in person only to those who were identified as cancer patients. The questionnaires accompanied hard copies of the same informed consent form included in the Internet format of the questionnaire, and the pen and pencil questionnaire included a sentence “filling out this questionnaire means that you are at least 18 years old and giving your consent to participate in this survey.” After the self-administered questionnaires were completed, community consultants retrieved all questionnaires in person at the community setting, except for five, which were mailed directly to the research team. With a level of 0.05, there were no statistically significant differences in psychometric properties between the Internet and pen and pencil formats of the

questionnaire, which can be found in the larger study (Im et al., 2007).

Data Analysis Process

The data from the Internet survey were saved automatically and directly in the databases as the participants entered the data. The data from the pen and pencil survey were entered by one research assistant (RA) into the database, and two additional RAs double-checked the data entry separately for validation. The SPSS 16.0 program was used for descriptive statistics, hierarchical cluster analysis, and multinomial logistic analysis. To determine the clusters of cancer patients by cancer pain experience (the BPI-SF, MSAS-SF, and FACT-G scores), a hierarchical clustering method was used with an agglomerative approach. The squared Euclidean distance for a measure of similarity of cases was computed using each sum of three variables. Then, the standardized scores of cancer pain, symptoms, and functional status were calculated, because their units of measurements were different. Then, the dendrogram was used to determine which clusters could be combined and formed into homogeneous groups. Then, ANOVA tests were used to determine the number of clusters. To examine differences in the participants' characteristics among clusters, descriptive statistics, χ^2 tests, ANOVA, and multinomial logistic regression analyses were used.

RESULTS

Clusters of Participants by Cancer Pain Experience

As the result of cluster analysis, two-, three-, and four-cluster solutions were found based on the dendrogram. Table 3 shows how the participants were divided into clusters by the BPI-SF, MSAS-SF, and FACT-G scores based on two-, three-, and four-cluster solutions. Table 3 also includes individual scores of each cluster in each cluster solution. After comparing the scores of the BPI-SF, MSAS-SF, and FACT-G, and the percentages of participants who belonged to each cluster in each solution, the three-cluster solution was adopted for this study.

There were significant differences in the BPI-SF, MSAS-SF, and FACT-G scores among the three clusters ($p = 0.00$) (Table 3). Forty-three percent of the participants were categorized as Cluster 1 with low pain, low symptoms, and high functional status. Forty-seven percent of the participants were categorized as Cluster 2 with moderate pain, low symptoms, and moderate functional status, and 8.8% of participants were categorized as Cluster 3 with high pain, moderate symptoms, and low functional status (Table 3).

In Table 4, the subcategory scores of the MSAS-SF and the FACT-G were compared among the three clusters. There were significant differences in all the subcategory scores of the MSAS-SF and the FACT-G among the three clusters, except for the subcategory scores of “the relationship with doctor.” There was no significant difference in the subcategory scores of “the relationship with doctor” between Clusters 2 and 3.

Ethnic Differences in Cancer Pain, Symptoms, and Functional Status in Each Cluster

Table 5 summarizes ethnic differences in cancer pain (the BPI-SF scores), symptoms (the MSAS-SF scores), and functional status (the FACT-G scores) in each cluster. There were no ethnic differences in the cancer pain scores and symptom scores of Cluster 1. However, in Cluster 2, there were ethnic difference in the cancer pain scores and functional status scores; Asian Americans reported lower pain scores than did other ethnic groups, and African Americans had higher functional status scores than did other ethnic groups. In Cluster 3, there were ethnic difference in the symptom scores ($p < 0.05$); African Americans reported higher symptom scores than did whites.

Differences in the Characteristics of Participants Among the Clusters

No significant difference was found among the three clusters in gender, education level, country of birth, and access to healthcare (Table 1). However, there were significant differences in age ($p < 0.05$), ethnicity ($p < 0.05$), employment status ($p < 0.01$), family income ($p < 0.01$), and self-related health ($p < 0.01$) among the clusters (Table 1). The cancer-related characteristics of the three clusters were compared in Table 2; there were no significant differences among the clusters except the use of pain medication ($p < 0.01$).

Table 6 summarizes the results of the multinomial logistic regression analysis to identify the predictors of being in Clusters 2 and 3. Reporting their health as “unhealthy” had the strongest associations with

Table 3. Comparisons of the cancer pain, symptom, and functional status scores among the two, three, and four cluster solutions

Cluster solution		Cluster 1 Mean \pm SD	Cluster 2 Mean \pm SD	Cluster 3 Mean \pm SD	Cluster 4 Mean \pm SD	<i>F</i>	<i>p</i> -value
Two cluster solution	<i>n</i> (%)	354 (91.2)		34 (8.8)			
	BPI-SF	31.8 \pm 26.4		81.9 \pm 14.9		118.5	0.00
	MSAS-SF	1.21 \pm 0.36		2.43 \pm 0.45		342.4	0.00
	FACT-G	77.1 \pm 16.1		43.4 \pm 14.0		138.3	0.00
Three cluster solution	<i>n</i> (%)	169 (43.6)	185 (47.7)	34 (8.8)			
	BPI-SF*	13.0 \pm 14.1 ^a	48.9 \pm 23.2 ^b	81.9 \pm 14.9 ^c		263.9	0.00
	MSAS-SF*	1.01 \pm 0.21 ^a	1.41 \pm 0.36 ^b	2.43 \pm 0.45 ^c		307.1	0.00
	FACT-G*	90.5 \pm 8.4 ^a	64.8 \pm 10.8 ^b	43.4 \pm 14.0 ^c		451.5	0.00
Four cluster solution	<i>n</i> (%)	169 (43.6)	185 (47.7)	7 (1.8)	27 (7.0)		
	BPI-SF*	13.0 \pm 14.1 ^a	48.9 \pm 23.2 ^b	73.6 \pm 24.9 ^c	84.0 \pm 10.7 ^c	176.8	0.00
	MSAS-SF*	1.01 \pm 0.21 ^a	1.41 \pm 0.36 ^b	2.02 \pm 0.43 ^c	2.54 \pm 0.39 ^d	217.7	0.00
	FACT-G*	90.5 \pm 8.4 ^a	64.8 \pm 10.8 ^b	23.1 \pm 6.2 ^d	48.6 \pm 10.0 ^c	342.9	0.00

BPI-SF, Brief Pain Inventory-Short form; MSAS-SF, Memorial Symptom Assessment Scale Short Form; and FACT-G, Functional Assessment Cancer Therapy-General.

*Post-hoc tests: Duncan tests (the different letters (a, b, c) indicate statistically significant differences at an α level of 0.05).

Table 4. The MSAS-SF and FACT-G scores among the three clusters

Subcategory (range)	Cluster 1 Mean ± SD	Cluster 2 Mean ± SD	Cluster 3 Mean ± SD	Total Mean ± SD	F	p-value
MSAS-SF						
GDI(0.8–4.0)*	1.01 ± 0.26 ^a	1.62 ± 0.79 ^b	2.76 ± 0.58 ^c	1.46 ± 0.65	281.57	0.00
PHYS(0.8–4.0)*	1.00 ± 0.26 ^a	1.62 ± 0.49 ^b	2.76 ± 0.58 ^c	1.46 ± 0.65	271.51	0.00
PSYCH(0.8–4.0)*	1.03 ± 0.31 ^a	1.73 ± 0.65 ^b	2.87 ± 0.70 ^c	1.53 ± 0.75	195.17	0.00
No. of symptoms(0–32)*	5.55 ± 4.87 ^a	12.1 ± 6.44 ^b	21.7 ± 5.47 ^c	10.1 ± 7.45	135.51	0.00
FACT-G						
PWB(0–28)*	24.3 ± 3.3 ^a	15.6 ± 5.5 ^b	5.6 ± 3.7 ^c	18.53 ± 7.3	311.66	0.00
SFWB(0–28)*	21.4 ± 5.1 ^a	15.9 ± 5.4 ^b	11.9 ± 7.1 ^c	18.0 ± 6.3	69.33	0.00
RWD(0–14)*	7.0 ± 1.5 ^a	5.9 ± 2.1 ^b	5.6 ± 2.5 ^b	6.4 ± 2.0	17.80	0.00
EWB(0–20)*	17.7 ± 2.5 ^a	13.1 ± 3.6 ^b	9.1 ± 5.1 ^c	14.8 ± 4.4	137.93	0.00
FWB(0–28)*	20.0 ± 3.2 ^a	14.3 ± 3.7 ^b	11.0 ± 3.9 ^c	16.5 ± 4.8	163.11	0.00

MSAS-SF, Memorial Symptom Assessment Scale Short Form; GDI, global distress index; PHYS, physical symptom distress score; PSYCH, psychological symptom distress score; FACT-G, Functional Assessment Cancer Therapy – General; PWB, physical well-being; SFWB, social/family well-being, RWD, relationship with doctor; EWB, emotional well-being; and FWB, functional well-being.

*Post-hoc tests: Duncan tests (the different letters (a, b, c) indicate statistically significant differences at an α level of 0.05).

Cluster 2 (adjusted OR, 6.88; 95% CI, 3.52–13.46) and Cluster 3 (adjusted OR, 22.48; 95% CI, 6.79–74.39). Not having pain medication was strongly associated with Cluster 2 (adjusted OR, 3.00; 95% CI, 1.68–5.35) and Cluster 3 (adjusted OR, 8.04, 95% CI, 2.83–22.81). Insufficient family income was strongly associated with Clusters 2 and 3. Compared with being a white, being an African American was more inversely associated with Cluster 2 (adjusted OR, 0.40; 95% CI, 0.19–0.88). However, ethnicity was not significantly associated with Cluster 3. Being employed (adjusted OR, 3.92; 95% CI, 1.18–12.98) and having no regular access to healthcare service (adjusted OR, 4.64, 95% CI, 1.36–15.78) were strongly associated with Cluster 3.

DISCUSSION

The findings of this secondary analysis indicated three major clusters of cancer patients by their cancer pain experience, which has rarely been reported in the literature. Most of the studies on symptom clusters tend to focus on clustering individual symptoms (e.g., pain, fatigue, depression) rather than on clustering cancer patients according to their symptom experience (e.g., pain experience including actual cancer pain, symptoms accompanying pain, and functional status) (Trask & Griffith, 2004; Bender et al., 2005; Glaus et al., 2006; Miaskowski et al., 2006; Ferreira et al., 2008; Gwede et al., 2008; Maliski et al., 2008; Pud et al., 2008; Dodd

Table 5. Ethnic difference in the cancer pain, symptom, and functional status scores in each cluster

Cluster	Hispanic	NH AA	NH Asian	White	Total	F	p value
1	N	33	47	33	89	169	
	BPI-SF	15.2 ± 15.0	14.1 ± 16.1	9.5 ± 11.3	12.9 ± 13.2	13.0 ± 14.1	1.03
	MSAS-SF	7.4 ± 7.9	8.9 ± 9.7	6.8 ± 6.2	8.9 ± 9.1	8.2 ± 8.5	0.63
	FACT-G	91.3 ± 8.7	91.9 ± 9.0	89.7 ± 7.1	89.3 ± 8.2	90.5 ± 8.4	1.02
2	N	44	28	33	80	185	
	BPI-SF*	51.5 ± 18.2 ^a	58.7 ± 23.5 ^a	31.4 ± 22.1 ^b	51.3 ± 22.7 ^a	48.9 ± 23.2	9.54
	MSAS-SF	23.5 ± 15.2	24.6 ± 17.6	22.3 ± 13.0	25.3 ± 13.0	24.2 ± 14.2	0.40
	FACT-G*	63.7 ± 10.5 ^a	73.4 ± 10.6 ^b	64.8 ± 7.5 ^a	62.4 ± 11.0 ^a	64.8 ± 70.8	8.23
3	N	10	5	9	10	34	
	BPI-SF	83.0 ± 10.1	89.4 ± 11.7	76.0 ± 17.6	82.3 ± 17.5	81.9 ± 14.9	0.91
	MSAS-SF*	67.4 ± 11.5 ^{ab}	77.2 ± 15.6 ^a	71.2 ± 22.7 ^{ab}	51.5 ± 11.8 ^b	65.2 ± 17.8	3.94
	FACT-G	48.0 ± 14.5	45.6 ± 16.0	43.3 ± 14.0	37.7 ± 14.5	43.4 ± 14.0	0.95

BPI-SF, Brief Pain Inventory-Short form; MSAS-SF, Memorial Symptom Assessment Scale Short Form; and FACT-G, Functional Assessment Cancer Therapy – General.

*Post-hoc tests: Duncan tests (the different letters (a, b, c) indicate statistically significant differences at an α level of 0.05).

Table 6. Results of the multinomial logistic regression analysis

Variables		Cluster 2 (ref. Cluster1)	Cluster 3 (ref. Cluster1)
		Adjusted OR (95% CI)	Adjusted OR (95% CI)
<i>Gender</i>			
Female	Male	1.66 (0.77–3.57)	1.70 (0.42–6.91)
<i>Age</i> *			
		0.99 (0.96–1.01)	0.96 (0.92–1.00)
<i>Ethnicity</i>			
Hispanic	N-H White	0.74 (0.31–1.78)	1.98 (0.40–9.78)
N-H Asian	N-H White	0.83 (0.24–2.85)	1.14 (0.13–9.66)
N-H African	N-H White	0.40* (0.19–0.88)	0.34 (0.29–6.26)
<i>Education</i>			
≤ Middle school	≥ College	0.47 (0.15–1.47)	0.14 (0.02–1.07)
High school	≥ College	0.75 (0.39–1.45)	0.29 (0.08–1.06)
<i>Employment</i>			
Yes	No	1.53 (0.86–2.72)	3.92* (1.18–12.98)
<i>Born in U.S</i>			
No	Yes	0.57 (0.20–1.62)	2.15 (0.38–12.10)
<i>Family Income</i>			
Insufficient	Sufficient	2.31* (1.13–4.74)	3.04 (0.86–10.76)
Somewhat	Sufficient	2.65** (1.39–5.02)	4.64* (1.36–15.78)
<i>Self-reported health</i>			
Unhealthy	Healthy	6.88** (3.52–13.46)	22.48** (6.79–74.39)
Don't know	Healthy	3.24** (1.49–7.05)	1.32 (0.13–13.08)
<i>Regular access to health care</i>			
No	Yes	3.21 (0.94–10.99)	4.64* (1.36–15.78)
<i>Cancer site</i>			
Gastrointestinal	Breast Ca.	1.04 (0.39–2.78)	1.95 (0.34–11.00)
Female reproductive organs	Breast Ca.	0.74 (0.28–1.94)	0.59 (0.09–3.66)
Lung	Breast Ca.	0.80 (0.26–2.45)	0.21 (0.02–2.71)
Other	Breast Ca.	0.96 (0.47–1.97)	1.22 (0.35–4.25)
<i>Cancer treatment</i>			
Combined	Others	0.79 (0.44–1.42)	1.12 (0.39–3.23)
<i>Cancer Stage</i>			
II-III	0-I	1.16 (0.48–2.76)	0.82 (0.13–5.19)
IV	0-I	0.63 (0.24–1.64)	1.25 (0.22–6.96)
Unknown	0-I	0.96 (0.49–1.88)	1.14 (0.26–4.99)
<i>Pain Medication</i>			
Yes	No	3.00** (1.68–5.35)	8.04** (2.83–22.81)

§Age is treated as a continuous variable.

* $p < 0.05$, ** $p < 0.01$

et al., 2010). For example, Dodd et al. (2010) clustered cancer patients as in this study, but did not consider pain, symptoms, and functional status at the same time in their clustering process; rather they focused on only symptom severity scores in their clustering and later tried to identify differences in functional status and quality of life among the symptom clusters. Another study by Miaskowski et al. (2006) also did not consider pain, symptoms, and functional status at the same time in their clustering process. Rather, they clustered subgroups of outpatients with cancer based on their experiences with fatigue, sleep disturbance, depression, and pain. Pud et al. (2008) also clustered cancer patients according to fatigue, sleep disturbance, depression, and pain, but still did not consider functional status

in the clustering process. Therefore, this study would be the first one that considered cancer pain, symptoms, and functional status at the same time in clustering cancer patients by their cancer pain experience and tried to identify groups at risk of inadequate cancer pain management.

The clusters that were found in this analysis included: 1) a cluster with “low pain, low symptoms, and high functional status”; 2) a cluster with “medium pain, low symptoms, and medium functional status”; and 3) a cluster with “high pain, medium symptoms, and low functional status.” Dodd et al. (2010) identified four symptom cluster groups: “all low,” “mild,” “moderate,” and “all high.” The main reason that this analysis did not identify “all high” group (high pain and high symptoms) would be that the

participants of the study tended to be a select group, many of whom were cancer survivors attending Internet cancer support groups, not in active treatment phases. However, the fact that a “high pain and low functional status” group was identified among the cancer survivors needs to be carefully considered in future development of cancer pain management interventions.

It is interesting that there were significant differences among the clusters in all the subcategory scores of the MSAS-SF and the FACT-G except in the subcategory scores of “the relationship with doctor.” This finding may mean that all cancer patients regardless their pain or pain management status have issues in their relationship with doctors, which may need further studies. Researchers have reported that inadequate cancer pain management frequently comes from miscommunication between patients and healthcare providers (mainly medical doctors), which usually results from not respecting diversity and complexities in cancer pain experience (Chan & Woodruff, 1997; De Schepper et al., 1997; Lin, 1998; Thomason et al., 1998).

The finding that African Americans were less likely to be included in Cluster 2 than were whites supports ethnic differences in cancer pain experience reported in previous studies (Wills & Wootton, 1999). In the literature, N-H Asians were frequently the ethnic group who reported the lowest cancer pain scores in all pain scales, Hispanics had the worst pain among multiethnic groups of cancer patients, and African American women and Latinas reported increased rates of pain and an increased number of symptoms (Eversley et al., 2005). The finding that African Americans were less likely to be in the moderate pain and low symptom group than were whites could be slightly different from those reported in the literature. However, because there were no significant differences in the low pain or high pain groups, this finding needs to be carefully interpreted.

The findings on significant differences among the clusters in age, employment status, family income, and self-related health agree with existing studies, which provides directions for future cancer pain management of cancer patients from multiethnic groups. Also, the findings on the predictors of being in a high-risk group (Clusters 2 or 3 compared with Cluster 1) agree with existing studies. Deimling et al. (2007) found that age-related factors accounted for 14% of the variance in pain, whereas cancer-related factors explained only 2% of the variance. Cancer patients with high incomes had fewer physical symptoms, including pain (Silveira et al., 2005) and cancer patients with low incomes were more likely to suffer pain (Rannestad & Skjeldestad, 2007). The literature also reported that cancer pain experience

differed depending upon the health/disease status of the cancer patient (Zabora et al., 2001; Wool & Mor, 2005) and pain management strategies (Foulaksh & Stommel, 2010; Vissers et al., 2010).

The study reported in this article has several methodological limitations. First of all, the sample size was predetermined because this study was a secondary analysis of existing data from a larger study. Also, the participants might not adequately represent ethnic minority cancer patients in the United States. In addition, there was no control over the data collection through the Internet because researchers could not be physically present to monitor the data collection process.

CONCLUSION

Based on the findings, we want to conclude this article with the following suggestions for future research and practice with cancer patients in pain. First, to identify groups at risk of inadequate cancer pain management, further studies are essential to cluster cancer patients according to their cancer pain experience. As discussed previously, few studies took an approach to clustering cancer patients by their cancer pain experience and most of the studies on cancer pain tend to focus on clustering individual symptoms. Also, more studies on predictors of cancer pain experience within clusters need to be conducted. As the findings indicate, several background factors including sociodemographic characteristics and health/disease status can predict cancer pain experience in each cluster of cancer patients by their cancer pain experience, which help identify high risk groups of cancer pain management. With further studies on the predictors, researchers and/or healthcare providers could identify the moderators and mediators of cancer pain experience that can be used for development of interventions for cancer pain management. In addition, national scope studies on clustering cancer patients by cancer pain experience using a systematic recruitment strategy would provide a more comprehensive and generalizable picture of clusters of cancer patients by their cancer pain experience. For future cancer care, healthcare providers need to be aware of ethnic differences in cancer pain experience and consider the differences in their cancer pain management. Also, as the predictors of being in Clusters 2 and 3 were identified in this study, healthcare providers need to consider in cancer pain management that some patients with specific characteristics to healthcare, and are African American and unemployed could experience higher cancer pain and symptoms and lower functional status than those without the characteristics.

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