Original Article

Nonmalignant Pain Symptom Subgroups in Nursing Home Residents

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Abstract

Context. Despite many nursing home residents experiencing pain, research about the multidimensional nature of nonmalignant pain in these residents is scant.

Objectives. To identify and describe pain symptom subgroups and to evaluate whether subgroups differed by sex.

Methods. Using Minimum Data Set 3.0 data (2011-2012), we identified newly admitted nursing home residents reporting pain ($n = 119{,}379$). A latent class analysis included 13 indicators: markers for pain (i.e., severity, frequency, impacts sleep, and function) and depressive symptoms. Sex was evaluated as a grouping variable. Multinomial logistic models identified the association between latent class membership and covariates, including age and cognitive impairment.

Results. Four latent subgroups were identified: severe (15.2%), moderate frequent (26.4%), moderate occasional with depressive symptoms (26.4%), and moderate occasional without depressive symptoms (32.0%). Measurement invariance by sex was ruled out. Depressed mood, sleep disturbances, and fatigue distinguished subgroups. Age ≥75 years was inversely associated with belonging to the severe, moderate frequent, or moderate occasional with depressive symptoms subgroups. Residents with severe cognitive impairment had reduced odds of membership in the severe pain subgroup (adjusted odds ratio [aOR]: 0.84; 95% confidence interval [CI]: 0.78-0.90) and moderate frequent pain subgroup (aOR: 0.60; 95% CI: 0.56-0.64) but increased odds in the moderate occasional pain with depressive symptoms subgroup (aOR: 1.12; 95% CI: 1.06-1.18).

Conclusion. Identifying subgroups of residents with different patterns of pain and depressive symptoms highlights the need to consider physical and psychological components of pain. Expanding knowledge about pain symptom subgroups may provide a promising avenue to improve pain management in nursing home residents. J Pain Symptom Manage 2019;57:535–544. © *2018 American Academy of Hospice and Palliative Medicine. Published by Elsevier Inc. All rights reserved.*

Key Words

Nonmalignant pain, pain symptoms, latent class analysis, nursing homes

Introduction

On any given day, ~1.4 million people live in U.S. nursing homes.[1] Pain in this setting is common, and treatment is often suboptimal.[2] Nursing home residents with pain are likely to experience mood impairments and related disorders such as depression.[3,4] Pain is a subjective experience that is not limited to nociception, a complexity unaddressed by most pain management strategies. Understanding the multidimensional nature of pain is challenging in nursing homes because residents often have cognitive and communication impairments[5]; multiple sources of pain (e.g., arthritis, wound, or injury healing)[6,7]; and multiple comorbid conditions.[8–10] Pain may be

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Accepted for publication: November 22, 2018.

0885-3924/$ - see front matter
https://doi.org/10.1016/j.jpainsymman.2018.11.023

modified by symptoms commonly experienced by nursing home residents, including fatigue, depression, anxiety, fear, and sleep disturbances.[9,10]

The 2011 Institute of Medicine report "Relieving Pain in America" called for a cultural transformation in understanding pain, recommending research on methods for subgrouping people with pain to develop personalized treatments.[11] In 2017, a working group convened by the National Institutes of Health (NIH) highlighted the importance of improving symptom science, particularly, in identifying patient subgroups based on clusters of the multiple simultaneously occurring symptoms in chronic conditions,[12] yet research on the multidimensional nature of pain experienced by nursing home residents is sparse. Evaluating whether subgroups of residents who experience similar patterns of pain symptoms can be identified is a first step. The existence of such subgroups would suggest shared mechanisms among co-occurring symptoms within each group. Increased understanding of pain subgroups is crucial to improve symptom management strategies.[13,14]

Using national data including virtually all U.S. nursing home residents, we sought to identify nonmalignant pain symptom subgroups. We hypothesized that pain symptom subgroups would be differentiated by descriptors of pain (e.g., frequency, severity, impact on sleep) and psychological variables (e.g., depressed mood, anhedonia). Our secondary objective was to evaluate whether pain symptom subgroups differed by sex, as called for by the 2016 National Pain Strategy and NIH mandates.[15,16] We hypothesized that women may be more likely to experience pain with depressive symptoms relative to men based on our previous work in pain[17] and depression.[18]

Methods

The University of Massachusetts Medical School Institutional Review Board approved this study.

Data Source

We used the federally mandated Minimum Data Set (MDS) 3.0 from 2011 to 2012.[19,20] A comprehensive clinical assessment tool administered by a multidisciplinary team for care planning, the MDS is completed for all residents of Medicare- and Medicaid-certified nursing facilities at admission and at other intervals throughout the nursing home stay. It includes items on active clinical diagnoses, treatments, physical functioning, and cognitive impairment.

Sample Selection

Our study cohort was comprised of 119,379 older adults newly admitted to the nursing home with pain in the past 5 days documented on the admission assessment (Fig. 1). Residents were considered newly admitted if the "federal Omnibus Budget Reconciliation Act of 1987 (OBRA) reason" was an admission assessment and they did not have an MDS assessment during the previous 90 days. We focused on newly admitted residents because this is the population for whom nursing homes need information regarding

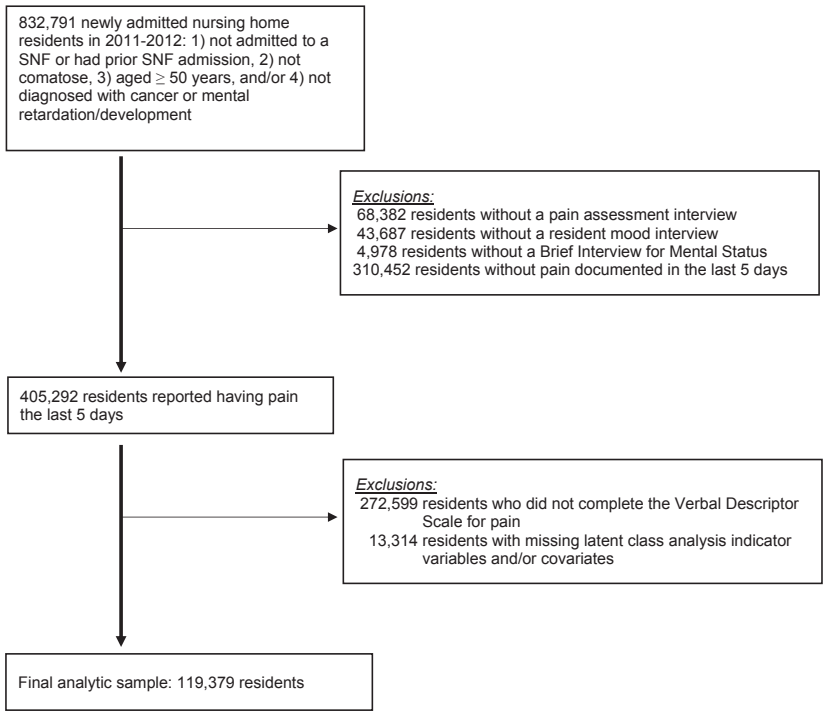

Fig. 1. Selection of sample.

pain to better meet their needs and we wanted comparability with respect to the time in the nursing home. Many of the indicator variables were determined only for those with pain in the five days since assessment. We focused on residents with nonmalignant pain because the underlying pain construct was likely different than those with cancer pain. Including residents who completed the Verbal Descriptor Scale created comparability in the measures. We included residents who were able to complete the self-reported versions of the Patient Health Questionnaire (PHQ-9) for depression,[21] the Brief Interview for Mental Status (BIMS) for cognitive function,[22] and the pain assessment. We excluded residents who were comatose and the small proportion of residents (<3%) with missing observed indicators of pain and depressive symptoms, sex, or covariates of interest due to issues with model building and convergence.[23]

Observed Indicators of Latent Pain Subgroup Membership

The latent subgroups were developed with indicators from the self-reported pain assessment interview and PHQ-9.

Pain

The pain assessment items included pain frequency, impact of pain on sleep, impact of pain on daily activities, and intensity of pain in the five days before the MDS assessment. All items were considered binary except for pain frequency (almost constantly, frequently, occasionally, and rarely) and intensity (mild, moderate, severe/very severe/horrible). We collapsed severe/very severe/horrible pain based on the distribution of residents' responses, and responses of severe, very severe, and horrible pain trigger care plans to address the pain.[20]

Depressive Symptoms

We included all items from the self-reported PHQ-9 except for suicidal ideation and attempts because few residents endorsed this item. These include anhedonia, hopelessness, insomnia/hypersomnia, poor appetite/overeating, worthlessness, impaired concentration, and psychomotor agitation/retardation within the past 2 weeks.[21] Each symptom (entered as individual categorical indicator variables) was considered present if endorsed by the resident as present, regardless of symptom frequency, to better capture subsyndromal symptoms.

Sex as a Grouping Variable

Women in nursing homes are more likely than men to experience intermittent and persistent pain.[17] We evaluated whether men and women belong to the same types of pain subgroups and determined if the prevalence of each pain subgroup differed by sex.

Covariates

Based on previous research,[24–26] we examined age, race/ethnicity, location before nursing home entry, cognitive impairment, functional impairment, several active painful conditions, and receipt of pain treatment as potential covariates of subgroup membership. We considered sex as a covariate after evaluating sex as a grouping variable. All covariates were dichotomized.

Demographics, Cognitive, and Functional Impairment

Age was categorized as 50-74 years and 75 years or older. Race/ethnicity was categorized as non-Hispanic white and racial/ethnic minorities. Cognitive impairment was assessed with the self-reported BIMS,[22] which includes one item on repetition of words, three items on temporal orientation, and three items on word recall. BIMS scores were categorized as cognitively intact (scores of 13-15)/moderately impaired (scores of 8-12) versus severely impaired (scores of 0-7). Functional impairment was assessed with the MDS-ADL Self-Performance Hierarchy.[27] Physical functioning was categorized as extensive/dependent (scores of 3-6) versus independent/limited ADL impairment (scores of 0-2).

Comorbidities

We examined a subset of active painful conditions as covariates including surgical wounds, fractures, diabetes, and arthritis. Physician-documented conditions are considered as active if they are present in the 7 days before the MDS assessment and have a direct relationship with the resident's health status.[20]

Pain Treatment

Receipt of pain treatment in the 5 days before the assessment is documented as scheduled pain medication regimen, *pro re nata* (PRN) pain medications, and nonmedication pain intervention (e.g., massage, acupuncture). Each pain management strategy was included as a separate covariate.

Analyses

Descriptive statistics of the demographic and clinical characteristics of men and women were calculated, and absolute differences in the frequency distributions of 5% or greater between men and women considered notable. We developed a basic latent class model by using the observed indicators of pain and depressive symptoms to fit a series of models with varying numbers of classes to identify the best number of groups of residents who shared similar patterns of symptoms. After this model was selected, we examined potential sex differences in

the subgroups by building models where sex was a grouping variable and evaluating measurement invariance.[28] We first fit a series of models separately for men and for women to determine if the number of subgroups was the same for each sex. We then explored whether the item-response probabilities were the same across men and women by fitting two series of nested multiple-group latent class analysis (LCA) models with sex as a grouping variable. In the first model, all parameters were unconstrained by sex. In the second model, the item-response probabilities were constrained to be equal across men and women. These nested models were then compared with a G^2 difference test to see if it could be concluded that measurement invariance existed across men and women. A significant G^2 difference test indicates differences between the sexes. After establishing the best-fitting model for men and women, we added the covariates.

To predict membership in one latent class relative to the reference class, covariates were initially added individually to the LCA model using multinomial logistic regression to produce unadjusted odds ratios of class membership for each covariate. The final step was to build an adjusted model with all covariates from which adjusted odds ratios (aORs) and 95% confidence intervals (CIs) were derived.

For each series of models, we fit multiple models with the number of latent classes varying from 2 to 7. Model selection was guided by consideration of parsimony, clinical interpretability, and fit indices such as AIC, BIC, Rissanen's sample size adjusted BIC,[29] entropy, [30] and the percentage of seeds associated with the best-fitting model. Lower AIC and BIC values indicate better fitting models. Higher values of entropy indicate better latent class separation.[28] We also decided a priori to exclude models with latent class prevalences of less than 5% because of concerns about the clinical relevance of rare subgroups. Random starting values for the item-response probability parameters were generated and 1000 iterations of each model were specified. All analyses were conducted using SAS 9.3, with PROC LCA for fitting the models.[23]

Results

Demographic and Clinical Characteristics of the Sample

Women comprised 68.3% of the sample (Table 1). Most were non-Hispanic white (81.1%) and entered the nursing home from an acute hospital (75.4%). Women were older than men. Greater proportions of women, than men, had a potentially painful musculoskeletal condition such as arthritis (37.7% vs. 25.7%), osteoporosis (19.1% vs. 4.6%), or fracture (22.3% vs. 14.9%); depression (35.0% vs. 28.6%); and anxiety disorder (21.9% vs. 15.1%).

The frequency of pain and depressive symptoms did not vary substantially by sex (Table 2). Pain was rated as severe or very severe by 21.5% of residents. The frequency of pain in the 5 days before the assessment was most often described as occasional but was reported as frequently occurring by >37% of residents. Pain affected sleep for 24% of residents. Functioning was affected by pain among 35.2% of men and women. The most common depressive symptoms

Table 1
Demographic and Clinical Characteristics of Newly Admitted Nursing Home Residents Who Completed the Verbal Descriptor Scale of Pain Intensity, by Sex

	Men (n = 37,884)	Women (n = 81,495)
Characteristic	Percentage	
Age, years		
50-64	33.7	20.2
65-74	19.6	16.6
75-84	25.3	28.6
85+	21.3	34.7
Married	45.3	24.2
Non-Hispanic white	78.6	82.2
Entered nursing home from		
Acute hospital	77.8	74.4
Community	12.6	16.3
Another nursing home or swing bed	6.9	7.2
Inpatient rehabilitation facility or psychiatric hospital	1.5	1.0
Psychiatric comorbidities		
Depression	28.6	35.0
Anxiety disorder	15.1	21.9
Comorbid conditions		
Neurological		
Dementia[a]	14.3	16.8
Alzheimer's disease	3.3	4.3
Stroke, cerebrovascular accident, transient ischemic attack	11.7	9.3
Parkinson's disease	5.1	3.1
Cardiovascular		
Hypertension	72.1	75.6
Coronary artery disease (CAD)	27.9	20.0
Musculoskeletal		
Arthritis	25.7	37.7
Osteoporosis	4.6	19.1
Any fracture	14.9	22.3
Other conditions		
Diabetes	31.7	31.2
Pressure ulcers	16.9	13.4
Surgical wounds	31.7	29.9
Extensive ADL impairment/ dependent[b]	19.1	21.2
Cognitive impairment[c]		
Moderate	22.4	21.2
Severe	11.8	13.4

Missing data: Marital status: n = 2825; Alzheimer's disease: n = 5; stroke: n = 6; dementia: n = 7; Parkinson's disease: n = 1; hypertension: n = 16; CAD: n = 8; osteoporosis: n = 7; pressure ulcers: n = 19.
[a]Defined in MDS 3.0 as non-Alzheimer's disease dementia; mixed dementia; frontotemporal dementia; and dementia related to stroke, Parkinson's, or Creutzfeldt-Jakob diseases.
[b]Defined as score of 5-6 on MDS-ADL Self-Performance Hierarchy.
[c]Brief Interview for Mental Status (BIMS).

Table 2
Frequency of Latent Class Indicators Among Newly Admitted Nursing Home Residents Who Completed the Verbal Descriptor Scale of Pain Intensity

	Men (n = 37,884)	Women (n = 81,495)
	Percentage	
Pain assessment items		
Pain intensity (Verbal Descriptor Scale)		
Mild	25.1	23.7
Moderate	54.0	54.6
Severe/very severe	20.9	21.7
Pain frequency		
Almost constantly	11.3	11.2
Frequently	34.4	37.0
Occasionally	45.6	44.6
Rarely	8.7	7.2
Pain affects sleep	24.2	24.0
Pain affects functioning	33.6	36.0
Pain management		
Scheduled	37.7	42.1
Pro re nata	82.2	84.6
Nonmedication intervention	41.3	44.6
PHQ-9 items		
Anhedonia	14.4	14.3
Depressed mood	34.5	36.3
Insomnia/hypersomnia	31.9	30.1
Fatigue	40.3	44.4
Decreased/increased appetite	17.6	22.1
Worthlessness	11.9	12.2
Impaired concentration	13.8	14.5
Psychomotor retardation/agitation	10.5	10.0

Missing data: Anhedonia: n = 262; depressed mood: n = 129; fatigue: n = 120; decreased/increased appetite: n = 273; worthlessness: n = 278; impaired concentration: n = 263; psychomotor retardation/agitation: n = 398.

reported were fatigue (43.1%), depressed mood (35.7%), and insomnia or hypersomnia (30.7%). Pain treatments were common (40.7% scheduled and 83.8% PRN pain medications; 43.5% nonmedication interventions).

LCA Model

A four-class LCA model appeared to describe the data best after considering the fit indices (Table 3), parsimony, and model interpretability. All the pain indicators contributed to distinguishing the subgroups (Table 4). Of the PHQ-9 indicators, depressed mood, insomnia/hypersomnia, and fatigue differentiated the subgroups. The four subgroups were labeled as severe, moderate frequent, moderate occasional with depressive symptoms, and moderate occasional without depressive symptoms. The prevalence for moderate occasional without depressive symptoms was highest (32.0%). Fifteen percent were likely to be in the severe group, whose members were likely to be experiencing pain that was severe, frequent, and affecting sleep and functioning with depressed mood, insomnia/hypersomnia, and fatigue. Those belonging to the moderate frequent group had a high likelihood of having moderate frequent pain that affected functioning but low likelihood of experiencing depressive symptoms. The members of the moderate occasional with depressive symptoms group were likely to have depressed mood and fatigue in addition to moderate occasional pain.

Sex Differences in Subgroups

Four-class models fit best when 1) models were fit separately for men and for women and 2) sex was included as a grouping variable (Supplementary Table 1). The G^2 difference test between the four-class multigroup model with measurement invariance imposed and the four-class multigroup model without measurement invariance was statistically significant (likelihood ratio $G^2 = G_2^2 - G_1^2 = 46{,}138.41 - 45{,}330.33 = 808.08$; $df = 24{,}509 - 24{,}449 = 60$; $P < 0.0001$). After considering the latent class prevalences and item-response probabilities in the model without measurement invariance, we decided that the few differences noted between men and women were slight. Because the G^2 difference test can be sensitive to large sample sizes,[28] we chose the basic four-class model without sex as a grouping variable.

Correlates of Subgroup Membership

Table 5 shows that residents in the severe group were less likely to be aged 75 years or older (aOR: 0.45; 95% CI: 0.43-0.47), be racial/ethnic minorities (aOR: 0.45; 95% CI: 0.43-0.48), enter the nursing home from an acute hospital (aOR: 0.76; 95% CI: 0.72-0.80), have severe cognitive impairment (aOR:

Table 3
Fit Indices for Basic[a] LCA Models

Number of Classes	*df*	G^2	AIC	BIC	Adjusted BIC	Entropy	% of Seeds Associated With Best-Fitting Model
Without sex as a grouping variable (n = 119,379)							
2	12,256	109,852.19	109,914.19	110,214.58	110,116.06	0.71	100.00
3	12,240	63,126.34	63,220.34	63,675.78	63,526.41	0.71	49.00
4	12,224	37,774.98	37,900.98	38,511.46	38,311.24	0.70	100.00
5	12,208	31,713.16	31,871.16	32,636.67	32,385.61	0.68	34.00
6	12,192	26,322.81	26,512.81	27,433.37	27,131.45	0.65	54.00
7	12,176	22,483.92	22,705.92	23,781.52	23,428.75	0.65	71.00

[a]Without covariates added.

Table 4
Prevalence of Latent Classes and Item-Response Probabilities of Endorsing Pain and Depressive Symptoms From a Four-Class Latent Class Model of Nursing Home Residents at Admission (n = 119,379)

	Severe	Moderate Frequent	Moderate Occasional with Depressive Symptoms	Moderate Occasional Without Depressive Symptoms
Latent class prevalence	15.2%	26.4%	26.4%	32.0%
Indicators (item-response probability)				
Pain assessment items				
Pain severity[a]				
Mild	0.02	0.02	0.38	0.41
Moderate	0.44	0.56	0.58	0.55
Severe/very severe	0.54	0.42	0.04	0.03
Pain frequency[a]				
Almost constantly	0.31	0.21	0.02	0.02
Frequently	0.55	0.60	0.22	0.19
Occasionally	0.14	0.19	0.64	0.66
Rarely	0.00	0.00	0.12	0.14
Pain affects sleep	0.65	0.44	0.07	0.02
Pain affects functioning	0.78	0.64	0.13	0.09
PHQ-9 items				
Anhedonia	0.38	0.03	0.28	0.01
Depressed mood	0.74	0.13	0.63	0.10
Insomnia/hypersomnia	0.64	0.19	0.49	0.09
Fatigue	0.83	0.23	0.75	0.14
Decreased/increased appetite	0.46	0.09	0.37	0.04
Worthlessness	0.34	0.02	0.24	0.01
Impaired concentration	0.35	0.03	0.28	0.02
Psychomotor retardation/agitation	0.26	0.02	0.19	0.02

[a]Item-response probabilities within each class do not always add to 1.00 due to rounding.

0.84; 95% CI: 0.78-0.90), and have surgical wounds (aOR: 0.70; 95% CI: 0.67-0.74) than those belonging to the moderate occasional without depressive symptoms group. Members of the severe group were more likely to be women (aOR: 95% CI: 1.18-1.29), have severe functional impairment (aOR: 1.25; 95% CI: 1.18-1.31), have fractures (aOR: 1.28; 95% CI: 1.21-1.35), have diabetes (aOR: 1.11; 95% CI: 1.06-1.17) and have arthritis (aOR: 1.23; 95% CI: 1.17-1.28). Members of the severe group were also more likely than those in the moderate occasional without depressive symptoms group to receive scheduled pharmacological (aOR: 2.63; 95% CI: 2.51-2.75), PRN pharmacological (aOR: 2.32; 95% CI: 2.17-2.48), and nonpharmacological pain treatments (aOR: 1.51; 95% CI: 1.44-1.57).

Residents in the moderate frequent group had lower odds, than those in the moderate occasional without depressive symptoms group, to be 75 years of age or older (aOR: 0.57; 95% CI: 0.55-0.60), be racial/ethnic minorities (aOR: 0.89; 95% CI: 0.85-0.93), and have severe cognitive impairment (aOR: 0.60; 95% CI: 0.56-0.64). Those belonging to the moderate frequent group had higher odds of being women (aOR: 1.10; 95% CI: 1.05-1.15), having surgical wounds (aOR: 1.18; 95% CI: 1.13-1.24), having fractures (aOR: 1.42 l 95% CI: 1.35-1.50), and having arthritis (aOR: 1.32; 95% CI: 1.27-1.38). Members of the moderate frequent group also had higher odds than those in the moderate occasional without depressive symptoms group to receive scheduled pharmacological (aOR: 2.34; 95% CI: 2.25-2.44), PRN pharmacological (aOR: 2.65; 95% CI: 2.49-2.83), and nonpharmacological pain treatments (aOR: 1.38; 95% CI: 1.33-1.44).

Those belonging to the moderate occasional with depressive symptoms group were less likely, than those in the moderate occasional without depressive symptoms group, to be 75 years or older (aOR: 0.90; 95% CI: 0.86-0.94), be racial/ethnic minorities (aOR: 0.58; 95% CI: 0.55-0.61), have entered the nursing home from an acute hospital (aOR: 0.81; 95% CI: 0.78-0.85), have surgical wounds (aOR: 0.67; 95% CI: 0.64-0.70), and have fractures (aOR: 0.88; 95% CI: 0.84-0.93). The residents in the moderate occasional with depressive symptoms group were more likely to be women (aOR: 1.11; 95% CI: 1.07-1.16), have severe cognitive impairment (aOR: 1.12; 95% CI: 1.06-1.18), have severe functional impairment (aOR: 1.28; 95% CI: 1.22-1.34), and have diabetes (aOR: 1.03; 95% CI: 1.01-1.10). These residents were more likely than those in the moderate occasional without depressive symptoms group to have received scheduled pharmacological (aOR: 1.14; 95% CI: 1.09-1.19) and nonpharmacological pain treatments (aOR: 1.08; 95% CI: 1.04-1.13).

Discussion

Among newly admitted nursing home residents with nonmalignant pain, we found four pain symptom subgroups differentiated by pain frequency, severity, and presence of depressive symptoms. Our study revealed

Table 5
Associations Between Demographic and Clinical Variables and Latent Class Membership

	Latent class[a]					
	Severe		Moderate Frequent		Moderate Occasional with Depressive Symptoms	
Covariates	Adjusted[b] Odds Ratio	95% Confidence Interval	Adjusted[b] Odds Ratio	95% Confidence Interval	Adjusted[b] Odds Ratio	95% Confidence Interval
Age ≥75 years	0.45	0.43-0.47	0.57	0.55-0.60	0.90	0.86-0.94
Women	1.23	1.18-1.29	1.10	1.05-1.15	1.11	1.07-1.16
Racial/ethnic minorities	0.45	0.43-0.48	0.89	0.85-0.93	0.58	0.55-0.61
Entered from acute hospital	0.76	0.72-0.80	1.00	0.95-1.05	0.81	0.78-0.85
Severe cognitive impairment	0.84	0.78-0.90	0.60	0.56-0.64	1.12	1.06-1.18
Extensive ADL impairment/dependent	1.25	1.18-1.31	0.99	0.94-1.04	1.28	1.22-1.34
Surgical wounds	0.70	0.67-0.74	1.18	1.13-1.24	0.67	0.64-0.70
Fractures	1.28	1.21-1.35	1.42	1.35-1.50	0.88	0.84-0.93
Diabetes	1.11	1.06-1.17	1.01	0.97-1.05	1.06	1.01-1.10
Arthritis	1.23	1.17-1.28	1.32	1.27-1.38	1.03	0.99-1.08
Pain treatment:						
Scheduled pharmacological	2.63	2.51-2.75	2.34	2.25-2.44	1.14	1.09-1.19
Pro re nata pharmacological	2.32	2.17-2.48	2.65	2.49-2.83	1.00	0.95-1.05
Nonpharmacological	1.51	1.44-1.57	1.38	1.33-1.44	1.08	1.04-1.13

[a]Reference class = moderate occasional without depressive symptoms.
[b]Models adjusted for age, race/ethnicity, location before nursing home admission, cognitive impairment, functional impairment, surgical wounds, fractures, diabetes, arthritis, scheduled pharmacological pain treatment, *pro re nata* pharmacological pain treatment, and nonpharmacological pain treatment. Unadjusted estimates are qualitatively similar for all odds ratios except for membership in the moderate occasional with depressive symptoms group for residents aged ≥75 years (unadjusted odds ratio: 1.15; 95% confidence interval: 1.10-1.20) and membership in the moderate frequent group for residents entering the nursing home from an acute hospital (unadjusted odds ratio: 1.37; 95% confidence interval: 1.31-1.44).

that these subgroups were qualitatively similar for men and women. We observed that residents of ≥75 years of age, racial ethnic minorities, and residents with severe cognitive impairment were less likely to belong to more severe pain subgroups and the subgroup differentiated by depressive symptoms than women.

Our analysis revealed two subgroups for which pain and depressive symptoms co-occurred. For the 15.2% of the residents likely to belong to the severe subgroup, pain was likely to impact sleep and function. These residents were also likely to endorse PHQ-9 items on depressed mood, sleep problems, and fatigue, whereas those in the moderate occasional with depression symptoms group were likely to report only depressed mood and fatigue. This is consistent with the observation that the association between pain and depressive symptoms is stronger with increased severity.[31,32] That the LCA model featured pain subgroups with depressive symptoms is somewhat consistent with research among older adults outside of the nursing home setting and in those with different painful conditions.[33–36]

Mood and fatigue were the two depressive symptoms that primarily distinguished the subgroups. The extent to which pain control helps relieve depressive symptoms or vice versa (relief of depressive symptoms provides relief from pain) remains unclear.[37] In addition, fatigue is not just a depressive symptom; it is also a multidimensional construct that warrants further investigation. Our findings extend previous work that documented the prevalence of excruciating pain but focused on its physical manifestations rather than indicators of mood.[38] The growing evidence supporting shared genetic, neurotransmitter, and biological pathways underscores the promise for future research in this area.[37,39] Treatment approaches that target co-occurring pain symptoms, rather than individual symptoms may hold promise to improve the safe and effective management of pain in frail nursing home residents.

Our hypothesis that there would be qualitative differences by sex in the types of pain subgroups experienced did not hold. This is consistent with some, but not all the literature.[33,40–43] Discrepancies with previous work may be because we restricted our sample to those who indicated any pain in the previous 5 days. Sex differences in dimensions of pain not assessed in MDS 3.0 may exist (e.g., anxiety and pain,[44] irritability[45]) and should be studied further.

We found that sex and other resident characteristics may predict latent class membership. Being a woman, having severe functional limitations and having a painful condition were consistently associated with increased odds of belonging to a more severe pain subgroup. These factors are consistent with ongoing concerns about adequate pain management for nursing home residents.[17,46] Approximately two-thirds of nursing home residents in the U.S. are women.[46] That severe cognitive impairment was associated with lower odds of belonging to the severe or moderate frequent subgroup but increased odds of belonging to the moderate occasional with depressive symptoms group may reflect neuropsychiatric symptoms of dementia or ascertainment bias. It is possible

that cognitive impairment limited the ability to report pain and depressive symptoms, contributing to the persistent problem of pain under-recognition in nursing homes.[47]

Receiving pain treatment was mostly associated with belonging to a more severe pain subgroup; this is intuitive. Only 40% with documented pain received scheduled pharmacological pain medications. The cross-sectional data preclude longitudinal examination of how treatment impacted the dimensions of pain throughout the nursing home stay.

Strengths and Limitations

The national data source provided a large sample size, and we demonstrated that LCA is a useful approach for distilling multidimensional MDS information. To our knowledge, this is the largest study using LCA methods to evaluate pain subgroups. Previously, LCA studies had limited sample sizes or unique clinical populations (e.g., oncology patients,[13,48] low back pain,[49] wrist/ankle fractures,[50] arthritis[36]). The indicator variables included in the latent class models may be misclassified. Over 90% of residents participate in the self-reported sections of the MDS.[51] We restricted the sample to residents able to complete the self-reported BIMS. Nevertheless, higher levels of cognitive impairment have been associated with lower rates of cancer pain documentation and treatment.[52] To our knowledge, methodological work on the impact of misclassification of indicator items is lacking in LCA.

Because we limited the sample to newly admitted residents to create comparability in the time observed, we could not differentiate acute versus chronic pain. We intentionally developed a "short list" of indicators for consideration to reduce the computational and conceptual complexity during our first foray into using LCA with the MDS. The low endorsement of indicators such as psychomotor retardation/agitation might have also contributed to reductions in the LCA model's ability to differentiate subgroups.[53] The MDS 3.0 lacks questions about anxiety, which commonly co-occurs with both pain and depression.[3,54,55] The MDS does not distinguish between insomnia and hypersomnia and did not capture the impact of pain on quality of life beyond whether pain impacts activities of daily living and sleep. Details about medication class and dose are not included on the MDS. Attempts to generalize these findings to residents at other time points during the nursing home stay or to international settings are not warranted.

Conclusion

We identified subgroups of pain symptoms among newly admitted nursing home residents, which reinforces the notion that pain syndromes may include a physical and a psychological component. Effective management of nonmalignant pain is sorely needed to improve quality of life,[56] relieve suffering, and to ensure dignity in care.[57] A better understanding of nonmalignant pain may lead to more effective management of pain and pain-related symptoms than if each symptom in isolation were treated. This study provides an important first step toward achieving this goal.

Disclosures and Acknowledgments

The authors have no competing interests to declare.

This work was supported by the National Institutes of Health (Grants: 1R56NR015498−01A1, 1R01NR016977, 1F31AG05607801, and 1R21AG056965). The funding source had no involvement in study design, collection, analysis, or interpretation of data; writing this report; or the decision to submit this article for publication.

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Appendix

Supplementary Table 1
Fit Indices for LCA Models by Sex

Number of Classes	*df*	G^2	AIC	BIC	Adjusted BIC	Entropy	% of Seeds Associated With Best-Fitting Model
No measurement invariance							
Men (n = 37,884)							
2	12,256	40,801.12	40,863.12	41,127.93	41,029.42	0.71	100.00
3	12,240	25,497.36	25,591.36	25,992.85	25,843.48	0.72	49.00
4	12,224	17,316.01	17,442.01	17,980.17	17,779.96	0.71	100.00
5	12,208	15,241.59	15,399.59	16,074.43	15,823.36	0.69	45.00
6	12,192	13,546.38	13,736.38	14,547.90	14,245.99	0.68	37.00
7	12,176	12,123.33	12,345.33	13,293.52	12,940.76	0.66	93.00
Women (n = 81,495)							
2	12,256	76,662.25	76,724.25	77,012.81	76,914.25	0.70	100.00
3	12,240	45,230.04	45,324.04	45,761.53	45,612.16	0.71	48.00
4	12,224	28,014.32	28,140.32	28,726.74	28,526.53	0.70	100.00
5	12,208	23,996.99	24,154.99	24,890.34	24,639.28	0.68	31.00
6	12,192	20,267.66	20,457.66	21,341.95	21,436.95	0.65	45.00
7	12,176	17,746.97	17,968.97	19,002.19	18,649.43	0.65	64.00
Sex as a grouping variable: no measurement invariance (n = 119,379)							
2	24,513	117,463.37	117,585.37	118,188.16	117,991.12	0.71	100.00
3	24,481	70,727.40	70,915.40	71,826.26	71,527.53	0.71	47.00
4	24,449	45,330.33	45,582.33	46,803.28	46,402.85	0.70	100.00
5	24,417	39,238.58	39,554.58	41,085.61	40,583.48	0.68	26.00
6	24,385	33,814.04	34,194.04	36,035.15	35,431.32	0.66	7.00
7	24,353	29,870.30	30,314.30	32,465.49	31,759.96	0.66	61.00
Sex as a grouping variable: measurement invariance—item-response probability parameters constrained to be equal (n = 119,379)							
2	24,543	118,246.19	118,310.19	118,620.27	118,518.58	0.71	100.00
3	24,526	71,514.86	71,612.86	72,087.67	71,931.95	0.71	49.00
4	24,509	46,138.41	46,270.41	46,909.96	46,700.21	0.70	100.00
5	24,492	40,057.19	40,223.19	41,027.46	40,763.69	0.68	33.00
6	24,475	34,630.01	34,830.01	35,799.01	35,481.21	0.65	55.00
7	24,458	30,791.03	31,025.03	32,158.76	31,786.93	0.65	72.00