ORIGINAL RESEARCH

A study of longitudinal data examining concomitance of pain and cognition in an elderly long-term care population

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Purpose: To examine if a concomitant relationship exists between cognition and pain in an elderly population residing in long-term care.

Background/significance: Prior research has found that cognitive load mediates interpretation of a stimulus. In the presence of decreased cognitive capacity as with dementia, the relationship between cognition and increasing pain is unknown in the elderly.

Patients and methods: Longitudinal cohort design. Data collected from the Minimum Data Set-Resident Assessment Instrument (MDS-RAI) from the 2001–2003 annual assessments of nursing home residents. A covariance model was used to evaluate the relationship between cognition and pain at three intervals.

Results: The sample included 56,494 subjects from nursing homes across the United States, with an average age of 83 ± 8.2 years. Analysis of variance scores (ANOVAs) indicated a significant effect ($P < 0.01$) for pain and cognition, with protected t test revealing scores decreasing significantly with these two measures. Relative stability was found for pain and cognition over time. Greater stability was found in the cognitive measure than the pain measure. Cross-legged effects observed between cognition and pain measures were inconsistent. A concomitant relationship was not found between cognition and pain. Even though the relationship was significant at the 0.01 level, the correlations were low ($r \leq 0.08$), indicating a weak association between cognition and pain.

Conclusion: Understanding the concomitance of pain and cognition aids in defining additional frameworks to extend models to include secondary needs, contextual factors, and resident outcomes. Cognitive decline, as with organic brain diseases, is progressive. Pain is a symptom that can be treated and reduced to improve resident quality of life. However, cognition can be used to determine the most appropriate method to assess pain in the elderly, thereby improving accuracy of pain detection in this population.

Keywords: cognitive impairment, Cognitive Performance Scale (CPS), Minimum Data Set 2.0

Introduction

Pain control is a primary concern across all care settings. Though a universal care concern, pain is frequently viewed in the elderly as a normal process of aging.[1] It is estimated that 49%–83% of the 1.8 million residents in long-term care have acute or chronic pain, yet the recognition and treatment of pain still presents a challenge.[2–6] Recognizing a spectrum of pain behaviors beyond the traditional self-reporting methods, and increasing this knowledge among clinicians and support staff, is still a significant challenge in the provision of care to the elderly.

Predominantly, pain and cognitive decline often coexist in the elderly, with approximately 47% of residents in nursing homes having a diagnosis of dementia.[2]

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Pain assessment and treatment is complex, because residents have varying degrees of cognitive function, complicating how their needs are communicated. When these symptoms do coexist, little is known about the interaction of pain and cognitive decline, beyond laboratory imaging of the brain from a pathophysiological perspective.[7,8] Empirical studies both support and refute poor neurocognitive performance in conjunction with increased pain intensity.[9–13] Evaluating longitudinal data to assess if a relationship exists between pain and cognitive decline may assist in addressing these ambiguous findings.

The aim of this research was to examine if concomitance exists between cognition and pain in the elderly residing in long-term care.

Research questions

In a sample of nursing home residents,

1. Is cognitive decline a predictor of increased pain?
2. Is increasing pain a predictor of cognitive decline?

Research evaluating the theoretical constructs of pain and its contributing factors is lacking. Theoretical modeling using clinical data is a method used to evaluate resident characteristics and symptoms for inter-relationships between variables. Modeling whether chronic pain leads to worsening or declining cognition, thereby contributing to worsened pain, would test the theoretical constructs of this relationship. The significance and correlation of these variables creates a foundation for building additional models, with secondary needs and resident outcomes. Long-term unresolved pain may lead to secondary symptoms and comorbidities. Information of the relationship between pain and cognition adds to an understanding of how resident outcomes occur, and how quality initiatives can be approached. These items are all fundamental to determine if resident care needs are being met.

Significance

Evaluating cognition in conjunction with pain helps clarify if treating either symptom lessens the severity of the other, or if the symptoms are independent. Organic brain disorders cause a progressive process of cognitive decline.[14] If it is not possible for patients to regain a normal level of cognitive function, then the process is degenerative. Pain may add to and/or potentiate symptoms of cognitive decline. Understanding the relationship between cognition and pain establishes how these two variables could be included in a theoretical framework. This enables resident outcomes to be more accurately measured through symptoms and treatments, determining the most effective and cost-conscious actions.

If pain and cognition were parallel to and not antecedent of each other, a symptom model would be inaccurate, making it difficult to determine where and what symptoms could be treated. Neglecting to include variables as a predictor of the other yields an incomplete clinical picture and theoretical model, making it difficult to find and measure care solutions because the root causes were not fully described.

Understanding the clinical pathways and interrelationships of resident symptoms is essential to the strategic planning and prioritizing of resident care needs. Resource allocation in a struggling Medicare-funded system is a difficult process to navigate. A new National Institutes of Health (NIH) nursing home rating system incorporates pain as a quality measure, previously neglected in long-term resident care assessments.[15,16] Staff assessments, resident nonverbal cues, verbal complaints, facial expressions, and protective body movements were added as additional assessment items to more fully convey pain in this population. The use of federally-mandated resident assessment surveys is a cost-effective, time-efficient tool to gain insight into resident care needs, and an opportunity to increase our understanding of resident symptom pathways and the effectiveness of interventions used. Using existing clinical data to test theoretical constructs adds valuable information to the validity of the models posited against real world, resident care data.

Background

Pain is an intricate sensory experience involving physiological, pathological, social, cognitive, and emotional factors.[17,18] Sensory process is modulated by cognitive load.[19–22] Cognitive load helps to describe how hard it is for the individual to make sense of a stimulus. Cognitive decline is progressive and may manifest as symptoms of aphasia (language), apraxia (perform directed acts), agnosia (recognize objects), and/or disturbances in global functioning (planning, organizing, sequencing, and abstract thoughts). Considerable issues exist in the detection of pain in residents with moderate-to-severe cognitive impairment. A lower incidence of pain is reported as cognition declines, largely due to measurement and communication issues.[23,24] The detection of pain behavioral cues by both formal and informal caregivers have marked differences depending on the resident's cognitive status, especially with the interpretation of body movements.[25]

A case report presented by Ashpole and Katz[17] described a patient with a lifelong history of pain (somatoform pain disorder). The patient's refractory pain was unresolved, causing daily verbal complaints of discomfort. After the onset of dementia, the patient's self-reports of pain sharply declined.

The pain symptoms were posited to be presenting as an altered mood (eg, depression or irritability) and cognitive decline. Chronic pain is attributed to increased risk of depression in the elderly.[26–29] Depressive symptoms are linked to decreased processing and motor function, but are not directly attributable to memory impairment.[30] Chronic pain results in changes to the resident's personality, social interactions, lifestyle, and functional status, impacting their quality of life.[27] Unresolved pain may result in a decline of the resident's quality of life causing delirium, depression, weight loss, social isolation, decreased activities of daily living, impaired gait, increased incidence of falls and comorbidities. Quality of life declines with chronic untreated pain, especially as the intensity of pain increases.[27] To date, the relationship between cognition and pain has been evaluated in case reports and pathophysiological studies, but not as a large-scale analysis of concomitance.

Theoretical framework

The concept of need-driven behaviors[31] and the framework extending this model to include the consequences of need-driven, dementia-compromised behaviors[32] serves as the theoretical platform for this research study. The need-driven behavior, ie, pain, is a coexisting symptom to cognitive state, a background factor. Proximal issues, eg, a decline in physical state and social and environmental causes, precipitate improvement or exacerbation of the original need: resolving the resident's pain.

The long-term consequence of unresolved, need-driven behaviors gives rise to additional behavioral symptoms and secondary unmet needs. The primary relationship between cognition and pain has been evaluated for this study. Future theoretical constructs, including the complete model, would further evaluate the relationship of secondary needs (ie, depression, weight loss, social isolation, higher risk of falls, decreased activities of daily living, impaired gait), and how appropriate interventions mitigate the occurrence of secondary needs. Appropriate interventions to primary needs could improve resident quality of life, use healthcare resources more efficaciously, and reduce staff burden. This theoretical framework enables the clinician to translate a complex system encompassing such factors as resident, caregiver, environment, and outcomes, into a measurable tool to improve care.

Methods
Design and sample

A longitudinal cohort design was used. Data were collected from 2001–2003 (inclusive) on residents residing in Medicare-receiving nursing homes across the United States. Minimum Data Set (MDS) 2.0[33] annual assessments were used as the data source, including all residents aged ≥65 years. Comatose residents were excluded from the sample, because key item sections (Sections B–F) could not be scored. These items are required for the pain index instrument used in this study. Noncompletion of the cognitive, communications/hearing, mood and behavior, and psychosocial well-being sections of MDS adheres to the instructions given to assessors completing the resident assessment forms.

Data were extracted from a deidentified resident database containing the MDS items. The sample yielded 56,494 subjects (see Figure 1 for sample methods). The University of Central Florida Institutional Review Board (IRB) assigned an exempt status to the study. Data collection was retrospective and no interventions were tested.

Instruments

The MDS is a nationally required assessment providing information on the quality of care provided in nursing homes.[16]
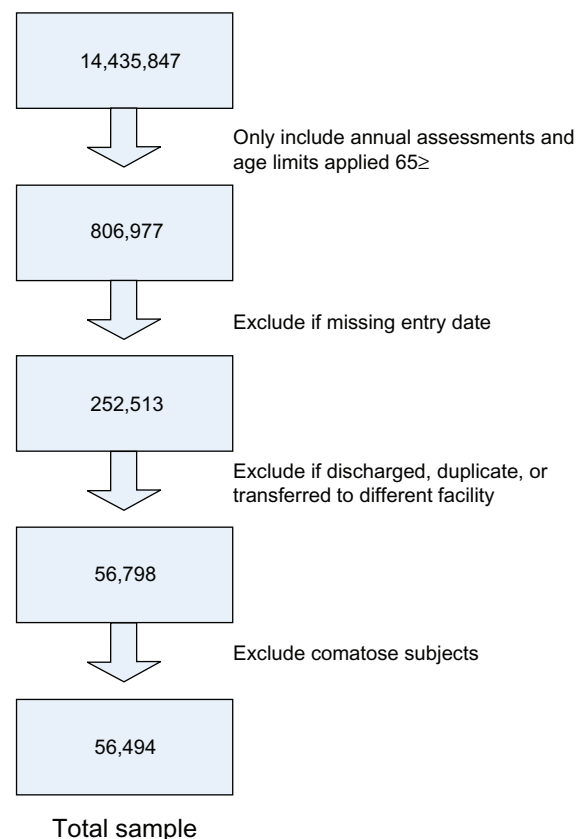
Total subject assessments

Figure 1 Sample method.

Core items from the MDS instrument are used for care planning to trigger events or symptoms requiring intervention (eg, pressure ulcers, delirium, cognitive loss, falls, and mood state). Pain is not a care-planning trigger from the Resident Assessment Protocol (RAP) however, it is a quality measure.[33] MDS items have demonstrated good-to-excellent validity and reliability[34–36] with interrater and test–retest reliability from 0.40–0.80, depending on the item section.[34] A composite score was used to detect pain from core MDS items (pain items analyzed are detailed in Table 1).

The significance ($P = 0.01$) and validity of the measures used in the pain index have been established in a previous pilot study.[24] Pain scores could range from 0–34. Score weighting is determined by the ordinal scoring used in the MDS instrument. The pain index includes Fries' pain scale[37] (PS) items (eg, J2a for pain frequency and item J2b, pain intensity). The PS items highly correlated with a pain sites summary score.[24] Additional dimensions of affective and behavioral items are also included to aid in detecting pain across cognitive states (Figure 2).

The Cognitive Performance Scale (CPS) was used to determine resident cognitive state. The CPS instrument uses key MDS items from sections B, C, and G of the resident assessment form.[38,39] The CPS measure correlates highly ($r \geq 0.70$) with the Folstein Mini-Mental Status Examination (MMSE).[40] The MDS-derived CPS scores were converted to MMSE average totals. The averaged scores could range from 0.04 (severe impairment) to 24.9, an intact cognitive state. A CPS score of 6 converts to an average MMSE of 0.4, a 3 to 15.4, and 0 to an MMSE of 24.9.[38] In validation testing of the CPS scores against the MMSE, a sensitivity of 0.94 and specificity of 0.94 were shown,[40] indicating that the utility of this instrument is viable in determining resident cognitive status from MDS-derived scores.

Statistical analysis

Descriptive statistics, correlations and repeated measures analyses of variance (ANOVAs) were completed using SPSS software (v 14.0; SPSS Inc, Chicago, IL). The SPSS statistical modeling program, AMOS (v 6.0; SPSS Inc), was used to build the covariance model of pain and cognitive state at three different time intervals for 2001, 2002, and 2003. Pain and cognition scores were hypothesized to be inversely related. Increasing pain score items indicated higher levels of pain. Cognitive decline was noted with a lower MMSE score. The analyses are one-tailed.

The covariance model was evaluated for integrity-of-fit statistics; however, the model is simplistic, with only six discrete measures and five residual terms, so fit statistics would indicate a recently identified model. Due to the required large sample size to run structural equation modeling, assessment of statistical power is complex.[41,42] Sample size requirements generally are the number of free parameters (n = 17) times five to ten, to estimate sample size. The sample total (n = 56,494) far exceeds this rule.

Table I Pain score items

| Indicators	
Variable	**Description**
Inferred/reported pain	
(J2A) Pain frequency	Frequency resident complains or shows evidence of pain
(J2B) Pain intensity	Intensity of pain described or displayed by the resident
Pain sites score	Cumulative pain site index, items J2a-J3j, K1c; higher scores indicates more pain sites
Affect	
(E1L) Sad facial expressions	Sad, pained, worried facial expressions, ie, furrowed brows
(E1M) Crying	Indicator of distress. Behavior is recorded by frequency in the last 30 days irrespective of the cause of the behavior (indicator)
(E3) Change in mood	Refers to status of any symptoms described in section E (mood); snapshot of current observation period, not just a point in time
Behavioral	
(E1A) Negative statements	Resident made negative statements, eg, "Nothing matters, would rather be dead, what's the use, regrets having lived so long"
(E1C) Repetitive verbalizations	Calling out for help, repeated statements
(E4DA) Inappropriate behavior frequency	Disruptive sounds, noisiness, screaming, self-abuse acts, sexual behavior or disrobing in public, smeared/threw feces, hoarding, rummaging through other's belongings
(E1N) Repetitive physical movements	Pacing, hand wringing, restlessness, fidgeting, picking
(E4CA) Physically abusive frequency	Others are hit, shoved, scratched, sexually abused
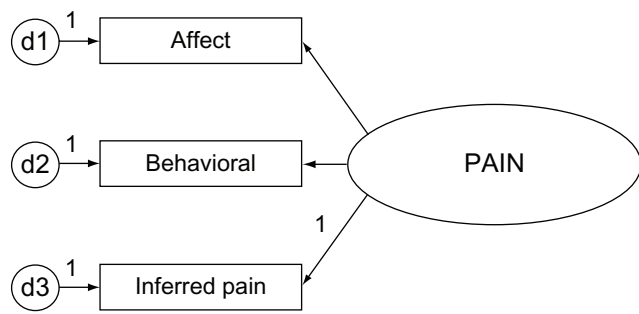
Figure 2 Pain construct.

Results

Select MDS items were collected on 56,494 subjects with a mean age of 83 years. In total, 80% of the sample was female, and 84% Caucasian. Table 2 shows the study demographics.

Table 2 Demographic of resident characteristics

(n = 56,494)	Mean ± SD/ percent of total	Range
Age	83.3 ± 8.2	65–112
Sex		
Male	20.4%	
Female	79.6%	
Marital status		
Never married	14.7%	
Married	14.9%	
Widowed	60.2%	
Separated	2.3%	
Divorced	7.9%	
Ethnicity		
American Indian/Alaskan Native	0.3%	
Asian/Pacific Islander	1.2%	
Black, not of Hispanic origin	11.7%	
Hispanic	2.9%	
White, not of Hispanic origin	83.9%	
Language		
English	94.6%	
Spanish	2.4%	
French	0.2%	
Other	2.8%	
Education level		
No schooling	3.0%	
8th grade/less	30.9%	
9–11 grade	14.4%	
High school	32.9%	
Technical or trade school	4.1%	
Some college	7.3%	
Bachelor's degree	4.2%	
Graduate degree	1.7%	
Not coded/missing	1.5%	

Table 3 Diseases/events with potential pain symptoms

Disease	Number from total (n = 56,494)	Percent of total
Diabetes	11,885	21.0%
Peripheral vascular disease	6459	11.4%
Arthritis	19,013	33.7%
Complaint of joint pain	8018	14.2%
Hip fracture	2181	3.9%
Multiple sclerosis	447	0.8%
Emphysema/chronic obstructive pulmonary disease	7021	12.4%
Cancer	3031	5.4%
Renal failure	1382	2.4%
Pneumonia	498	0.9%
Respiratory infection	1277	2.3%
Septicemia	31	0.1%
Tuberculosis	20	0.0004%
Urinary tract infection	2865	5.1%
Wound infection	295	0.5%

The most prevalent diagnosis was arthritis (33.7%) with 14.2% of the sample complaining of joint pain at the first data collection (Table 3).

Over the 3-year period, the diagnoses of arthritis increased by 8%, and recorded joint pain dropped to 11.3%. Cognitive state did not fluctuate over the three measures observed. Cognition declined slightly over the 3-year period, as did pain (Table 4).

The majority of the sample, 60%–67%, was moderately-to-severely cognitively impaired. A one-way repeated measure ANOVA was calculated for cognition and pain. Each variable compared subject scores at three different time intervals: 2001, 2002, and 2003. A significant effect was found for cognition ($F(2,112986) = 5949.23$; $P < 0.01$) and pain ($F(2,112986) = 271.82$; $P < 0.01$). Significant ANOVAs require a post-hoc analysis. Follow-up protected t-test with repeated measures was used, because of limitations of

Table 4 Longitudinal chart of the cognitive and pain scores

Cognitive status	2001	2002	2003
CPS mean score	2.9 ± 1.8	3.0 ± 1.9	3.2 ± 1.9
MMSE mean score	14.5 ± 7.8	13.7 ± 8.1	12.8 ± 8.3
Intact	13.6%	12.2%	10.4%
Mild	26.7%	24.4%	22.2%
Moderate	29.4%	29.0%	28.4%
Severe	30.3%	34.3%	39.0%
Average Pain Score	2.4 ± 2.9	2.34 ± 2.8	2.18 ± 2.8
Mode	0	0	0
Range (Possible range 0–34)	0–26	0–20	0–22
No pain symptoms reported	42.0%	43.0%	45.0%

Abbreviations: CPS, Cognitive Performance Scale; MMSE, Mini-Mental State Examination.

SPSS software to run a post-hoc analysis for within-subject factors.[43] A protected *t*-test between each measure inflates the risk of Type I errors, so a significance level of 0.017 was used (0.05/3 measures) instead of 0.05. The follow-up protected *t*-test revealed that scores decreased significantly ($P < 0.017$) for cognition1 (mean [M] = 14.5, standard deviation [SD] = 1.80), cognition2 (M = 13.7, SD = 8.1), and cognition3 (M = 12.8, SD = 8.3), and decreased significantly ($P = 0.017$) for pain1 (M = 2.4, SD = 2.9), pain2 (M = 2.34, SD = 2.8), and pain3 (M = 2.18, SD = 2.8).

Regression weights of 1 were assigned to each residual variable. A residual term was not attached to Cognition1 (Figure 3), because there was no predictor for these variables.

The covariance models indicate pain (1–3) and cognition (1–3) measurements were stable over time with previous measures being a good predictor of subsequent measures. Higher stability was observed with the cognitive measure than with the measure of pain. The cross-legged effect of both cognitive and pain measures was inconsistent. Very little association was found between cognition and pain variables, regardless of the time interval. A concomitant relationship was significant ($P < 0.01$), but the associations were weak and ranged from absolute values of 0.03 to 0.08 (Table 5).

Model 1 depicts cognitive decline as a predictor of increased pain, and Model 2 represents the inverse model, increasing pain as a predictor of cognitive decline. The root-mean-square residual (RMR) is the averaged squared amount by which the sample variances and covariances differ

in their estimates.[42] A smaller RMR is preferred with a value of 0 indicating a perfect fit (see Table 6).

The goodness-of-fit index (GFI), as it approaches 1 indicates a perfect fit. The optimal values yielded by the model for the GFI, Tucker–Lewis Index, and adjusted GFI could be attributed to the simplicity of the model, even though all three were approaching 1.0.

Discussion

The sample data do not confirm the presence of concomitance between pain and cognition in this long-term care population. The theoretical construct does not support either measure as a predictor of the other. These findings support Kovach's model of consequences of need-driven, dementia-compromised behaviors (C-NDB).[32] Cognition (background factor) and pain (proximal factor) exist as contributing aspects of how need-driven behaviors are manifested and communicated. Kovach's C-NDB model serves as the template for understanding how symptoms and environmental factors interact. This system contains environmental and contextual factors, affecting both resident and care outcomes. Failing to identify resident care needs is not in isolation of the resident, but is a complex system involving clinician, support staff, environmental factors, and the resident.

MDS can be used as a reliable tool to track resident characteristics and outcomes over time. Reporting was consistent for cognition and pain over the 3-year period, and considerable fluctuations in recorded values of cognition and pain did not occur. Because pain assessments were recorded annually, differences in pain would be anticipated.
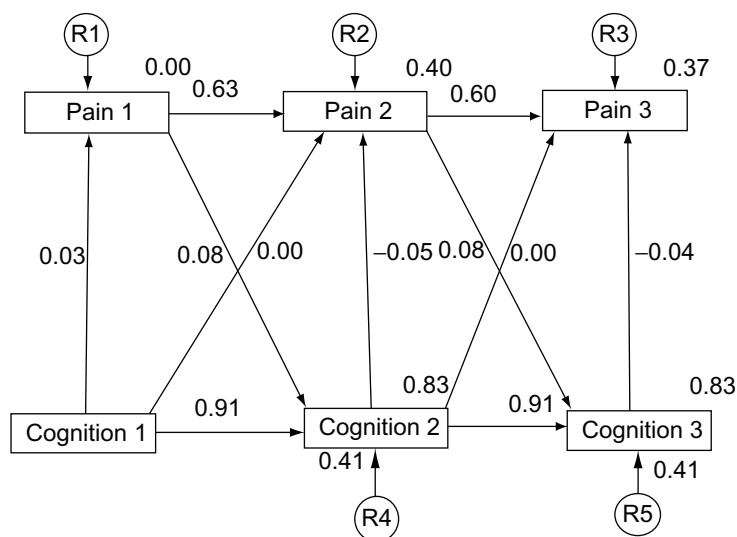

Figure 3 Covariance model 1 of 3-year concomitance of cognition and pain.

Table 5 Correlations

N = 56,494	Mean	SD	I	2	3	4	5	6
I. Pain score 2001	2.43	2.89	1.00					
2. MMSE 2001	14.51	7.88	0.028**	1.00				
3. Pain score 2002	2.34	2.85	0.635**	0.056**	1.00			
4. MMSE 2002	13.59	8.20	0.022**	0.912**	0.041**	1.00		
5. Pain 2003	2.1	2.77	0.492**	0.073**	0.606**	0.065**	1.00	
6. MMSE 2003	12.63	8.36	0.019**	0.851**	0.036**	0.913**	0.052**	1.00

Note: **Correlation is significant at the 0.01 level (one-tailed).
Abbreviation: MMSE, Mini-Mental State Examination.

The findings showed a gradual decline in recorded pain over the 3-year period, as cognition also declined. This raises concern, because these findings may support previous research, indicating pain is underreported and undertreated in residents with cognitive decline.[44–46]

Reductions in pain scores at the third interval may also be attributable to residents having less pain, or residents having received appropriate interventions for their pain. Differences in pain would be expected with recent events like fracture, surgery, or falls. Partitioning this group of residents into a separate cohort could evaluate the consistency of pain reporting, and pain measures specific to these acute events. Until clinicians and support staff increase their awareness of affective, cognitive, and behavioral indicators of pain, the reliability of MDS for pain measures will continue to be a concern.

Results suggest the importance of assessing memory function when managing physiologically distressed residents, because this information aids in determining the best methods to assess resident pain.[26,47,48] Over the 3-year period, declines in cognitive status occurred which were consistent with the progression of organic brain disease. Acute declines in cognition may be indicative of a change in mental status not attributable to the progression of a pre-existing disease, but the onset of infection (ie, urinary tract infection, pneumonia, or sepsis), or psychiatric illness.

Further research could look at specific diagnoses and the consistency of cognitive decline and pain measures over time. Additional variables like the use of multiple medications (eg, polypharmacy), or certain classes of medications, ie, antipsychotics or hypnotics, may yield valuable information about the contributing factors to resident decline, and create an index of outcomes for pharmacoeconomic and clinical data supporting resident care guidelines and health policy reform. Supplemental theoretical modeling could evaluate latent growth models, with predictors combining pain, cognition, age, sex, and facility characteristics, enabling a greater understanding of pain and cognition in the elderly beyond this concomitance study. Additionally, research examining a growth curve model, plotting parallel points in time, would provide valuable information to trends in data distribution and would clarify if the model were polynomial.

One limitation of this method – that of using scores derived only from annual assessments of cognition and pain – is that it measures only a single point in time, and does not fully capture the day-to-day variation in resident scores. A linear relationship was statistically analyzed between pain and cognition. Additional research could examine the non-linear relationship of these two variables, to determine if a nonlinear relationship exists. Additionally, composite pain scores were used to increase the ease of score totaling from individual score items, to improve the use of the pain indicators in the long-term care setting. Further research is required to examine the effect of medication use by class, and how other comorbidities influence pain measures.

A further limitation of this research was the data distribution. Normality and population distribution were unequal. The majority of the population assessed was not experiencing pain, and cognitive groups were also unequal. While the population demographics are representative of

Table 6 Goodness-of-fit statistics of the covariance model

Goodness-of-fit statistics	Model I	Model 2
χ^2	2524.9	2828.6
Degrees of freedom (df)	4	4
P	0.000	0.000
Number of free parameters	17	17
χ^2/df	631.224	707.158
RMR	0.332	0.205
GFI	0.986	0.984
TLI	0.964	0.959
AGFI	0.924	0.915
RMSEA	0.106	0.112
Hoelter (0.01)	298	266

Abbreviations: AGFI, Adjusted Goodness-of-Fit Index; GFI, Goodness-of-Fit Index; RMR, root-mean-square residual; RMSEA, Root-Mean-Square Error of Approximation; TLI, Tucker–Lewis Index.
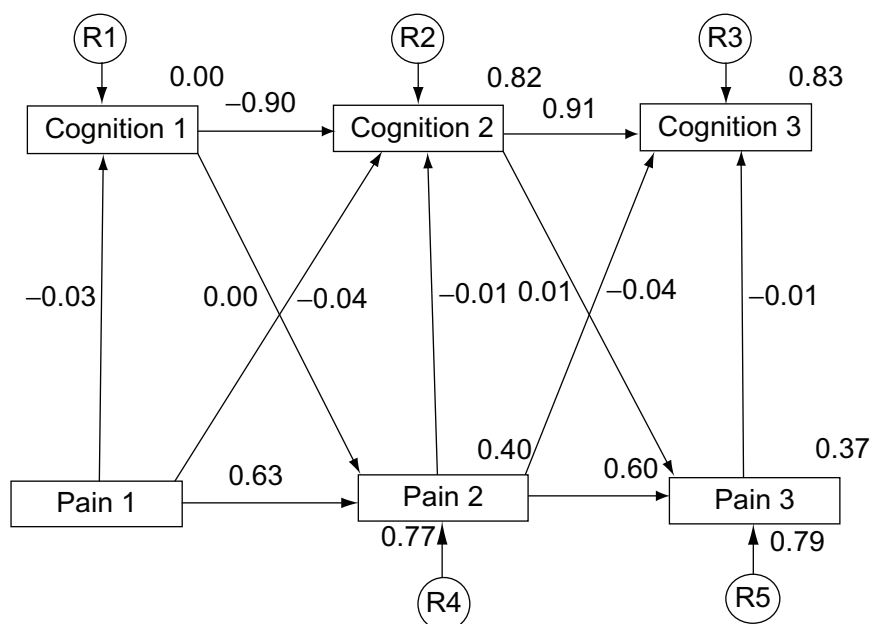
Figure 4 Covariance model 2 of 3-year concomitance of pain and cognition.

nursing homes, very distinct population demographics (ie, sex, race, educational background, socioeconomic factors) limit generalizability beyond this setting. Variations in the interpretation of reliability measures between those rating the MDS sections for mood and behavior have been reported.[49,50]

The research was limited to the available items in MDS, and these items might not capture, define or describe all pain symptoms. Even with the further criteria added to measure pain across cognitive states, there remain dimensions of pain still to be discovered and defined.

Table 7 Goodness-of-Fit statistical terms

Goodness-of-Fit statistics	Terms and understanding statistical output
χ^2 (chi-square)	Best for models with sample sizes between 75–100; for n > 100 chi-square is almost always significant since the magnitude is affected by the sample size; also affected by the size of correlations in the model, the larger the correlations the poorer the fit
Degrees of freedom (df)	The number of degrees of freedom and equals p–q (the # of sample moments subtract the # of parameters estimated)
P	The probability is ideally nonsignificant; however, significant models can still yield valuable theoretical construct information
Number of free parameters	Multiple times 5–10 to estimate required sample size for the study
χ^2/df	Use to compare models; this number should decrease from model to model; <5 is good, but must have P > 0.05; close to 1.0 means it is a correct model
RMR	Root-mean-square residual is the square root of the average amount that the sample variances and covariances differ from their estimates, smaller values are better
GFI (also GOF)	Slightly less than or equal (0–1) to 1 indicates a perfect fit; acceptable values are above 0.90; affected by sample size and can be large for poorly specified models
TLI	The Tucker–Lewis Index coefficient should be between 0–1, values close to 1 indicate a very good fit
AGFI (also AGOF)	Adjusted Goodness-of-Fit Index, takes into account the df available for testing the model; AGFI is bound by 1, which indicates a perfect fit; however it is not bound by 0
RMSEA	Should be less than 0.05; score of less than 0.05 indicates a close fit of the model in relation to the df. Not definitive but the rule of thumb is a RMSEA of 0.01 is an exact fit, a score of 0.08 or less indicates a reasonable error of approximation. A model with an RMSEA of greater than 0.1 should not be used – indicates a poor fit
Hoelter (0.05)	The largest sample size for which one would accept the hypothesis that the model is correct; the index should only calculated if the chi-square is statistically significant. How small one's sample size would have to be for chi-square to no longer be significant. Hoelter recommends values of at least 200, values ≤75 indicate a poor fit

Abbreviations: AGFI, Adjusted Goodness-of-Fit Index; GFI, Goodness-of-Fit Index; RMR, root-mean-square residual; RMSEA, Root-Mean-Square Error of Approximation; TLI, Tucker–Lewis Index.

Conclusion

This research sought to ascertain whether in fact a relationship exists between pain and cognition, and if so, to gain preliminary insight into the relationship. Investigating whether cognition is a predictor of pain in a concomitant relationship helped to define how secondary patient outcomes might be mediated. Further research should be used to link cognition, resident ability to communicate, and levels of pain for significance with quality of life measures like depression, disturbances in gait, weight loss, decreased activity, declines in functional status, or social isolation. In the case of most organic brain diseases, instead of returning to a normal level of cognitive functioning, a progressive decline occurs. Pain is a cycle that can be intervened upon, and symptoms can be lessened through medicinal and non-medicinal treatments, improving resident comfort. With an understanding of the role of cognition in identifying how pain is communicated, we can improve pain detection and uniformity of measures to ameliorate symptoms. The significance of confirming, theoretical frameworks with advanced multivariate analysis is an opportunity to evaluate interactions of key variables. A global assessment of concomitance between pain and cognition offers a unique insight towards a better understanding of the relationship of pain and cognition in a general nursing home population.

Disclosure

The authors report no conflicts of interest in this work.

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