Research Article

Does Pain Mediate or Moderate the Effect of Cognitive Impairment on Aggression in Nursing Home Residents with Dementia?

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S U M M A R Y

Purpose: The purpose of this study was to investigate if pain mediates or moderates the relationship between cognitive impairment and aggressive behaviors in nursing home residents with dementia based on the Need-driven Dementia-compromised Behavior model.
Methods: This was a secondary analysis of the Minimum Data Set assessment data on long-term care from the state of Florida during calendar year 2009. The data used in this study was the first comprehensive assessment data from residents with dementia ($N = 56,577$) in Medicare-certified or Medicaid-certified nursing homes. Path analysis using a series of hierarchical regression analyses and two-way analysis of variance was used to evaluate the mediating and moderating effect of pain on the relationship between the level of cognitive impairment and aggression.
Results: Results indicated that pain did not mediate the relationship between cognition and aggressive behaviors, but there was evidence of a significant moderating effect of pain only for residents with severe cognitive impairment. Only among the residents with severe cognitive impairment, those with pain had significantly more frequent aggressive behaviors than those without pain.
Conclusion: A change in the frequency of aggressive behaviors in severely cognitively impaired residents should signal the possibility that the person is experiencing pain. Accurate but simple pain assessment in this population including these behavioral changes should be developed further, and pain should be well controlled to reduce these problematic behaviors.

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Introduction

Aggressive behaviors are common among nursing home (NH) residents with dementia (Ahn & Horgas, 2013; Kunik et al., 2010). Aggression is defined as an overt act, involving the delivery of noxious stimuli to (but not necessarily aimed at) another organism, object or self, which is clearly not accidental, and includes verbally or physically abusive and threatening behaviors (Nösman, Bucht, Eriksson, & Sandman, 1993; Patel & Hope, 1992; Ryden, 1988). Aggression occurs in about 40%–80% of NH residents with cognitive impairments (Brodaty et al., 2001; Chen, Borson, & Scanlan, 2000; Kunik et al., 2007; Schreiner, 2001). These behaviors are associated with injuries, hospitalization, or decreased health-related qualify of life among older adults with dementia, and stress and burnout among caregiving staff (Norton, Allen, Snow, Hardin, & Burgio, 2010).

These aggressive behaviors are hard to deal with, therefore physical restraints or psychoactive medications are commonly used in order to control these behaviors. The use of physical restraints in NHs has declined since the implementation of the Omnibus Budget Reconciliation Act of 1987 (OBRA '87) which established regulatory guidelines for the use of chemical and physical restraints (Guttman, Altman, & Karlan, 1999). However, restraints are still often used to manage aggressive behaviors in older adults with dementia (Evans & Cotter, 2008). Pharmacological interventions using psychoactive medications are also commonly used for NH residents with dementia to control aggressive behaviors, but these medications are associated with decreased health-related quality of life, and increased risk for sedation, extrapyramidal symptoms, and falls (Cohen-Mansfield & Jensen, 2008).

Recent studies suggest that pain may contribute to aggressive behaviors in older adults with dementia. Dementia impairs cognitive and communicative abilities (Ko & Shin, 2013). Thus, older adults with severe dementia may express pain through aggressive behaviors because they cannot properly verbalize their pain experience (Scherder et al., 2009; Shega et al., 2007; Snow et al.,

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2009). Ahn and Horgas (2013) reported pain is significantly related to aggressive behaviors among NH residents in Florida. Cipher and Clifford (2004) also reported that pain affected aggressive behaviors among 234 residents living in long-term care facilities in Texas.

Aggressive behaviors can be interpreted as meaningful bodily expressions that describe something about the person's needs or wishes that require addressing, such as pain (Algase et al., 1996). The use of physical or chemical restraints as a behavior management mechanism for older adults with dementia violates the respect for autonomy (Touhy, 2004). The better approach to managing aggressive behaviors is to control their possible cause rather than using restraints to control NH residents and thus reduce these behaviors.

The Need-driven Dementia-compromised Behavior (NDB) model (Algase, Yao, Beel-Bates, & Song, 2007) provides the theoretical basis for this study (Figure 1). The NDB model posits that there are two main constructs that predict NDBs: background factors and proximal factors. Background factors include those characteristics that place older adults with dementia at risk for behavioral symptoms. Proximal factors represent the conditions under which behavioral symptoms occur. For this study, the level of cognitive impairment represents a background factor, and pain represents a proximal factor. The NDB model (Algase et al., 2007) does not clearly specify the nature of the relationships among background, proximal, and outcome variables, but instead states that proximal factors may mediate or moderate the relationship between background and outcome variables. Aggressive behaviors are one type of NDB, and are the focus of this paper. Thus, we seek to explore and clarify these relationships using the association among cognitive impairment level (background factor), pain (proximal factor), and aggressive behaviors (outcome variable) as the exemplar.

The aim of this study is to determine if pain mediates or moderates the relationship between cognition and aggressive behaviors in NH residents with dementia. We tested the following hypotheses:

- For mediating effect of pain on the relationship between cognitive impairment and aggression, we hypothesize that, among NH residents with dementia, the higher levels of cognitive impairment are negatively associated with pain severity, and this under-diagnosed pain contributes to more frequent aggressive behaviors.
- For moderating effect of pain on the relationship between cognitive impairment and aggression, we hypothesize that, among NH residents with dementia, the relationship between cognitive impairment and aggression varies depending on the presence of pain. Pain positively affects aggressive behaviors in only severely cognitively impaired residents with dementia. People with mild or moderate dementia are able to verbalize their pain level to the simple pain assessment interview so that they can get the pain treatment, without causing the increment in aggressive behaviors.
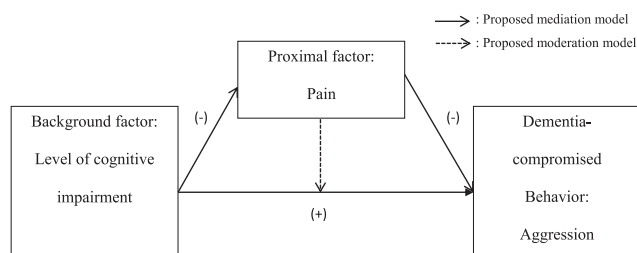

Figure 1. Theoretical framework: Need-driven Dementia-compromised Behavior model.

Methods

Study design

This was a secondary analysis of the Minimum Data Set (MDS) assessment data on long-term care from the state of Florida during calendar year 2009. The MDS assessment data is mandatory in all U.S. nursing homes certified to participate in Medicare and Medicaid, and contains standardized physical, psychological and psychosocial assessment data of their residents. Although it is largely used for clinical purposes in NH residents, the MDS has also been used for research for this population (Ahn & Horgas, 2013; Ahn, Stechmiller, & Horgas, 2013; Burfield, Wan, Sole, & Cooper, 2012; Carpenter, Hastie, Morris, Fries, & Ankri, 2006). An exploratory cross-sectional design was used for this study. Cross-sectional data, the first MDS comprehensive assessment data for each NH residents during the 12-month time frame, were used to explore the relationship between pain and aggressive behaviors.

Setting and sample

Participants in this study were residents with dementia in Medicare-certified or Medicaid-certified NHs in the state of Florida between January 1, 2009 and December 31, 2009 who have an MDS comprehensive assessment on file. Inclusion criteria were NH residents older than 65 years and a documented diagnosis of Alzheimer disease or other dementia. Exclusion criteria were comatose status because these residents cannot display aggressive behaviors.

Ethical consideration

Approval for the study was obtained from the University of Florida Health Science Center Institutional Review Board.

Measurement

Several subscales from the MDS were used for this study. The MDS-Pain Severity Scale (MDS-PSS) (Fries, Simon, Morris, Flodstrom, & Bookstein, 2001), combining both pain frequency and pain intensity, was used to assess pain severity. MDS-PSS (Fries et al.) is recorded on a 4-point scale, 0 (no pain), 1 (mild pain), 2 (moderate pain), and 3 (excruciating pain). NH residents' self report is reflected in the MDS pain items if residents can self report and staff completing MDS assessments have confidence with residents' self report. Otherwise, a staff member completes the MDS assessment document pain symptoms based on observation on pain behavioral indicators and/or the proxy reports from facility nursing staff or family caregivers who take care of the residents. The MDS-PSS is frequently used for measuring pain in the cognitively impaired older adults in NHs (Ahn & Horgas, 2013; Ahn et al., 2013; Burfield et al., 2012), and has been reported to have an inter-rater reliability coefficient of .73 and higher, and kappa coefficient of .70 with a visual analogue scale in a study involving 95 NH residents at 25 Medicare-certified skilled nursing facilities in Massachusetts (Fries et al.).

The MDS-Cognitive Performance Scale (MDS-CPS) (Morris et al., 1994) was used to measure the level of cognitive impairment. The MDS-CPS score is calculated using five MDS items: comatose, short-term memory, cognitive skills or daily decision making, making oneself understood, and self-performance in eating. The MDS-CPS ranges from 0 to 6, with higher scores indicating more severe cognitive impairment. The MDS-CPS has a kappa coefficient of .45—.75 with Mini-Mental State Examination, .41—.77 against Global Deterioration Scale, and .45 against Mattis Dementia Rating Scale in

older adults in NHs (Bula & Wietlisbach, 2009; McConnell, Branch, Sloane, & Pieper, 2003).

The MDS-Aggressive Behavior Scale (MDS-ABS) was used to measure the frequency of aggressive behaviors (Perlman & Hirdes, 2008). The MDS-ABS is a sum score of four MDS items: verbally abusive behavioral symptoms, physically abusive behavioral symptoms, socially inappropriate behavioral symptoms, and resisting care. The MDS-ABS ranges from 0 to 12, with higher scores indicating a higher frequency of aggressive behaviors. The MDS-ABS has been reported to have a reliability coefficient of .79−.95, and a kappa coefficient of .72 with the aggression subscale of the Cohen−Mansfield Agitation Inventory in 125,125 older adults in NHs or continuing care units (Perlman & Hirdes).

Data collection

MDS assessment data from Florida NHs were acquired from the U.S. Centers for Medicare and Medicaid Services (CMS) through the Research Data Assistance Center. All of the U.S. nursing home MDS assessment is collected quarterly by CMS, and stored in American Standard Code for Information Interchange format text file. The Research Data Assistance Center, based at the University of Minnesota, is the data-coordinating agency that pre-reviews proposals for MDS use and helps distribute MDS data from CMS to researchers.

Data analysis

Analyses were performed using SPSS (version 20; IBM Inc., Armonk, NY). Path analysis using a series of hierarchical regression analyses was used to evaluate the mediating effect of pain on the relationship between the level of cognitive impairment and aggression, after controlling for covariates (e.g., sociodemographic factors, functional impairments). To evaluate the potential role of pain as a mediator, three hierarchical regression analyses are performed, following the approach outlined by Baron and Kenny (1986). These include (a) the hierarchical regression between the level of cognitive impairment (predictor) and aggression (outcome), (b) the hierarchical regression between the level of cognitive impairment (predictor) and pain (mediator), and (c) the hierarchical regression among the level of cognitive impairment and pain as independent variables with aggression as a dependent variable (Baron & Kenny; Holmbeck, 1997). Three conditions should be met for mediating effect. First, the predictor should be significantly associated with the outcome. Two, the predictor should be significantly associated with the mediator. Finally, the mediator should be significantly associated with the outcome, but the predictor should not be significantly associated with outcome when the mediator is in the regression model.

Two-way analysis of variance (ANOVA) was also used to evaluate the moderating effect of pain on the relationship between the level of cognitive impairment and aggression. For the analysis of moderation, pain was dichotomized into presence or absence of pain, and the level of cognitive impairment was categorized as mild impairment (CPS at 0−2), moderate impairment (CPS at 3), and severe impairment (CPS at 4−6). This method of classification has been commonly used in the literature (Carpenter et al., 2006; McConnell et al., 2003).

Results

Descriptive findings

The sample ($N = 56,577$) was mostly female (67.7%), widowed (53.7 %), high school graduates or less (72.5%), Caucasian (78.7%),

with a mean age of 84 years (range: 65−109). Table 1 shows the sample characteristics and the description of main variables.

Mediating effect of pain on aggressive behaviors

The first step of path analysis, hierarchical regression of the level of cognitive impairment (predictor) on aggression (outcome), is statistically significant ($\beta = .20$, $p < .001$). The second step, hierarchical regression of the level of cognitive impairment (predictor) on pain (mediator), is statistically significant ($\beta = -.20$, $p < .001$). The third step, the hierarchical regression of pain (mediator) on aggression (outcome) is not statistically significant ($\beta = .01$, $p = .070$), and the hierarchical regression of the level of cognitive impairment (predictor) on aggression (outcome) is still significant ($\beta = .20$, $p < .001$). There should be a significant relationship between pain (mediator) and aggression (outcome). Moreover, there should be a nonsignificant relationship between the level of cognitive impairment (predictor) and aggression (outcome) when pain (mediator) is in the regression model, if the full mediating effect exists (Holmbeck, 1997). Therefore, pain does not mediate the relationship between the level of cognitive impairment and aggressive behaviors.

Moderating effect of pain on aggressive behaviors

The results of two-way ANOVA to analyze the moderating effect of pain on aggressive behaviors are summarized in Table 2. In two-way ANOVA models, significant main effects of the level of cognitive impairment on aggression ($F[2, 56524] = 1121.60$, $p < .001$) and significant main effect of pain on aggression ($F[1, 56524] = 5.46$, $p = .019$) were noted. However, these relationships were qualified by a significant interaction effect of the level of cognitive impairment and pain ($F[2, 56524] = 14.30$, $p < .001$), indicating that the relationship between pain and aggression differed by the level of cognitive impairment. Pain did not affect aggression in the residents with mild or moderate cognitive impairment (mildly impaired residents: mean difference [MD] = 0.02, $SD = 0.02$, $t = 1.40$, $p = .156$; moderately impaired residents: [MD] = 0.01, $SD = 0.02$, $t = 0.41$, $p = .681$). However, for residents with severe

Table 1 *Participant Characteristics (N = 56,577)*

Characteristic	Number	n (%)	M ± SD
Age (yr)	56,577		84.37 ± 7.43
Gender	56,566		
Male		18,265 (32.3)	
Female		38,301 (67.7)	
Marital status	55,920		
Separated		659 (1.2)	
Never married		3,994 (7.1)	
Divorced		4,292 (7.7)	
Married		16,937 (30.3)	
Widowed		30,038 (53.7)	
MDS-CPS[a] (score)	56,543		3.17 ± 1.52
Mild Impairment (0−2)		15,955 (28.2)	
Moderate Impairment (3)		21,657 (38.3)	
Severe Impairment (4−6)		18,931 (33.5)	
MDS-PSS[b] (score)	56,568		0.48 ± 0.70
No (0)		35,710 (63.1)	
Mild (1)		15,139 (26.8)	
Moderate (2)		5,227 (9.2)	
Excruciating (3)		492 (0.9)	
MDS-ABS[c]	56,577		0.54 ± 1.27

Note. MDS-CPS = Minimum Data Set Cognitive Performance Scale; PSS = Pain Severity Scale; ABS = Aggressive Behavior Scale.
[a] CPS: 0−6, higher scores indicating more severe cognitive impairment.
[b] PSS: 0−3, higher scores indicating more severe pain.
[c] ABS: 0−12, higher scores indicating a higher frequency of aggressive behaviors.

Table 2 *Results of Two-way Analysis of Variance (N = 56,530)*

	Aggressive behaviors				
	SS	df	MS	F	p
Pain	8.39	1	8.39	5.46	.019
Cognitive impairment	3446.75	2	1723.37	1121.60	<.001
Interaction (Pain × Cognitive impairment)	43.93	2	21.97	14.30	<.001

Note. SS = sum of squares; MS = mean square.

cognitive impairment, pain was associated with a significant increase in the frequency of aggression (MD = 0.11, SD = 0.02, t = 5.40, p < .001) (Figure 2).

Discussion

In the NDB model, Algase and colleagues (1996) initially conceptualized pain (a proximal factor) as a mediator of the relationship between background factors and dementia-compromised behavior. The level of cognitive impairment (a background factor) was hypothesized to directly affect pain (a proximal factor), and then pain affected aggressive behaviors. Later, Algase and colleagues (2007) modified the theory to state that pain affects the relationship between the level of cognitive impairment and aggression as either mediator or moderator. They presented the propositions that "Proximal factors occur and are perceived by the persons with dementia in the context of existing background factors… Both background and proximal factors interact or combine in some sequence to produce dementia-compromised behaviors." This opened the doorway to conceptualize pain as a moderator such that the relationship between the level of cognitive impairment and aggressive behaviors differed depending on the presence of pain.

We examined both the mediating and moderating effect of pain based on the NDB model (Algase et al., 2007). We did not find a mediating effect of pain on the relationship between the level of cognitive impairment and the frequency of aggressive behaviors.
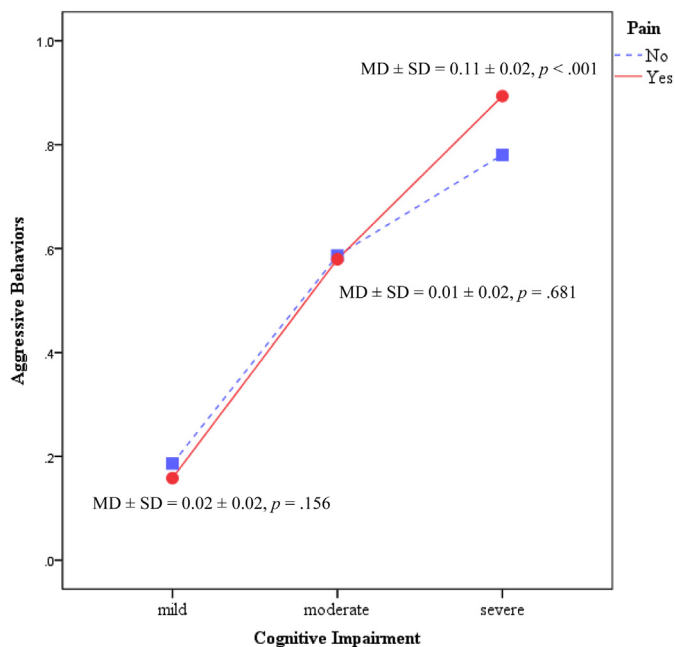

Figure 2. The result of the moderating model: the relationship between pain and aggression differed by the level of cognitive impairment.

Instead, we found that pain moderates the relationship between the level of cognitive impairment and aggression. Pain exacerbated aggressive behaviors only for severely cognitively impaired residents. This may indicate that mildly or moderately cognitively impaired residents can verbally express their pain level. This explanation is consistent with a small but growing body of the literature indicating that older adults with mild to moderate cognitively impairments are able to provide valid self-reports of pain, although it is not the sole means of assessments (Engle, Graney, & Chan, 2001; Hadjistavropoulos, Fitzgerald, & Marchildon, 2010; Hadjistavropoulos et al., 2007; Saliba & Buchanan, 2012). As a result, pain does not increase aggression in those individuals. However, severely cognitively impaired residents cannot adequately articulate their pain. As a result, they may express their pain through aggressive behaviors.

Several limitations of this study should be noted. First, this study is inherently limited by secondary analysis of the MDS assessment data, and the effect of clustering within facility is not controlled for in this study. These data may have some variability due to different skills of MDS coordinators in each facility. Second, this study design is cross-sectional such that we were not able to examine the causal relationships. Finally, the NDB model was adapted to guide this study, but this study did not include all the variables in the NDB model. We only included cognitive impairment and pain to predict aggressive behaviors in NH residents with dementia, because these two variables showed significant association with aggressive behaviors consistently in the current literature (Ahn & Horgas, 2013; Norton et al., 2010). The other variables (e.g., sociodemographic factors, functional impairments) showed somewhat inconclusive relationship with aggressive behaviors (Eustace et al., 2001; Menon et al., 2001; Zeisel et al., 2003). Furthermore, these results of mediation and moderation model are the same when the models include other variables. Thus, we opted for the more parsimonious model.

The result of this study suggested there is a moderating effect, not a mediating effect, of proximal factors on the relationship between background factors and dementia-compromised behaviors in NDB model. To validate these findings, further research is warranted.

Conclusion

Pain exacerbated aggressive behaviors only among NH residents with severe cognitive impairment. In this population, pain assessment based on self-report from residents is not a reliable assessment method. Instead, use of nonverbal, behavioral assessments of pain must be utilized (Herr et al., 2006). These assessments should include the display of aggressive behaviors. Further, a change in the frequency of aggressive behaviors should signal the possibility that the person is experiencing pain. Accurate but simple pain assessment in persons with severely cognitively impairment including these behavioral changes should be developed further, and pain should be well controlled to reduce these problematic behaviors.

Conflict of Interest

The authors have no financial or any other kind of personal conflicts with this manuscript.

Acknowledgment

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