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Physical Restraint Use and Falls in Nursing Homes: A Comparison Between Residents With and Without Dementia

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Abstract

Aims: To estimate the use of different types of physical restraints and assess their associations to falls and injuries among residents with and without Alzheimer's disease (AD) or dementia in US nursing homes. **Methods:** Data were from the 2004 National Nursing Home Survey. AD or dementia was identified using *International Classification of Diseases, Ninth Revision* (*ICD-9*) codes. Analyses were conducted with the Surveyfreq and Surveylogistic procedures in SAS v.9.1. **Results:** Residents with either AD or dementia were more likely to be physically restrained (9.99% vs 3.91%, $P < .001$) and less likely to have bed rails (35.06% vs 38.43%, $P < .001$) than those residents without the disease. The use of trunk restraints was associated with higher risk for falls (adjusted odds ratio [AOR] = 1.66, $P < .001$) and fractures (AOR = 2.77, $P < .01$) among residents with the disease. The use of full bed rails was associated with lower risk for falls among residents with and without the disease (AOR = 0.67 and AOR = 0.72, $Ps < .05$, respectively). **Conclusions:** The use of a trunk restraint is associated with a higher risk for falls and fractures among residents with either AD or dementia.

Keywords

physical restraints, falls and fractures, dementia, nursing homes

Introduction

Alzheimer's disease (AD) is the most common cause of dementia and approximately 5.3 million people in the United States (US) had this disease in 2009.[1] The prevalence of AD is predicted to increase to 13.2 million by 2050.[2] Furthermore, the majority of people with dementia will be institutionalized in a nursing home (NH) in their lifetime,[3] and they are at an increased risk of being physically restrained.[4,5] The adverse outcomes associated with restraint use have been well documented, including falls and injuries,[6] incontinence, circulation impairment, agitation, social isolation,[7-9] and even death.[10,11] However, there is limited information on physical restraint use and the associated outcomes among NH residents with dementia. Most previous studies on restraint use and outcomes did not assess how different types of restraints were correlated with falls and injuries, and how the use of restraints and outcomes vary across residents with or without dementia. This study assessed the prevalence of different types of restraints and the associated outcomes in US NHs employing a nationally representative sample. The objectives of this study are (1) To estimate the use of different types of restraints among residents with and without either AD or dementia; (2) To assess the association of different types of restraints to falls and fractures among residents with and without either AD or dementia.

Methods

Data Source

The data for this study were from the 2004 National Nursing Home Survey (NNHS). The NNHS is a 2-stage, cross-sectional probability sample of US NH residents. First, a sample of NHs was selected from all US NHs operating in 2004. Subsequently, in each participating NH, NNHS surveyors drew a random sample of current residents. Up to 12 current residents were sampled at each NH in the 2004 NNHS. Detailed information on each resident was collected from staff members at the NH, typically registered nurses, who answered questions by referring to the residents' medical records and other documentation. No residents were directly interviewed. Data were collected for 13507 residents in 1174 NHs, including residents'

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demographic characteristics, date of admission, current functional status, and admission and current diagnoses.[12]

Study Sample

Residents who were comatose (n = 68) at the time of survey were excluded from our study sample. Following previous research,[13,14] residents with AD or dementia were identified by the following *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes in their admission or current diagnoses: 290 and 797 (senile/presenile dementia), 331.0 (Alzheimer's disease), 294.1 (other conditions associated with dementia), 294.8 and 310 (organic brain syndromes). We combined these codes and labeled them as AD or dementia. In the 2004 NNHS, there are 6576 residents with a diagnosis of AD or dementia and 6759 residents without, which constitute the study sample to accomplish the first objective of this study—to estimate the prevalence of different types of restraints in NHs. Next, to accomplish the second objective—to assess the association of different types of physical restraints to falls and fractures, we focused on residents with a length of stay (LOS) of 180 days or more. This is because in the 2004 NNHS file, residents' incidents of falls and fractures (hip or other) were recorded in the past 180 days, which could include falls or injuries not occurring inside the facility.[12] Therefore, we excluded residents whose LOS was less than 180 days. Consequently, the final sample for this analysis included 5057 residents with AD or dementia and 4224 residents without.

Measures

Outcome variables. The 2 outcome variables examined in this study were falls and fractures experienced by residents in the past 180 days. In the 2004 NNHS, 2 questions were used to identify whether a resident fell, either in the past 30 days or in the past 31 to 180 days.[12] Thus, a resident was considered as having a fall if "yes" is recorded to either of these 2 questions. Fractures were also identified by 2 questions—either a hip fracture in the past 180 days or other fracture in the past 180 days. Similarly, a resident was classified as having a fracture if "yes" was recorded to either of these 2 questions.

Independent variables. The independent variables include 5 different types of restraints including limb restraint, trunk restraint, chairs that prevent rising, full bed rails (rails on all open side of the bed), and side rails (including half rails or 1 side rails).[12] The frequency of use for each of these 5 types of restraint was recorded as "not used," "used less than daily," "used daily," "DK (don't know)," and "not ascertained" in the 2004 NNHS.[12] Because the recorded frequencies for some responses (eg, "used less than daily") were very small, we combined "used less than daily" and "used daily" into 1 category to indicate whether "a restraint was used." We recoded responses "DK" and "not ascertained" as missing. Then, we measured these 5 types of restraints as binary variables: limb (yes/no), trunk (yes/no), chair (yes/no), full bed rails (yes/no), and side rails (yes/no). In addition, in accordance with the classification of restraint use in previous research,[15] we grouped the restraints/devices into 2 main categories: physical restraints—limb restraint, trunk restraint, and a chair that prevents residents from rising, and bed rails—full bed rails and side rails, when estimating the prevalence of restraint use.

Control variables. Based on a review of existing literature,[16] we included other risk factors for falls and fractures as control variables in the multivariable models, representing both resident and facility characteristics. Resident characteristics included demographic measures for age (<65, 65–74, 75–84, and 85+ years), sex (female vs. male), and race (white vs non-white). Among physical characteristics, 3 categories of walking ability status were included[12]: independent (resident can walk independently), needing help (resident needs assistance in walking), and no walking activity in the past 7 days. We divided length of stay (LOS) into 3 categories: less than 2 years, between 2 and 4 years, and 4 or more years. Following previous research,[15] an NH resident's impairment in the 5 activities of daily living (ADLs; transferring, eating, toileting, dressing, and bathing) was recoded into 3 categories: minimal (0-1 ADL), moderate (2-3 ADLs), and dependent (4-5 ADLs). A resident's ability to make decisions regarding tasks of daily life was measured in 4 levels: independent, modified independence, moderately impaired, and severely impaired. Resident's behavioral problems (yes/no) included disruptive behaviors, abusive actions, screaming, and resisting care. Incontinence (yes/no) referred to either bowel or urinary incontinence. The 7 responses to a resident's bowel continence and bladder continence levels recorded in the 2004 NNHS included "continent," "usually continent," "occasionally incontinent," "frequently incontinent," "incontinent," "DK," and "not ascertained." We combined the second through fourth responses into 1 category and coded as Incontinence (yes), and coded the first response as Incontinence (no), "DK" and "not ascertained" as missing. Depressive mood (yes/no) referred to whether a resident had indicators of depressed mood. The 5 responses were "no mood indicators," "indicators present, easily altered," "indicators present, not easily altered," "DK," and "not ascertained." We recoded the second and third response as having depressed mood (yes), the first response as not having depressed mood (no), and the fourth and fifth responses as missing. The total number of medications taken by a resident was divided into 3 categories: <7, 7-9, and $\geq$10 medications. Residence in a special care unit (SCU) for Alzheimer's and dementia care (yes/no). This classification was identified through 2 questions in the 2004 NNHS: "Whether a resident was assigned to a bed in a specialty unit?" and "What condition is the specialty unit?" In this study, a resident was identified as residing in an SCU (yes) only if a resident was "assigned to a bed on a specialty unit" and if the specialty unit was for "Alzheimer's and dementia care." The facility characteristics variables included bed size (<100,

Table 1. Prevalence of Restraints Among Residents With and Without AD or Dementia: 2004 NNHS

	Residents With AD or Dementia (n = 6,576)	Residents Without AD or Dementia (n = 6,759)	*P* Value[b]
	%[a] (95% CI)	%[a] (95% CI)	
Physical restraints			
Any	9.99 (9.16-10.82)	3.91 (3.38-4.45)	<.001
Limb[c]	0.51 (0.30-0.72)	0.28 (0.12-0.44)	.10
Trunk	5.64 (5.00-6.28)	2.10 (1.72-2.47)	<.001
Chair restraints	4.62 (4.04-5.20)	2.07 (1.67-2.47)	<.001
Total	6.99 (6.50-7.49)		
Bed rails			
Any	35.06 (33.92-36.21)	38.43 (37.22-39.63)	<.001
Full bed rails	13.13 (12.32-13.95)	14.48 (13.61-15.36)	.04
Side rails	23.53 (22.49-24.57)	25.92 (24.78-27.06)	.01
Total	36.79 (36.09-37.49)		

Abbreviations: AD, Alzheimer's disease; NNHS, National Nursing Home Survey; CI, Confidence interval.
[a] Weighted percentage.
[b] Wald chi-square test.
[c] Estimates may not be valid due to small sample size (n = 42).

100-199, and 200+ beds), ownership (for-profit vs. non-profit), and metropolitan location (MSA vs non-MSA).[12]

Statistical Analyses

To account for the stratified survey design, we conducted weighted analyses with the Surveyfreq and Surveylogistic procedures in SAS version 9.1 (SAS Institute, Cary, North Carolina). These procedures generate statistical estimates that reflect national prevalence of restraints and falls and fractures in US NHs. Multivariable logistic regressions were used to assess the associations of different types of restraints to falls and fractures among residents with or without either AD or dementia, controlling for a series of risk factors. Odds ratios and 95% confidence intervals (CI) were calculated. Statistical significance was based on a threshold of $P = .05$.

Results

Rate of Use of Physical Restraints and Bed Rails

The use of different types of restraints/devices is presented in Table 1. With regard to use of physical restraints, residents with either AD or dementia were more likely to be in trunk restraints than residents without the disease (5.64% vs 2.10%) and more likely to be placed in chairs that prevent them from rising (4.62% vs 2.07%). Overall, residents with either AD or dementia were more likely to be physically restrained (9.99% vs 3.91%).

With regard to use of bed rails, residents with either AD or dementia are less likely to have either full bed rails (13.13% vs 14.48%) or side rails (23.53% vs 25.92%), with an overall lower rate of either type of bed rail (35.06% vs 38.43%). On the whole, in 2004, the rate of physical restraint use among NH residents was 6.99% (95% CI: 6.50-7.49) and that of bed rails was 36.79% (95% CI: 36.09-37.49; see Table 1).

Resident Characteristics (Residents With LOS >180 Days)

As shown in Table 2, in comparison with residents without AD or dementia, residents with the disease were more likely to be older than 75 years, female, and white. They are less likely to be able to walk independently and make decisions on tasks of daily living independently. They are more likely to have behavioral problems and depressed mood, have more ADL impairment, be incontinent, take fewer medications, and live in an SCU. Moreover, they are more likely to use trunk restraints, and chair restraints, but less likely to use full bed rails. They were more likely to have falls over the past 180 days (36.31% vs 26.31%), with similar rates of fractures (2.16% vs 1.81%). Finally, they are less likely to be in for-profit NHs but more likely to be in NHs located in an MSA.

Restraint Use and Falls (LOS >180 Days)

As shown in Table 3, among residents with either AD or dementia, the use of trunk restraints was associated with higher risk of falls (adjusted odds ratio [AOR] =1.66, 95% CI: 1.21-2.27), and the use of full bed rails was associated with lower risk of falls (AOR = 0.67, 95% CI: 0.54-0.83). Similarly, in residents without AD or dementia, the use of full bed rails was protective of falls (AOR = 0.72, 95% CI: 0.56-0.94), while the use of chair restraints was marginally significant (AOR = 1.83, $P = .054$).

Restraint Use and Fractures (LOS >180 Days)

The association between different types of restraints and fractures is summarized in Table 4. Among residents with either AD or dementia, the use of trunk restraints was associated with higher risk of fractures (AOR = 2.77, 95% CI: 1.35-5.68). Other coefficients did not reach statistical significance at the conventional $P = .05$ level.

Discussion

This study estimated the use of different types of physical restraints in a national sample of NH residents and assessed their associations with falls and fractures among long-stay residents (LOS > 180). The study results show that US NHs are still relying on the use of physical restraints and bed rails for resident management. Moreover, the study results suggest that the use of trunk restraints was associated with higher risks of falls and fractures among residents with either AD or dementia, a finding not found among those without AD or dementia. The use of full bed rails seems to be protective of falls in NH residents, regardless of AD or dementia diagnosis.

Table 2. Descriptive Statistics of Residents With or Without Alzheimer's Disease or Dementia (LOS > 180 Days)

	Alzheimer's disease or Dementia	
	Yes (n = 5,057)	No (n = 4,224)
Variables	%[a] (SE)	%[a] (SE)
Resident characteristics		
Age		
<65	4.56 (0.35)[b]	18.51 (0.67)
65-74	8.20 (0.44)	14.40 (0.64)
75-84	32.09 (0.77)	27.30 (0.80)
85+	55.15 (0.81)	18.48 (0.86)
Female	77.33 (0.67)[b]	69.47 (0.83)
White	87.26 (0.51)[b]	83.99 (0.62)
Walking status		
Independent	15.91 (0.58)[b]	20.68 (0.70)
Need help	41.05 (0.80)	35.71 (0.86)
No walking	43.03 (0.81)	43.61 (0.89)
LOS (years)		
<2	45.75 (0.81)	47.44 (0.91)
2-3	29.66 (0.74)	27.14 (0.81)
≥4	24.59 (0.70)	25.42 (0.79)
ADL impairment[c]		
Minimal	5.21 (0.35)[b]	13.11 (0.59)
Moderate	11.89 (0.52)	14.75 (0.63)
Dependent	82.90 (0.60)	72.14 (0.79)
Decision-making on tasks of daily life		
Independent	5.40 (0.37)[b]	28.71 (0.79)
Modified independent	14.95 (0.58)	30.87 (0.82)
Moderately impaired	49.14 (0.81)	31.83 (0.83)
Severely impaired	30.50 (0.74)	8.59 (0.47)
Behavioral problem	38.19 (0.77)[d]	20.86 (0.71)
Incontinence	82.22 (0.62)[d]	66.05 (0.84)
Depressed mood	47.99 (0.77)[d]	39.81 (0.84)
No. of medications		
<7	35.06 (0.78)[b]	25.09 (0.78)
7-9	31.52 (0.77)	27.02 (0.81)
>=10	33.42 (0.76)	47.89 (0.88)
Residence in SCU	15.01 (0.55)[b]	1.38 (0.23)
Restraints		
Limb[d]	0.53 (0.13)	0.23 (0.09)
Trunk	5.62 (0.38)[b]	2.54 (0.26)
Chair restraints	4.77 (0.34)[b]	2.29 (0.27)
Full bed rails	13.12 (0.47)[b]	15.94 (0.59)
Side rails	22.90 (0.59)	24.74 (0.73)
Falls	36.31 (0.78)[b]	26.31 (0.78)
Fractures	2.16 (0.22)	1.81 (0.26)
Facility characteristics		
For profit	58.84 (0.52)[e]	61.55 (0.65)
Bed size		
<100	31.69 (0.43)	33.60 (0.55)
100-199	52.94 (0.52)	50.80 (0.66)
200+	15.37 (0.50)	15.60 (0.62)
MSA	75.26 (0.38)[f]	72.70 (0.49)

Abbreviations: SE, standard error; ADL, activities of daily living (transferring, eating, toileting, dressing, and bathing); LOS, length of stay; SCU, special care unit for Alzheimer's disease or dementia care; MSA, metropolitan statistical area.

[a] Weighted percentage.

[b] $P < .001$.

[c] Minimum: 0-1 ADL, moderate: 2-3 ADLs, dependent: 4-5 ADLs.

[d] Estimates may not be valid due to small sample size (<60).

[e] $P < .05$.

[f] $P < .01$.

Since the implementation of the Nursing Home Reform Act in the Omnibus Budget Reconciliation Act (OBRA) of 1987, the prevalence of physical restraints in NHs has been reduced.[17] For example, the prevalence of physical restraint use was 36% in 1988, 13.1% in 1998, and 8.86% in 2003.[18,19] Overall, our results show that the national prevalence of physical restraints was 6.99%, including 9.99% for residents with AD or dementia and 3.91% for residents without these cognitive limitations in 2004. Thus, our results indicate that NHs have made further progress toward minimum restraint use targets for the US NH population.[20,21] Recent Nursing Home Compare data indicate that an average of 3% of long-stay residents are physically restrained across all US NHs. Yet, there is widespread variability with 6.1% of NHs having greater than 10% of their residents restrained and 36.4% of NHs having no residents restrained.[22]

Our study results reveal that residents with either AD or dementia had higher usage of trunk and chair restraints. Of greater concern, they also had a higher rate of falls (36.31% vs 26.31%, $P < .001$) and a higher rate of fractures (though not significant at $P = .05$) than those without the disease. Restraints could be avoided in residents with dementia through better understanding of their unmet needs, regular assessment of their health status, and close surveillance.[23]

According to Centers for Medicare and Medicaid Services (CMS), side rails are restraints if they are used to prevent voluntarily getting out of bed.[24] Yet, there are limited national data on the prevalence of bed rail use in US NHs. Earlier studies reported a 62% of rate for use of bed rails (bilateral and side rails) in Connecticut NHs[25] and 58.7% in Pennsylvania NHs.[26] To our knowledge, our study is the first to provide a national estimate of the prevalence of bed rails use. Our results show that in 2004 the overall prevalence of bed rails use was 36.79% among all US NH residents. However, we do not know whether the use of bed rails has been increasing or decreasing in US NHs. Further, our study results show that the rate of use of bed rails (full bed rails and side rails) was lower among residents with AD or dementia than those residents without (35.06% vs 38.43%). It is well acknowledged that the side rails may serve as a reminder for cognitively intact residents to call for assistance when they want to get out of bed. Yet, for those with moderate-to-severe dementia, bed rails could be considered as barriers and could cause injuries of falls when residents try to exit.[27]

Our results, to some extent, reveal associations between use of different types of restraints and falls and fractures vary across residents with AD or dementia and those without. For example, the use of chair restraints was associated with higher risks of falls among residents without AD or dementia ($P < .1$), while the unadjusted and adjusted odds ratios show that trunk restraint was associated with higher risks of falls and fractures among residents with AD or dementia. In general, our results are consistent with previous research,[6,20,28-30] though most of them did not differentiate between residents with or without AD or dementia. For instance, 1 earlier study of Pennsylvania NHs found that physical restraints increased the likelihood of

Table 3. Multiple Logistic Regression Results of Association between Restraint Use and Falls Among Residents With or Without Alzheimer's or Other Dementia

	Alzheimer's disease or other Dementia			
	Yes (n = 5,057)		No (n = 4,224)	
Restraints	OR[a] (95% CI)	AOR[b] (95% CI)	OR[a] (95% CI)	AOR[b] (95% CI)
Limb[c]	NA	NA	NA	NA
Trunk	1.48 (1.11-1.98)[d]	1.66 (1.21-2.27)[d]	0.86 (0.50-1.48)	1.23 (0.66-2.37)
Chair restraints	1.21 (0.89-1.64)	1.14 (0.83-1.57)	1.07 (0.61-1.86)	1.83 (0.99-3.36)
Full bed rails	0.59 (0.49-0.71)[e]	0.67 (0.54-0.83)[e]	0.63 (0.51-0.79)[e]	0.72 (0.56-0.94)[f]
Side rails	0.99 (0.85-1.17)	0.96 (0.81-1.14)	1.04 (0.86-1.24)	1.00 (0.82-1.23)

Abbreviations: OR, odds ratio; AOR, adjusted odds ratio; CI, Confidence interval.
[a] Crude odds ratio.
[b] Adjusted odds ratio. Adjusted for resident characteristics: age, gender, race, walking status, length of stay (LOS), activities of daily living (ADLs) impairment, decision-making on tasks of daily life, behavioral problem, incontinence, depressed mood, number of medications, and residence in special care unit for Alzheimer's disease or dementia; facility characteristics: for profit, bed size, metropolitan statistical area (MSA) (see Table 1).
[c] The estimates for limb are not presented because they lack statistical power due to small sample size. They are available from authors.
[d] $P < .001$.
[e] $P < .01$.
[f] $P < .05$.

Table 4. Multiple Logistic Regression Results of Association between Restraint Use and Fracture Among Residents With or Without Alzheimer's or Other Dementia

	Alzheimer's disease or other Dementia			
	Yes (n = 5,057)		No (n = 4,224)	
Restraints	OR[a] (95% CI)	AOR[b] (95% CI)	OR[a] (95% CI)	AOR[b] (95% CI)
Limb[c]	NA	NA	NA	NA
Trunk	2.61 (1.33-5.14)[d]	2.77 (1.35-5.68)[d]	1.40 (0.39-5.05)	0.96 (0.23-3.93)
Chair restraints	1.65 (0.79-3.44)	1.80 (0.83-3.91)	0.83 (0.16-4.26)	0.44 (0.09-2.16)
Full bed rails	0.76 (0.40-1.45)	0.68 (0.35-1.33)	0.92 (0.45-1.86)	0.94 (0.42-2.11)
Side rails	0.94 (0.58 -1.52)	0.83 (0.50-1.37)	1.62 (0.94-2.77)	1.37 (0.80-2.36)

Abbreviations: OR, odds ratio; AOR, adjusted odds ratio; CI, Confidence interval.
[a] Crude odds ratio.
[b] Adjusted for resident characteristics: age, gender, race, walking status, length of stay (LOS), activities of daily living (ADLs) impairment, decision-making on tasks of daily life, behavioral problem, incontinence, depressed mood, number of medications, and residence in special care unit for Alzheimer's disease or dementia; facility characteristics: for profit, bed size, metropolitan statistical area (MSA) (see Table 1).
[c] The estimates for limb are not presented because they lack statistical power due to small sample size. They are available from authors.
[d] $P < .01$.

falls among confused and ambulatory residents.[31] More recently, using the Minimum Data Set (MDS) of 2004-2005, 1 study found physical restraints (limb, trunk, or chair restraints) contributed to falls and other adverse outcomes including ADL dependence, behavioral problems, and pressure ulcers.[28] Further, it is worthwhile to note that prior evidence also suggests that interventions to reduce restraints did not increase falls or fall-related injuries[32,33] and unrestrained residents tend to be less agitated, less fatigued, and more social.[34] For example, 1 study compared fall and injury rates in NH residents, and found that restraint removal significantly reduced minor injuries because of falls.[32]

Our results show that the use of full bed rails was protective of falls for residents with and without AD or dementia. Specifically, the use of full bed rails decreased the odds of falls by 33% and 28% for these 2 groups of residents, respectively. And the use of full bed rails was associated with lower risks of fractures, though not significant. Our findings are consistent with Doorn and colleagues' study, where they found that the use of bedrails was protective of falls. They also found that the use of a trunk restraint increased fall risk and the use of bed rails (both full and side rails) is associated with lower risk of fractures (though was not significant at $p = .05$)[4].

However, most literature on bed rails in NHs shows that a reduction of restrictive bed rails (both full and half rails) did not increase the risk of serious falls.[26,35-37] A recent study examined the effect of an advanced practice nurse consultation program on restrictive side rail usage. In the group whose restrictive side rails were removed, there was a significantly reduced fall rate, whereas in the group that continued to have

restrictive side rails, there was not a significantly reduced fall rate.[35] Still, other prior research found that residents were injured as a result of falls while attempting climbing over bed rails.[38]

Nevertheless, given the cross-sectional nature of our study, our results on the association of bed rails to falls and fractures should be interpreted with caution. We only examined the association of bed rails and 2 related outcomes—falls and fractures. But bed rails have been found to be correlated with other adverse outcomes including agitation, injuries, and death.[38-40] Thus, it is reasonable to hypothesize that bed rails may be protective of falls but may contribute to ADL dependence and depression in the meantime. Recent reviews on use of bed rails noted that the risk associated with the use of bed rails for falls and injuries is inconclusive.[41,42] Thus, an individualized assessment is necessary when applying these devices in NHs.[27]

To ensure the robustness of our results, we performed additional analyses. First, we examined the interactions of dementia status and the use of different types of restraints, controlling for other factors. These interactions were not significant in their associations with falls and fractures. Second, as post hoc sensitivity analyses, we performed stratified analyses. For instance, we examined the association of use of restraints and falls among the subgroup that needs help in walking. The results were similar to those results discussed above. Specifically, among residents with AD or dementia and needing help in walking, the use of trunk restraints was associated with higher risks (AOR = 1.63, 95% CI: 1.05-2.53) and the use of full bed rails was associated with lower risks of falls (AOR = 0.71, 95% CI: 0.53-0.93); whereas, among residents without AD or dementia but needing help in walking, the uses of trunk restraints (AOR = 0.68, 95% CI: 0.23-2.04) and full bed rails (AOR = 0.88, 95% CI: 0.65-1.18) were not significant (data not shown).

Several limitations of our study should be noted. First, all incidents of falls and fractures are reported by NH staff, so this could be subject to underreporting. Second, due to data limitations, we did not account for the intensity of physical restraint use (eg, daily use vs use less than daily), and we could not discern the intended use of bed rails (eg, enable bed movements or keep from getting out of bed).[12] Third, our measures of the outcomes are simply a binary indicator (yes/no), so they do not provide insight into the frequencies of falls and fractures. Fourth, though we included a series of confounders including resident and facility characteristics, we could not include other factors, such as nurse staffing levels, staff ratios, and psychotropic medications because they are not available in the 2004 NNHS public file. Fifth, a case of Alzheimer's disease or other dementia was identified through *International Classification of Diseases, Ninth Revision* (*ICD-9*) codes, and this could be also subject to underreporting. Last, the analyses were cross-sectional and causality cannot be determined.

Conclusions

Our results demonstrate that different types of restraints still remain a resident management tool in US NHs and there is a higher utilization of physical restraints and higher rates of falls and fractures among residents with either AD or dementia. More effort is needed to achieve physical restraint-free NHs, including additional resources to facilitate effective resident management strategies. The use of a trunk restraint is associated with higher risks for falls and fractures for residents with AD or dementia, while the use of full bed rails is protective of falls among residents with dementia. Given the special needs of residents with AD or dementia, the use of physical restraints on residents with a diagnosis of dementia should be avoided,[23,43] and an individualized assessment should be implemented to ensure the safety and quality of care for this special group of residents. Additional research is needed to understand resident outcomes when physical restraints and bedrails are used for different purposes.

Declaration of Conflicting Interests

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References

1. Alzheimer's Association. 2009 Alzheimer's disease facts and figures. *Alzheimers Dement*. 2009;5(3):234-270.
2. Hebert LE, Scherr PA, Bienias JL, Bennett DA, Evans DA. Alzheimer disease in the US population: prevalence estimates using the 2000 census. *Arch Neurol*. 2003;60(8):1119-1122.
3. Smith GE, Kokmen E, O'Brien PC. Risk factors for nursing home placement in a population-based dementia cohort. *J Am Geriatr Soc*. 2000;48(5):519-525.
4. Doorn CV, Gruber-Baldini AL, Zimmerman S, et al. Dementia as a risk factor for falls and fall injuries among nursing home residents. *J Am Geriatr Soc*. 2003;51(9):1213-1218.
5. Sullivan-Marx EM, Strumpf NE, Evans LK, Baumgarten M, Maislin G. Initiation of physical restraint in nursing home residents following restraint reduction efforts. *Res Nurs Health*. 1999;22(5):369-379.
6. Tinetti ME, Liu WL, Ginter SF. Mechanical restraint use and fall-related injuries among residents of skilled nursing facilities. *Ann Intern Med*. 1992;116(5):369-374.
7. Evans LK, Strumpf NE. Myths about elder restraint. *Image J Nurs Sch*. 1990;22(2):124-128.
8. Sullivan-Marx EM. Achieving restraint-free care of acutely confused older adults. *J Gerontol Nurs*. 2001;27(4):56-61.
9. Williams CC, Finch CE. Physical restraint: not fit for woman, man, or beast. *J Am Geriatr Soc*. 1997;45(6):773-775.
10. Miles SH, Irvine P. Deaths caused by physical restraints. *Gerontologist*. 1992;32(6):762-766.
11. Marcy-Edwards D. Bed rails. Is there an up side? *Can Nurse*. 2005;101(1):30-34.
12. Jones AL, Dwyer LL, Bercovitz AR, Strahan GW. The national nursing home survey: 2004 overview. *Vital Health Stat 13*. 2009;13(167):1-155.

13. Luo H, Fang X, Liao Y, Elliott A, Zhang X. Associations of special care units and outcomes of residents with dementia: 2004 national nursing home survey. *Gerontologist*. 2010;50(4): 509-518.
14. Decker FH. The relationship of nursing staff to the hospitalization of nursing home residents. *Res Nurs Health*. 2008;31(3):238-251.
15. Gruneir A, Lapane KL, Miller SC, Mor V. Is dementia special care really special? A new look at an old question. *J Am Geriatr Soc*. 2008;56(2):199-205.
16. Rubenstein LZ, Josephson KR, Robbins AS. Falls in the nursing home. *Ann Intern Med*. 1994;121(6):442-451.
17. Medicare and Medicaid; requirements for long term care facilities–HCFA. Final rule with comment period. *Fed Regist*. 1989;54(21):5316-5373.
18. Zinn JS. Market competition and the quality of nursing home care. *J Health Polit Policy Law*. 1994;19(3):555-582.
19. Capezuti E. Minimizing the use of restrictive devices in dementia patients at risk for falling. *Nurs Clin North Am*. 2004;39(3): 625-647.
20. Ejaz FK, Folmar SJ, Kaufmann M, Rose MS, Goldman B. Restraint reduction: can it be achieved? *Gerontologist*. 1994; 34(5):694-699.
21. Werner P, Koroknay V, Braun J, Cohen-Mansfield J. Individualized care alternatives used in the process of removing physical restraints in the nursing home. *J Am Geriatr Soc*. 1994;42(3): 321-325.
22. Centers for Medicare and Medicaid Services. Nursing Home Compare. http://www.medicare.gov/NHCompare. Accessed July 26, 2010.
23. Evans LK, Cotter VT. Avoiding restraints in patients with dementia: understanding, prevention, and management are the keys. *Am J Nurs*. 2008;108(3):40-49; quiz 50.
24. Health Care Financing Administration Medicare Department of Health and Human Services (DHHS). State operations manual provider certification transmittal 20. http://www.cmshhs.gov/manuals/pm_trans/R20SOM.pdf. Accessed January 29, 2010.
25. Tinetti ME, Liu WL, Marottoli RA, Ginter SF. Mechanical restraint use among residents of skilled nursing facilities. Prevalence, patterns, and predictors. *JAMA*. 1991;265(4):468-471.
26. Capezuti E, Maislin G, Strumpf N, Evans LK. Side rail use and bed-related fall outcomes among nursing home residents. *J Am Geriatr Soc*. 2002;50(1):90-96.
27. Capezuti E, Talerico KA, Strumpf N, Evans L. Individualized assessment and intervention in bilateral siderail use. *Geriatr Nurs*. 1998;19(6):322-330.
28. Castle NG, Engberg J. The health consequences of using physical restraints in nursing homes. *Med Care*. 2009;47(11):1164-1173.
29. Mion LC, Frengley JD, Jakovcic CA, Marino JA. A further exploration of the use of physical restraints in hospitalized patients. *J Am Geriatr Soc*. 1989;37(10):949-956.
30. Werner P, Cohen-Mansfield J, Braun J, Marx MS. Physical restraints and agitation in nursing home residents. *J Am Geriatr Soc*. 1989;37(12):1122-1126.
31. Capezuti E, Evans L, Strumpf N, Maislin G. Physical restraint use and falls in nursing home residents. *J Am Geriatr Soc*. 1996; 44(6):627-633.
32. Capezuti E, Strumpf NE, Evans LK, Grisso JA, Maislin G. The relationship between physical restraint removal and falls and injuries among nursing home residents. *J Gerontol A Biol Sci Med Sci*. 1998;53(1):M47-M52.
33. Castle NG, Mor V. Physical restraints in nursing homes: a review of the literature since the Nursing Home Reform Act of 1987. *Med Care Res Rev*. 1998;55(2):139-170; ; discussion 171-136.
34. Dunbar JM, Neufeld RR, Libow LS, Cohen CE, Foley WJ. Taking charge. The role of nursing administrators in removing restraints. *J Nurs Adm*. 1997;27(3):42-48.
35. Capezuti E, Wagner LM, Brush BL, Boltz M, Renz S, Talerico KA. Consequences of an intervention to reduce restrictive side rail use in nursing homes. *J Am Geriatr Soc*. 2007;55(3):334-341.
36. Hanger HC, Ball MC, Wood LA. An analysis of falls in the hospital: can we do without bedrails? *J Am Geriatr Soc*. 1999;47(5): 529-531.
37. Si M, Neufeld RR, Dunbar J. Removal of bedrails on a short-term nursing home rehabilitation unit. *Gerontologist*. 1999;39(5): 611-614.
38. Parker K, Miles SH. Deaths caused by bedrails. *J Am Geriatr Soc*. 1997;45(7):797-802.
39. O'Keeffe S, Jack CI, Lye M. Use of restraints and bedrails in a British hospital. *J Am Geriatr Soc*. 1996;44(9):1086-1088.
40. Miles SH. Deaths between bedrails and air pressure mattresses. *J Am Geriatr Soc*. 2002;50(6):1124-1125.
41. Healey F, Oliver D. Bedrails, falls and injury: evidence or opinion? A review of their use and effects. *Nurs Times*. 2009;105(26):20-24.
42. Healey F, Oliver D, Milne A, Connelly JB. The effect of bedrails on falls and injury: a systematic review of clinical studies. *Age Ageing*. 2008;37(4):368-378.
43. Evans LK, Strumpf NE. Tying down the elderly. A review of the literature on physical restraint. *J Am Geriatr Soc*. 1989;37(1): 65-74.