

Contractures in Frail Nursing Home Residents

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Contractures are a common but preventable consequence of prolonged physical immobility among nursing home residents. Significant for their associated costs in institutions rendering care to frail elder residents, contractures further reduce mobility and increase the risk of other outcomes of decreased mobility, such as pressure ulcers. This secondary analysis examines the prevalence of contractures in 273 residents who participated in an interventional study focusing on reducing restrictive siderails. Almost two thirds of the participants had at least 1 contracture, with the most common locations being the shoulder and knee. Presence of pain and being non-White were significant predictors of contracture presence. This study highlights the high prevalence of contractures, the underlying factors associated with them, and the need to prevent or minimize contracture formation, including the role restorative nursing care plays in this avoidable condition. (*Geriatr Nurs* 2008;29:259-266)

According to the 2005 Online Survey, Certification, and Reporting (OSCAR) data, 28.9% or approximately 386,000 nursing home residents across the United States have contractures.¹ These staggering numbers reflect a 20% increase in the rate of contractures since 1999. The percentage of facilities receiving deficiencies for not providing appropriate treatment and services to residents with limited range of motion was 6.6% in 2005, down from 9.7% in 1999. Although the OSCAR data about residents are based on aggregate resident characteristics, these depict an issue of significant magnitude among nursing home residents. Even more significant is that a contracture, defined as a lack of full active or passive range-of-motion due to joint, muscle, or soft tissue limitations is

often preventable² and is an important predictor of physical function change.³

Contractures occur as a result of prolonged immobility and inactivity.^{4,5} When an individual is restricted or limited in normal mobility, such as through a medically ordered bed or chair restriction, restraint use (including restrictive siderails), or lack of assistance to mobilize, range of motion in any of their joints, including fingers, wrist, elbows, shoulders, hips, knees, and ankles, can be affected.^{6,7} Joint contracture is the result of fibrosis of the skeletal muscle tissue attached to the bone. Over time, this fibrotic tissue builds up, causing shortening of the muscle fibers and a fixed resistance to passive stretch.^{2,8} Eventually, the immobile joint maintains a static position that causes painful movement and difficulty or inability with carrying out activities of daily living such as eating, bathing, and dressing. Although not an exhaustive list, immobility is associated with increased risk of osteoporosis, osteoarthritis, pressure ulcers, impaired cardiac performance (e.g., postural hypotension), pain, constipation, atelectasis, incontinence, and depression.^{2,5,9}

Although contractures are a common occurrence and can result in debilitating adverse consequences, little interventional research has been conducted in the nursing home setting to prevent their development. Interventions to minimize contractures that have been tested have primarily focused on prolonged stretch, or splinting, to increase or maintain range of motion.^{10,11} Randomized controlled trials conducted to improve physical function in frail nursing home residents have only shown modest improvements and are difficult to implement because residents often have multiple physical and cognitive comorbidities.^{12,13}

Given the limited research concerning contractures and associated factors in nursing home residents, we used data from a study ex-

aming the effect of an advanced practice nurse (APN) consultation on restrictive siderail usage reduction.^{14,15} This study aimed to quantify the presence of and factors associated with contractures among nursing home residents.

Methodology

Design, Participants, and Setting

This study was a descriptive correlational design using secondary data collected in an intervention study conducted in 4 medium-sized (range: 120–235 beds) nursing homes in the metropolitan Philadelphia area.^{14,15} First, observation methods were used to evaluate restrictive siderail usage in each nursing home. All residents identified with restrictive siderails (defined as 2 full-length or 4 half-length raised siderails) at baseline were eligible to participate in the primary study. A total of 276 residents (or their surrogate decision maker) consented and received individualized APN evaluations. Three participants refused to complete the evaluations, thereby demonstrating a lack of assent to participate, and were removed from the study. Thus, the final sample for this study was 273 participants. The study and written informed consent procedure was approved by the University of Pennsylvania Institutional Review Board.

Participant's demographic characteristics were gathered from medical records to ascertain information such as residents' age, sex, insurance or payor mechanism, comorbid health conditions, length of nursing home confinement, and treatment regimens (eg, restraint, psychoactive and pain medication usage). In addition, cognition was evaluated through resident interviews.¹⁶ The resident's primary nurse was interviewed to determine each resident's physical functional status,¹⁷ "life space,"¹⁸ cognitive level (for consent purposes), and presence of behavioral symptoms.¹⁹

The physical function subscale of the Psychogeriatric Dependency Rating Scale was used to measure overall functional status. With reported interrater reliability of .94,¹⁷ it measures the resident's ability to perform basic activities of daily living, degree of sensory impairment, and presence of urinary or fecal incontinence. Sixteen items are rated according to frequency of occurrence, degree of impairment, or level of assistance required. Total scores ranges from 0 to 39, with higher scores representing poorer

functional status. Life space—the extent of a resident's general mobility within the facility—was assessed using the 4-item Life-Space Diameter Scale with reported interrater reliability of .95 and test-retest reliability of .92.¹⁸ Each life-space item (movement within room and outside room, unit, and facility) is calculated as a composite of the frequency of times that level is attained and the degree of assistance required. Scores range from 0 (*complete bedrest*) to 40 (*independently leaving the facility daily*). The Mini-Mental State Examination (MMSE),¹⁶ a 30-item questionnaire, was used to test cognition. The MMSE has demonstrated evidence of intrarater reliability ($r = .89$),²⁰ interrater reliability ($r = .99$),²¹ and construct validity²² across diverse populations.²³ The Nursing Home Behavior Problem Scale¹⁹ is a 29-item inventory that relies on staff report of the frequency of specific behaviors. The interrater reliability, measured by the Pearson correlation coefficient, is approximately .80.¹⁹ The instrument has good face validity, as well as high convergent validity.

Finally, each resident was assessed by a gerontological APN using a standardized process.^{24,25} The APN examination included a detailed history and physical examination specific to each resident's level of transfer and mobility, fall risk, continence, mental status, and siderail usage. A neuromuscular examination elicited the resident's ability to perform active and passive range of motion in the major joints of the body, the presence or absence of a contracture in each defined joint, verbal and behavioral expressions of pain, and whether the resident could move around in bed (e.g., side to side or pull oneself up with or without siderails) or transfer in and out of bed, either independently or with assistance (i.e., with siderails).

Analysis

All analyses were conducted using SPSS for Windows version 15.0 (Chicago, IL). A P value $<.05$ was considered significant for all tests. First, descriptive statistics were used to characterize the participants in the study and the contracture prevalence. Inferential statistics such as chi-square and t tests were used to compare resident characteristics, treatment regimens, and performance abilities of those with and without contractures. The statistically signifi-

Table 1.
Prevalence of Contractures
(*n* = 273)

Contracture Prevalence	<i>n</i> (%)
Contracture present	167 (61.2)
Multiple contractures (≥ 2)	124 (45.4)
Upper extremity	143 (52.4)
Shoulder	120 (44.0)
Elbow	58 (21.2)
Wrist/hand	56 (20.5)
Lower extremity	132 (48.4)
Hip	73 (26.7)
Knee	120 (44.0)
Ankle/foot	53 (19.4)

Note: All values reported as frequency (%).

cant bivariate associations between these characteristics were included in a binary logistic regression analysis to more clearly identify the factors associated with the presence or absence of contractures among the participants studied.

Results

The mean age of all residents in the sample was 83.69 years (SD = 9.39). The majority were female (72%) and White (69%), and their payor source was Medicaid (65%). Table 1 presents the prevalence of contractures. A total of 480 contractures were identified. Over 60% of the sample ($n = 167$) had at least 1 contracture, with 45.4% having 2 or more contractures. The most frequent joints affected were the shoulder (44%) and the knee (44%).

Table 2 compares demographic, physical and mental health characteristics and comorbid conditions, and treatment regimen data in individuals with and without contractures. Neither age ($t = 1.175$; $df = 253$; $P = .241$) nor sex ($\chi^2 = .936$; $df = 1$; $P = .333$) was associated with contractures; however, non-Whites (72.9%) were significantly more likely than Whites (55.9%) to have contractures ($\chi^2 = 7.198$; $df = 1$; $P = .007$). Also, nursing home length of stay was significantly greater in those residents who had contractures ($t = 2.64$; $df = 254$; $P = .009$), and those on Medicaid were significantly more likely to have contractures ($\chi^2 = 5.457$; $df = 1$; $P = .019$).

Those participants who had a history of stroke, a diagnosis of urinary incontinence, and

who were physically restrained also had a significantly higher prevalence of contractures. Of individuals who experienced pain with range of motion during the musculoskeletal examination ($n = 48$) upon passive or active movement, only half were prescribed pain medication (ie, “as needed” or scheduled; $\chi^2 = 3.65$; $df = 1$; $P = .056$).

Functional status, the ability to move around the facility independently (life space), mobility, and cognition were all significantly lower among residents with a contracture compared with those without ($P < .001$). The presence of contractures was also significantly greater in residents requiring more assistance or in those who were unable to perform the functional performance tests (eg, ability to change position in bed) during the APN examination (Table 3).

In an attempt to more clearly determine the factors associated with contractures in the participants studied, we conducted a multistep regression analysis. First, the 16 resident characteristics (race, length of stay, Medicaid payor status, functional status, life space, mobility, pain, cognition, physical restraint, stroke, urinary incontinence) and functional performance measures (change position in bed, roll to either side, sit up in bed, transfer from bed to chair, transfer from bed to standing position) that were statistically significant in the bivariate associations were loaded into a linear regression model with contracture (presence or absence) as the outcome to assess for multicollinearity. From this, the 5 performance-based measures were eliminated because of high correlations with each other. The remaining variables were modeled into a logistic regression analysis (“Enter” method) against contracture (presence or absence) as the dependent variable. The model’s estimates fit the data at an acceptable level (Hosmer and Lemeshow test, $P = .177$). Statistically significant increased odds for both pain ($P = .001$) and minority race ($P = .009$) was noted (Table 4).

Discussion

This study identified a high prevalence of contractures among nursing home residents—twice the national average reported by Harrington and colleagues.¹ The participants in this study were selected based on siderail use for the primary study¹⁴ and thus represent cognitively aware

Table 2.
Difference in Baseline Characteristics by Postintervention Siderail Use Group

Characteristics	Overall (n = 273)	Contracture Present (n = 167)	Contracture not Present (n = 106)	P Value
Demographics				
Age*	83.69 (9.39)	83.13 (10.33)	84.55 (7.67)	.212
White	188 (68.9)	105 (62.9)	83 (78.3)	.002
Female	197 (72.2)	124 (74.3)	73 (68.9)	.333
Medicaid†	176 (64.5)	116 (69.5)	60 (56.6)	.019
Length of stay (in years)*	3.27 (3.33)	3.7 (3.51)	2.58 (2.91)	.009
Physical health				
Functional status‡**	24.29 (7.94)	25.72 (7.27)	21.91 (8.46)	.001
Life space§**	16.02 (8.64)	14.06 (8.33)	19.31 (8.19)	.001
Mobility *	14.88 (5.22)	16.39 (4.48)	12.38 (5.42)	.001
Fall risk¶*	48.01 (18.6)	46.32 (17.14)	50.84 (20.61)	.075
Pain during examination	81 (29.7)	70 (41.9)	11 (10.4)	.001
Mental health*				
Cognition#	13.52 (9.8)	11.92 (9.99)	16.29 (8.87)	.002
Behavioral symptoms**	5.15 (9.27)	4.56 (8.83)	6.11 (9.93)	.217
Treatment				
Physical restraint	23 (8.4)	20 (12)	3 (2.8)	.005
Psychoactive drug use	163 (59.7)	101 (60.5)	62 (58.5)	.744
Pain medication use	105 (38.5)	66 (39.5)	39 (36.8)	.652
Comorbidities				
Stroke	98 (35.9)	69 (41.3)	29 (27.4)	.019
Arthritis	75 (27.5)	52 (31.1)	23 (21.7)	.089
Fracture (any site)	68 (24.9)	40 (24)	28 (26.4)	.647
Urinary incontinence	225 (82.4)	147 (88)	78 (73.6)	.002

*All values are frequency (percentages) except where mean (SD) is noted.

†Medicaid refers to the percentage of residents for whom Medicaid was the primary payor of nursing home care.

‡Functional status was quantified with the physical function subscale of the Psychogeriatric Dependency Rating Scale; scores range from 0 to 39, and higher scores indicate poorer function.

§Life space was measured with the Life-Space Diameter Scale. Scores range from 0 (complete bedrest) to 100 (independently leaving the facility daily).

||Mobility assesses bed mobility, transfer ability and ambulation with scores ranging from 1 to 25, with higher scores indicating reduced mobility.

¶Fall risk was evaluated with the Morse Fall Scale; total scores range from 1 to 125, with scores greater than 44 indicating a high risk for falls.

#Cognition is measured with the Mini-Mental State Examination. Scores range from 0 to 30, with lower scores indicating poorer cognitive function.

**Behavioral symptoms were measured with the Nursing Home Behavior Problem Scale. Scores range from 0 to 116, with higher scores representing a greater number of behavioral symptoms.

residents who were still functionally able to transfer in and out of bed and also included cognitively impaired residents who were at risk for falls. Because this study did not follow individuals over time from admission to the nursing home, we cannot comment on incidence nor can we infer contracture causation from either resident characteristics or institutional practices. Furthermore, the 480 contractures we identified is a conservative number because our

coding process did not discriminate on which side (left, right, bilateral) the contracture was located. Contracture data were not collected from each resident's nursing home Minimum Data Set (MDS), thus we do not know whether the high prevalence found in this sample reflects inaccuracies in the MDS²⁶ or the focused physical assessment by the APNs.

Consistent with other studies,^{4,6,7,27} several participant characteristics were found to have

Table 3.
Presence of Contractures and Functional Performance

Ability to Perform Performance-based Tests*	Overall (n = 261)	Contracture Present (n = 161)	No Contracture (n = 100)	P Value
Change position in bed				
Independent/assistive device	100 (36.6)	43 (26.7)	57 (57)	.001
Requires human assistance	161 (59.0)	118 (73.3)	43 (43)	
Roll to either side				
Independent/assistive device	99 (36.3)	40 (24.8)	59 (59)	.001
Requires human assistance	162 (59.3)	121 (75.2)	41 (41)	
Sit up in bed				
Independent/assistive device	83 (30.4)	33 (20.5)	50 (50)	.001
Requires human assistance	178 (65.2)	128 (79.5)	50 (50)	
Transfer from the bed to a chair				
Independent/assistive device	50 (18.3)	16 (9.9)	34 (34)	.001
Human assistance/unable	211 (77.3)	145 (90.1)	66 (66)	
Transfer from the bed to a standing position				
Independent/assistive device	51 (18.7)	17 (10.6)	34 (34)	.001
Human assistance/unable	210 (76.9)	144 (89.4)	66 (66)	

Note: All values reported as frequency (percentage). Overall percentages do not equal 100% because there were 12 missing values (4.4%) from the data set for these performance-based tests. Chi-square P values are reported.

**Tests were conducted by the advanced practice nurse.*

been associated with contractures. Participants in our study with a physical restraint order were significantly more likely to have contractures. Those with contractures are likely to have lower functional levels and most likely to be unsafe for this reason; thus, staff members restrain residents on the basis of their belief that it protects them from injury. The functional changes might have occurred before the restraint was applied.

Neurological and psychological conditions such as stroke and dementia were significantly associated with presence of contractures. Findings show that spasticity can cause contractures after stroke, and weakness following stroke is a major contributor to upper limb limitation.²⁸ Contractures are common following stroke, especially in the shoulder. Shoulder contractures, present in 44% of the residents in this sample, make tasks such as eating, drinking, dressing, and hair combing more difficult for residents to perform.²⁹ Moreover, shoulder pain is a frequent complication following stroke³⁰ that further limits residents from performing self-care activities.

Our finding that those with urinary incontinence were more likely to have contractures is

new, although given that residents with contractures require more assistance with carrying out activities of daily living such as toileting,⁶ this finding is not surprising. Furthermore, greater dependence, measured by performance-based tests, as well as poorer physical health, was highly associated with the presence of contractures. Although not a statistically significant association with contractures in this sample, chronic musculoskeletal diseases such as arthritis and fracture were prevalent. Some contractures occur as a result of intrinsic structural changes associated with inflammation due to these conditions² and not entirely as a result of poor care provided to the resident.

The multivariable modeling identified that residents experiencing pain and those of non-White race (primarily African American) had significantly increased odds of contractures. There is sufficient evidence in the literature that racial disparities are present in care provided to nursing home residents, including secondary stroke prevention.³¹ These disparities are likely due to organizational or community factors that limit access to quality long-term care services.³² Of the 66 participants with contractures who

Table 4.
Multivariate Analysis of Contracture Predictors

Variable	Odds Ratio	95% Confidence Interval		P Value
non-White	3.573	1.377	9.272	.009
Medicaid*	1.951	.694	5.482	.205
Length of stay (years)	1.027	.912	1.156	.663
Functional status [†]	.939	.868	1.014	.110
Life space [‡]	.943	.884	1.006	.077
Mobility [§]	1.077	.955	1.214	.229
Pain during examination	6.788	2.194	21.000	.001
Cognition	.998	.948	1.051	.947
Physical restraint	4.078	.968	17.175	.055
Stroke	1.340	.574	3.128	.499
Urinary incontinence	2.623	.851	8.086	.093

*Medicaid refers to the percentage of residents for whom Medicaid was the primary payor of nursing home care.
[†]Functional status was quantified with the physical function subscale of the Psychogeriatric Dependency Rating Scale; scores range from 0 to 39, with higher scores indicating poorer function.
[‡]Life space was measured with the Life-Space Diameter Scale. Scores range from 0 (complete bedrest) to 100 (independently leaving the facility daily).
[§]Mobility assesses bed mobility, transfer ability, and ambulation; scores range from 1 to 25, with higher scores indicating reduced mobility.
^{||}Cognition is measured with the Mini-Mental State Examination. Scores range from 0 to 30 with lower scores indicating poorer cognitive function.

were receiving pain medication (“as needed” or scheduled), 44% of them reported pain during the APN musculoskeletal examination. Because the process of restoring range of motion can be painful, administering analgesia to the resident before range-of-motion exercises is imperative² in residents with continuing pain. One limitation of this study is that we did not collect complete data regarding participants’ pain medication regimens, thus we are unable to identify associations between the types (eg, nonnarcotic, opioid) or frequency of pain medications offered to residents.

Despite the numerous musculoskeletal problems and neurological issues that influence functional range, it is critical for nurses to optimize residents’ functional status in the face of these diseases. With appropriate care planning and identification of residents at greater risk for developing contractures, this unfortunate spiral can often be prevented. In addition to registered nurses, residents with contractures may benefit from interventions provided by a restorative nursing assistant,³³ physical therapist,²⁷ or physiatrist and include activities such as a walking and ambulation program,³⁴ active and passive range of motion,³⁵ soft tissue manipulation,³⁶ splinting,² in-

dividualized wheelchair seating,³⁷ transfers and bed mobility,³⁸ heat application,³⁹ and botulinum toxin type A administration.⁴⁰

Restorative nursing care is one of the most common means to prevent contractures in nursing home residents.³³ This philosophy of care is used to maximize the resident’s functional level to prevent further decreases in range of motion. Indeed, because of the high frequency of contractures in this study, almost two thirds of the primary study’s participants were recommended for a restorative nursing consult by the APN.¹⁵ Rather than having a referral completed, all residents should be assessed and considered from a restorative perspective on admission so that their functional level is optimized and maintained throughout.

Despite evidence that restorative nursing care is effective in maintaining physical mobility,⁴¹⁻⁴³ it is often seen as a compartmentalized part rather than a central tenet of nursing home care. For example, many nursing facilities employ a nursing assistant to be the restorative nursing assistant, rather than educate and train all staff in promoting residents’ functional independence. Implementation of an integrated, comprehensive restorative nursing care intervention

promotes independence and preserves function by encouraging residents to independently perform as many activities of daily living as possible rather than performing functions according to a restorative aide's schedule. The intervention is geared toward maximizing residents' abilities, which is strongly based in the caring interactions between the nursing assistant and the resident. An integrated restorative care model may also be more cost-effective because it can be costly for a nursing home to hire a staff person solely responsible for restorative care.⁴⁴

Restorative care not only maintains residents' physical function but also improves their social interaction, strengthens confidence, and improves quality of life. It also emphasizes the prevention of the consequences of immobility such as decreased appetite and cognition, venous thrombosis, learned dependence, and increased risk for falls.⁴⁵ Implementing a program for restorative nursing to reduce contractures and prevent immobility requires motivation of all members of the interdisciplinary care team.

Reduction in the usage of restrictive siderails is one change that is congruent with the philosophy of restorative care. A common reason for restrictive siderail use is as an assistive device to improve bed mobility (eg, turning side to side) while the resident is in bed. However, many residents with restrictive siderails may be too frail and immobile for the siderails to assist with bed mobility. In this study, shoulder contractures were one of the most common locations. Even if the resident with this type of contracture were still able to use the siderail for bed mobility, a shorter rail (two half-rails) might be just as effective, thus reducing the resident's risk of entrapment, as well as increasing his or her ability to transfer safely to a bedside commode to toilet independently.

Although this study included a relatively small sample of residents from 4 facilities within a single geographic area, it demonstrates that contractures are highly prevalent among nursing home residents. Further research on the prevalence and magnitude of contractures among nursing home residents is necessary. An important first step in addressing this problem is determining ways to implement health-promoting and health-restorative nursing best practices in all nursing homes so that high-risk individuals will maintain mobility and independence to the best of their ability. The combination of insurance reimbursement restrictions, staff knowledge, institu-

tional awareness, and available resources and a growing population of frail elders promises to be a challenge in preventing contractures from occurring in the first place.

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