Physical frailty and cognitive impairment in older adults in United States nursing homes

Supplemental Materials (A)

Method Supplement

Sample inclusion criteria

Nursing home residents were eligible if they were (1) newly-admitted between 01/01/2014 and 06/30/2016, (2) aged 65 years and over with life expectancy of six months or greater at admission, (3) stayed in the nursing home for 6 months or longer, and (4) had Minimum Data Set (MDS) 3.0 assessments at admission, 3 months and 6 months of nursing home stay.

"Newly-admitted" was defined as having no nursing home episodes during a 90-day look-back period before the given nursing home admission. MDS 3.0 admission assessment was used to determine residents' age and life expectancy.[1] Explicitly, the question "Does the resident have a condition or chronic disease that may result in a life expectancy of less than 6 months? (yes/no)" requires physician documentation[1] and was shown to be a strong indicator for 6-month mortality.[2,3] Focusing on the first 6 months of stay, we identified residents' 3-month and 6-month MDS 3.0 assessments as the ones respectively completed closet to 90 and 180 days after admission within a +/-31-day window. For the purpose of longitudinal follow-up, only those who had the 3-month and 6-month assessments were included. Finally, between 01/01/2014 and 06/30/2016, residents may have multiple nursing home episodes that met the aforementioned criteria. In such case, only the first episode was selected. The final sample included 571,139 older residents.

Measurement of cognitive impairment: Brief Interview for Mental Status (BIMS) and Cognitive Performance Scale (CPS)

In MDS 3.0, cognitive impairment can be measured either through the Brief Interview for Mental Status (BIMS; total score: 0-15) [4] when the resident can participate in the interview, or the Cognitive Performance Scale (CPS; total score: 0-6),[5] which is completed by the staff when the resident could not understand or refused BIMS. The current study combined and categorized the two scales following the measurement of cognitive impairment used by the Centers for Medicare & Medicaid Services in the Nursing Home Data Compendium: none/mild impairment (BIMS 13-15/CPS 0-2), moderate impairment (BIMS 8-12/CPS 3-4), and severe impairment (BIMS 0-7/CPS 5-6).[6]

Demographic characteristics

Demographics were assessed at admission: age groups, sex (male; female), race/ethnicity (non-Hispanic White; racial/ethnic minority, including American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian Other Pacific Islander, multi-racial, and Hispanic or Latino of any race), NH location (urban; rural), admission sources [community; acute hospital; other, including another NH/swing bed, psychiatric hospital, inpatient rehabilitation facility, facility for the mentally retarded or developmentally disabled (MR/DD facility), hospice, and other unspecified facilities].

Reference

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2. Ogarek JA, McCreedy EM, Thomas KS, Teno JM, Gozalo PL. Minimum Data Set Changes in Health, End-Stage Disease and Symptoms and Signs Scale: A Revised Measure to Predict Mortality in Nursing Home Residents. *J Am Geriatr Soc.* 2018;66(5):976-981. doi:10.1111/jgs.15305

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4. Saliba D, Buchanan J, Edelen MO, et al. MDS 3.0: Brief Interview for Mental Status. *J Am Med Dir Assoc.* 2012;13(7):611-617. doi:10.1016/j.jamda.2012.06.004

5. Morris JN, Fries BE, Mehr DR, et al. MDS Cognitive Performance Scale. *J Gerontol*. 1994;49(4):M174-82. Accessed April 6, 2019. http://www.ncbi.nlm.nih.gov/pubmed/8014392

6. Centers for Medicare & Medicaid Services. *Nursing Home Data Compendium 2015*.; 2015.

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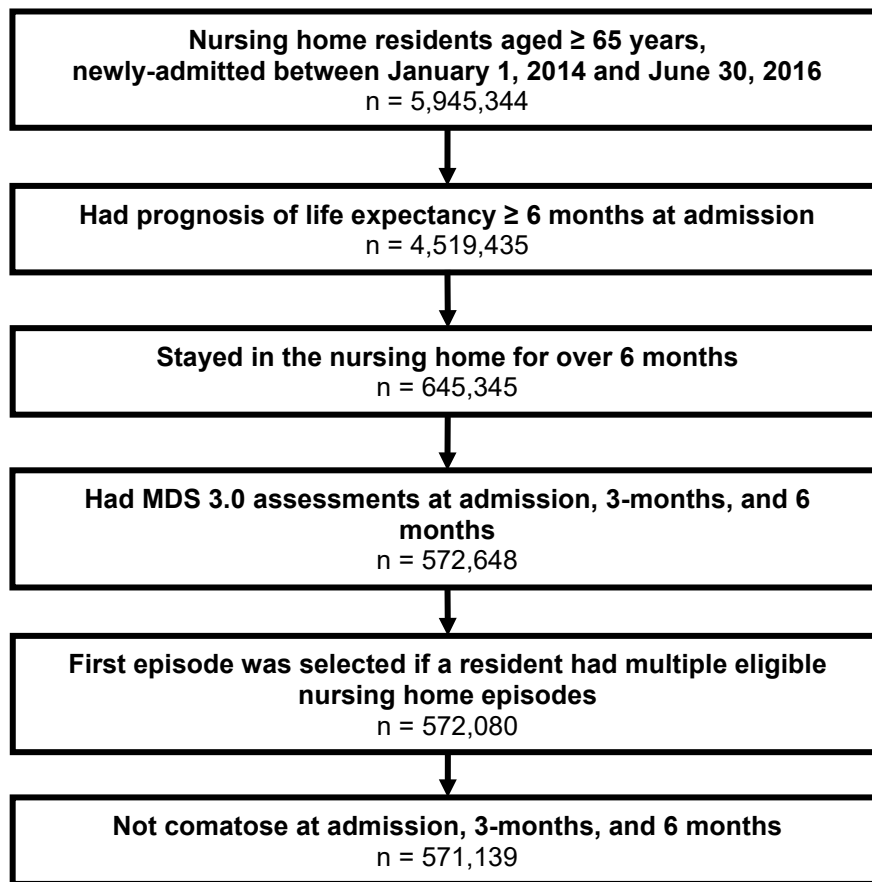
Supplemental Materials (B)

Supplementary Figure and Tables

Supplementary Figure S1. Sample selection flowchart

Supplementary Table S1. Items in the FRAIL-NH scale

Supplementary Table S2. Concurrent associations between physical frailty and cognitive impairment, demographic and clinical characteristics over time in newly-admitted, long-stay older nursing home residents

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┌─────────────────────────────────────────────────────────────┐
│           Nursing home residents aged ≥ 65 years,            │
│   newly-admitted between January 1, 2014 and June 30, 2016   │
│                       n = 5,945,344                          │
└─────────────────────────────────────────────────────────────┘
                              │
                              ▼
┌─────────────────────────────────────────────────────────────┐
│      Had prognosis of life expectancy ≥ 6 months at admission │
│                       n = 4,519,435                          │
└─────────────────────────────────────────────────────────────┘
                              │
                              ▼
┌─────────────────────────────────────────────────────────────┐
│            Stayed in the nursing home for over 6 months      │
│                        n = 645,345                           │
└─────────────────────────────────────────────────────────────┘
                              │
                              ▼
┌─────────────────────────────────────────────────────────────┐
│     Had MDS 3.0 assessments at admission, 3-months, and 6    │
│                           months                             │
│                        n = 572,648                           │
└─────────────────────────────────────────────────────────────┘
                              │
                              ▼
┌─────────────────────────────────────────────────────────────┐
│    First episode was selected if a resident had multiple     │
│              eligible nursing home episodes                  │
│                        n = 572,080                           │
└─────────────────────────────────────────────────────────────┘
                              │
                              ▼
┌─────────────────────────────────────────────────────────────┐
│    Not comatose at admission, 3-months, and 6 months         │
│                        n = 571,139                           │
└─────────────────────────────────────────────────────────────┘
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Supplementary Figure S1. Sample selection flowchart

Note. "Newly-admitted" was defined as having no NH episodes during a 90-day look-back period before the given NH admission. MDS 3.0 admission assessment was used to determine residents' age and life expectancy ["Does the resident have a condition or chronic disease that may result in a life expectancy of less than 6 months? (yes/no)]. Focusing on the first 6 months of stay, we identified residents' 3-month and 6-month MDS 3.0 assessments as the ones respectively completed closet to 90 and 180 days after admission within a +/-31-day window. For the purpose of longitudinal follow-up, only those who had the 3-month and 6-month assessments were included. Finally, for residents that may have multiple eligible NH episodes, only the first one was selected.

Supplementary Table S1. Items in the FRAIL-NH scale [1]

Items	Item Score			Items in MDS 3.0
	0	**1**	**2**	
Fatigue [b]	No (never or 1 day)	Yes (several days or everyday)	PHQ-9 >= 10	Section D Mood: D0300/D0600; D0200-D/D0500-D
Resistance [c]	Independent	With set-up only	Need physical assistance	Section G Functional Status: G0110B2
Ambulation [d]	Independent	With assistive device (walker/cane)	Cannot walk	Section G Functional Status: G0110E1; G0110F1; G0600A; G0600B; G0600C
Incontinence	None	Urinary incontinence only	Bowel incontinence	Section H Bladder and Bowel: H0300; H0400
Loss of weight	None	>= 5% in the past 3 months or >= 10% in the past 6 months	n/a [e]	Section K Swallowing/Nutritional Status: K0300
Nutritional approach	Regular diet	Mechanically altered diet	Require feeding tube	Section K Swallowing/Nutritional Status: K0500
Help with dressing	Independent	Need help with set up only	Need physical help	Section G Functional Status: G0110G2

Note.

[1] Kaehr EW, Pape LC, Malmstrom TK, Morley JE. FRAIL-NH predicts outcomes in long term care. J Nutr Health Aging. 2016;20(2):192-198. doi:10.1007/s12603-016-0682-5

[2] Based on residents' response to the Patient Health Questionnaire (PHQ-9; MDS 3.0 Section D: Mood).

[3] Measures if the resident needs assistance to be transferred from one location to another.

[4] Measures if the resident can walk in a room.

[5] This item will only receive a score of 0 or 1. A score of 2 is not applicable.

Supplementary Table S2. Concurrent associations between physical frailty and cognitive impairment, demographic and clinical characteristics over older residents' first six months of nursing home stay [1]

	Physical frailty at admission				Physical frailty at 3-month				Physical frailty at 6-month			
	Frail vs. Pre-frail/Robust		Frail/Pre-frail vs. Robust		Frail vs. Pre-frail/Robust		Frail/Pre-frail vs. Robust		Frail vs. Pre-frail/Robust		Frail/Pre-frail vs. Robust	
	aOR	95% CI	aOR	95% CI	aOR	95% CI	aOR	95% CI	aOR	95% CI	aOR	95% CI
Cognitive impairment [2] (ref: none/mild impairment)												
Moderate impairment	1.35	(1.33-1.37)	1.25	(1.22-1.27)	1.42	(1.40-1.43)	1.34	(1.32-1.36)	1.50	(1.48-1.51)	1.42	(1.39-1.44)
Severe impairment	1.74	(1.72-1.77)	1.58	(1.54-1.62)	1.96	(1.94-1.99)	1.84	(1.80-1.87)	2.24	(2.21-2.27)	2.10	(2.06-2.13)
Age (ref: ≥ 85 years)												
65 - <75 years	0.78	(0.77-0.79)	0.51	(0.50-0.52)	0.76	(0.75-0.77)	0.57	(0.56-0.58)	0.73	(0.72-0.74)	0.55	(0.54-0.56)
75 - <85 years	0.91	(0.89-0.92)	0.72	(0.71-0.74)	0.89	(0.88-0.90)	0.75	(0.74-0.77)	0.87	(0.85-0.88)	0.74	(0.73-0.76)
Female (ref: Male)	1.05	(1.04-1.07)	1.20	(1.18-1.23)	1.09	(1.07-1.10)	1.16	(1.14-1.18)	1.09	(1.07-1.10)	1.14	(1.13-1.16)
Racial/ethnic minority (ref: Non-Hispanic White)	1.25	(1.23-1.27)	1.16	(1.13-1.19)	1.30	(1.28-1.32)	1.29	(1.27-1.32)	1.27	(1.25-1.29)	1.27	(1.25-1.30)
Rural nursing home (ref: urban)	0.69	(0.68-0.70)	0.61	(0.59-0.62)	0.67	(0.66-0.68)	0.60	(0.59-0.61)	0.67	(0.66-0.68)	0.61	(0.60-0.62)
Admission source (ref: community)												
Acute hospital	2.87	(2.83-2.91)	4.62	(4.52-4.73)	2.01	(1.98-2.04)	2.22	(2.18-2.26)	1.78	(1.75-1.80)	1.90	(1.87-1.94)
Other	1.92	(1.89-1.96)	1.86	(1.82-1.91)	1.72	(1.69-1.75)	1.67	(1.63-1.70)	1.62	(1.59-1.65)	1.59	(1.55-1.62)
Diagnosed conditions (ref: without the given condition)												
Arthritis	1.01	(1.00-1.02)	1.11	(1.09-1.14)	1.02	(1.01-1.03)	1.11	(1.09-1.13)	1.04	(1.03-1.05)	1.10	(1.08-1.12)
Diabetes mellitus	1.11	(1.09-1.12)	1.16	(1.14-1.18)	1.13	(1.11-1.14)	1.17	(1.15-1.19)	1.14	(1.12-1.15)	1.20	(1.18-1.22)
Hypertension	0.98	(0.96-0.99)	1.02	(1.00-1.04)	0.96	(0.94-0.97)	1.01	(0.99-1.02)	0.97	(0.95-0.98)	1.00	(0.98-1.02)
Cancer	1.04	(1.01-1.07)	1.09	(1.05-1.13)	1.04	(1.02-1.07)	1.07	(1.03-1.10)	1.07	(1.05-1.10)	1.09	(1.05-1.12)
Cerebrovascular accident/TIA/stroke	1.79	(1.76-1.82)	1.94	(1.88-2.01)	1.74	(1.71-1.77)	1.86	(1.81-1.91)	1.70	(1.67-1.73)	1.81	(1.77-1.86)
Heart failure	1.10	(1.08-1.12)	1.27	(1.23-1.30)	1.09	(1.07-1.11)	1.20	(1.17-1.22)	1.09	(1.07-1.10)	1.19	(1.16-1.21)
Asthma/COPD/chronic lung disease	0.97	(0.95-0.98)	0.96	(0.94-0.99)	0.94	(0.93-0.96)	0.93	(0.91-0.94)	0.95	(0.93-0.96)	0.93	(0.91-0.95)
Dementia	0.93	(0.92-0.95)	0.85	(0.83-0.87)	0.96	(0.95-0.98)	0.91	(0.90-0.93)	0.98	(0.97-0.99)	0.93	(0.91-0.94)
Alzheimer's disease	0.92	(0.90-0.93)	0.84	(0.82-0.86)	0.99	(0.97-1.01)	0.95	(0.92-0.97)	1.00	(0.98-1.02)	0.95	(0.93-0.97)
Parkinson's disease	1.78	(1.73-1.83)	2.48	(2.36-2.60)	1.82	(1.78-1.87)	2.35	(2.26-2.45)	1.88	(1.83-1.93)	2.38	(2.29-2.48)
Anxiety disorder	0.95	(0.94-0.97)	0.92	(0.89-0.94)	0.92	(0.91-0.94)	0.91	(0.89-0.92)	0.91	(0.89-0.92)	0.88	(0.86-0.89)
Depression	1.07	(1.05-1.09)	1.10	(1.07-1.12)	1.07	(1.05-1.08)	1.09	(1.07-1.11)	1.07	(1.05-1.08)	1.10	(1.08-1.12)
Hip fracture	1.98	(1.91-2.04)	5.05	(4.54-5.61)	1.57	(1.52-1.62)	2.16	(2.06-2.27)	1.42	(1.38-1.46)	1.76	(1.69-1.84)
Other fracture	1.29	(1.26-1.32)	2.52	(2.38-2.67)	1.14	(1.12-1.17)	1.44	(1.40-1.49)	1.06	(1.04-1.08)	1.23	(1.19-1.27)
Osteoporosis	0.99	(0.97-1.01)	1.04	(1.01-1.07)	0.98	(0.97-1.00)	1.01	(0.99-1.04)	0.98	(0.97-1.00)	1.02	(1.00-1.05)
Multiple sclerosis	2.36	(2.15-2.59)	3.86	(3.24-4.60)	2.44	(2.24-2.67)	3.86	(3.33-4.47)	2.39	(2.19-2.61)	4.00	(3.47-4.63)
Seizure disorder/Epilepsy	1.32	(1.29-1.36)	1.37	(1.31-1.43)	1.31	(1.28-1.34)	1.33	(1.28-1.37)	1.31	(1.27-1.34)	1.31	(1.27-1.36)
Any presence of pain [2] (ref: no presence)	1.18	(1.17-1.19)	1.31	(1.29-1.33)	1.09	(1.08-1.10)	1.11	(1.09-1.12)	1.11	(1.10-1.12)	1.15	(1.13-1.16)
Receipt of psychotropic medication [2] (ref: no receipt)												
Antipsychotics	0.93	(0.92-0.95)	0.83	(0.82-0.85)	1.02	(1.01-1.03)	0.99	(0.97-1.00)	1.07	(1.05-1.08)	1.07	(1.05-1.09)
Antianxiety medications	1.07	(1.06-1.09)	1.09	(1.06-1.11)	1.13	(1.11-1.14)	1.15	(1.13-1.17)	1.16	(1.15-1.18)	1.17	(1.15-1.19)
Antidepressants	1.09	(1.07-1.10)	1.07	(1.05-1.10)	1.14	(1.13-1.16)	1.15	(1.13-1.17)	1.16	(1.15-1.18)	1.17	(1.15-1.18)
Hypnotics	0.95	(0.93-0.98)	0.94	(0.90-0.98)	0.97	(0.95-0.99)	0.97	(0.94-1.00)	0.96	(0.93-0.98)	0.97	(0.94-1.00)

Note. Abbreviation: TIA = transient ischemic attack; COPD = chronic obstructive pulmonary disease

[1] This supplementary table summarizes the estimates in Figure 1. Non-proportional odds model was used to examine the association between physical frailty and cognitive impairment, adjusting for covariates age group, sex, race/ethnicity, nursing home location, admission source, diagnoses (arthritis, diabetes mellitus, hypertension, cancer, cerebrovascular accident/transient ischemic attack/stroke, heart failure, asthma/chronic obstructive pulmonary disease/chronic lung disease, dementia, Alzheimer's disease, Parkinson's disease, anxiety disorder, depression, hip fracture, other fracture, osteoporosis, multiple sclerosis, seizure disorder/epilepsy), presence of pain, and receipt of psychotropic medications (antipsychotics, antianxiety medications, antidepressants, hypnotics).

[2] Time-varying variables (cognitive impairment, any presence of pain, receipt of psychotropic medications) were measured at admission, 3-month and 6-month. All other variables were time-invariant and measured at admission.