Long-Term Care Residents’ Geriatric Syndromes at Admission and Disablement Over Time: An Observational Cohort Study

Natasha E. Lane, PhD,1,2 Thérèse A. Stukel, PhD,1,2,3 Cynthia M. Boyd, MD,4,5,6 and Walter P. Wodchis, PhD1,2,7

1Institute of Health Policy, Management and Evaluation, University of Toronto, Ontario, Canada. 2Institute for Clinical Evaluative Sciences, Toronto, Ontario, Canada. 3Dartmouth Institute for Health Policy & Clinical Practice, Geisel School of Medicine at Dartmouth, Hanover, New Hampshire. 4Johns Hopkins School of Medicine, Baltimore, Maryland. 5Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland. 6Johns Hopkins Center on Aging and Health, Baltimore, Maryland. 7Institute for Better Health, Trillium Health Partners, Mississauga, Ontario.

Address correspondence to: Natasha E. Lane, PhD, Institute of Health Policy, Management and Evaluation, University of Toronto, 155 College St., 4th Floor, Toronto, Ontario MST 3M6, Canada. E-mail: natasha.lane@mail.utoronto.ca

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Abstract

Background: Disablement occurs when people lose their ability to perform activities of daily living (ADLs) like bathing and dressing, and is measured as the rate of increasing disability over time. We examined whether balance impairment, cognitive impairment, or pain among residents at admission to long-term care homes were predictive of their rate of disablement over the subsequent 2 years.

Methods: Linked administrative databases were used to conduct a longitudinal cohort study of 12,334 residents admitted to 633 long-term care (LTC) homes between April 1, 2011 and March 31, 2012, in Ontario, Canada. Residents received an admission assessment of disability upon admission to LTC using the RAI-MDS 2.0 ADL long-form score (ADL LFS, range 0–28) and at least two subsequent disability assessments. Multivariable regression models estimated the adjusted association between balance impairment, cognitive impairment, and pain present at admission and residents’ subsequent disablement over 2 years.

Results: This population sample of newly admitted Ontario long-term care residents had a median disability score of 13 (interquartile range [IQR] = 7, 19) at admission. Greater balance impairment and cognitive impairment at admission were significantly associated with faster resident disablement over 2 years in adjusted models, while daily pain was not.

Conclusions: Balance impairment and cognitive impairment among newly admitted long-term care home residents are associated with increased rate of disablement over the following 2 years. Further research should examine the mechanisms driving this association and identify whether they are amenable to intervention.

Keywords: Activities of daily living, Disability, Geriatric syndrome, Nursing homes

At the time of admission to a long-term care home (LTC, or nursing home), most residents need help with activities of daily living (ADLs) (1) and become more dependent on others for ADLs over time (2). Disability refers to residents needing help with ADLs measured at one point in time, while disablement refers to increasing disability over time (3). A recent cross-sectional study found that geriatric syndromes such as balance impairment, cognitive impairment, and pain, accounted for half of the between-resident differences in disability in a population sample (4). We hypothesized that in addition to these cross-sectional associations, balance impairment, cognitive impairment, and pain present at admission to an LTC would increase residents’ rate of disablement over time. Past studies of these geriatric syndromes’ association with disablement were conducted either in select subpopulations of LTC residents (5,6) or did not
account for the effect of baseline disability (5,7,8). It is therefore unclear whether balance impairment, cognitive impairment, and pain are simply acting as proxy measures for baseline disability, and whether their association with disability and disablenent is due to selection bias in restricted samples.

This study examines the independent associations of pain, balance, and cognitive impairment at admission and LTCH residents’ subsequent disablenent over 2 years in a population sample. Plausible mechanisms—such as medication side effects (9), activity restriction (10) or fear of falling (11)—may link these geriatric syndromes with disablenent and are amenable to intervention. Knowing whether residents with these common geriatric syndromes present at admission experience more rapid subsequent disablenent during their long-term care stay is important to guide future interventions that prevent or slow disablenent in LTCH residents.

Method

Study Cohort

We conducted a population-based longitudinal cohort study to determine the association between balance impairment, moderate to severe cognitive impairment, and daily pain (henceforth: balance impairment, cognitive impairment, and pain) at admission to long-term care with disablenent over 2 years. We enrolled all LTCH residents in Ontario, Canada, who were newly admitted to an LTCH and received a Resident Assessment Instrument Minimum Dataset 2.0 (RAI-MDS) admission assessment between April 1, 2011 and March 31, 2012. We then applied several exclusions (Supplementary Figure S1), such that residents included in the study sample had at least two subsequent RAI-MDS assessments in the LTCH that they were admitted to and had admission disability scores below the maximum score of 28. These exclusions allowed for longitudinal tracking of disablenent among residents following their admission.

Data Sources

Data for this study were drawn from health administrative databases containing information on all hospital admissions, physician visits, and LTC resident functional assessments. Because Ontario finances and regulates all licensed LTC care, the data represent a complete population cohort of LTCH residents. Data were linked at the Institute for Clinical Evaluative Sciences (ICES) using unique, anonymized identifiers. Data included the Canadian Institute for Health Information (CIHI) Discharge Abstract Database (DAD) to determine chronic conditions coded during hospital admissions, the Ontario Health Insurance Plan (OHIP) physician billings to determine diagnoses in physician claims, the Registered Persons Database (RPDB) for resident age and sex, and the CIHI Continuing Care Reporting System (CCRS) for baseline demographic characteristics and geriatric syndrome diagnoses as well as repeated resident disability measures obtained from RAI-MDS assessments (12). The RAI-MDS is a standardized, multidimensional assessment tool used in LTCs across Canada, the United States, and internationally (13). Trained LTC staff complete the assessments when residents are admitted to LTCH, every 90 days thereafter, and when there are any significant changes in resident health status (14). National and international evaluations have demonstrated that the RAI-MDS scales used to identify geriatric syndromes in this study are reliable (13) and valid (12). This study received ethics approval from the University of Toronto Office of Research Ethics and the Sunnybrook Health Sciences Research Ethics Board. Results are reported in accordance with the RECORD extension of the STROBE criteria for observational studies conducted in health administrative data (15).

Outcome

The primary outcome was the repeated measure of disability from RAI-MDS assessments. Resident disability was measured using the Activities of Daily Living Long-Form Score (ADL LFS) on a scale from 0 to 28 based on degree of dependence on others for bed mobility, transfer, locomotion, dressing, eating, toilet use, and personal hygiene. A one-point increase in ADL LFS indicates increased dependence in an ADL or dependence in a new ADL, both of which are associated with intensified care needs from LTCH staff (5). The ADL LFS has been validated against standardized measures of disability (16,17), is reliable and internally consistent (18,19), and responsive to changes in disability over time (5). Time was measured in months since the date of residents’ admission assessment.

Disablenent was measured using the ADL LFS treated as a continuous linear variable, as in previous research (4,20,21). Figure S2 shows the distribution of disability scores in sample residents at admission. Among individuals who died during the 2-year observation period, a final disability measure of 28 was imputed on the date of their death. This analytic treatment of missing data due to censoring has precedent in other longitudinal studies of disablenent (22,23) and aligns with extant knowledge on the rapid disablenent individuals experience in the month prior to death (24).

Geriatric Syndrome Exposures

Residents were classified as having balance impairment if during an admission test of balance from standing, they required partial physical support or were unable to balance from standing. This RAI-MDS balance assessment has been used to study balance impairment in older nursing home populations from several countries (7,21,25). Moderately severe to severe cognitive impairment was defined as RAI-MDS cognitive performance score of 4, 5, or 6, which is equivalent to a Mini-Mental State Exam (MMSE) score of seven or less (26). Residents who reported daily or severe daily pain were classified as having pain at admission (27).

Covariates

Sociodemographic characteristics, 16 coexisting chronic conditions that had been treated or affected medical management in the 5 years prior to admission, and six additional geriatric syndromes (bowel incontinence, urinary incontinence, hearing impairment, visual impairment underweight BMI, and pressure ulcer) prevalent at admission were included as covariates in multivariable models (Supplementary Tables S1 and S2).

Statistical Analyses

The unit of analysis was the individual resident. Nested hierarchical linear regression models were used to assess the relationship between disablenent and the geriatric syndrome exposures, controlling for baseline disability, sociodemographic characteristics, time in months since admission, chronic conditions, and the additional geriatric syndromes. The effects of the geriatric syndrome exposures on disablenent were estimated through interactions between these geriatric syndromes and time, controlling for the interaction between baseline disability and time (Supplementary Appendix Equation 1). The latter interaction was included to enable assessment of the incremental effect of geriatric syndrome exposures beyond the effect of disability.
on disablement. The models accounted for nesting of time within residents and residents within LTCHs by including random effects for LTCH and resident (Supplementary Table S3). The assumptions of normally distributed random effects and residual errors were confirmed, and a quadratic term for time was tested. Regression modeling was performed using STATA xtmixed (28).

**Sensitivity Analyses**

The prevalence of the geriatric syndrome exposures among those who subsequently died were examined, as were characteristics of residents excluded because they had fewer than two postadmission RAI-MDS assessments. We also examined the impact of imputation of a final disability score of 28 among those who died as well as rerunning the analysis, excluding residents who died during follow-up.

**Results**

**Resident Characteristics**

A total of 12,334 residents from 633 Ontario LTCHs were included in the study (Table 1). The mean disability score at admission was 13.0 (SD: 7.2); mean age was 84.1 years (SD: 7.2) and 67.7% were female. Residents had a median of nine assessments (interquartile range [IQR]: 7, 9) in the observation period, including their admission assessment. The median number of days between assessments was 90.5 (IQR: 85.0, 91.0).

A total of 4,213 (34%) residents died during follow-up; the geriatric syndrome exposures were more prevalent among decedents (Supplementary Table S4). Similarly, residents excluded because they had fewer than two postadmission assessments also had higher prevalence of geriatric syndrome exposures (Supplementary Table S4), higher baseline disability and increased prevalence of most chronic conditions (Supplementary Table S5).

**Main Results**

Table 2 reports the association of disablement with balance impairment, cognitive impairment, and pain present at admission, the geriatric syndrome exposures, adjusted for baseline disability, demographic characteristics, chronic conditions, and other geriatric syndromes. Higher ADL LFS equates to more disability; thus, positive regression coefficients indicate a higher rate of disablement over time. Balance impairment (0.42, 95% CI: 0.28, 0.56) and cognitive impairment (0.85, 95% CI: 0.66, 1.03) were both associated with slightly higher disability, whereas daily pain was not. Balance impairment at admission was associated with an average 0.04 (95% CI: 0.02, 0.06) monthly increase in residents’ ADL LFS over 2 years; cognitive impairment also increased rate of disablement by 0.08 (95% CI: 0.06, 0.10) per month. Daily pain present at admission was conversely associated with a small decrease in residents’ rate of disablement (−0.03, 95% CI: −0.05, −0.01) over 2 years. Full model estimates, including coefficients for adjustment variables, are available in Supplementary Table S3.

Figure 1 is based on the estimates in Table 2, and illustrates differences in admission disability and disablement over 2 years in Ontario LTCH residents. The reference rate of disablement (+0.56 ADL LFS points/month, 95% CI: 0.54, 0.58) was estimated as the mean monthly rate (slope) of increasing disability in residents with no balance impairment, cognitive impairment or pain at admission, adjusted for all other model covariates. The association of balance impairment, cognitive impairment, and pain with disablement were interpreted as the incremental effects of each exposure on the reference rate of disablement. In addition to their association with higher disability, both balance impairment and cognitive impairment were associated with significantly increased rates of disablement over 2 years. Adjusting for all variables, residents who were admitted to an LTCH with balance impairment had ADL LFS scores an average of 1.38 points higher 2 years later than ones with no balance impairment at admission. Similarly, residents admitted with moderate severe to severe cognitive impairment had average ADL LFS scores 2.77 points higher 2 years later than those with moderate, mild or no cognitive impairment at admission. In contrast, residents admitted to LTCH with daily pain experienced slightly slower rates of disablement than residents with no pain or nondaily pain at admission and had an average ADL LFS score 0.77 points lower 2 years postadmission.

**Discussion**

A population-based sample of 12,334 newly admitted Ontario LTCH residents experienced disablement over the course of 2 years. Balance impairment and cognitive impairment were associated with higher baseline disability and increased rate of disablement over 2 years in adjusted models, whereas pain was not. We found balance impairment and cognitive impairment present at residents’ admission to long-term care were associated with increased rate of disablement over 2 years, independent of baseline disability, sociodemographic characteristics, six prevalent geriatric syndromes (bowel incontinence, urinary incontinence, hearing impairment, visual impairment underweight BMI, and pressure ulcer) and 16 prevalent chronic conditions. These findings from a population sample enhance our understanding of the independent role balance impairment and cognitive impairment may play in increasing LTCH residents’ disablement over time.

We hypothesized that balance impairment, cognitive impairment, and pain present at admission to a LTCH would increase disablement in residents, independent of their baseline ADL disability. We posited that this may occur through a variety of mechanisms, such as activity restriction due to balance impairment and fear of falling (10,11), discomfort with movement due to pain (29), lack of comprehension or motivation to maintain activity (30,31), or medication side effects (9) associated with cognitive impairment. We did not test these mechanisms directly.

Given the breadth of covariates adjusted for in the multivariable analysis, it is unsurprising that balance and cognitive impairment were associated with relatively modest increases in the rate of residents’ disablement. Furthermore, although our study only accounted for these geriatric syndrome exposures at admission to LTCH, differences in residents’ rate of disablement persisted over the subsequent 2 years. Even small differences in the rate of disablement are...
**Table 1. Ontario LTCH Resident Characteristics at Admission to Long-Term Care**

| Category                                      | N  | %    | Mean ADL LFS (SD) at Admission |
|-----------------------------------------------|----|------|-------------------------------|
| **Study Cohort**                              |    |      |                               |
| Age (years)                                   |    |      |                               |
| 65–74                                         | 1,321 | 10.7 | 12.9 (7.5)                    |
| 75–84                                         | 4,580 | 37.1 | 12.7 (7.2)                    |
| 85–94                                         | 5,697 | 46.2 | 13.0 (7.2)                    |
| 95+                                           | 736  | 6.0  | 14.3 (7.0)                    |
| **Sex**                                       |    |      |                               |
| Female                                        | 8,348 | 67.7 | 12.9 (7.2)                    |
| Male                                          | 3,986 | 32.3 | 13.0 (7.3)                    |
| **Marital Status**                            |    |      |                               |
| Married                                       | 3,713 | 30.1 | 13.5 (7.3)                    |
| Widowed                                       | 6,870 | 55.7 | 12.7 (7.2)                    |
| Never married/Separated/Divorced              | 1,518 | 12.3 | 12.5 (7.3)                    |
| Missing                                       | 233  | 1.9  | 13.3 (7.2)                    |
| **Pre-NH Neighborhood Income Quintile**       |    |      |                               |
| 1 (low)                                       | 2,830 | 22.9 | 12.4 (7.3)                    |
| 2                                             | 2,306 | 18.7 | 13.2 (7.2)                    |
| 3                                             | 2,039 | 16.5 | 13.1 (7.2)                    |
| 4                                             | 1,786 | 14.5 | 13.1 (7.2)                    |
| 5 (high)                                      | 1,551 | 12.6 | 13.3 (7.1)                    |
| Missing                                       | 1,822 | 14.8 | 13.0 (7.4)                    |
| **Geriatric Syndrome Exposures**              |    |      |                               |
| Balance impairment                            | 7,790 | 63.2 | 15.6 (6.7)                    |
| Cognitive impairment                          |    |      |                               |
| Intact or borderline                          | 3,309 | 26.8 | 11.3 (7.6)                    |
| Moderate impairment                           | 7,246 | 58.8 | 12.6 (6.8)                    |
| Moderate-severe/very severe impairment         | 1,779 | 14.4 | 17.5 (6.3)                    |
| Pain                                          |    |      |                               |
| No pain                                       | 7,169 | 58.1 | 12.4 (7.2)                    |
| Less than daily pain                          | 3,095 | 25.1 | 13.5 (7.0)                    |
| Daily or severe daily pain                    | 2,070 | 16.8 | 14.1 (7.3)                    |
| **Other Geriatric Syndromes**                 |    |      |                               |
| Bowel incontinence                            | 3,746 | 30.4 | 18.3 (5.6)                    |
| Hearing impaired                              | 1,762 | 14.3 | 13.9 (6.9)                    |
| **BMI**                                       |    |      |                               |
| BMI < 18.5                                    | 1,251 | 10.1 | 14.8 (7.2)                    |
| 18.5 ≤ BMI ≤ 25                               | 5,583 | 45.3 | 13.0 (7.2)                    |
| 25 < BMI ≤ 30                                 | 3,353 | 27.2 | 12.2 (7.2)                    |
| BMI ≥ 30                                      | 2,145 | 17.4 | 13.0 (7.2)                    |
| Pressure ulcer                                | 662  | 5.4  | 18.8 (5.7)                    |
| Urinary incontinence                          | 6,878 | 55.8 | 16.0 (6.2)                    |
| Visual impairment                             |    |      |                               |
| Moderate impairment                           | 4,131 | 33.5 | 13.9 (7.0)                    |
| Severe impairment                             | 588  | 4.8  | 16.6 (7.1)                    |
| **Chronic Conditions**                        |    |      |                               |
| Arthritis                                     | 5,897 | 47.8 | 13.4 (7.2)                    |
| Asthma                                        | 688  | 5.6  | 13.4 (7.1)                    |
| Cancer                                        | 4,305 | 34.9 | 12.9 (7.3)                    |
| Kidney disease                                | 2,479 | 20.1 | 14.2 (7.2)                    |
| Coronary artery disease                       | 4,303 | 34.9 | 13.2 (7.3)                    |
| COPD                                          | 1,974 | 16.0 | 12.9 (7.3)                    |
| Dementia                                      | 8,572 | 69.5 | 13.1 (7.2)                    |
| Diabetes                                      | 3,664 | 29.7 | 13.4 (7.2)                    |
| Epilepsy                                      | 426  | 3.5  | 14.3 (7.2)                    |
| Heart failure                                 | 2,703 | 21.9 | 13.9 (7.2)                    |
| Limb paralysis or amputation                  | 1,802 | 14.6 | 12.9 (7.0)                    |
| Mood disorders                                | 1,941 | 15.7 | 13.1 (7.4)                    |
| Parkinson’s disease                           | 896  | 7.3  | 16.0 (6.6)                    |
| Peripheral vascular disease                   | 440  | 3.6  | 13.3 (7.0)                    |
| Psychiatric conditions other than depression  | 2,661 | 21.6 | 13.4 (7.2)                    |
| Stroke                                        | 2,517 | 20.4 | 15.2 (7.1)                    |

*Note: ADL = Activities of daily living; BMI = Body mass index; COPD = Chronic obstructive pulmonary disease; LFS = Long form score; LTCH = Long-term care home; NH = Nursing home.*
The median 2-year follow-up period in this study also afforded an important long-term view of associations between balance and cognitive impairment with disablement in LTCH residents. For example, Burge et al. found that both balance and cognitive impairment were associated with increased hazard of a dichotomous ADL “decline” outcome in 10,199 nursing home residents (7); Wang et al. found that balance dysfunction was independently associated with loss of independence in personal hygiene and toileting in 4,942 Minnesota nursing home residents, whereas pain was not associated with disablement in any ADLs (21). But because these studies examined predictors of disablement over 8–12 months, the longer-term impact of being admitted with one of these geriatric syndrome exposures could not be determined. In our study, the median frequency and intervals between...
RAI-MDS assessments indicate that the vast majority of those who survived were followed for the full 2 years. LTCH residents’ length of stay varies across countries and sociodemographic characteristics (32,33); in the United States, the mean length of stay is 1.1 years (33), compared to 2 to 3 years in Canada, England, and Switzerland (32,34,35). Findings from the present study are more generalizable that past research for care planning among newly admitted LTCH residents in populations where the majority of LTCH residents live 2 years or more after admission.

A major strength of our study was the use of data from a representative population cohort of newly admitted LTCH residents in a single-payer health system. Second, we tracked changes in a validated measure of disability over multiple time points using robust statistical models. Third, we also used validated administrative claims data to adjust for the effects of comorbidities. Fourth, unlike other studies of these relationships, ours tracked residents after their admission and did not exclude anyone based on comorbidities.

Our study was subject to some limitations. First, our requirement that residents have at least two subsequent assessments after admission may have caused selection bias. However, we provided information on the characteristics of these excluded subjects so that the likely effects of their exclusion could be assessed. Second, 34% of the sample died during the follow-up period, but sensitivity analyses revealed a minimal impact of this on findings, other than balance impairment which was not associated with disability in the healthier subset of residents in a complete case analysis.

A third limitation is that the ADL IES measure may be relatively insensitive to changes in disability as residents approach the higher range of the scale (36). In our study, this would lead to potential underestimation of disablement, rendering our findings conservative estimates of potentially larger true relationships. Fourth, the psychometric properties of the RAI-MDS balance assessment have not been formally assessed; however, it has high face validity and has been widely used in studies of balance impairment in LTC populations (7,21,25). Fifth, the Ontario Ministry of Health reimburses LTCHs more to care for residents who are more disabled; this potentially incentivizes operators to code residents as having higher levels of disability over time; however, this equally affects residents with and without the geriatric syndrome exposures in this study.

Future research needs to examine the mechanisms linking cognitive and balance impairment at admission with LTCH residents’ rate of disablement over the subsequent 2 years. Studies can examine the allocation of resources among persons with these and other geriatric syndromes to identify which are most responsible for ameliorating the effect of geriatric syndromes on subsequent disablement, as well as intervening events (ie, hospitalizations) that worsen the trajectory of disablement. Studies of interventions to improve balance or cognitive function in LTCH residents could also enhance the evidence base by measuring rate of disablement as an outcome.

Balance impairment and cognitive impairment among newly admitted LTCH residents are associated with increased rate of disablement over the following 2 years. Future research must elucidate the mechanisms driving these potentially causal associations so that appropriate action can be taken to slow disablement in LTCH residents.

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**Conflict of Interest**

None reported.

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**Supplementary Material**

Supplementary data is available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.
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