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Original Research Article

Hearing and Cognitive Impairments Increase the Risk of Long-term Care Admissions

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Abstract

Background and Objectives: The objective of the study was to understand how sensory impairments, alone or in combination with cognitive impairment (CI), relate to long-term care (LTC) admissions.

Research Design and Methods: This retrospective cohort study used existing information from two interRAI assessments; the Resident Assessment Instrument for Home Care (RAI-HC) and the Minimum Data Set 2.0 (MDS 2.0), which were linked at the individual level for 371,696 unique individuals aged 65+ years. The exposure variables of interest included hearing impairment (HI), vision impairment (VI) and dual sensory impairment (DSI) ascertained at participants' most recent RAI-HC assessment. The main outcome was admission to LTC. Survival analysis, using Cox proportional hazards regression models and Kaplan–Meier curves, was used to identify risk factors associated with LTC admissions. Observations were censored if they remained in home care, died or were discharged somewhere other than to LTC.

Results: In this sample, 12.7% of clients were admitted to LTC, with a mean time to admission of 49.6 months (*SE* = 0.20). The main risk factor for LTC admission was a diagnosis of Alzheimer's dementia (HR = 1.87; CI: 1.83, 1.90). A significant interaction between HI and CI was found, whereby individuals with HI but no CI had a slightly faster time to admission (40.5 months; HR = 1.14) versus clients with both HI and CI (44.9 months; HR = 2.11).

Discussion and Implications: Although CI increases the risk of LTC admission, HI is also important, making it is imperative to continue to screen for sensory issues among older home care clients.

Translational Significance: Risk factors for long-term care (LTC) admission has been well document; however, little is known about how sensory impairments, alone or in combination with cognitive impairment, relate to LTC admissions. There appears to be a link between hearing impairment and the risk of admission to LTC.

Keywords: Dual sensory impairment, Hearing impairment, interRAI, Vision impairment

The percentage of Canadians 65 years of age and older who live in a residential care home or long-term care (LTC) home is 7%, whereas the percentage of those over 85 years of age is around four times higher (ie, 30%; Garner, Tanuseputro, Manuel, & Sanmartin, 2018). Older adults admitted to LTC experience multiple losses including the loss of independence (Paque, Goossens, Elseviers, Van Bogaert, & Dilles, 2017), a reduction in social interactions with friends and family (Bonifas, Simons, Biel, & Kramer, 2014), and a loss of autonomy (Kehyayan, Hirdes, Tyas, & Stolee, 2015), all of which can precipitate loneliness (Prieto-Flores, Forjaz, Fernandez-Mayoralas, Rojo-Perez, & Martinez-Martin, 2011). Evidence shows that the majority of older adults prefer to "age in place" and remain in their own homes for as long as possible (Wiles, Leibing, Guberman, Reeve, & Allen, 2012), and home care is provided to roughly two million Canadians, of whom, about 40% are aged 65 years and older (Sinha & Bleakney, 2014). The LTC home is often viewed as imposing constraints on daily life, and the very nature of being required to share a space, makes this an undesirable destination for some (Gaugler, Duval, Anderson, & Kane, 2007). The transition into LTC also can lead to anxiety among the person's spouse/partner (Schulz et al., 2004).

The study of risk factors for admission into LTC has a long history and is well-documented (Harrison et al., 2017). Key factors frequently cited include advanced age (Andel, Hyer, & Slack, 2007), being unmarried (Cepoiu-Martin, Tam-Tham, Patten, Maxwell, & Hogan, 2016), exhibiting dementia/probable dementia (Greiner et al., 2014), showing responsive behaviors (eg, verbally abusive, wandering; Gaugler et al., 2011), demonstrating impairment in activities of daily living (ADLs; eg, eating, bathing, dressing), and instrumental ADLs (IADLs; eg, using the telephone, managing finances; Verbeek et al., 2015), and having a caregiver that is experiencing stress (Cepoiu-Martin, et al., 2016). Four published studies have evaluated the contribution of sensory impairments to the risk of LTC admission (Klein, Klein, & Lee, 1996; Tomiak, Berthelot, Guimond, & Mustard, 2000; Wang, Mitchell, Cumming, & Smith, 2009; Young, Forbes, & Hirdes, 1994). Among these, two are Canadian (Tomiak, et al., 2000; Young, et al., 1994). A recent review and meta-analysis of predictors of LTC admission in individuals with dementia (Cepoiu-Martin, et al., 2016) cited only one Canadian study (Hebert, Dubois, Wolfson, Chambers, & Cohen, 2001), which did not explore sensory impairments and risk for institutionalization.

Impairments in hearing and vision are very prevalent among older adults (Feder, Michaud, Ramage-Morin, McNamee, & Beauregard, 2015). Age-related hearing impairment (HI) and vision impairment (VI) were, in 2015, among the top burdens of disease among middle- and high-income countries (Global Burden of Disease 2015 Collaborators, 2016). HI and VI are related to poor self-rated health (Choi et al., 2015), difficulties with ADLs/IADLs (Chen et al., 2015), problems with memory (Choi et al., 2015) and reduced social participation (Laliberte Rudman et al., 2016). In our previous cross-sectional work we found that, compared to home care clients with only cognitive impairments (CIs) but no sensory impairments, individuals with both CI and HI and VI, or a dual sensory impairment (DSI) were rated as being more impaired in their functional abilities and in their decision-making and communication skills (Guthrie et al., 2018).

Risk factors for LTC admission are well-described in the literature; however, sensory impairments have generally not been considered. As such, we set out to fill this gap by exploring how sensory impairments alone, or in combination with CI, relate to LTC admissions in a sample of Ontario home care clients. We anticipated that several factors in conjunction with sensory impairments would increase the risk of LTC placement including being older, being unmarried, having a caregiver experiencing stress and functional impairments (ie, ADLs, IADLs).

Research Design and Method

Study Design

This retrospective cohort study utilized secondary data collected using the Resident Assessment Instrument for Home Care (RAI-HC) in Ontario. The RAI-HC is a standardized assessment being used routinely for all long-stay home care clients who are expected to receive at least 60 days of care in their home (Ministry of Health and Long-Term Care, 2007). Home care offers an array of services including health promotion, rehabilitation, support and maintenance and end-of-life care, which is available for all ages of individuals in Canada. Across Canada, the policies, services and delivery of home care is quite varied in response of the needs and resources available in each province. The overall level of care

that is provided to an individual is based on an assessment of their needs (Canadian Home Care Association, 2008). In Ontario, a referral from a physician is not required to receive home care; however, a common path for receiving home care is following a hospital admission. If home care is required, upon completion of the assessment, the case manager determines the level and intensity of care based on their clinical judgment. The RAI-HC contains roughly 300 items capturing domains such as communication abilities, sensory function, cognitive status and functional abilities. Assessments are completed in a client's home by trained assessors (eg, registered nurses, social workers and other allied health professionals). The assessment contains information gathered from the client, her/his informal caregivers, and other professionals (eg, primary care physician), as needed. Assessors are instructed to complete the RAI-HC assessment only when all hearing and/or vision aids (eg, hearing aids, glasses) are put in place. Assessments are completed every 6–12 months following admission into the home care program, or following a change in clients' clinical status (Morris, Bernabei, et al., 1999). RAI-HC assessment data were linked with the Minimum Data Set (MDS) 2.0, another standardized assessment created by interRAI. interRAI is a not-for-profit organization of 100 researchers and clinicians representing 35 countries who develop and implement standardized assessments like the RAI-HC and MDS 2.0. The majority of items on the MDS 2.0 have similar or identical wording and response options as found on the RAI-HC. For purposes of this study, a single variable was used from the MDS 2.0, representing the person's date of admission to LTC. Missing data are virtually nonexistent because the assessor is unable to close the assessment until all fields have been given a value. All electronic assessments are stored in a national data warehouse held by the Canadian Institute for Health Information (CIHI) in Ottawa, Canada.

Sample

Staff from CIHI linked individual RAI-HC data collected between 2006 and 2014 with the individual's MDS 2.0 admission assessment. All client-related identifiers were removed from the data before being shared with the research team. The linked data set included 371,696 unique clients aged 65+ years (see Supplementary Figure 1). The RAI-HC assessment that was chosen for linkage was the one that was closest, chronologically, with the time of the person's admission to LTC. The project was reviewed and approved by the Research Ethics Board at Wilfrid Laurier University (REB #4184).

Outcome Measures

There are six health index scales embedded within the RAI-HC which are automatically generated upon completion of the assessment. These scales are used to help guide individual care planning. Across all scales, a higher score indicates a greater degree of impairment.

1. *The ADL Self-Performance Hierarchy Scale (ADL-H)* ranges from 0 (independent) to 6 (total dependence) and includes items such as bathing and dressing (Morris, Fries, & Morris, 1999).
2. *The Instrumental ADL (IADL) Involvement Scale* is a summative score that ranges from 0 to 21 and includes seven items (eg, meal preparation, ordinary housework, etc.). Both the ADL-H and IADL scale are valid and reliable measures of functional ability (Morris, Fries, et al., 1999).
3. *The Cognitive Performance Scale (CPS)* is scored from 0 (no impairment) to 6 (severe impairment), possesses excellent inter-rater reliability (average kappa = 0.85), has been validated against the Mini-Mental State Examination (MMSE; Gruber-Baldini, Zimmerman, Mortimore, & Magaziner, 2000), and is correlated with the Montreal Cognitive Assessment (MoCA; Jones, Perlman, Hirdes, & Scott, 2010).
4. *The Pain Scale* includes two items which capture the frequency and intensity of pain and is scored from 0 (no pain) to 4 (severe and/or daily pain). This scale has been validated against the vertical version of the Visual Analog Scale (Fries, Simon, Morris, Flodstrom, & Bookstein, 2001).
5. *The Depression Rating Scale (DRS)* is a summative scale across seven items pertaining to mood and behavior. The scale ranges from 0 to 14, where a score of three or higher is predictive of a clinical diagnosis of depression (Martin et al., 2008).
6. *The Changes in Health, End-Stage Disease and Signs and Symptoms (CHESS) scale* includes 12 items such as prognosis and shortness of breath. It is scored from zero to five. For every one-point increase on the scale, there is a nearly twofold increased risk of dying (Hirdes, Poss, Mitchell, Korngut, & Heckman, 2014).

Sensory Measures

The presence of HI was identified by a single item within the RAI-HC that scores perceived functional hearing ability from zero (no impairment) to three (highly impaired). A score of one or higher indicated the presence of HI. Similarly, VI was measured using a single item within the RAI-HC that ranged from zero (no impairment) to four (severely impaired). A score of one or higher indicated VI. Finally, a score of three or higher on the Deafblind Severity Index (DbSI) identified clients with a DSI of both vision and hearing (Dalby et al., 2009). The DbSI uses the two items that measure hearing and vision to identify clients with at least minimal losses in both senses. Expressive communication was measured with a single item within the RAI-HC scored from zero (always understood) to four (rarely understood). A score of one or higher indicated some difficulty in being understood by others. Similarly, receptive communication was measured

with a single item ranging from zero to four where a score of one or higher indicated some difficulty understanding others.

Other Measures

Several other dichotomous variables (measured as yes/no) were examined including responsive behaviors (eg, wandering, verbal abuse and socially inappropriate behaviors), bladder incontinence, at least one fall within the last 90 days, and the presence of Alzheimer's dementia/other type of dementia. Other diagnoses known to be clinically relevant and/or prevalent in older adults (eg, stroke, Parkinson's disease, hypertension, coronary artery disease) were also explored.

Univariable Analysis

Survival analysis, using Cox proportional hazards regression models and Kaplan–Meier curves, was used to identify risk factors associated with the time to LTC admission. Time to LTC admission was measured in months, comparing the date of clients' most recent RAI-HC to the date of their discharge from home care. If clients died or were discharged to another location (eg, assisted living, hospital), the date of this transition was used as their discharge date. In survival analysis, all observations must have a value for the discharge date. Clients who were not discharged and therefore remained in home care, were manually assigned a discharge date in order for their data to remain available for analysis. The last possible discharge date listed in our data set was March 31, 2014, which was manually assigned. All clients who remained in home care, died or were discharged to a location other than LTC were treated as censored observations since they did not experience the outcome of interest.

Differences in the characteristics between clients admitted versus not admitted to LTC were analyzed using the chi-square statistic. Unadjusted hazard ratios (HRs) were obtained by entering each covariate independently into the Cox model. Given the large sample size and high probability of Type I error, we chose not to rely solely on *p*-values, but also calculated the standardized difference (stdiff) between proportions to highlight meaningful differences between those who did versus those who did not enter LTC. The standardized difference is the difference in means between two groups divided by an estimate of the standard deviation of the variable (Austin, 2009). Standardized differences are one metric by which to understand the effect size when comparing proportions. In line with other research, a standardized difference of 0.2 or higher was used to indicate an effect size that was at least a small effect (Azuero, 2016).

Multivariable Analysis—Main Effects Model

Based on our goals for this project, we first examined a preliminary main effects model (Model 1) that included HI only, VI only and DSI. The choice of variables considered for inclusion in our multivariable model were based on several factors including statistical significance (HR and 95% confidence interval), the size of the standardized difference, and was based on our goals and objectives. The proportional hazards assumption was assessed for all potential covariates using Martingale residuals and the log-negative-log of the Kaplan–Meier estimates (Lin, Wei, & Ying, 1993). All covariates under consideration met this assumption and were entered into the model as time-constant predictors.

Several techniques were useful to guide the final model (Model 2), but it was determined that the combination of statistical significance and the size of the standardized difference would be used. Forward, backward and stepwise selection methods were used as tools to help identify variables that were important for further consideration. Variables that were statistically significant (alpha level = 0.01) in at least one of the selection procedures were considered for future steps of the analysis. We forced variables such as VI and DSI into the model, even though they were not statistically significant, given the goals of this project. Ultimately, they were not retained. Best subsets selection was also used to identify the models with the highest likelihood score. The overall fit of the model was examined using the goodness-of-fit statistic. Multi-collinearity was assessed using polychoric correlations, where a cutoff of 0.40 was used to identify variable pairs that needed to be removed to avoid multi-collinearity (Gadermann, Guhn, & Zumbo, 2012). The IADL scale, wandering and socially inappropriate behaviors all exceeded this cutoff and were removed from the model.

Multivariable Analysis—Interactions Model

All two-way interactions between single sensory impairments and the two ways of identifying CI (eg, CPS score or a diagnosis of Alzheimer's dementia/other type of dementia) were examined. There was only one significant interaction present between HI only and a CPS score of 1+. Due to this interaction, we then performed a stratified analysis to examine this relationship further and to determine how it related to the risk of LTC admission.

All statistical analyses were completed using SAS Enterprise Guide, version 7.1 (SAS Institute Inc., 2016). The study followed the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines (see https://www.strobe-statement.org/fileadmin/Strobe/uploads/checklists/STROBE_checklist_v4_cohort.pdf; von Elm et al., 2007).

Results

Using data from the RAI-HC, the mean age of the sample was 82.5 years (standard deviation = 7.9 years), 62.5% were women and 55.2% were widowed, separated or divorced.

Of the 371,696 clients in the sample, 47,079 (12.7%) were admitted to LTC, with the mean time of admission between a client's RAI-HC assessment and discharge from home care of 49.6 months (standard error = 0.2 months). Clients with CI-only experienced the fastest mean time to LTC admission at 38.6 months, followed by clients with VI + CI (40.1 months), HI-only (40.5 months) and DSI-only (41.9 months); see Supplementary Figure 2 and Supplementary Table 1.

Univariable Analysis

Several variables significantly increased the risk of LTC admission including older age (HR: 2.30; confidence interval: 2.23, 2.37; standardized difference (stdiff = −0.23)) and ADL impairments (HR: 1.61, confidence interval: 1.58, 1.64; stdiff = −0.21) and IADL impairments (HR: 2.38; confidence interval: 2.33, 2.42; stdiff = −0.45). Individuals who were never married (HR: 1.25; confidence interval: 1.19, 1.31) or widowed/separated/divorced were statistically more likely to be admitted to LTC (HR: 1.27; confidence interval: 1.24, 1.29) compared to those who were married; however, these were not significant based on the stdiff (−0.02 and −0.13, respectively). The presence of responsive behaviors, such as wandering (HR: 3.62; confidence interval: 3.51, 3.75; stdiff = −0.28) and verbally abusive behaviors (HR: 2.50; confidence interval: 2.42, 2.59; stdiff = −0.22) also increased the risk of admission. Additionally, those with bladder incontinence were more likely to be admitted (HR: 1.63; confidence interval: 1.60, 1.66; stdiff = −0.27), whereas a hospital admission (acute care) in the last 90 days *decreased* the risk of admission to LTC (HR: 0.76; confidence interval: 0.74, 0.77; stdiff = 0.21). Clients with a caregiver who reported feeling distressed, angry or depressed were 1.94 times more likely to be admitted to LTC compared with clients whose caregivers did not express these feelings (HR: 1.94; confidence interval: 1.90, 1.97; stdiff = −0.28). Although the presence of HI-only (HR: 1.16; confidence interval: 1.14, 1.18) and DSI-only (HR: 1.27; confidence interval: 1.24, 1.30) were statistically significant, the differences were not meaningful based on the standardized difference. Clients with dementia had a 2.81 greater risk for admission to LTC (HR: 2.81; confidence interval: 2.76, 2.86; stdiff= −0.54), very similar to the risk for clients with at least a mild degree of CI, based on the CPS score (HR: 3.32; confidence interval: 3.16, 3.32; stdiff= −0.55); Table 1.

Multivariable Analysis—Main Effects Model

A preliminary main effects model (Model 1) that included HI-only, VI-only and DSI-only was examined. Clients with VI-only had a 1.2 times increased risk of admission to LTC (HR = 1.20; confidence interval: 1.16, 1.24), whereas those with HI-only had a 1.35 times increased risk (HR = 1.35; confidence interval: 1.32, 1.38) and clients with DSI-only had a 1.47 times increased risk (HR = 1.47; confidence interval: 1.43. 1.51) of being admitted to LTC. Since all of these variables were significant in the preliminary main effects model, they were all retained and examined in the final main effects model (Table 2).

In the final main effects model (Model 2), the most significant risk factor for LTC admission was having a diagnosis of Alzheimer's dementia/other type of dementia (HR = 1.87; confidence interval: 1.83, 1.90). With each increasing year of age, clients had a small increased risk of admission to LTC (HR: 1.02). Clients who were verbally abusive (HR = 1.42; confidence interval: 1.37, 1.47), had a caregiver who was distressed, angry or depressed (HR = 1.35; confidence interval: 1.32, 1.38), had at least one fall (HR = 1.33; confidence interval: 1.30, 1.35), and/or experienced bladder incontinence (HR = 1.18; confidence interval: 1.16, 1.21) all had an increased risk in the final model. After adjusting for all variables in the model, clients who were verbally abusive had the fastest mean time to LTC admission (25.5 months), followed by a diagnosis of Alzheimer's dementia/other type of dementia (35.4 months), and caregivers who were feeling distressed (38.6 months). In this adjusted model, VI-only and DSI-only were no longer significant and did not remain in the model. Model 2 therefore contained all of the variables listed above, except for VI-only and DSI-only. A significant interaction was found between HI-only and a CPS score of 1+ (Table 2).

Multivariable Analysis—Interactions Model

A significant interaction was present in the final multivariable model between a CPS score of 1+ (indicating CI) and HI. To understand this interaction better, a stratified analysis was completed, first for clients with HI and then separately for clients with no HI. In the group with HI, the risk of LTC admission was fastest in those without cognitive issues (mean = 40.5 months), when compared with 44.9 months in the group with both HI and CI. Among clients with no HI, the opposite was true, such that clients with a CI had the faster time to admission (42.2 months vs 53.8 months in the group with no HI and no CI); Table 2.

To investigate further why clients with HI but no CI had an increased risk of LTC admission, we looked at a subsample of these clients and examined several factors that differentiated the two groups based on LTC admission. For example, clients who were admitted to LTC were more likely, compared to those not admitted, to have a child as their primary caregiver (63.7% vs 53.9%; stdiff = 0.20), whereas those not admitted were more likely to have a spouse (16.2% vs 31.9%; stdiff = −0.37). Clients with a primary caregiver who did not reside with them (63.3% vs 49.1%; stdiff = 0.29) were more likely to be admitted than clients who lived with their caregiver (34.1% vs 48.7%; stdiff = −0.30). Additionally, clients who were 85+ years (62.6% vs 42.8%; stdiff = 0.41), had a more severe HI (33.6% vs 24.4%; stdiff = 0.20), and had bladder

Table 1. Demographical and Clinical Characteristics Comparing Clients Who were Admitted and Not Admitted to Long-term Care

	Not admitted to LTC (*n* = 324,617)	Admitted to LTC (*n* = 47,079)	Univariable HRs (95% CI)	Standardized difference
Variable	Column % (*n*)			
Age group				
65–74	20.6 (66,748)	10.5 (4,942)	Reference	0.28
75–84	39.4 (127,999)	38.2 (17,999)	1.81 (1.75, 1.87)	0.02
85+	40.0 (129,870)	51.3 (24,138)	2.30 (2.23, 2.37)	−0.23
Sex				
Male	38.1 (123,550)	33.6 (15,824)	Reference	0.09
Female	61.9 (201,067)	66.4 (31,255)	1.14 (1.12, 1.16)	−0.09
Marital status				
Married	40.6 (131,688)	33.5 (15,788)	Reference	0.15
Never married	4.2 (13,466)	4.6 (21,777)	1.25 (1.19, 1.31)	−0.02
Widowed/separated/divorced	54.3 (176,352)	61.1 (28,741)	1.27 (1.24, 1.29)	−0.13
Other	0.9 (3,111)	0.8 (373)	1.01 (0.91, 1.12)	0.01
Level of education completed				
Postsecondary	30.2 (71,098)	26.1 (9,564)	Reference	0.21
High school	40.9 (96,041)	42.2 (15,485)	1.21 (1.18, 1.24)	−0.03
Some/no high school	28.9 (67,953)	31.7 (11,612)	1.18 (1.15, 1.21)	−0.06
Activities of daily living (ADL) self-performance hierarchy				
Independent/minor supervision (0–1)	68.0 (220,856)	57.7 (27,180)	Reference	0.21
Moderate/severe impairment (2–6)	32.0 (103,761)	42.3 (19,899)	1.61 (1.58, 1.64)	−0.21
Instrumental activities of daily living (IADL) involvement scale				
None/minor difficulty (0–13)	53.2 (172,705)	31.7 (14,938)	Reference	0.45
Moderate/major difficulty (14–21)	46.8 (151,909)	68.3 (32,140)	2.38 (2.33, 2.42)	−0.45
Cognitive Performance Scale (CPS)				
No cognitive impairment (0)	38.3 (124,214)	14.9 (7,034)	Reference	0.55
Mild /severe cognitive impairment (1–6)	61.7 (200,403)	85.1 (40,045)	3.24 (3.16, 3.32)	−0.55
Pain Scale				
No pain/less than daily (0–1)	44.3 (143,671)	51.9 (24,413)	Reference	−0.15
Daily/severe pain (2–3)	55.7 (180,933)	48.1 (22,666)	0.75 (0.74, 0.77)	0.15
Depression Rating Scale (DRS)				
No signs/symptoms of depression (0–2)	82.7 (268,400)	77.1 (36,291)	Reference	0.14
Signs/symptoms of depression (3–14)	17.3 (56,216)	22.9 (10,788)	1.43 (1.40, 1.46)	−0.14
Change in Health, End-stage disease, Signs and Symptoms Scale (CHESS)				
None/mild health instability (0–1)	55.8 (175,392)	49.2 (22,646)	Reference	0.13
Moderate/severe health instability (2–5)	44.2 (138,824)	50.8 (23,422)	1.41 (1.38, 1.44)	−0.13
Responsive behaviors (reference = does not exhibit the issue)				
Wandering	2.1 (6,712)	8.2 (3,843)	3.62 (3.51, 3.75)	−0.28
Verbally abusive	3.1 (10,147)	8.1 (3,789)	2.50 (2.42, 2.59)	−0.22
Physically abusive	0.8 (2,637)	2.2 (1,041)	2.63 (2.47, 2.79)	−0.12
Socially inappropriate behavior	1.5 (4,821)	4.7 (2,216)	2.92 (2.80, 3.05)	−0.19
Problem conditions				
Fell in the last 90 days	35.7 (115,877)	44.3 (20,835)	1.41 (1.38, 1.44)	−0.18
Bladder incontinence	31.8 (102,803)	44.8 (21,051)	1.63 (1.60, 1.66)	−0.27
Hospital admission within the last 90 days	35.3 (114,674)	25.9 (12,214)	0.76 (0.74, 0.77)	0.21
Emergency department visit within the last 90 days	21.9 (71,025)	22.2 (10,466)	1.09 (1.07, 1.12)	−0.01
Disease diagnoses				
Stroke	17.4 (56,353)	19.8 (9,328)	1.14 (1.11, 1.17)	−0.06
Multiple sclerosis	0.5 (1,652)	0.4 (182)	0.72 (0.62, 0.83)	0.01

Table 1. Continued

Variable	Not admitted to LTC (*n* = 324,617)	Admitted to LTC (*n* = 47,079)	Univariable HRs (95% CI)	Standardized difference
	Column % (*n*)			
Parkinson's disease	3.9 (12,897)	6.3 (2,977)	1.50 (1.44, 1.55)	–0.11
Hypertension	61.9 (201,111)	61.8 (29,136)	0.97 (0.96, 0.99)	0.0
Alzheimer's dementia (AD) or another type of dementia	20.8 (67,529)	45.3 (21,345)	2.81 (2.76, 2.86)	–0.54
Caregiver's relationship to client				
Child or child-in-law	53.7 (170,759)	60.4 (27,989)	Reference	–0.14
Spouse	32.6 (103,555)	24.7 (11,429)	0.72 (0.71, 0.74)	0.18
Other relative	7.9 (25,034)	9.2 (4,261)	1.03 (1.00, 1.07)	–0.05
Friend/neighbor	5.8 (18,491)	5.7 (2,655)	0.89 (0.86, 0.93)	0.0
Caregiver experiences feelings of distress, anger or depression	18.1 (58,746)	30.1 (14,184)	1.94 (1.90, 1.97)	–0.28
Sensory impairments (reference = no impairment)				
Hearing impairment only	28.6 (92,925)	32.0 (15,075)	1.16 (1.14, 1.18)	–0.07
Vision impairment only	11.6 (37,680)	11.7 (5,528)	0.99 (0.96, 1.02)	–0.0
Dual sensory impairment	18.6 (60,378)	23.2 (10,917)	1.27 (1.24, 1.30)	–0.11
Communication				
Difficulties with making self-understood (expressive communication)	28.9 (93,890)	48.1 (22,657)	2.16 (2.12, 2.20)	–0.40
Difficulties in understanding others (receptive communication)	31.2 (101,167)	53.3 (25,077)	2.36 (2.31, 2.40)	–0.46

Note: CI = cognitive impairment; HR = hazard ratio; LTC = long-term care.

Table 2. Final Cox Proportional Hazards Ratios Modeling Risk of Long-term Care Admission

Variable	Model 1: Adjusted HR and 95% confidence interval	Model 2: Adjusted HR and 95% confidence interval	Adjusted mean time to LTC admission (months)
Hearing impairment only	1.35 (1.32, 1.38)	–	48.6
Vision impairment only	1.20 (1.16, 1.24)	–	–
Dual sensory impairment	1.47 (1.43, 1.51)	–	–
Verbally abusive behavior	–	1.42 (1.37, 1.47)	25.5
Diagnosis of AD or another type of dementia	–	1.87 (1.83, 1.90)	35.4
Caregiver distress	–	1.35 (1.32, 1.38)	38.6
Bladder incontinence	–	1.18 (1.16, 1.21)	41.9
Fell in last 90 days	–	1.33 (1.30, 1.35)	43.9
Age at assessment	–	1.02 (1.02, 1.02)	–
CPS score of 1+	–	–	44.8
CPS*hearing impairment (HI = yes and CI = no)	–	1.14 (1.08, 1.20)	40.5
CPS*hearing impairment (HI = no and CI = yes)	–	2.07 (2.00, 2.13)	42.2
CPS*hearing impairment (HI = yes and CI = yes)	–	2.11 (2.04, 2.19)	44.9
CPS*hearing impairment (HI = no and CI = no)	–	0.88 (0.84, 0.93)	53.8

Note: AD = Alzheimer's dementia; CI = cognitive impairment; CPS = Cognitive Performance Scale; HI = hearing impairment; HR = hazard ratio; LTC = long-term care.

incontinence (29.3% vs 20.4%; stdiff = 0.21) were all more likely to be admitted (Table 3).

Discussion and Implications

In the study sample of 371,696 older home care clients, 12.7% were admitted to LTC over an average of 4 years. Clients with CI and/or HI were admitted earlier compared to those without these challenges. The presence of VI or DSI did not alter the risk. To the best of our knowledge, this is one of the few studies to explore the risk of LTC admission for older Canadians, particularly those with sensory impairments. Since sensory impairments are highly prevalent among older adults and can have serious

Table 3. Characteristics of Clients Admitted and Not Admitted to Long-term Care With a Hearing Impairment and No Cognitive Impairment (based on the CPS score)

Variable	Clients with a HI, no CI and admitted to LTC (n = 2,032)	Clients with a HI, no CI and not admitted to LTC (n = 30,023)	Standardized difference
	Column % (n)		
Age group			
65–74 years	6.4 (130)	16.2 (4,872)	0.25
75–84 years	31.0 (629)	41.0 (12,293)	−0.21
85+ years	62.6 (1,273)	42.8 (12,858)	0.41
Sex			
Male	35.7 (726)	43.3 (13,000)	−0.16
Female	64.3 (1,306)	56.7 (17,023)	0.16
Degree of hearing impairment			
0 (no impairment)	0 (0)	0 (0)	0.0
1 (minimal difficulty—when not in quiet setting)	65.3 (1,326)	74.7 (22,419)	−0.21
2 (hears in special situations only—speaker has to adjust tonal quality and speak distinctly)	33.6 (682)	24.4 (7,331)	0.20
3 (highly impaired—absence of useful hearing)	1.2 (24)	0.91 (273)	−0.36
Difficulties with making self-understood (expressive communication)	0 (0)	0 (0)	0.0
Difficulties in understanding others (receptive communication)	11.1 (225)	9.9 (2,961)	0.04
Health index scales			
ADL impairment (2+)	22.0 (446)	17.6 (5,293)	0.11
IADL impairment (14+)	28.5 (580)	21.5 (6.446)	0.16
Pain Scale (2+)	62.2 (1,263)	61.6 (18,506)	0.01
Depression Rating Scale (3+)	9.6 (194)	9.8 (2,951)	−0.01
CHESS (1+)	36.4 (726)	39.4 (11,388)	−0.01
Disease diagnosis			
Diagnosis of Alzheimer's dementia or another type of dementia	1.4 (29)	0.8 (232)	0.05
Coronary artery disease	30.0 (610)	30.1 (9,043)	−0.0
Congestive heart failure	18.2 (369)	16.8 (5,034)	0.04
Parkinson's disease	3.8 (78)	1.9 (561)	0.11
Stroke	15.8 (321)	11.4 (3,413)	0.13
COPD	20.0 (407)	23.0 (6,905)	−0.07
Problem conditions			
Bladder incontinence	29.3 (593)	20.4 (6,091)	0.21
Verbally abusive behavior	0.8 (16)	0.5 (143)	0.04
Falls	39.6 (804)	31.7 (9,508)	0.17
Caregiver status			
Caregiver has feelings of distress, anger or depression	11.2 (228)	8.1 (2,421)	0.11
Caregiver is unable to continue caring activities	7.4 (151)	6.1 (1,837)	0.05
Primary caregiver's relationship to the client			
Child or child-in law	63.7 (1,260)	53.9 (18,838)	0.20
Spouse	16.2 (321)	31.9 (9,362)	−0.37
Other relative	11.2 (222)	7.6 (2,228)	0.12
Friend/neighbor	8.9 (175)	6.7 (1,955)	0.08
Living arrangement			
Caregiver lives with client	34.1 (692)	48.7 (14,622)	−0.30
Caregiver does not live with client	63.3 (1,286)	49.1 (14,757)	0.29
Client does not have a primary caregiver	2.7 (54)	2.2 (644)	0.03
Hours of informal care[a]			
0–8	52.7 (1,071)	47.6 (14,296)	0.10
9–168	47.3 (961)	52.4 (15,722)	−0.10

Note: ADL = activity of daily living; CHESS = Changes in Health, End-Stage Disease and Signs and Symptoms; IADL = instrumental activity of daily living; CI = cognitive impairment; CPS = Cognitive Performance Scale; HI = hearing impairment; LTC = long-term care.
[a]Dichotomized at the median.

implications for their health and quality of life, this study represents a critical first step in understanding these complex relationships.

Many previous studies have cited factors such as CI (Andel, et al., 2007; Greiner, et al., 2014), caregiver burden (Rockwood et al., 2014) and impairments in ADLs/IADLs (Verbeek, et al., 2015) as risk factors for LTC admission, in line with the current findings. Even after adjusting for other important potential confounders, a diagnosis of dementia nearly doubled a person's risk.

The relationship between HI and CI is complicated because they both result in similar difficulties such as understanding speech, which may be correlated with social isolation (Slaughter, Hopper, Ickert, & Erin, 2014). Age, vascular risk factors (eg, diabetes) or social factors such as level of education may be common mechanisms that underlie the relationship between hearing loss and cognition. Additionally, the effects of HI on cognitive load, brain structure and decreased social engagement may also contribute to poorer cognitive functioning (Lin & Albert, 2014).

Although CI was found as a main risk factor, it was not always the driving factor for LTC admission. Clients with HI and *no CI* had a higher risk of admission compared to those with both of these issues. When the presence of HI was held constant, the main differences between those who went to LTC and those who stayed in their home was driven by caregiver characteristics. We anticipated that marital status would be a risk factor for LTC admission such that individuals who were unmarried would be more likely to be admitted to LTC. Marital status was statistically significant in the univariable analysis; however, it was not significant based on the standardized difference and again was also not significant in the multivariable analysis. However, we did find that clients with an adult–child caregiver were more likely to be admitted to LTC compared to those whose caregiver was a spouse. Spouses and adult–children may experience the caregiving role differently. Spouses are more likely to live with the care recipient and have a different emotional relationship compared to children (Chappell, Dujela, & Smith, 2014). Spouses tend to view the caregiver role as an extension of their marital relationship and tend to stay in the caregiver role for as long as the care they provide is consistent with their marital relationship (Savundranayagam & Montgomery, 2010). Conversely, children may be part of the "sandwich" generation where they are caring for their own children as well as their aging parents. This dual-caregiving situation is a reality for nearly 30% of Canadians (Sinha, 2013). The role of caring for one's aging parents may be perceived as an added burden on top of other responsibilities and may explain why the risk for LTC admission was higher in this group.

There are several strengths in the current study including the longitudinal design and large sample size. To the best of our knowledge, this is one of the only Canadian studies to examine the risk for LTC admission among individuals with some degree of sensory and/or CI. Using data from the RAI-HC enabled us to look deeply into a wide variety of potential risk factors. This is a strength of using data from these standardized, electronic assessments. However, the RAI-HC does not include information on the date of onset for sensory and CIs, limiting our capacity to understand how these impairments developed over time. Additionally, there is no information in the RAI-HC as to whether assistive devices, such as hearing aids or glasses, are being used regularly by home care clients.

HI is the leading cause of disability among men over 60 years and is second, for years lived with disability, among women of the same age (World Health Organization, 2018). Even though sensory impairments are highly prevalent and rehabilitative options are available, they often are under-detected and untreated in older adults residing in or transitioning into LTC, particularly among those with dementia (Campos et al., 2019). Recognizing and treating HI is important since a person's degree of hearing loss is likely to continue to deteriorate over time, which can lead to difficulties with communication (Williams, Guthrie, Davidson, Fisher, & Griffith, 2018). If the person's hearing worsens, communication can become more impaired, putting added strain on the relationship between the client and their caregiver (Mick, Parfyonov, Wittich, Phillips, & Pichora-Fuller, 2018; Savundranayagam, Hummert, & Montgomery, 2005). Communication breakdown can lead to a decline in the quality of relationships as interactions become more challenging. This can in turn leave clients feeling socially isolated (which is an identified risk factor for cognitive decline) and result in added stress for their caregiver.

Screening for sensory and CIs by using a standardized assessment, like the RAI-HC, can enable the appropriate interventions and connections to be put in place. For example, screening for HI may increase the likelihood that assistive devices such as hearing aids are prescribed. Although it is well documented that the use of assistive devices has the potential to improve quality of life (Boi et al., 2012), hearing aid uptake is still quite low. A national study in Canada found that overall, 12% of adults aged 20–79 with hearing loss used a hearing aid. Of those 60–69 years of age, only 9% wore hearing aids; however, the rate did increase to 24% for those 70–79 years (Feder, et al., 2015), which was similar to the rate (19%) for Americans aged 70 or older (Lin, Thorpe, Gordon-Salant, & Ferrucci, 2011). One of the reasons for a lack of hearing aid use has been attributed to their associated costs (Knudsen, Oberg, Nielsen, Naylor, & Kramer, 2010). In Ontario, every individual that has had a device recommended by a qualified health professional is eligible for a flat subsidy if they do not already have funding from another source (Government of Ontario, 2016). Currently, in the United States, hearing aids are not covered by a person's health insurance or Medicaid

(Arnold, Hyer, & Chisolm, 2017). However, more options such as over-the-counter hearing aids are being proposed by the Food and Drug Administration (FDA), which will allow for a lower cost option that does not require an audiological evaluation (see https://www.fda.gov/news-events/press-announcements/fda-takes-steps-improve-hearing-aid-accessibility). Continued screening for these sensory impairments is therefore vital as the potential benefits from having the proper supports and devices in place can allow for an overall improvement in health outcomes and independence. Our results demonstrate the necessity of routinely assessing sensory impairments in home care clients as these issues may influence the risk of LTC admission. Screening for all types of sensory impairments is beneficial for both older adults and their caregivers. Identifying and treating these issues can enhance communication, and in turn, optimize the care and supports they are receiving, ultimately improving the quality of life for the person and their caregivers.

Supplementary Material

Supplementary data are available at *Innovation in Aging* online.

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Conflict of Interest

Dr. Guthrie is an Associate Fellow with interRAI. We have no conflicts of interest to declare.

References

Andel, R., Hyer, K., & Slack, A. (2007). Risk factors for nursing home placement in older adults with and without dementia. *Journal of Aging and Health*, **19**(2), 213–228. doi:10.1177/0898264307299359

Arnold, M. L., Hyer, K., & Chisolm, T. (2017). Medicaid hearing aid coverage for older adult beneficiaries: A state-by-state comparison. *Health Affairs (Project Hope)*, **36**, 1476–1484. doi:10.1377/hlthaff.2016.1610

Austin, P. C. (2009). Using the standardized difference to compare the prevalence of a binary variable between two groups in observational research. *Communications in Statistics - Simulation and Computation*, **38**(6), 1228–1234. doi:10.1080/03610910902859574

Azuero, A. (2016). A note on the magnitude of hazard ratios. *Cancer*, **122**, 1298–1299. doi:10.1002/cncr.29924

Boi, R., Racca, L., Cavallero, A., Carpaneto, V., Racca, M., Dall' Acqua, F.,..., Odetti, P. (2012). Hearing loss and depressive symptoms in elderly patients. *Geriatrics & Gerontology International*, **12**, 440–445. doi:10.1111/j.1447-0594.2011.00789.x

Bonifas, R. P., Simons, K., Biel, B., & Kramer, C. (2014). Aging and place in long-term care settings: Influences on social relationships. *Journal of Aging and Health*, **26**, 1320–1339. doi:10.1177/0898264314535632

Campos, J. L., Höbler, F., Bitton, E., Labreche, T., McGilton, K. S., & Wittich, W. (2019). Screening for vision impairments in individuals with dementia living in long-term care: A scoping review. *Journal of Alzheimer's Disease: JAD*, **68**, 1039–1049. doi:10.3233/JAD-181129

Canadian Home Care Association. (2008). *Portraits of home care in Canada*. Mississauga, ON: Canadian Home Care Association. http://www.alwaysbestcare.info/portraitsofhomecarecanada.pdf.

Cepoiu-Martin, M., Tam-Tham, H., Patten, S., Maxwell, C. J., & Hogan, D. B. (2016). Predictors of long-term care placement in persons with dementia: A systematic review and meta-analysis. *International Journal of Geriatric Psychiatry*, **31**, 1151–1171. doi:10.1002/gps.4449

Chappell, N. L., Dujela, C., & Smith, A. (2014). Spouse and adult child differences in caregiving burden. *Canadian Journal on Aging = La Revue Canadienne Du Vieillissement*, **33**, 462–472. doi:10.1017/S0714980814000336

Chen, D. S., Betz, J., Yaffe, K., Ayonayon, H. N., Kritchevsky, S., Martin, K. R.,..., Lin, F. R. (2015). Association of hearing impairment with declines in physical functioning and the risk of disability in older adults. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, **70**, 654–661. doi:10.1093/gerona/glu207

Choi, J. S., Betz, J., Deal, J., Contrera, K. J., Genther, D. J., Chen, D. S.,..., Lin, F. R. (2015). A comparison of self-report and audiometric measures of hearing and their associations with functional outcomes in older adults. *Journal of Aging and Health*, **28**, 890–910. doi:10.1177/0898264315614006

Dalby, D., Hirdes, J. P., Stolee, P., Strong, J. G., Poss, J., Tjam, E. Y.,..., Ashworth, M. (2009). Development and psychometric properties of a standardized assessment for adults who are deaf-blind. *Journal of Visual Impairment and Blindness*, **103**(1), 1–18. doi:10.1177/0145482X0910300103

von Elm, E., Egger, M., Altman, D. G., Pocock, S. J., Gotzsche, P. C., & Vandenbroucke, J. P. (2007). Strengthening the reporting of observational studies in epidemiology (STROBE) statement: Guidelines for reporting observational studies. *British Medical Journal*, **335**, 806–808. doi:10.1016/j.jclinepi.2007.11.008

Feder, K., Michaud, D., Ramage-Morin, P., McNamee, J., & Beauregard, Y. (2015). *Prevalence of hearing loss among Canadians aged 20 to 79: Audiometric results from the 2012/2013 Canadian health measures survey*. Ottawa, ON: Statistics Canada. Retrieved from https://www150.statcan.gc.ca/n1/en/pub/82-003-x/2015007/article/14206-eng.pdf?st=6vnXNmtS.

Fries, B. E., Simon, S. E., Morris, J. N., Flodstrom, C., & Bookstein, F. L. (2001). Pain in U.S. nursing homes: Validating a pain scale for the minimum data set. *Gerontologist*, **41**, 173–179. doi:10.1093/geront/41.2.173

Gadermann, A. M., Guhn, M., & Zumbo, B. D. (2012). Estimating ordinal reliability for Likert-type and ordinal item response data: A conceptual, empirical, and practical guide. *Practical Assessment, Research and Evaluation*, **17**(3), 1–13. Retrieved from https://pareonline.net/getvn.asp?v=17&n=3

Garner, R., Tanuseputro, P., Manuel, D. G., & Sanmartin, C. (2018). *Transitions to long-term care and residential care among older Canadians*. Ottawa, ON: Statistics Canada. Retrieved from https://www150.statcan.gc.ca/n1/en/pub/82-003-x/2018005/article/54966-eng.pdf?st=-ZGNL5Ax.

Gaugler, J. E., Duval, S., Anderson, K. A., & Kane, R. L. (2007). Predicting nursing home admission in the U.S: A meta-analysis. *BMC Geriatrics*, **7**, 13. doi:10.1186/1471-2318-7-13

Gaugler, J. E., Wall, M. M., Kane, R. L., Menk, J. S., Sarsour, K., Johnston, J. A.,…,Newcomer, R. (2011). Does caregiver burden mediate the effects of behavioral disturbances on nursing home admission? *American Journal of Geriatric Psychiatry: Official Journal of the American Association for Geriatric Psychiatry*, **19**, 497–506. doi:10.1097/JGP.0b013e31820d92cc

Global Burden of Disease 2015 Collaborators. (2016). Global, regional, and national incidence, prevalence, and years lived with disability for 310 disease and injuries, 1990–2015: A systematic analysis for the global burden of disease study 2015. *Lancet*, **338**(10053), 1545–1602. doi:10.1016/S0140-6736(16)31678-6

Government of Ontario. (2016). Hearing devices. Retrieved from https://www.ontario.ca/page/hearing-devices

Greiner, M. A., Qualls, L. G., Iwata, I., White, H. K., Molony, S. L., Sullivan, M. T.,…Setoguchi, S. (2014). Predicting nursing home placement among home- and community-based services program participants. *American Journal of Managed Care*, **20**, e535–e536.

Gruber-Baldini, A. L., Zimmerman, S. I., Mortimore, E., & Magaziner, J. (2000). The validity of the minimum data set in measuring the cognitive impairment of persons admitted to nursing homes. *Journal of the American Geriatrics Society*, **48**, 1601–1606. doi:10.1111/j.1532-5415.2000.tb03870.x

Guthrie, D. M., Davidson, J. G. S., Williams, N., Campos, J., Hunter, K., Mick, P.,…,Wittich, W. (2018). Combined impairments in vision, hearing and cognition are associated with greater levels of functional and communication difficulties than cognitive impairment alone: Analysis of interRAI data for home care and long-term care recipients in Ontario. *PLoS One*, **13**, e0192971. doi:10.1371/journal.pone.0192971

Harrison, J. K., Walesby, K. E., Hamilton, L., Armstrong, C., Starr, J. M., Reynish, E. L.,…,Shenkin, S. D. (2017). Predicting discharge to institutional long-term care following acute hospitalisation: A systematic review and meta-analysis. *Age and Ageing*, **46**, 547–558. doi:10.1093/ageing/afx047

Hébert, R., Dubois, M. F., Wolfson, C., Chambers, L., & Cohen, C. (2001). Factors associated with long-term institutionalization of older people with dementia: Data from the Canadian study of health and aging. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, **56**, M693–M699. doi:10.1093/gerona/56.11.m693

Hirdes, J. P., Poss, J. W., Mitchell, L., Korngut, L., & Heckman, G. (2014). Use of the interRAI CHESS scale to predict mortality among persons with neurological conditions in three care settings. *PLoS One*, **9**, e99066. doi:10.1371/journal.pone.0099066

Jones, K., Perlman, C. M., Hirdes, J. P., & Scott, T. (2010). Screening cognitive performance with the resident assessment instrument for mental health cognitive performance scale. *Canadian Journal of Psychiatry. Revue Canadienne De Psychiatrie*, **55**, 736–740. doi:10.1177/070674371005501108

Kehyayan, V., Hirdes, J. P., Tyas, S. L., & Stolee, P. (2015). Residents' self-reported quality of life in long-term care facilities in Canada. *Canadian Journal on Aging = La Revue Canadienne Du Vieillissement*, **34**, 149–164. doi:10.1017/S0714980814000579

Klein, R., Klein, B. E., & Lee, K. E. (1996). Changes in visual acuity in a population. The Beaver Dam Eye Study. *Ophthalmology*, **103**, 1169–1178. doi:10.1016/s0161-6420(96)30526-5

Knudsen, L. V., Oberg, M., Nielsen, C., Naylor, G., & Kramer, S. E. (2010). Factors influencing help seeking, hearing aid uptake, hearing aid use and satisfaction with hearing aids: A review of the literature. *Trends in Amplification*, **14**, 127–154. doi:10.1177/1084713810385712

Laliberte Rudman, D., Gold, D., McGrath, C., Zuvela, B., Spafford, M. M., & Renwick, R. (2016). "Why would I want to go out?": Age-related vision loss and social participation. *Canadian Journal on Aging = La Revue Canadienne Du Vieillissement*, **35**, 465–478. doi:10.1017/S0714980816000490

Lin, F. R., & Albert, M. (2014). Hearing loss and dementia – Who is listening? *Aging & Mental Health*, **18**, 671–673. doi:10.1080/13607863.2014.915924

Lin, F. R., Thorpe, R., Gordon-Salant, S., & Ferrucci, L. (2011). Hearing loss prevalence and risk factors among older adults in the United States. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, **66**, 582–590. doi:10.1093/gerona/glr002

Lin, D. Y., Wei, L. J., & Ying, Z. (1993). Checking the Cox model with cumulative sums of martingale-based residuals. *Biometrika*, **80**(3), 557–572. doi:10.2307/2337177

Martin, L., Poss, J. W., Hirdes, J. P., Jones, R. N., Stones, M. J., & Fries, B. E. (2008). Predictors of a new depression diagnosis among older adults admitted to complex continuing care: Implications for the depression rating scale (DRS). *Age and Ageing*, **37**, 51–56. doi:10.1093/ageing/afm162

Mick, P., Parfyonov, M., Wittich, W., Phillips, N., Guthrie, D., & Kathleen Pichora-Fuller, M. (2018). Associations between sensory loss and social networks, participation, support, and loneliness: Analysis of the Canadian longitudinal study on aging. *Canadian Family Physician Medecin De Famille Canadien*, **64**, e33–e41.

Ministry of Health and Long-Term Care. (2007). *Community care access centres: Client services policy manual*. Toronto, ON: Government of Ontario. http://www.health.gov.on.ca/english/providers/pub/manuals/ccac/ccac_mn.html.

Morris, J. N., Bernabei, R., Ikegami, N., Gilgen, R., Frijters, D., Hirdes, J. P., et al. (1999). *RAI-home care (RAI-HC) assessment manual for version 2.0*. Washington, DC: interRAI Corporation.

Morris, J. N., Fries, B. E., & Morris, S. A. (1999). Scaling ADLs within the MDS. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, **54**, M546–M553. doi:10.1093/gerona/54.11.m546

Paque, K., Goossens, K., Elseviers, M., Van Bogaert, P., & Dilles, T. (2017). Autonomy and social functioning of recently admitted nursing home residents. *Aging & Mental Health*, **21**, 910–916. doi:10.1080/13607863.2016.1181711

Prieto-Flores, M. E., Forjaz, M. J., Fernandez-Mayoralas, G., Rojo-Perez, F., & Martinez-Martin, P. (2011). Factors associated with loneliness of noninstitutionalized and institutionalized older adults. *Journal of Aging and Health*, **23**, 177–194. doi:10.1177/0898264310382658

Rockwood, J. K. h., Richard, M., Garden, K., Hominick, K., Mitnitski, A., & Rockwood, K. (2014). Precipitating and predisposing events and symptoms for admission to assisted living or nursing home care. *Canadian Geriatrics Journal: CGJ*, **17**, 16–21. doi:10.5770/cgj.17.93

SAS Institute Inc. (2016). *SAS enterprise guide*. Carey, NC: SAS Institute, Inc.

Savundranayagam, M. Y., Hummert, M. L., & Montgomery, R. J. (2005). Investigating the effects of communication problems on caregiver burden. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, **60**, S48–S55. doi:10.1093/geronb/60.1.s48

Savundranayagam, M. Y., & Montgomery, R. J. V. (2010). Impact of role discrepancies on caregiver burden among spouses. *Research on Aging*, **32**(2), 175–199. doi:10.1177/0164027509351473

Schulz, R., Belle, S. H., Czaja, S. J., McGinnis, K. A., Stevens, A., & Zhang, S. (2004). Long-term care placement of dementia patients and caregiver health and well-being. *JAMA*, **292**, 961–967. doi:10.1001/jama.292.8.961

Sinha, M. (2013). *Portrait of caregivers, 2012*. Ottawa, ON: Statistics Canada Catalogue no. 89-652-X. Retrieved from https://www150.statcan.gc.ca/n1/en/pub/89-652-x/89-652-x2013001-eng.pdf?st=qzxTWu0R.

Sinha, M., & Bleakney, A. (2014). *Receiving care at home*. Ottawa, ON: Statistics Canada. Retrieved from https://www150.statcan.gc.ca/n1/pub/89-652-x/89-652-x2014002-eng.htm.

Slaughter, S. E., Hopper, T., Ickert, C., & Erin, D. F. (2014). Indentification of hearing loss among residents with dementia: Perceptions of health care aides. *Geriatric Nursing*, 35, 434–440. doi:10.1016/j.gerinurse.2014.07.001

Tomiak, M., Berthelot, J. M., Guimond, E., & Mustard, C. A. (2000). Factors associated with nursing-home entry for elders in Manitoba, Canada. *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences*, **55**, M279–M287. doi:10.1093/gerona/55.5.m279

Verbeek, H., Meyer, G., Challis, D., Zabalegui, A., Soto, M. E., Leino-Kilpi, H.,..., Hamers, J. P. H. (2015). Inter-country exploration of factors associated with admission to long-term institutional dementia care: Evidence from the right time place care study. *Journal of Advanced Nursing*, **71**(6), 1338–1350. doi:10.1111/jan.12663

Wang, J. J., Mitchell, P., Cumming, R. G., & Smith, W. (2009). Visual impairment and nursing home placement in older Australians: The blue mountains eye study. *Ophthalmic Epidemiology*, **10**(1), 3–13. doi:10.1076/opep.10.1.3.13773

Wiles, J. L., Leibing, A., Guberman, N., Reeve, J., & Allen, R. E. (2012). The meaning of "aging in place" to older people. *Gerontologist*, **52**(3), 357–366. doi:10.1093/geront/gnr098

Williams, N., Guthrie, D. M., Davidson, J. G. S., Fisher, K., & Griffith, L. E. (2018). A deterioration in hearing is associated with functional and cognitive impairments, difficulty with communication, and greater health instability. *Journal of Applied Gerontology*, 1–28. doi:10.1177/0733464818755312

World Health Organization. (2018). *Addressing the rising prevalence of hearing loss*. Geneva: World Health Organization. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/260336/9789241550260-eng.pdf?sequence=1&isAllowed=y.

Young, J. E., Forbes, W. F., & Hirdes, J. P. (1994). The association of disability with long-term care institutionalization of the elderly. *Canadian Journal on Aging*, **13**(1), 15–29. doi:10.1017/S0714980800006528