ORIGINAL RESEARCH

Social Vulnerability and Frailty in Hospitalized Older Adults

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ABSTRACT

Background

Social vulnerability is the accumulation of disadvantageous social circumstances resulting in susceptibility to adverse health outcomes. Associated with increased mortality, cognitive decline, and disability, social vulnerability has primarily been studied in large population databases rather than frail hospitalized individuals. We examined how social vulnerability contributes to hospital outcomes and use of hospital resources for older adults presenting to the Emergency Department.

Methods

We analyzed patients 65 years of age or older admitted through the Emergency Department and consulted to internal medicine or geriatrics at a Canadian tertiary care hospital from July 2009 to September 2020. A 20-item social vulnerability index (SVI) and a 57-item frailty index (FI) were calculated, using a deficit accumulation approach. Outcomes were length of stay (LOS), extended hospital LOS designation, alternative level of care (ALC) designation, in-hospital mortality, and discharge to long-term care (LTC).

Results

In 1,146 patients (mean age 80.5±8.3, 54.0% female), mean SVI was 0.40±0.16 and FI was 0.44±0.14. The SVI scores were not associated with admission to hospital. Amongst those admitted, for every 0.1 unit increase in SVI, LOS increased by 1.15 days (p<.001) after adjusting for age, sex and FI. SVI was associated with staying over the expected LOS (aOR: 1.19, 1.05-1.34, p=.009) and ALC status (aOR 1.39, 1.12-1.74, p<.004). SVI was not associated with in-hospital mortality, but was associated with incident discharge to LTC (aOR 1.03, 1.02-1.04, p<.001).

Conclusion

Independent of frailty, being socially vulnerable was associated with increased LOS, designation as ALC, and being discharged to LTC from hospital. Consideration of social vulnerability's influence on prolonged hospitalization and long-term care needs has implications for screening and hospital resources.

Key words: social vulnerability, frailty, emergency department, hospitalization, long-term care placement, social vulnerability index, frail elderly

INTRODUCTION

Non-medical factors influencing health outcomes are known as the social determinants of health. Social determinants are risk factors leading to poor health in older adults.(1) Social determinants also have bidirectional effects; they are risk factors for prolonged hospitalization and delayed discharge from hospital. Consider two older adults presenting to the Emergency Department (ED) with the same acute illness and the same degree of frailty. One experiences a lengthy hospital stay as an alternative level of care (ALC) patient and the other is able to return home after a short admission—many of these differences are explained by social circumstances.

The concept of social vulnerability offers a means of conceptualizing and operationalizing the collective impact of social determinants of health. Social vulnerability is defined as the degree to which an individual's or community's overall social circumstances leave them susceptible to further insults (i.e., health or socially related adverse events).(2) High social vulnerability is associated with an increased risk of mortality,(3–5) disability,(5) and cognitive decline.(6)

Well-established indices of social vulnerability include Cutter, Boruff and Shirley's social vulnerability index to environmental hazards,[7] the Centers for Disease Control and Prevention's index for disaster management planning using census data,[8] and Andrew, Mitnitski and Rockwood's social vulnerability index (SVI) using population based surveys.[9] All the indices reflect different instrumental ways of measuring similar constructs and all have been used previously for health research.

This paper uses the latter method of SVI construction as it is the most common of the three used to examine vulnerability of individuals (rather than community vulnerability). This SVI has been constructed in several large population data sets internationally including the Canadian Study of Health and Aging,[6,9] the Survey of Health, Aging and Retirement in Europe (SHARE),[5] and the Honolulu Asia Aging Study.[10] However, social vulnerability is rarely examined in hospital-based cohorts, which is a setting that can benefit from systematic social vulnerability evaluation for discharge planning.

This paper addresses the gap between population cohorts and hospital cohorts by evaluating how social vulnerability influences a patient's course in hospital, from presentation in the ED to length of stay (LOS) to discharge from hospital. Drawing upon a deficit accumulation approach to conceptualize social vulnerability, this study aims to answer the broad research question: How does social vulnerability contribute to hospital outcomes and use of hospital resources for older adults presenting to the ED?

METHODS

Hypotheses

We hypothesized that higher social vulnerability would be associated with: 1) increased risk of admission to hospital, 2) longer stays in hospital, and 3) increased risk of not returning home after hospitalization.

Study Design and Data

This is a secondary data analysis of the Geriatric Patient Information Database, a single-site cohort study of prospectively enrolled older adults presenting to the ED in a large Canadian tertiary care center in Halifax, Nova Scotia from July 2009 to September 2020. Patients 65 years or older were seen by a geriatrician, senior internist or member of their team (senior medical resident or geriatric fellow) and completed a Comprehensive Geriatric Assessment (CGA). This database, known as the Geriatric Patient Information Database (GPID) has been described in previous publications.[11,12]

The GPID was linked to Vital Statistics data (birth and death data from the Government of Nova Scotia up to March 2020) and the Discharge Abstract Database (hospital outcome database up to April 2020 developed by the Canadian Institute for Health Information). Neighbourhood level variables from the 2016 Canadian Census were linked to the GPID using the Postal Code Conversion File Plus (PCCF+) 7C.

Measures

A 20-item SVI was calculated using deficit accumulation methodology.[4,6,13] Candidate variables for inclusion in the SVI were identified from the CGA (Appendix A) based on several criteria. First, variable (or item or deficit) selection had to include a wide range of factors representing a holistic view of the patient's social circumstances. We included measures of socio-economic status, social engagement, social isolation, living situation, advanced care planning, and caregiver relationships. Second, the variables chosen had to reflect strictly social circumstances and not overlap with variables comprising the frailty index. Finally, variables included had literature demonstrating potential to adversely impact health outcomes in a deprivation state.

Building on the SVI described by Andrew and Keefe,[3] we included eight neighbourhood-level variables because an individual's social vulnerability is directly influenced by their larger social networks, cultures, environments, and institutions.[3] An example of a neighbourhood variable is the unemployment rate of a dissemination area (DA) compared to the rest of the DAs in the province. DAs represent approximately 500 individuals and are the smallest standard geographic unit for census data. The 2016 Canadian Census was chosen as the best and most recent representation of this cohort's living situation. We demonstrate the 20 SVI variables situated within an ecological framework in Figure 1.

Each social deficit is coded between 0 and 1, with 1 indicating the greatest state of relative vulnerability (e.g., being married is coded 0 and single or widowed is coded 1). For intermediate responses, deficits may take a value of 0.5. Ordinal variables rank into a score according to number

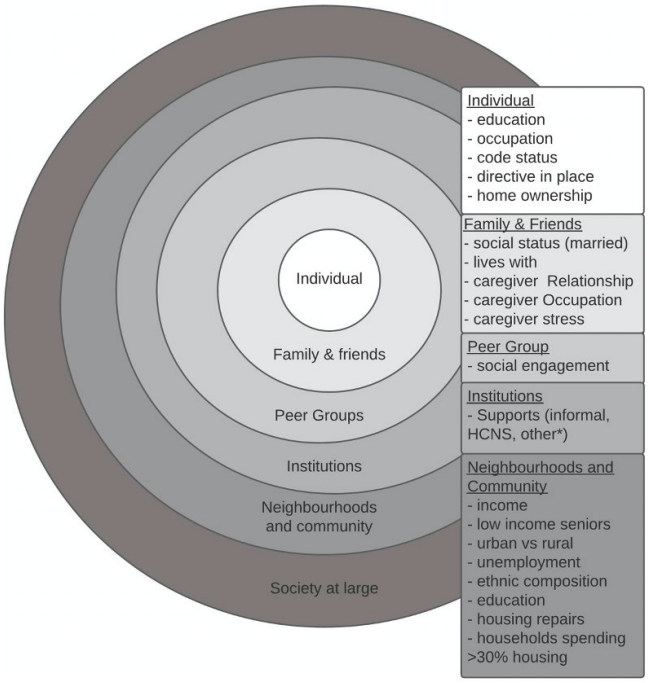

FIGURE 1. Social variables used to construct the SVI, organized within an ecological framework

of levels. For example, a deficit with four levels would be coded 0 for the social variable characteristic that is most protective, 0.33 and 0.66 for middle states of vulnerability, and 1 for the most detrimental characteristic for vulnerability. The scores for all social deficits were summed and divided by the total (/20), yielding a range of final SVI scores from 0–1. Appendix B shows each social deficit included in the SVI and their coding.

Frailty is measured as a 57-item frailty index (FI) using the same methods described above. The variables and coding of the FI is available in Appendix B and in previous publications.[11] The SVI and FI were multiplied by 10 before addition to the regression models, allowing us to interpret adjusted odds ratios (aORs) and LOS for each 0.1 increase in these indices.

Outcomes

The outcomes reflect an older adult's journey from ED presentation to hospital admission to discharge. The outcomes are: 1) admission to hospital, 2) extended hospital length of stay designation (defined as staying longer than the expected length of stay calculated for an individual's case mix), 3) LOS in hospital measured in days, 4) being designated ALC status (defined as utilizing a hospital bed but determined not to require the acuity of the services), 5) in-hospital mortality, 6) discharge to home with or without services, and 7) incident discharge to a long-term care (LTC) home (new admissions, excludes the 23 patients who were already living in a LTC home).

Statistical Methods

Summary statistics of baseline categorical and continuous variables and of missing data were produced using descriptive statistics (frequencies and proportions). *T*-tests and chi-square testing were used to describe differences in means and proportions between the older adults seen only in the ED and those admitted to hospital. Multivariable Poisson regression was used to determine the association between SVI or FI (explanatory variables) and hospital LOS (outcome). Separate multivariable logistic regression models were employed for the remaining binary outcomes described in the previous section. *P* values shown at this step are calculated from the likelihood ratio test, except for new long-term care placement. As the rarest event in the data set (<5% prevalence), the association between the odds of new LTC home placement and social vulnerability or frailty was calculated using Firth's penalized likelihood logistic regression to help remove small sample bias.[14] The final models were adjusted for age and gender, which were identified as having a priori importance as potential confounders. All analyses were conducted in RStudio (Boston, MA; www.rstudio.com).

Missing Data

Individuals (n=853) with data for at least 80% of the social variables comprising the SVI (at least 16 social deficits recorded) were compared to individuals missing more than 20% of the SVI variables (n=293). Compared to those with more complete data, individuals in the missing data group demonstrated no difference in mean age (missing group age = 79.85 [SD 8.11] vs. complete group age = 80.74 [SD 8.33], *t*-test p=.11), or mean frailty score (missing group FI = 0.43[SD0.14] vs. complete group FI = 0.45[SD0.14], *t*-test p=.14). In total, the proportion of missing data among all individuals was 15.3% and the proportion of missing data among patients admitted to hospital was 8.8%. We would expect a higher rate of missing data in the patients who were only seen in the emergency department compared to those who were admitted to hospital with a longer duration of follow-up. In instances where there are more than 10% missing data , statistical analyses are likely to be biased[15] and necessitate some method of accounting for missing data beyond complete case analysis or pairwise deletion.[16] Modern analysis methods include multiple imputation, maximum likelihood, and expectation-maximization. To date, several studies have not found significant differences between the approaches,[15,16] therefore suggesting leaving the decision at the discretion of the authors and data. Missing data at the item level was therefore handled using multiple imputation via chained equations.[17] The results of 20 imputed data sets were pooled using Rubin's rules[18] to avoid underestimation of the impact of social vulnerability on older adults for whom missing data may be due to being more socially vulnerable. Appendix C includes the fraction of missing information (the proportion of sampling error due to missing data) per effect estimate.

Ethics Approval

All individuals or their substitute decision-makers consented in writing to their data being collected as part of the GPID. This study was approved by the Nova Scotia Health Authority Research Ethics Board (NSHA-REB File No. 1022792).

RESULTS

Descriptive Statistics

Of 1,146 older adults with a mean age of 80.5 years (SD8.3), half were women (54.0%). Most were residents of Nova Scotia (98.9%), and 93.5% lived in the Halifax census metropolitan area. In the ED, the mean SVI score was 0.40(SD 0.16) and the mean FI score was 0.44(SD 0.14). Women were more likely to have greater SVI scores (p<.001), but not higher frailty scores (p=.08) (Appendix D). The association between age or frailty and SVI was not statistically significant. Over half of the older adults seen in the ED were subsequently admitted to hospital (62.0%). Individuals admitted to hospital were more likely to be older and living with greater frailty but were not more likely to be socially vulnerable. Table 1 shows the characteristics of all participants.

Hypothesis 1: Admission to Hospital

Frailty, but not social vulnerability, was associated with admission to hospital (aOR 1.25, CI: 1.14–1.36, p<.001). No significant interaction was found between SVI and FI or SVI and gender for admission to hospital or for any outcome discussed below.

Hypothesis 2: Hospitalization

Once admitted to hospital SVI was associated with an extended length of stay and ALC status. For every 0.1 increase in the SVI, older adults had 1.4 times increased odds of becoming ALC status on the way to incident LTC placement (adjusted OR 1.39, CI: 1.12-1.74, p =.004) or 1.2 times increased odds of having an extended hospital LOS designation (OR 1.19, CI: 1.05-1.34, p =.008) as shown in Figure 2. For every 0.1 increase in the SVI, length of stay in hospital increased by 1.15 days (CI: 1.12–1.17, p<.001).

Hypothesis 3: Discharge Destination

Figure 2 also summarizes the association between SVI, FI, and discharge destination. FI, but not SVI, was associated with a 70% increase in odds of dying in hospital (aOR 1.69, CI: 1.42, 2.00, p<.001). Among older adults who did not die in hospital, those with higher social vulnerability were less likely to return home (aOR 0.84, 95% CI 0.73, 0.96, p=.009). In a penalized regression model, SVI was also associated with greater odds of incident LTC home admission (aOR 1.03, CI: 1.02, 1.04, p<.001). Effect estimates, confidence intervals, and p values of all outcomes are available in Appendix C.

DISCUSSION

By aiming to understand the role of social vulnerability in this population of older adults presenting to the ED, we found that social vulnerability played a larger role once admitted to hospital, and contributed to longer stays in hospital and being unable to leave after resolution of an acute illness (designated ALC status). Frailty, rather than social vulnerability, was associated with increased risk of admission to hospital. Frailty appeared to drive in hospital mortality. Both high social vulnerability and frailty, independent of the other, were associated with decreased odds of returning home and with increased LTC home admission.

Our results indicate key similarities and differences between previous studies conducted with the SVI in large population data sets. We also found that women were more socially vulnerable than men.[19] We did not find social vulnerability to be a robust marker of mortality after adjusting for frailty. This sample of older adults demonstrated greater degrees of frailty and social vulnerability than previously studied populations, particularly in contrast to community dwelling older adults. This may suggest that when a person reaches a certain level of frailty, it is the acuity of the medical illness that drives immediate outcomes. SVI was important once the acute medical illness had stabilized. This is consistent with the lone study of this SVI in a hospitalized cohort; Godin and colleagues found that social vulnerability mattered most for admission to LTC following hospitalization in the oldest old with influenza and acute respiratory illnesses.[20]

Our finding that individuals admitted to hospital were more likely to be older and living with greater frailty but were not

TABLE 1.
Demographic characteristics: means (SD) or frequency (%)

	All	*ED Only*	*Admitted after ED*
n (%)	1146 (100)	435 (38.0)	711 (62.0)
Mean age (SD)	80.51(8.3)	79.53 (8.36)[a]	81.11(8.18) [a]
n female (%)	619(54.0)	234(53.8)	385(54.2)
Mean SVI (SD)	0.40 (0.16)	0.38 (0.13)	0.38(0.13)
Mean FI (SD)	0.44 (0.14)	0.41(0.16) [a]	0.46(0.13) [a]

[a]*T*-test met statistical significance at p<.01.

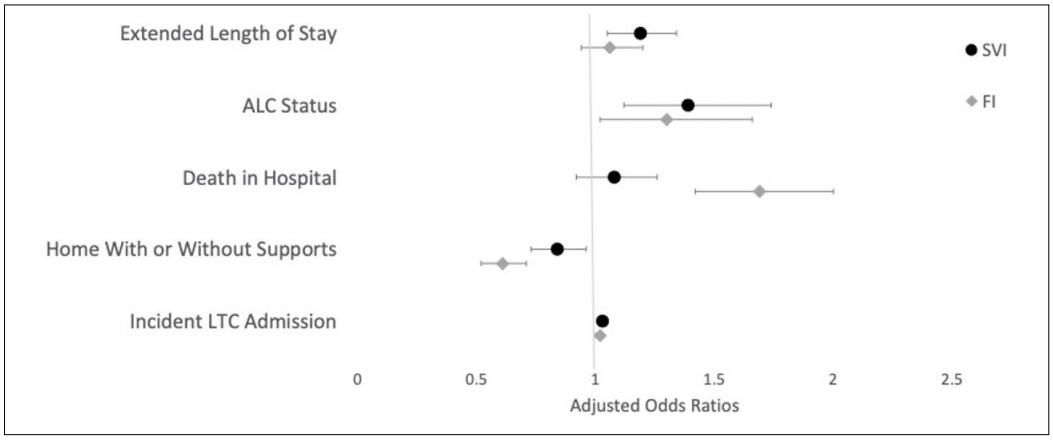

FIGURE 2. Associations between frailty, social vulnerability and hospital outcomes of extended length of stay designation, ALC status, death, and discharge destination

more likely to be socially vulnerable raises additional questions. Is the decision to [not] admit potentially a key place to intervene for the socially vulnerable to avoid lengthy hospital admissions or having to move to LTC? Or are we better at ignoring the contributions of social vulnerability in the ED and feel more comfortable for these individuals to be admitted to be assessed in a safe (in-patient) environment by a multidisciplinary team? Could the Emergency Department before admission be the ideal location to implement a hospital at-home program as described by previous studies?[21] In this situation, a dilemma arises: How do we balance safe discharge with allowing dignity of individual risk? We also found that social vulnerability, but not frailty, was associated with extended LOS defined as LOS greater than expected according to case-mix definitions. This suggests that currently used case-mix allowances for LOS do a better job accounting for frailty than accounting for SV. This would be important to policy makers, especially as these case-mix definitions are used to compensate institutions for patient stays and track performance. If a hospital admits from more socially vulnerable populations, it will be unsurprising that they will have longer LOS; for this they should be resourced, not punished.

Our study is not without limitations. The GPID represents a prospectively recruited sample of older adults seen by an internal medicine or geriatric specialist in the ED prior to admission in one province. Assessment by physicians comfortable with medically and socially complex patients may contribute to Hypothesis 1 results trending towards the null value. The same results may not be seen in a broader population of older adults presenting to the ED who were not seen by such a specialist. Furthermore, the GPID was collected at a single site, which limits generalizability of these findings. It would be interesting to repeat these analyses on a broad sample of all patients admitted across services, who have not had specialist assessment on presentation, or to repeat this study at another hospital site. As in any clinical database, there were some missing data, however no important between-group differences in age or frailty were noted for those with vs. without missing data, and a robust multiple imputation methodology was used.

One strength of this sample is that it captures older adults in crises, as the ED is often the safety net for untreated medical or social issues, and this is reflected in the high vulnerability of the FIs and SVIs.

CONCLUSION

This study demonstrated that being socially vulnerable, independent of frailty, was associated with increased LOS, becoming ALC, and being newly discharged to LTC from hospital. The findings—that the acuity of the medical illness drives admission and mortality outcomes in the most frail populations, but social vulnerability keeps them in hospital or otherwise institutionalized—contributes to the evolving literature on understanding how to use social vulnerability in different settings when caring for an aging population.

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CONFLICT OF INTEREST DISCLOSURES

JCM's graduate studies are supported by scholarships from the Pierre Elliot Trudeau Foundation, Dalhousie Medical Research Foundation's Dr. Patrick Madore Scholarship, Dalhousie University's Department of Medicine's Killam Postgraduate Medical Scholarship & University Internal Medicine Research Foundation Fellowship. KR is President and Chief Science Officer of DGI Clinical, which in the last five years has contracts with pharma and device manufacturers on individualized outcome measurement. In 2019 he attended an advisory board meeting with Nutricia. Otherwise any personal fees are for invited guest lectures and academic symposia, received directly from event organizers, chiefly for presentations on frailty. He is Associate Director of the Canadian Consortium on Neurodegeneration in Aging, which is funded by the Canadian Institutes of Health Research, and with additional funding from the Alzheimer Society of Canada and several other charities. He receives career support from the Dalhousie Medical Research Foundation as the Kathryn Allen Weldon Professor of Alzheimer Research, and research support from the Canadian Institutes of Health Research, the QEII Health Science Centre Foundation, the Capital Health Research Fund and the Fountain Family Innovation Fund of the QEII Health Science Centre Foundation. KR has asserted copyright of the Clinical Frailty Scale through Dalhousie University. Use is free for research, education or not-for-profit care (users are asked not to change it or charge for its use). MKA reports grants from Canadian Consortium on Neurodegeneration in Aging (CCNA), with funding from Canadian Institutes of Health Research (CIHR). MKA reports grant funding and honoraria from Sanofi, GSK, Pfizer, Seqirus and the Canadian Frailty Network for work relating to frailty and vaccine preventable illness. All other authors declare that they have no competing interests.

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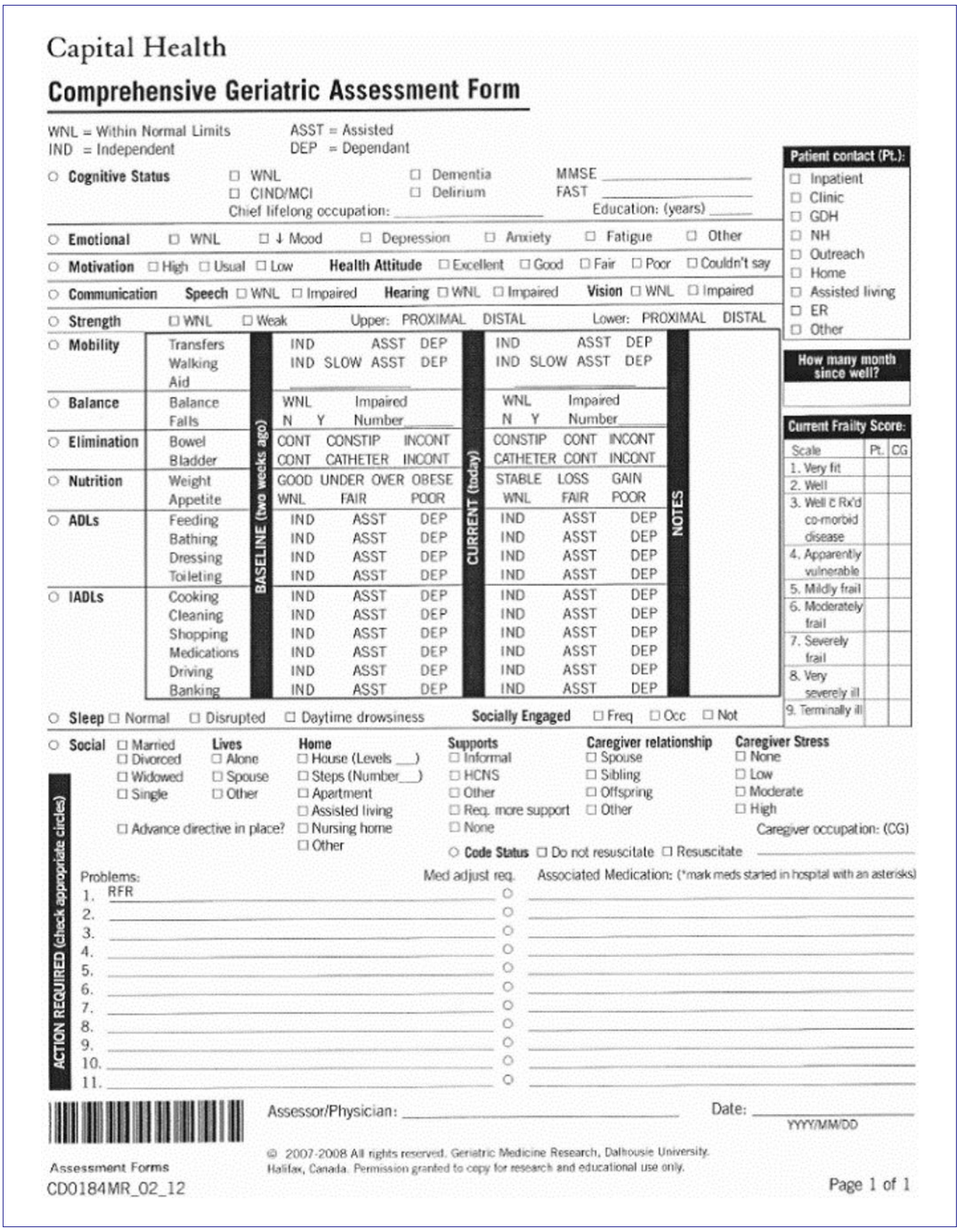
APPENDIX A. Comprehensive geriatric assessment



Capital Health

Comprehensive Geriatric Assessment Form

WNL = Within Normal Limits
IND = Independent
ASST = Assisted
DEP = Dependant

Patient contact (Pt.): ☐ Inpatient ☐ Clinic ☐ GDH ☐ NH ☐ Outreach ☐ Home ☐ Assisted living ☐ ER ☐ Other

How many month since well?

○ **Cognitive Status** ☐ WNL ☐ CIND/MCI ☐ Dementia ☐ Delirium MMSE _____ FAST _____ Chief lifelong occupation: _____ Education: (years) _____

○ **Emotional** ☐ WNL ☐ ↓ Mood ☐ Depression ☐ Anxiety ☐ Fatigue ☐ Other

○ **Motivation** ☐ High ☐ Usual ☐ Low **Health Attitude** ☐ Excellent ☐ Good ☐ Fair ☐ Poor ☐ Couldn't say

○ **Communication** **Speech** ☐ WNL ☐ Impaired **Hearing** ☐ WNL ☐ Impaired **Vision** ☐ WNL ☐ Impaired

○ **Strength** ☐ WNL ☐ Weak Upper: PROXIMAL DISTAL Lower: PROXIMAL DISTAL

		BASELINE (two weeks ago)	CURRENT (today)	NOTES
○ **Mobility**	Transfers	IND ASST DEP	IND ASST DEP	
	Walking	IND SLOW ASST DEP	IND SLOW ASST DEP	
	Aid			
○ **Balance**	Balance	WNL Impaired	WNL Impaired	
	Falls	N Y Number_____	N Y Number_____	
○ **Elimination**	Bowel	CONT CONSTIP INCONT	CONSTIP CONT INCONT	
	Bladder	CONT CATHETER INCONT	CATHETER CONT INCONT	
○ **Nutrition**	Weight	GOOD UNDER OVER OBESE	STABLE LOSS GAIN	
	Appetite	WNL FAIR POOR	WNL FAIR POOR	
○ **ADLs**	Feeding	IND ASST DEP	IND ASST DEP	
	Bathing	IND ASST DEP	IND ASST DEP	
	Dressing	IND ASST DEP	IND ASST DEP	
	Toileting	IND ASST DEP	IND ASST DEP	
○ **IADLs**	Cooking	IND ASST DEP	IND ASST DEP	
	Cleaning	IND ASST DEP	IND ASST DEP	
	Shopping	IND ASST DEP	IND ASST DEP	
	Medications	IND ASST DEP	IND ASST DEP	
	Driving	IND ASST DEP	IND ASST DEP	
	Banking	IND ASST DEP	IND ASST DEP	

Current Frailty Score:

Scale	Pt.	CG
1. Very fit		
2. Well		
3. Well c Rx'd co-morbid disease		
4. Apparently vulnerable		
5. Mildly frail		
6. Moderately frail		
7. Severely frail		
8. Very severely ill		
9. Terminally ill		

○ **Sleep** ☐ Normal ☐ Disrupted ☐ Daytime drowsiness **Socially Engaged** ☐ Freq ☐ Occ ☐ Not

○ **Social** ☐ Married ☐ Divorced ☐ Widowed ☐ Single **Lives** ☐ Alone ☐ Spouse ☐ Other ☐ Advance directive in place? **Home** ☐ House (Levels ___) ☐ Steps (Number___) ☐ Apartment ☐ Assisted living ☐ Nursing home ☐ Other **Supports** ☐ Informal ☐ HCNS ☐ Other ☐ Req. more support ☐ None **Caregiver relationship** ☐ Spouse ☐ Sibling ☐ Offspring ☐ Other **Caregiver Stress** ☐ None ☐ Low ☐ Moderate ☐ High Caregiver occupation: (CG)

○ **Code Status** ☐ Do not resuscitate ☐ Resuscitate

ACTION REQUIRED (check appropriate circles)

Problems:	Med adjust req.	Associated Medication: (*mark meds started in hospital with an asterisks)
1. RFR	○	
2.	○	
3.	○	
4.	○	
5.	○	
6.	○	
7.	○	
8.	○	
9.	○	
10.	○	
11.	○	

Assessor/Physician: _____ Date: _____ YYYY/MM/DD

Assessment Forms
CD0184MR_02_12

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APPENDIX B. Variables and coding used in constructing the social vulnerability index (SVI) and frailty index (FI)

SVI Variable	*Deficit Scores*				
	0	*0.33*	*0.5*	*0.66*	*1*
Education (yrs)	Num ≥13		9 ≤num≤12		num≤8
Classification of Occupation (number)	num=1	num=2		num=3	num=4
Socially Engaged	Frequently		Occasionally		Not
Social Status	Married				Divorced; Widowed; Single
Lives	Spouse; Other				Alone
Home	House; Apartment				Assisted Living; Nursing Home; Other
Supports	Informal; HCNS; Other; None				Req. more support
Caregiver Relationship	Spouse		Sibling; Offspring		Other
Caregiver Stress	None	Low		Moderate	High
Classification of Caregiver Occupation (number)	num=1	num=2		num=3	num=4
Directive in Place	Box is checked				Box is unchecked
Code Status	Do not resuscitate; resuscitate				Not Known
Neighbourhood Low Income Seniors	Prevalence <3.7%				Prevalence > 3.7% (>75th percentile in NS)
Urban vs. Rural	Large urban population centre				Other
Neighbourhood Unemployment	<Provincial unemployment rate (8.8)				>Provincial unemployment rate (8.8)
Neighbourhood Ethnic Composition (African NS + Aboriginal NS)	Prevalence <12.2%				Prevalence >12.2% (75th percentile in NS)
Neighbourhood Education (high school plus)	Highest quartile	Second highest quartile		Second lowest quartile	Lowest quartile
Neighbourhood House in need of Major Repairs	Highest quartile	Second highest quartile		Second lowest quartile	Lowest quartile
Neighbourhood Households Spending >30% on Shelter	Highest quartile	Second highest quartile		Second lowest quartile	Lowest quartile

	1	*0.25*	*0.5*	*0.75*	*1*
Neighbourhood Income	*Highest quintile*	*Med-High quintile*	*Med quintile*	*Low-med quintile*	*Lowest quintile*

Domain	*FI Variable*	*Coding*
Cognitive Status	Cognitive Status	Within normal limits = 0; Cognitively impaired, not demented/Mild cognitive impairment = 0.5; Dementia = 1
	Delirium	No = 0; Yes = 1
	Mini-Mental State Examination	≥25 = 0; ≥20 and ≤24 = 0.33; ≥11 and ≤19 = 0.66; ≤10 = 1
	Functional Assessment Staging Scale	1 or 2 = 0; 3 or 4 = 0.5; ≥5 = 1

APPENDIX B. Continued

	1	*0.25*	*0.5*	*0.75*	*1*
Neighbourhood Income	*Highest quintile*	*Med-High quintile*	*Med quintile*	*Low-med quintile*	*Lowest quintile*
Domain	*FI Variable*			*Coding*	
Emotional	Low Mood Depression Anxiety Fatigue Other			No = 0; Yes = 1	
Motivation	Motivation			High or Usual = 0; Low = 1	
	Health Attitude			Excellent or Good = 0; Fair = 0.5; Poor or Couldn't say = 1	
Communication	Speech Hearing Vision			Within normal limits = 0; Impaired = 1	
Strength	Strength			Within normal limits = 0; Weak = 1	
	Upper/Lower Proximal/Distal Strength			No impairment = 0; 1 area = 0.25; 2 areas = 0.5; 3 areas = 0.75; All 4 areas = 1	
Mobility	Transfers Walking Walking Aid			Independent = 0; Assisted = 0.5; Dependent = 1 Independent = 0; Slow = 0.33; Assisted = 0.66; Dependent = 1 None = 0; Cane or Walker or Wheelchair = 1	
Balance	Balance			Within normal limits = 0; Impaired = 1	
Elimination	Bowel Bladder Use of Catheter Constipation			Continent = 0; Incontinent = 1 No = 0; Yes = 1	
Nutrition	Weight			If Pre-admission Weight = Good & Admission Weight: Stable = 0; Loss or Gain = 0.5 If Pre-admission Weight = Under & Admission Weight: Stable or Under = 1; Gain = 0 If Pre-admission Weight = Over & Admission Weight: Stable = 0.5; Loss = 0; Gain = 1 If Pre-admission Weight = Obese & Admission Weight: Stable or Gain = 1; Loss = 0	
ADLs	Feeding Bathing Dressing Toileting			Independent = 0; Assisted = 0.5; Dependent = 1	
IADLs	Cooking Cleaning Shopping Medications Driving Banking				
Sleep	Day Drowsiness			No = 0; Yes = 1	
Number of Problems				Number up to a maximum of 18	
Number of Medications				≥0 and ≤4 = 0; ≥5 and ≤9 = 1; ≥10 and ≤14 = 2; ≥15 = 3	

APPENDIX C. Adjusted odds ratios, confidence intervals, *p* values, and fraction of missing information of hospital outcomes

	n (/711)	SVI				*FI*			
		b[a]	aOR[a]	p	fmi	b[b]	aOR[b]	p	fmi
Hospital Course									
Extended LOS	364	0.16 (0.04, 0.28)	1.19 (1.05, 1.34)	0.009	0.015	0.055 (-0.06, 0.17)	1.06 (0.94, 1.20)	0.368	0.033
ALC Status	54	0.33 (0.11, 0.55)	1.39 (1.12, 1.74)	0.004	0.062	0.26 (0.02, 0.51)	1.30 (1.02, 1.66)	0.033	0.12
Hospital Discharge Destinations									
Death in Hospital	150	0.074 (-0.08, 0.23)	1.08 (0.92, 1.26)	0.352	0.038	0.52 (0.35, 0.69)	1.69 (1.42, 2.00)	<0.001	0.036
Readmission to Hospital	114	-0.04 (-0.10, -0.19)	0.96 (0.83, 1.13)	0.648	0.035	-0.17 (-0.33, -0.02)	0.84 (0.72, 0.98)	0.030	0.0035
Home With or Without Supports	488	-0.18 (-0.31, -0.04)	0.84 (0.73, 0.96)	0.009	0.033	-0.50 (-0.65, -0.35)	0.61 (0.52, 0.71)	<0.001	0.071
Incident LTC home admission	34	0.030 (0.020, 0.039)	1.03 (1.02-1.04)	<0.001	0.054	0.20 (0, 0.31)	1.02 (1.00,1.03)	<0.001	0.015

[a]All models are adjusted for age, gender, and FI.
[b]All models are adjusted for age, gender, and SVI.
aOR = adjusted odds ratio; fmi = fraction of missing information.

APPENDIX D. SVI and FI sex differences