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Original Research

Comparing two common frailty measures in the resident assessment instrument in home care (RAI-HC): a cross-sectional cohort study in Alberta

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ABSTRACT

Background: Many older adults living with frailty rely on publicly funded home care services; however, the health profile of home care clients in Alberta is not well characterized, particularly regarding how different frailty measures embedded within the Resident Assessment Instrument in Home Care (RAI-HC) classify frailty. We aimed to compare the Changes in Health, End-stage disease and Signs Scale (CHESS) and the 72-item Frailty Index (Full FI) in this study.

Methods: A cross-sectional study was conducted using Alberta population-based administrative data linked to RAI-HC assessments for long-stay home care clients aged 65–104 years ($N = 19{,}916$) between 2015 and 2016. Various health and functional characteristics were summarized across robust, pre-frail, and frail groups as defined by CHESS and Full FI. Group differences were examined using chi-square tests, and agreement between measures was assessed using a weighted kappa statistic.

Results: Frailty prevalence differed markedly by measure: 27% were classified as frail using CHESS compared with 11% using the Full FI. Agreement between measures was fair ($k = 0.31$), reflecting their measurement of different constructs; acute health instability (CHESS) versus multidimensional deficit accumulation (Full FI).

Conclusions: Differences in frailty classification underscore the conceptual distinctions between CHESS and the Full FI. The Full FI is feasible to derive from RAI-HC data and may better identify modifiable deficits relevant to care planning, while CHESS is more sensitive to acute deterioration. Using both measures together may enhance frailty identification, support tailored home care interventions, and improve resource allocation for older adults aging in place.

1. Introduction

As the population ages and individuals live longer with chronic conditions including frailty, better-integrated health and social support systems are needed. Globally, frailty prevalence was 31% in Oceania (95% CI=20–42%; $n = 4$, I^2=99%; $P < 0.001$), 25% in the Americas (95% CI=16–35%; $n = 10$, I^2=100%; $P < 0.001$), and 19% in Europe (95% CI=16–21%; $n = 9$, I^2=100%; $P < 0.001$) [1]. In Canada, about 1.8 million older adults by 2031, will require home care services; an increase of just over 50% from 2019 [2]; and within the next decade, an increase of 1.6–2.5 million older adults with frailty is expected [3]. In response, global and national priorities have shifted to emphasize strategies to deliver home- and community-based care, so that older adults can age in place with appropriate supports [4–6]. Home care services in Canada include publicly and privately funded services by nurses, healthcare aides, or allied health professionals [7–9] with one out of six older adults ≥ 65 years with frailty receiving publicly funded home care [10].

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Frailty is defined by two dominant perspectives: Frailty Index [11] (defined as a state) and Fried Phenotype [12] (defined as a syndrome). Frailty Index was developed based on an accumulation of deficits (i.e., impairments in physical, psychological, and social domains) where estimations of degree of frailty are presented as ratios [13]. Fried Phenotype is based on the presence or absence of five criteria: unintentional weight loss; weakness; self-reported exhaustion; slow walking speed; and/or low physical activity to characterize individuals who are robust, pre-frail/intermediate, or frail [12].

Older adults with frailty have complex care needs because of multiple comorbidities that further complicate acute health issues, all of which can lead to major changes in health status [14,15]. The progressive nature of frailty and related functional decline necessitates increases in home care services and, at times, transition to long-term care (LTC), increased risk of extended hospital stays, number of hospitalizations, and mortality [16–19].

Although frailty is an important phenomenon in the home care population, an established measure has not been implemented. In prior research, comparisons of frailty measures in home care and assisted living populations have yielded substantially different frailty prevalence estimates and only modest agreement despite associations with adverse outcomes [20–22]. Comparing commonly used frailty measures based on the Resident Assessment Instrument in Home Care (RAI-HC) data is needed for accurate interpretation and application in geriatric clinical assessment and health services research. To address this gap, we conducted a cross-sectional cohort study using home care population-based data from Alberta, Canada. The objective of this study was to compare two common methods of measuring frailty in the RAI-HC. The results contributed to understanding the profile of publicly funded home care clients with frailty using appropriate frailty measures and helped identify those at risk of further decline in health or functional ability, which can inform home care coordination efforts.

2. Materials and methods

2.1. Setting

Alberta Health Services is the province-wide health authority responsible for delivering and coordinating health care across Alberta, including hospital, community, and continuing care services (includes home care services). Home care services are provided to assist clients (with valid healthcare cards) on a long-stay (>30 days; ongoing care to remain independent and safe) or short-stay basis (<30 days; care for post-surgical recovery or temporary respite) to remain safe, competent, and in good health while living in their homes or in congregated settings, such as a lodge [23]. Clients who received publicly funded home care services, either in their own homes or from specific congregated settings comprised our cohort.

2.2. Data sources

Encrypted and linked population-based administrative datasets were used in this study: (1) RAI-HC: standardized and validated clinical assessment tool completed by home care case managers and repeated at 12-month intervals or earlier during significant clinical changes (housed within Alberta Continuing Care Information System) [10]; (2) National Ambulatory Care Reporting System (NACRS): contains standardized reporting on all emergency department (ED) visits [24,25]; (3) Discharge Abstract Database (DAD): contains standardized chart abstractions on all hospitalizations [24,26]; (4) Practitioner Claims database: for physician visits [27]; and (5) Pharmaceutical Information Network (PIN) Dispenses database: for community and outpatient prescriptions. These datasets are commonly used for research purposes [28–30] and have been studied extensively for validity. They were linked at the individual level using encrypted identifiers by the analyst from the Data Enterprise Warehouse and transferred securely to the Health Research Database Repository at the University of Alberta (U of A) for analyses.

This study was approved by the research ethics board at the U of A (ID: Pro00094280). Informed consent was waived because population level data without identifiers were obtained for analyses.

2.3. Cohort

The cohort for this study comprised Alberta residents aged 65 years or older who received home care services on January 1, 2015 (baseline) and underwent at least one RAI-HC assessment between January 1, 2015, and April 1, 2016 (index assessment). If more than one assessment was completed during this period, routine RAI-HC assessment closest to the baseline was selected to ensure that variables measured reflect clients' statuses as close to the start of the observation period. For each cohort member, a 1-year look-back window from index assessment was used to capture health service use in the administrative claims data. Age (65–74, 75–84, or 85–105 years) and sex (male or female) data were obtained from RAI-HC. Age was stratified as above based on widely used gerontological research groupings to observe age-related trends of health status, functional capacity, frailty, hospitalization or non-linear increases in risk [31].

2.4. Health status measures

2.4.1. Chronic conditions and medications

Chronic conditions highly associated with frailty obtained as coded diagnoses in RAI-HC were diabetes, congestive heart failure, hypertension, chronic obstructive pulmonary disease, Alzheimer's disease, dementia, arthritis, and osteoporosis [12,32–34]. Prescription medications classified according to the Anatomical Therapeutic Chemical code and organized by diagnoses from PIN data were counted. Respective anticholinergic risks were reported for a 1-year look-back period from index assessment because this class of medication is highly related to frailty and has an increased risk of adverse effects in older adults such as falls, cognitive decline, functional impairment, and mortality [35].

2.4.2. Functional status, cognitive status and depression

Functional and cognitive statuses were determined using outcome scales in RAI-HC, with scale score cutoffs presented as three groups based on previous studies [36–42]. Activities of Daily Living (ADL) Hierarchy Scale is used to measure self-performance (i.e. personal hygiene and eating), with scores from 0–6 (no impairment-total dependence). Disablement processes are reflected by grouping impairment levels into stages of loss that indicate progression of functional decline [37,42–44].

Instrumental Activities of Daily Living (IADL) Difficulty Scale is a hierarchical index used to measure difficulties experienced when completing tasks such as meal preparation, ordinary housework, and using a phone with scores from 0–2, reflecting early, middle, and late stages of loss, respectively [44].

Cognitive Performance Scale (CPS) comprises four items (memory; communication; executive function; complete dependence in eating), with scores from 0–6 (intact to severe) that reflect cognitive function [42].

Depression Rating Scale (DRS) comprises seven items based on frequency of depression symptoms over the last 72 h with scores from 0–14 and ≥3 indicating potential or actual depression [44].

2.5. Frailty measures

Changes in Health, End-stage disease and Signs Scale (CHESS) and Full Frailty Index (Full FI) were selected because they were used to examine frailty in home care research, are derived from RAI-HC, and have discrete categories of frailty (robust, pre-frail, and frail), for comparability of findings.

Table 1
RAI-HC items used to calculate the CHESS scale.

Worsening of decision-making
ADL Decline
Less than six months to live
Vomiting
Edema
Shortness of breath
Unintended weight loss
Noticeable decrease in food/fluid consumed
Insufficient fluid

Note: RAI-HC: Resident Assessment Instrument-Home Care.
CHESS: Changes in Health, End-stage disease and Signs Scale.
ADL: Activities of Daily Living.

2.5.1. CHESS (See Table 1)

CHESS was developed to measure health instability in LTC residents but has been used to classify frailty in assisted living residents and home care clients [20–22,45], and is considered a proxy measure of frailty. CHESS was derived from nine RAI-HC items that reflect acute changes in health status [20] and is an embedded outcome scale in RAI-HC. Total scores range from 0–5, denoting increasing level of instability. When collapsed into three categories, these scores denote frailty with cut-points defined as robust (0), pre-frail (1), and frail (2–5) [20,45]. CHESS is conceptually aligned with frailty because it captures short-term clinical changes in clients that can result in rapid decline in health status.

2.5.2. Full FI (See supplementary table S1)

Full FI is an accumulation of deficits type of index derived from RAI-HC items, with scores ranging from 0–1, representing the proportion of the 72 items endorsed in individual assessments [20,46]. Final cut-points were defined as robust (<0.2), pre-frail (0.2–0.3), and frail (>0.3), consistent with findings from studies with 0.2 approaching a frail state [21,46,47].

2.6. Health service use measures

Number of ED visits per client was counted, and among them, the number of potentially preventable visits, defined as those related to ambulatory care sensitive conditions (ACSC) [48] such as angina, asthma, chronic obstructive pulmonary disease, diabetes, epilepsy, heart failure, pulmonary edema, and hypertension, were identified using a 1-year look-back period from index assessment [49,50]. Number of hospitalization episodes per individual was counted using 1-year look-back period from index assessment. If more than one hospitalization episode occurred within 24 h, they were counted as a single episode to account for transfers between hospitals. These measures were chosen because frailty increases vulnerability to acute illness, infections, functional decline, falls, and medication-related complications, which can frequently lead to urgent and unplanned acute care use.

Number of alternate level of care (ALC) days during hospitalization were counted. ALC days are periods when patients ready for discharge remain in hospital after a point where they no longer require hospital services. ALC days is a critical indicator in frailty research because it captures the intersection between patient-level vulnerability (e.g., prolonged recovery times, complex discharge needs, limited caregiver support) and system-level challenges (e.g., home care support availability, assisted living/LTC placement).

Frequency of family physician visits was identified using 1-year look-back from index assessment.

2.7. Data analysis

Frequencies of demographic, health status, and health service use measures were reported for robust, pre-frail, and frail individuals. Categorical variables were evaluated using chi-square tests at index assessment to compare frailty groups identified using Full FI and CHESS, first as a 3-way group (robust vs. prefrail vs. frail) and then as pairwise groups (robust vs. pre-frail and pre-frail vs. frail). No adjustments were applied in either group comparisons. A weighted kappa statistic was calculated to assess agreement between the collapsed CHESS scale and Full FI classification (robust, pre-frail, or frail), interpreted as follows: poor if $k < 0.00$, slight if $0.00 \leq k \leq 0.20$, fair if $0.21 \leq k \leq 0.40$, moderate if $0.41 \leq k \leq 0.60$, substantial if $0.61 \leq k \leq 0.80$, and almost perfect if $k > 0.80$ [51]. Since the primary aim was to compare frailty classification and agreement between measures, analyses of health service use were conducted descriptively and were not adjusted for confounders. Also, many potential confounders (e.g., comorbidities, function, cognition) are embedded within the Full FI. Adjusting for these would constitute overadjustment and may attenuate or obscure the association of interest. All analyses were 2-tailed, defined at $P < 0.05$ statistical significance level, and conducted using SAS © software version 9.4 (SAS Institute Inc., Cary, NC, USA).

3. Results

3.1. Frailty classification

A baseline cohort of 19,916 home care clients was identified and categorized according to frailty status using both Full FI (Table 2) and CHESS (Table 3). Large differences were observed in proportions of clients in frailty groups between the two measures as follows: 61% robust, 28% pre-frail, and 11% frail (Full FI) vs. 43% robust, 30% pre-frail, and 27% frail (CHESS).

Statistically significant differences by age were observed between pre-frail and frail groups (frail older, $P = 0.05$), and by sex between robust and pre-frail groups (fewer females among pre-frail, $P = 0.03$) categorized by Full FI. Significant differences were observed across three frailty groups for age ($P = 0.03$) and sex ($P \leq 0.0001$), between robust and pre-frail groups for age (robust older, $P = 0.01$), and pre-frail and frail groups for sex (fewer females among frail, $P \leq 0.0001$) categorized by CHESS.

Chronic conditions associated with frailty showed statistically significant differences across all group comparisons because Full FI includes almost all conditions contained in RAI-HC, leading to stronger associations than those observed with CHESS. CHESS showed significantly increased prevalence across increasing frailty levels for congestive heart failure and lung disease.

Sex-stratified analyses demonstrated statistically significant differences across frailty categories for both women and men using both the Full FI and CHESS (see Supplementary Tables S2-S3); however, the magnitude and consistency of these associations differed between measures. Using the Full FI, significant differences were observed across all frailty groups for multiple domains in both sexes, including comorbidities, functional status, cognition, mood, and medication burden ($P < 0.0001$). For example, among females, dementia increased significantly from 11.5% in the robust group to 38.2% in the frail group ($P < 0.0001$), and among males from 12.3% to 45.6% ($P < 0.0001$). Similarly, severe functional dependence (ADL hierarchy score ≥ 3) increased significantly across frailty levels for both females (1.3% to 36.0%, $P < 0.0001$) and males (2.3% to 41.5%, $P < 0.0001$). In contrast, CHESS also demonstrated statistically significant differences across frailty categories in both sexes across multiple domains, including functional status, cognition, mood, and health service use; however, these associations were less consistent across all variables. Strong and consistent increases were observed for congestive heart failure and lung disease across frailty groups in both females and males (all groups $P < 0.0001$).

For all ED visits, ED falls, and potentially preventable ED visits, where significant differences existed, higher levels of frailty were associated with more ED visits, hospitalizations, and ALC days. Statistically significant differences in health service use were also observed with sex-

Table 2
Characteristics of home care clients in Alberta by frailty status categorized using the Full FI.

	Overall Cohort (N=19,916) Full FI Frailty Groups					
Frailty Groups categorized by Full FI	Robust n (%)	Pre-frail n (%)	Frail n (%)			
	12,050 (60.5)	5,602 (28.1)	2,264 (11.4)			
Characteristics				*p-values significant if ≤0.05*		
				3-way groups	robust vs pre-frail	pre-frail vs frail
Age group						
65 – 74 y	2,349 (19.5)	1,126 (20.1)	411 (18.2)	P=0.1884	P=0.5145	P=0.0452
75 – 84 y	4,463 (37.0)	2,086 (37.2)	825 (36.4)			
85 – 105 y	5,238 (43.5)	2,390 (42.7)	1,028 (45.4)			
Sex						
Male	4,206 (34.9)	2,051 (36.6)	798 (35.3)	P=0.0859	P=0.0273	P=0.2543
Female	7,844 (65.1)	3,551 (63.4)	1,466 (64.8)			
Comorbidities						
Osteoporosis	2,095 (17.4)	1,303 (23.3)	647 (28.2)	P=<.0001	P=<.0001	P=<.0001
Arthritis	5,919 (49.1)	3,265 (58.3)	1,412 (62.4)	P=<.0001	P=<.0001	P=0.0008
Alzheimer disease	453 (3.8)	434 (7.8)	254 (11.2)	P=<.0001	P=<.0001	P=<.0001
Dementia	1,422 (11.8)	1,400 (25.0)	924 (40.8)	P=<.0001	P=<.0001	P=<.0001
Hypertension	7,655 (63.5)	3,997 (71.4)	1,641 (72.5)	P=<.0001	P=<.0001	P=0.3127
Congestive heart failure	1,178 (9.8)	1,033 (18.4)	479 (21.2)	P=<.0001	P=<.0001	P=0.0056
Lung disease (Emphysema/ COPD/ asthma)	2,144 (17.8)	1,392 (24.9)	615 (27.2)	P=<.0001	P=<.0001	P=0.0329
Diabetes	2,770 (23.0)	1,765 (31.5)	730 (32.2)	P=<.0001	P=<.0001	P=0.5247
ADL Hierarchy Scale						
0 (independent)	10,821 (89.8)	3,539 (63.2)	666 (29.4)	P=<.0001	P=<.0001	P=<.0001
1 or 2 (setup only)	1,029 (8.5)	1,544 (27.6)	739 (32.6)			
≥3 (extensive assistance/total dependence)	200 (1.7)	519 (9.3)	859 (37.9)			
IADL Difficulty Scale						
0 (no difficulty to perform IADLs)	1,709 (14.2)	104 (1.9)	13 (0.6)	P=<.0001	P=<.0001	P=<.0001
1 or 2 (some difficulty to perform IADLs)	4,479 (37.2)	931 (16.6)	87 (3.8)			
≥3 (some/great difficulty to perform IADLs)	5,862 (48.7)	4,567 (81.5)	2,164 (95.6)			
Cognitive Performance Scale						
0 (no impairment)	7,363 (61.1)	1,667 (29.8)	219 (9.7)	P=<.0001	P=<.0001	P=<.0001
1 or 2 (moderate impairment)	4,423 (36.7)	3,189 (56.9)	1,106 (48.9)			
≥3 (moderate to severe impairment)	264 (2.2)	746 (13.3)	939 (41.5)			
Depression Rating Scale						
0 (no mood symptoms)	9,698 (80.5)	2,583 (46.1)	492 (21.7)	P=<.0001	P=<.0001	P=<.0001
1 or 2 (few mood symptoms)	1,891 (15.7)	1,700 (30.4)	552 (24.4)			
≥3 (depression)	461 (3.8)	1,319 (23.6)	1,200 (53.9)			
Unique prescription medications by ATC Code						
0-5	4,563 (37.9)	1,579 (28.2)	614 (27.1)	P=<.0001	P=<.0001	P=0.4222
6-9	4,033 (33.5)	1,764 (31.5)	702 (31.0)			
10	3,454 (28.7)	2,259 (40.3)	948 (41.9)			
ARS Scale						
0	11,533 (95.7)	5,331 (95.2)	2,120 (93.6)	P=0.0003	P=0.0899	P=0.0236
1 or 2	403 (3.3)	223 (4.0)	118 (5.2)			
≥3	114 (1.0)	48 (0.9)	26 (1.2)			
Family Physician Visits						
0	263 (2.2)	104 (1.9)	55 (2.4)	P=<.0001	P=0.0004	P=0.2856
1-14	8,549 (71.0)	3,835 (68.5)	1,514 (66.9)			
15-28	2,469 (20.5)	1,237 (22.1)	515 (22.8)			
29+	769 (6.4)	426 (7.6)	180 (8.0)			
ED visits						
ED visits category						
0	4,733 (39.2)	1,876 (33.5)	712 (31.5)	P=<.0001	P=<.0001	P=0.0601
1-3	5,582 (46.3)	2,733 (48.8)	1,105 (48.8)			

(*continued on next page*)

Table 2 (*continued*)

	Overall Cohort (N=19,916) Full FI Frailty Groups					
Frailty Groups categorized by Full FI	Robust n (%) 12,050 (60.5)	Pre-frail n (%) 5,602 (28.1)	Frail n (%) 2,264 (11.4)			
Characteristics				*p-values significant if ≤0.05*		
				3-way groups	robust vs pre-frail	pre-frail vs frail
4+	1,735 (14.4)	993 (17.7)	447 (19.7)			
ED Falls						
0	10,424 (86.5)	4,704 (84.0)	1,817 (80.3)	P=<.0001	P=<.0001	P=<.0001
≥1	1,626 (13.5)	898 (16.0)	447 (19.7)			
Potentially preventable ED visits						
0	10,841 (90.0)	4,856 (86.7)	1,985 (87.7)	P=<.0001	P=<.0001	P=0.3593
≥1	1,209 (10.0)	746 (13.4)	279 (12.3)			
Non-elective Hospitalizations						
LOS category (days)						
No hospitalization	8,004 (66.4)	3,374 (60.2)	1,267 (56.0)	P=<.0001	P=<.0001	P=<.0001
1-6	1,258 (10.4)	609 (10.9)	213 (9.4)			
7-13	1,145 (9.5)	572 (10.2)	244 (10.8)			
14+	1,643 (13.6)	1,047 (18.7)	540 (23.9)			
ALC days in hospital category (days)						
0	11,772 (97.7)	5,383 (96.1)	2,156 (95.2)	P=<.0001	P=<.0001	P=0.0833
≥1	278 (2.3)	219 (3.9)	108 (4.8)			
Fall-related hospitalizations						
No	11,385 (94.5)	5,235 (93.5)	2,088 (92.2)	P=<.0001	P=0.0065	P=0.0528
Yes (≥1)	665 (5.5)	367 (6.6)	176 (7.8)			

Full FI: the 72-item Frailty Index, ED: emergency department, COPD: chronic obstructive pulmonary disease ADL: activities of daily living, IADL: instrumental ADL, ALC: alternate level of care LOS: length of hospital stay, ARS: Anticholinergic Risk Scale, ATC: Anatomical Therapeutic Chemical.

stratified analyses, particularly for CHESS. Among females, ED visits showed significant differences across frailty groups ($P < 0.0001$), with the proportion of clients with ≥4 visits increasing from 11.3% in the robust group to 19.3% in the frail group. Similar significant differences were observed among males from 15.7% to 23.0% ($P < 0.0001$). Prolonged hospital stays (≥14 days) also differed significantly across CHESS frailty levels for both females (10.9% to 20.8%, $P < 0.0001$) and males (13.0% to 25.2%, $P < 0.0001$). In comparison, while Full FI also showed significant associations with some service use measures, these differences were less consistent across sexes, particularly for ED visits among males.

Overall, both measures demonstrated statistically significant differences across frailty categories in women and men; however, Full FI showed more consistent associations across multidimensional health domains, whereas CHESS demonstrated stronger associations with select clinical conditions and health service use indicators. However, the sex-stratified analyses did not reveal substantive differences in the overall pattern of associations compared to the main analysis.

3.2. Level of agreement between chess and full FI

In Table 4, of the 12,050 clients classified as robust by Full FI, 58% were categorized as robust, 30% pre-frail and 12% frail by CHESS. Of the 5602 clients classified as pre-frail by Full FI, 34% were categorized as pre-frail, 24% robust, and 42% frail by CHESS. Of the 2264 clients classified as frail by Full FI, 65% were categorized as frail, 13% robust, and 21% pre-frail by CHESS. In Fig. 1, a fair agreement between both frailty measures ($k = 0.31$ [0.30–0.32]) is shown; exact agreement reflects number of clients assigned to the same frailty category by both CHESS and Full FI; partial agreement reflects those classified into different frailty groups.

4. Discussion

In this study, baseline health characteristics were significantly different between pre-frail and frail groups, because clients in these groups have different health trajectories. Pre-frail clients often present as "clinically silent" and are at risk of ADL and IADL decline, whereas frail clients exhibit functional impairment and are at higher risk of adverse outcomes [14,15,52]. These results align with established literature about frailty in that transitions from robustness to pre-frailty and subsequently frailty are clinically meaningful stages that require tailored approaches to assessment and intervention.

Proportions of pre-frail and frail home care clients identified using CHESS and Full FI differed. A larger proportion of clients were identified as frail using CHESS compared to Full FI. Clients identified as frail using Full FI were considered as "more frail" because of the degree of distributional differences between the two measures. CHESS, an algorithm calculated using nine RAI-HC items that reflect acute changes in health status, with scores ranging from 0–5, has low granularity compared with the Full FI [20], contributes to distributional difference. Caution must be exercised when interpreting CHESS as a stand-alone proxy of frailty rather than as a marker of short-term health instability.

Full FI was developed based on an accumulation of deficits approach, with degrees of impairments that are multidimensional within a closed system [53]. Full FI better establishes a gradient (compared to CHESS, a 6-point scale) for identifying at-risk groups, as it includes multidimensional domains that can be reviewed in more detail to examine where deficits lie. This type of in-depth examination can be used to prioritize specialized home care services for pre-frail/frail groups to prevent further decline.

CHESS was developed to examine mortality over a three-year period in institutionalized individuals [54], meaning it is better used for identifying risk of decline and, per our results, categorized more individuals as frail than Full FI. Comparative studies show that CHESS, tends to identify individuals experiencing more acute changes, while

Table 3
Characteristics of home care clients in Alberta by frailty status categorized using the CHESS scale.

	Overall Cohort (N=19,916) CHESS Frailty Groups					
Frailty Groups categorized by CHESS	Robust n (%)	Pre-frail n (%)	Frail n (%)			
	8,579 (43.1)	6,015 (30.2)	5,322 (26.7)			
Characteristics				*p-values significant if ≤0.05*		
				3-way groups	robust vs prefrail	pre-frail vs frail
Age group						
65 – 74 y	1,639 (19.1)	1,207 (20.1)	1,040 (19.5)	P=0.0317	P=0.0088	P=0.6750
75 – 84 y	3,103 (36.2)	2,272 (37.8)	1,999 (37.6)			
85 – 105 y	3,837 (44.7)	2,536 (42.2)	2,283 (42.9)			
Sex						
Male	2,987 (34.8)	2,045 (34.0)	2,023 (38.0)	P=<.0001	P=0.3054	P=<.0001
Female	5,592 (65.2)	3,970 (66.0)	3,299 (62.0)			
Comorbidities						
Osteoporosis	1,692 (19.7)	1,275 (21.2)	1,078 (20.3)	P=0.0924	P=0.0294	P=0.2174
Arthritis	4,426 (51.6)	3,271 (54.4)	2,899 (54.5)	P=0.0004	P=0.0009	P=0.9224
Alzheimer disease	431 (5.0)	335 (5.6)	375 (7.1)	P=<.0001	P=0.1458	P=0.0012
Dementia	1,450 (16.9)	1,080 (18.0)	1,216 (22.9)	P=<.0001	P=0.0980	P=<.0001
Hypertension	5,641 (65.8)	3,990 (66.3)	3,662 (68.8)	P=0.0007	P=0.4662	P=0.0050
Congestive heart failure	740 (8.6)	815 (13.6)	1135 (21.3)	P=<.0001	P=<.0001	P=<.0001
Lung disease (emphysema/COPD/ asthma)	1,237 (14.4)	1,320 (22.0)	1,594 (30.0)	P=<.0001	P=<.0001	P=<.0001
Diabetes	2,171 (25.3)	1,578 (26.2)	1,516 (28.4)	P=0.0002	P=0.2064	P=0.0072
ADL Hierarchy Scale						
0 (independent)	7,021 (81.8)	4,668 (77.6)	3,337 (62.7)	P=<.0001	P=<.0001	P=<.0001
1 or 2 (setup only)	1,056 (12.3)	892 (14.8)	1364 (25.6)			
≥3 (extensive assistance/total dependence)	502 (5.9)	455 (7.6)	621 (11.7)			
IADL Difficulty Scale						
0 (no difficulty to perform IADLs)	1,194 (13.9)	436 (7.3)	196 (3.7)	P=<.0001	P=<.0001	P=<.0001
1 or 2 (some difficulty to perform IADLs)	2,810 (32.8)	1,658 (27.6)	1,029 (19.4)			
≥3 (some/great difficulty to perform IADLs)	4,575 (53.3)	3,921 (65.2)	4,097 (77.0)			
Cognitive Performance Scale						
0 (no impairment)	4,467 (52.1)	2,844 (47.3)	1,938 (36.4)	P=<.0001	P=<.0001	P=<.0001
1 or 2 (moderate impairment)	3,546 (41.3)	2,680 (44.6)	2,492 (46.8)			
≥3 (moderate to severe impairment)	566 (6.6)	491 (8.2)	892 (16.8)			
Depression Rating Scale						
0 (no mood symptoms)	6,409 (74.7)	3,829 (63.7)	2,535 (47.6)	P=<.0001	P=<.0001	P=<.0001
1 or 2 (few mood symptoms)	1,465 (17.1)	1,305 (21.7)	1,373 (25.8)			
≥3 (depression)	705 (8.2)	881(14.7)	1,414 (26.6)			
Unique prescription medications by ATC Code						
0-5	3,286 (38.3)	1,907 (31.7)	1,563 (29.4)	P=<.0001	P=<.0001	P=<.0001
6-9	2,826 (32.9)	2,045 (34.0)	1,628 (30.6)			
10	2,467 (28.8)	2,063 (34.3)	2,131 (40.0)			
ARS Scale						
0	8,186 (95.4)	5,723 (95.2)	5,075 (95.4)	P=0.5168	P=0.4575	P=0.2465
1 or 2	315 (3.7)	225 (3.7)	204 (3.8)			
≥3	78 (0.9)	67 (1.1)	43 (0.8)			
Family Physician Visits						
0	215 (2.5)	127 (2.1)	80 (1.5)	P=<.0001	P=<.0001	P=<.0001
1-14	6,213 (72.4)	4,168 (69.3)	3,517 (66.1)			
15-28	1,633 (19.0)	1,307 (21.7)	1,281 (24.1)			
29+	518 (6.0)	413 (6.9)	444 (8.3)			
ED visits						
ED visits category						
0	3,706 (43.2)	2,099 (34.9)	1,516 (28.5)	P=<.0001	P=<.0001	P=<.0001
1-3	3,771 (44.0)	2,943 (48.9)	2,706 (50.9)			

(*continued on next page*)

Table 3 (*continued*)

	Overall Cohort (N=19,916) CHESS Frailty Groups					
Frailty Groups categorized by CHESS	Robust n (%) 8,579 (43.1)	Pre-frail n (%) 6,015 (30.2)	Frail n (%) 5,322 (26.7)			
Characteristics				*p-values significant if ≤0.05*		
				3-way groups	robust vs prefrail	pre-frail vs frail
4+	1,102 (12.9)	973 (16.2)	1,100 (20.7)			
ED Falls						
0	7,444 (86.8)	5,092 (84.7)	4,409 (82.8)	P=<.0001	P=0.0003	P=0.0090
≥	1,135 (13.2)	923 (15.3)	913 (17.2)			
Potentially preventable ED visits						
0	7,952 (92.7)	5,301 (88.1)	4,429 (83.2)	P=<.0001	P=<.0001	P=<.0001
≥1	627 (7.3)	714 (11.9)	893 (16.8)			
Non-elective Hospitalizations						
LOS category (days)						
No hospitalization	6,047 (70.5)	3,696 (61.5)	2,902 (54.5)	P=<.0001	P=<.0001	P=<.0001
1-6	852 (9.9)	636 (10.6)	592 (11.1)			
7-13	682 (8.0)	645 (10.7)	634 (11.9)			
14+	998 (11.6)	1,038 (17.3)	1,194 (22.4)			
ALC days in hospital category (days)						
0	8,377 (97.7)	5,827 (96.9)	5,107 (96.0)	P=<.0001	P=0.0045	P=0.0087
≥1	202 (2.4)	188 (3.1)	215 (4.0)			
Fall-related hospitalizations						
No	8,168 (95.2)	5,594 (93.0)	4,946 (92.9)	P=<.0001	P=<.0001	P=0.8911
Yes (≥1)	411 (4.8)	421 (7.0)	376 (7.1)			

CHESS: Changes in Health, End-stage disease and Signs Scale, ED: emergency department, COPD: chronic obstructive pulmonary disease ADL: activities of daily living, IADL: instrumental ADL, ALC: alternate level of care LOS: length of hospital stay, ARS: Anticholinergic Risk Scale, ATC: Anatomical Therapeutic Chemical.

Table 4
Crosstabulation of the CHESS and Full FI frailty categories.

Frailty Measures	CHESS (N = 19,916)		
Full FI (N = 19,916)	Robust (n, %)	Pre-frail (n, %)	Frail (n, %)
Robust (n = 12,050)	6929 (57.5)	3636 (30.1)	1495 (12.4)
Pre-Frail (n = 5602)	1347 (24.0)	1908 (34.1)	2347 (41.9)
Frail (n = 2264)	303 (13.4)	481 (21.3)	1480 (65.3)

CHESS: the Changes in Health, End-stage disease and Signs Scale, Full FI: the 72-item Frailty Index.

Note: Proportion of clients classified into each frailty category by CHESS when compared to Full FI.

Weighted kappa statistic: k = 0.31 [95% CI: 0.30–00.32], indicating fair agreement between the two measures.

Fig. 1. Agreement between the CHESS and the Full FI CHESS: Changes in Health, End-stage disease and Signs Scale; Full FI: 72-item Frailty Index.

Full FI captures multidimensional vulnerability (i.e. comorbidities, functional changes), resulting in different risk profiles and prevalence estimates across populations [20–22,53].

CHESS should be interpreted primarily as a measure of acute health instability rather than a proxy frailty measure. It was originally developed to predict mortality and clinical decline based on acute changes in health status, and captures recent deterioration such as fluctuating cognition, symptoms, and physiological instability. In contrast, the Full FI operationalizes frailty as the accumulation of multidimensional deficits across functional, cognitive, psychosocial, and disease domains. These conceptual differences explain the observed discrepancies in prevalence and classification between the two measures and reinforce that they represent related but distinct constructs.

CHESS is well-suited to detect acute deterioration that guides immediate risk management whereas Full FI identifies longer-term frailty burden progression needing targeted interventions such as rehabilitation and home care support. Conceptually, CHESS answers: “is this person unstable right now?”; Full FI answers: “how frail is this client overall?”; and when used together answers: “what does this client need today and over time?” From a clinical perspective, discordant classifications between CHESS and Full FI may be informative rather than problematic. For example, a high CHESS score with a low Full FI may indicate acute deterioration in a client with relatively low accumulated deficits, warranting immediate monitoring or reassessment. Conversely, a high Full FI score with a low CHESS score may reflect chronic multidimensional vulnerability requiring anticipatory care planning, rehabilitation, or long-term support services. When both measures indicate frailty, clients may require both urgent clinical attention and comprehensive care planning. Integrating both measures into routine assessment may therefore support more nuanced decision-making without increasing assessment burden, as both are derived from existing RAI-HC

data. Therefore, home care planning can be optimized with complementary use of CHESS and Full FI.

The sex-stratified analyses provide additional insight into how these measures perform across women and men and further support the conceptual distinction between CHESS and the Full FI. Women are known to access long-stay home care services earlier, and home care services typically meet the needs of women better, as shown in a previous study [55]. In our study, the Full FI demonstrated consistent and statistically significant differences across increasing levels of frailty for both sexes across domains, including comorbidity burden, functional impairment, cognitive decline, depressive symptoms, and health service use. These findings reflect the multidimensional nature of deficit accumulation and support the robustness of the frailty index in capturing broad vulnerability across physiological systems.

In contrast, CHESS also identified significant differences across frailty categories in both sexes, including functional status, cognition, mood, and health service use; however, these associations were less consistent across all domains and varied by condition. The strongest and most consistent associations were observed for select clinical conditions, such as congestive heart failure and lung disease, and for indicators of acute care use, including ED visits and prolonged hospital stays. These findings align with prior research demonstrating that frailty indices capture broad vulnerability across multiple physiological systems, whereas CHESS is more sensitive to acute clinical instability and short-term risk of adverse outcomes [22,56,57]. The observed sex-stratified patterns also support existing evidence that, although frailty is more prevalent in women, men with frailty often experience greater severity of deficits and worse outcomes [58,59]. Notably, in our study, increases in cognitive impairment and functional dependence were more pronounced among males in some frailty categories, whereas females comprised a larger proportion of the cohort overall, reflecting known sex differences in longevity and care utilization.

Overall, these findings suggest that both measures perform similarly across sexes in identifying increasing risk compared to the main analysis, although the magnitude and consistency of associations vary by domain. Full FI provides a more comprehensive assessment of multidimensional frailty relevant for long-term care planning, while CHESS may be more informative for identifying acute instability and short-term service needs. Incorporating sex-specific considerations into frailty assessment may further enhance the precision of care planning and resource allocation in home care settings.

This study has several limitations. Our analyses were restricted to frailty measures derived from RAI-HC data and did not include any comparative analyses with other clinical measures (e.g., Fried Frailty Phenotype [12]), as this study was focused on embedded scales in RAI-HC and those that could be derived using RAI-HC data. Therefore, direct comparability with international studies employing physical performance-based assessments is limited. In our study, measures examined were either concurrent at the time of or backward-looking in the year prior to index assessment and did not consider the future state. Health service use, death, or institutionalization after index assessment are important aspects in understanding implications of frailty and can inform home care service coordination for community-dwelling older adults. Accordingly, the present findings should be interpreted as reflecting differences in classification and baseline risk profiles rather than the ability of CHESS or the Full FI to predict longitudinal outcomes such as mortality, long-term care placement, or future hospitalization. Determining the comparative prognostic performance of these measures will require longitudinal analyses with follow-up beyond the index assessment. As well, comparisons of health service use across frailty groups were unadjusted and should be interpreted as descriptive. Observed differences in ED visits, hospitalizations, and ALC days may be confounded by age, sex, comorbidity, or functional status. Future studies using multivariate analyses are required to determine the independent association between frailty measures and health service use.

Finally, although the RAI-HC is completed by trained healthcare professionals using standardized assessment protocols, the large cohort size implies that assessments were conducted by many different assessors across settings. This may introduce inter-rater variability in the measurement of certain domains, such as functional or cognitive status, despite established reliability of the instrument. Variability in clinical judgment and documentation practices may contribute to some degree of non-differential misclassification, of select items such as functional status due to unconscious bias, even though RAI-HC is valid and reliable overall [42], which should be considered when interpreting the results.

In conclusion, the results from this study highlight the complementary value of CHESS and Full FI in Alberta's publicly funded home care system. CHESS is best used to identify short-term health instability, that would enable immediate clinical response and targeted monitoring whereas Full FI provides comprehensive and multidimensional assessments for care planning, chronic disease management, and anticipatory resource allocation. Recognizing that frailty is both progressive and dynamic, suggests that using these measures together offers a more complete understanding of clients' needs. Integrating Full FI using RAI-HC with the embedded RAI-HC CHESS into routine practice in Alberta can enhance the precision of identifying older adults at risk of frailty, guide resources allocation, and strengthen the capacity of the system to support healthy aging in place.

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Data availability statement

The data is owned by the data custodian, Health Shared Services (previously Alberta Health Services) and they do not authorize publicly releasing data because it can only be released with proper research ethics board approval and data sharing agreements. Further inquiries can be submitted through the Alberta SPOR SUPPORT Unit at http://absporu.ca.

Declaration of generative AI and AI-assisted technologies in the manuscript preparation process

During the preparation of this work the author(s) did not use generative AI or AI-assisted technologies.

CRediT authorship contribution statement

Jananee Rasiah: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. **Andrea Gruneir:** Writing – review & editing, Supervision, Methodology. **Jeffrey Poss:** Writing – review & editing, Supervision, Methodology. **Jayna Holroyd-Leduc:** Writing – review & editing, Supervision. **Greta.G. Cummings:** Writing – review & editing, Supervision.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

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