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RESEARCH PAPER

Frailty change based on minimally important difference in nursing home residents: FIRST cohort study findings

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Abstract

Background: Frailty is common among residential aged care services (RACS) residents; however, little is known about how frailty changes over time in this population. This study aimed to estimate minimally important difference (MID) in frailty to then describe: frailty change over 12 months; and factors associated with worsening frailty.
Methods: Prospective cohort study across 12 RACS sites of a single aged care organisation in South Australia ($n = 548$ residents, mean age 87.7 ± 7.2 years, 72.6% female). Frailty was measured using a frailty index (FI) with 12 months between baseline and follow-up. MID was calculated cross-sectionally (anchor-based using self-reported health, and $^1/_2$SD for distribution-based).
Results: Between-person MID for the FI was identified as 0.037 (anchor-based) and 0.063 (distribution-based). Using the conservative value of 0.063 as the basis for change, 32.3% ($n = 177$) of residents remained stable, 13.7% ($n = 75$) improved, 33.0% ($n = 181$) worsened and 21.0% ($n = 115$) died over 12 months. In a multivariable analysis, significant predictors of the dichotomous outcome of worsening and death at 12 months were: being malnourished (odds ratio (OR) = 2.15, 95% confidence interval (CI) = 1.23, 3.75), at risk of malnutrition (OR = 1.98, 95%CI = 1.34, 2.91) and diabetes (OR = 1.61, 95%CI = 1.06, 2.42) compared to those who remained stable or improved.
Conclusions: A 6.3% change in frailty for RACS residents is a conservative MID. Frailty is dynamic in RACS residents, and stability or improvement was possible even for the most-frail. Treatments such as nutritional interventions, exercise and diabetes management are likely to benefit frailty.

Keywords: frailty, nursing home, Australia, minimally important difference, aged, older people

Key Points

- A 6.3% change in frailty was identified as a conservative minimally important difference (MID) in nursing home residents.
- Using MID as the basis of change, 32.3% of residents remained stable, 13.7% improved, 33.0% worsened and 21% died over 12 months.
- Significant predictors of worsening included: being malnourished or at risk of malnutrition and diabetes.

Introduction

Frailty is a state of decreased physiological reserve across multiple body systems associated with adverse health outcomes and increased use of healthcare resources [1] and is highly prevalent among residential aged care services (RACS) residents [2]. It can be mistakenly assumed that, because of frailty, a 'point of no return' is crossed with an inevitable downward trajectory of health and functional status [3]. However, it is recognised that improvement in frailty is possible and remaining stable over ≥12 months is common among community-dwelling older people [4].

We do not know if stability of frailty or improvement occurs in people living in RACS. The provision of care and support services upon entering RACS may lead to stabilising and improvement of health and function [5]. There has been little examination of frailty change in RACS, apart from one Korean study which found frailty improvement (9%) and stability (26%) were possible when measured using the frailty phenotype (FP) [6]. In part, this might be because of the difficultly of phenotypical assessment of gait and grip strength in this population [7]. One option for progressing the investigation of frailty change is to use the cumulative deficit, or frailty index (FI), methodology and consider change from the perspective of minimally important difference (MID) [8]. MID is a score representing a change in a health outcome that is considered meaningful both to the individual and clinically [9]. There is an advantage of using MID to examine change, rather than category change, as there is consistency in the magnitude of what is considered 'change'.

A few community studies have examined frailty MID and identified a FI change between 0.06 and 0.11 as being potentially meaningful for community-dwelling older adults, with the higher value being the more conservative estimate [10, 11]. No study to date has investigated MID in RACS residents. Furthermore, it is important to develop an understanding of the nature of frailty change of RACS residents, based on a change that residents perceive to be important as well as being clinically important, in order to provide a risk profile of individuals who could benefit from interventions to reverse or delay frailty and maximise quality of life.

The aims of this study were to estimate MID in FI scores for RACS residents and then use this as the basis for describing frailty change and factors associated with worsening (including death) compared to remaining stable or improving over 1 year.

Methods

The protocol for this study has been published and is briefly described here [12]. Ethics approval was granted by the University of Adelaide Human Research Ethics Committee (HREC-2018-247).

Participants and setting

This sample consisted of participants from the Frailty in Residential Aged Care Sector Over Time (FIRST) Study [12], a prospective cohort of South Australian (SA) older adults living in RACS. Participants were recruited across 12 RACS (7 from a metropolitan area, 2 outer-metropolitan and 3 in regional areas) operated by one aged care organisation. SA is the Australian state with the second highest mean age, with 21.6% of the population born overseas (2.3% lower than the national average). In Australia, individuals must meet national eligibility criteria to enter RACS: having a condition of frailty or disability requiring continuing personal care; and being incapable of living in the community without support, with care funded by the Australian Government [13]. RACS is the preferred Australian term consistent with the international consensus definition of nursing home [14].

Of 1,243 residents across the RACS, 183 (14.7%) were excluded from baseline assessment (respite admission, ≤8 weeks in RACS, palliative, substitute decision-maker (SDM) not available, guardianship order, inadequate English to comprehend study information, deemed by clinical staff to be inappropriate or medically unstable). There were 367 (34.6%) residents and 105 (9.9%) SDMs who declined participation, and 27 (2.6%) withdrawals. There were $n = 4$ (discharged, hospital admission) residents lost to follow-up over 12 months. Residents missing >20% FI variables (baseline $n = 8$, follow-up $n = 5$) were excluded from analysis. We included 548 residents in this study. All participants had either a follow-up assessment or mortality data drawn from resident records at least 12 months post baseline. There were no COVID-19 deaths in RACS in South Australia during the follow-up period.

Consent

Informed consent was sought from participants. For those without capacity to consent, a SDM provided informed consent.

Data collected

Baseline data were collected (March–October 2019) from a combination of residents' records, observations, physical assessments and questionnaires administered by research registered nurses (RNs) and answered by residents and site-RNs. Site-RNs were required to have known the respective resident for at least 2 weeks prior to baseline assessment. Domains in the baseline assessment: socio-demographic information, medical history, medication, activities of daily living, pain, level of sedation, grip strength, sarcopenia risk, quality of life, life space diameter and frailty status. Follow-up assessment occurred 12 months after baseline (≤10 days beyond 12 months) Due to COVID-related visiting restrictions being implemented between 25 March 2020 and 22 June 2020, there was no face-to-face follow-up data collection, and site-RN reporting was used instead. Face-to-face data

Table 1. Frailty index variables and data source

	T1	T2		T1	T2		T1	T2
Congestive heart failure	RR	RR	Any tumour	RR	RR	Dozing as a passenger in a car[a]	SR/RN	RN
Peripheral vascular disease	RR	RR	Falls	RR	RR	Dozing while lying down to rest[a]	SR/RN	RN
Connective tissue disease	RR	RR	Bathing assistance[b]	RR	RR	Dozing while sitting after lunch[a]	SR/RN	RN
Ulcer disease	RR	RR	Dressing assistance[b]	RR	RR	Napping frequency[c]	SR/RN	RN
Hypertension	RR	RR	Toileting assistance[b]	RR	RR	Memory[d]	RN	RN
Atrial fibrillation	RR	RR	Energy[e]	SR/RN	RN	Speech and language[d]	RN	RN
Insomnia	RR	RR	Mood[e]	SR/RN	RN	Recognition of family members[d]	RN	RN
Depression	RR	RR	Living situation[e]	SR/RN	RN	Orientation to time[d]	RN	RN
Arthritis	RR	RR	Family[e]	SR/RN	RN	Orientation to place[d]	RN	RN
Hip fracture	RR	RR	Friends[e]	SR/RN	RN	Ability to make decisions[d]	RN	RN
Other fracture	RR	RR	Self as a whole[e]	SR/RN	RN	Social and community activity[d]	RN	RN
Osteoporosis	RR	RR	Ability to do things for fun[e]	SR/RN	RN	Home activities and responsibilities[d]	RN	RN
Gout	RR	RR	Life as a whole[e]	SR/RN	RN	Personal care, cleanliness[d]	RN	RN
Pressure sores	RR	RR	Dozing while reading[a]	SR/RN	RN	Eating[d]	RN	RN
Dry eyes	RR	RR	Dozing while watching TV[a]	SR/RN	RN	Control of urination and bowels[d]	RN	RN
Urinary incontinence	RR	RR	Dozing while sitting in public[a]	SR/RN	RN			

T1, baseline; T2, 12-month follow-up; RR, resident record; SR, self-report by resident; RN, site-registered nurse response. Source of wording for variables: [a]Epworth Sleepiness Scale (baseline: $n = 400$ self-report by resident, $n = 148$ report by site-RN. [b]Katz Activities of Daily Living Scale. [c]Sleep Quality Questionnaire (baseline: $n = 402$ self-report by resident, $n = 146$ report by site-RN. [d]Dementia Severity Rating Scale. [e]Quality of Life in Alzheimer's Disease Scale (baseline: $n = 406$ self-report by resident, $n = 142$ report by site-RN).

collection resumed post 22 June 2020, with a preference for site-RNs to answer questions whenever possible to minimise resident exposure time to the study nurse, replacing resident self-report for 15 FI variables.

Frailty

Frailty was measured using a 47-item FI covering a variety of health and functional characteristics [15, 16]. Variables were coded between zero (no deficit) and one (maximal deficit expression), and we reported the proportion of deficits as a continuous FI. FI deciles (≤20%, >20–30%, >30–40%, >40–50%, >50–60% and >60%) were also used. (three-category FI in Supplementary Table S2) [15]. We excluded variables from the FI which were used in other instruments or single covariable, or not available and identical at baseline and follow-up. FI variables for each time-point are described in Table 1.

Covariables

We used the Mini Nutritional Assessment—Short Form (MNA) to measure nutritional status. MNA scores range between 0 (worst status) and 14 points (best nutritional status). [17] Nutritional status was classified as normal (12–14 points), at risk (8–11 points) and malnourished (0–7 points). MNA scores were retrieved from resident records. The MNA is completed on entry to the RACS, every 6 months, and following an acute change in condition.

A modified SARC-F was used to measure sarcopenia risk in this study. The SARC-F measures five characteristics: strength; assistance with walking; rising from a chair; climbing stairs; and falls [18]. Scores range from 0 (best) to 10 (worst), with those scoring ≥4 classified as being at risk of sarcopenia. We used one physically assessed variable (strength), and one RACS record-based variable (number of falls), with all other variables based on site-RN answers. (Supplementary Table S1 describes SARC-F variables and scoring.)

The Nursing Home Life Space Diameter (NHLSD) measures the range and frequency of mobility of RACS residents [19]. Life space diameter is measured in terms of both extent of movement (1, within room; 2, outside room, within the unit; 3, outside the unit, throughout the facility and 4, outside the facility) and frequency (0, never; 1, less than weekly; 2, at least weekly; 3, >2 times a week; 4, 1–3 times a week and 5, >3 times a week). Each diameter score is multiplied by a frequency score and summed to produce a total score. Possible scores range from 0 (bed-bound) to 50 (able to leave the facility daily). Site-RNs reported NHLSD.

Other covariates included: age, sex, length of residential stay, comorbidities (myocardial infarction, stroke, chronic obstructive pulmonary disease, dementia, diabetes) and polypharmacy (≥9 medications).

Minimally important difference

Two approaches were used to estimate a MID range in this sample: anchor-based and distribution-based methods [9, 20]. The anchor-based approach for estimating MID is based on the relationship between changes in the outcome variable to an important 'anchor' variable [9]. A weighted average of the difference in FI (range: 0–1) continuous scores between each successive category of responses to the question on self-rated physical health was used as an anchor-based estimate and was drawn from the Quality of Life in Alzheimer's Disease Scale (QOLAD) [21] question: 'How do you feel about your physical health?' scored [1] poor, [2] fair, [3] Good, [4] excellent. Only participants with self-rated responses ($n = 415$) were included in the estimation. The average was weighted by the number of observations contributing to

each mean score. Between-group and between-person MID were identified using this approach with the baseline cross-sectional data. Because the site-RN completed the QOLAD for all patients at follow-up, within-person MID could not be estimated because of a lack of suitable patient-reported outcome at both time-points [20]. The distribution-based method for estimating MID is based on the distribution of observed scores in a sample. We used a half standard deviation (SD) of FI scores as the basis for distribution-based measurement as this is recognised as an important conservative clinical estimate [9].

Frailty change

Frailty change was based on the largest, and therefore, more conservative MID estimate. Change directions included: (i) stable (did not improve or worsen beyond MID), (ii) improved (greater than MID), (iii) worsened (greater than MID) and (iv) dead.

Analysis

SPSS v.23 software (IBM Corp, Armonk, NY) was used for all statistical analyses. An alpha value of 0.05 was used for determining statistical significance. Death details were drawn from RACS records. Significance testing of cross-tabs used Pearson chi-squared test for categorical variables and Kruskal–Wallis test for continuous variables, which were non-normally distributed.

Independent associations

We compared two groups of residents: (i) those who worsened (including dead) and (ii) those who remained stable or improved. Univariate logistic regression was used to identify candidate variables for multivariate analysis. All covariates were examined. We included variables with a P-value of <0.25 as well as age and sex. A final multivariable logistic regression model was derived using backward elimination of non-significant variables, checking for confounding at each step. Baseline frailty status was not included in the regression analysis as it would have violated the assumptions of the model, being a component of both dependent and independent variables. Instead, we examined differences between the observed and expected counts in the cells of the cross tabulation of baseline FI deciles and frailty MID change (improved, same, worse and dead) using adjusted standardised residuals to identify significant differences. Values >2.0 or < -2.0 were considered significantly different.

Results

We identified frailty between-person MID estimates in a cohort of $n = 548$ RACS residents (mean age 87.7(7.2) years, 72.6% female) (Table 2). Using an anchor-based method (with QOLAD self-rated health as an anchor), the MID for the FI was 0.037 and was slightly higher in a sensitivity analysis that excluded residents with dementia (0.040). A distribution-based approach of $^1/_2$SD applied to the whole sample identified a change of 0.063 as minimally important. This was higher than the $^1/_2$SD MID of 0.049 for the subset who had a QOLAD health anchor. The larger and more conservative MID estimate of 0.063 was used in this study as the basis of frailty change.

The mean baseline frailty score was 0.40 (0.13) (range 0.12–0.78) (Table 2. See Supplementary Table S2 for three-category frailty classification). Over 12 months, 32.3% ($n = 177$) of residents remained stable, while 13.7% ($n = 75$) experienced a MID improvement (a mean improvement of 0.11 ± 0.04), and 54.0% ($n = 296$) worsened (which included death for 21.0% [$n = 115$]), with a mean worsening of 0.15 ± 0.07. Mean frailty score at follow-up was 0.42 (0.14) (range 0.11–0.81). Adjusted standardised residuals between baseline FI deciles and frailty MID change (improved, same, worse and dead) revealed that remaining stable was significantly more likely in the 20–30% range, and the 12–20% range had a higher estimated proportion but not statistically significant due to small sample size. (Figure 1, Supplementary Table S3) Successive deciles of baseline frailty experienced progressively higher mortality rates. A worse frailty change was more likely for those in the moderate baseline frailty range 20–30% and 30–40%; however, those with >50% baseline frailty were less likely to worsen and more likely to die. Those most-frail, >60% baseline decile, experienced significantly higher rates of both improvement and mortality. (Mean change in individual FI variables for the cohort and stratified by frailty severity are described in Supplementary Tables S4–6.)

A sensitivity analysis comparing mode of reporting (self-report [$n = 395$] or site-RN [$n = 153$]) of some FI variables at baseline identified significantly higher mean frailty scores for residents with site-RN scored variables (0.52) compared with self-report (0.35, $P < 0.001$). However, there was no significant difference ($P = 0.902$) in frailty change between residents' self-report or site-RN scoring in multivariable analysis.

Significant predictors of worsening frailty status over 12 months in multivariable analysis (Table 3) included: older age (odds ratio (OR) = 1.04; 95% confidence interval (CI) = 1.01, 1.06), risk of malnutrition (OR = 1.98, 95%CI = 1.34, 2.91), malnourished (OR = 2.15; 95%CI = 1.23, 3.75) and diabetes (OR = 1.61; 95%CI = 1.06, 2.42) (Table 4).

Discussion

We identified MID estimates for frailty for the first time in a sample of RACS residents, ranging between 0.037 (anchor-based) and 0.063 (distribution-based). Anchor- and distribution-based approaches are recognised as producing MID estimates that are worthwhile to both individuals and clinically through either direct comparison to a patient-reported indicator or 'anchor', in this case self-rated physical health, or indirectly through the distribution of (frailty)

Table 2. Characteristics of participants at baseline and relationship with change in MID frailty change (0.063) over 1 year. Worse includes dead

		Frailty change[a]				
	Total *n* (%)	Improved *n* (%)	Same *n* (%)	Worse *n* (%)	Dead *n* (%)	*P*-value
Total	548	75 (13.7)	177 (32.3)	181 (33.0)	115 (21.0)	–
Age (years), mean (SD)	87.7 (7.2)	85.0 (7.8)	87.6 (7.0)	87.9 (7.3)	89.4 (6.7)	0.001*
Sex						
Male	150 (27.4)	21 (28.0)	45 (25.4)	42 (23.2)	42 (36.5)	0.079
Female	398 (72.6)	54 (72.0)	132 (74.6)	139 (76.8)	73 (63.5)	–
Frailty: continuous mean (SD)	0.40 (0.13)	0.45 (0.13)	0.37 (0.12)	0.36 (0.10)	0.47 (0.12)	<0.001*
Frailty deciles						
≤20%	16 (2.9)	0 (0.0)	8 (4.5)	7 (3.9)	1 (0.9)	<0.001*
>20–30%	117 (21.4)	10 (13.3)	48 (27.1)	50 (27.6)	9 (7.8)	–
>30–40%	180 (32.8)	20 (26.7)	62 (35.0)	73 (40.3)	25 (21.7)	–
>40–50%	113 (20.6)	19 (25.3)	29 (16.4)	34 (18.8)	31 (27.0)	–
>50–60%	81 (14.8)	16 (21.3)	21 (11.9)	15 (8.3)	29 (25.2)	–
>60%	41 (7.5)	10 (13.3)	9 (5.1)	2 (1.1)	20 (17.4)	–
Nutritional status[b]						
Normal	170 (31.1)	21 (28.0)	76 (42.9)	55 (30.4)	18 (15.8)	<0.001*
At risk	299 (54.7)	41 (54.7)	83 (46.9)	115 (63.5)	60 (52.6)	–
Malnourished	78 (14.3)	13 (17.3)	18 (10.2)	11 (6.1)	36 (31.6)	–
Comorbidities						
MI	156 (28.5)	19 (25.3)	41 (23.2)	57 (31.5)	39 (33.9)	0.151
Stroke	162 (29.6)	19 (25.3)	48 (27.1)	56 (30.9)	39 (33.9)	0.501
COPD	130 (23.7)	20 (26.7)	40 (22.6)	43 (23.8)	27 (23.5)	0.922
Dementia	206 (37.6)	28 (37.3)	57 (32.2)	73 (40.3)	48 (41.7)	0.306
Diabetes	132 (24.1)	15 (20.0)	37 (20.9)	51 (28.2)	29 (25.2)	0.334
Polypharmacy						
0–8 medications	198 (36.1)	21 (28.0)	69 (39.0)	66 (36.5)	42 (36.5)	0.425
9+ medications	350 (63.9)	54 (72.0)	108 (61.0)	115 (63.5)	73 (63.5)	–
SARC-F sarcopenia risk[c]						
Healthy	57 (10.5)	4 (5.3)	26 (14.9)	26 (14.5)	1 (0.9)	<0.001*
Symptomatic	485 (89.5)	71 (94.7)	149 (85.1)	153 (85.5)	112 (99.1)	–
NHLSD[d] mean (SD)	27.8 (10.2)	27.3 (10.6)	30.3 (9.3)	28.4 (9.7)	23.3 (10.5)	<0.001*
Length of stay, years (SD)	2.5 (2.7)	2.5 (2.4)	2.2 (2.3)	2.5 (2.7)	3.0 (3.1)	0.065
Measures[e] reported by						
Resident	395 (72.1)	52 (69.3)	129 (72.9)	143 (79.0)	71 (61.7)	0.013*
Site RN (1+ measure)	153 (27.9)	23 (30.7)	48 (27.1)	38 (21.0)	44 (38.3)	–

[a]A MID of 0.063 in frailty score was used as the basis for frailty change. [b]Mini Nutritional Assessment, number of points: 12–14, normal; 8–11, at risk; 0–7, malnourished. [c]SARC-F categories, number of characteristics present: 0–3, healthy, ≥4, symptomatic. [d]Nursing Home Life Space Diameter—Score range: minimum 0, maximum 50. A higher score is indicative of greater utilisation of life space. [e]Measures (Quality of Life Alzheimer's Disease Scale, Epworth Sleepiness Scale, Sleep Questionnaire) may be reported either by resident or site-registered nurse, depending on resident capacity. *$P < 0.05$. Main effects reported.

scores across the sample [9]. We used the larger and most conservative MID estimate of 6.3% for measuring frailty change over 12 months. Our MID estimates for the FI are smaller than reported elsewhere: between 0.07 (distribution-based) and 0.11 (anchor-based) in an Australian study of 874 community-dwelling older adults; [8] and between 0.06 (distribution-based) and 0.08 (anchor-based) for conservative estimates among 925 Korean community-dwelling adults [11]. The smaller anchor estimate in our study is likely due to the high frailty prevalence in the cohort with a relatively narrow distribution of frailty scores. Our MID estimates will be useful for determining samples sizes for frailty intervention studies based in RACS and for guiding care planning discussions with residents and their families.

Thus far, only one other study has examined frailty change in RACS over ≥12 months using the FP [6], and none using the FI. Another novelty of our study was the measurement of frailty change based on MID. When frailty change was examined 12 months after baseline, based on a 6.3% MID, we identified that almost half of residents either remained stable or experienced a MID improvement.

Worsening (not including death) was most common among those with moderate frailty (>20–40%), while the severely frail (>50%) were more likely to die rather than worsen, consistent with known FI upper limits of around 0.6–0.7 where accumulating further deficits is untenable [16]. Importantly, a large proportion of the most-frail improved, and this variability in frailty status likely reflects higher vulnerability to stressors and fluctuating presentation. The exclusion of participants from this study who were medically unstable or at end of life will have decreased the proportion dying and increased proportions in all other

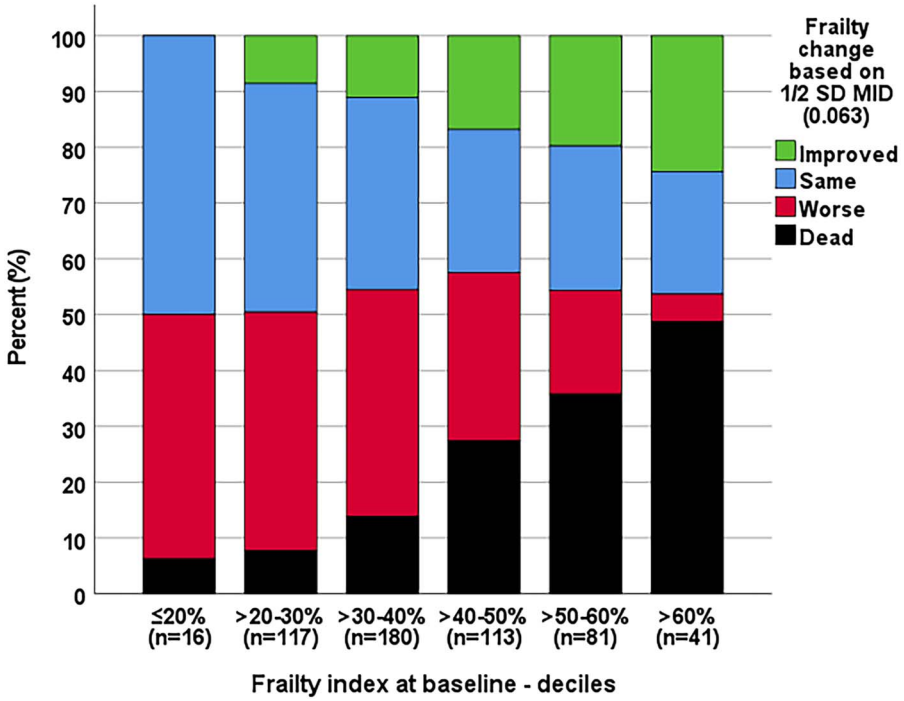

Figure 1. Frailty change (based on a minimally important difference of 0.063) over 1 year according to baseline frailty deciles. There were no residents with frailty scores <12%.

Table 3. Logistic regression of factors associated with frailty change over 12 months. Univariable analysis. Worse includes dead. Reference category is 'the same and improved' ($n = 252$)

		Frailty MID change[a]	
	Total *n* (%)	Worse and dead OR (95% CI)	*P*-value
Total	548		
Age (years), mean (SD)	87.7 (7.2)	1.03 (1.01, 1.06)	0.008*
Sex			
Male	150 (27.4)	1.12 (0.77, 1.63)	0.567
Female	398 (72.6)	1	–
Nutritional status[b]			
Normal	170 (31.1)	1	–
At risk	299 (54.7)	1.88 (1.28, 2.75)	0.001*
Malnourished	78 (14.3)	2.02 (1.17, 3.48)	0.012*
Comorbidities			
MI	156 (28.5)	1.54 (1.05, 2.24)	0.026*
Stroke	162 (29.6)	1.31 (0.90, 1.89)	0.160
COPD	130 (23.7)	0.99 (0.67, 1.47)	0.965
Dementia	206 (37.6)	1.36 (0.96, 1.93)	0.085
Diabetes	132 (24.1)	1.43 (0.96, 2.12)	0.082
Polypharmacy			
0–8 medications	198 (36.1)	1	–
9+ medications	350 (63.9)	0.97 (0.68, 1.37)	0.851
SARC-F sarcopenia risk[c]			
Healthy	57 (10.5)	1	–
Symptomatic	485 (89.5)	1.34 (0.77, 2.32)	0.299
NHLSD[d] mean (SD)	27.8 (10.2)	0.97 (0.95, 0.99)	<0.001*
Length of stay, years (SD)	2.5 (2.7)	1.07 (1.00, 1.14)	0.064

[a]A minimally important difference of 0.063 was used as the basis for frailty change. [b]Mini Nutritional Assessment, number of points: 12–14, normal; 8–11, at risk; 0–7, malnourished. [c]SARC-F categories, number of characteristics present: 0–3, healthy, ≥4, symptomatic. [d]Nursing Home Life Space Diameter—Score range: minimum 0, maximum 50. A higher score is indicative of greater utilisation of life space. *$P < 0.05$.

Table 4. Logistic regression of factors associated with frailty change over 12 months. Multivariable analysis. Reference category is 'the same and improved'. ($n = 252$)

		Frailty MID change[a]	
	Total *n* (%)	Worse and dead OR (95% CI)	*P*-value
Age (years), mean (SD)	87.7 (7.2)	1.04 (1.01, 1.06)	0.005*
Nutritional status[b]			
Normal	170 (31.1)	1	–
At risk	299 (54.7)	1.98 (1.34, 2.91)	<0.001*
Malnourished	78 (14.3)	2.15 (1.23, 3.75)	0.007*
Diabetes	132 (24.1)	1.61 (1.06, 2.42)	0.025*

[a]A MID of 0.063 was used as the basis for frailty change. [b]Mini Nutritional Assessment, number of points: 12–14, normal; 8–11, at risk; 0–7, malnourished. *$P < 0.05$. Main effects reported.

categories. The high rate of stability, and even improvement, of the most-frail residents in our study emphasises the importance of promoting resident well-being through personalised care planning regardless of frailty scores [22].

Our finding of malnutrition risk being a significant predictor of worsening frailty status (including death) over 12 months in multi-variable analysis is consistent with evidence linking malnutrition and frailty, where inadequate intake results in changed body composition and function [23, 24] The higher nutritional risk profile of RACS residents is well known, and there may be a bidirectional relationship between functional and nutritional status, [23] particularly as unintentional weight loss is recognised as a criterion of the FP [1]. A recent Australian Royal Commission into Aged Care reported a high prevalence of undernutrition (68%) among RACS residents with a range of contributing factors including poor quality and unappetising food, and lack of assistance with eating and drinking [25]. Addressing these fundamentals of care is an important step in reducing the nutritional risk of RACS residents. Additionally, preventive strategies such as care planning, and optimising protein and energy intake are important in maintaining the well-being of frail older adults [24]. For residents approaching the very end of life, priorities might instead be focused on comfort.

The role of diabetes in worsening frailty (including death) of residents in this study may be attributable to the condition being associated with an acceleration of loss of skeletal muscle strength [26]. Systemic inflammation and the presence and severity of peripheral neuropathy are considered to be mechanisms by which diabetes contributes to muscle loss [27, 28]. Frail older adults with diabetes are at higher risk of hypoglycaemia, with a range of contributing factors including polypharmacy, endocrine deficits, inadequate nutrition and hydration, cognitive impairment, cardiovascular disease and renal dysfunction [26]. Hypoglycaemia is associated with adverse outcomes including falls, hospitalisation and mortality. Residents with diabetes are likely to benefit from the prevention of hyper- and hypoglycaemia, and strategies for diabetes management should be individualised around frailty status, comorbidities and functional status, aiming to minimise adverse side effects [26], and avoid restricted diets which might exacerbate malnutrition [29].

Study limitations included measurement of frailty at only two time-points. Additional measurements would give a better indication of trajectory, as 12 months is a long timeframe in a frail population. Extreme FI values at one time-point of measurement may be less extreme at another time-point; therefore, some variation in item mean differences could be due to regression to the mean. Variation between self-report and site-RN report of some FI variables may have affected findings, as proxy report is more likely to overestimate impairment [30]; however, we addressed this in a sensitivity analysis. The use of between-person MID rather than within-person is another limitation to generalisability. Dementia prevalence, drawn from resident records, was lower than expected at 37.6%; however, under-reporting of geriatric syndromes is common in RACS records [12]. Finally, all RACS in this study were from one aged care organisation. Further investigations involving RACS from other aged care providers in different jurisdictions in and out of Australia would be beneficial.

In conclusion, we identified 6.3% as a MID for frailty among RACS residents and, using this conservative estimate as a basis of change, found that nearly half of residents either remained stable or improved over 12 months. Malnutrition and diabetes were significant predictors of worsening status. Baseline frailty status was associated with frailty status change; however, stability and improvement were observed even among the most-frail. A focus on nutrition and exercise interventions and diabetes management are potential strategies for achieving healthy longevity in this population.

Supplementary Data: Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

Declaration of Conflicts of Interest: R.V. was previously a board member of Resthaven Inc. and is currently on the clinical governance committee. In the recent past, she has received honorarium, speaker and educational grants in various combinations from Nutricia, Abbott and Nestle.

M.Q.T. is currently an allied health contractor to Resthaven Inc. Community Services.

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