JAMDA xxx (2022) 1–6

ELSEVIER

JAMDA

journal homepage: www.jamda.com

Original Studies

Life-Space Mobility in Aged Care Residents: Frailty In Residential Sector over Time (FIRST) Study Findings

Agathe Daria Jadczak PhD [a,b,*], Suzanne Edwards GDipMStat [c], Renuka Visvanathan PhD [a,b,d]

[a] National Health and Medical Research Council Center of Research Excellence Frailty and Healthy Aging, Adelaide Medical School, Faculty of Health and Medical Sciences, University of Adelaide, Adelaide, South Australia, Australia
[b] Adelaide Geriatrics Training and Research with Aged Care (G-TRAC) Center, Adelaide Medical School, Faculty of Health and Medical Sciences, University of Adelaide, Adelaide, South Australia, Australia
[c] Adelaide Health Technology Assessment, Faculty of Health and Medical Sciences, University of Adelaide, Adelaide, South Australia, Australia
[d] Aged and Extended Care Services, The Queen Elizabeth Hospital, Central Adelaide Local Health Network, Woodville South, South Australia, Australia

Keywords:
Life-space mobility
aged care
nursing homes

A B S T R A C T

Objectives: Life-space mobility is a measure of the extent and frequency of mobility in older adults reflecting not only physical function, but also cognitive, psychosocial, and environmental factors. This study aimed to (1) develop life-space mobility profiles for nursing home residents; (2) examine independent factors associated with these profiles; and (3) identify health outcomes [ie, mortality, quality of life (QoL) and falls] associated with the life-space mobility profiles at 1 year.
Design: Prospective cohort study.
Setting and Participants: Twelve nursing homes including 556 residents, mean age 87.73 ± 7.25 years, 73.0% female.
Methods: Life-space mobility was measured using the Nursing Home Life-Space Diameter (NHLSD). Mortality and falls were extracted from residents' records. QoL was measured using the QoL in Alzheimer Disease (QoL-AD) scale.
Results: NHLSD scores ranged from 0 to 50 with a mean score of 27.86 ± 10.12. Resident life-space mobility was mainly centered around their room (94.8%, n = 527) and wing (86.4%, n = 485). One-half of the residents left their wing daily (51.0%, n = 284), and over one-quarter (26.4%, n = 147) ventured outside their nursing home at least weekly. Significant associations ($P < .05$) with high life-space mobility, identified through multivariable analyses, included lower age [odds ratio (OR) 0.70, 95% confidence interval (CI) 0.51, 0.96]; lower frailty levels (OR 0.67, 95% CI 0.50, 0.86); lower sarcopenia risk (OR 0.72, 95% CI 0.65, 0.79); and a better nutritional status (OR 1.16, 95% CI 1.05, 1.29). High life-space mobility was a predictor ($P < .05$) of lower mortality, lower falls rate, and higher QoL at 1 year when compared with moderate or low mobility.
Conclusions and Implications: Given the independent association between high life-space mobility and lower frailty status, lower sarcopenia risk, and a better nutritional status, physical activity and nutritional interventions may be beneficial in leading to improved life-space use. This requires further investigation. Improved life-space mobility can lead to improved health outcomes, such as lower mortality, lower falls rate, and improved QoL.

The Frailty In Residential Sector over Time (FIRST) Study was funded by the South Australian Department for Innovation and Skills; the Hospital Research Foundation; the National Health and Medical Research Council of Australia through the Center of Research Excellence Scheme (Project ID 1102208); and Resthaven Inc. through the GTRAC-Resthaven Research Grants Scheme. Apart from Resthaven Inc., the funders did not have a role in the study design, operations, or analysis.

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. A.D.J. and S.E. declare no conflicts of interest.

* Address correspondence to Agathe Daria Jadczak, PhD, National Health and Medical Research Council Center of Research Excellence Frailty and Healthy Aging, Adelaide Medical School, Faculty of Health and Medical Sciences, Basil Hetzel Institute, 37 Woodville Rd, Woodville South, South Australia 5011, Australia.
E-mail address: agathedaria.jadczak@adelaide.edu.au (A.D. Jadczak).

https://doi.org/10.1016/j.jamda.2022.04.013
1525-8610/

Life-space mobility not only considers an older person's mobility but also takes into account the geographic extent of the person's interaction with their environment, in and out of the home.[1,2] A person's mobility is not only determined by their physical function, but also their cognitive, psychosocial, and environmental factors.[2] These additional determinants showcase the need to capture a person's mobility beyond specific physical abilities [ie, activities of daily living (ADLs) or walking] as this allows for the identification of additional modifiable factors[3] and the development of comprehensive management strategies.[2]

In a nursing home setting, life-space mobility can been assessed through the Nursing Home Life-Space Diameter (NHLSD),[4] a validated life-space mobility questionnaire specifically developed for use with nursing home residents. Low life-space mobility in nursing home residents has been associated with older age,[5] low cognitive function,[5,6] and low physical capacity (including low muscle strength, gait speed, balance, and mobility).[6] Further, there is evidence that life-space mobility can also be influenced by the architectural design of a nursing home (ie, unit size),[5] in line with the concept of healthy aging, where functional ability is influenced not only by the intrinsic capacity of a resident, but also the environment in which they live in.[7]

Although frailty[8] and malnutrition[3] have been shown to be associated with low life-space mobility in community-based studies, no studies in nursing homes to date have examined the associations between life-space mobility and highly prevalent geriatric syndromes such as frailty,[9] sarcopenia[10,11] or malnutrition.[12] To the best of our knowledge, there has also been no study investigating the impact of varying life-space mobility profiles on longitudinal health outcomes in nursing home residents. Community studies, however, have shown that low life-space mobility is a predictor for more rapid cognitive decline,[13–15] increased risk of falls,[16] increased hospitalization and emergency department visits,[17] as well as increased admission into nursing homes,[18] hospital re-admission,[19] and mortality[20–22] over time. We, therefore, hypothesize that in nursing home residents, life-space mobility is associated with geriatric syndromes such as frailty, sarcopenia, and malnutrition, and that higher life-space mobility is associated with better health outcomes.

This study utilizing the NHLSD with nursing home residents aimed to (1) develop life-space mobility of profiles for residents; (2) examine independent factors associated with these life-space mobility profiles; and (3) identify health outcomes [ie, mortality, quality of life (QoL) and falls] associated with the life-space mobility profiles at 1 year after adjusting for age and sex.

Methods

Study Population and Setting

This is a substudy of the Frailty In Residential Sector over Time (FIRST) Study.[23] The FIRST Study involved 561 permanent residents at baseline from 12 nursing homes of one aged care organization in metropolitan and rural South Australia between March and October 2019. Residents were included if they had resided permanently in the nursing home for the previous 8 weeks and were medically stable. End of life (estimated <3 months to live) residents or those not fluent in English were excluded, as were those in respite or transition care programs. Each resident provided written informed consent, either personally or through a substitute decision maker, such as a family member. The study received ethics approval (HREC-2018-247) and was registered with the Australian New Zealand Clinical Trials Registry (ACTRN12619000500156).

Data Collection

Data were collected at baseline (March to October 2019) and at 1-year follow-up (March to October 2020) by trained research registered nurses (RNs) using resident nursing home records, observations, and interviews with the residents and on-site RN who were required to have known the resident for the preceding 2 weeks.

All face-to-face data collection ceased from March to June 2020 because of restrictions imposed to protect residents from the risk of exposure to COVID-19. During this period, observations and interviews with the residents stopped, and only questionnaires that could be answered by the on-site RN were completed during this time.

Baseline Data

Life-space mobility

Resident life-space mobility was assessed using the NHLSD, a questionnaire developed for use in nursing homes with a high inter-rater (0.95) and test-retest reliability (0.92).[4] The NHLSD investigates resident extent (or diameter) and frequency of mobility over a 2-week period and was completed by the on-site RN. The NHLSD captures 4 diameters: movement within the room; movement outside the room but within the unit (or wing); movement outside the unit but within the nursing home; movement outside the nursing home and/or leaving the nursing home. Frequency of movement is recorded on a continuum from (0) never, (1) less than weekly, (2) at least weekly, (3) >2 times a week, (4) 1–3 times a day, to (5) >3 times a day. Higher scores indicate a greater use of life-space. The total score consists of the sum of each diameter multiplied by frequency, and ranges from 0 (bed-/chair-bound) to 50 (able to leave the nursing home). A blank form of the NHLSD is provided as a supplemental file (Supplementary Material 1).

Other characteristics

Data collected at baseline from resident nursing home records included resident sociodemographic information, medical health history (up to 30 comorbidities),[23] number of falls, medication, and Katz ADLs.[24] Pain and level of sedation were assessed by the research RN by observing the resident for 5 minutes before completing the Pain Assessment in Advanced Dementia Scale[25] and the Pasero Opioid-induced Sedation Scale.[26]

The following scales were also administered: the Epworth Sleepiness Scale[27]; SARC-F[28]; the Dementia Severity Rating Scale[29]; the Patient Health Questionnaire-4[30]; and the Mini-Nutritional Assessment Short Form.[31] A 49-item frailty index (FI)[32] was constructed from the data collected at baseline (Supplementary Material 2). Frailty was categorized as nonfrail (0 to ≤0.1), vulnerable (>0.1 to ≤0.21), frail (>0.21 to <0.45), and most frail (≥0.45 or more).[33]

Outcome Measures

Quality of life

Each resident QoL was assessed using the 13-item Qol in Alzheimer Disease (QoL-AD) scale.[34] The QoL-AD was administered at baseline and at 1-year follow-up. At baseline, the QoL-AD was answered by the resident where possible, or else by the on-site RN at the respective nursing home. At 1 year, the Qol-AD was answered by the on-site RN only. The QoL-AD includes 13 items (physical health, energy, mood, living situation, memory, family, marriage, friends, self as a whole, ability to do chores, ability to do things for fun, money, and life as a whole). Response options are (1) poor, (2) fair, (3) good, or (4) excellent. Scores range from 13 to 52, with higher scores indicating better QoL.

Falls

The number of falls over the previous 12 months was obtained from the resident nursing home records at baseline and 1-year follow-up. Falls were defined as slipping, tripping, rolling, and sliding, resulting in the resident coming to rest inadvertently on the ground, floor, or other lower level.[35] Falls were recorded as present if residents had ≥1 fall over the past 12 months.

Mortality

Mortality (decease date and reason if known) was assessed at 1-year follow-up using resident nursing home records.

Statistical Analyses

One-way analysis of variance (ANOVA) was used to determine differences in NHLSD mean scores between the nursing homes. A Ward clustering technique (minimum variance method) was used to construct life-space mobility profiles based on the 4 NHLSD diameters (score range 1–5 for each diameter). Descriptive data were presented as mean and standard deviation, median and interquartile range, and frequency and percentage. A χ^2 test, Fisher Exact test, one-way ANOVA, and Kruskal-Wallis test were used where appropriate to compare baseline characteristics across the life-space mobility profiles.

An initial multivariable ordinal logistic generalized estimating equation (GEE) model was created with outcome: mobility profile vs a number of predictors, adjusting for clustering on nursing homes. The predictors were age, sex, nutritional status, FI, number of medications, number of comorbidities, pain, sedation levels, sleepiness, ADLs, sarcopenia risk, dementia, and anxiety/depression. Backwards elimination was then performed, removing the covariate with the highest P value one model at a time until all P values were less than .2.[36]

An unadjusted and an adjusted (age and sex) binary logistic GEE model was then performed for 1-year mortality vs mobility profile controlling for clustering on nursing homes.

Similarly, for the outcome QoL an unadjusted and adjusted (age and sex) model was performed, this time using linear mixed-effects models adjusting for repeated measurement over time and including nursing home as the random effect. Baseline QoL was included as a confounder. Assumptions of a linear model were found to be upheld by inspection of histograms and scatter plots of residuals and predicted values.

Unadjusted and adjusted (age and sex) models were then performed for the outcome: falls (binary) across time. (The continuous falls variable did not meet the assumptions of a linear model, even when a logarithmic transformation was used). Binary falls were derived as no falls versus ≥1 falls at baseline or one-year. Binary logistic GEE models were used, adjusting for repeated measurements over time and controlling for clustering on nursing homes. Baseline falls were accounted for in the binary falls variable. Residents with missing data (ie, lost to follow-up) at 1 year were not included in the binary logistic or linear-mixed-effects models.

The statistical software used was SAS v 9.4 (SAS Institute Inc) and SPSS v 25 (IBM Corporation). The level of statistical significance was set at $P < .05$.

Results

Five residents had missing NHLSD data at baseline. Therefore, data from 556 residents were included in the analyses. The mean age of the residents was 87.73 ± 7.25 years, with the majority of residents being female (n = 406, 73.0%), and either frail (n = 357, 64.5%) or most frail (n = 174, 31.5%).

Life-Space Mobility

Resident NHLSD scores ranged from 0 (bed-/chair-bound) to 50 (leaving nursing home daily) with a mean score of 27.86 ± 10.12. Table 1 presents NHLSD mean scores across the 12 nursing homes, which varied significantly ($P < .001$). One-half of the residents left their wing daily (51.0%, n = 284) and one-quarter (26.4%, n = 147) of residents ventured outside their nursing home at least weekly (Figure 1). One quarter of residents (n = 144, 25.9%) were nursing home bound. Resident life-space mobility was mainly centered around their room (94.8%, n = 527) and wing (86.4%, n = 485).

Construction of Life-Space Mobility Profiles

Three mobility profiles were identified using cluster analysis: high life-space mobility (n = 48; NHLSD score range = 40–50) with high mean values; moderate life-space mobility (n = 458; NHLSD score range = 12–39) with moderate mean values; and low life-space mobility (n = 50; NHLSD score range = 0–19) with low mean values for all four NHLSD diameters. Two of the mobility profiles (ie, moderate and low life-space mobility) overlap in terms of total NHLSD scores as the clustering was based on the 4 NHLSD diameters: within room, within unit, within nursing home, and outside the nursing home, each given a score of 0 to 5 depending on the frequency of that movement.

Baseline Characteristics by Life-Space Mobility Profiles

Residents with high life-space mobility were significantly ($P < .05$) more likely to be younger, more independent in their ADLs, have a lower FI, fewer comorbidities, lower daytime sleepiness, lower sedation levels, a lower risk of sarcopenia, and a better nutritional and cognitive status compared with residents with moderate or low mobility (Table 2).

In a multivariable model (Table 3), the following covariates were identified as significant predictors for high life-space mobility: lower age [odds ratio (OR) 0.70, 95% confidence interval (CI) 0.51, 0.96]; lower FI (OR 0.67, 95% CI 0.50, 0.86); lower sarcopenia risk (OR 0.72, 95% CI 0.65, 0.79); and a better nutritional status (OR 1.16, 95% CI 1.05, 1.29).

Predictive Validity of Life-Space Mobility Profiles

One-year mortality

One-year mortality was lowest in residents with high life-space mobility (6.3%) and highest in those with low mobility (38%). Those

Table 1
Nursing Home Life-Space Diameter Scores Across 12 Nursing Homes

Nursing Home	Number of Residents	NHLSD Score (0–50)	
		Mean (SD)	Range
1	31	30.45 (11.10)	12–50
2	51	29.51 (10.44)	4–50
3	45	30.67 (7.55)	5–46
4	38	20.29 (11.97)	0–42
5	39	30.26 (10.55)	0–50
6	79	27.38 (7.92)	1–38
7	54	26.15 (10.29)	0–43
8	42	32.90 (11.10)	0–50
9	32	28.72 (7.65)	0–46
10	61	23.31 (8.27)	4–50
11	32	29.25 (9.70)	10–46
12	52	28.40 (10.47)	0–50
Total	556	27.86 (10.12)	0–50

NHLSD, nursing home life-space diameter; SD, standard deviation.
NHLSD scores 0 (low life-space mobility) to 50 (high life-space mobility).

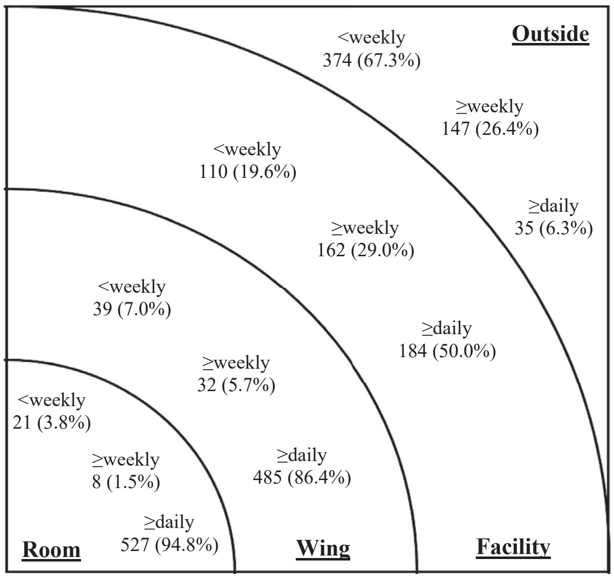

Fig. 1. Resident use of life-space based on nursing home life-space diameter.

with moderate life-space mobility (20.8%) scored in between. There was a statistically significant association between 1-year mortality and life-space mobility in an unadjusted binary logistic GEE model (global $P < .001$), as well as in the adjusted model (global $P = .001$). Compared with high mobility, residents with moderate life-space mobility (OR 3.50, 95% CI 1.63, 7.52, $P = .001$) and low life-space mobility (OR 7.88, 95% CI 2.33, 26.6, $P < .001$) had 3.5 and 7.9 times higher odds of mortality at 1-year, respectively (Table 4).

Quality of life

QoL mean scores at baseline were highest in residents with high life-space mobility (mean score 37.1 $\pm$ 5.5), followed by residents with moderate mobility (mean score 33.8 $\pm$ 6.6) and low mobility (mean score 32.3 $\pm$ 7.3) ($P = .001$). There was a statistically significant association between QoL and life-space mobility in the unadjusted linear mixed-effects model (global $P = .011$), as well as in the adjusted model (global $P = .008$). Compared with high life-space mobility, residents with moderate mobility (mean difference = −5.43, 95% CI −8.08, −2.78, $P = .005$) and low mobility (mean difference = −3.99, 95% CI −5.99, −1.99, $P = .005$) scored 5.4 and 4.0 less for QoL at 1-year, respectively (Table 4). There was no significant interaction between time (baseline/1-year) and life-space mobility profile (interaction $P = .430$).

Table 3
Multivariable Ordinal Logistic GEE Model for Life-Space Mobility Profiles vs Predictors Adjusted for Nursing Home Clustering: Modeling the Probability of High Life-Space Mobility

Predictor and Comparison		OR[*] (95% CI)	*P* Value
Age (years)	per 10 year increase	0.70 (0.51, 0.96)	.029[†]
Frailty Index (49-item)	per one 0.1 increase	0.67 (0.50, 0.89)	.006[†]
Number of medications	per one unit increase	1.03 (0.99, 1.07)	.162
Nutritional status[*]	per one score increase	1.16 (1.05, 1.29)	.005[†]
Sarcopenia risk[‡]	per one score increase	0.72 (0.65, 0.79)	<.001[†]

[*]Mini-Nutritional Assessment Scores 0 (worst) to 14 (best).
[†]Significant: ≤.05.
[‡]SARC-F Scores 0 (best) to 10 (worst).

Falls

Falls (≥1 falls) at baseline were lowest in residents with high life-space mobility (33.3%, n = 16), followed by residents with moderate mobility (62.8%, n = 288) and low mobility (64.0%, n = 32) ($P < .001$). There was a statistically significant association between falling (≥1) and life-space mobility in the unadjusted binary logistic GEE model (global $P < .001$), as well as in the adjusted model (global $P = .002$). Compared with residents with high life-space mobility, residents with moderate mobility (OR 2.37, 95% CI 1.43, 3.94, $P < .001$) and low mobility (OR 2.85, 95% CI 1.40, 5.84, $P = .004$) had 2.4 and 2.9 higher odds of >1 fall at 1-year, respectively (Table 4). There was no significant interaction between time (baseline/1-year) and life-space mobility profile (interaction $P = .180$).

Discussion

Although there might be a misconception that nursing home residents are room bound, this research found that at least one-half of the residents moved out of their assigned wing daily, and over one-quarter ventured outside their nursing home at least weekly. Although we know that life-space mobility within the nursing homes might be impacted by resident cognitive status,[5,6] and the need for daily assistance with ADLs,[4,6] life-space mobility can also be

Table 2
Resident Baseline Characteristics by Life-Space Mobility Based on Nursing Home Life-Space Diameter

Characteristics	High Life-Space Mobility (n = 48)	Moderate Life-Space Mobility (n = 458)	Low Life-Space Mobility (n = 50)	*P* Value
Age, mean (SD)[*]	83.85 (8.01)	88.13 (6.94)	87.80 (8.34)	<.001[†]
Female, n (%)[‡]	33 (68.60)	341 (74.50)	32 (64.0)	.224
Frailty Index 49-Item, mean (SD)[*]	0.28 (0.07)	0.39 (0.10)	0.45 (0.11)	<.001[†]
Number medications, mean (SD)[*]	11.23 (4.97)	10.32 (4.32)	10.24 (4.48)	.385
Number comorbidities, mean (SD)[*]	7.50 (2.65)	8.73 (2.53)	9.50 (2.89)	.001[†]
Pain PAINAD, mean (SD)[*]	0.02 (0.15)	0.15 (0.66)	0.14 (0.46)	.384
Sedation POSS, mean (SD)[*]	1.00 (0.00)	1.09 (0.52)	1.33 (0.88)	.006[†]
Sleepiness ESS, mean (SD)[*]	4.81 (5.10)	7.98 (5.90)	9.83 (6.23)	<.001[†]
Katz ADL, mean (SD)[*]	0.69 (0.72)	0.30 (0.62)	0.16 (0.55)	<.001[†]
Sarcopenia SARC-F, mean (SD)[*]	4.28 (2.11)	6.54 (2.02)	7.81 (1.44)	<.001[†]
Nutrition MNA-SF, mean (SD)[*]	12.00 (1.75)	10.12 (8.67)	8.67 (2.36)	<.001[†]
Dementia DSRS, mean (SD)[*]	10.25 (9.22)	24.16 (13.83)	31.24 (12.37)	<.001[†]
Anxiety/Depression PHQ-4, median (IQR)[§]	2 (0,4)	2 (0,4)	3 (0,7)	.089

COPD, chronic obstructive pulmonary disease; DSRS, Dementia Severity Rating Scale; ESS, Epworth Sleepiness Scale; IQR, interquartile range; MNA-SF, Mini Nutritional Assessment Short Form; PAINAD, Pain Assessment in Advanced Dementia; PHQ-4: Patient Health Questionnaire-4; POSS, Pasero Opioid Induced Sedation Scale; SD, standard deviation.
[*]One-way Analysis of Variance.
[†]Significant: ≤.05.
[‡]Fisher Exact Test.
[§]Kruskal-Wallis Test.

Table 4
Predictive Ability of Life-Space Mobility Profiles on 1-Year Mortality, Quality of Life and Falls

Outcomes	Adjustment/Confounder	Life-Space Mobility Comparison	OR/Mean Difference (95% CI)	Comparison *P* Value	Global *P* Value
1-year mortality	Unadjusted	Low vs moderate	2.34 (0.87, 6.32)	.093	<.001*
		Moderate vs high	3.93 (1.85,8.35)	<.001*	
		Low vs high	9.19 (2.74, 30.83)	<.001*	
	Adjusted for age and sex	Low vs moderate	2.25 (0.80, 6.32)	.124	.001*
		Moderate vs high	3.50 (1.63, 7.52)	.001*	
		Low vs high	7.88 (2.33, 26.6)	<.001*	
Quality of life	Unadjusted	Low vs moderate	−0.41 (−0.18, 0.45)	.349	.011*
		Moderate vs high	−1.16 (−1.97, −0.34)	.005*	
		Low vs high	−1.57 (−2.72, −0.42)	.007*	
	Adjusted for age and sex	Low vs moderate	−0.45 (−1.32, 0.42)	.308	.008*
		Moderate vs high	−5.43 (−8.08, −2.78)	.004*	
		Low vs high	−3.99 (−5.99, −1.99)	.005*	
Falls	Unadjusted	Low vs moderate	1.25 (0.72, 2.16)	.429	<.001*
		Moderate vs high	2.52 (1.53, 4.15)	<.001*	
		Low vs high	3.15 (1.56, 6.35)	.001*	
	Adjusted for age and sex	Low vs moderate	1.20 (0.69, 2.11)	.517	.002*
		Moderate vs high	2.37 (1.43, 3.94)	<.001*	
		Low vs high	2.85 (1.40, 5.84)	.004*	

CI, confidence interval; OR, odds ratio.
*Significant: ≤.05.

influenced by the architectural design of the nursing home.[5] NHLSD mean scores varied significantly across our nursing homes, and the proportion of residents venturing outside daily was lower in our study than seen in the study conducted by Sverdrup et al (6.3% vs 10.4%).[5] Sverdrup et al examined the life-space mobility of 583 residents with dementia across 47 nursing homes in Norway and demonstrated that living in smaller units was associated with higher life-space mobility.[5] It is, therefore, possible that building size accounted for the differing patterns of resident life-space mobility.

Geriatric syndromes such as frailty, sarcopenia, and risk of malnutrition were associated with life-space mobility. Research has demonstrated that all 3 syndromes can be improved through increased physical activity and nutrition interventions.[37,38] Improving health characteristics through comprehensive geriatric assessment,[39] and intervening through physical activity and nutrition intervention, while enabling the environment to support activity are therefore strategies that could improve resident life-space mobility and functional ability, allowing residents to better achieve healthy aging. It remains to be seen if such interventions can lead to increased life-space mobility in nursing home residents, perhaps something to be investigated in future studies.

Similar to community-based study, lower life-space mobility was associated with increased mortality and falls, and lower QoL. The OR for mortality associated with low life-space mobility reported in the community[20–22] (adjusting for confounders) was much lower (1.2 to 2.4 times over up to 5 years) compared with our study (7.9 times at 1-year). Similarly, the odds for having ≥1 falls in community-dwelling older adults (adjusted for confounders) with low life-space mobility was also lower (OR ≥1 falls at 6-months 1.2[16] vs at 1-year 2.4–2.9). In terms of the predictive ability of life-space mobility on QoL, Rantakokko et al[40] studied 848 community-dwelling older people over 2 years (adjusted for confounders) in Finland, and found that the decline in QoL scores was greater among those with decreased life-space mobility compared with those whose life-space mobility remained stable or improved. Physical activity and nutrition interventions combined with a supportive environment could therefore not only improve prevalent geriatric syndromes, but also contribute to reduced mortality and falls rates, and better QoL in the long-term.

Major strengths of this study were that our research enabled the participation by residents with dementia, and that it included nursing homes in rural and metropolitan areas. A limitation of this study was that although data were collected from multiple nursing homes, all were operated by one aged care organization and in one state, limiting the generalizability of the findings. Also, whilst some residents completed the QoL questionnaire at baseline, the QoL questionnaires at follow-up were completed by the on-site RN. This might have affected the study findings. Further, objective measures such as accelerometer sensors or global positioning system (GPS) trackers to measure life-space mobility may have revealed greater insights into resident life-space mobility, but might have also limited recruitment risking generalizability of findings. Currently, studies including GPS trackers or sensors to measure life-space mobility in nursing homes are sparse and tend to have small sample sizes (eg, 65 residents in one study).[41] Another limitations was that medications were only examined based on number rather than type. Anticholinergics and sedatives, for example, have shown to affect the number of days residents spend outside,[42] something to be investigated in future studies.

Conclusions and Implications

Given the independent association between high life-space mobility and lower frailty status, lower sarcopenia risk and a better nutritional status, physical activity and nutritional interventions combined with a supportive environment may be beneficial in leading to improved life-space mobility. This requires further investigation. Improved life-space mobility can lead to improved health outcomes, such as lower mortality rate, lower falls rate, and improved QoL.

Acknowledgments

We acknowledge Terry Shortt for supporting the study coordination and contributing to the study design, as well as Hilary Ashby who supported the study coordination. We thank our study nurses Jean Zhang, Victoria Foy, and Kim Testi who conducted the data collection and collected informed consent. We also acknowledge Tina Cooper and Leonie Robson for contributing to the study design, and thank Tina Cooper and Merridy Baylis for reviewing the manuscript.

References

1. Johnson J, Rodriguez MA, Al Snih S. Life-space mobility in the elderly: current perspectives. *Clin Interv Aging*. 2020;15:1665–1674.
2. Webber SC, Porter MM, Menec VH. Mobility in older adults: A comprehensive framework. *Gerontologist*. 2010;50:443–450.
3. Kuspinar A, Verschoor CP, Beauchamp MK, et al. Modifiable factors related to life-space mobility in community-dwelling older adults: Results from the Canadian Longitudinal Study on Aging. *BMC Geriatr*. 2020;20:35.
4. Tinetti ME, Ginter SF. The nursing home life-space diameter. A measure of extent and frequency of mobility among nursing home residents. *J Am Geriatr Soc*. 1990;38:1311–1315.
5. Sverdrup K, Bergh S, Selbæk G, et al. Exploring life-space in the nursing home. An observational longitudinal study. *BMC Geriatr*. 2021;21:396.
6. Bergland A, Narum I, Grönstedt H, et al. Evaluating the feasibility and intercorrelation of measurements on the functioning of residents living in Scandinavian nursing homes. *Phys Occup Ther Geriatr*. 2010;28:154–169.
7. Beard JR, Officer A, de Carvalho IA, et al. The World report on ageing and health: a policy framework for healthy ageing. *Lancet*. 2016;387:2145–2154.
8. Xue Q-L, Fried LP, Glass TA, Laffan A, Chaves PHM. Life-space constriction, development of frailty, and the competing risk of mortality: The women's health and aging study I. Am. *J Epidemiol*. 2007;167:240–248.
9. Kojima G. Prevalence of frailty in nursing homes: A systematic review and meta-analysis. *J Am Med Dir Assoc*. 2015;16:940–945.
10. Thompson MQ, Jadczak AD, Yu S, Tucker GR, Visvanathan R. Sarcopenia risk in nursing home residents using SARC-F: FIRST study findings. *Geriatr Gerontol Int*. 2022;22:206–212.
11. Bauer JM, Kaiser MJ, Sieber CC. Sarcopenia in nursing home residents. *J Am Med Dir Assoc*. 2008;9:545–551.
12. Bell CL, Lee AS, Tamura BK. Malnutrition in the nursing home. *Curr Opin Clin Nutr Metab Care*. 2015;18:17–23.
13. James BD, Boyle PA, Buchman AS, Barnes LL, Bennett DA. Life space and risk of alzheimer disease, mild cognitive impairment, and cognitive decline in old age. *Am J Geriatr Psychiatry*. 2011;19:961–969.
14. Silberschmidt S, Kumar A, Raji MM, Markides K, Ottenbacher KJ, Al Snih S. Life-space mobility and cognitive decline among mexican Americans aged 75 years and older. *J Am Geriatr Soc*. 2017;65:1514–1520.
15. Crowe M, Andel R, Wadley VG, Okonkwo OC, Sawyer P, Allman RM. Life-space and cognitive decline in a community-based sample of African American and Caucasian older adults. *J Gerontol A Biol Sci Med Sci*. 2008;63:1241–1245.
16. Lo AX, Rundle AG, Buys D, et al. Neighborhood disadvantage and life-space mobility are associated with incident falls in community-dwelling older adults. *J Am Geriatr Soc*. 2016;64:2218–2225.
17. Kennedy RE, Williams CP, Sawyer P, et al. Life-space predicts health care utilization in community-dwelling older adults. *J Aging Health*. 2017;31:280–292.
18. Sheppard KD, Sawyer P, Ritchie CS, Allman RM, Brown CJ. Life-space mobility predicts nursing home admission over 6 years. *J Aging Health*. 2013;25:907–920.
19. Fathi R, Bacchetti P, Haan MN, Houston TK, Patel K, Ritchie CS. Life-space assessment predicts hospital readmission in home-limited adults. *J Am Geriatr Soc*. 2017;65:1004–1011.
20. Kennedy RE, Sawyer P, Williams CP, et al. Life-space mobility change predicts 6-month mortality. *J Am Geriatr Soc*. 2017;65:833–838.
21. Mackey DC, Cauley JA, Barrett-Connor E, et al. Life-space mobility and mortality in older men: A prospective cohort study. *J Am Geriatr Soc*. 2014;62:1288–1296.
22. Mackey DC, Lui L-Y, Cawthon PM, Ensrud K, Yaffe K, Cummings SR. Life-space mobility and mortality in older women: Prospective results from the study of osteoporotic fractures. *J Am Geriatr Soc*. 2016;64:2226–2234.
23. Jadczak AD, Robson L, Cooper T, Bell JS, Visvanathan R. The Frailty In Residential Sector over Time (FIRST) study: Methods and baseline cohort description. *BMC Geriatr*. 2021;21:99.
24. Shelkey M, Wallace M. Katz index of independence in activities of daily living (ADL). *Director*. 2000;8:72–73.
25. Warden V, Hurley AC, Volicer L. Development and psychometric evaluation of the Pain Assessment in Advanced Dementia (PAINAD) scale. *J Am Med Dir Assoc*. 2003;4:9–15.
26. Pasero C, McCaffery M. Monitoring sedation. *Am J Nurs*. 2002;102:67–69.
27. Johns MW. A new method for measuring daytime sleepiness: The Epworth sleepiness scale. *Sleep*. 1991;14:540–545.
28. Woo J, Leung J, Morley JE. Validating the SARC-F: A suitable community screening tool for sarcopenia? *J Am Med Dir Assoc*. 2014;15:630–634.
29. Clark CM, Ewbank DC. Performance of the dementia severity rating scale: A caregiver questionnaire for rating severity in Alzheimer disease. *Alzheimer Dis Assoc Disord*. 1996;10:31–39.
30. Kroenke K, Spitzer RL, Williams JB, Lowe B. An ultra-brief screening scale for anxiety and depression: The PHQ-4. *Psychosomatics*. 2009;50:613–621.
31. Guigoz Y, Lauque S, Vellas BJ. Identifying the elderly at risk for malnutrition. The Mini Nutritional Assessment. *Clin Geriatr Med*. 2002;18:737–757.
32. Mitnitski AB, Mogilner AJ, Rockwood K. Accumulation of deficits as a proxy measure of aging. *Scientific World J*. 2001;8:323–336.
33. Hoover M, Rotermann M, Sanmartin C, Bernier J. Validation of an index to estimate the prevalence of frailty among community-dwelling seniors. *Health Rep*. 2013;24:10–17.
34. Logsdon RG, Gibbons LE, McCurry SM, Teri L. Assessing quality of life in older adults with cognitive impairment. *Psychosom Med*. 2002;64:510–519.
35. World Health Organization. *WHO global report on falls prevention in older age*. World Health Organization; 2008.
36. Heinze G, Dunkler D. Five myths about variable selection. *Transpl Int*. 2017;30:6–10.
37. Cruz-Jentoft AJ, Kiesswetter E, Drey M, Sieber CC. Nutrition, frailty, and sarcopenia. *Aging Clin Exp Res*. 2017;29:43–48.
38. Clegg A, Young J, Iliffe S, Rikkert MO, Rockwood K. Frailty in elderly people. *Lancet*. 2013;381:752–762.
39. Pilotto A, Cella A, Pilotto A, et al. Three decades of comprehensive geriatric assessment: Evidence coming from different healthcare settings and specific clinical conditions. *J Am Med Dir Assoc*. 2017;18:192. e1–e11.
40. Rantakokko M, Portegijs E, Viljanen A, Iwarsson S, Kauppinen M, Rantanen T. Changes in life-space mobility and quality of life among community-dwelling older people: A 2-year follow-up study. *Qual Life Res*. 2016;25:1189–1197.
41. Jansen C-P, Diegelmann M, Schnabel E-L, Wahl H-W, Hauer K. Life-space and movement behavior in nursing home residents: Results of a new sensor-based assessment and associated factors. *BMC Geriatr*. 2017;17:36.
42. Wouters H, Hilmer SN, Twisk J, et al. Drug burden index and cognitive and physical function in aged care residents: A longitudinal study. *J Am Med Dir Assoc*. 2020;21:1086–1092.e1.