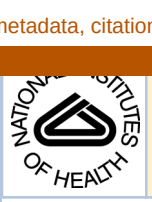

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Physical Performance Characteristics of Assisted Living Residents and Risk for Adverse Health Outcomes

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Abstract

Purpose—Little is known about the physical performance ability of residential care/assisted living (RC/AL) residents and its relationship to adverse outcomes such as fracture, nursing home placement, functional decline, and death. The purposes of this paper are to: 1) describe the functional characteristics of RC/AL residents; 2) examine the relationships between resident- and facility-characteristics and physical performance; and 3) determine the predictive value of physical performance for adverse outcomes.

Design and Methods—Data were derived from 1791 residents in 189 RC/AL facilities, participating in the Collaborative Studies of Long-Term Care. At baseline, residents were tested on four performance measures (grip strength, chair rise, balance, and walking speed), and other resident- and facility-level information was collected. Adverse outcomes were measured over one year.

Results—Average grip strength was 14 ± 7 kg; 61% of residents walked < 0.6 m/second (average 0.41 m/second); 26% could perform five chair rises; and only 19% could perform a tandem stand for a least one second. Multivariable analyses showed that more cognitive and functional impairment, depressive symptoms and comorbid conditions, and for-profit ownership, were associated with poorer physical performance. Controlling for individual characteristics, better performance on the four physical performance measures was associated with a reduced risk of nursing home placement, fracture, and decline in function over one year.

Implication—Simple performance measures identify modifiable functional deficits, and suggest targeted interventions to prolong independent mobility and aging in place in RC/AL facilities.

Keywords

Mobility; Function; Long-term care; Adverse outcomes; Fracture

More than 900,000 Americans live in an estimated 36,000 residential care/assisted living (RC/AL) facilities in the United States (Mollica, 2003). Assisted living housing promises supportive care where older adults can maintain a level of independence and age in place even when physical function declines. Several reports clearly indicate that older adults do not want to go to nursing homes, due to the high cost of care, loss of individual freedom, and the institutional/hospital-like setting (Kane, Kane, & Ladd, 1998; Mattimore, Wenger, Cesbiens, Teno, Hamel, Liu, et al., 1997). Assisted living may provide an attractive alternative, especially for older adults who need supervision or minimal assistance.

Increased dependency in activities of daily living (ADL) is one of the most common reasons for discharge from RC/AL to a nursing home (Aud & Rantz, 2005; Golant, 2004; Pruchno & Rose, 2000; Zimmerman, Gruber-Baldini, Sloane, Eckert, Hebel, Morgan, et al., 2003). Pruchno & Rose (2000) suggested that increased impairments may be caused by a lack of appropriate assessment and treatment. Thus, identifying RC/AL residents at high risk for decline in ADL, incident fracture, or nursing home placement could help target intervention programs that would prevent or delay these adverse outcomes (Zimmerman et al., 2003).

While measures of ADL are valuable for identifying disability and estimating a resident's required level of care, they are not useful for identifying modifiable impairment and functional limitations that contribute to disability. On the other hand, several studies reported that physical performance measures of impairment and function are valuable predictors of disability, death, and nursing home placement, even among older adults who self-reported no disability (Fried, Bandeen-Roche, Chaves, Johnson, 2000; Guralnik, Ferrucci, Simonsick, Salive, & Wallace, 1995; Guralnik & Winograd, 1994). Unfortunately, other than one recent study of 17 RC/AL facilities in Australia, there are no benchmarks for functional data of residents in RC/AL facilities (Lord, Castell, Corcoran, Dayhew, Matters, Shan, et al., 2003). To date, most studies on RC/AL residents in the United States only report general functional ability such as ADLs (Zimmerman, Sloane, Eckert, Gruber-Baldini, Morgan, Hebel, et al., 2005; Kerse, Butler, Robinson, Todd, 2004). The few studies that report physical function are limited to small sample intervention studies, and often the type of long-term care residence is not clearly defined (Nowalk, Prendergast, Bayles, D'Amico, & Colvin, 2001; Hawes, Phillips, Rose, Holan, & Sherman, 2003; Singh, Chin A Paw, Bosscher, & van Mechelen, 2006).

Because characteristics of RC/AL residents vary systematically by facility size, staffing ratios, admission and discharge policies, and supportive programs, it is important that studies examining RC/AL resident characteristics account for these and other differences in facility characteristics. For example, smaller RC/AL facilities seem to house more impaired residents than larger, traditional types of board and care facilities (Zimmerman et al., 2003). Furthermore, these differences relate to the facility's capacity and likelihood to maintain residents in the face of functional decline. This concept is best understood in relation to the model of aging in place (Bernard, Zimmerman, & Eckert, 2001). This framework recognizes that the physical performance ability of RC/AL residents and related outcomes are influenced by several individual/resident (demographic, health, and function) and facility-level factors (facility characteristics and environment). Understanding the relationships among these factors and the physical performance measures can guide interventions that maintain or improve function and allow residents to age in place in RC/AL facilities. Thus, the purposes of this paper are to: 1) describe the functional characteristics (using physical performance and report) of RC/AL residents; 2) examine the relationships between resident- and facility-characteristics and physical performance; and 3) determine the value of physical performance as a predictor of adverse outcomes in this population.

Methods

Participants

Data examined for these analyses were derived from the Collaborative Studies of Long-Term Care (CS-LTC), a study of 2,078 residents in 193 RC/AL facilities in Florida, Maryland, New Jersey, and North Carolina (Zimmerman, Sloane, Eckert, Buie, Walsh, Koch, et al., 2001). The CS-LTC defined RC/AL as facilities or discrete portions of facilities licensed by the state at a non-nursing home level of care, which provide room, board, 24-hour oversight, and assistance with activities of daily living. To capture the broad range of RC/AL, they were classified and sampled in three strata: 1) facilities with fewer than 16 beds; 2) traditional "board-and-care" type facilities with 16 or more beds; and 3) "new-model" type facilities with 16 or more beds. The new-model stratum was developed to reflect a new health services model developing over the last decades; these were defined as built after 1987 and having at least one of the following characteristics: 1) at least two different private-pay monthly rates; 2) 20% or more of the resident population require assistance with transfers; 3) 25% or more of the resident population with daily incontinence; or 4) either an RN or an LPN on duty at all times. In the smaller facilities, all residents 65 and older were recruited for participation, whereas in the larger facilities, residents were randomly approached until a maximum of 20 residents consented.

The four state nature of this study was chosen to create variation in the sample, reflecting the diversity of the field. The states were selected based on review of state regulation and recommendation of experts, and also proximity to allow on-site data collection. New Jersey was included as it had progressed the furthest in defining new-model RC/AL facilities; Florida was included as it contained a high representation of RC/AL beds compared to other states; North Carolina was included as it contained more RC/AL Medicaid beneficiaries compared to other states; and Maryland was included as it had fewer regulations compared to other states. Details of the sample and facilities are described elsewhere (Zimmerman et al., 2001).

Facility Measures

Facility administrators provided data regarding proprietary status and the availability of nursing staff (RN or LPN). Trained interviewers conducted a structured walk-through evaluation of the environment, using the Therapeutic Environment Screening Survey - Residential Care (TESS-RC) (Zimmerman, Mitchell, Chen, Morgan, Gruber-Baldini, Sloane, et al., in press). The TESS-RC yields the Assisted Living Environmental Quality Scale (AL-EQS), a 15-item scale including items such as facility cleanliness, homelikeness, and privacy (alpha = 0.75).

Resident Measures, Baseline

In addition to basic resident demographics (age, race, education, gender, marital status, and medical conditions), CS-LTC staff gathered data on cognition, depression, function, comorbidities, and observed physical performance. The care provider who best knew the resident reported cognitive status using the Minimum Data Set Cognition Scale (MDS-COGS) (Hartmaier, Sloane, Guess, & Kock, 1994). The MDS-COGS combines eight items into a 10-point additive scale, ranging from no impairment (0-1) to very severe cognitive impairment (9-10). The care provider also provided information about depression, using the Cornell Scale for Depression in Dementia (CSD-D), an observer-rated scale of depressive symptoms designed to rate depression in persons with dementia; the CSD-D consists of 19 items, each scored 0-2, with scores of 8 or higher thought to indicate depression for people with dementia (Alexopoulos, Abrahms, Young, & Shamoian, 1988). The need for assistance in seven ADLs (bed mobility, eating, locomotion, transfer, toileting, dressing, and personal

hygiene) was determined from items on the Minimum Data Set (MDS-ADL) (Morris, Fries, & Morris, 1999). Scores ranging from 0 (independence/no assistance) to 4 (total dependence) for each activity were reported by the care provider. From these reported scores, we also calculated a value for mobility ADLs (bed mobility, locomotion, transfer) to describe resident ability. The presence of comorbid conditions was recorded from resident records and summed.

Performance-based Measures

Physical performance was assessed using grip strength (Simonsick, Maffeo, Rogers, Skinner, Davis, Guralnik, et al., 1997) and the Short Physical Performance Battery from the Established Populations for Epidemiologic Studies of the Elderly (EPESE) (walking speed, chair rise, balance), (Guralnik, Simonsick, Ferrucci, Glynn, Berkman, Blazer, et al., 1994). Grip strength has been associated with overall strength, and is a predictor of mortality (Al Snih, Markides, Ray, Ostir, & Goodwin, et al., 2002), functional decline (Laukkanen, Heikkinen, & Kauppinen, 1995; Rantanen, Era, & Heikkinen, 1994; Rantanen, Guralnik, Foley, Masaki, Leveille, Curb, et al., 1999), and nursing home placement (Al Snih et al., 2002; Lord, Ward, & Williams, 1994). Previous work in a community population suggested that each one kilogram decrease in grip strength was associated with a 3% increased risk of mortality (Al Snih et al., 2002).

Grip Strength—With residents seated in a chair, grip strength in kilograms (kg) was measured in the stronger arm (identified by self-report) using a dynamometer. The greater value of two trials was used for data analysis.

Walking Speed—Residents were timed as they walked eight feet at their usual pace. Assistive devices were allowed if needed and type of device was recorded. The best performance of two trials was converted to speed in meters per second (m/second) for analysis.

Chair Rise—Residents were instructed to stand up from a standard height chair with their arms folded across their chest after the tester demonstrated the task (Guralnik et al., 1994). Residents first attempted a single chair rise. Those who could not stand from the chair were classified as unable. Residents who could complete the single stand then attempted five repeated chair rises as quickly as possible. Time to complete the task and the numbers of stands completed were recorded.

Balance—For balance testing, residents were asked to stand in three progressively difficult positions. First, residents were tested standing with their feet side-by-side, then in a semi-tandem position (heel of one foot beside the big toe of the other foot), and last in a tandem position (heel of one foot directly in front of the toe of the other foot), for ten seconds in each position (Guralnik et al., 1994). Prior to testing, residents received instructions on each position, followed by a demonstration. The time residents maintained each position was recorded in seconds.

Resident Measures, Adverse Outcomes

On a quarterly basis for one year after participant enrollment, facility staff were contacted by telephone and asked to report each resident's current functional (MDS-ADL) status, and whether each resident had died, experienced a fracture, or transferred to a nursing home. For residents who had died or were discharged, fractures were retrospectively reported up to time of discharge/death and the MDS-ADL level of the resident immediately prior to discharge/death was reported.

Analyses

Data were available for 1791 residents from 189 facilities. An additional 287 residents who did not participate in performance testing (were ill, unavailable, or refused) were included only for analyses related to facility questions. Univariate statistics were calculated for the four physical performance measures (grip strength, walking speed, chair rise, and balance) as were bivariate associations between physical performance, resident and facility variables, and outcomes. The coding of individual performance variables is described as follows.

Grip Strength—Two cut points were used for grip strength. One cut point (14 kg) was established close to the mean (13.97 kg) for our sample. This value also corresponds to the lowest quartile of grip strength for community-dwelling older adults reported in other studies (Al Snih, et al., 2002; Guralnik & Winograd, 1994; Onder, Penninx, Lapuerta, Fried, Ostir, Guralnik, et al., 2002). A second cut point was set at 10 kg, and represents the lowest quartile value for RC/AL residents in this study. Residents whose strength was above the cut points were compared to those with lower grip strength and those unable to perform the test.

Walking Speed—Walking speed was classified as ≥0.6 m/second, <0.6 m/second, or unable. Walking speed less than 0.6 m/second is a strong predictor of decline in physical function and increased difficulty in ADLs (Guralnik & Ferrucci, 2002; Guralnik, et al., 1995; Studenski, Perera, Wallace, Chandler, Duncan, Rooney, et al., 2003; Van Swearingen, Paschal, Bonino, & Chen, 1998) in community dwelling older adults.

Chair Rise—Residents who were unable to complete a single chair stand were classified as "unable." For the remainder of the sample, residents were classified as able to perform five consecutive stands; or able to perform one-four stands but unable to do five consecutive stands. A single chair rise is viewed as a measure of transfer ability and the repeated chair rise task as an indication of leg strength (Simonsick et al., 1997).

Balance—Residents who could not stand independently were classified as unable. Based on our distribution and similar to Guralnik and colleagues (1995) a categorical variable was constructed that recorded the ability to tandem stand for at least one second; or unable to tandem stand. The decision for a cut point at one-second tandem stand was based on the ability of residents to semi-tandem stand for 10 seconds and assume the tandem stand position. The large majority of residents were unable to tandem stand (81%), 11% could stand 1-9 seconds, and only 8% could stand for 10 seconds.

Descriptive statistics and univariate distributions were analyzed in SAS 8.2 (SAS Institute, Inc., Cary, NC) and multivariate modeling (Tables 4 and 5) was conducted using Stata 7.0 (StataCorp., 2001). All regression models controlled for clustering within the facility and for length of follow up (exposure) using STATA xtgee procedure, which uses robust variance estimation (Huber, 1967; StataCorp., 2001). Logistic regression was used to examine differences in physical performance by resident and facility factors (Table 4). The probability of *good* versus *poor* physical function was modeled as a dichotomous outcome. Rates of mortality and probability of nursing home transfer (Table 5) were modeled using Cox proportional hazards methods (Cox, 1972). Fracture was modeled as incidence per quarter using repeated measures analysis, in which generalized estimating equations (GEE) were employed to fit a Poisson regression model (Liang & Zeger, 1986). Functional change was modeled using GEE to estimate differences in means at baseline and follow-up, assuming a Gaussian distribution and identity link function (Liang & Zeger, 1986).

Models for each performance predictor were run separately. Relative risks of outcome events (mortality, nursing home transfer, fracture) were calculated using performance

measures as the explanatory variables, controlling for baseline individual characteristics (age, gender, race, marital status, seven ADLs, MDS-COGS, CSD-D, and comorbidities). A relative risk greater than one indicates that the rate in the higher performance group (those with higher tested performance) is higher than in the reference group (unable to perform or lower level performance); values lower than one indicate that the rate is lower in the higher performance group than the reference group. For GEE analyses of functional change, larger numbers indicate greater functional decline (increased impairment).

Results

Descriptive Characteristics

Resident (N=1791) and facility (N=189) characteristics are provided in Table 1. Mean resident age was 84 ± 7.8 years. Most participants were white (90.6%) and female (75.6%). On average, residents had five ± 2.7 comorbid medical conditions. Although only 57.1% were independent in all seven ADLs, 80.9% were independent in the three mobility ADLs (bed mobility, walking, transfer). Using MDS-COGS scores, 40.2% had no cognitive deficit, and based on the CSD-D, a minority (13.6%) were depressed. The majority of facilities were for-profit (82.7%) and had either an LPN or RN on staff (65.8%). The average AL-EQS score across all facilities was 16.5 (range = 5-26, with higher scores indicating better environmental quality).

Tables 2 and 3 provide descriptive characteristics for grip strength, walking speed, chair rise, and balance. Average grip strength for the 90.4% of residents who could perform the test was 13.97 kg ± 6.85, with no difference between men and women. Most residents (72.2%) were able to perform the walking test and 42.6% used an assistive device when tested. Average walking speed was 0.41 m/second ± 0.19; 61% of residents walked < 0.6 m/second. Only 26.2% of residents tested were able to perform five successive chair rises, and the average time for completion was 17.82 seconds ± 7.62. In terms of balance ability, progressively fewer residents were able to maintain the more difficult semi-tandem and tandem balance test positions. For example, 60.5% of residents could perform the side-by-side stand for 10 seconds, 34.3% could perform the semi-tandem stand for 10 seconds, and only 8.3% could perform the tandem stand for 10 seconds.

Relationship of Resident and Facility Characteristics to Physical Performance

Table 4 shows associations between resident and facility characteristics and physical performance. Poorer physical performance was significantly and consistently associated with older age, reported ADL impairment, and moderate and severe cognitive impairment. Lower performance values were also observed for females, whites and those with depressive symptoms, although these results were not always statistically significant. An increased number of comorbid conditions was related to poorer performance in walk speed (OR 0.70), chair rise (OR 0.59) and balance (OR 0.71), but was associated with stronger grip strength (OR 1.22).

With respect to facility variables, residence in a for-profit facility was generally associated with poorer performance (walking speed OR 0.62), while facility type had an inconsistent relationship with performance. Traditional facility was associated with better grip strength (OR 1.45), but not with other performance measures. There were no associations between performance measures and having a nurse on staff or with environmental quality (AL-EQS scores).

Relative Risk of Adverse Outcomes Related to Physical Performance

Table 5 demonstrates the relationship of physical performance to adverse outcomes over one year. In general, adjusted analyses indicated that better physical performance was associated with the reduced risk of nursing home transfer, fracture, and functional change during a one-year interval. Walking speed ≥0.6 m/second (RR range 0.49-0.61) and ability to perform chair rise five times (RR range 0.46-0.57) were most protective for these outcomes in analyses adjusting for resident age, sex, race, marital status, cognition, ADLs, affect, morbidities, and within-facility clustering. Greater grip strength (>14 kg) and ability to tandem stand for more than one second were also associated with the reduced risk of each outcome, but adjusted relative risks were not always statistically significant. None of the physical performance measures was associated with mortality in adjusted analyses.

Discussion

This is the first paper to observe and report on the physical performance of residents from a large and diverse sample of RC/AL facilities and to explore the role of physical performance as a predictor of adverse outcomes in this setting. Study results indicate that more than half of these RC/AL residents (57%) were independent in all seven reported ADLs, compared with 42% of a sample of residents with low income (Fonda, Clipp, & Maddox, 2002). Comparing data from our cohort with older adults with disability who are living independently in the community, ADL values were similar yet performance in grip strength, walking speed, chair rise, and balance were below values for community-dwelling older adults (Guralnik, et al., 1995; Guralnik, Ferrucci, Pieper, Leveille, Markides, Ostir et al., 2000; Onder et al., 2002; Ostir, Markides, Black, & Goodwin, 1998; Rantanen, Guralnik, Sakari-Rantala, Leveille, Simonsick, Ling et al., 1999).

Grip strength, which is a good indicator of overall function, disability and mortality risk, averaged 14 kg in this RC/AL cohort, well below the 17 kg reported for the lowest quartile of community-dwelling women with disability in the Women's Health and Aging Study (WHAS), (Guralnik, et al., 1995; Onder et al., 2002) and similar to the lowest quartile for Mexican American women (Al Snih et al., 2002). Given that 42% of Mexican American women with grip strength less than 14 kg, and 38% of the men with grip strength less than 22 kg, died within five years (Al Snih et al., 2002), this finding suggests that many of these RC/AL residents are at high risk for adverse outcomes.

Further evidence that RC/AL residents in this sample were not functioning as well as their reported ADL level might indicate is the very slow average walking speed of 0.41 m/second, which is well below the average speed for community-dwelling older adults, and associated with increased risk of adverse outcomes in numerous previous studies (Guralnik et al., 2000; Onder et al., 2002; Studenski et al., 2003). Slower walking speed also is associated with using an assistive device. However, while residents who used an assistive device had an average walking speed of 0.33 m/second, the 57.4% who walked independently without an assistive device only walked at 0.48 m/seconds. Therefore, it is unlikely that use of a device accounts for the extremely slow walking in these residents. Average walking speed for healthy older adults is 1.0-1.2 m/seconds (Brach, VanSwearingen, Newman, & Kiska, 2002; Onder et al., 2002). Several authors have shown that in community-dwelling older adults, walking speed <0.6 m/second is an independent predictor of change in health status, decline in function, falls, nursing home placement, and disability (Guralnik et al., 1995; Lan, Melzer, Tom, & Guralnik, 2002; Onder et al., 2002; Studenski et al., 2003; Van Swearingen et al., 1998).

Chair rise ability is also an area of concern in this population because it is associated with walking, transfers and other key mobility skills. Fifty percent of these residents were unable

to stand once from a standard-height chair without using their hands, which is more than the 26% that Alexander and colleagues (2001) reported among residents in congregate housing. For the 26.2% of our residents who were able to perform five repeated chair rises, their average time was 18 seconds. In comparison, the lowest quartile a community sample was 16.7 seconds (Guralnik et al., 2000). Values over 16.7 seconds are associated with risk of decreased mobility (Ostir et al., 1998). Several investigators attribute decreased strength, flexibility, and balance to chair rise difficulty (Lord et al., 2002; McCarthy, Horvat, Holtsberg, & Wisenbaker, 2004).

Standing balance was also severely impaired in these RC/AL residents; 39.6% were unable to stand with feet side by side for 10 seconds, and only 19.2% of residents could stand at least one or more seconds in the tandem stand position. Difficulties with tandem stance are associated with increased lateral balance instability, hip muscle weakness, and increased risk of falls (Gill, Allum, Carpenter, Held-Ziolkowska, Adkin, Honegger, et al., 2001; Stel, Smit, Pluijm, & Lips, 2003). These balance impairments are also indicators of walking disability (walking speed less than 0.4 m/second) (Rantanen, Guralnik, Ferrucci, Penninx, Leveille, Sipila, et al., 2001).

Although there is ample evidence that physical performance is a good predictor of adverse events in community-dwelling older adults, such relationships have not been studied in RC/AL residents in a large sample. This study examined the ability of these measures to predict adverse events, including death, nursing home placement, fracture, and functional decline among more than 1700 residents of 189 facilities. At one-year follow up, better grip strength, walking speed, and chair rise at baseline were associated with decreased risk of nursing home placement, fracture, and functional decline; however, none of these performance variables predicted mortality. These findings suggest that residents who are at risk for adverse events may be identified using simple tests of physical performance, but that mortality is most likely associated with some other variable (e.g., comorbidity).

Although intervention studies are largely lacking in the RC/AL setting, these results suggest that interventions that improve physical performance may decrease the incidence of fracture and disability in this population, as has been demonstrated in community-dwelling older adults (Gill, Baker, Gottschalk, Peduzzi, Allore, & Byers, 2002; King, Whipple, Gruman, Judge Schmidt, & Wolfson, 2002; Lord, Ward, & Williams, 1995; Malbut, Dinan, & Young, 2002; Resnick, Magaziner, Orwig, & Zimmerman, 2002; Rubenstein, Josephson, Trueblood, Loy, Harker, Pietruszka, et al., 2000). A recent study showed that providing a task-specific strength and flexibility program, in a small sample of RC/AL residents who had mobility disability, improved chair rise ability (Alexander, Galecki, Grenier, Nyquist, Hofmeyer, Grunawalt, et al., 2001). Similarly, an exercise program for 280 residents living in intermediate-care housing units improved function and reduced falls (Lord et al., 2003). This intervention used a group exercise program of strength, balance, endurance training, and functional tasks that emphasized enjoyment and social interaction. Additional research is needed to identify interventions that maintain or improve the function of RC/AL residents, especially those that target residents at risk and are feasible within the constraints of the facility and the health care system.

This study's large sample of facilities also permitted examination of the relationship between facility characteristics and physical performance. The only association for facility type was that residence in traditional facilities was associated with better grip strength, but not other performance measures. Traditional facilities tend to have a less impaired resident case mix; however, it is difficult to explain why only grip strength was associated with traditional facility type because grip strength is associated with overall functional ability and ADL. Poorer physical performance was more common in for-profit settings, but having a nurse

available and environmental quality was not related to performance. Residents in for-profit facilities tend to be more impaired, which may be related to their less restrictive admission and discharge policies (Zimmerman et al., 2003), which helps explain some of these results. The few facility associations observed suggest that resident characteristics are far stronger predictors of physical function than are facility factors. However, the association between proprietary status and function merits further investigation, most likely requiring comparative study of admission cohorts in non-profit and for-profit settings.

Noted limitations of this study include reporting of adverse events and ADL status. The reporting of adverse events was based on recall from facility staff during phone interviews conducted each quarter. Functional status (ADL) at time of discharge or death was also reported by a caretaker who was most familiar with the resident. We acknowledge that reported recall or the quality of records maintained by each caretaker or facility is prone to recall error and misinformation.

Most of the RC/AL residents in this study were reportedly independent in ADLs; however, based on actual physical performance, residents had substantial mobility-related problems. These analyses indicate that a few simple performance measures may identify functional deficits that are modifiable. This is an important finding, because RC/AL facilities provide supportive services to help residents maintain independence, competence, dignity, and quality of life. These services usually include up to three meals a day served in a common dining area; housekeeping services; assistance with eating, bathing, dressing, toileting and walking; and other medical and safety services. Results of this study suggest that in addition to these supportive services, programs are needed that promote optimal physical function. The prevalence of physical impairment reported in this study, and its relationship to adverse outcomes, suggest that RC/AL residents might benefit from performance-based screening for mobility disability, exercise interventions, and physical activities designed to improve physical performance. Indeed, if RC/AL facilities intend to meet the needs of their residents and allow them to age in place, they will need to address the deficits that lead to increased disability and transfer to a nursing home. By implementing effective interventions, it may be possible to prolong independent mobility so that RC/AL residents can remain in the more homelike RC/AL facility environment rather than be transferred to a potentially objectionable and more costly nursing home.

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Table 1

Descriptions of Participating Residents (n=1791) and RC/AL Facilities (n=189)[a]

Resident Variables	Percent of Residents (%) or M (SD)
Distribution of residents by state	
Florida	24%
Maryland	30%
New Jersey	21%
North Carolina	25%
Age (years)	84.0 (7.8)
≥85	51.6%
Gender (female)	75.6 %
Race (white)	90.6 %
Number of comorbid conditions[b]	5.0 (2.7)
ADL Function	
Independent in 7 ADLs	57.1%
Independent in 3 mobility-related ADLs (bed mobility, transfer, walk)	80.9%
Cognition (MDS-COGS score)[c]	
Intact (0-1)	40.2%
Mild-moderately impaired (2-4)	34.7 %
Severely impaired (5-8)	19.3 %
Very severely impaired (9-10)	5.9 %
Depressed (CSD-D score > 7)	13.6 %

Facility Variables	Percent of Facilities or Mean (SD)
Facility Type (n of residents)	
< 16 beds (608)	58.2%
Traditional (568)	21.2%
New-model (615)	20.6%
For-profit ownership	75.5%
Have an RN or LPN	65.8%
AL-EQS[e]	16.5 (5.1)

d Cornell Scale for Depression in Dementia; range 0-38 (19 items, each scored 0-2).

[a]Missing values ranged 1 to 60 for resident variables and 0 to 38 for facility variables.

[b]31 items of comorbidity ranged 0 – 15, higher scores indicate more comorbidity.

[c]Minimum Data Set Cognition Scale; range 0-10.

[e]Assisted Living Environmental Quality Score; range 5–26, higher scores indicate better environment.

Table 2

Grip Strength, Walking Speed, and Chair Rise Distributions of Participating RC/AL Residents

Test and Subgroup of Residents	Number (%) of Residents	M (SD)
Grip Strength	n=1776	Strength in kilograms
Performed	90.4 %	13.97 (6.85)
Female	90.3 %	13.96 (6.75)
Male	90.8 %	13.96 (7.11)
Walk Speed	n=1776	Speed in meters/second
Performed	72.2 %	0.41 (0.19)
Without device	57.4 %	0.48 (0.20)
With device	42.6 %	0.33 (0.15)
Chair Rise	n=1780	Time in seconds
Performed five times	26.2 %	17.82 (7.62)

Table 3

Balance Test Performance Distributions of Participating RC/AL Residents

Test and Response	Number (%) of Residents
Side by Side Stand	n=1777[b]
Unable[a]	598 (33.7 %)
Stand 1-9 seconds	104 (5.9 %)
Stand 10 seconds	1075 (60.5 %)
Semi-Tandem Stand	n=1746[b]
Unable[a]	984 (56.4 %)
Stand 1-9 seconds	163 (9.3 %)
Stand 10 seconds	599 (34.3 %)
Tandem Stand	n=1703[b]
Unable[a]	1376 (80.8 %)
Stand 1-9 seconds	186 (10.9 %)
Stand 10 seconds	141 (8.3 %)

[a] "Unable" category represents "unable, attempted or not," "interviewer felt unsafe," "resident felt unsafe," and "refused."

[b] Missing values range from 14 to 88; and include "unable to perform" in some cases.

Table 4

Bivariate Relationships Between Physical Performance Measures and Select Resident and Facility Characteristics[a]

Resident Variables	Grip Strength		Walk Speed	Repeated Chair Rise	Balance (tandem)
	Able (14+ kg)	Able (10+ kg)	Able (≥0.6 m/sec)	Able (5 times)	Able (1-10 sec)
Percent able	45.0%	66.9%	11.3%	26.2%	19.2%
Age (85 ≥)	0.41*** (0.34 – 0.49)	0.62*** (0.50 – 0.75)	0.43*** (0.32 – 0.58)	0.50*** (0.41 – 0.62)	0.55*** (0.43 – 0.72)
Gender (male)	4.70*** (3.70 – 5.96)	3.59*** (2.69 – 4.80)	1.42+ (0.98 – 2.05)	1.22+ (0.97 – 1.56)	1.11 (0.84 – 1.45)
Race (white)	0.66* (0.47 – 0.92)	0.82 (0.58 – 1.17)	0.83 (0.51 – 1.37)	0.91 (0.64 – 1.31)	0.82 (0.55 – 1.23)
Comorbidity (5 ≥)	1.22* (1.01 – 1.50)	1.35** (1.10 – 1.66)	0.70* (0.50 – 0.99)	0.59*** (0.47 – 0.74)	0.71** (0.55 – 0.91)
Independence in ADLs	2.97*** (2.38 – 3.70)	3.61*** (2.83 – 4.61)	4.37*** (2.91 – 6.55)	4.23*** (3.21 – 5.58)	4.51*** (3.28 – 6.20)
Cognition (MDS-COGS)					
Intact (0-1)	1.0 (ref)	1.0 (ref))	1.0 (ref)	1.0 (ref)	1.0 (ref)
Mildly impaired (2-4)	0.87 (0.71 – 1.07)	0.80+ (0.63 – 1.01)	0.84 (0.60 – 1.18)	0.96 (0.77 – 1.21)	0.89 (0.68 – 1.17)
Moderately impaired (5-8)	0.37*** (0.27 – 0.50)	0.30*** (0.23 – 0.39)	0.35*** (0.20 – 0.61)	0.62** (0.45 – 0.86)	0.40*** (0.26 – 0.60)
Severely impaired (9-10)	0.10*** (0.04 – 0.23)	0.06*** (0.03 – 0.12)	0.13** (0.04 – 0.46)	0.13*** (0.04 – 0.38)	0.10*** (0.03 – 0.29)
Depressed (7 ≥ CSD-D)	0.77+ (0.58 – 1.03)	0.62*** (0.47 – 0.82)	0.68 (0.42 – 1.09)	0.58** (0.41 – 0.81)	0.72 (0.49 – 1.08)
Facility Variables					
Facility Type					
< 16 beds	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)
Traditional	1.45* (1.05 – 1.98)	1.60** (1.14 – 2.25)	1.16 (0.72 – 1.88)	0.92 (0.65 – 1.30)	0.77 (0.50 – 1.18)
New-model	1.12 (0.82 -– 1.54)	1.12 (0.80 – 1.58)	1.19 (0.73 – 1.96)	0.82 (0.59 – 1.12)	1.09 (0.71- 1.66)
For-profit ownership	1.06 (0.76 – 1.49)	0.72+ (0.49 – 1.06)	0.62* (0.39 – 0.98)	0.91 (0.64 – 1.30)	0.79 (0.52 – 1.19)

Resident Variables	Grip Strength		Walk Speed	Repeated Chair Rise	Balance (tandem)
	Able (14+ kg)	Able (10+ kg)	Able (≥0.6 m/sec)	Able (5 times)	Able (1-10 sec)
Have an RN or LPN	0.99 (0.74)	1.03 (0.75 – 1.41)	0.92 (0.58 – 1.47)	0.91 (0.65 – 1.26)	1.00 (0.66 – 1.53)
Higher AL-EQS (18-26 vs 5-17)	0.92 (0.69 – 1.22)	1.01 (0.74 – 1.38)	1.13 (0.76 – 1.70)	0.99 (0.75 – 1.30)	1.11 (0.75 – 1.63)

[a] N=1791. Results show odds ratios and 95% confidence intervals, calculated using logistic regression, controlling for within facility clustering.

*** p<.001

** p<.01

* p<.05

+ p<.10. Sec = seconds

Table 5

Relationship Between Physical Performance Measures and the Relative Risk of Mortality, Nursing Home Transfer, Fracture, and Functional Change over One Year[a]

	Mortality		Nursing Home Transfer		Fracture		Functional Change (ADL) (average decline per 100 days)	
	Unadjusted	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
Grip strength								
≥ 14 kg	0.57*** (0.43 – 0.77)	0.89 (0.65 – 1.23)	0.69** (0.53 – 0.90)	0.75+ (0.55 – 1.04)	0.52*** (0.36 – 0.75)	0.53* (0.33 – 0.86)	0.63* (0.50- 0.76)	0.62*** (0.49 – 0.76)
< 14 kg	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	0.88	0.95
Grip strength								
≥ 10 kg	0.56*** (0.42 – 0.75)	0.94 (0.67 – 1.31)	0.71** (0.55 – 0.92)	0.87 (0.65 – 1.17)	0.63* (0.44 – 0.89)	0.68 (0.43 – 1.08)	0.76 (0.64-0.87)	0.74+ (0.62 – 0.85)
< 10 kg	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	0.79	0.93
Walk speed								
≥ 0.6 m/sec	0.58* (0.36 – 0.93)	1.21 (0.75 – 1.96)	0.51** (0.32 – 0.81)	0.61* (0.37 – 0.99)	0.45** (0.21 – 0.93)	0.51+ (0.24 – 1.08)	0.49* (0.27-0.71)	0.49** (0.27 – 0.72)
< 0.6 m/sec	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	0.79	0.84
Chair rise								
Able 5 times	0.41*** (0.29 – 0.58)	0.76 (0.52 – 1.13)	0.49*** (0.35 – 0.70)	0.57** (0.40 – 0.83)	0.48*** (0.30 – 0.75)	0.46** (0.28 – 0.77)	0.48*** (0.33-0.63)	0.47*** (0.32 – 0.61)
Unable	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	0.86	0.91
Balance: Tandem								
Able 1-10 sec	0.39*** (0.23 – 0.64)	0.72 (0.44 – 1.17)	0.56*** (0.41 – 0.78)	0.75 (0.53 – 1.06)	0.75 (0.46 – 1.23)	0.88 (0.52 – 1.49)	0.60+ (0.41-0.78)	0.57** (0.40 – 0.75)
Unable	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	1.0 (ref)	0.81	0.87

[a]Results show relative risks and 95% confidence intervals. N ranges from 1772 for unadjusted mortality (chair rise) to 1594 for adjusted fracture (tandem stand). Relative risks based on Proportional Hazards or GEE models (adjusting for within-facility clustering). Adjusted models control for age, sex, race, marital status, cognitive impairment (MDS-COGS), seven ADLs, depression (CDS-D), and comorbidities.

*** p<.001

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** $p<.01$

* $p<.05$

+ $p<.10$