Geriatric Rehabilitation Inpatients Roam at Home! A Matched Cohort Study of Objectively Measured Physical Activity and Sedentary Behavior in Home-Based and Hospital-Based Settings

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Abstract

Objectives: This study aimed to describe objectively measured physical activity and sedentary behavior in geriatric rehabilitation patients receiving care in the home-based compared to the hospital-based setting.

Design: Observational matched cohort study.

Setting and Participants: Home-based (patient’s home) or hospital-based (ward) geriatric rehabilitation was delivered to inpatients within the REStORing health of acutely unwell adults (RESORT) observational, longitudinal cohort of the Royal Melbourne Hospital (Melbourne, Victoria, Australia).

Methods: Patients were asked to wear ActivPAL4 accelerometers for 1 week and were assessed by a comprehensive geriatric assessment at admission, discharge, and followed up after 3 months. Hospital-based patients were matched to home-based patients for sex and baseline physical function [Short Physical Performance Battery (SPPB), activities (instrumental) of daily living, and Clinical Frailty Scale]. Differences in patient characteristics and physical activity (total, standing and walking durations, number of steps and sit-to-stand transitions) and sedentary behavior (total, sitting and lying durations) were assessed.

Results: A total of 159 patients were included: 18 home-based [mean age: 81.9 ± 8.6 years, 38.9% female, median (interquartile range [IQR]) SPPB: 7.0 (5.0-9.0)] and 141 hospital-based [mean age: 82.9 ± 7.8 years, 57.4% female, median (IQR) SPPB: 1.0 (0.0-4.0)] patients, of whom 18 were matched [mean age: 80.1 ± 7.4 years, 38.9% female, median (IQR) SPPB: 6.5 (4.8-10.0)]. Median physical activity measures were consistently higher in home-based patients compared to the total group of hospital-based patients. After matching, physical activity measures remained >2.4 times higher and were significantly different for all measures (total physical activity, standing and walking durations, number of steps and sit-to-stand transitions) and sedentary behavior (total, sitting and lying durations) were assessed.

The authors declare no conflicts of interest.

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Conclusions and Implications: Home-based inpatients are more physically active than hospital-based inpatients independent of matching for sex and baseline physical function, which supports home-based geriatric rehabilitation.

Methods

Setting and Participants

“REStOring health of acutely unwell adults” (RESORT) is an observational longitudinal cohort of patients admitted to the Royal Melbourne Hospital (Victoria, Australia) for geriatric rehabilitation (commenced October 16, 2017). Next to the traditional hospital-based care provided in 4 wards, the Royal Melbourne Hospital offers a home-based inpatient rehabilitation program [Royal Melbourne Hospital@Home (RMH@Home)], which provides bed-substitution care that is replicative of the hospital-based setting via a multidisciplinary team, including physicians, nurses, and allied health professionals, for patients living within 30 minutes’ driving distance from the Royal Melbourne Hospital and operated at a 15-bed capacity at the time of investigation. Patients, who would have otherwise received hospital-based care, are deemed suitable for home-based care by physicians to ensure medical stability, ability to independently transfer and use the toilet safely, and adequate cognitive capacity. Patients in both settings were assessed by a Comprehensive Geriatric Assessment by physicians, nurses, occupational therapists and physiotherapists within 48 hours of admission and discharge and followed up at 3 months via phone interviews. This study was approved by the Melbourne Health Human Research Ethics Committee (no. HREC/17/MH/103), with all ethical guidelines followed according to the Declaration of Helsinki. Written informed consent was obtained from all patients or their legal proxies. Inability to provide informed consent and/or receiving palliative care at admission were exclusion criteria.

Patient Characteristics

Demographics included age, sex, marital status, living situation, and smoking status and were self-reported or extracted from medical records. Reason for hospital admissions and number of medications were obtained from medical records. Disease burden was assessed by the Charlson Comorbidity Index (0–36 points), where a higher score indicates greater burden. Frailty was assessed using the Clinical Frailty Scale (CFS), which classifies frailty from 1 to 9 points representing very fit to terminally ill. Malnutrition was assessed by theMalnutrition Screening Tool (0–5 points) where higher scores indicate greater risk of malnutrition. History of falls in the past year was ascertained by self-report or medical records. Length of stay was extracted from medical records. Cognition was assessed by the standardized Mini-Mental State Examination (0–30 points), where lower scores reflect worse cognition. Cognitive impairment was defined as previously described, and delirium was assessed with the Short Confusion Assessment Method. Height (centimeters) was assessed using a stadiometer and for those who could not stand, height was calculated from knee height using the Chumlea equation for Caucasians. Depending on ambulatory status, weight (kilograms) was assessed by either a standing or seated scale, or a weighted hoist. Body mass index was calculated by weight divided by height squared (kg/m²).

Physical Function

The Functional Ambulation Classification was used by physicians to assess ambulation status, with scores ranging from 0 (non-functional) to 5 (independent). Ability to walk, use of a walking aid, difficulty walking 100 m, and difficulty climbing stairs were dichotomous (yes/no) self-reported data assessed at preadmission (respectively at admission), admission, and 3-month follow-up, and were obtained from patient surveys or extracted from medical records. Activities of daily living were assessed by occupational therapists at admission, discharge, and 3-month follow-up by the Katz Index of Activities of Daily Living (ADL) and the Lawton and Brody Instrumental ADL (IADL) where higher scores indicate greater ability to complete tasks, respectively. The Short Physical Performance Battery (SPPB), made up of balance tests (0–4 points), a 4-m walk test (0–4 points), and a chair stand test (0–4 points), was assessed by physiotherapists with higher scores indicating better physical performance (0–12 points). Maximum hand grip strength was measured by physiotherapists from 3 attempts with each hand using a handheld dynamometer (JAMAR hand dynamometer; Sammons Preston, Inc, Bolingbrook, IL).
### Objectively Measured Physical Activity and Sedentary Behavior

From October 22, 2019, to March 29, 2020, patients on their fifth (range 2-7) day of hospital admission were asked to wear an ActivePAL4 triaxial accelerometer (PAL Technologies Ltd, Glasgow, Scotland, UK) on their right thigh for 7 days to objectively assess daily physical activity and sedentary behavior. The ActivePAL is an inertial sensor that uses static acceleration (range ±4g) and inclination to directly measure and quantify an individual’s postural allocation and partition these behaviors into time spent upright including standing and sitting, lying and postural transitions. Patients wore the accelerometer for 7 days and recorded the time spent in each activity category using the ActivePAL software. Physical activity was defined as the time spent in upright, standing or walking, and sedentary behavior was defined as the time spent in lying or sitting. The accelerometer recorded activity data in 1-second epochs.

### Table 1: Patient Characteristics of Geriatric Rehabilitation Inpatients at Admission Receiving Care in the Home-Based vs Hospital-Based Setting (Matched and Total, Respectively)

| Variable                                      | Home-Based Total (n = 18) | Hospital-Based Matched (n = 18) | P       | Hospital-Based Total (n = 141) | P       |
|------------------------------------------------|---------------------------|---------------------------------|---------|---------------------------------|---------|
| Demographics                                   |                           |                                  |         |                                 |         |
| Age, y, mean ± SD                              | 81.9 ± 6.6                | 80.1 ± 7.4                       | .516    | 82.9 ± 7.8                      | .63     |
| Female, n (%)                                  | 18                         | 17                               | .35     | 18                               | .14     |
| Married, n (%)                                 | 17                         | 16                               | .24     | 18                               | .22     |
| Living situation, n (%)                        |                           |                                  |         |                                 |         |
| Living alone                                   | 4 (22.2)                   | 11 (61.1)                        | .018    | 71 (50.4)                       | .024    |
| With partner                                   | 9 (50.0)                   | 6 (33.3)                         | .310    | 45 (31.9)                       | .13     |
| With children                                  | 4 (22.2)                   | 1 (5.6)                          | .34     | 1 (23.6)                        | .51     |
| With roommates                                 | 1 (5.6)                    | 0 (0.0)                          | .99     | 0 (0.0)                         | .11     |
| Other                                          | 0 (0.0)                    | 0 (0.0)                          | .99     | 0 (0.0)                         | .99     |
| Institutionalized, n (%)                       | 0 (0.0)                    | 0 (0.0)                          | .99     | 0 (0.0)                         | .99     |
| Current smoker, n (%)                          | 0 (0.0)                    | 0 (0.0)                          | .99     | 0 (0.0)                         | .99     |
| Clinical characteristics                       |                           |                                  |         |                                 |         |
| Primary reason for hospital admission, n (%)   |                           |                                  |         |                                 |         |
| Musculoskeletal                                | 7 (38.9)                   | 11 (61.1)                        | .18     | 68 (48.2)                       | .46     |
| Neurologic                                     | 4 (22.2)                   | 2 (11.1)                         | .66     | 20 (14.2)                       | .48     |
| Infection                                      | 2 (11.1)                   | 0 (0.0)                          | .49     | 14 (10.0)                       | .14     |
| Cardiac                                        | 1 (5.6)                    | 0 (0.0)                          | .99     | 9 (6.4)                         | .99     |
| Respiratory                                    | 1 (5.6)                    | 1 (5.6)                          | >.99    | 11 (7.8)                        | >.99    |
| Metabolic                                      | 1 (5.6)                    | 1 (5.6)                          | >.99    | 3 (2.1)                         | >.99    |
| Gastrointestinal                               | 1 (5.6)                    | 0 (0.0)                          | >.99    | 11 (7.8)                        | >.99    |
| Hematologic                                    | 1 (5.6)                    | 0 (0.0)                          | >.99    | 1 (0.7)                         | >.99    |
| Psychiatry                                     | 0 (0.0)                    | 3 (16.7)                         | .23     | 1 (6.4)                         | .66     |
| Urology                                        | 0 (0.0)                    | 0 (0.0)                          | >.99    | 14 (28.6)                       | >.99    |
| Ophthalmology                                  | 0 (0.0)                    | 0 (0.0)                          | >.99    | 14 (28.6)                       | >.99    |
| CCI score, points (0-36)                       |                           |                                  |         |                                 |         |
| Current smoker, n (%)                          | 0 (0.0)                    | 0 (0.0)                          | >.99    | 14 (28.6)                       | >.99    |
| Neurologic                                     | 4 (22.2)                   | 2 (11.1)                         | .66     | 20 (14.2)                       | .48     |
| CCI score, points (0-36)                       |                           |                                  |         |                                 |         |
| Infection                                      | 2 (11.1)                   | 0 (0.0)                          | .49     | 14 (10.0)                       | .14     |
| Cardiac                                        | 1 (5.6)                    | 0 (0.0)                          | .99     | 9 (6.4)                         | .99     |
| Respiratory                                    | 1 (5.6)                    | 1 (5.6)                          | >.99    | 11 (7.8)                        | >.99    |
| Metabolic                                      | 1 (5.6)                    | 1 (5.6)                          | >.99    | 3 (2.1)                         | >.99    |
| Gastrointestinal                               | 1 (5.6)                    | 0 (0.0)                          | >.99    | 11 (7.8)                        | >.99    |
| Hematologic                                    | 1 (5.6)                    | 0 (0.0)                          | >.99    | 1 (0.7)                         | >.99    |
| Psychiatry                                     | 0 (0.0)                    | 3 (16.7)                         | .23     | 1 (6.4)                         | .66     |
| Urology                                        | 0 (0.0)                    | 0 (0.0)                          | >.99    | 14 (28.6)                       | >.99    |
| Ophthalmology                                  | 0 (0.0)                    | 0 (0.0)                          | >.99    | 14 (28.6)                       | >.99    |
| CCI score, points (0-36)                       |                           |                                  |         |                                 |         |
| Current smoker, n (%)                          | 0 (0.0)                    | 0 (0.0)                          | >.99    | 14 (28.6)                       | >.99    |
| Neurologic                                     | 4 (22.2)                   | 2 (11.1)                         | .66     | 20 (14.2)                       | .48     |
| CCI score, points (0-36)                       |                           |                                  |         |                                 |         |
| Infection                                      | 2 (11.1)                   | 0 (0.0)                          | .49     | 14 (10.0)                       | .14     |
| Cardiac                                        | 1 (5.6)                    | 0 (0.0)                          | .99     | 9 (6.4)                         | .99     |
| Respiratory                                    | 1 (5.6)                    | 1 (5.6)                          | >.99    | 11 (7.8)                        | >.99    |
| Metabolic                                      | 1 (5.6)                    | 1 (5.6)                          | >.99    | 3 (2.1)                         | >.99    |
| Gastrointestinal                               | 1 (5.6)                    | 0 (0.0)                          | >.99    | 11 (7.8)                        | >.99    |
| Hematologic                                    | 1 (5.6)                    | 0 (0.0)                          | >.99    | 1 (0.7)                         | >.99    |
| Psychiatry                                     | 0 (0.0)                    | 3 (16.7)                         | .23     | 1 (6.4)                         | .66     |
| Urology                                        | 0 (0.0)                    | 0 (0.0)                          | >.99    | 14 (28.6)                       | >.99    |

ADL, Activities of Daily Living; CCI, Charlson Comorbidity Index; CFS, Clinical Frailty Scale; d, days; LOS, length of stay; MST, Malnutrition Screening Tool; short CAM, Short Confusion Assessment Method; BMI, body mass index; FAC, Functional Ambulation Classification; HDL, Instrumental Activities of Daily Living; kg, kilograms; M, meters; SD, standard deviation; sMMSE, Standardized Mini Mental State Examination; SPPB, Short Physical Performance Battery; y, year.

*Number of patients for which data were available. P values are based on the difference of patients characteristic for the home-based group compared with the matched hospital-based group and total hospital-based group, respectively, using the following tests: independent samples t test for normally distributed variables, Mann-Whitney U test for non-normally distributed (skewed) variables, chi-square test for categorical variables when the expected values in each group were >5, and Fisher exact test for categorical variables when expected values in each group were <5. P values <.05 are presented in bold.
walking vs time spent non-upright including sitting and lying (inclination approximately > or < 20° from horizontal (0°)) and it also counts number of steps and sit-to-stand transitions.\textsuperscript{35} Data were collected in 15-second epochs with a sampling frequency of 20 Hz and analyzed in 60-second epochs. A valid day was defined as at least 20 out of 24 hours of wear, and patients were required to complete ≥ 1 valid day to be included. Total wear time was expressed as days per week and other duration variables as minutes per day. Total physical activity duration was defined as the mean time spent upright over valid days and was the sum of standing and walking durations. Steps and sit-to-stand transitions were defined as the mean number or count over valid days. Sedentary duration was defined as the mean time spent non-upright over valid days and was the sum of sitting and lying durations.

### Statistical Analysis

As patients were not randomized to care settings, selection bias was anticipated, particularly for physical function. Subsequently, post hoc nearest-neighbor one-to-one matching techniques were employed. Each home-based patient was matched to a hospital-based patient by sex and physical function measured by SPPB score. If the SPPB score was missing or there was more than 1 match, ADL score, IADL score, Functional Ambulation Classification score, Clinical Frailty Scale score, and age were progressively evaluated until a match was identified.

Descriptive statistics for patient characteristics, physical activity and sedentary behavior were reported as means ± standard deviations and compared with independent samples t tests (continuous variables, normally distributed), medians with interquartile ranges, and compared with Mann-Whitney U tests (continuous variables, skewed), or numbers (n) with percentages (%) and compared with either chi-square or Fisher exact tests (categorical variables). Statistical significance was set at α = 0.05. All analyses were performed using the Statistical Package for the Social Sciences software (IBM SPSS Statistics, version 25.0; IBM Corp, Armonk, NY). Physical activity over the 24-hour day was visualized by multiple series line graphs using Microsoft Excel (version 16.16.22) by plotting the median (solid lines) and interquartile range (dotted lines) of each group’s mean physical activity over valid days, respectively, for each 30-minute period. To demonstrate the clinical relevance of physical activity during geriatric inpatient rehabilitation, physical function over time was summarized in box plots using Plotly (Plotly Technologies Inc, Montreal, Québec, Canada) for

### Results

#### Inclusion

A total of 159 inpatients participated in accelerometer data collection: 18 home-based and 145 hospital-based patients. Four patients participated in accelerometer in both settings and were subsequently included as home-based patients to avoid double-counting; comparisons of their physical activity and sedentary behavior in each setting are in Supplementary Figure 1.

#### Patient Characteristics

Of the 18 home-based patients, 7 were female (mean age 81.9 ± 8.6 years), and of the total 141 hospital-based patients, 57.4% were female (mean age 82.9 ± 7.8 years) (Table 1). A greater proportion of hospital-based patients lived alone; they were significantly more frail and at a greater risk for malnutrition compared with home-based patients. Physical function expressed by Functional Ambulation Classification, ADL, IADL, SPPB (including its subtests), and hand grip strength were significantly lower in the group of hospital-based compared to home-based patients. Matching of hospital-based to home-based patients resulted in a sex and physical function matched hospital-based group of 18 patients including 7 women (mean age 80.1 ± 7.4 years). SPPB scores were not statistically different between home-based and matched hospital-based patients. After matching, more matched hospital-based patients lived alone and had worse ADL and IADL scores compared with home-based patients.

#### Physical Activity and Sedentary Behavior During Geriatric Inpatient Rehabilitation

Median physical activity was significantly higher and median sedentary behavior was significantly lower in home-based patients compared with total hospital-based patients for all measures (all \( P < .001 \)), with the exception of sitting duration, which was non-significantly higher in home-based patients (\( P = .11 \) (Table 2). Differences between home- and hospital-based patients persisted after matching; home-based patients were >2.4 times more active than matched hospital-based patients for all physical activity measures with the exception of sit-to-stand transitions. Comparing medians and

### Table 1

| Home-Based | Hospital-Based | Matched (n = 18) | Total (n = 141) |
|------------|---------------|-----------------|-----------------|
| Wear time, d | 6 [5-6] | 6 [5-6] | 58.42 [25.61-120.54] |
| Physical activity duration, min/d | 18 | 122.81 [52.48-219.36] | 1.014 | 122.81 [52.48-219.36] |
| Standing duration | 263.01 [132.16-307.68] | 18 | 104.52 [36.46-177.14] | .012 | 145 | 46.83 [22.87-101.99] |
| Walking duration | 49.46 [30.43-67.58] | 18 | 20.70 [10.30-32.76] | .002 | 145 | 7.44 [1.54-14.54] |
| Steps per day | 2984.10 [1641.90-4752.86] | 18 | 1236.17 [701.33-2359.92] | .004 | 145 | 401.57 [65.26-898.67] |
| Sit-to-stands per day | 39.08 [29.71-53.63] | 18 | 24.50 [13.14-46.75] | .10 | 145 | 20.33 [9.50-30.00] |
| Sedentary duration, min/d | 1123.73 [1065.40-1279.88] | 18 | 1317.19 [1220.64-1413.97] | .011 | 145 | 1318.58 [1319.46-1413.97] |
| Sitting duration | 612.17 [486.00-679.27] | 18 | 532.75 [140.13-651.98] | .09 | 145 | 550.90 [152.25-694.15] |
| Lying duration | 564.48 [472.78-661.71] | 18 | 708.74 [549.50-1235.54] | .020 | 145 | 771.53 [602.33-1230.44] |
interquartile ranges of home-based patients to matched hospital-based patients more time was spent physically active (\(P = .011\)), including both a longer time standing (\(P = .012\)) and walking (\(P = .002\)). Home-based patients took significantly more steps than matched hospital-based patients (\(P = .004\)) and sit-to-stand transitions, but differences for sit-to-stands were non-significant (\(P = .10\)). Sedentary behavior was significantly lower for home-based patients compared with matched hospital-based patients (\(P = .011\)). Of sedentary time, home-based patients spent more time than matched hospital-based patients sitting (\(P = .09\)) and spent significantly less time lying (\(P = .020\)).

Over the course of the day, physical activity in both groups was highest from 8 AM to 3 PM and began tapering from 6 to 9 PM (Figure 1). The home-based group exhibited clear and consistent patterns of higher physical activity compared to the total hospital-based group; with the 25th percentiles for steps and standing duration of the home-based group being higher than the 75th percentiles of the total hospital-based group. Measures of sedentary behavior exhibited similar patterns in both groups, with the home-based participants spending more of their sedentary time sitting and the hospital-based patients spending more time lying. Patients who wore the ActivPAL in both the home-based and hospital-based settings exhibited similar patterns in both settings, with higher physical activity in the home-based setting present in patients with longer times between accelerometer measurements (Supplementary Figure 1).

**Physical Function Over Time**

Descriptive analysis showed that both median ADL and IADL increased from admission to discharge in all groups with larger gains in the hospital-based groups. ADL and IADL remained stable (equal medians) from discharge to 3-month follow-up in all groups (Figure 2). The proportion of patients reporting the use of a walking aid, difficulty walking 100 m, or difficulty climbing stairs either declined or remained stable from preadmission to 3-month follow-up in hospital-based patients, and 1 additional home-based patient
reported the use of a walking aid and difficulty climbing stairs, respectively. At 3 month follow-up, 1 of 18 home-based patients fell, whereas 3 of 12 matched and 27 of 92 total hospital-based patients fell (Table 3).

**Discussion**

Geriatric inpatient rehabilitation delivered in the home-based setting is associated with higher physical activity than in the hospital-based setting; however, time spent sedentary was similar. Matching confirmed results and demonstrated that these findings are independent of sex and baseline physical function.

Daily physical activity was more than 2.4 times higher in home-based patients compared with matched hospital-based patients for all measures except for sit-to-stand transitions, which is clinically relevant given that greater physical activity is associated with numerous positive health outcomes including better physical function and reduced mortality.33–36 Partitioning sedentary behavior into sitting and lying duration, time allocation was similar between patients in the home-based and hospital-based settings. This was an unexpected finding that reflects high sedentary behavior in geriatric rehabilitation inpatients is independent of setting and from physical activity,37 which is in line with recent recommendations to focus on both ends of the activity spectrum by creating a physical environment.
Table 3
Physical Function Assessed at Preadmission, Admission, and 3-Month Follow-up in Geriatric Rehabilitation Inpatients Receiving Care in the Home-Based vs Hospital-Based Setting (Matched and Total, Respectively)

| Home-Based (Total n = 18) | Hospital-Based (Matched n = 18) | Hospital-Based (Total n = 141) |
|---------------------------|---------------------------------|--------------------------------|
| Preadmission, n (%)       | Admission, n (%)                 | 3-mo Follow-Up, n (%)          |
| Use of a walking aid      | 11 (61.1)                       | 13 (72.2)                      | 12 (66.7)                       |
| Difficulty walking 100 m  | 8 (47.1)                        | 9 (50.0)                       | 8 (47.1)                        |
| Difficulty climbing stairs| 10 (55.6)                       | 9 (52.9)                       | 11 (64.7)                       |
| Had a fall                | 14 (77.8)                       | N/A                            | 1 (5.1)                         | 13 (72.2)                       | 3 (23.1)                       | 92 (76.6)                      | N/A                            | 27 (29.3)                       |

All variables are presented as the number of patients with variable present (n) and percentage of total (%).

Our results are corroborated by a recent pilot study for a randomized controlled trial comparing 9 home-based and 11 hospital-based acutely admitted patients using a skin patch (physIQ or VitalConnect) to assess physical activity.15,39 The median physical activity duration [209 (90) vs 78 (44) minutes/d, P < .01], steps [1820 (3300) vs 159 (508) per day, P < .06], and standing duration [4.8 (1.4) vs 2.7 (1.8) hours/d, P < .01] were all higher in the home- vs the hospital-based group.39 The subsequent randomized controlled trial of 43 home-based and 48 hospital-based acutely admitted inpatients assessed sedentary and lying duration, which was, respectively, 11% and 37% higher in hospital vs home-based patients.15 Smaller differences between groups are likely explained by the acute setting, rather than the rehabilitation setting in the current study; although there are many benefits to home-based hospitalization, it is likely insufficient to impede the systemic effects of acute illness on functional ability and subsequent engagement in physical activity. Furthermore, although their median age was comparable to the current study, anyone >18 years was eligible for inclusion, which may also explain these differences. A recent systematic review seeking to investigate if geriatric inpatients >60 years old receiving acute care in a home-based setting are more active than hospital-based patients identified that there was a complete absence of studies designed to answer this question.40 The present study, although in the rehabilitation setting, is the first to provide evidence for higher physical activity in home-based geriatric inpatients and thus gives incentive for future research in a larger sample.

Our findings suggest that receiving care in the home-based setting may facilitate physical activity by overcoming institutional and cultural restrictive barriers and allowing more opportunity for engagement in physical activities.41 Safety concerns, specifically, avoiding falls, is commonly cited as a concern by clinicians against increasing physical activity in hospitalized patients; however, this is not supported by research and has led to a pervasive implementation of falls prevention measures that have little efficacy in preventing falls, but present substantial consequences by inhibiting mobility.42 Another common misconception of clinicians is that hospitalized patients lack the motivation to be mobilized or initiate physical activity themselves.41,43 Previous qualitative research identified a willingness and even desire of hospitalized patients to have more opportunity and autonomy in out-of-bed activity.10 The present study supports these ethnographic findings by showing that patients outside of the hospital environment choose to engage in more physical activity. Furthermore, the absence of a difference in the number of sit-to-stand transitions between the home-based and hospital-based settings show that the frequency of activity bouts was similar; however, the duration of physical activity after transitioning from sitting to standing was significantly and consistently (throughout the day) shorter in hospital-based patients, suggesting that once a patient is activated there should be adequate opportunity for them to remain active.

Changes in ADL and IADL over time showed that on the group level there is improvement from admission to and stability from discharge to 3-month follow-up in all groups. The larger improvements in physical function identified in the hospital-based group were likely because of the clear presence of a ceiling effect for both ADL and IADL. We subsequently did not expect that the short duration and likely low intensity of physical activity during geriatric rehabilitation would correspond with short-term changes in ADL and IADL in this cohort; rather, these changes were more likely due to disease burden and subsequent treatment response,44 which we were unable to control for given the small sample. Furthermore, physical activity assessed postdischarge is likely a better determinant of future ADL and IADL trajectories as it is free of the previously mentioned hospital-associated barriers. Therefore, future studies should incorporate physical activity and sedentary behavior assessment postdischarge, as is being highlighted using data of the Hospital-ADL cohort of acute patients,15 and include more distant follow-up to evaluate the long-term role of physical activity during and post-hospitalization.

To our knowledge, this is the first study using accelerometer in home-based rehabilitation inpatients and subsequently the first to compare levels of physical activity and sedentary behavior with hospital-based patients. Recruitment was from a large metropolitan hospital, inclusion for accelerometer was random, and exclusion criteria were minimal; thus, increasing the generalizability of our findings. Randomization to home-based care is particularly challenging in geriatric inpatients populations45 and selection bias was anticipated in this study, which was minimized through matching; however, the differences in ADL and IADL between groups were unable to be ameliorated, which represents a limitation. Furthermore, this study is limited by the small sample size of patients included in the home-based group, as data collection was stopped early due to the COVID-19 pandemic and the home-based service only operated with 15 beds at the time of accelerometer data collection, which has since been expanded because of successful implementation and increasing demand.46 However, we confirmed that sample sizes were large enough to perform the analyses presented.47

Conclusions and Implications

Home-based geriatric inpatient rehabilitation is associated with greater physical activity compared with the hospital-based setting even after matching for sex and physical function and therefore promotes rehabilitation goals of mobilization. This adds to the emerging body of literature that provides benefits of home-based care. Future research should confirm findings in a larger sample, identify unique
enablers of physical activity in the home setting at the individual and environmental levels that could be implemented into hospital settings, and assess long-term impacts of higher physical activity during home-based care.

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Supplementary Fig. 1. Mean physical activity and sedentary behavior per 30-minute period of the 24-hour day cycle of 4 geriatric inpatients who wore ActivPALs in both the hospital-based and home-based settings. Accelerometry measurements were taken on 2 different occasions; the left and right arrows in the legend indicate the number of days in between accelerometry measurements.
