

Recovery From Disability Among Community-Dwelling Older Persons

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DISABILITY IN BASIC ACTIVITIES of daily living (ADLs) is common among community-dwelling older persons, with prevalence rates ranging from 7% in those aged 65 to 74 years to 24% in those aged 85 years or older.¹ Although disability in older persons is often thought to be progressive or permanent, previous research has shown that it is a dynamic process, with individuals moving in and out of states of disability.² Indeed, recovery rates as high as 28% have been demonstrated in previous longitudinal studies of community-dwelling older persons that have included assessment intervals of 12 to 24 months.^{1,3,4} More recent evidence has demonstrated that assessment intervals longer than 3 to 6 months lead to incomplete ascertainment of disability and that this incomplete ascertainment is largely due to recovery from disability.⁵ These results suggest that recovery may be considerably more common than previous studies have indicated.

To set realistic goals and plan for appropriate care, disabled older persons, along with their families and clinicians, need accurate information about the likelihood and time course of recovery. The objectives of this study were to determine the rate of and time to recovery of independent function in community-dwelling older persons who become newly disabled in their ADLs, to determine the duration of recovery, and to compare the likelihood of recovery among pertinent subgroups of older persons.

Context Previous studies have found that a sizeable minority of newly disabled older persons recover independent function; however, long intervals between assessments have led to difficulty in determining the true incidence and duration of disability, and therefore in accurately characterizing the probability and course of recovery.

Objectives To determine the rate of and time to recovery of independent function in community-dwelling older persons who become newly disabled in their activities of daily living (ADLs), to determine the duration of recovery, and to compare the likelihood of recovery among pertinent subgroups of older persons.

Design, Setting, and Participants Prospective cohort study, with monthly assessments of ADL function, for 754 initially nondisabled, community-dwelling persons aged 70 years or older, performed in a small urban area from March 1998 to May 2003.

Main Outcome Measures Demographic features, chronic conditions, cognitive function, and physical frailty were determined during comprehensive assessments at 18-month intervals. Disability, defined as needing personal assistance with 1 or more key ADLs (bathing, dressing, walking, and transferring), was assessed during monthly telephone interviews.

Results A total of 420 participants (56%) experienced disability during a median follow-up of 51 months. Of these participants, 399 (81%) recovered (ie, regained independence in all 4 ADLs) within 12 months of their initial disability episode, and a majority (57%) of these maintained independence for at least 6 months. Among participants who experienced 3 or more consecutive months of disability, a majority (60%) recovered, but only a third of these maintained independence for at least 6 months. Persons who were cognitively impaired, physically frail, or severely disabled (ie, in 3-4 ADLs) at onset were less likely to recover than those who were cognitively intact, nonfrail, or mildly disabled, respectively. Nonetheless, a majority of participants within each subgroup recovered.

Conclusions Newly disabled older persons recover independent ADL function at rates far exceeding those that have been previously reported. Recovery from disability, however, is often short-lasting, suggesting that additional efforts are warranted to maintain independence in this high-risk group.

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METHODS

Study Population

The study population was drawn from members of the Precipitating Events Project (PEP), a longitudinal study of 754 community-dwelling persons, aged 70 years or older, who were nondisabled (ie, required no personal assistance) in 4 key ADLs—bathing, dressing, walking inside the house, and transferring from a chair. The assembly of the cohort, which took place be-

tween March 1998 and October 1999, is summarized in FIGURE 1 and has been described in detail elsewhere.⁶ Potential participants were identified from a computerized list of 3157 age-eligible members of a large health plan in greater New Haven, Conn. To mini-

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mize potential selection effects, each member was assigned a unique number using a computerized randomization program, and screening for eligibility and enrollment proceeded sequentially. Eligibility was determined during a screening telephone interview and was confirmed during an in-home assessment. Persons who were physically frail, as denoted by a timed score of greater than 10 seconds on the rapid gait test (ie, walking back and forth over a 10-foot course as quickly as possible), were oversampled to ensure a sufficient number of participants at increased risk for ADL disability.^{7,8} Slow gait speed has repeatedly been shown to be the single best predictor of ADL disability.⁸⁻¹⁰

Potential participants were excluded if they had a life expectancy less than 12 months, planned to move out of the New Haven area during the next 12 months, or were unable to speak English. Participants with significant cognitive impairment (as defined below) were excluded only if they had no available proxy.⁵ Only 4.6% of the 2753 health plan members who were alive and could be contacted refused to complete a screening telephone interview, and 75.2% of the 1002 eligible members agreed to participate in the study. Persons who refused to participate did not differ significantly from those who were enrolled in terms of age or sex. The study protocol was approved by the Yale Human Investigation Committee, and all participants gave verbal informed consent.

Data Collection

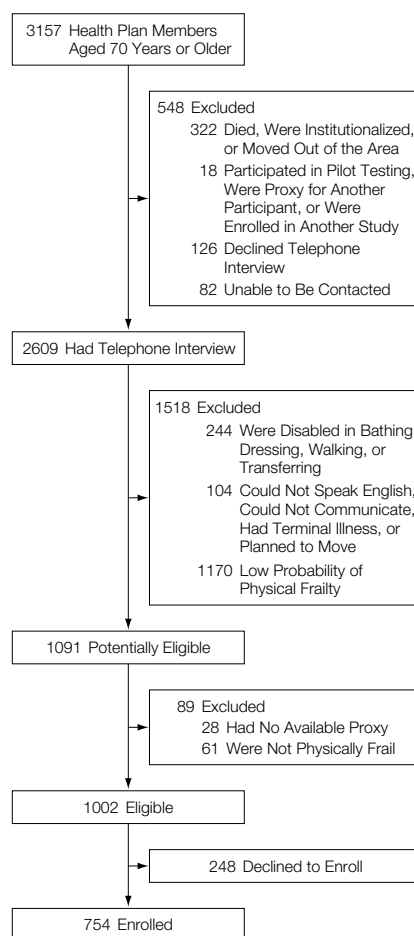
PEP participants underwent comprehensive in-home assessments at baseline, 18, and 36 months and had monthly telephone interviews for up to 53 months. The comprehensive assessments were completed by trained research nurses using standard instruments. In addition to gait speed, data were collected on demographic characteristics⁹; self-reported, physician-diagnosed chronic conditions, namely, hypertension, myocardial infarction, congestive heart failure, stroke, diabetes, arthritis, hip fracture, chronic lung dis-

ease, and cancer (other than minor skin cancers); and cognitive function.¹¹

During monthly telephone interviews, participants were assessed for disability in 4 key ADL tasks—bathing, dressing, walking, and transferring. Interviewers used standard questions^{4,8} that have been described in detail elsewhere.⁵ For each ADL, participants were asked, “At the present time, do you need help from another person to” perform the task? Those participants who needed help with or were unable to complete 1 or more of the ADL tasks were considered disabled. Participants were not asked about eating, toileting, or grooming because the incidence of disability in these 3 ADLs is low among community-dwelling older persons,^{7,8} and disability in these ADLs is uncommon without concurrent disability in bathing, dressing, walking, or transferring.^{7,8,12} Among a subgroup of 91 participants who were interviewed twice within a 2-day period by different interviewers, we found that the reliability of our disability assessment was substantial,¹³ with $\kappa=0.75$ for disability in 1 or more of the 4 ADLs; κ was 1.0 for the 18 paired interviews that were completed independently by different interviewers on the same day. A designated proxy, defined as a person who is cognitively intact and who either lives with the participant or visits the participant at least 3 days per week,⁵ completed the interviews for participants who had significant cognitive impairment, defined as recall of none of the 3 items on the short-term memory portion of the Folstein Mini-Mental State Examination¹¹ (MMSE) or a score of less than 20 on the MMSE and recall of 1 or 2 of the 3 memory items.⁵ The accuracy of these proxy reports was found to be excellent, with $\kappa=1.0$.⁵

Follow-up interviews completed through May 2003 were included. One hundred fifty-one participants (20%) died after a median follow-up of 30 months, and 31 (4.0%) dropped out of the study after a median follow-up of 21 months. Data are otherwise available for 99.4% of the remaining 34 220 monthly telephone interviews. Seven percent (2521/34 014) of the inter-

Figure 1. Assembly of the Study Cohort



Persons who were physically frail were oversampled as described in detail elsewhere.⁶ After the prespecified number of nonfrail participants were enrolled, potential participants were excluded if they had a low likelihood of physical frailty based on the telephone screen and, subsequently, if they were found not to be physically frail during the in-home assessment.

views were completed by proxy. Our results did not change appreciably when interviews with proxies were excluded. Of the 641 participants interviewed at 12 months, 73 (10.2%) were disabled in 1 or more ADLs, a rate that is consistent with previous point estimates of disability among previously nondisabled community-living persons aged 70 years or older.^{1,4}

Participants who reported ADL disability during at least 1 month of the follow-up period were considered to have experienced disability. Disability at onset was defined as severe if it was

Table 1. Baseline Characteristics of Participants (N = 754)

Characteristic	Experienced Any Disability		P Value
	Yes (n = 420)	No (n = 334)	
Age, mean (SD), y	79.6 (5.3)	76.9 (4.7)	<.001
Women, No. (%)	272 (65)	215 (65)	>.99
White, No. (%)	380 (90)	300 (90)	.96
Education, mean (SD), y	11.7 (3.0)	12.3 (2.3)	.002
Living alone, No. (%)	171 (41)	127 (38)	.49
Chronic conditions, mean (SD), No.	1.9 (1.2)	1.4 (1.0)	<.001
MMSE score, mean (SD)*	26.4 (2.6)	27.3 (2.3)	<.001
Physically frail, No. (%)†	234 (56)	86 (26)	<.001

Abbreviation: MMSE, Folstein Mini-Mental State Examination.
 *Scores range from 0 to 30, with higher scores representing better cognitive function.
 †As defined in "Methods."

reported in 3 or 4 ADLs in the initial month,¹⁴ and as mild if it was reported in 1 or 2 ADLs. Recovery occurred in the first month during which a participant reported no disability in any of the 4 key ADLs.

Statistical Analysis

We compared the baseline characteristics of the PEP participants who did and did not experience ADL disability using the *t* test for continuous variables and the χ^2 test for categorical variables. Subsequent analyses included only participants who experienced disability. We entered PEP participants into the analytic sample at the time of their first episode of disability and followed them up until they recovered independence (ie, reported no disability in any of the 4 key ADLs), died, or were lost to follow-up. Participants who recovered independence were subsequently followed up until they developed recurrent disability, died, or were lost to follow-up. We did not adjust for the original sampling strategy since the analytic sample represented a select subgroup of participants who had developed disability at differing times over the course of 53 months. Instead, we evaluated the probability of recovery by physical frailty as described below.

We calculated Kaplan-Meier estimates of recovery over time (presented as recovery curves) for all participants in the analytic sample. We censored participants who had not recovered 12 months after the initial onset of disability,

since few participants remained eligible to recover after 12 months. To address the potential concern that brief episodes of disability (ie, those lasting only 1 month) could represent measurement error or very transient conditions, we also calculated Kaplan-Meier estimates of recovery over time for "persistent" disability,^{5,15} defined as a new disability that was present for at least 2 consecutive months, and for "chronic" disability,^{15,16} defined as a new disability that was present for at least 3 consecutive months. To simplify our presentation and avoid violating the statistical assumption of independence, only the first episodes of any, persistent, and chronic disability were included, respectively, for each participant in the time-to-recovery analyses. Thus, a participant whose first episode of disability lasted 1 month and whose second episode lasted 4 months would have the first episode included in the analyses of any disability and the second episode included in the analyses of persistent and chronic disability. We defined zero-time (ie, the time at which a participant becomes eligible to recover)¹⁷ as the first month of disability for any disability, the second month of disability for persistent disability, and the third month of disability for chronic disability. For each type of disability, we present the percentage of participants who recovered and, among those who recovered, the percentage of participants who achieved, respectively, 2 or more consecutive months and 6 or more consecu-

tive months of independence. We also present the mean duration of recovery, defined as the time from regaining independence to recurrent disability, death, or loss to follow-up.

Finally, we compared the likelihood of recovery among pertinent subgroups of older persons using Kaplan-Meier recovery curves and the log-rank test. Subgroups were defined on the basis of age at onset of disability, sex, cognitive function (as measured by the MMSE), physical frailty, and severity of disability at onset, each assessed at the most recent comprehensive assessment. A composite "worst case" subgroup, which included participants who were physically frail, who had MMSE scores less than 28, and who had severe disability at onset, was also created and compared with the remaining participants. While not exhaustive, the aforementioned subgroups reflect the most pertinent demographic features and prognostic factors for disability.^{18,19}

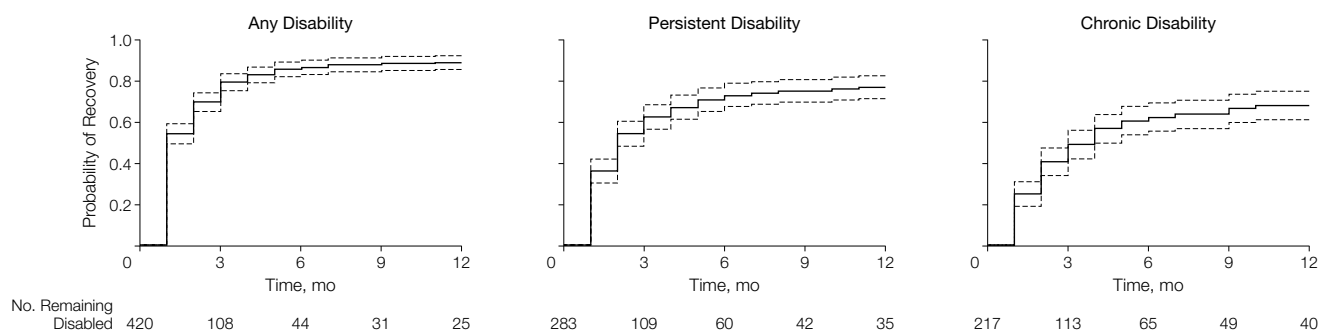
All analyses were performed using SAS version 8,²⁰ and all *P* values are 2-tailed. *P* < .05 was considered significant.

RESULTS

Of the 754 PEP participants, 420 (52%) experienced at least 1 month of ADL disability during a median follow-up of 51 months. The baseline characteristics of the PEP participants who did and did not experience ADL disability are presented in TABLE 1. Participants who experienced disability were older, were more likely to be physically frail, and had fewer years of education, lower cognitive function, and more chronic conditions than participants who did not experience disability.

Of the newly disabled participants, 339 (81%) recovered independence within 12 months. Only 3 participants (<1%) recovered after more than 12 consecutive months of disability, and each of these participants experienced only a single month of subsequent independence. The majority of disability episodes were brief, with 272 (65%) lasting only 1 or 2 months.

Of the 754 PEP participants, 283 (38%) experienced an episode of per-

Figure 2. Kaplan-Meier Estimates for the Probability of Recovery From Disability in Activities of Daily Living

"Any" denotes at least 1 month of disability, "persistent" denotes 2 or more consecutive months of disability, and "chronic" denotes 3 or more consecutive months of disability. Dashed lines represent 95% confidence intervals.

sistent disability and 217 (29%) experienced an episode of chronic disability. Of the participants who experienced persistent and chronic disability, respectively, 193 (68%) and 131 (60%) subsequently recovered independence within 12 months.

FIGURE 2 shows Kaplan-Meier estimates for the probability of recovering independent function for any, persistent, and chronic disability. For all 3 of these types of disability, the majority of participants recovered, and the vast majority of participants who recovered did so within 6 months.

For participants who recovered independent function, the mean (SD) duration of recovery was 11.9 (13.0) months for any disability, 6.5 (8.5) months for persistent disability, and 5.3 (7.3) months for chronic disability. TABLE 2 shows the proportions of participants who maintained independence for 2 or more months and 6 or more months, respectively, among participants with any, persistent, and chronic disability. For each of these 3 types of disability, a majority of participants who recovered maintained independence for 2 or more months. Whereas a majority of participants who recovered from any disability maintained independence for 6 or more months, only a minority of participants who recovered from persistent or chronic disability maintained independence for 6 or more months.

FIGURE 3 shows the Kaplan-Meier estimates for the probability of recovery among pertinent subgroups of partici-

pants with any disability. While recovery differed little by age or sex, participants who had at least mild cognitive impairment (ie, MMSE scores ≤ 27), who were physically frail, and who had severe disability were less likely to recover independent function than participants who were not frail, who were cognitively intact, and who had mild disability, respectively. Nonetheless, for all subgroups, a majority of participants recovered independence. A majority (62%) also recovered independence among participants with the worst combination of prognostic factors, including cognitive impairment, physical frailty, and severe disability. Similar results by subgroup were found for persistent and chronic disability (data not shown), except that recovery rates across subgroups were lower.

COMMENT

In the current study, which included monthly assessments of ADL function, we found that the vast majority of newly disabled community-dwelling older persons recovered independent function, usually within the first 6 months after disability onset. For those who recovered, independent function was sustained for at least 6 months among a majority of persons with disability of any duration, but only among a minority of persons with disability lasting 2 or more months. Persons who were cognitively impaired, physically frail, or severely disabled at onset were less likely to recover than those who

Table 2. Duration of Recovery Among Participants With Any, Persistent, and Chronic Disability*

Type of Disability	No. With Disability/ Total No. (%)	
	Recovery ≥ 2 mo	Recovery ≥ 6 mo
Any	265/335 (79)	177/313 (57)
Persistent	120/187 (64)	68/171 (40)
Chronic	74/129 (57)	38/116 (33)

*Among participants followed 2 and 6 months after recovering independence.

were cognitively intact, nonfrail, or mildly disabled, respectively, but a majority of participants with any disability recovered within each subgroup.

Our rates of recovery from ADL disability are much higher than those that have been reported in previous studies.^{1,3,4} Our results are unlikely to be due to measurement error, as the reliability of our disability assessment was high, and persons with persistent and chronic disability also had high rates of recovery. Because we oversampled persons with physical frailty, our rates of recovery may actually underestimate the true rate in the general population of community-dwelling older persons. While the point prevalence of disability in our population was comparable to rates reported in previous studies of community-dwelling older persons,^{1,4} the frequency of our assessments enabled us to ascertain brief episodes of disability that are disproportionately missed in longitudinal studies with assessment intervals of 6 to 24 months,⁵ likely accounting for our higher recovery rates. In fact,

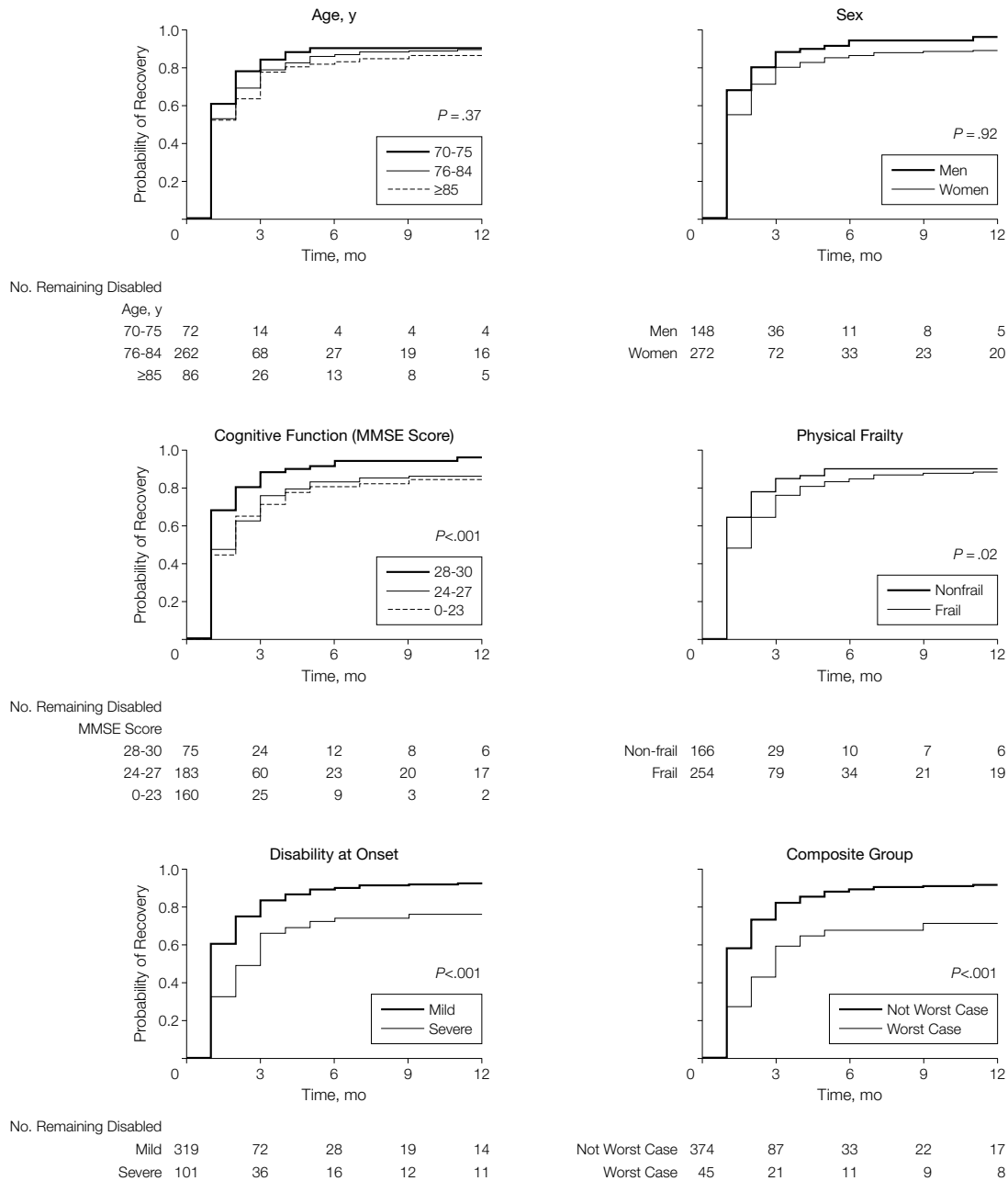
brief episodes of disability were very common in our study population, with over half of the initial disability episodes lasting only 1 or 2 months. While the clinical relevance of short-term disability has been questioned,²¹ we have re-

cently demonstrated that disability lasting only 1 or 2 months is strongly associated with the development of future disability and death.²²

Many of our participants developed recurrent disability, as evidenced by the

large minority of persons with any disability who did not maintain independence for more than 6 months. In a recently published report, we found that more than half of the PEP participants who experienced any disability during

Figure 3. Probability of Recovery for Pertinent Subgroups Among Participants With Any Disability



Participants were considered physically frail if they had a timed score of more than 10 seconds on the rapid gait test. Disability at onset was defined as "severe" if present in 3 to 4 activities of daily living (ADLs) and "mild" if present in 1 to 2 ADLs. The worst case composite group are those participants who have Mini-Mental State Examination (MMSE) scores of 27 or lower, are physically frail, and have mild disability at onset. *P* values for log-rank test for difference among groups.

a 2-year period experienced multiple episodes.¹⁵ In one of the few other studies with assessment intervals less than 6 months, Verbrugge and colleagues² found that functional status among a sample of 165 older persons following hospitalization often fluctuated substantially during the course of a year, with many persons neither consistently improving nor worsening. These results, together with ours, demonstrate that the disabling process among many older persons is complex, with multiple and possibly interrelated disability episodes, even over relatively short periods of time. While other studies have incorporated multiple transitions between disabled and independent states in models of the disabling process,^{23,24} the effects of prior disability episodes on recovery from future episodes have not been explicitly considered.

The dynamic nature of disability among our participants raises important questions regarding much prior research on the recovery process. In studies with assessment intervals of 6 or more months, many participants likely experienced multiple transitions between states of disability and independence within each assessment interval. Studies of ADL recovery after specific events (eg, hospitalization, hip fracture, or stroke) that have included assessments of functional status 6 or more months later may have assessed participants during or after a subsequent (rather than the initial) episode of disability. For example, one study of recovery after hip fracture, which included follow-up assessments at 6 and 12 months, found that about 10% to 20% of participants had recovered at 6 months, but had declined again at 12 months.²⁵ Studies such as ours, which include frequent assessments of functional status, may allow the course of recovery to be characterized more accurately. Although recovery rates were consistently high among our participants, the duration of recovery varied widely. This variation suggests that there may be different patterns of recovery with potentially different predictive factors. Further research is needed to elucidate the different patterns of re-

covery and to determine predictors of these patterns.

While our finding that cognitive function and severity of disability are associated with the likelihood of recovery is consistent with previous research,^{1,3} we found no difference in recovery among age groups, in contrast to most prior studies.^{1,3,26} Because these other studies had long assessment intervals, it is possible that the oldest old were more likely than the younger old to have died or experienced another distinct disability episode prior to the next follow-up interval. In fact, Hansen and colleagues,²⁷ who also used a short assessment interval of 1 month, found no age effect on recovery from disability after hospitalization.

Unlike other studies, we did not evaluate recovery after a single disease process or injury, such as stroke or hip fracture, nor did we have information on the etiology of disability, which may not be readily apparent in the absence of a catastrophic event.²⁸ Disability, like delirium and other geriatric syndromes, is thought to result from the interaction of predisposing factors and precipitating events.²⁹⁻³² Disability may have either a rapid or gradual onset, and many episodes of disability are not preceded by an acute illness or injury leading to hospitalization.^{32,33} Because the likelihood and course of recovery may differ depending on the type of precipitating event (eg, a surgical procedure vs an acute illness vs a stressful life event),³⁴ further research is warranted to evaluate the effect of specific precipitating events on the recovery process, particularly noncatastrophic events that have received relatively little attention to date. Many older persons, for example, report common symptoms such as pain, weakness, and fatigue as the cause of prevalent disability,²⁸ and recent evidence indicates that events leading to restricted activity are independently associated with decline in ADL function.³⁵

While the high rates of recovery across multiple subgroups of older persons indicate that the short-term prognosis for any individual episode of ADL disabil-

ity is quite good, the high rates of recurrent disability suggest the need for a paradigm shift on how ADL disability is viewed clinically. In addition to treating the individual episodes, clinicians might be advised to manage disability in the context of the chronic disease model. Buchner and Wagner³⁰ have described a state of reduced physiologic reserve associated with increased susceptibility to disability. Prevention of functional decline and disability would include not only management of acute episodes of disability and promotion of recovery, but also ongoing evaluation and management of key risk factors for disability and use of preventive interventions. The high likelihood of recurrent disability among older persons suggests that those who have recently recovered from an episode of disability are an important target population for preventive interventions. While some interventions designed to prevent recurrent disability may be disease-specific, eg, anticoagulation after embolic stroke, others may be broadly applicable regardless of the specific precipitant of disability, eg, exercise-based programs.^{36,37} Further research is needed to determine the causes of recurrent disability episodes and to elucidate the relationships between episodes.

Several other aspects of our study deserve comment. First, because our participants were members of a single health plan in a small urban area, our results may not be generalizable to older persons in other settings. However, our population did reflect the demographic characteristics of persons aged 65 years or older in New Haven County, which are comparable to the United States as a whole, with the exception of race (New Haven County has a larger proportion of non-Hispanic whites in this age group than the United States, 91% vs 84%).³⁸ Furthermore, generalizability depends not only on the characteristics of the study population, but also on its stability over time.³⁹ The high participation and follow-up rates of our study both enhance the generalizability of our findings. Second, we had no information on the possible use of re-

storative interventions among our participants after the onset of disability. Finally, our study focused on basic ADLs because they are essential for living independently. However, transitions between independence and disability for instrumental ADLs and mobility are likely to be as common, suggesting that studies evaluating disability in these higher-level tasks over shorter intervals need to be undertaken.

In summary, recovery from disability in essential ADLs among community-dwelling older persons is much more common than previous studies have indicated, but is often transient. While most newly disabled older persons can be reassured that they will regain independent function, those who recover are at high risk for recurrent disability. Our results provide additional evidence that disability is a recurrent rather than an enduring condition and suggest that interventions to maintain independence after recovery are needed.

Author Contributions: As principal investigator, Dr Hardy had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Hardy, Gill.

Acquisition of data: Gill.

Analysis and interpretation of data: Hardy, Gill.

Drafting of the manuscript: Hardy.

Critical revision of the manuscript for important intellectual content: Gill.

Statistical expertise: Hardy.

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Supervision: Gill.

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