Factors Associated With Recovery of Independence Among Newly Disabled Older Persons

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Background: Recent evidence indicates that most older persons who develop disability in their activities of daily living (ADLs) regain independent function, but many of these persons subsequently experience recurrent disability. The aims of this study were to identify independent predictors of time to and duration of recovery of independent ADL function among newly disabled community-dwelling older persons.

Methods: From a cohort of 754 persons 70 years or older, we studied the 420 participants who experienced at least 1 episode of disability involving 1 or more key ADLs (bathing, dressing, walking, or transferring) during a median follow-up of 53 months. Comprehensive evaluations at baseline and every 18 months included demographic, medical, cognitive, psychological, social, behavioral, and physical factors. Activities of daily living function and hospital admissions were assessed during monthly telephone interviews, with a completion rate of 99.4%.

Results: Of the 420 newly disabled participants, 342 (81.4%) recovered independent ADL function after a mean±SD of 4.9±0.5 months. In multivariable proportional hazards analysis, habitual physical activity, mild disability (1-2 ADLs) at onset, and hospitalization in the month of disability onset were independently associated with shorter time to recovery. Among participants who recovered, 251 (73.4%) experienced recurrent disability or death after a mean±SD of 7.3±8.5 months. Younger age, greater habitual physical activity, higher functional self-efficacy, and shorter duration of the prior disability episode were independently associated with longer duration of recovery.

Conclusions: Habitual physical activity is an independent predictor of time to and duration of recovery of independent ADL function among newly disabled community-dwelling older persons. Because the other independent predictors for time to recovery differ from those for maintenance of recovery, different mechanisms may underlie these 2 recovery outcomes, suggesting that different interventions may be required to promote recovery than to maintain independent ADL function after recovery.

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Disability in basic activities of daily living (ADLs), such as bathing and walking, is common among community-dwelling older persons and is often considered progressive or permanent. Prior studies have either focused on recovery after specific events such as a hip fracture or used assessment intervals of 6 months or longer, thereby underestimating the incidence of disability. The objectives of this study were to identify independent predictors of time to and duration of recovery of ADL independence among newly disabled community-dwelling older persons. By improving prognostication, we hope to empower older persons, their families, and their clinicians to set realistic goals and plan for appropriate care. Also, some predictors may be modifiable and, hence, amenable to intervention.
METHODS

STUDY POPULATION

Participants were drawn from an ongoing longitudinal study, described in detail elsewhere, of 754 community-dwelling persons, 70 years and older, who were nondisabled in 4 key ADLs (bathing, dressing, walking, and transferring). Potential participants were members of a large health plan and were excluded for life expectancy of less than 12 months, plans to move out of the area, or inability to speak English. Only 4.6% of persons contacted refused screening, and 75.2% of those eligible agreed to participate. To ensure a sufficient incidence of disability, persons with slow gait speed were oversampled. Participants underwent comprehensive in-home assessments at baseline and at 18 and 36 months, and had monthly telephone interviews for a median of 53 months.

DATA COLLECTION

The comprehensive assessments were completed by trained research nurses using standard instruments. Data were collected on candidate predictors from several domains: demographic, medical, cognitive, psychological, social, behavioral, and physical (Table 1). The amount of missing data was less than 1% for all candidate predictors in the baseline assessments and less than 5% for subsequent assessments. During monthly telephone interviews, disability in each of the 4 key ADLs was assessed with the question, “At the present time, do you need help from another person to perform the task. Participants who required personal assistance with at least 1 ADL were considered disabled. The reliability of our disability assessment was substantial for reassessments within 48 hours (κ = 0.75) and almost perfect for reassessments completed the same day (κ = 1.0). Disability in 3 or 4 ADLs was defined as severe, and in 1 or 2 ADLs, as mild. Recovery occurred when a participant reported no disability in any of the 4 ADLs. Restricted activity, defined as staying in bed for half a day or cutting down on one’s usual activities, and overnight hospitalizations during the past month were also ascertained. Follow-up interviews were included through May 19, 2003, when 151 (20.0%) of the participants had died and 31 (4.1%) had dropped out. Data are otherwise available for 99.4% of the remaining 31,244 monthly interviews.

STATISTICAL ANALYSIS

Potential prognostic factors, chosen from factors previously associated with either disability or recovery, were evaluated during the most recent comprehensive assessment or the telephone interview in the month of disability onset. Variables were modeled as continuous unless there was evidence of a nonlinear relationship with either outcome. To observe the statistical assumption of independence, we included only the first episode of disability for each participant. We assessed the associations of potential prognostic factors with time to duration of recovery using proportional hazards regression, because these models allow full use of our monthly data. Furthermore, when recovery is evaluated at a single time point, as in logistic regression analysis, any intervening transitions between disability and independence are ignored. Factors associated with time to outcome in the bivariate analyses (P < .10) were considered in the multivariable analyses, which were adjusted for the time from the most recent comprehensive assessment to disability onset. Many of the potential predictors were highly correlated, particularly the physical measures, physical activity, and self-efficacy (Spearman r for all comparisons, 0.3-0.6). Because of this high collinearity, backward elimination with a criterion of P < 0.05 was used to identify the independent predictors. All multivariable models had at least 20 events per variable. All P values are 2-tailed, and all analyses were performed using SAS statistical software, version 8.

RESULTS

Time to Recovery

Participants were entered into the analytic sample (n = 420) at their first episode of disability and were observed until they recovered independence, died, or reached the end of follow-up. Participants who died were censored at the time of death in the primary analysis and at the end of the study (May 19, 2003) in a secondary analysis. We defined zero time as the first month of disability. Results were confirmed with logistic regression models of recovery at 3 months. To address the concern that recovery episodes lasting only 1 month might be due to measurement error, we repeated our primary analysis for recovery lasting 2 consecutive months or longer (ie, “persistent”).

Duration of Recovery

Participants were entered into the analytic sample (n = 342) at the time of recovery of independence. Duration was defined as the time from recovery to the first month of recurrent disability or death. Participants who experienced neither recurrent disability nor death were censored at the end of follow-up. In addition to the potential predictors considered for time to recovery, the duration of the preceding disability episode was considered as a potential predictor of duration of recovery.

The descriptive statistics for the potential prognostic factors among the 420 participants who experienced disability are presented in Table 1. Participants had a range of 0 to 6 chronic conditions. The most common conditions were hypertension (n = 239), arthritis (n = 156), diabetes mellitus (n = 94), and myocardial infarction (n = 89). Of the 420 participants, 342 (81.4%) regained independent ADL function after a mean ± SD follow-up of 4.9 ± 0.9 months; 215 participants (51.2%) recovered after a single month of disability. Among the remaining 127 participants, the most common patterns of recovery were stable disability until recovery (n = 59) and a gradual decrease in the number of ADL disabilities (n = 38). The characteristics of disability and recovery by specific ADL disabilities in the month of onset are presented in Table 2. Bathing disability was most common, and walking disability was least common, with most participants having other concurrent ADL disabilities. The patterns of recovery among the 4 ADLs were comparable. The bivariate associations of potential prognostic factors with time to recovery are presented in Table 1. In multivariable analyses, habitual physical activity, mild disability, and hospitalization remained independent predictors of time to recovery (Table 3). These same variables were independent predictors of recovery at 3 months. When the analysis was repeated for persistent recovery, the effect of hospitalization was considerably reduced (hazard ratio = 1.05, P = .70). Censoring participants who died at the end of the study period had no effect on the results.
The descriptive statistics for the potential prognostic factors among the 342 participants who recovered are also presented in Table 1. Of these 342 participants, 251 (73.4%) experienced recurrent disability or death after a mean±SD follow-up of 7.3±8.5 months; 72 (21.1%) experienced only 1 month of recovery. Of these 72 participants, 57 (79.2%) had subsequent periods of independence, 46 (63.9%) had subsequent periods lasting 2 months or longer, and 37 (51.4%) were hospitalized or had restricted activity during the month of their recurrent disability.
The associations of potential prognostic factors with duration of recovery are presented in Table 1. Age, habitual physical activity, self-efficacy, and duration of the prior disability episode remained independent predictors of duration of recovery in multivariable analyses (Table 4). These results did not change appreciably in subsequent analyses that omitted the 3 ADL items from the self-efficacy scale and that considered participants with only a single month of subsequent independence as non-recovered for the remainder of the follow-up. In a model that did not include duration of the prior disability episode, the other 3 independent predictors remained the same, and no new candidate predictors were significant.

In this prospective cohort study, which included monthly assessments of ADL function, we found that habitual physical activity, the initial severity of disability, and hospitalization in the month of disability onset were independently associated with time to recovery of independent ADL function among newly disabled community-dwelling older persons. Furthermore, among persons who had recovered, we found that habitual physical activity, age, self-efficacy, and the duration of the prior disability episode were independently associated with duration of recovery.

Habitual physical activity was a strong independent predictor of time to and duration of recovery. Multiple previous studies have demonstrated a strong association between habitual physical activity and maintenance of functional independence, and several randomized trials have shown that exercise-based interventions can slow or prevent functional decline among older persons. As a potentially modifiable factor, physical activity represents an attractive target for interventions designed to promote recovery and maintenance of ADL independence.
cover than those whose disability develops insidiously, perhaps because of gradual progression of underlying conditions. This association, which was not attributable to the censoring of participants who died, may reflect different pathways to disability, such as the catastrophic vs progressive pathways described by Ferrucci and colleagues. The receipt of rehabilitative services after hospitalization is another possible explanation for this finding. Interventions that quickly identify and ameliorate the effects of events leading to hospitalization may facilitate recovery by decreasing the severity of disability. For example, efforts to increase mobility during hospital stays are associated with less functional decline in older persons, and might also lead to more rapid recovery. Further research is warranted to evaluate the effects of rehabilitative services on the recovery process and to better characterize the events that precipitate disability.

While several previous studies have found that younger age is associated with a higher rate of recovery among older persons, our findings of no age effect are consistent with those of Hansen and colleagues, who studied recovery from disability 1 month after hospitalization. One possible explanation for this discrepancy is the difference in the length of the assessment intervals between our study and others. We found that younger age was associated with longer duration of recovery, indicating that older persons who recover are more likely to experience recurrent disability or death over 6 to 12 months and, thus, would have been classified as “not recovered” in prior studies with assessment intervals of 6 months or longer.

The monthly assessments of function provided a unique opportunity to examine predictors of the duration of recovery among older persons who recovered independent function. In addition to habitual physical activity, we found that younger age, greater self-efficacy, and duration of the prior disability episode were independent predictors of longer duration of recovery. To help interpret the magnitude of the hazard ratios, we offer 2 examples. First, walking for 30 minutes 5 days a week would add 50 points to the physical activity score, which would reduce the likelihood of recurrent disability by about 20%. Second, a change from being fairly to completely confident on 5 of the 10 self-efficacy activities would reduce the likelihood of recurrent disability by 26%. It is unlikely that self-efficacy is simply a surrogate for recurrent disability because participants were explicitly asked about their confidence rather than their actual performance of the activities, self-efficacy was assessed before the disabling event, and our results did not change after the 3 ADL questions were omitted from the efficacy scale.

The duration of the prior disability episode was strongly associated with the duration of recovery. It is unlikely that this association is attributable to participants with longer disability durations having less subsequent follow-up during which to experience recurrent disability or death. Because the duration of total follow-up in our study was much longer than the durations of disability and recovery, we were able to observe nearly three quarters of participants until recurrent disability or death. In addition, disability durations were shorter and recovery durations were substantially longer among those who remained independent compared with those who experienced recurrent disability or death (data not shown), suggesting that the association between the durations of disability and recovery was not an artifact of limited follow-up. Recent research has demonstrated that a history of disability, even only of 1 or 2 months, is strongly associated with future disability and death. This finding and those of the present study suggest that history of disability, including attributes such as duration and number of episodes, may be an important determinant of subsequent disability and recovery. While some previous studies have incorporated multiple transitions between disabled and independent states in models of the disabling process, the effects of prior disability episodes on subsequent recovery have not been explicitly considered. Future studies will need to incorporate multiple episodes of disability and recovery and account for the effects of disability history.

Physical measures, particularly gait speed, have consistently been shown in previous studies to be strong independent predictors of disability. Although all of our physical measures were significant predictors of recurrent disability in bivariate analyses, none were identified as independent predictors. There are several possible explanations for this apparent discrepancy. First, in contrast to other studies, our outcome was recurrent disability, contingent on recovery from a previous episode of disability. Second, our physical measures were assessed before the initial disability episode and may have been altered more by the intervening disabling event than other potential predictors, such as self-efficacy. Third, the physical measures were highly correlated with physical activity and self-efficacy.

Because many of the prognostic factors identified in bivariate analyses were highly intercorrelated, the independent predictors we identified may not be the best prognostic factors in other populations. Other significant factors from the bivariate analyses may still have effects on recovery, either directly or through their effect on the independent factors. For example, improving balance and gait through physical therapy or exercise may increase the duration of recovery either directly or indirectly through enhancement of self-efficacy or increased physical activity.

With the exception of habitual physical activity, the factors associated with time to recovery differed from those associated with duration of recovery. Time to recovery was most strongly associated with factors related to the onset of disability (ie, the type of precipitating event), while duration of recovery was more strongly associated with factors previously associated with risk for disability. Some of these are indicators of frailty, defined as a state of reduced physiologic reserve associated with increased susceptibility to disability. Our bivariate results provide additional support for a mechanistic difference, because few of the factors that predicted time to recovery also predicted duration of recovery. Because older persons who have recently recovered independent function are at high risk for recurrent disability, they represent an important target population for interventions to promote maintenance of independence. We recognize that the associations found in our epidemiologic study support, but do not prove, causation. Randomized trials will be needed to determine if interven-
tions directed at the identified predictors can alter disability outcomes.

Patterns of recovery among the 4 key ADLs were comparable. Although dressing and bathing may be more affected by some risk factors (eg, deficits in cognitive or upper extremity function) than walking and transferring, disability for each of these activities is likely multifactorial. Further research is needed to determine whether similar mechanisms account for recovery and maintenance of independence for these different ADLs.

It is unlikely that brief recovery durations (ie, only 1 month) were attributable to measurement error. First, most participants with brief recoveries experienced subsequent periods of independence. Second, most recurrent episodes were preceded by hospitalization or restricted activity. Third, our disability assessment was highly reliable. These brief recoveries may reflect unstable disability, defined as substantial fluctuations in function with minor external events. Because brief periods of disability have considerable prognostic importance, brief periods of recovery may also be clinically important.

We were unable to determine the precise cause of our participants’ disability, which may not be readily apparent in the absence of a catastrophic event. Disability is multifactorial, and many episodes of disability are not preceded by a problem leading to hospitalization or restricted activity. Many older persons, for example, report common symptoms, such as pain and fatigue, as the cause of prevalent disability, and recent evidence indicates that events leading to restricted activity, another multifactorial process, are independently associated with decline in ADL function. Although the time to and duration of recovery likely differ depending on the specific events precipitating disability, determination of the causes of individual episodes is complex and beyond the scope of this study.

Because persons with slow gait speed were oversampled, our population may have had lower rates of recovery and levels of physical activity and self-efficacy than a population-based sample of older adults. Because our participants were members of a single health plan in a small urban area, our results may not be generalizable to other populations. However, our population reflects the demographic characteristics of persons 65 years or older in New Haven County, Connecticut, which are comparable to the United States as a whole with the exception of race. Furthermore, the high participation and follow-up rates and the paucity of missing data enhance the generalizability of our findings.

In summary, habitual physical activity is an important predictor of time to and duration of recovery. Because the other independent predictors for time to recovery differ from those for maintenance of recovery, different mechanisms may underlie these 2 outcomes, suggesting that different interventions may be required to promote recovery than to maintain independent ADL function.

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